

VOCABULARY OF A DOCTORAL STUDENT

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Version 1.3, 3.8.2008

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This vocabulary has been prepared in aid of a doctoral student in engineering, but it may be useful also for students in science. The selected terms are those that most students face during the course of their work, including literature searches, research methods, and writing papers and a thesis. Since there seems to be not much literature available about philosophy of technology, I have used the terminology from philosophy of science, systems engineering, product design, and economics. Science has been conventionally based on an analytical or reductive approach. The opposite systems or holistic approach should be seen as a complementary approach. In social sciences a third approach called actors approach is also used. Some explanations are controversial and I have tried to give a neutral definition. The vocabulary is not meant to replace dictionaries where a more complete explanation can be found. I have tried to collect especially such stipulative definitions, which are difficult to find from dictionaries. Some of the definitions are ostensive pseudodefinitions if not actual definition has been found.

Each item includes a term in bold, translation into Finnish in parentheses, and a definition or explanation in English, unless the explanation is assumed to be trivial or too abstract without much practical use. Similar explanations are separated by a comma, and different explanations are separated by a semicolon. A division is marked with Arabic numbers. Cross-references to other terms in the vocabulary are marked in *italics*. Some of the most important terms are marked with an asterisk (*) to help to start conceptual analysis. Those terms include *concept, *development, *document, *model, *organization, *problem, *product, *reductionism, *research, *system, *theory, and *thing. By following the cross-references many other families of terms are found. The number of terms is over 2000. At the end of the vocabulary and special characters are some abbreviations explained. Also the most important literature references are listed there. Companion documents include "Bibliography of a doctoral student" and "Chronology of science and engineering."

abduction (abduktio) "*inference to the best explanation*" [Honderich05], opposite to *deduction*. *Observations* are explained by a *theory* which best explains them. See *strong inference*, *induction*.

abrupt change (äkillinen muutos) jump, usually not amenable to *analysis*, opposite to *continuity* [Wolfram02], [Taylor90], see *anomaly*, *catastrophe theory*.

absorption cost (omakustannusarvo, OKA) *prime cost*.

abstract (abstrakti, tiivistelmä) a usually one-paragraph *summary* of a *document* after the *title* and the list of *authors*, starting with a *topic sentence*, which establishes the context and scope of the paper. A preferred form of an abstract is *informative*, but it can be also descriptive [Young02]. An abstract includes 1) what the author has done, 2) how it was done (if it is important), 3) principal *results* (numerically, when possible), and 4) *significance* of the results [Spectrum65]. The recommended maximum length of the abstract for *letters* is 50 words, for *full papers* 75-200 words, and for *conference papers* 150 words. See *abstracts database*, *executive summary*, *extended abstract*, *introduction*, *conclusions*, *keyword*

abstraction (abstraktio, abstrahointi) *idealization*, the *bottom-up* procedure for going upwards one description *level* to another towards less detail [Calvez93], [Hall62], opposite to *refinement*.

abstracts database (tiivistelmätietokanta) a collection of information on *publications*, usually *scientific journal* and *conference papers*, including *titles*, names of *authors*, *abstracts* and *keywords*. See *citation database*, *digital library*, *literature search*, *information retrieval*.

academician (akateemikko, akatemian jäsen) member of an *academy*. In Finland a honorary title given by the President of the Republic.

academy (akatemia; korkeakoulu) a *scientific society* representing the highest achievements in its field; *university*, *Academy of Finland*.

[Academy of Finland](#) (Suomen Akatemia) a funding agency for *basic research* in Finland, operates within the Ministry of Education, see *Tekes*, *Sitra*.

accent (paino) word stress, see *acute accent*, *grave accent*, *circumflex*.

acceptance rate (hyväksymissuhde) *acceptance ratio*

acceptance ratio (hyväksymissuhde) acceptance rate, the ratio of *accepted* and *submitted manuscripts*, especially in a *conference*.

accepted reference value (hyväksytty vertailuarvo) agreed *reference value*, see *conventional true value*.

accommodation (mukauttaminen) *transformation of knowledge structures*, see *assimilation*.

accurate (tarkka)

accuracy (tarkkuus) accuracy of measurement, "the closeness of agreement between a *measurement* result and the accepted *reference value*" [amc03], inversely related to both *systematic errors* and *random errors*, and thus includes the terms *trueness* and *precision*, but cannot be expressed as a numerical value [ISO Guide 99:2004]. The most appropriate means of expressing the accuracy is *uncertainty* [amc03]. See *mean-square error*, *instrument*.

acknowledgment (kiitokset) an author's statement expressing thanks to those who have assisted in the preparation of a *document* [Random House99] or to those who have given *funding* for *research*, located in a *preface*, in a *footnote* on the *title* page, or in a separate *section* before *appendices* and *references*.

acronym (akronyymi, lyhenne, kirjainsana) an abbreviation that is pronounced as a word [Young02]

action (toiminta) behaviour, i.e., effect that is under our control and that has a *reason*, including desire and belief [Rosenberg08], see *actor*.

action research (toimintatutkimus) an *experimental*, *iterative*, *qualitative*, *idiographic research method* in *social sciences*, "the use of *techniques* of social and psychological research to identify social problems in a group or community coupled with active participation of the investigators in group efforts to solve these problems" [Webster's New World01]. The *problem* is solved by certain *actions*

whose consequences are evaluated and new actions are specified. See *iterative improvement, actor, actors approach, case study*.

active voice (aktiivimuoto) usually the preferred voice instead of *passive voice* [Day98].

actor (toimija) *subject, "active, reflective, and creative human being"* [Arbno97], see *observer, free will, intentionality*.

actors approach (toimijakeskeinen lähestymistapa) a *methodological approach* that is interested in *understanding social wholes* and - unlike in *analytical* and *systems approaches* - *knowledge exists only as a social construction* and is not independent of *observers* [Arbno97]. See *idiographic research, hermeneutics, phenomenology, existentialism, postmodernism, dialectic methodology, thesis–antithesis–synthesis*.

actuator (toimielin) a mechanical device for moving or controlling a *system*, see *sensor*.

acute accent (akuuttiaksentti) mark (´), for example é. The meaning depends on the language. Usually it indicates word stress or *accent*, in French it indicates that the vowel is close or tense [Random House99]. See *grave accent, circumflex, double acute, accent*.

adaptability (adaptoituvuus) see *flexibility, reconfigurability*.

adaptation (adaptoituminen) see *self-organizing system*.

adaptive (adaptiivinen) capable of adjusting itself to the environment, a simple form of *learning* [Claasen85], see *artificial intelligence*.

addition (yhteenlasku) summation, see *physical additivity, mathematical additivity, subtraction, multiplication, division*.

additive noise (additiivinen kohina) *random noise* that is added to the *signal* in the *channel* in contrast to *multiplicative noise*, see *interference*.

adjunct professor (dosentti) docent, a *professor* attached or belonging to a *university* without full or permanent status [Random House99].

adjustment (viritys) see *calibration, verification*.

adviser (ohjaaja) *advisor*.

advisor (ohjaaja) thesis advisor, adviser, mentor, tutor, a person who gives advice to a student, especially somebody who is an expert in the same field [Hornby95], see *supervisor*.

aesthetics (estetiikka) esthetics, a branch of *axiology*, see *humanities*.

affection (tunne) the feeling aspect of *consciousness*, distinguished from *conation* and *cognition* [Webster's Third New93].

affine geometry (affiininen geometria) a part of *geometry* where uniform magnification is allowed and parallelism remain, a special case of *topology* and a generalization of *Euclidean geometry* [Medawar84].

affine transformation (affiininen kuvaus) a *transformation* that maps parallel lines to parallel lines and finite points to finite points [Random House99], see *linear, geometry*.

agreement (sopimus) see *contract, nondisclosure agreement*.

agenda (asialista) a list of things to be discussed in a meeting, considered a singular word [Young02].

algebra (algebra) a branch of *mathematics*, generalization and extension of *arithmetic*, deals with general statements of *relations*, usually *functions*, using letters and other *symbols* to represent *quantities* in the description of such relations [Random House99], see *analysis*.

algorithm (algoritmi) a set of rules for solving a *problem* in a finite number of steps [Random House99], see *method, behavioral model, genetic algorithm, iteration, recursion, protocol, halting problem*.

algorithmic complexity (algoritminen kompleksisuus) Kolmogorov *complexity*, algorithmic information content, algorithmic randomness, descriptive complexity, the length of the shortest program that describes an *algorithm* to generate a message string, the expected algorithmic complexity of a random variable is approximately equal to its *entropy* [Skyttner05], [Baeyer05], [Cover06], [Pagels88], [Gell-Mann94], see *complexity*.

alliance (allianssi, liitto, liittouma) "formal arrangement with a separate company for purposes of development, and involving exchange of *information, hardware, intellectual property*, or enabling *technology*" [Belliveau02], see *forum*.

alpha coefficient (alfakerroin) in *regression analysis* the value of the dependent *variable* when the independent variables are zero, see *beta coefficient*.

alpha prototype (alfaprototyyppe) an early *prototype*, built with parts with the same geometry and material properties as intended for the production version of the product, tested to determine whether or not the *product* will work as *designed* and whether or not the *product* satisfies the key *customer needs* [Ulrich95], see *beta prototype, gamma test*.

alpha test (alfatestaus) in-house testing of the *alpha prototype* [Belliveau02].

alternative hypothesis (vaihtoehtoinen hypoteesi) research hypothesis, competing hypothesis, an alternative to the *null hypothesis*, if the null hypothesis is rejected, the alternative hypothesis must be accepted [McCuen96].

ambient intelligence (läsnä-äly) electronic environment that is sensitive and responsive to the presence of people, based on *ubiquitous computing*, see *artificial intelligence*.

ambiguity (epäselvyys, epävarmuus, monikäsitteisyys, moniselitteisyys) equivocation, "the condition of admitting more than one meaning" [Random House99], for example in a phase estimator, see *term*.

ampersand (et-merkki) mark &.

anachorism (anakronismi, vanhentunut käsitys) see *diachronism*.

analog model (analogiamalli) a *model*, for example electrical network, which uses a physical appearance different to the phenomenon or *object* to be characterized, see *cybernetics*.

analogy (analogia, vastaavuus) a similarity, probably only superficial, between like features of two things, on which a comparison can be made [Random House99], [Bertalanffy98]; a form of *reasoning* in which one thing is *inferred* to be similar to another thing in a certain respect, on the basis of known similarities in other respects, see *isomorphism, homomorphism, homology, explanation, induction, creativity, correspondence, metaphor, cybernetics*.

analysis (analyysi, erittely) 1) generalization and extension of *algebra*, study of the changes of a continuously varying *function*, including differential and integral calculus and its higher developments, analysis corresponds to *deduction* if no approximations are made [Hall62, p. 110]. 2) discussion of a problem by *algebra*, as opposed to *geometry* [Random House99]. 3) ontological *reduction*, resolving or separating a whole into its elements or component parts, opposite to *synthesis* [Wilson99]. See *systems analysis, reverse engineering, check list, catastrophe theory*.

analysis of variance (ANOVA) (varianssianalyysi) *statistical analysis* used to test for differences among three or more *independent* groups, see *chi-square test*.

analytical approach (analyyttinen lähestymistapa) reductive approach, scientific approach [Checkland99], a *methodological approach* where, unlike in the *systems approach*, a *whole* is the sum of its *parts* and *knowledge* is independent of *observer*. Analytical approach is interested in *cause-effect* relations in *deterministic* phenomena and *correlation* in *stochastic* phenomena [Arbno97]. See *positivism, reality, model, causality, explanation, hypothesis, analysis, ceteris paribus*.

analytical model (analyyttinen malli) *symbolic model*.

analytic philosophy of science (analyyttinen tieteenfilosofia) a modern trend of *philosophy of science* in addition to *hermeneutics* [Niiniluoto02]. Subjects in analytic philosophy of science include logical analysis of scientific *language* and *concepts*, ideal model for scientific *theory construction* and scientific *inference*, and critical evaluation of presuppositions of disciplines and their *research methods*.

analytic solution (analyyttinen ratkaisu) a *solution* found with mathematical *analysis*, see *numerical solution, Monte Carlo method, mathematical model*.

angle bracket (kulmasulku) marks < ... >.

annex (lisäys, liite) something added to a *document* [Random House99], see *appendix*.

annotation (huomaus) a critical or explanatory note added to a text [Random House99].

annotated bibliography (kirjallisuusluettelo huomautuksin) see *annotation, bibliography*.

anomaly (anomalia, poikkeama, epänormaalisuus) discrepancy, for example *abrupt change*, *trend*, *periodicity*, or statistical *correlation* [Wilson90].

ansible (in *science fiction*) instantaneous *telecommunications* between two points, regardless the distance between them [Clute95].

anthology (antologia, kokoelma, kokoomateos) collective work, compilation.

antipositivism (antipositivismi) opposite to *positivism*, see *actors approach*.

antirealism (antirealismi) instrumentalism, denial of *realism*, *theories* are treated as computational devices for describing *predictions* of *phenomena* [Rosenberg00].

antithesis (vastaväite) see *dialectic methodology*.

antonym (vastakohta) opposite to *synonym*, see *thesaurus*.

a posteriori (posteriori-, posteriorinen) known only by *experience*, see *a priori*.

apostrophe (heittomerkki) mark ' , see *single quotation mark*, *punctuation*, *cedilla*.

apparatus (laitos, laite) technical system whose main flow is material-based [Pahl07], see *machine*, *device*.

appendix (liite) supplementary material at the end of a *document* [Random House99], see *annex*, *enclosure*, *attachment*.

application (sovellus; hakemus)

application layer (sovelluskerros) the highest layer in the *OSI model* above the *presentation layer*, provides a means for *application processes* to access the OSI environment, examples of protocols at this layer are file transfer and electronic mail, communication *services* are using the application layer [Tanenbaum96], [Stallings91], see *source coding*.

applied science (sovellettu tiede) a misnomer for *technology* or *engineering* [Leppälä03].

applied research (soveltava tutkimus, tavoitetutkimus) targeted *research* directed primarily towards a specific practical or commercial aim or objective with respect to *products*, *processes*, or *services*, research where *ideas* are put into an operational *form* [Jain97], see *development*, *oriented basic research*.

approach (lähestymistapa, ote) see *methodological approach*, *research approach*, *research method*.

a priori (priori-, priorinen) known without *experience*, see *a posteriori*.

architecture (arkkitehtuuri) structure, the scheme by which the *functional parts* are arranged into *physical parts* and by which the *parts* interact [Ulrich95], see *modular architecture*, *integral architecture*, *product architecture*, *layered architecture*, *nested hierarchy*, *system*.

archival journal (tieteellinen lehti) *scientific journal*, a *journal* with *peer review* publishing original *research results*.

area (alue) extent, range, *scope* [Random House99], see *field*, *study area*.

argument (argumentti, perustelu) a process of *reasoning*, series of reasons [Random House99].

argument (argumentti) independent *variable* of a *function*; the angle corresponding to a point representing a given complex number in a *polar coordinate system* [Random House99].

arithmetic (aritmetiikka) the most elementary branch of *mathematics* [Random House99], simple *number theory*.

arithmetic mean (aritmeettinen keskiarvo) *sample mean*, *average*.

art (taide) in contrast with *science* [Wilson99], see *engineering*, *humanities*, *university of art and design*.

artefact (artefakti, ihmiskäden työ, tekninen luomus) a *product*, any object made by humans, also for example a bird's nest can be called artifact. Technical artifacts include in *mechanical engineering* in the order of increasing complexity 1) *components*, 2) *machine elements* or *assemblies*, 3) *machines*, 4) *equipment*, and 5) *plant* [Pahl07]. The hierarchical order can vary. In electrical engineering they include 1) passive *components* and *devices*, 2) *assemblies*, and 3) *equipment* [Young79].

article (artikkeli, kirjoitus) a factual piece of writing, usually on a single topic [Random House99], see *document*.

articulated knowledge (selvästi ilmaistu tieto) explicit *knowledge*, opposite to *tacit knowledge* [Leppälä03].

artifact (artefakti, ihmiskäden työ) *artefact*.

artificial (keinotekoinen) man-made, opposite to *natural*.

artificial intelligence (tekoäly) design of devices programmed to perform functions analogous to learning and decision making [Random House99], see *cognitive science, smart, ambient intelligence, systems theory, Turing test*.

artificial life (tekoelämä) computer programs are used to emulate various features of biological systems [Wolfram02], see *self-organization, systems theory*.

assembly (kone-elin; koneikko; moduuli) 1) machine element, 2) set of *machines, machinery* [Pahl07], 3) set of *components* [Young79], see *artefact, module*.

assimilation (omaksuminen) adding new *information* to existing *knowledge*, see *accommodation*.

assistant (assistentti) a faculty member in a *university* ranking below an *assistant professor* or *senior assistant*.

assistant professor (lähin vastine: yliassistentti) a university teacher ranking above a *lecturer* and below an *associate professor* [Random House99], see *senior assistant*.

associate editor (apulaiseditori) see *editor*.

associate member (liitännäisjäsen) see *member*.

associate professor (apulaisprofessori) a university teacher ranking above an *assistant professor* and below a *professor* [Random House99]. In Finland there are no associate professors any more.

associative law (liitälaki) see *commutative law*.

assume (olettaa)

assumption (oletus) something taken for granted [Random House99], see *definition, condition, axiom, postulate, idealization, default, fact, presumptive knowledge, tacit assumption, presumption*.

asterisk (asteriski, tähti, tähtimerkki) mark *.

attachment (liite, liitetiedosto) a file attached to an email, *enclosure*, a *document* added to a letter [Random House99], see *appendix, annex*.

attractor (attraktori) a solution into which an equation is drawn, especially in chaotic systems. If a system is in the basin of attraction in the *state space*, it gets inexorably into the corresponding attractor. Attractors include 1) fixed point, 2) *limit cycle*, 3) quasi-periodic attractor, and 4) strange attractor [Pagels88], see *chaos*.

attribute (attribuutti, ominaisuus, tunnusmerkki) a quality, character, characteristic, or *property* attributed as belonging to a *thing* [Honderich05], see *substance*.

audio (audio, ääneen liittyvä)

audio-visual (audiovisuaalinen)

audit (seuranta, tarkastus) "an appraisal of the effectiveness of the *processes* by which the new *product* was developed and brought to the market" [Belliveau02].

author (tekijä, kirjoittaja) the writer of a *document*, see *coauthor*

authentic (autenttinen, aito)

authority (auktoriteetti, viranomainen, asiantuntija) an expert on a *subject*; a person or body of persons in whom the power to determine is vested [Random House99], see *certification, reference value, measurement standard, verification*.

autocorrelation (autokorrelaatio) *correlation* with itself, see *cross-correlation*.

auxiliary hypothesis (apuhypoteesi) additional *hypothesis* [Rosenberg00].

average (keskiarvo) *sample mean, arithmetic mean, see mean, median, mode, bias, estimation theory, mathematical statistics.*

aware (tietoinen) *see cognitive, conscious.*

awareness (tieto, tietoisuus) *see cognition, consciousness.*

axiology (arvoteoria) *value theory dealing values in 1) ethics, 2) aesthetics, and 3) religion [Random House99], a part of philosophy.*

axiom (aksiooma) *a proposition or premise assumed without proof in an axiomatic system, see assumption, hypothesis, postulate, logic, intrinsic value, presumptive knowledge.*

axiomatic system (aksioomajärjestelmä) *a deductive system that has axioms, a deductively organized system of 1) primitive symbols, 2) rules of formation distinguishing well-formed from ill-formed expressions, 3) definitions, 4) axioms, and 5) rules of inference establishing how theorems are proved from the set of axioms [Honderich05], see proposition, corollary.*

bachelor of science (luonnontieteiden kandidaatti, tekniikan kandidaatti) *an undergraduate degree ranking below master of science, see polytechnic, college, university.*

bachelor's degree (kandidaatintutkinto)

backslash (kenoviiva) *reverse solidus, reversed virgule, mark \, see slash.*

backup copy (varmuuskopio) *see manuscript.*

backwards causality (kausaalisuus taaksepäin) *teleological causality, causality based on a final cause [Honderich05], opposite to forwards causality.*

bandwidth (kaistanleveys) *1) the range of frequencies required to transmit a particular signal, the range of frequencies that a system can pass; 2) the bit rate at which information can be transmitted, see throughput.*

banquet (banketti, juhla-ateria) *a common dinner in a conference.*

bar chart (pylväskuvio) *see histogram.*

baseline (vertailukohta) *reference value.*

base quantity (perussuure) *a quantity from which other quantities are derived [ISO Guide 99:2004], see derived quantity.*

basic research (perustutkimus) *generic research with no specific application or immediate commercial objectives in mind although it may be in fields of present or potential commercial interest, results are usually published in scientific journals [Jain97], see oriented basic research, applied research.*

behavior (käyttäytyminen) *see phenomenon.*

behavioral model (käyttäytymismalli) *a description model which describes the behavior of internal functions of a system, thus expressing the contribution of each function to its environment, specification of algorithms for the functions, hierarchically between the functional model and executive model [Calvez93], see product specification, OSI model.*

behavioral science (käyttäytymistiede) *a science, as psychology, sociology, or anthropology, that derives its concepts from observation of the behaviour of living organisms [Random House99], see social science.*

behaviourism (behaviorismi) *a paradigm of learning where learning is a change in behaviour, see reward, punishment.*

belief (usko, uskomus, luulo) *see knowledge.*

bench (penkki, työpöytä) *see laboratory.*

benchmark (vertailutesti, mittapuu) *see reference value.*

benchmarking (vertailuanalyysi) *a study of the performance data of existing products with functionality similar to that of the product under development, see reference system.*

benchmark problem (testitehtävä)

benchmark program (testausohjelma, nopeustestiohjelma)

benefit (etu, hyöty) a *performance metric* that specifies an advantage [Bock01], see *payoff*.

beta coefficient (beetakerroin) a coefficient measuring the correlation between variables in *regression analysis*, see *alpha coefficient*.

beta prototype (beetaprototyyppi) a late *prototype* built with *parts* supplied by the intended production *processes*, extensively evaluated internally and also typically tested by customers in their own use environment [Ulrich95], see *alpha prototype*, *gamma test*.

beta test (beetatesti) an external test of a *beta prototype* [Belliveau02].

bias (harha) average *error*, the systematic error in a *measurement* result, the difference between the average value of a *measurement* result and the accepted *reference value* [amc03], [Kay93], see *trueness*, *average*, *biased*, *mean-square error*.

biased (harhainen) having a *bias* [Random House99].

bibliographical data (dokumentin kuvailu- ja luettelointitiedot) see *reference*.

bibliography (kirjallisuusluettelo) a complete or selected list of *publications* compiled upon some common principle and ordered according to subject or author [Random House99], see *annotated bibliography*, *reference*, *literature search*.

bijection (bijektio) a *function* that is *one-to-one* and *onto*, a *function* that is both *injection* and *surjection* [Mathworld], an *inverse function* exists for a bijection.

biological system (biologinen järjestelmä) an *open system* with a *dynamic equilibrium* with the main objective to maintain *structure* [Arbnor97].

biology (biologia) the scientific study of life, a branch of *natural science*, see *evolution theory*, *artificial life*, *artificial intelligence*, *bionics*, *neural network*, *genetic algorithm*.

biography (biografia, henkilöhistoria) a written account of an *author's* life [Random House99], see *curriculum vitae*.

bionics (bioniikka) the study and means by which humans and animals perform tasks and solve problems, and of the application of the findings to the design of electronic and mechanical parts [Random House99], see *biology*, *cybernetics*, *systems theory*.

black box (musta laatikko) a *system* whose internal workings are unknown or irrelevant to current purposes.

blind review (sokkotarkastus) a *peer review* where the *referees* are anonymous to the *authors* but usually the authors are known to the referees, see *double blind review*.

block diagram (lohkokaavio) a diagram using labelled blocks connected by lines to represent the *relationship of parts or phases* [Random House99].

body (ruumis, runko, kappale) see *mind*.

boldface (lihava kirjasin, lihava kirjasinlaji) see *letter*, *italic*, *roman*.

bold-faced (lihavoitu)

boldfacing (lihavointi) see *italicization*, *underlining*, *spacing out*, *equation*, *document*.

book (kirja) a book is divided into 1) *parts*, 2) *chapters*, 3) *sections*, and 4) *paragraphs* which consist of *complex sentences*. Books about science can be divided into 1) *monographs*, 2) *reference books*, 3) *textbooks*, and 4) *trade books* [Day98], see *literature*, *style book*.

bootstrapping (vyörytys) self-generating or self-sustained *process* [Random House99], see *initial condition*.

bottom-up (kokoava, alhaalta ylöspäin etenevä) upwards, opposite to *top-down*, see *abstraction*, *synthesis*, *epistemological reduction*, *upwards causality*.

boundary (rajapinta) something that distinguishes a *system* from its *environment* [Checkland99], see *interface*.

boundary condition (reunaehto, rajaehto) a *condition* under which certain *laws* are believed to hold [Losee01], see *initial condition, assumption, constraint*.

brace (aallosulku) curly bracket, marks { ... }, see *equation, punctuation*.

bracket (hakasulku, sulku) 1) *square bracket* or 2) *parentheses* of various forms [Random House99], see *brace, angle bracket, equation, references*.

brainstorming (aivoriihi) think-tank, "a group technique for solving *problems*, generating ideas, stimulating creative thinking, etc., by unrestrained spontaneous participation in discussion without immediate *criticism*" [Random House99], in contrast with *groupthink*, see *creativity*.

brand (brändi, tavaramerkki) *trademark* [Belliveau02].

breadboard (koekytkentälevy)

breadboarding (koekytkentä)

breadboard model (koekytkentämalli) "a proof-of-concept modelling technique that represents how a *product* will work, but not how a product will look" [Belliveau02], see *prototype*.

breve (brevis, lyhyen vokaalin merkki, lyhyysmerkki) mark ˇ showing that a vowel is short, for example ü [Webster's Third New93], see *circumflex, macron*.

broken bar (katkopystyviiva) mark †, see *broken line, vertical bar*.

broken line (katkoviiva) see *broken bar*.

browser (selainohjelma) see *abstracts database, search engine, electronic journal*.

budget (budjetti, talousarvio, tulo- ja menoarvio) see *organization*.

bullet (luetelmapallo, listamerkki) mark •.

business idea (liikeidea, toiminta-ajatus) a summary of the *strategy* of an *organization*, the way the organization earns its income [Kamensky00].

byte (tavu) a group of eight bits [Kurzweil99].

calibration (kalibrointi) see *measurement standard, working standard, trueness, traceability, verification, adjustment*.

camera-ready copy (kuvausvalmis kopio) the final, ready to be photographed version of a *manuscript* that will be published in a *conference proceedings*.

capacity (kapasiteetti, suorituskyky) see *information theory*

capital (pääoma) one of the *production factors*, see *cost, price, economy, investing, resource*.

capital asset pricing model (käyttöomaisuuden hinnoittelumalli)

capital letter (suuri kirjain, suuraakkonen, versaali) *upper case letter*.

caption (kuvateksti, taulukkoteksti) a title or explanation for a *figure* or *table* [Random House99], see *legend*.

career (ammattiura) see *vocation*.

caret (poisjäätimerkki) mark ^ made in written matter to show the place where something is to be inserted [Random House99], see *circumflex*.

caron (hattu, ylösalainen sirkumfleksi, suhumerkki) inverted circumflex, haček, wedge, mark ˇ to indicate that the sound is palatalized [Random House99], [Webster's New World01], see *circumflex*.

Cartesian coordinate system (karteesinen koordinaatisto) rectangular coordinate system, see *polar coordinate system*.

case study (tapaustutkimus) "a method of research used esp. in sociology by which accumulated case histories are analyzed with a view toward formulating general principles" [Webster's Third New93], (in the *social sciences*) "an analytical study of the development of an individual unit, as person, family, or social institution" [Random House99], an *empirical, mostly qualitative, idiographic research method*, the study is done by *observation* without *experiments* in contrast with *action research*.

catastrophe theory (katastrofiteoria) a theory for *abrupt changes* in nonlinear dynamic systems, a moderate change in a system parameter may cause the system to shift suddenly to the other or even unstable state [Simon96], see *chaos theory, systems theory, nonlinear dynamics*.

category (kategoria, luokka) *class*, the most fundamental division of some subject-matter in *philosophy* [Honderich05].

causal (kausaallinen)

causal explanation (kausaallinen selitys) see *deductive-nomological (D-N) model*.

causality (kausaallisuus, syy-seuraussuhde) causation, genuine relation between two *events*. It is *necessary* but not *sufficient* that causality has a *temporal order*, i.e., the *effect* happens after the *cause* [Honderich05]. See *final cause, determinism, free will, correlation, deduction, upwards causality, downwards causality, function*.

causal law (kausaallilaki) a *scientific law* that is based on *causality*, one form of *sequential laws*. All causal laws are *deterministic* [Nagel79] and are included in the *deductive-nomological (D-N) model* [Wright71], but there are deterministic laws which are not causal [Nagel79]. See *theory*.

causal relation (kausaallisuhte, syy-seurasuhte)

causation (kausaallisuus) *causality*.

cause (syy) efficient cause, *explanation* of some *event* called *effect* by identifying an earlier event referred to as cause [Honderich05], different from a *reason* [Rosenberg08], opposite to a *final cause*. Aristotle's four causes include *efficient cause, final cause, formal cause, and material cause*. See *causality, factor, producer, analytical approach*.

cause-effect relation (syy-seuraussuhde) a *causal relation* used in the *analytical approach*, opposite to *producer-product relation*, see *cause, effect*.

cedilla (sedilji) mark ç , an *apostrophe* usually used below the letter c as in ç to show that c is pronounced as s (in French) [Random House99].

center of excellence (osaamiskeskus) "a geographic or organizational group with an acknowledged technical, business, or competitive competency" [Belliveau02], see *organization*.

central dilation (dilataatio) *dilation, translation and expansion* [Weisstein05], see *spiral similarity*.

centralized (keskitetty) in contrast to *distributed*.

central limit theorem (keskeinen raja-arvolause) see *statistics*.

certification (sertifiointi, varmentaminen) 1) "a *process* of formally acknowledging that someone has mastered a body of *knowledge* on a *subject*" [Belliveau02]; 2) an external *validation* given by an accredited *authority* [Calvez93]. See *verification, organization, trueness, registered sign*.

ceteris paribus other things being equal, all other things remaining unchanged [Arbno97], see *analytical approach*.

chance (sattuma) see *determinism, free will, probability*.

channel (kanava) a medium for transmitting *signals* in one direction between two points, see *distortion, interference, crosstalk, noise*.

channel coding (kanavakoodaus) *coding* that adds *redundancy* for efficient error detection and control, see *data link layer, modulation, information theory, source coding*.

chaos (kaaos) 1) deterministic chaos, apparently *random* behaviour within a *nonlinear deterministic* system, whose outcome is sensitive to minute, unmeasurable variations in the *initial conditions* [Wolfram02]; 2) random chaos. See *chance, nonlinear dynamics, attractor, turbulence, three-body problem*.

chaos theory (kaaosteoria) the theory of deterministic *chaos*, "the theory of nonlinear dynamic systems in which infinitesimal changes in initial conditions can result in very large changes in subsequent behaviour" [Barbour97]. See *catastrophe theory, systems theory*.

chapter (luku; jaosto) 1) a main division of a *book*, technical report, or the like [Random House99], see *document, section*; 2) division of a *section* in a *scientific society*.

chart (kaavio, kuvio) *diagram, graph*.

checklist (muistilista, tarkistuslista) see *analysis, creativity*.

chemical engineering (kemianteekniikka)

chemistry (kemia) a branch of *natural science*.

chi-square test (khiin neliötesti) a statistical test, for example for *independence*, in which the test statistic has a chi-square distribution when the *null hypothesis* is true, see *statistical analysis, analysis of variance (ANOVA)*.

chunk (fyysinen rakennusosa) physical building block of a product *architecture* [Ulrich95], [Belliveau02].

Church-Turing thesis (Churchin-Turingin teesi) a *conjecture* that states that all problems that a human being can solve can be reduced to a set of algorithms, i.e., human intelligence is equivalent to machine intelligence [Kurzweil99].

circuit (piiri, virtapiiri, kytkentä) a set of *components* and conductors, fulfilling a desired *function* [Young79], see *system, integrated circuit, microcircuit*.

circular definition (kehämääritelmä) a *definition* that is using the *term* that is being defined.

circular reasoning (kehäpäätely) *reasoning* in which an alleged *proof* of a given *conjecture* involves at some point the assumption of the conjecture to be proved.

circumflex (sirkumfleksi) circumflex *accent*, mark $\hat{\ }$ or $\tilde{\ }$, for example \hat{o} . The meaning depends on the language, in French the marks $\hat{\ }$ or $\tilde{\ }$ show that the vowel is long, the mark $\hat{\ }$ being more common [Random House99], [Webster's New World01], [Webster's Third New93]. See *tilde, swung dash, macron, breve, acute accent, grave accent, caron, caret*.

citation (sitaatti, lainaus, ote, lähdeviite, viite) quotation, *reference*.

citation database (viitetietokanta) an *abstracts database* that includes also *references* of *publications*, called *citations*, see *electronic library*.

cite (viitata) quote, *refer*.

cited half-life (viittausten mediaani-ikä) the median age of citations, the number of *journal* publication years going back from the current year which account for 50% of the total citations received by the cited journal in the current year, see *impact factor, immediacy index*.

class (luokka) *category*, a collection of *things*, a *set* whose members may be specified by means of a list or by reference to a *property* which all and only the members of the class possess [Honderich05].

classical realism (klassinen realismi) scientific realism, "the view that valid models and theories provide a representation of the world as it is in itself apart from the observer" [Barbour97], see *realism, critical realism*.

classification (luokittelu) the assignment of *things* to groups within a system of categories distinguished by some *property* [Random House99], see *taxonomy*.

classified (luokiteltu, luottamuksellinen, salainen) assigned to classification, as restricted, confidential, or secret, that limits its use to authorized persons [Random House99], see *nondisclosure agreement*.

clause (lause) *main* or *subordinate clause*.

client (asiakas, tilaaja) *customer, user*, see *server*.

closed system (suljettu systeemi) opposite to *open system*, see *mechanic system*.

cluster (klusteri, ryväs) a heterogeneous sub-population, representative of the whole *population*, see *stratum*.

coauthor (tekijäkumppani) one of two or more joint *authors* [Random House99].

code (koodi, säännöt) see *coding, code of ethics*.

code of ethics (tapasäännöstö) code of *ethics* of a *scientific society* and its *members*.

coding (koodaus) see *formatting, source coding, encryption, channel coding, modulation*.

coefficient of determination (determinaatiokerroin, selityssaste) a *statistic* that gives some information about the goodness of fit of a model, it is a statistical measure of how well the regression line approximates the real data points, see *regression analysis*.

coefficient of variation (variaatiokerroin) *variation coefficient*.

cognition (tieto, havainto, havaitsemiskyky) the *knowledge* aspect in *consciousness*, distinguished from *affection* and *conation* [Webster's Third New93].

cognitive (kognitiivinen, tiedollinen, havainto-) "of or pertaining to the mental processes of perception, memory, judgment, and reasoning, as contrasted with emotional and volitional processes" [Random House99], see *affection, conation, consciousness, aware*.

cognitive science (kognitiotiede) a science of human information processing using psychology, *computer science*, linguistics, and *philosophy*, see *artificial intelligence*.

coherent (koherentti)

coherence (koherenssi, yhtenäisyys, johdonmukaisuus) consistence, consilience, unity, the quality of being logically integrated, consistent, and intelligible [Webster's New World01], a quality in *theory*.

collective standard (ryhmännormaali) a group of *instruments* whose weighted average value is used as a *measurement standard*, see *individual standard*.

collective work (kokoomateos, kooste, kokoelma) *anthology*, compilation, compiled work, compendium.

college (college, opisto, korkeakoulu) an institution of higher learning that provides a general education in the liberal arts and *sciences* and grants a *bachelor's degree* [Random House99], see *bachelor of science, university*.

colon (kaksoispiste) mark :

combined standard uncertainty (yhdistetty normaaliepävarmuus) estimated *standard uncertainty* of a combination of *measurement results*, see *uncertainty*.

comma (pilkku) mark (,), see *prime, apostrophe*.

commercial at (ät-merkki, taksamerkki) mark @, at the rate of sign.

commercial publisher (kaupallinen julkaisija, kustantamo) a company whose business is the publishing of *books, periodicals*, computer software, etc. [Random House99], see *publisher, scientific society*.

communication (viestintä) transfer of *information*, transference of meaning between systems by the conveying of information [Skyttner05], a matter of encoding a thought in a form that one's audience can decipher, putting one's thoughts into words and one's audience will reverse the process [Honderich05], see *language, transaction*.

communications (tietoliikenne) *telecommunications*.

commutation (vaihtaminen, kääntäminen)

commutative law (vaihdantalaki) a *law valid* for addition and *scalar* multiplication, but not for *matrix* multiplication, see *associative law*.

compartment theory (lokeroteoria) theory of *systems* that consist of subunits with certain *boundary conditions* between which transport processes take place [Bertalanffy98], see *graph theory*.

compatible (yhteensopiva, vaihtokelpoinen) able to run on a specified *computer*, able to work with a specified *device*, functionally equivalent to another, usually widely used system [Random House99], opposite to *incompatible*.

competence (pätevyys) see *ability, profession, referee*.

competing hypothesis (kilpaileva hypoteesi) *alternative hypothesis* [Wilson99], see *hypothesis, null hypothesis, strong inference*.

competitive strategy (kilpailustrategia) answers to the question how an *organization* will acquire, maintain, and strengthen its competitive advantages [Kamensky00]. Competition centers first on 1) *functionality*, followed by 2) *reliability*, 3) convenience, and 4) finally *price* [Christensen03]. See *strategy*.

compilation (kokoomateos) *anthology*.

compile (koota, kääntää)

complementarity (komplementaarisuus, täydentävyys) *duality*, "the relationship between contrasting models and concepts, such as wave and particle, used to describe the same entity" [Barbour97].

complete (täydellinen)

complete induction (täydellinen induktio) *induction* where all the special cases of the generalization are enumerated, in fact a form of *deduction* [Niiniluoto83], see *mathematical induction*.

complex (kompleksinen, monimutkainen) composed of many interconnected parts [Random House99].

complexity (kompleksisuus, monimutkaisuus) number of *parts* and their *relations* in a *system*, "emergence of higher levels of order in systems with many parts" [Barbour97], system *property* measured in engineering for example by size, weight, *energy* consumption, and *delay* of *implementation*, see *complex*, *algorithmic complexity*, *crude complexity*, *effective complexity*, *logical depth*, *statistical complexity*, *computational complexity*, *information*.

complexity science (kompleksisuustiede) *science of complexity* [Skyttner06].

complexity theory (kompleksisuusteoria) a theory of complexity in *biology*, usually based on the idea that nature is a cellular automaton [Wolfram02], see *computational complexity theory*, *systems theory*.

complex number (kompleksiluku) an ordered pair of two real *numbers*, see *vector*, *matrix*.

complex sentence (virke) a sentence including a *main clause* and one or more *subordinate clauses* [Random House99], represents a thought, see *word*, *punctuation*, *tense*, *voice*, *first person*.

component (komponentti, rakenneos) 1) a part of electrical or mechanical system, 2) a discrete packaged electronic element, passive or active, that performs one electrical function [Young79], see *artefact*, *assembly*, *device*, *circuit*, *system*.

compound (yhdyssana) see *hyphen*, *word*.

comprehensive prototype (täydellinen prototyyppi) a full-scale, fully operational version of a *product*, for example *beta prototype* [Ulrich95], see *focused prototype*, *prototype*.

computational complexity (laskennan kompleksisuus) the shortest time in which a computer can produce a solution to a problem [Gell-Mann94], see *computational complexity theory*, *complexity*.

computational complexity theory (laskennan kompleksisuusteoria) a branch of *computer science* that deals with *resources* (time, memory, usually not *energy*) required to solve *problems* [Wolfram02], see *complexity*, *complexity theory*, *systems theory*, *Turing machine*.

computer (tietokone) a machine, usually programmable, that implements an algorithm [Kurzweil99], see *information engineering*, *Turing machine*.

computer science (tietojenkäsittelyoppi, tietojenkäsittelytiede) information science, a branch of *formal sciences*, see *computational complexity theory*.

conation (konaatio, toimintavire) the volitional aspect of *consciousness*, related to *free will*, distinguished from *affection* and *cognition* [Webster's Third New93].

*concept (käsite) an abstract *idea* of an *object* formed by mentally combining all its characteristics or *properties* in a *definition* [Random House99], see *universal*, *semiotic triangle*, *term*, *product concept*.

concept formation (käsitteenmuodostus) conception, formation of new *concepts*, see *theory construction*, *scientific method*.

conception (käsitys, ajatus, käsitteenmuodostus) *idea*; *concept formation*.

conceptual analysis (käsiteanalyysi) see *concept*, *analytic philosophy of science*, *mind map*.

conceptualism (konseptualismi) any of the several doctrines existing as a compromise between *realism* and *nominalism* and regarding *universals* as *concepts*.

conceptual model (käsitteellinen malli) a model based on the use of symbols to represent qualitative aspects, for example *functional* or *behavioral model* [Calvez93], used as a basis for an *mathematical model*.

conceptual system (käsitejärjestelmä) see *concept*.

conclusion (johtopäätös) the final *result* of a task that states the extent to which the task *objective* has been achieved [Bock02], see *conclusive knowledge*.

conclusions (johtopäätökset) a part of a *scientific paper*, more focused than *discussion*, includes 1) what is shown by the work and its significance, 2) limitations and advantages, 3) applications of the results, and 4) recommendations for further work [Spectrum65], see *abstract, introduction*.

conclusion validity (johtopäätöksen valideetti) statistical conclusion validity, *validity* concerned with the *relationship* between the *treatment* and the outcome of the *experiment*, we want to make sure that there is a *statistical* relationship with a given *significance* [Wohlin99].

conclusive knowledge (johdettu tieto) *knowledge* that is obtained by *deduction* or *statistical inference* [Bock02], including *result, conclusion, theorem, lemma*.

concurrency (samanaikaisuus) a large number of similar computations are performed at the same time [Haykin91], see *parallelism, modularity*.

concurrent (samanaikainen)

concurrent engineering (samanaikainen tuote- ja valmistussuunnittelu) simultaneous engineering, "when product design and manufacturing process development occur concurrently in an integrated fashion, using a cross-functional team, rather than sequentially by separate functions" [Belliveau02], all product related information is visible to all participants [Leppälä03], see *transparent, generative order*.

condition (ehto, varaus) a restricting, limiting, or modifying circumstance [Random House99], see *initial and boundary condition, assumption, optimum, explanation*.

conditioning (ehdollistaminen, ehdollistuminen)

conference (konferenssi) a formal scientific meeting of a number of people for *discussion* and *consultation* [Random House99], usually larger than a *symposium* and *workshop*, see *acceptance ratio, deadline, keynote speaker, invited paper, session, track, exhibition, selection committee, peer review, audience, registration, treasurer, banquet*.

conference paper (konferenssijulkaisu) see *journal paper*.

conference proceedings (konferenssitalenne) a record of the *papers* presented at a *conference*, see *literature, camera-ready copy, page charge*.

confidence interval (luottamusväli) coverage interval [Kreyszig83], [ISO Guide 99:2004], the interval for which the *confidence level* of a random variable is defined, the interval between the lower and upper *confidence limits*.

confidence level (luottamustaso) level of confidence [Kreyszig83], [Taylor94], coverage probability [ISO Guide 99:2004], the *probability* that a random variable is within the *confidence interval*.

confidence limit (luottamusraja) lower or upper limit of the *confidence interval* [Kreyszig83].

confirmation (vahvistus, vahvistaminen, varmennus, varmistus, vahvistus) justification, sometimes seen as a weaker *term* than *verification* [Pagels88].

conjecture (konjektuuri) *hypothesis* in *formal sciences*, a hunch proposed as a possible *theorem* to be *proved* [Honderich05].

conscious (tietoinen) see *cognitive, aware*.

consciousness (tietoisuus, taju) "ability to have subjective experience" [Kurzweil99], includes 1) *affection*, 2) *conation*, and 3) *cognition* [Webster's New World01].

consensus (yksimielisyys) common opinion in a *scientific* community, see *truth theory*.

consistence (konsistenssi, yhtenäisyys, johdonmukaisuus) *coherence*, freedom from contradiction.

consistent (konsistentti, tarkentuva) see *estimator*.

consilience (konsilienssi, yhtenäisyys) unity of knowledge [Wilson99], *coherence*.

constant (vakio) see *variable, parameter*.

constraint (rajoite, ehto) limitation or restriction [Random House99], constraints come from 1) safety, 2) ergonomics, 3) production, 4) quality control, 5) assembly, 6) transport, 7) operation, 8) maintenance, 9) expenditure, 10) recycling [Pahl07], see *estimation theory, optimum, product requirement*.

construction engineering (rakennustekniikka)

constructive (konstruktiiivinen, rakenteellinen)

constructive proof (konstruktiiivinen todistus) a *proof* where the *object* is actually constructed, opposite to *existence proof*.

constructive research (konstruktiiivinen tutkimus) *design science*, a *research method* where the *solution* of the *problem* is actually constructed, may be conceptual or technical development [Iivari91]. The *term* constructive research is used especially in *engineering* and *economics*, see *existence proof*.

constructivism (konstruktivismi) 1) a *paradigm of learning* where learning is a process of constructing *knowledge*; 2) a movement in *philosophy of science* according to which *knowledge* is a social construction. See *actors approach, positivism, pragmatism*.

constructivist (konstruktivistinen)

construct validity (teoreettisen rakennelman valideetti) *validity* concerned with the *relation* between *theory* and *observation* [Wohlin99], see *isomorphism*.

consultant (konsultti, asiantuntija) see *expert*.

consumer (kuluttaja) *user*, a person who is using *products*.

consumer need (kuluttajatarve) "a *problem* the *consumer* would like to have solved" [Belliveau02], see *customer need*.

contents (sisällysluettelo) a list of usually numbered *parts, chapters* and *sections* in a *book*.

context (yhteys, asiayhteys) see *frame problem, semantics, ambient intelligence*.

contextualism (kontekstualismi, asiayhteyttä korostava)

contingent (mahdollinen) "an event or relationship is contingent if it is not necessary or if it is dependent on particular conditions that may or may not occur" [Barbour97].

continuity (jatkuvuus) opposite to *abrupt change*, see *analysis, regularity*.

contract (kontrahti, sopimus) see *agreement*.

contraction (kutistuminen) see *geometric contraction*.

contradiction (ristiriita, ristiriitaisuus) see *consistency*.

contribute (osallistua, avustaa, edistää, myötävaikuttaa) to solve a scientific or technical *problem*.

contribution (osuus, panos, myötävaikutus) a course of action that helps to solve an *engineering problem*, see *credit*.

contribution margin (kate) see *prime cost*.

control (säätö, ohjaus) regulation, see *system*.

control theory (säätöteoria) see *systems theory, feedback, plant, cybernetics*.

control unit (säätöyksikkö) controller, regulating mechanism [Random House99], see *state machine, system*.

convenience sampling (lähiotanta) a *nonprobability sampling* method.

convention (konventio, tapa) a rule, method or practice established by use, custom [Random House99], see *stipulative knowledge*.

conventional true value (käypä todellinen arvo, suureen oikeaksi sovittu arvo) *true value* accepted for a given purpose, the accepted *true value* of the *measurand* [amc03], the best estimate of the true

value. The conventional true value is defined by 1) an adopted physical or other standard, 2) geometric laws, or 3) a system or data decided as correct by some recognized authority [Buckner97a]. See *reference value, trueness, accuracy, uncertainty, error, bias, measurement standard, benchmark, reference value scale* see *accepted reference value*.

conversion (muutto)

convert (muuttaa) to change in *quality*, see *transform*

copy (kopio, jäljennös, moniste, kappale (yksittäinen kirja), (lehden) numero) see *issue, volume, hard copy*.

copy editor (kustannustoimittaja, tekstitoimittaja) an employee of a *publisher* whose responsibility is to prepare *manuscripts* for publication by providing markup for the printer as well as any needed improvements in *spelling, grammar, and style* [Day98].

copyright (tekijänoikeus, painatusoikeus) mark ©, the “exclusive ownership of and the right to make use of a literary or artistic work, protected by law for a specified period of time” [Skillin74]. The copyright protects the form of expression rather than the subject matter of the writing [US-PTM]. The copyright continues to be valid even after the death of the author for a specified number of years, usually for 70 years. After this the work enters into the *public domain*. Copyright protection does not include *titles*, which are protected by *trademarks* or ideas which are protected by *patents* [Skillin74]. See *permission, intellectual property, paraphrase, quotation*.

copyright form (tekijänoikeuslomake)

core competence (ydinosaaminen) “that capability at which an *organization* does better than other organizations” [Belliveau02].

corollary (korollaari, seurauslause) a *proposition* that is incidentally proved in proving another proposition [Random House99], see *lemma*.

correct (virheetön, oikea) representing the *truth*, see *plausible*.

corrected result (korjattu tulos) *result* from which the known *systematic error* is removed, opposite to *uncorrected result*.

correction factor (korjauskerroin) a *factor* which is used to remove the *systematic error* from the *measurement result* by multiplying with the correction factor.

correctness (virheettömyys, oikeellisuus) see *truthfulness, original paper*.

correlation (korrelaatio, riippuvuussuhde) the degree to which two or more *quantities* show a tendency to vary together [Random House99]. Correlation does not reflect *causal* connection [Rosenberg00]. For example, the quantities may be causes of the same *factor* or the quantities measure the same thing. Uncorrelatedness is weaker than *independence*. See *causality, internal validity, statistical analysis, hypothesis*.

correlation coefficient (korrelaatiokerroin)

correspondence (kirje; yhteensopivuus) 1) *letter*; 2) agreement with something else or with one another, conformity, similarity, *analogy* [Webster’s New World01].

cosmogony (kosmogonia) a *theory* of the origin and development of the universe [Random House99], see *cosmology*.

cosmology (kosmologia) a part of *metaphysics*, “philosophical or scientific beliefs about the origin, structure, and nature of the universe” [Barbour97], see *cosmogony, free will*.

cost (hinta, kustannus, kulu) 1) expense, the *price* paid to acquire, produce, accomplish, or maintain anything [Random House99]; 2) a *performance metric* that specifies an immediate or long-term disadvantage of an associated *benefit* [Bock01]. See *payoff, capital, labor costs, direct costs, indirect costs, overhead costs, prime cost*.

cost function (kustannusfunktio) *performance metric*.

countable (numeroituva)

counterexample (vastaesimerkki) see *falsification*.

coverage factor (kattavuuskerroin) the number by which the *standard deviation* is multiplied to obtain the *expanded standard uncertainty* [Taylor94].

coverage interval (kattavuusväli) *confidence interval* [Kreyszig83], an estimate of the range of values within which the true *value* is assumed to be with a certain *coverage probability*, a means of expressing *uncertainty*, including systematic and random errors [amc03], [ISO Guide 99:2004]. See *bias, standard deviation, mathematical statistics*.

coverage probability (kattavuustodennäköisyys) *confidence level* [Kreyszig83], level of confidence [Taylor94], the probability that the true value is within the *coverage interval* [ISO Guide 99:2004], for example 95%, 99%, or 99.9% [Buckner97b], [Kreyszig83], see *uncertainty, trueness, precision*.

covering law model (peittävän lain malli) *deductive-nomological (D-N) model* [Rosenberg00].

cover letter (saatekirje, saate)

creativity (luovuus) *originality* of thought [Random House99], see *brainstorming, analogue, metaphor, mind map, extreme, opposite, research, development, lateral thinking, serendipity, invention, morphological analysis*.

credit (opintopiste) ECTS credit, 60 credits is equivalent to one academic year or 1600 hours of full-time work of a student.

credit (kunnia, ansio) see *contribution*.

criterion (kriteeri) a standard of judgement, a rule or principle for evaluating or testing something [Random House99]. The plural form is criteria. See *metric, optimum, performance criterion*.

critical path (kriittinen polku) "a single sequence of tasks whose combined required times define the minimum possible completion time for the entire set of tasks" in a *project* [Ulrich95], see *PERT chart*.

critical realism (kriittinen realismi) "the view that models and theories inadequately and selectively represent particular aspects of the world for specific purposes", a position intermediate between *classical realism* and *antirealism* [Barbour97].

criticism (kriitikki) the act of analyzing and evaluating of a work [Random House99] with the aim to improve it, see *groupthink, values*.

cross-correlation (ristikorrelaatio) see *autocorrelation*.

cross-layer design (kerrosten välinen suunnittelu) see *layered architecture, holism*.

crosstalk (ylikuuluminen) *interference* whose source is signals on one or more communication *channels* [Hall62].

crucial experiment (ratkaiseva koe) see *experiment*.

crude complexity (karkea kompleksisuus) the length of the shortest message describing a system [Gell-Mann94], see *complexity*.

cultural history (kulttuurihistoria)

culture (kulttuuri) a status in a society based on long-term cooperation, see *value-laden system*.

cumulative index (hakemistojen yhdistelmä) an author and subject *index* that covers several recent *volumes* of a certain *journal*.

curly bracket (aallosulku) *brace*.

currency (valuutta) mark ₤.

curriculum (opetussuunnitelma)

curriculum vitae (curriculum vitae, ansioluettelo) track record, a summary of one's personal history and professional qualifications, as that submitted by a job applicant [Webster's New World01], see *biography*.

curve fitting (käyrän sovitus) see *estimation theory, model fit*.

customer (asiakas, tilaaja) client, user, see *funding, marketing, industry*.

customer need (asiakastarve) any *attribute* of a potential *product* that is desired by the customer, expressed in the *language* of the customer, see *product requirement, consumer need, feature*.

custos (kustos) chairman of the *public defence*, usually the same as the *supervisor*.

cybernetics (kybernetiikka) “science of control and communication in animals and machines” [Kurzweil99], see *control theory, analogy, homology, bionics, biology, systems theory, systems science*

cycle time (kierrosaika) “the length of time for any *operation*, from start to completion” [Belliveau02].

dagger (risti) mark † [Webster’s Third New93], used often for *footnotes*, see *double dagger*.

dash (ajatusviiva) usually the same as *em dash*, see *en dash, tilde, punctuation, hyphen*.

data (data, tiedot) *information* prepared for or stored by a computer, a plural noun.

data analysis (data-analyysi)

database (tietokanta) see *abstracts database, citation database, electronic library, data mining*.

data book (datakirja) *component* catalogue.

data collection (datan kerääminen) see *data reduction, sampling method*.

data link layer (siirtoyhteyskerros) the *layer* above the *physical layer* and below the *network layer* in the *OSI model*. The principal service provided by the data link layer to the higher layers is that of error detection and control, the layer attempts to make the physical link error-free and provides the means to activate, maintain, and deactivate the link. The bottom part of the data link layer is *medium access control sublayer* [Tanenbaum96], [Stallings91]. See *error rate, channel coding*.

data mining (analysoiva tiedonhaku, tiedonrikastus) *knowledge* discovery in *databases*. The nontrivial extraction of *implicit*, previously unknown, and potentially useful *information* from *data* [Frawley92]. See *literature search, information retrieval*.

data reduction (datan pelkistäminen) see *statistical analysis, reduction, data collection*.

deadline (takaraja, aikaraja, määräaika, määräpäivä) the *time* by which the *manuscript* must be *submitted* to a *conference*, a *special issue* of a *journal* or a *book*.

debugging (debuggaus, virheiden etsintä ja poisto) detecting and removing errors from a computer program [Random House99], see *verification, testing, patching*.

decision theory (päästöteoria) a mathematical theory of decision-making, a special case of *game theory* when there is only one player against nature, see *detection theory*.

deduce (dedusoida) see *deduction*.

deduction (deduktio) a form of *inference*, opposite to *aduction*. If the *premises* are true the conclusion must be true, i.e., deduction preserves the *truth* [Honderich05]. If the conclusion is false, at least one of the premises must be false. Deduction is often inaccurately defined as drawing of a particular truth from a general truth. Deduction corresponds to *analysis* [Hall62, p. 110]. *Deterministic* and *causal* systems can be presented as deductive systems, but not all deterministic theories are causal [Nagel79]. See *reduction, complete induction, causality, abduction, measurement, conclusive knowledge*.

deductive (deduktiivinen) see *deduction*.

deductive-nomological (D-N) model (deduktiivis-nomologinen malli) a *model* of *explanation* where every explanation includes a *deductive* argument containing at least one *deterministic law* and is *empirically* testable [Rosenberg00]. Deterministic laws include for example 1) *causal laws*, 2) *static laws* and 3) *dynamical laws* [Nagel79]. See *inductive-statistical (I-S) model, deductive explanation, scientific law*.

deductive system (deduktiivinen järjestelmä) a system that has at least one rule of *inference* but need not have any *axioms* [Honderich05], see *axiomatic system, natural deductive system*.

deductive explanation (deduktiivinen selitys) a form of *scientific explanation* that is based on a *deductive system* [Nagel79], see *axiomatic system*.

default (oletusarvo) a preset value that a computer system assumes or an action that it takes unless otherwise instructed [Random House99], see *assumption*.

definition (määritelmä) explanation of the meaning of a word or expression, naming wider *class* to which something belongs and distinguishing *properties* [Honderich05], probably using *primitive symbols or terms* [Rosenberg00]. Definitions are divided into 1) *ostensive*, 2) *dictionary* and 2) *stipulative definitions* [Honderich05]. See *assumption, semantics, well-defined problem, ill-defined problem, stipulative knowledge*.

degree (tutkinto) an academic title conferred by universities and colleges upon the completion of studies [Random House99], see *bachelor of science, master of science, doctor of philosophy, doctor of science, doctor of technology*.

degree of freedom (vapausaste) see *mathematical statistics, chi-square test*.

delay (viive) the period of *time* for which something is delayed, see *performance, response time, latency, transmission delay, transfer delay, jitter, lag, response time*.

deliverable (tulos) "the output (such as test reports, regulatory approvals, working *prototypes*, or marketing research reports) that shows a *project* has achieved a result" [Belliveau02].

delivery (toimitus, jakelu) see *value chain*.

demand (kysyntä) the desire for a commodity or *products* together with ability to pay for it [Webster's New World01], see *supply, price-quality ratio, law of supply and demand, industry*.

demographic (demografinen, väestöä koskeva)

demonstration (demonstratio, havaintoesitys, todistaminen, näyteluento) see *prototype*.

derived quantity (johdannaisuure) see *base quantity, quantity* [ISO Guide 99:2004].

description (kuvaus) a description is given to better understand a *phenomenon* [Nagel79], see *explanation*.

description model (esitysmallli, kuvausmalli) description models include 1) *functional*, 2) *behavioral*, and 3) *executive model* [Calvez93], see *OSI model*.

descriptive (deskriptiivinen, kuvaileva)

design (suunnittelu) *product design*.

design science (suunnittelutiede) *constructive research*, the term design science is used especially in software development.

destructive test (ainetta rikkova koe) see *test*.

detection (ilmaisu) demodulation, the *process* of recovering at the receiver a signal that has been modulated on a carrier wave [Sklar01], see *modulation, channel coding*.

detection theory (ilmaisuteoria) a part of *estimation theory* where the parameter to be estimated is a set of data *symbols*, see *detection, decision theory*.

detector (ilmaisin)

determinism (determinismi) thesis that all *events* without exception are *effects*, or events necessitated by earlier events which are *causes*. Future events are fixed and unalterable as the past is fixed and unalterable [Honderich05]. Determinism is "the claim that every event is the lawful consequence of antecedent events and is in principle predictable from knowledge of scientific laws and antecedent conditions" [Barbour97]. All *causal laws* are *deterministic*, but some *deterministic* laws do not directly describe *causality* [Nagel79], [Wright71]. Determinism is contrasted with *chance* and *free will*. See *causality, chaos, explanation, deterministic law, deductive-nomological (D-N) model*.

deterministic (deterministinen) see *determinism*.

deterministic law (deterministinen laki) a *law* based on *determinism*, used in the *deductive-nomological (D-N) model*, includes 1) *sequential* and 2) *functional laws*, opposite to *statistical law* [Nagel79].

deterministic model (deterministinen malli) a model that includes only a *deterministic* part, see *statistical model, regression model*.

*development (kehitystyö) *systematic* use of the existing *knowledge* for production of useful *materials, devices, systems*, or methods, including design and development of *prototypes* and processes [Jain97], see *product development*.

developmental law (kehityslaki) incomplete *scientific law* based on historical or genetic descriptions, one form of *sequential laws* [Nagel79], see *genetic explanation*.

deviation (poikkeama) see *standard deviation, error*.

device (laite, koje; aktiivinen komponentti) 1) technical system whose main flow is signal-based [Pahl07], 2) an active electronic *component* [Young79], see *machine, apparatus, component*.

diachronism (diakronismi, historiallisuus) see *anachronism*.

diaeresis (diereesi) *dieresis*.

diagram (diagrammi, kaavio) *chart, graph*, see *bar chart, histogram, PERT chart, flowchart, Gantt chart, pie chart, block diagram, scatter diagram*.

dial (näyttötäulu) the part of a *displaying device* where the *scale* is.

dialectic methodology (dialektinen metodologia) a *methodology* in *actors approach* from *thesis* and *antithesis* to *synthesis* [Arbnor97].

dialectics (dialektiikka, väittelyoppi) the art of discourse, debate, or discussion [Arbnor97].

dialogue (dialogi, vuoropuhelu) conversation, see *discourse*.

dictionary (sanakirja) see *language, thesaurus*.

dictionary definition (sanakirjamääritelmä) *definition* of the meaning of a word or expression "as established in a language" [Honderich05].

dieresis (diereesi, treema) diaeresis, the mark "¨" placed over a vowel to indicate that the vowel is pronounced in a separate syllable, for example "öö" or "Brontë" [Random House99], [Webster's Third New93], see *umlaut*.

digital library (digitaalinen kirjasto) electronic library, virtual library, a *library* where the *literature* is in an electronic form, see *electronic book, electronic journal*.

dilation (dilataatio, venyminen) *translation* or *central dilation* [Weisstein05], see *function*.

direct cost (välitön kustannus) costs that do not include *indirect costs*.

director (johtaja) hierarchically above a *manager*.

discipline (tieteenala, tiedonhaara) a branch of *knowledge*, learning, or *science* [Webster's New World01], see *interdisciplinary reduction, multidisciplinary*.

discourse (diskurssi, keskustelu) conversation, see *dialogue*.

discover (keksiä, löytää) see *knowledge*.

discovery (keksintö, löytö) the *process* with which the *hypothesis* is found after the *problem* has been defined, see *scientific method, hypothetico-deductive method, experimental-inductive method, knowledge, verification, creativity, explanation*.

discrete (diskreetti, epäjatkua, erillinen) distinct, made of distinct parts [Random House99].

discrimination (erottelukynnys) discrimination threshold, the largest change in the *stimulus* that does not cause any noticeable change in the *response* of an *instrument* when the stimulus is changing slowly and monotonically [SFS Handbook 19], see *sensitivity*.

discrimination threshold (erottelukynnys) *discrimination*.

discursive (diskursiivinen, erittelevä, loogisesti etenevä) thinking that involves many small conscious steps, opposite to *intuitive* [Pahl07]

discuss (keskustella, pohtia)

discussion (pohdinta) a part of a *scientific paper*, more general than *conclusions*, see *document*.

disorder (epäjärjestys) opposite to *order*.

dispersion (dispersio, hajonta)

displayed equation (numeroitu yhtälö) an *equation* for which a *number* in *parentheses* is given for future reference, see *in-text equation*.

displaying device (näyttölaite) see *scale, instrument*.

dissertation (opinnäyte) a *thesis*, especially one written by a candidate for a *doctorate* [Random House99].

distortion (vääristymä, särö) a wave, sound or signal modified so as to produce an unfaithful reproduction [Webster's New World01]. Distortion can also be caused by *multiplicative noise*. In a time-invariant *system* a particular transmitted signal always produces the same received signal, i.e., the received signal is a definite *function* of the transmitted signal [Shannon98, p. 65]. See *channel, interference, crosstalk, noise, additive noise, linear, nonlinear*.

distributed (hajautettu, jakautunut) in contrast to *centralized* and *lumped*.

distribution (jakelu) delivery, see *industry*.

distribution function (kertymäfunktio) integral of the *probability density function*.

ditto mark (toistomerkki) repeat mark, mark " or – – [Webster's Third New93].

diversity (diversiteetti, monimuotoisuus)

diversity of science (tieteen monimuotoisuus) the claim that *science* is a network of *theories* that mutually support and partially explain each other and do not have a privileged foundational level, say physics, opposite to *foundationalism* or *unity of science* [Honderich05], see *holism*.

divide and conquer (hajota ja hallitse) *reductive method*, a *problem* solving method based on *methodological reduction* [Pagels88], see *experimental-inductive method, iterative improvement*.

division (jakolasku, jakaminen) see *multiplication*.

DNA computing (DNA-laskenta) "a form of computing in which deoxyribonucleid acid (DNA) molecules are used to solve complex mathematical problems" [Kurzweil99].

docent (dosentti) *adjunct professor*, a university lecturer who has a *doctor's* degree, ability to teach, and significant research results after his or her doctor's degree, roughly equivalent to a second doctoral *thesis*.

doctor (tohtori) a *graduate* degree ranking above *master of science*, a person who has passed the required *graduate* courses and published and successfully defended a doctoral thesis in a *public defence*. A doctor is required to independently discover new *scientific knowledge*.

doctoral candidate (väittelijä) see *doctor*.

doctoral thesis (väitöskirja) a *thesis* published by a *doctoral candidate* after the two *referees* selected by the university have written a positive *review* about the thesis *manuscript*, see *dissertation, pre-examination*.

doctorate (tohtorinarvo) *doctor's* degree.

doctor of philosophy (filosofian tai tekniikan tohtori) a *graduate* degree ranking above a *master of science* and below *doctor of science*.

doctor of science (tekniikan tai filosofian tohtori) a *graduate* degree ranking above a *doctor of philosophy*, corresponding to a *fellow* of a scientific society, especially in the United Kingdom (UK). In some countries (for example in the United States at the Massachusetts Institute of Technology, MIT) equivalent to *doctor of philosophy*.

doctor of technology (tekniikan tohtori) see *doctor of philosophy, doctor of science*.

doctrine (oppi, oppijärjestelmä, opinkappale, oppisuunta) see *dogma*.

*document (dokumentti, asiakirja, asiapaperi) see *book, article, paper, publication, standard, patent, thesis* or other *technical report*, in general includes a *title, authors, abstract, table of contents, preface, glossary, list of abbreviations, list of symbols, introduction, materials and methods, system model, results, discussion, conclusions, summary, appendix, and index*, and the text consists of *parts* (in books), *chapters, sections, paragraphs, complex sentences, tables, figures, equations, and footnotes*, see *readership, literature search, transparent, voice, tense, italicization, bold-facing, punctuation*.

dogma (dogma, opinkappale) doctrine that is accepted irrespective of reason or evidence [Honderich05], see *paradigm, speculative knowledge*.

dogmatic (dogmaattinen, ahdasmielinen, suvaitsematon)

domain (arvojoukko; alue) the *set* of *values* for which a *function* is defined [Weisstein05], see *range*.

dot (piste) see *period*.

dot above (pisteaksentti, kirjaimen yläpuolinen piste) mark \cdot , sometimes replaces a *prime*, see *middle dot*, *period*, *ring above*.

double acute (kaksoisakuutti) mark $\ddot{}$, see *acute*.

double blind review (kaksoissokkotarkastus) a *blind review* where also the *authors* are anonymous to the *referees*.

double dagger (kaksoisristi) mark \ddagger [Webster's Third New93], used for a *footnote* if the *dagger* has been already used.

double hierarchy (kaksijakoinen hierarkia) double ladder, a hierarchy in a research organization providing two separate advancement opportunities, inc. 1) management hierarchy, 2) professional hierarchy [Jain97], see *triple hierarchy*.

double ladder (kaksoisportaikko) *double hierarchy*.

double low line (kaksoisalaviiva) mark $\underline{\underline{}}$, see *low line*.

double prime (kaksoispilkku) mark $\prime\prime$, used to distinguish one character from another, to indicate second or inch, or second differentiation of a *function*, see *prime*.

double spacing (normaali riviväli) see *single spacing*, *manuscript*.

downwards causality (alaspäin suuntautuva kausaalisuus) *top-down causality* from the *whole* to its *parts* [Honderich05] implying *strong emergence*, opposite to *upwards causality*. Downwards causality is suspected in *natural science*, see *backwards causality*.

draft (luonnos, luonnostella) see *outline*, *sketch*, *revision*, *document*.

drift (ajautuma, ryömintä) slow change in the *properties* of an *instrument*, see *stability*.

dual (duaali, kahtalainen, kaksitahoinen, kaksinainen) having a twofold, or double, character or nature [Random House99].

dual hierarchy (kaksijakoinen hierarkia) a *hierarchy* in a *research organization* which includes a management hierarchy and a professional hierarchy [Jain97], see *triple hierarchy*.

dualism (dualismi, kahtiajako) duality, *complementarity*, the view that substances are either material or mental [Random House99], "the claim that there are two distinct types of basic entity in the world, such as soul and body or mind and matter" [Barbour97], opposite to *materialism*.

duality (duaalisuus, kahtalaisuus, kahtiajako) *dualism*, see *symmetry*.

duration (kesto aika) length of time something continues or exists [Random House99].

dynamic (dynaaminen, muuttuva, kehittyvä; muistillinen) 1) opposite to *static*, 2) characterized by or producing *change* or progression [Random House99]; (a *system*) with memory.

dynamical law (dynaaminen laki) a form of *functional laws* which show the manner a *magnitude* of some *quantity* varies with time or more generally how a change in magnitude per unit of time is related to other magnitudes. Dynamical laws are not *causal laws*. An example is Galileo's law of falling bodies [Nagel79]. See *statical law*.

dynamical systems theory (dynaaminen systeemitheoria) study of systems that evolve in time according to mathematical equations [Wolfram02], see *dynamic*, *nonlinear dynamics*, *systems theory*.

dynamic measurement (dynaaminen mittaus) *measurement* where the *quantity* may be changing, see *static measurement*.

dynamic range (dynamiikka-alue) an *linear signal* range whose upper bound is defined by saturation and lower bound by *noise*, see *system*.

dynamic structure (dynaaminen rakenne) a *structure* that is changing with *time*, opposite to *static structure* [Bohm92], see *order*, *dynamic order*.

dynamics (dynamiikka) the branch of *mechanics* that deals with the motion and equilibrium of *systems* under the action of forces [Random House99].

e-book (elektroninen kirja) *electronic book*.

economics (taloustiede, kansantaloustiede) a branch of *social science*, see *cost, price, capital, school of economics*.

ECTS credit (opintopiste) see *credit*

edition (laitos, painos) one of a series of printings of a *book*, each differing from another by alterations, additions, etc. [Random House99], see *print, book*.

editor (editori, toimittaja, päätoimittaja) 1) a person who decides what will be published in a multi-author book; 2) a person in a *journal* who organizes the *peer review* process and decides whether a submitted *manuscript* is published or not in the journal, see *copy editor, associate editor*.

editorial board (toimituskunta, toimitus) the board of *editors* in a *journal*.

editor in chief (päätoimittaja) 1) the principal *editor* of a large *book*; 2) the principal editor of a *journal* to whom the *manuscripts* are submitted and who selects the *editor* to organize the *peer review*.

effect (seuraus) see *cause, reason, action*.

efficacy (toimivuus) a *measure* of the extent to which a *system* contributes to the purposes of a higher level system of which it may be a *subsystem* [Skyttner05].

effective complexity (tehollinen kompleksisuus) the length of a concise description of a system's regularities identified in the schema of a system [Gell-Mann94], see *complexity*.

effectiveness (vaikuttavuus) a *measure* of the extent to which a *system* achieves its intended *transformation* [Skyttner05].

efficiency (tehokkuus, hyötysuhde) a *measure* of the extent to which a *system* achieves its intended *transformation* with the minimum use of *resources* [Skyttner05], see *performance*.

efficient (tehokas) see *efficiency, estimator*.

efficient cause (vaikuttava syy) one of Aristotle's causes, now simply called *cause*, opposite to *final cause*.

e-journal (elektroninen lehti) *electronic journal*.

electrical engineering (sähkötekniikka) see *electronics, information engineering, and telecommunications*.

electromagnetics (sähkömagnetismioppi) a branch of *physics*.

electronic book (elektroninen kirja) e-book, a book published electronically but may not be freely available.

electronic library (elektroninen kirjasto) *digital library*.

electronic journal (elektroninen lehti) e-journal, a *journal* published electronically but may not be freely available, see *open access journal*.

electronics (elektroniikka) *development and application* of *devices* and *systems* involving the flow of electrons in a vacuum, in gaseous media, and in semiconductors [Random House99], see *microelectronics, nanotechnology, information engineering*.

element (elementti, osa, alkio) *part*.

ellipsis (ellipsi, kolme pistettä vaakasuunnassa, sananpoisto, poisheitto) suspension points, mark ..., ..., or —, used in a quotation for leaving out of a word or phrase that is not necessary for meaning [Young02], [Skillin74], [Webster's Third New93].

embedded (sulautettu)

em dash (m-viiva, pitkä ajatusviiva) mark —, whose length is equal to the width of letter M, used to replace some missing words or to show a sudden break or abrupt changes in a quotation [Chicago93], see *en dash, dash, ellipsis*.

emergence (emergenssi, ilmaantuminen) occurrence of *properties* at higher *hierarchy levels* of *organization* which are not predictable from properties found at lower levels [Nagel79]. Emergence is ignored in *reductionism*. See *strong emergence*, *weak emergence*, *holism*, *free will*, *downwards causality*, *system*, *synergy*.

emergent property (emergentti ominaisuus)

empirical (empiirinen) based on fact or *observation* [Young02], see *experimental*, *trial and error*.

empirical-inductive method (empiiris-induktiivinen menetelmä) a *scientific method* in *empirical sciences* based on *observations* and *inductive* generalizations [Kragh02], see *experimental-inductive method*, *reductive method*.

empirical science (empiirinen tiede) *science* based on *observations*, especially *natural science*, opposite to *formal science*.

empiricism (empirismi) *empirism*.

empirism (empirismi) "the claim that sensory experience is the primary source of knowledge and justification for the truth of propositions" [Barbour97], contrasted with *rationalism*.

emulator (emulaattori) real-time simulator, see *simulation*.

enabling (mahdollistava) see *technology*.

enclosure (liite) *attachment*, something enclosed or included within a letter [Random House99], see *appendix*, *annex*.

encryption (salaus) enciphering, adding a *code* to *data* being sent over a public network to prevent its unauthorized *detection* [Sklar05], see *presentation layer*, *coding*.

encyclopedia (ensyklopedia, tietosanakirja) a *book* or set of books giving information on all or many branches of *knowledge*, generally in *articles* alphabetically arranged [Random House99], see *language*, *literature*.

en dash (n-viiva, lyhyt ajatusviiva, ajatusviiva, väliviiva, luetteloviiva) mark —, whose length is equal to the width of letter N, half of the length of *em dash*, used to connect continuing or inclusive numbers [Chicago93].

energy (energia) capacity to do work [Random House99], one of the basic *resources*, see *power*, *complexity*.

engine (kone) a *machine* that takes *energy* from some *material* (burning or flowing) and turns it into *work* in the form of rotating motion [Asimov74], see *motor*.

engineer (insinööri) an expert in *engineering*, see *scientist*.

engineering (tekniikka) practical application of *science* and *mathematics*, as in the design and construction of new *products* and *services* [Random House99], not existing in the nature, inc. *chemical*, *civil*, *electrical*, *industrial*, and *mechanical engineering*, see *art*, *science*, *artefact*, *reverse engineering*, *technology*.

engineering design (tekninen suunnittelu) mechanical, electrical, software, etc. *design* of a *product*, in contrast to *industrial design* [Ulrich95].

enlightenment (valistus) an ambition to develop society with *scientific knowledge* and rationality.

entrance examination (pääsykoe) see *university*.

entrepreneur (yrittäjä)

entropy (entropia, energian epäkäytettävyys, epäjärjestys; entropia, keskimääräinen informaatio) 1a) "a measure of disorder of a system" [Barbour97], 1b) unavailability of energy [Asimov84]. Increasing entropy is accompanied by the loss of useful energy (in *thermodynamics*) and loss of *semantic information* although *syntactic information* may be increased [Barbour97]. 2) Average *syntactic information* content per source symbol in *information theory* [Checkland99], see *equivocation*.

environment (ympäristö) what lies outside the system *boundary* [Checkland99], see *system*, *systems approach*, *product requirement*, *telepresence*, *virtual reality*.

epistemological (epistemologinen) "referring to characteristics of knowledge" [Barbour97].

epistemological reduction (epistemologinen reduktio) *intertheoretical* and *interdisciplinary reduction*, "the claim that theories or laws at any level of analysis are derivable from theories or laws at lower levels" [Barbour97], opposite to *deduction*, see *reduction, ontological reduction, induction, abduction*.

epistemology (epistemologia, tietoteoria) theory of knowledge [Rosenberg00], part of *philosophy*, study of the origin, nature, methods and limits of human *knowledge* [Random House99], inc. 1) *logic* and 2) *philosophy of science*, see *positivism, constructivism, pragmatism*.

equation (yhtälö) see *displayed equation, in-text equation, variable, bold-facing, italicization, parenthesis, bracket, curly bracket, subscript, superscript, index, formula*.

equilibrium (tasapainotila, tasapaino) see *steady state, stability*.

equipment (koneisto; laitteisto, laite) 1) set of *machines, machinery* [Pahl07], 2) set of *assemblies* [Young79], see *artefact, module*.

equivocation (ekvivokaatio, epämääräisyys, moniselitteisyys) *ambiguity*, especially in a frequency estimator; conditional *entropy* in *information theory*.

ergonomics (ergonomia, työtiede) see *industrial design*.

error (virhe) the difference between a *measurement* result and the accepted *reference value* [amc03], see *systematic error, random error, bias, standard deviation, mean-square error, curve fitting, mistake, raw error, fractional error, normalized error, zero error, tracking error*.

error rate (virhesuhde) the ratio of erroneously received *symbols* and all received *symbols*, see *performance, data link layer*.

esthetics (estetiikka) *aesthetics*

estimate (estimaatti, arvioitu arvo, arvio)

estimation theory (estimointiteoria) see *telecommunications, detection theory, constraint, likelihood, mean-square error, least squares method, outlier, statistic, mathematical statistics, average, mean, median, mode, bias, standard deviation*.

estimator (estimaattori) see *consistent, efficient, sufficient*.

ethical (eettinen) see *ethics*.

ethicality (eettisyys)

ethics (etiikka) a branch of *axiology*, see *code of ethics, self-deception*.

ethos (henki, periaate, asenne) see *research culture*.

Euclidean geometry (euklidinen geometria) Euclidian geometry, a part of *geometry* where symmetrical magnification is allowed and shape is invariant and thus similarity is retained, a special case of *affine geometry* and a generalization of *metric geometry* [Medawar84].

event (tapahtuma) an event is constituted by changes [Honderich05], see *phenomenon, scenario, process, thing*.

evidence (evidenssi, näyttö, todiste, todistus) *proof*, see *experiment, verification, indirect evidence*.

evolution theory (evoluutioteoria) see *biology, genetic algorithm, systems theory*.

exclamation mark (huutomerkki) exclamation point, mark !.

exclamation point (huutomerkki) *exclamation mark*.

executive summary (johtajille tehty yhteenveto) an *abstract* prepared for executives.

executive model (toteutusmalli) implementation model, a *description model* that specifies the physical parts of the *system*, consisting of processors for information transformation and decision making, memories for storing data, and communication nodes as intermediate elements for information transit points, hierarchically below the *functional model* and *behavioral model* [Calvez93], see *OSI model, product specification*.

exhibition (näyttely, messut) see *conference*.

existence proof (olemassaolotodistus) see *constructive proof*.

existentialism (eksistentialismi) a philosophical movement that stresses the individual's position as a self-determining agent responsible for his or her choices, a branch of *phenomenology* [Arbnor97], see *free will*.

expanded uncertainty (laajennettu epävarmuus, kokonaisepävarmuus) *uncertainty* expressed with *standard deviation* multiplied by a given *coverage factor*.

expansion (venytys) enlargement, *dilation*, opposite to *geometric contraction* [Weisstein05], see *function, scaling, stretch, shrink*.

expectation (odotusarvo) expected value, mean.

expected value (odotusarvo) *expectation*, mean.

expenditure (panostus)

expense (kulu, kustannus) cost, see *reward*.

experience (kokemus) new *knowledge* gained by *observation* or *experiment* [Rosenberg00], see *a priori, a posteriori*.

experiment (koe) a *scientific* test or a set of tests done carefully to study what happens, to gain new *knowledge*, and to test a *theory* or *hypothesis* [Wohlin99] under controlled conditions in a *laboratory* [Bock02], see *crucial experiment, observation, evidence, empirism, rationalism, laboratory experiment, field trial, pilot*.

experimental (kokeellinen) based on *experiments* and *observations*, see *empirical, trial and error*.

experimental-inductive method (kokeellis-induktiivinen menetelmä) a *scientific method* based on *experiments* and *induction* [Losee01], see *empirical-inductive method, reductive method, divide and conquer, iterative improvement, hypothetico-deductive method, discovery*.

experimental mathematics (kokeellinen matematiikka) finding mathematical results by doing experiments with a computer, for example simulation of a cellular automaton [Wolfram02]. Discrete and symbolic computations can be absolutely precise. See *systems theory*.

expert (asiantuntija) specialist, in contrast to *generalist*, see *consultant, task force*.

expert system (asiantuntijajärjestelmä) "a computer program that solves a problem using a database of expert knowledge on a topic" [Kurzweil99], see *artificial intelligence, knowledge engineering*.

expertise (asiantuntemus, ammattitaito) see *skill*.

explain (selittää) to present more or less general *relations* among characteristics, behaviors, or both [Arbnor97], see *positivism, understand*.

explanation (selitys) answer to the question "how", complementary to *understanding*. The statement of specific *conditions* or *causes* and *laws* that are valid for an individual object or for a class of objects [Bertalanffy98]. Explanations are used in *analytical* and *systems approaches*. Most scientific explanations are in fact *descriptions* [Nagel79, p. 26]. Explanations include 1) *causality*, 2) *chance*, and 3) *free will*. See *isomorphism, homology, theory, hypothesis, discovery, scientific explanation, causality, model, description*.

explanatory power (selitysvoima)

explicit (eksplisiittinen, selvä) fully and clearly expressed or demonstrated [Random House99], opposite to *implicit*, see *original paper*.

explorative (tutkiva)

explorative study (alustava tutkimus) study whose *objective* is to formulate *hypotheses* [Arbnor97], see *feasibility study*.

exponent (eksponentti)

exponential (eksponentiaalinen, eksponentiaali-) inverse of *logarithmic*.

exponential complexity (eksponentiaalinen kompleksisuus) an algorithm has exponential complexity if the number of steps in the algorithm is an exponential function of the size of the problem [Dewdney04], see *intractable problem*.

exponentiation (potenssiin korotus) see *multiplication, logarithm*.

expression (lauseke, ilmaisu) a mathematical *symbol* or combination of symbols representing a value, *relation*, or the like [Random House99], see *equation*.

extended abstract (laajennettu tiivistelmä) a long *abstract* based on which some *conferences* make their decisions about acceptance before the *camera-ready copy* is *submitted*. The extended abstract is a summary of the final paper, it usually follows the *IMRAD structure*, and its length is 1-2 pages.

externalism (eksternalismi) attention to external features or aspects [Merriam-Webster].

external validity (ulkoinen valideetti) generalizable true, the question of how general the findings are, can the result of the study be generalized outside the scope of the study [Wohlin99], see *validity*, *internal validity*, *reliability*, *induction*.

extreme (ääripää) see *opposite*.

fact (fakta, tosiasia) something that has been verified, a statement of *objective* reality [Bock02], see *assumption*, *verification*, *stipulative knowledge*.

factor (faktori, tekijä, osatekijä, syy, kerroin) a condition or *parameter* whose value is intentionally varied to measure its impact on the *results* [Bock02], see *treatment*, *cause*, *level*, *model*.

factor analysis (faktorianalyysi) isolation, by way of mathematical analysis, of *factors* in multivariable phenomena [Bertalanffy98]. A statistical *data reduction* technique used to explain variability among observed *random variables* in terms of fewer unobserved random variables called *factors*. See *statistical analysis*, *systems theory*.

failure (epäonnistuminen)

false (virheellinen, epätosi) opposite to *true*.

false alarm (väärä hälytys) false positive, *type I error*, see *missed detection*.

false negative (väärä negatiivinen) *type II error*.

false positive (väärä positiivinen) *type I error*.

falsifiability (falsifioitavuus, kumottavuus) refutability, see *falsification*.

falsifiable (kumottavissa oleva) refutable.

falsification (falsifointi, kumoaminen) refutation, demonstration that the *hypothesis* is false by the discovery of a *counterexample*, opposite to *verification* [Rosenberg00], see *underdetermination*.

falsify (falsifioida, kumota, osoittaa vääräksi) refute.

fault (vika, virhe, häiriö) see *robust*, *operational*.

feasibility study (esitutkimus) "major unknowns (technical or market) are examined to produce *knowledge* about how to resolve or overcome them or to clarify the nature of any limitations" [Belliveau02], see *research*, *explorative study*.

feature (piirre) "the solution to a *customer need* or *problem*" [Belliveau02].

feature detector (piirreilmaisin)

feedback (takaisinkytkentä, palaute) closed loop, return of part of the *output* of a circuit, *system*, or device to the *input* [Random House99], see *stability*, *feedforward*, *control theory*.

feedforward (myötäkytkentä) open loop, see *feedback*.

fellow (fellow, ansiotunut jäsen) a member of a *scientific society* ranking above a *senior member* and below a *life fellow*, a person with an extraordinary record of accomplishments in a specific field.

fellowship (apuraha) see *scholarship*, *grant*, *fellow*.

field (kenttä, alue) 1) an *area* where practical work is done, away from the *laboratory*; 2) the realm of *knowledge* or a special work or opportunity [Webster's New World01].

field study (kenttätutkimus) field research, *research* in the *field*.

field test (kenttätesti) see *field trial*

field trial (kenttätesti) a trial of a new *product* or *procedure* to determine its usefulness or *efficiency* in actual performance [Random House99], see *validation*.

figure (kuva; numeromerkki, lukumäärä) 1) figures may be *graphs*, photographs, or line drawings [Day98], see *document*, *legend*, *caption*, *histogram*; 2) a numerical symbol, an amount or value expressed in *numbers* [Random House99].

figure of merit (hyvyytluku, laatuluku) *performance index* which tends to compensate for size and number of units involved, for example damping ratio [Chestnut67].

final cause (finaalisyy) purpose over time, *explanation* of some *event* by identifying the *purpose*, goal or end which it serves to attain [Honderich05]. Final cause is contrasted with *efficient cause*. Final causes are suspected in *natural science*. See *teleological cause*, *emergence*, *backwards causality*, *downwards causality*, *systems approach*.

finality (finaalisuus) dynamic *teleology*, purposefulness over time.

financial theory (rahoitusteoria) financial *economics*.

finite state machine (äärellinen tilakone) a *state machine* with a finite number of *states* [Fletcher80].

first person (ensimmäinen persoona) preferably use the active voice and first person in a *document* rather than the *passive voice* [Day98], [Young02], see *complex sentence*.

flexibility (joustavuus) see *adaptability*, *reconfigurability*.

flowchart (vuokaavio, virtauskaavio) a *diagram* to show a detailed sequence of steps in a *process*, including start and stop.

focus (fokus, keskittyminen) central point of attention [Random House99], see *object*, *research*.

focused prototype (kohdistettu prototyyppi) prototype made to "implement one or a few of the attributes of a *product*" [Ulrich95], see *prototype*, *comprehensive prototype*.

font (fontti, kirjasin, kirjasinlaji, kirjasantyyppi) see *manuscript*.

font size (fonttikoko, kirjaskoko) the usual font size is 12 points, for *indices* it is 10 points, see *manuscript*.

footnote (alahuomautus) see *dagger*, *double dagger*.

forecasting (ennustaminen) *prediction*.

form (muoto) *organization*, *structure*, shape, or pattern given to some *material*, complementary to *matter* [Honderich05], see *morphology*.

formal (muodollinen) opposite to *informal*.

formal cause (formaalinen syy) one of Aristotle's *causes*, *structure* of an object.

formalism (formalisi, kaavamaisuus) strict adherence to or observance of prescribed or traditional forms [Random House99], see *instrumentalism*, *creativity*

formalist (formalisti) opposite to an *intuitionist*, see *proof*.

formalization (formalisointi, virallistaminen)

formal logic (formaalinen logiikka)

formal science (muodollinen tiede) a branch of *science*, inc. 1) *logic*, 2) *set theory*, 3) *mathematics*, 4) *computer science*, and 5) *information theory*, see *empirical science*, *mathematical statistics*.

format (formaatti, ulkoasu, muoto) a specific arrangement in accordance with which computer *data* are processed, stored, printed, etc. [Sklar02], see *presentation layer*.

formatting (formatointi, muotoilu) see *format*.

formula (kaava) an *equation* where a *quantity* is expressed in terms of other quantities.

forum (foorumi, arena, keskusteluareena) see *alliance*.

forwards causality (kausaalisuus eteenpäin) *causality* based on *efficient cause* [Honderich05]

foundation (säätio) see *funding*, *grant*, *scholarship*

foundationalism (käsitys tieteiden yhtenäisyydestä) *unity of science*.

fractal (fraktaali) a nested shape whose dimension is not an integer, whose length is infinite but whose area is finite.

fractal geometry (fraktaaligeometria) theory of nested shapes [Wolfram02], see *systems theory*.

fractional error (suhteellinen virhe) ratio of *raw error* and the *reference value* [Bock02], see *error*.

frame problem (kehysongelma) frame of reference problem. The problem of the context dependence of the meaning of the signs [Pagels88]. See *semantics*.

free will (vapaa tahto) will that is not completely governed either by *deterministic causal laws* [Honderich05] or by *chance*, see *conation, cognition, consciousness, determinism, chance, emergence, actor, intentionality, existentialism*.

fruitfulness (hedelmällisyys) part of *significance*, see *generality*.

F-test (F-testi) a statistical test that compares the variances of two groups, see *t-test, statistical analysis*.

full paper (täysimittainen julkaisu) a full-length *original journal paper*, a well-rounded treatment of a *problem* area [IEEE-IT]. The length of the *manuscript* is usually limited to 24-30 *double-spaced* pages or 8-10 printed pages, see *letter*.

full-stop (piste) *period*.

function (funktio, kuvaus; toiminto) 1) map, mapping, transformation, correspondence, *operation* [Random House99]. A *relation* that uniquely associates members of one *set* with members of another set. A function is therefore a many-to-one or sometimes one-to-one relation. The set of values at which a function is defined is called its *domain*, while the set of values that the function can produce is called its *range*. Different geometric transformations include *identity, scaling, expansion, stretch, geometric contraction, translation, central dilation, spiral similarity, inversion operation -x, glide, rotation, twirl, rotoinversion, shear, twist, and inversion 1/x*. See *analysis, system, variable, domain, range, order, structure, process, monotonic, inverse function, causality, algebra*; 2) "an abstracted description of work that a *product* must perform to meet *customer needs*" [Belliveau02], activities, *effects, goals, and constraints* [Pahl07].

functional (funktionaalinen) see *function*.

functional design (toiminnallinen suunnittelu) a complete functional solution in accordance with the *product specifications* and with qualities which will benefit the entire *product* life [Belliveau02].

functional element (funktionaalinen osa) "the individual operations that a product performs" [Belliveau02].

functional law (funktionaalinen laki) a form of *scientific laws*, including 1) *statical laws* and 2) *dynamical laws*. Functional laws are not *causal laws* [Nagel79].

functional model (toiminnallinen malli, rakennemalli) functional schematic [Belliveau02], a structural model, a *description model* where a *structure* built using functions and relations between them. Decomposition into functions corresponds to a topological rather than a temporal point of view of application activities. The functional model is hierarchically above the *behavioral model* and *executive model* [Calvez93]. See *structure, product specification, abstraction, refinement, OSI model*.

functional organization (toiminnallinen organisaatio) a work *organization* where "organizational links are primarily among those who perform similar functions" [Ulrich95], see *project organization, matrix organization*.

functional parts (toiminnalliset osat) functional elements, "individual operations and transformations that contribute to the overall *performance* of the *product*" [Ulrich95], see *physical parts*.

functional testing (toiminnallinen testaus)

funding (rahoitus) financial support, see *marketing, customer, proposal, foundation, sponsor*.

funding agency (rahoitusorganisaatio) see *Academy of Finland, Tekes, Sitra, MATINE*.

funds (rahavarat) capital.

future perfect tense (futuurin perfekti) see *perfect tense, future tense*.

future tense (futuuri) see *tense*

futurology (futurologia, tulevaisuudentutkimus) see *vision, scenario, roadmap*.

fuzzy logic (sumea logiikka) a type of logic used in computers and other electronic devices for processing imprecise or variable data, in place of the traditional binary values. Fuzzy logic employs a range of values for greater flexibility [Webster's New World01].

fuzzy set (sumea joukko)

game theory (peliteoria) a mathematical *theory* that deals with *strategies* for maximizing *utility* within prescribed *constraints* [Random House99]. The other player may be nature as in *decision theory* [Bertalanffy98]. See *systems theory, zero-sum game*.

gamma test (gammatestaus) "a product use test in which the developers measure the extent to which the product meets the needs of target customers, solves the problem(s) targeted during development, and leaves the customer satisfied" [Belliveau02].

Gantt chart (Gantt-kaavio) time line, *timing plan*, a chart that depicts progress in relation to time, often used in planning and tracking a *project*, but does not explicitly display the dependencies among tasks [Ulrich95], see *PERT chart*.

gatekeeper (portinvartija, porttivahti) a person who has a good social network and act as *information* sources in a group [Jain97], see *research culture*.

generalist (generalisti) in contrast to *specialist*.

generality (yleisyys) a quality in *theory* [Wilson99], part of *significance*.

generalization (yleistys) see *induction*.

general systems theory (yleinen systeemiteoria) study of large networks of elements [Wolfram02], see *systems theory*.

generative order (generatiivinen järjestys, uutta luova järjestys) an overall order, a creative *order* between *timeless order* and *sequential order*, a deep and inward order out of which the manifest form of *things* can emerge creatively, an order where *time* does not have priority in contrast to *sequential order*, and internal interrelations are included, especially *iterations* [Bohm92], see *spiral model, iterative model, outline, refinement, concurrent engineering, PERT chart, holism*.

generic (geneerinen, yleinen, yleispätevä) general.

genetic algorithm (geneettinen algoritmi) an *algorithm* inspired by the *evolution theory*, solutions are improved among several alternatives by combining solutions (hybridization), by generating random variation (mutation), and by selecting the most fitted (natural selection), see *neural network, biology*.

genetic explanation (geneettinen selitys) one form of *scientific explanations* based on genes [Nagel79], see *developmental law*.

genetic system (geneettinen järjestelmä) *self-organizing system* [Checkland99], [Arbnoor97]

geometric contraction (kutistuminen, supistuminen, lyheneminen) opposite to *expansion* [Weisstein05], see *function, scaling, shrink*

geometry (geometria) a part of *mathematics*, opposite to *analysis*. Different geometries form a hierarchy, including from bottom up *topology, affine geometry, Euclidean geometry, and metric geometry* [Medawar84].

glide (peilaava siirto) *reflection* in a line and *translation* along the same line [Weisstein05], see *function*.

glossary (sanasto, luettelo) a part of a *document*, see *list of abbreviations, list of symbols, terminology, vocabulary*.

goal (päämäärä) 1) aim or purpose, suggests something broad, abstract, general, attained only by prolonged effort and hardship [Merriam-Webster], 2) hypothetical *solution*, some new *system* matched to a certain *environment* [Hall62], *product specification*. See *objective, hypothesis*.

Gödel's incompleteness theorem (Gödelin epätäydellisysteoreema) a *theorem* which states that "for any consistent formal system containing a certain part of arithmetic, a sentence in the language of this system can be constructed which is neither provable nor refutable in the system" [Honderic05].

gradeful degradation (vähittäinen huononeminen) opposite to catastrophic failure [Belliveau02].

grade (arvosana, arvostella) see *mark*.

graduate (akateemisen välitutkinnon jälkeinen) studies after the *bachelor of science degree*, see *master of science, doctor of philosophy, doctor of science*.

graduate student member (jatko-opiskelijajäsen) see *student member*.

grammar (kielioppi) see *language, syntax, complex sentence, copy editor*.

grammar book (kielioppi) a *reference book* on the way *complex sentences* of a *language* are constructed, especially the study of morphology and *syntax*.

grand unified theory (suuri yhtenäisteoria) "a theory encompassing electromagnetic, weak nuclear, and strong nuclear forces" [Barbour97].

grant (apuraha) *scholarship, fellowship*, see *award, reward, foundation*.

granularity (rakeisuus) the smallest measurement increment specified for a device or quantity [Bock01], see *precision, resolution*.

graph (graafi, kaavio) 1) *diagram, chart*, 2) a collection of vertices or "nodes" and a collection of edges that connect pairs of vertices, graphs may be undirected or directed, see *graph theory*.

graphic presentation (graafinen esitys)

graph theory (graafiteoria) theory of *graphs* that elaborates relational structures by representing them in a topological space [Bertalanffy98], see *topology, network theory, matrix algebra, compartment theory, open system*.

grave accent (gravis) mark ` , for example è. The meaning depends on the language. It may indicate secondary stress. In French it indicates that the vowel is open or lax (i.e., relaxed) [Random House99]. See *acute accent, circumflex*.

grounded theory (aineistopohjainen teoria) a *qualitative research method* in *social sciences* emphasizing generation of *theory* from *data*.

groupthink (ryhmäajattelu) a mentality of group agreement without the individual minds sorting out the best decision or solution to a *problem* leading to poor *performance* [Jain97], in contrast with *criticism*, see *brainstorming*.

haček (hattu, ylösalainen sirkumfleksi, suhumerkki) *caron*.

halting problem (pysähtymisongelma) a problem in *computer science* concerning the question whether for a given input and *algorithm* the algorithm will stop.

handout (luentomoniste) see *lecture, slide presentation*.

hang-up (roikkuminen) a *limit cycle* in a nonlinear system, see *attractor, nonlinear dynamics*.

haptic interaction (haptinen vuoro vaikutus) *interaction* with the sense of touch, including sensing of pressure and temperature [Kurzweil99], see *multi-sense interaction*.

hard copy (paperikopio, kalvokopio) a *copy* on film or paper as opposed to magnetic disk or tape.

hard decision (kova päätös) see *soft decision*.

hardware (laitteisto) see *software, middleware*.

heading (otsikko) a title of a *chapter* or *section*.

hermeneutics (hermeneutiikka, tekstintulkintaoppi) the art or science of *interpretation* [Random House99], a *research method*, used especially within *actors approach* and partly within *systems approach*. A modern trend in *philosophy of science* [Niiniluoto02]. See *analytic philosophy of science*.

hermeneutic circle (hermeneuttinen kehä) inherent circularity of all understanding [Honderich05], a circle in interpretation, which comes from the fact that details must be understood in the light of the whole, but the whole can be understood only from the details.

heuristic (heuristinen, keksimään johtava) encouraging a person to solve *problems* for example by *experimenting*, evaluating possible answers or *solutions*, or by *trial and error* [Random House99].

heuristics (heuristiikka, keksimistaito)

hierarchical (hierarkkinen, monitasoisesti luokitteleva)

hierarchical control (hierarkkinen säätö) *control* in a hierarchical system [Checkland99], see *hierarchy*.

hierarchy (hierarkia, arvoasteikko, arvojärjestys) any *system* of persons or *things* ranked above another [Random House99], see *reduction*, *nested hierarchy*, *hierarchy level*, *layered architecture*, *OSI model*, *serial hierarchical system*, *parallel network system*.

hierarchy level (hierarkiataso) in a *system hierarchy*, each hierarchy level is more complex than the one below, "a part or aspect that is relatively integrated and stable even when it interacts with other systems or subsystems in a hierarchy of levels" [Barbour97]. A level is characterized by *emergent properties* which do not exist at the lower level [Checkland99]. See *layer*.

high culture (korkeakulttuuri) a culture that has shown major change in history [Bertalanffy98].

histogram (histogrammi, pylväsdiagrammi) see *mathematical statistics*, *figure*, *bar chart*.

historiography (historiografia, historiankirjoitus) methods of historical *research* [Random House99], see *idiographic*, *actors approach*

history (historia) 1) study of past *events*; 2) acts, ideas, or events that will or can shape the course of the future [Random House99], see *developmental law*, *trend*, *idiographic science*.

holism (holismi) opposite to *reductionism*, theory that whole entities, as fundamental components of reality, have an existence other than as a mere sum of their parts [Random House99]. See *systems approach*, *emergence*, *hierarchy level*, *vitalism*, *integral system*, *parallel network system*, *diversity of science*, *generative order*, *cross-layer design*.

holistic (holistinen, kokonaisvaltainen)

holistic approach (kokonaisajattelu) *systems approach* [Checkland99], [Arbno97].

holodeck (holodekki) (in *science fiction*) *telepresence* and *virtual reality* combined: all involved are in a virtual environment.

hologram (hologrammi) see *telepresence*.

holograph (hologrammi) *hologram*.

homology (homologia, samasyntyisyys) 1) likeness in *structure* between parts of different organisms due to evolutionary differentiation from a corresponding part in a common ancestor (in biology) [Merriam-Webster], 2) a useful *analogy* where the *causes* are different, but the *laws* are formally identical [Bertalanffy98], analogy that is based on similar *structures* [Arbno97]. See *isomorphism*.

homomorphic model (homomorfinen malli) a *model* that reproduces the gross effects of interactions in a real system [Chestnut65], see *isomorphic model*.

homomorphism (homomorfismi, operaation säilyttävä kuvaus) (in *mathematics*) "a mapping of a mathematical set into or onto another set in such a way that the result obtained by applying the operations to elements of the first set is mapped onto the result obtained by applying the corresponding operations to their respective images in the second set" [Merriam-Webster], see *isomorphism*.

honorary member (kunniajäsen) see *member*.

horizontal bar (vaakaviiva) horizontal line, mark —, see *vertical bar*.

horizontal line (vaakaviiva) *horizontal bar*.

hot spot (hotspotti, kuuma piste)

humanities (humanistiset tieteet) inc. 1) *history*, 2) *philosophy*, 3) *linguistics*, 4) study of literature, visual arts, music, etc., 5) *jurisprudence*, and 6) science of religion.

hypermedia (hypermedia) "a *system* where various forms of *information*, as *data*, text, graphics, video, and audio, are linked together by a *hypertext program*" [Random House99].

hypertext (hyperteksti) "a method of storing data through a computer program that allows a user to create and link fields of *information* at will and to retrieve the *data* nonsequentially" [Random House99], see *sequential*.

hyphen (tavuviiva) mark -, see *compound*, *dash*.

hypothesis (hypoteesi) a hunch proposed as a possible *solution* to a *problem* [Honderich05], an idea of a *causal relationship* or *correlation* [Wohlin99], an assumed relation between variables, see *goal*, *competing hypothesis*, *null hypothesis*, *auxiliary hypothesis*, *objective*, *conjecture*, *explorative study*.

hypothetico-deductive method (hypoteettis-deduktiivinen menetelmä) method based on the thesis that *science* proceeds by hypothesizing general statements or *hypotheses* from which observational consequences may be *deduced* to indirectly *verify* the hypotheses [Honderich05], see *axiomatic system*, *theory*, *scientific method*, *experimental-inductive method*, *empirical-inductive method*.

hypothetico-deductive system (hypoteettis-deduktiivinen järjestelmä) *axiomatic system* or other *theory* that is *experimentally verified* by using the *hypothetico-deductive method* [Niiniluoto02].

hysteresis (hystereesi) see *instrument*.

iconic model (ikonimalli, kuvakemalli) a scaled *physical model* describing static things, for example a map in the form of globe [Chestnut65].

idea (idea, ajatus, käsite) "any conception existing in the mind as a result of mental understanding, awareness, or activity, a thought, a plan of action, a *concept* developed by the mind" [Random House99], ideas are generated through a unique communication network of a *research organization* and facilitated by the *ethos* of a scientific community [Jain97], see *research*.

ideal (ideaali, ihanne; ideaalinen, ihanteellinen)

idealization (idealisointi) something considered or represented in a perfect form, to approximate a thing in the real world, *abstraction* [Hall62], see *assumption*, *reductionism*.

idealism (idealismi) "a philosophical position asserting that mind or ideas are more fundamental than matter" [Barbour97], see *materialism*, *dualism*, *realism*.

ideation (ideointi) *idea* generation [Belliveau02].

identity (identtisyy, samanlaisuus, identiteettikuvaus, identtinen yhtälö) [Weisstein05], see *function*.

ideographic (idiografinen) *idiographic*.

idiographic (idiografinen, yksilöä tutkiva) ideographic, dealing with the *concrete*, individual, or unique [Merriam-Webster], contrasted with *nomothetic*. For example *history* is an idiographic discipline. See *historiography*.

idiographic research (idiografinen tutkimus) a *research method* used in social sciences emphasizing unique phenomena, inc. 1) *case study* and 2) *action research* [Iivari91], see *nomothetic research*, *constructive research*.

ill-defined problem (huonosti määritelty ongelma) badly defined *problem*, opposite to *well-defined problem*, see *definition*, *customer needs*.

illustration (kuva, kuvitus) see *figure*

image (arvojoukko; kuva) *range*

immediacy index (välitön vaikuttavuus) the average number of times recent articles in a specific *journal* were cited in the present year, see *impact factor*, *cited half-life*

impact (vaikutus) influence, effect, see *significance*.

impact factor (vaikuttavuusluku) the average number of times recent articles in a specific *journal* were cited in one year, usually averaged over two preceding years, see *immediacy index*, *cited half-life*.

imperfect tense (imperfekti) *past tense*.

impersonal (persoonaton, puolueeton) *objective*, see *research culture*.

implementation (toteutus) "*development* of the required operational material object described by the implementation specification using hardware or software, satisfying the *product requirement*" [Belliveau02], see *product specification, development, complexity*.

implementation model (toteutusmalli) *executive model*.

implication (implikaatio, johtopäätös, seuraamus) see *imply*.

implicative (implikatiivinen, seuraamuksia sisältävä)

implicit (implisiittinen, epäsuora) opposite to *explicit*, see *imply, tacit knowledge*.

implied assumption (hiljainen oletus) *tacit assumption*.

imply (sisältää, käsittää) 1) to indicate or suggest without being *explicitly* stated; 2) derivable by *deduction* [Rosenberg00].

imprecision (epätasällisyys) numerical value expressing precision, for example with *standard deviation* [amc03], [ISO Guide 99:2004]. The term is not recommended in [Taylor94]. See *precision, accuracy, uncertainty*.

improper rotation (kiertoinversio) *rotoinversion*.

impulse response (impulssivaste) response of a *linear* system to an impulse, see *transfer function*.

inaccuracy (epätarkkuus) see *accuracy*.

incommensurability (yhteismitattomuus) the supposed untranslatability of one *theory* or *paradigm* into another [Rosenberg00], see *interdisciplinary reduction, intertheoretical reduction*.

incompatible (yhteensopimaton) opposite to *compatible*.

incremental improvement (inkrementaalinen paraneminen) iterative improvement.

incubation (haudonta) see *creativity*.

indentation (sisennys) see *paragraph*.

independence (riippumattomuus, itsenäisyys) stronger than uncorrelatedness, see *correlation, physical additivity*.

indeterminism (indeterminismi) a view incompatible with *determinism* [Honderich05], uncertainty "is ascribed to the presence of a range of potentialities and absence of exact laws in nature itself, rather than to the limitations of our knowledge about the nature" [Barbour97], see *free will, trend, quantum mechanics*.

index (indeksi, hakemisto, luettelo; osoitin) 1) see *subscript, superscript, glossary, cumulative index, immediacy index, document*; 2) the part of a displaying device whose location with respect to the *scale marks* gives the *indication*.

index of performance (suorituskykyindeksi) *performance metric*.

indication (näyttämä) the *quantity value* given by an *instrument*, see *range of indication*.

independence (riippumattomuus) see *correlation, chi-square test*.

indirect cost (välillinen kustannus) *overhead cost*, added to the *direct costs*.

indirect evidence (epäsuora todiste) see *evidence*.

individual standard (yksilönormali) an *instrument* used as a *measurement standard*.

induce (indusoida) see *induction*.

induction (induktio) scientific induction, a form of *inference* in which the conclusion, though supported by the *premises*, does not follow from them necessarily [Honderich05]. Induction is often inaccurately defined as *reasoning* from particular cases to general conclusions. Scientific induction is incomplete and does not necessarily preserve the *truth*. Induction is essentially based on *regularity* of the world and usually *analogies* are used. A form of inductive reasoning is statistical reasoning. See *complete induction, abduction, deduction, probability, underdetermination, external validity, theory construction*.

inductive (induktiivinen) see *induction*.

inductive method (induktiivinen menetelmä) a *scientific method* based on *induction*, see *experimental-inductive method*, *empirical-inductive method*, *hypothetico-deductive method*.

inductive-statistical (I-S) model (induktiivis-tilastollinen malli) a model of explanation for *statistical* generalizations instead of strict laws [Rosenberg00], see *deductive-nomological (D-N) model*, *statistical explanation*, *conclusive knowledge*.

industrial design (teollinen muotoilu) *design* of aesthetics, *ergonomics*, and user interfaces of a *product*, in contrast to *engineering design* [Ulrich95].

industrial engineering (tuotantotekniikka) *engineering* applied to the planning, design, and control of industrial *operations* [Random House99].

industrial revolution (teollinen vallankumous) a revolution in technology that enabled the mass production of goods and materials [Kurzweil99].

industry (teollisuus) *manufacturing* productive enterprises collectively, see *organization*, *invention*, *product*, *investing*, *capital*, *people*, *energy*, *material*, *research*, *development*, *design*, *manufacturing*, *marketing*, *distribution*, *mass product*, *customer*, *supply*, *demand*, *law of supply and demand*, *instrumentation*.

industry standard (teollisuusstandardi)

infer (päättellä, tehdä johtopäätös) see *inference*.

inference (päättely) upgrading or adjustment of belief in the light of the play of new *information* upon current beliefs, inc. *deduction*, *induction*, *abduction* [Honderich05], see *reasoning*, *analogy*, *strong inference*.

influence quantity (vaikutussuure) a *quantity* in the *environment*, *instrument*, etc. that affects the *measurement result* without being the *measurement quantity*.

informal (epämuodollinen) opposite to *formal*.

information (informaatio) 1) semantic information [Skyttner06], *communications* about *relations* in *forms* [Baeyer05], "a sequence of *data* that is meaningful in a *process*", "nonmaterial resource" [Kurzweil99], "an ordered *pattern* that is one among many possible *states* of a *system*", "information is communicated when another system responds to the pattern selectively" [Barbour97], a distinction which reduces uncertainty or increases *order* [Checkland99], one of the basic *resources*, see *semantics*, *knowledge*, *message*, *pattern*, *complexity*; 2) syntactic information [Skyttner06], a measure of randomness. Any information transmission requires a change in *energy* [Pagels88], [Pahl07]. See *data*, *knowledge*, *message*, *entropy*, *pattern*, *random*, *complexity*, *syntactics*, *information theory*.

information engineering (tietotekniikka) the study or use of electronic equipment, especially *computers*, for storing, analyzing, and distributing *information* of all kinds, including words, numbers, and pictures, see *electronics*.

information retrieval (tiedonhaku) see *literature search*, *abstracts database*, *data mining*.

information revolution (informaatiovallankumous) a revolution that started after the *syntactic information* was better understood [Checkland99].

information science (tietojenkäsittelyoppi, tietojenkäsittelytiede) *computer science*.

information theory (informaatioteoria) statistical information theory [Checkland99], mathematical theory of *information* concerned with the content, transmission, storage, and retrieval of information, usually in the form of messages or *data* [Random House99], see *telecommunications*, *capacity*, *systems theory*, *source coding*, *channel coding*, *modulation*, *network information theory*, *semantic information theory*, *formal science*.

information transparency (tiedon läpinäkyvyys) visibility of information [Leppälä03].

informative (informatiivinen, valaiseva) see *abstract*, *title*.

infrastructure (infrastrukturi, perusrakenne) see *research culture*.

initial condition (alkuehto, alkutila) a condition that is realized prior to, or at the same *time* as, the phenomenon to be explained [Losee01], see *boundary condition*, *assumption*, *bootstrapping*.

injection (injektio) *one-to-one*, a *function* that is *one-to-one* and not *onto*. An injection maps distinct *objects* to distinct objects [Mathworld]. An injection has a *postinverse*. See *bijection*, *surjection*.

innovation (innovaatio) the act or process of introducing new methods, devices, etc., widespread social, cultural or commercial adoption and application of a new idea, usually based on an *invention* [Leppälä03].

input (tulo) stimulus, anything that crosses the *boundary* of a *system* and comes into the system [Checkland99], for example *information*, *energy*, or *material*, see *output*, *sensitivity*.

inquiry (kysely, tutkimus)

insight (näkemys) see *intuition*.

instantaneous value (hetkellisarvo)

instruction (opetus) *teaching*.

instructor (opettaja) *teacher*.

instrument (instrumentti, mittari, mittauslaite) a *device* for measuring the present *value* of a *quantity* under observation [Random House99], see *calibration*, *trueness*, *precision*, *accuracy*, *uncertainty*, *scale*, *scale division*, *scale interval*, *scale spacing*, *range of indication*, *nominal value*, *drift*, *sensor*, *actuator*, *quantity value*, *hysteresis*.

instrumental (välineellinen)

instrumentalism (intrumentalismi) *antirealism*, see *formalism*.

instrumental value (välinearvo) a value that can be explained to others, opposite to *intrinsic value*, see *values*.

instrumentation (instrumentointi, mittauslaitteet, laitteisto, niiden käyttö ja hoito) 1) the use of or work done by *instruments*; 2) the *process* of *developing*, *manufacturing*, and using instruments, especially in *science* and *industry*.

integral architecture (yhteenrakennettu arkkitehtuuri, yhdysrakenteinen arkkitehtuuri) integrated architecture [Belliveau02], an *architecture* where "functional elements of the product are implemented using more than one physical building block, a single chunk implements many functional elements, the interactions between physical chunks are ill-defined and may be incidental to the primary functions of the product" [Ulrich95], opposite to *modular architecture*, see *holism*.

integrated circuit (integroitu piiri) integrated *microcircuit*, see *circuit*

integrated microcircuit (integroitu mikropiiri)

integrated pedagogy (integroiva pedagogiikka) *pedagogy* that integrates the ideas of *constructivism* and *situated learning*.

integration (integrointi) see *modular architecture*.

integrity (rehellisyys) honesty, see *ethics*, *values*.

intellectual property (aineeton omaisuus) "*information*, including proprietary *knowledge*, technical competences, and design information, that provides commercially exploitable competitive benefit to an *organization*" [Belliveau02], see *copyright*, *patent*, *trademark*.

intelligence (älykkyys) "the ability to use optimally limited resources—including time—to achieve a set of goals" [Kurzweil99].

intelligence quotient (älykkyysosamäärä)

intentionality (tavoitteellisuus)

interaction (vuorovaikutus) reciprocal action, effect, or influence [Random House99], see *haptic interaction*, *multisense interaction*, *virtual reality*, *telepresence*.

interdisciplinary reduction (tieteiden välinen reduktio) *reductionist hierarchy* of sciences from bottom up is *physics*, *chemistry*, *biology*, *psychology*, *sociology*, *economics*, and *history* [Checkland99], see *unity of science*, *diversity of science*, *intertheoretical reduction*, *reduction*, *incommensurability*.

interface (liityntä, rajapinta) 1) a common boundary or interconnection between *systems*, equipment, *concepts*, or people; 2) *boundary* between hierarchy levels [Checkland99].

interfere (interferoida) see *superposition*.

interference (interferenssi, häiriö) interfering *signal*, any unwanted *signal* that *interferes* with the signal being communicated, either *crosstalk* or *noise* [Hall62], in contrast to *distortion* [Shannon98, p. 65], see *additive noise*.

internal validity (sisäinen valideetti) *validity* within the given environment and the reliability of the results. We must make sure that it is a causal relationship, and that it is not a result of a factor of which we have no control or have not measured [Wohlin99]. See *external validity*, *correlation*.

interpretation (tulkinta) the meaning assigned to another's creative work, action, behaviour, etc., see *hermeneutics*.

interrelation (keskinäinen suhde, vuorovaikutus) interrelationship, see *relation*.

interrelationship (keskinäinen suhde, vuorovaikutus) *interrelation*.

interrogation mark (kysymysmerkki) *question mark*.

interrogation point (kysymysmerkki) *question mark*.

intertheoretical reduction (teorioiden välinen reduktio) the *relation* between a less general and a more general *theory* that enables the more general theory to explain the truth of the less general theory. The laws of the *reduced theory* can be derived by *deduction* from that of the *reducing theory* [Rosenberg00], [Honderich05]. See *reduction*, *incommensurability*.

interval scale (intervalliasteikko, välimatka-asteikko) an *ordinal scale* where the groups have a meaningful numerical separation, but an arbitrary zero point as its origin, for example temperature scale, see *ratio scale*.

interview (haastattelu) a *research method* in *social sciences*, see *questionnaire*, *scientific method*.

interviewee (haastateltava) see *respondent*.

in-text equation (tekstin sisäinen yhtälö) an *equation* within a text without a number, see *displayed equation*.

intractable problem (vaikeasti käsiteltävä ongelma, ongelma joka ei ole matemaattisesti hallittavissa) not *tractable problem*, not manageable *problem*. Intractable problems include 1) problems with *exponential complexity*, 2) *NP problems*, or 3) *unsolvable problems* [Dewdney04]. See *mathematics*, *ill-defined problem*, *quantum computing*.

intrinsic value (itseisarvo) a *value* that need not and cannot be explained to others, opposite to *instrumental value*, see *values*, *axiom*.

introduction (johdanto) a preliminary part of a *document* leading up to the main part [Random House99]. Introduction includes 1) nature of the problem, 2) background of previous work, 3) purpose and significance of the paper, 4) method by which the problem is approached, and 5) organization of the paper [Spectrum65]. See *motivation*, *orientation*, *scope*, *literature review*, *abstract*, *conclusions*.

intuition (intuitio, vaisto) ability to make conclusions from fragmentary *information*, see *logic*, *guess*.

intuitionist (intuitionisti) see *formalist*, *proof*.

intuitive (intuitiivinen, vaistonvarainen) thinking that is unconscious, opposite to *discursive* [Pahl07]

invention (keksintö) something thought out, produced, or devised for the first time, a sudden and abrupt emergence of a new idea, see *patent*, *intellectual property*, *innovation*, *knowledge*, *creativity*.

inventor (keksijä)

inverse (inverssi, käänteisluku) see *preinverse*, *postinverse*.

inverse function $f^{-1}(x)$ (käänteisfunktio) an inverse function exists if the *function* is a *bijection*, see *preinverse*, *postinverse*.

inversion $1/x$ (kääntö) [Weisstein05], see *function, inversion operation*.

inversion operation $-x$ (merkinvaihto, peilaus) [Weisstein05], see *function, inversion, subtraction, reflection, rotoinversion*.

inverted circumflex (hattu) *caron*.

investigator (tutkija) *researcher*.

investing (investointi, sijoittaminen) putting money into business for the purpose of obtaining an income or profit, see *industry, research, capital*.

invisible hand (näkyvätön käsi) an instance of the invisible hand is any *order* which arises spontaneously without intention or design, especially in *economics* [Honderich05], see *evolution theory*.

invited paper (kutsuttu esitelmä tai julkaisu) see *conference, journal, keynote speaker*.

irreducible (redusoimaton, pelkistymätön, jaoton, supistumaton) see *reduction*.

isomorphic (isomorfinen) being of identical or similar form, shape, or *structure* [Merriam-Webster].

isomorphic model (isomorfinen malli) a *model* which includes all the operational features of the real situation [Chestnut65]. Related terms include 1) *analogy*, 2) *homology*, and 3) *explanation* [Bertalanffy98]. See *homomorphic model*.

isomorphism (isomorfismi, samanmuotoisuus, rakenteellinen samankaltaisuus) 1) similarity in organisms of different ancestry resulting from convergence (in *biology*), see *homology*; 2) a one-to-one correspondence between two mathematical sets, especially a *homomorphism* that is one-to-one (in *mathematics*) [Merriam-Webster], see *isomorphic*, see *construct validity*.

issue (lehden numero) see *copy, volume, journal, number*.

italic (kursivoitu) see *letter, boldface, roman*.

italicization (kursivointi) see *bold-facing, underlining, spacing out, equation, document*.

italics (kursiivi)

item (asia, kohta)

iteration (iteraatio, toisto) a problem-solving or computational method in which a succession of *approximations*, each building on the one preceding, is used to achieve a desired degree of *accuracy* [Random House99], see *recursion*.

iterative (iteratiivinen, toistuva) see *iteration, recursive*.

iterative improvement (iteratiivinen parantaminen) incremental improvement, *trial and error*, a *problem solving* method based on *iterations* [Pagels88], see *action research, divide and conquer*.

iterative model (iteratiivinen malli) a timing plan of a *project* where the product is designed through a series of small design steps and modifications [Leppälä03], see *waterfall model, spiral model, generative order*.

jargon (ammattikieli, ammattislangi, kapulakieli) language, especially the vocabulary peculiar to a particular trade, profession, or group [Random House99], see *terminology*.

jitter (värinä) variability of carrier phase or *latency*.

journal (lehti, tieteellinen lehti) professional journal, a *periodical* dealing with scientific or professional matters [Webster's New World01], see *literature, archival journal, impact factor, immediacy index, cited half-life, editor, peer review, issue, special issue, electronic journal, invited paper*.

journal paper (lehtijulkaisu) see *conference paper, full paper, letter*.

judgment (arviointi, harkinta)

judgment sampling (harkintaotanta) a *nonprobabilistic sampling* method.

jurisprudence (juridiikka, oikeustiede) science of law, a part of *humanities*.

justification (oikeuttaminen, oikeutus, peruste, perustelu) confirmation, *verification*.

keynote speaker (pääpuhujaja) see *conference, invited paper*.

keyword (asiasana; hakusana, hakutermi) a word or phrase based on which a *literature search* is made. Abstract are often used below an *abstract*.

kinesthetic (kinesteettinen, liikunnallinen)

knowledge (tieto, tietämys, tietous) an organized body of *information* accumulated by mankind or shared by people in a particular field. Sources of knowledge include *observation* and *experiment*, reasoning (*deduction* and *induction*), memory, and other sources (especially *intuition* and *imagination*) [Honderich05]. Different definitions of knowledge are given by *positivism*, *pragmatism*, and *constructivism*. Knowledge is divided into 1) *speculative*, 2) *presumptive*, 3) *stipulative*, and 4) *conclusive knowledge* [Bock01]. See *belief, discovery, verification, invention, literature*.

knowledge engineering (tietämystekniikka) the art of designing and building *expert systems* [Kurzweil99].

laboratory (laboratorio) see *field, bench, experiment*.

laboratory experiment (laboratoriokoe) see *experiment, field trial*.

labor (työvoima) one of the *production factors* [Arbno97].

labor costs (työkustannukset) see *cost*.

lag (hitaus) extended or unexpected *delay*, see *latency*.

landmark book (uraaurtava kirja) see *landmark paper*.

landmark paper (uraaurtava julkaisu) milestone paper, seminal paper, visionary, pioneering, or groundbreaking *scientific paper*.

language (kieli) see *communication, symbol, sign, encyclopedia, vocabulary, grammar, thesaurus, stylebook, metalanguage*.

large technological system (LTS) (suuri teknologinen järjestelmä)

latency (latenssi, alkuvie) initial delay, the *delay* between the transmission of the first bit of a packet and the reception of the first bit of the packet [Sheldon01], the delay of a *pipeline* [Allen85], see *delay, transmission delay, transfer delay, jitter, lag*.

lateral thinking (lateraalinen ajattelu, uudenlainen ajattelu) considering a problem statement from a fresh viewpoint [Leppälä03], see *creativity*.

law (laki) *natural law*, see *trend, regularity, rule, presumptive knowledge*.

law of large numbers (suurten lukujen laki)

law of supply and demand (kysynnän ja tarjonnan laki) the law that determines the *prices* of *products* and *services*, see *supply, demand, price-quality ratio*.

layer (kerros) see *hierarchy level, OSI model*.

layered architecture (kerroksellinen arkkitehtuuri) see *cross-layer design, hierarchy*.

learning (oppiminen, oppi) *paradigms* of learning include *behaviorism, constructivism*, and *situated learning*, see *teaching, pedagogy*.

least squares method (pienimmän neliösumman menetelmä) method of least squares, see *estimation theory, mean-square error*.

leading scientist (johtava tutkija) a *researcher* ranking above a *senior research scientist* and below a *research professor*, see *docent, associate professor*.

least significant bit (vähiten merkitsevä bitti) see *most significant bit, precision*.

lecture (luento) see *handout*.

lecturer (luennoitsija, lehtori) a university teacher ranking below *assistant professor* [Random House99].

legend (merkintä) explanatory information about a *figure*, see *caption*.

lemma (lemma, apuväittäjä) help *theorem* [Honderich05], see *conclusive knowledge, corollary*.

letter (kirje; kirjain) 1) correspondence, a short *original journal paper* that is published fast and includes comments on published papers, corrections, open *problems*, or enhancements of a previous paper [IEEE-COM]. The manuscript is usually limited to 9 double-spaced pages or 3-4 printed pages; 2) a part of *word*, a *symbol* or character that is part of an alphabet, corresponding to a speech *sound* or sounds [Webster's New World01], see *upper case letter, lower case letter, roman, italic, boldface*.

level (taso) see *hierarchy level, factor, treatment*.

level of confidence (luottamustaso) *coverage probability* [ISO Guide 99:2004].

level of significance (merkitsevyytaso) probability of a *false alarm* of the *null hypothesis* in a statistical test.

liberal arts (humanistiset tieteet) *humanities*.

library (kirjasto) see *literature, digital library*.

license (lisenssi, lupa) see *patent*.

licentiate in technology (tekniikan lisensiaatti) a degree between *master of science* and *doctor of philosophy*.

life (elämä) the ability of organisms (patterns of matter and energy) to reproduce into future generations [Kurzweil99], see *biology*.

life fellow (life fellow, elinikäinen ansioitunut jäsen) a lifetime member of a *scientific society* ranking above a *fellow*, given in recognition of the many years of loyal membership and support of the activities of the scientific society.

likelihood (uskottavuus) the hypothetical probability that an event that has already occurred would yield a specific outcome. A *probability* refers to the occurrence of future *events* while a likelihood refers to past events with known outcomes [Weisstein05]. See *maximum likelihood method, estimation theory*

limit (raja) see *stability*.

limitation (rajoitus) restriction in application, see *conclusions*.

limiting conditions (ääriolosuhteet) conditions where an *instrument* should remain undamaged, see *rated operating conditions, reference conditions*.

limit cycle (rajavärähtely) a periodic unwanted phenomenon in a *recursive* nonlinear system, one of the *attractors*, see *hang-up, nonlinear dynamics*.

linear (lineaarinen) consisting of, involving, or describable by terms of the first degree [Random House99], following the *superposition* principle, see *affine*.

linear complexity (lineaarinen kompleksisuus) *polynomial complexity* of first order.

linearity (lineaarisuus) *mathematical additivity*, see *linear, soliton*.

linear model (lineaarinen malli) a *linear regression model*.

linear scale (lineaarinen asteikko)

linguistics (lingvistiikka, kielitiede) study of *languages*, a part of *humanities*.

list of abbreviations (lyhenneluettelo) see *document*.

list of symbols (symboliluettelo) see *document*.

literature (kirjallisuus) the writings dealing with a particular subject, usually collected in *libraries*, see *book, journal, magazine, conference proceedings, standard, patent, thesis, technical report, language, abstracts database*.

literature review (kirjallisuuskatsaus) review, overview, or survey of *literature*, such as in a doctoral *thesis* or *technical report*, or in the beginning of a *scientific paper*, see *review paper*.

literature search (kirjallisuusselvitys) search of *literature* for a *literature review*, see *abstracts database, information retrieval, bibliography, document, data mining*.

logarithm (logaritmi) see *exponentiation*.

logarithmic (logaritminen) see *exponential*.

logarithmic complexity (logaritminen kompleksisuus) see *exponential complexity*.

logic (logiikka) the study of correct or reliable reasoning, based on *deduction*, a branch of *formal sciences*. Logic includes 1) *set theory* which is identical to *mathematics*, 2) model theory for modeling of *axioms*, 3) *proof theory*, 4) intuitionism or constructive *reasoning*, and 5) *recursion theory* for *algorithms* [Pagels88], see *rationalism, intuition*.

logical (looginen)

logical depth (looginen syvyys) the computing time or the number of instruction cycles needed to generate a message string [Pagels88], [Baeyer05], see *complexity*.

logical empiricism (looginen empirismi) *logical positivism*, a new form of *positivism*, aiming to combine *empiricism* and *logic* [Rosenberg00], see *rationalism, Vienna Circle*.

logical positivism (looginen positivismi) *logical empiricism*.

logistic (logistinen, huoltoa koskeva, huolto-)

logistic model (logistinen malli) a logistic *regression model* used for *prediction* of the *probability* of occurrence of an *event*.

logistic regression (logistinen regressio)

logistics (logistiikka, materiaalitoiminnot, kuljetus- ja materiaalitalous)

loss (tappio) negative *reward*, see *profit*

lot (erä)

lower case letter (pieni kirjain, pienaakkonen, gemena) see *letter*.

low line (alaviiva, alleviivaus) mark $_$, see *double low line, overline*.

lumped (keskitetty) in contrast to *distributed*.

machine (kone) set of *machine elements*, technical system whose main flow is energy-based [Pahl07]. Machines include 1) a clock-like mechanism, *deterministic* and preprogrammed, 2) *statistical machine*, and 3) *self-regulated machine* [Checkland99]. See *artefact, device, apparatus, engine, motor, state machine, machine element, machinery, equipment, assembly, mechanism*.

machine element (kone-elin) part of a *machine*

machinery (koneisto, laitteisto) set of *machines*, set of *equipment*

macron (pituusmerkki) mark $\bar{}$ showing that the vowel is long, for example \bar{o} [Webster's Third New93], see *overline, breve, circumflex*.

macroscopic model (makromalli) a large-scale *physical model* [Honderich05].

magazine a *periodical*, see *literature, journal, newspaper*.

magnitude (itseisarvo; suuruus, koko) 1) absolute value, modulus; 2) a *number* characterizing a *quantity* and forming a basis for comparison with similar quantities [Random House99], [SFS-ISO 31-11]. See *measurement*.

main clause (päälause) a primary *sentence* that is a part of a *complex sentence*, see *subordinate clause, word*.

maintenance (kunnossapito, ylläpito, huolto) see *operation, logistics*.

Malthusian law (Malthusin laki) an exponential law, the law of natural unrestricted growth [Bertalanffy98], see *Verhulst law, Moore's law*.

manager (päällikkö) hierarchically below a *director*.

man-made (keinotekoinen, ihmisen tekemä) *artificial*.

manual of style (tyyliopas) *stylebook*.

manufacture (valmistaa, tuottaa) to make or *produce* by hand or *machinery*, especially on a large scale [Random House99], see *research, development, product*.

manufacturing (valmistaminen, tuottaminen) “designing and operating the production system in order to produce the product; broadly defined, the manufacturing function also often includes purchasing, distribution, and installation” [Ulrich95], see *development, industry*.

manufacturer (valmistaja, tuottaja) see *manufacture*.

manuscript (käsikirjoitus) the manuscript is usually written for *submission* using *double spacing* with the 12-point *font*, having 2.5 cm *margins* on all sides. The length of the *title* and the *abstract*, the number of pages and the total number of *figures* and *tables* are usually limited by the *publisher*, depending on whether it is a *letter* or *full paper*. See *page proof, proofreading, camera-ready copy, backup copy, peer review*.

margin (marginaali)

mark (merkki; arvosana) 1) *sign*, a *symbol* used in writing or printing; 2) *grade* [Random House99].

marketing (markkinointi) “mediates the interactions between the firm and its customers, marketing often facilitates the identification of *product* opportunities, the *definition* of market segments, and the identification of *customer needs*, and typically arranges for *communication* between the firm and its *customers*, sets *prices*, and oversees the launch and promotion of the *product*” [Ulrich95], see *industry, funding*.

market test (markkinatesti)

market vision (markkinavisio) status of business areas in the future, see *vision*.

master of science (filosofian maisteri, diplomi-insinööri) a *graduate* degree ranking above a *bachelor of science* and below a *doctor of philosophy*.

master's degree (filosofian maisterin tutkinto, diplomi-intinöörin tutkinto)

mass (massa) *quantity of matter* [Checkland99].

mass product (massatuote) see *industry*.

material (materiaali, aines; aineisto) 1) *matter* with certain properties (in engineering) [Pahl07], one of the basic *resources*, one of the *production factors* [Arbno97], 2) *data* used in a *publication*, see *raw material*.

material cause (materiaalinen syy) one of Aristotle's *causes*, the material of an object.

materialism (materialismi) opposite to *dualism*, “the belief that matter is the fundamental reality in the universe and that all phenomena can in principle be explained by the laws of matter” [Barbour97], see *ontological reduction, idealism*.

materials and methods (aineisto ja menetelmät) a part of a *scientific paper* after the *introduction* and before the *results*, sometimes included in the introduction, see *document*.

mathematical additivity (matemaattinen summautuvuus) *linearity*, summativity in the mathematical sense. The change in the total system obeys an equation of the same form as the equations of the parts [Bertalanffy98], stronger than *physical additivity*.

mathematical induction (matemaattinen induktio) a form of *complete induction* which is used in mathematical proofs [Niiniluoto83].

mathematical model (matemaattinen malli) an analytical model, a symbolic model, a *theoretical model* given in terms of *mathematics* [Niiniluoto02], see *simulation*.

mathematical statistics (tilastotiede) statistics, a branch of *mathematics*, “collecting, classifying and analyzing *information* shown in *numbers*, often using probability theory” [Random House99], see *estimation theory, information theory, central limit theorem, sample, average, mean, median, mode, bias, standard deviation, coverage interval, coverage probability, histogram, degree of freedom, moment, formal science*.

mathematics (matematiikka) a branch of *logic* of *sets* [Honderich05], *science of order and relations*, identical to *set theory* [Pagels88], *formal science* dealing with *quantities* and *forms* and their *relationships* by the use of *numbers* and *symbols* [Webster's New World01], inc. *arithmetic* and

number theory, algebra, mathematical statistics, trigonometry, analysis, and geometry, see intractable problem.

[MATINE](#) (MATINE, Maanpuolustuksen tieteellinen neuvottelukunta) Scientific Advisory Board for Defence, operates within the Ministry of Defence in Finland.

matrix (matriisi; muotti) 1) an ordered set of *scalars, symbols, or functions* in a form of a rectangular array [Random House99], see *complex number, vector, equation*; 2) a die or *mold* for casting and shaping [Webster's New World01].

matrix algebra (matriisialgebra) see *matrix, graph theory*.

matrix organization (matriisiorganisaatio) a hybrid of *functional* and *project organizations*, "each individual is linked to others according to both project they work on and their function" [Ulrich95].

matter (materia, aine) complementary to *form*, see *material, mass*.

maximum likelihood estimation (suurimman uskottavuuden estimointi)

maximum likelihood estimator (suurimman uskottavuuden estimaattori)

maximum likelihood method (suurimman uskottavuuden menetelmä) a statistical method for estimating parameters from sample data that that selects as estimates those parameter values maximizing the probability of obtaining the observed data [Merriam-Webster], see *likelihood*.

mean (odotusarvo) *expectation, expected value, statistical average, ensemble average, see median, mode, bias, standard deviation, estimation theory*.

meaning (merkitys) *significance, purpose, understanding* [Arbnor97].

mean-square error (keskineliövirhe) a quadratic error *metric* that includes the effects of *bias* and *standard deviation* [Kay93], see *accuracy, uncertainty, estimation theory, least squares method*.

measurand (mittaus suure) *quantity* intended to be measured [ISO Guide 99:2004], measured quantity, measurement quantity, see *reference value*.

measure (mitta, mitata; mittayksikkö) see *measurement, unit, metric, performance metric*.

measurement (mittaus) an *experimental procedure* for ascertaining the *magnitude* of a given *quantitative property* possessed by an *object*. Any measurement has three values associated with it including the estimate of 1) *quantity value*, 2) *confidence interval*, and 3) *confidence level* [Buckner97b], [amc03], [ISO Guide 99:2004]. See *measurand, measurement result, measurement standard, verification, measurement signal, unit, numerical quantity value, instrument, accuracy, uncertainty, trueness, precision, simulation, deduction, static measurement, dynamic measurement*.

measurement precision (mittaustäsmällisyys) *precision* [ISO Guide 99:2004].

measurement quantity (mittaus suure) *measurand*.

measurement result (mittaustulos) result of a *measurement* [ISO Guide 99:2004].

measurement signal (mittaussignaali) see *measurand*.

measurement standard (mittanormaali) measurement standard is used to define a measurement *unit*, see *working standard, primary standard, secondary standard, collective standard, individual standard*.

measurement uncertainty (mittausepävarmuus) *uncertainty* [ISO Guide 99:2004].

measurement unit (mittayksikkö) *unit* [ISO Guide 99:2004].

measuring instrument (mittari) *instrument*.

measuring range (mittausalue) the *quantity values* for which the *error* of an *instrument* is in the specified *limits*, see *scale*.

measuring transducer (mittauslähetin; mittamuunnin, mittausmuunnin, mittausanturi) 1) a *sensor* that gives a standard signal; 2) an equipment for which there is a defined *relationship* between the *response* and *stimulus*

mechanical engineering (konetekniikka)

mechanics (mekaniikka) a branch of *physics*, see *dynamics, quantum mechanics, relativity theory*.

mechanic system (mekaaninen järjestelmä) a *system* that is *closed* and *static* [Arbno97].

mechanism (mekanismi, koneisto) moving parts of a *machine*, *machinery*, see *procedure*, *method*
media access control sublayer (MAC-kerros) see *medium access control sublayer*.

median (mediaani) a *quantile* of 50%, see *average*, *mean*, *mode*, *estimation theory*, *cited half-life*.

medium access control (monipalvelujärjestelmäliittymän ohjaus, siirtotien varauskerros)

medium access control sublayer (MAC-kerros, siirtotien varauskerros) the bottom part of the *data link layer* above the *physical layer* in the *OSI model*, the sublayer that controls access to the transmission medium using *multiple access protocols* [Tanenbaum96], [Stallings91], see *multiplexing*, *network information theory*.

member (jäsen) a member of a *scientific society* ranking below a *senior member*, see *student member*, *graduate student member*, *associate member*, *honorary member*, *fellow*, *life fellow*.

memo (muistio) memorandum.

mentor (ohjaaja) *advisor*, *tutor*.

mereology (mereologia) the formal *theory* of *part-whole relations* [Honderich05].

message (sanoma) see *information*.

metalanguage (metakieli) "a *language* or *symbolic system* used to discuss, describe, or analyze another language or symbolic system" [Random House99].

metaphor (metafora, kielikuva, vertaus) "the application of a *word* or phrase to an *object* or *concept* it does not literally denote, suggesting comparison, to that object or concept" [Random House99], see *analogy*, *creativity*.

metaphysical (metafyysinen) see *pseudo-problem*.

metaphysics (metafyysiikka) the study of first principles, a branch of *philosophy*, inc. 1) *ontology* and 2) *cosmology* [Random House99]. See *epistemology*.

method (metodi, menetelmä) a concrete guiding principle for discovering new *knowledge* in practice, the method is selected with a *methodological procedure* from the available *techniques* [Arbno97], a set of well-defined rules which lead to a correct *solution* to a *problem*, see *scientific method*, *algorithm*, *mechanism*, *procedure*, *tool*.

methodological approach (methodologinen lähestymistapa) "a set of ultimate ideas about the constitution of reality, the structure of science, and so on, that is important to *methods*". Methodological approaches in *philosophy of science* include 1) *analytical approach*, 2) *systems approach*, and 3) *actors approach* [Arbno97]. See *tool*, *technique*, *method*, *paradigm*.

methodological procedure (methodologinen proseduuri) the conscious and *explicit* way with which a *researcher* turns an available *technique* to a *method* that fits both the research *problem* and the *methodological approach* [Arbno97].

methodological reduction (methodologinen reduktio) "a research strategy in which the behaviour of complex wholes is approached by analyzing their component parts" [Barbour97], see *Occam's razor*, *reduction*.

methodology (metodologia, metodiikka, menetelmäoppi) the philosophical study of *scientific methods* [Honderich05], a set or system of *methods*, principles, and rules used for determining the way in which a *problem* can be solved in a given *discipline* [Random House99].

methods (menetelmät) see *materials and methods*, *scientific method*.

metric (metriikka, mitta) 1) a geometric function having properties analogous to those of the distance between points on a real line [Random House99], 2) a measure that reflects the degree to which the product satisfies *customer needs*, see *criterion*, *performance metric*, *optimum*.

metric geometry (metrinen geometria) a part of *geometry* which allows *translations* and *rotations* and therefore the distance, size, and shape are retained, a special case of *Euclidean geometry* [Medawar84].

metrology (metrologia) see *measurement* [ISO Guide 99:2004].

microcircuit (mikropiiri) see *integrated circuit, circuit*

microscopic model (pienoismalli) a small-scale *physical model* [Honderich05], see *iconic model*.

microelectronics (mikroelektoniikka) see *electronics, microtechnology*.

microtechnology (mikroteknologia) *technology of machines* of the order of a micrometer across, see *nanotechnology*.

middle dot (piste keskellä, rivinkeskinen piste, kertomerkki) half-high dot, mark \cdot , see *dot above, period, cross*.

middleware (väliohjelmisto) software layer between the application software and the operating system, to hide technical complexity and unnecessary details from application developers [Leppälä03], see *software, hardware*.

milestone (välitavoite) see *timing plan*.

milestone paper (uraaurtava julkaisu) *landmark paper*.

mind (mieli, ajatukset, muisti, tajunta, tietoisuus, henki, psyyke) see *consciousness, body*.

mind-body problem (mieli-ruumisongelma) philosophical question about the *emergence* of the mind from the brain [Kurzweil99].

mind map (muistikartta) see *creativity, outline, conceptual analysis*.

miniaturization (miniatyrisointi, pienoiskoossa rakentaminen) making in greatly reduced size [Random House99].

miniature model (pienoismalli) *microscopic model*.

misnomer (harhaanjohtava nimitys)

miss (menetyks) missed detection.

missed detection (menetyks) miss, false negative, *type II error*, see *false alarm*.

mission (missio, elämäntehtävä) the special task or purpose for which an *organization* is destined for life [Kamensky00], see *values, business idea, vision, strategy*.

mistake (erehdys) blunder, see *error*.

mode (moodi, toimintatila; tyyppiarvo, keskiarvo) see *average, mean, median, estimation theory*.

*model (malli) an intentionally simplified description of regularities governing a process or a definition of such a system, usually mathematical. A model consists of formal definitions and claims about what things in the world satisfy these definitions [Rosenberg00]. A model is a representation that involves some kind of *analogy* between the model and either *reality* or some other scientific claim, inc. *isomorphic* and *homomorphic model* [Chestnut65]. A model is "an imaginative representation of characteristics of an entity that is not directly observable and that is postulated by analogy with entities in a more familiar domain" [Barbour97]. Models can be classided in different ways: 1) *physical* and 2) *theoretical model* [Honderich65], 1) *iconic*, 2) *analog*, and 3) *symbolic model* [Chestnut65], 1) *functional*, 2) *behavioral*, and 3) *executive model* [Calvez93], 1) *deterministic*, 2) *statistical*, and 3) *regression model*. Methods of solution include 1) *analytical solution*, 2) *numerical solution*, and 3) *Monte Carlo method*. See *isomorphism, causality, OSI model*.

model fit (mallin sopivuus) see *coefficient of determination, regression analysis, curve fitting*.

modelling (mallintaminen) creation of a *model*.

moderator (puheenjohtaja) chairman.

modular (modulaarinen) a *system* composed of standardized units or sections for easy construction or flexible arrangement [Random House99], see *module, modularity*.

modular architecture (modulaarinen arkkitehtuuri) an *architecture* where "chunks implement one or a few functional elements in their entirety, the interactions between the chunks are well defined and are generally fundamental to the primary functions of the product" [Ulrich95], see *integral architecture, reduction*.

modularity (modulaarisuus) see *modular, parallelism, concurrency, hierarchy, system*.

modulation (modulaatio, modulointi) varying of amplitude, frequency, or phase of a carrier wave in accordance with some *signal* [Sklar02], see *physical layer, detection*.

module (moduuli, laiteyksikkö) a separable component, frequently one that is interchangeable with others, for assembly into units of differing size, *complexity*, or *function* [Random House99], see *assembly, equipment*.

moment (momentti) see *mathematical statistics*.

monograph (monografia, erikoistutkielma) a detailed written study of a single subject, often equivalent to a long *review paper* [Day98], and usually includes *original* results, see *thesis, book*.

monotonic (monotoninen) see *function*.

Monte Carlo method (Monte Carlo –menetelmä) random sampling, stochastic sampling, a method for testing states of a *model* to determine some statistical *property* of the system [Chestnut65].

Moore's law (Mooren laki) an exponential law on the development of *electronics*, see *Malthus law*.

morphological analysis (morfologinen analyysi) see *creativity*.

morphology (morfologia, muoto-oppi) science of *structure* and *form*.

most significant bit (eniten merkitsevä bitti) see *least significant bit, precision*.

motivation (motivointi, innostaminen, kannustus) an introductory text in the *introduction* that causes the reader to continue reading after the introduction of a *document*, see *orientation*.

motor (moottori) a *machine* that takes *energy* from electricity and turns it into *work* in the form of rotating motion [Asimov74], see *engine*.

multidisciplinary (monitieteellinen) see *discipline*.

multiple access (moniliittymä) remote sharing of the channel, users' requirements may be dynamically changing [Sklar02], see *medium access layer, multiplexing*.

multiplexing (multiplekointi, kanavointi) local sharing of the channel. User requirements are fixed or at most slowly changing. The resource allocation is assigned a priori, and the sharing is usually a *process* that takes place within the confines of a local site, for example a *circuit* board [Sklar02]. See *physical layer, multiple access*.

multiplication (kertolasku, monistaminen, moninkertaistaminen) see *addition, subtraction, division, exponentiation*.

multiplicative noise (multiplikatiivinen kohina) *distortion*, noise in contrast to *additive noise*.

multisense interaction (monen aistin vuorovaikutus) *interaction* with all the five senses, see *haptic interaction, virtual reality*.

nonobot (nanobotti) robot using *nanotechnology*.

nanotechnology (nanoteknologia) *technology* of very small size, working components are atoms, envisages machines perhaps of molecular size [Clute95], see *microtechnology, electronics*.

nanoengineering (nanotekniikka)

natural (luonnollinen) opposite to *artificial*.

natural deductive system (luonnollinen deduktiivinen järjestelmä) a *deductive system* that does not have *axioms* [Honderich05].

naturalism (naturalismi) the thesis that the *natural sciences* are the best guides to inquiry in *philosophy* [Rosenberg00], and *transcendental* phenomena are denied.

natural law (luonnonlaki) a *regularity* that actually governs *processes* in nature and which *science* sets out to discover [Rosenberg00], see *scientific law*.

natural science (luonnontiede) science, a branch of *science*, systematized *knowledge* of nature and the physical world [Webster's New World01], inc. *physics, chemistry* and *biology*.

necessary (välttämätön) see *sufficient, contingent*.

neopositivism (uuspositivismi) *logical empirism* [Arbno97].

nested hierarchy (sisäkkäinen hierarkia) see *hierarchy, subsystem, wider system*.

network (verkko) a directed *graph* with weighted edges, see *parallel network system, serial hierarchical system*.

network information theory (verkkoinformaatioteoria) see *information theory, medium access control sublayer, queuing theory, systems theory*.

network layer (verkkokerros) the *layer* above the *data link layer* and below *transport layer* in the *OSI model*. The layer is concerned with controlling the operation of the subnet. A key design problem is determining how packets are routed from source to the destination. The layer relieves higher layers of the need to know anything about the underlying data transmission and switching technologies used to connect systems [Tanenbaum96], [Stallings91].

network theory (verkkoteoria) part of *graph theory* where the *graphs* are directed.

neural network (neuroverkko) neural net, "a computer model designed to simulate the behaviour of biological neural networks as pattern recognition, language processing, and problem solving with the goal of self-directed information processing" [Random House99], see *genetic algorithm, biology*.

neutrality (neutraalisuus, puolueettomuus) *objectivity*.

newspaper (sanomalehti) see *periodical, subscribe*.

noise (kohina, suhina, melu, hälinä) *interference* that is not *crosstalk* [Hall62], originally referring to interference that is similar to unwanted acoustical noise [Chestnut67], see *distortion, waste*.

nomadic (kiertelevä, liikkuva) see *mobile*.

nominalism (nominalismi) the philosophical doctrine that general or abstract words do not stand for objectively existing entities and that *universals* are no more than names assigned to them, opposite to *realism*.

nominal range (nimellisarvo) the range of a *displaying device* which is obtained for a given setting of the knobs, see *instrument, span*.

nominal scale (nominaaliasteikko, luokitusasteikko) a simple measurement scale where measurement results are classified in several groups [McCuen96].

nominal value (nimellisarvo, tavoitearvo) target value, see *instrument*.

nomological (nomologinen) relating to or expressing basic *physical laws* or rules of *reasoning* [Merriam-Webster], see *deductive-nomological (D-N) model*.

nomology (nomologia, oppi yleisistä lainalaisuuksista)

nomothetic (nomoteettinen, luonnonlakeja selvittelevä) "relating to ... abstract, general, or universal statements or *laws*, formulating general statements of *scientific laws*" [Merriam-Webster], contrasted with *idiographic*.

nomothetic research (nomoteettinen tutkimus) a *positivistic research method*. The aim is to find 1) *deductive* and *causal explanations*, or 2) *statistical explanations* for phenomena. Nomothetic research includes 1) formal *mathematical analysis*, 2) *experiments* in *laboratory* or *field*, and 3) *field studies* and *surveys* [Iivari91]. See *constructive research, idiographic research, hypothesis, model, hypothetico-deductive method, deductive-nomological (D-N) model, inductive-statistical (I-S) model*.

nondestructive test (ainetta rikkomaton koe) see *test*.

nondeterministic (ei-deterministinen) *random*, not *deterministic*, see *non-random*.

nondisclosure agreement, NDA (salassapitosopimus) see *classified*.

nonlinear (epälineaarinen) not *linear*, see *affine, physical additivity, hang-up*.

nonlinear dynamics (epälineaarinen dynamiikka) study of *systems* that evolve in time according to *nonlinear* mathematical equations [Wolfram02], see *dynamical systems theory, systems theory, chaos theory, catastrophe theory, attractor, soliton*.

nonlinear dynamic system (epälineaarinen dynaaminen systeemi) see *nonlinear dynamics*.

nonparametric (parametriton) opposite to *parametric*.

nonprobability sampling (ei-todennäköisyysotanta) sampling method that includes *convenience sampling*, *quota sampling*, *judgment sampling*, and *snowball sampling*, see *probability sampling*.

nonrandom (ei-satunnainen) *deterministic*, not *random*, see *nondeterministic*.

norm (normi, käyttäytymissääntö) a rule or standard of behavior expected to be followed by each member of a social group [Random House99], norms are defined to protect the *values*.

normalized error (normalisoitu virhe) error normalized in the range [-1, +1] [Bock02], see *error*.

normal science (normaalitiede) a period of *science* during which the existing *paradigm* is not challenged [Honderich05], see *scientific revolution*.

notebook (vihko) see *research*.

novel (uusi, uudenlainen) *original*.

novelty (uutuus) *originality*.

novice (noviisi, aloittelija)

NP complete problem (NP-täydellinen ongelma) an *intractable* nondeterministic polynomial-time problem for which no deterministic *polynomial-time algorithm* is known, it can only be solved with a nondeterministic algorithm in polynomial time, i.e., by guessing [Dewdney04].

null hypothesis (nollahypoteesi) a hypothesis deliberately raised to threaten the *alternative hypothesis* [Wilson99]. If the null hypothesis cannot be proved, the alternative hypothesis would be true. A null hypothesis is sometimes used to guarantee *objectivity*. Null hypothesis is usually a neutral hypothesis. Thus in radar the null hypothesis refers to the case where there is no signal but only *noise*. See *competing hypothesis*, *false alarm*, *missed detection*, *chi-square test*.

number (numero, luku, lukumäärä, mittaluku) see *quantity*, *numerical quantity value* [ISO Guide 99:2004], *issue*.

number sign (ristikkomerkki, ruutu) hash sign, mark #.

number theory (lukuteoria) generalization and extension of *arithmetic*, a branch of *mathematics*.

numerical quantity value (suureen lukuarvo, mittaluku) numerical *value* of a *quantity*, numerical value, number in the representation of a *quantity value* [ISO Guide 99:2004].

numerical solution (numeerinen ratkaisu) a deterministic method usually involving *iterative* procedures to test a number of specific states of a *model* to determine such conditions as optimum state or worst case state [Chestnut65], see *analytical solution*, *Monte Carlo method*, *simulation*, *algorithm*, *approximation*.

numerical value of a quantity (suureen lukuarvo, mittaluku) *numerical quantity value* [ISO Guide 99:2004].

object (objekti, kohde) a *thing* to which attention is directed [Random House99], see *semiotic triangle*, *concept*, *term*, *subject*, *focus*.

objective (objektiivinen, puolueeton) neutral, impersonal, without *bias*, opposite to *subjective*, see *prejudice*, *object*.

objective (tavoite) 1) aim, implies something narrow, *concrete*, *precise*, and immediately attainable [Merriam-Webster], desired consequences, 2) a refined form of *problem* statement [Hall62], *product requirement*. See *goal*.

objectivity (objektiivisuus, puolueettomuus) neutrality

observable (havaittavissa oleva, havaittava ominaisuus) a *property* that can be observed, see *phenomenon*.

observe (havaita) see *observation*.

observed value (havainto, havaittu arvo) *observation*.

observer (havainnoija, tarkkailija) see *actor*.

observation (havainto) 1) observed value; 2) an act or instance of watching or noting something for a *scientific* purpose, see *experiment*, *experience*, *perception*.

occupation (ammatti) in contrast with *profession*, see *vocation*.

Occam's razor (Okkamin partaveitsi) Ockham's razor, law of *parsimony*, the simplest explanation is best [Cover06].

Ockham's razor (Okkamin partaveitsi) *Occam's razor*.

offprint (eripainos) *reprint*.

one-to-one (yksi yhteen) *injection*.

onto *surjection*.

ontology (ontologia) branch of *metaphysics*, science of being, embracing such issues as the nature of existence and the categorial structure of reality, see *category*, *epistemology*.

ontological (ontologinen) "referring to the characteristics of reality" [Barbour97], see *epistemological*.

ontological reduction (ontologinen reduktio) division of a *whole* into a minimal number of entities or *substances*, opposite to *synthesis*, "the metaphysical claim that reality consists only of the simplest components organized in particular ways" [Barbour97], see *reduction*, *epistemological reduction*, *materialism*.

open access (vapaa saatavuus) free availability, see *open source*.

open access journal (vapaasti luettava lehti) an *electronic journal* that is free for readers. The papers usually have a *referee process*.

open source (vapaa muokattavuus) *open access* source that freely available for modification.

open system (avoin systeemi) a *system* which may exchange *materials*, *energy*, or *information* with its environment [Hall62], [Bertalanffy98], [Checkland99], opposite to *closed system*, see *biological system*.

Open Systems Interconnection model (OSI-malli) *OSI model*.

operation (operaatio, toiminta; käyttö) 1) "a mathematical *process*, as addition, multiplication, or differentiation"; "the action of applying a mathematical process to a *quantity* or quantities" [Random House99]; 2) exploitation phase of a product *development* including *maintenance*, see *cycle time*, *function*.

operational (operatiivinen, toiminnallinen, kunnossaoleva) see *fault*, *robust*.

operations research (operaatioanalyysi) the analysis, usually involving mathematical treatment, of a *process*, *problem*, or *operation* to determine its purpose and effectiveness and to gain maximum *efficiency*, see *systems science*.

operator (operaattori) a *symbol* for expressing a mathematical or logical *operation*; a *function*, especially one transforming a *function*, *set*, etc. into another [Random House99].

opinion (mielipide) see *speculative knowledge*.

opponent (vastaväittäjä) a person who asks the doctoral candidate critical questions in a *public defence* and writes his or her opinion about the defence and the *thesis*.

opposite (vastakohta) see *creativity*, *extreme*.

optimal (optimaalinen) see *optimum*.

optimization (optimointi) securing the best fit between a *system* and its *environment* [Hall62, p. 73].

optimum (optimi) the best *result* obtainable under specific *conditions* [Random House99], see *constraint*, *metric*, *criterion*.

oral presentation (suullinen esitelmä) a conference *talk* given in front of an audience in a given *session*, see *poster presentation*, *regular session*.

order (järjestys) "*information* that fits a purpose" [Kurzweil99], a condition in which each *thing* is properly disposed with reference to other things and to its purpose [Random House99], methodical or harmonious arrangement. Different forms of order include 1) *timeless order*, 2) *sequential order*, and

3) *generative order* [Bohm92]. Order of *parts* is a *structure*, order of *processes* is a *function* [Bertalanffy98]. See *complexity*, *static structure*, *dynamic structure*, *disorder*.

ordinal scale (ordinaaliasteikko, järjestysasteikko) a measurement scale where the measurements are classified in an ordered set of groups, see *nominal scale*.

*organization (organisaatio, rakenne) a body of persons organized for some specific purpose, see *research organization*, *functional organization*, *project organization*, *matrix organization*, *process*, *team*, *mission*, *values*, *business idea*, *vision*, *roadmap*, *strategy*, *norm*, *ethos*, *budget*, *center of excellence*, *core competence*, *certification*, *recruiting*; the structure of a *publication*, see *outline*.

organized complexity (järjestäytynyt kompleksisuus) interaction of large but not infinite number of variables, unsolvable with classical *scientific method* [Checkland99], [Bertalanffy98]. See *three-body problem*.

orientation (orientointi, perehdyttäminen) an introductory text to guide the reader in adjusting to the topic of the *document* [Random House99], included in the *introduction*, see *motivation*.

oriented basic research (kohdistettu perustutkimus) *basic research* to produce a broad base of *knowledge* likely to form the background to the *solution* of recognized or expected current or future *problems* of possibilities [Jain97].

original (alkuperäinen) novel, see *originality*.

originality (alkuperäisyys) *novelty*, having original *results*, *methods*, *observations*, or *concepts*, *synthesis* of or new insights into previously reported *research* [IEEE-IT], see *original paper*.

original paper (alkuperäisjulkaisu) a *scientific paper* presenting new scientific *knowledge*. An original paper is made to find out, through a blind *peer review* process, on whether the conclusions drawn by the *author* were 1) *original*, 2) *significant*, 3) *correct*, and 4) *explicit*. The "judge" is the *editor* or *associate editor* who is using two or more *referees* to support the decision.

orthogonal (ortogonaalinen, kohtisuora, erillinen, eroteltavissa oleva) separate, resolvable; pertaining to or involving right angles or perpendiculars (in *mathematics*) [Random House99].

orthogonality (ortogonaalisuus) separability.

OSI model (OSI-malli) Open Systems Interconnection model, OSI reference model, an *architecture model* for a *telecommunications system*, open for communication with other systems, inc. from bottom up 1) *physical layer*, 2) *data link layer*, 3) *network layer*, 4) *transport layer*, 5) *session layer*, 6) *presentation layer*, and 7) *application layer* [Tanenbaum96], [Stallings91], see *hierarchy*, *description model*, *functional model*, *behavioral model*, *executive model*.

ostensive definition (näennäinen määritelmä) pseudodefinition, elementary terms [Rosenberg00] are explained by examples to avoid an endless loop of definitions [Honderich05], see *definition*.

outcome (tulos)

outlier (vieras havainto) see *estimation theory*.

outline (jäsenitys, hahmotelma, luonnos) a general account or report, indicating only the main features of a subject [Random House99], used to define the *organization* of a *document* or *presentation*, see *draft*, *sketch*, *refinement*, *mind map*, *template*, *generative order*.

output (lähtö) anything that crosses the *boundary* of a *system* and comes out from the system [Checkland99], for example *information*, *energy*, or *material*, see *response*, *input*.

outsourcing (alihankinta) "the *process* of procuring a good or *service* from someone else, rather than the *organization* producing it themselves" [Belliveau02].

overhead cost (yleiskustannus) *indirect cost*, general fixed *cost* of running a business, as management and rent [Random House99], see *project*.

overhead rate (yleiskustannuskerroin)

overline (yläviiva) mark $\bar{\quad}$, see *macron*, *low line*.

page charge (sivumaksu) a page charge is requested for extra pages in *conference proceedings* or in *journal papers*.

page proof (sivuedos, taittovedos) proof, a trial impression, sent to the *authors* for marking corrections, see *proofreading*, *copy editor*.

panel (paneeli, keskusteluryhmä) a group of persons selected for a specific purpose, as discussing an issue publicly [Webster's New World01] for example in a *conference*.

paper (julkaisu, tutkielma) see *scientific paper*.

paper evaluation sheet (julkaisun arviointilomake) *paper review form*.

paper review form (julkaisun arviointilomake) paper evaluation form, a *template* with which a *referee* evaluates a *manuscript*, see *original paper*.

paradigm (paradigma, toimintamalli) unquestioned theory or set of beliefs [Honderich05], existing world-view, used during *normal science*, "any set of general and ultimate ideas about the constitution of reality, the structure of science, scientific ideals, and the like" [Arbnor97], "a cluster of conceptual, methodological, and metaphysical presuppositions embodied in a tradition of scientific research" [Barbour97], see *scientific revolution*, *dogma*.

paradigm shift (paradigman muutos) change of *paradigm*, "basic concepts are reformulated and familiar data are reinterpreted in radically new ways" [Barbour97].

paradox (paradoksi) a seemingly contradictory or absurd statement that expresses a possible *truth* [Random House99].

paragraph (kappale) a distinct portion of written or printed matter dealing with a particular idea [Random House99]. The beginning on a new line that is usually intended. A paragraph begins with a *topic sentence* or some other indication of the subject [Young02]. A paragraph consists of *complex sentences* and is a part of *section*.

paragraph sign (kappalemerkki) pilcrow sign, mark ¶.

parallel (rinnakkainen)

parallelism (rinnakkaisuus) a large number of operations is performed side by side [Haykin91], see *concurrency*, *modularity*.

parallel network system (rinnakkainen verkkojärjestelmä) a *system* which does not have a top and bottom [Pagels88], see *serial hierarchical system*, *holism*.

parallel processing (rinnakkaiskäsitely) see *serial processing*.

parallels (kaksoispystyviiva) mark || [Webster's Third New93], see *vertical line*, *broken bar*.

parameter (parametri) a quantity or *constant* whose value varies with the circumstance of its application [Webster's New World01], see *variable*, *system*, *setting*, *estimation*, *stability*.

parametric (parametrinen) opposite to *nonparametric*.

paraphrase (kertoa omin sanoin) original author's material is restated in your own words. The *reference* must be given [McCuen96]. See *copyright*, *quote*.

parenthesis (sulku, sulkumerkki, sulje) marks (...), see *equation*, *punctuation*.

parsimony (parsimonia, kitsaus) economy, measures a quality in *theory* [Wilson99], see *Ockham's razor*.

part (osa) element, a portion or division of a *whole* that is separate or distinct [Random House99], see *mereology*, *system*, *thing*, *order*, *structure*.

partitioning (partitiointi, osittaminen, jakaminen)

passive voice (passiivimuoto) see *active voice*.

past perfect tense (pluskvamperfekti) pluperfect tense, see *past tense*, *perfect tense*.

past tense (imperfekti) imperfect tense, see *past perfect tense*.

patching (paikkaus, täydennys) see *debugging*.

patent (patentti) "the right to exclude others from making, using, offering for sale, or selling the invention" [US-PTM], usually for 20 years from the date on which the application for the patent was

filed. A patent is published as a *technical report*. See *literature, intellectual property, trademark, copyright, royalty, license*.

pattern (hahmo) see *information*.

pattern recognition (hahmontunnistus)

payoff (voitto, tuotto) arithmetic combination of several *benefits* and *costs* that summarizes the impact of their interaction by increasing in value with increasing benefit and decreasing in value with increasing cost [Bock01], see *quality*.

peak-to-valley value (huipusta-pohjaan-arvo, kokonaisvaihtelun arvo) the difference between *peak* and *valley values*.

peak value (huippuarvo) maximum value, see *valley value, peak to valley value*.

pedagogy (pedagogia, kasvatustiete) see *integrative pedagogy, learning, teaching*.

peer (vertainen) a person who is the equal of the *author* in abilities, qualifications, or background [Random House99].

peer review (vertaistarkastus) an evaluation of a *manuscript* usually made anonymously by some *peers* of the author, or *referees*, organized by an *editor* or *review organizer*, see *blind review, pre-examination*.

percentage (prosenttiluku, prosenttiosuus)

perception (havainto) see *observation*.

perfect tense (perfekti) present perfect tense, a verb *tense* indicating an action or state extending up to, or having results continuing up to the present, see *present tense*.

performance (suorituskyky) performance value, "the manner in which or the *efficiency* in using the available *resources* with which something reacts or fulfils its intended purpose" [Random House99], objective *quality* [Hall62], see *quality of service*.

performance criterion (suorituskykykriteeri) *performance metric*.

performance index (suorituskykyindeksi) *performance metric*.

performance measure (suorituskykymitta) *performance metric*.

performance metric (suorituskykymitta) performance measure, performance criterion, performance index, index of performance, performance indicator, cost function, a *function* of some *quantity values* which is used to measure *performance* and whose output is *performance value* [Haykin01], [Kay93], [Blomqvist79], [Bock01], [Chestnut65], [Chestnut67], [Belliveau02], see *figure of merit, metric, performance requirement, benchmark*.

performance requirement (suorituskykyvaatimus) desired *performance* [Bock01], see *performance, performance metric, product requirement, constraint*.

performance value (suorituskyky, suoritusarvo, tekninen arvo) *performance*, numerical *value* of the *performance metric*, to be compared with the *performance requirement* [Bock01].

period (piste) full stop, mark ., see *dot, middle dot, dot above, punctuation*.

periodical (aikakauslehti) a periodical *publication*, inc. *journal* and *magazine*, see *newspaper, subscribe*.

permission (lupa) *license*, see *copyright*.

perseverance (sinnikkyys, pitkäjänteisyys) persistence.

personality (persoonallisuus)

PERT chart (PERT-kaavio) program evaluation and review technique [Belliveau02]. A PERT chart presents dependencies and timing of tasks in a *project*. Tasks are represented by blocks with the name of the task and its expected duration. The chart does not allow for loops or feedback and so cannot show coupling explicitly [Ulrich95]. See *Gantt chart, critical path, block diagram*.

pervasive computing (sulautettu tietotekniikka) *ubiquitous computing*, see *ambient intelligence*.

phase (vaihe) see *block diagram*.

phenomenon (ilmiö) a fact, *event*, or circumstance observed or *observable*, see *behaviour*.

phenomenology (fenomenologia) a *research method* in *social sciences*, the study of *phenomena* as distinct from *ontology* [Random House99], see *existentialism*.

philosophy (filosofia) general principles of a field of *knowledge* [Webster's News World01], divided into 1) *metaphysics*, 2) *epistemology*, and 3) *axiology*.

philosophy of science (tieteenfilosofia) *theory of science*, study of general principles of science, a branch of *epistemology*, see *analytic philosophy of science*, *hermeneutics*.

phrase (fraasi, sanonta, sanaliitto, sanayhdistelmä)

physical additivity (fysikaalinen summautuvuus) physical summativity, *independence*, variation of a system is the physical sum of the variations of its parts, each element is independent of the others [Hall62], [Bertalanffy98]. Such a system may be *nonlinear*. Physical additivity is a weaker *property* than *mathematical additivity*.

physical layer (fyysinen kerros) the lowest *layer* of the *OSI model* below the *data link layer*, concerned with transmitting raw bits over a communication *channel*, the layer has four important characteristics, inc. mechanical, electrical, functional and procedural [Tanenbaum96], [Stallings91], see *modulation*, *multiplexing*, *synchronization*, *scrambler*, *detection*.

physical model (fysikaalinen malli) a *model* based on a *material* construction, inc. 1) *macroscopic model*, 2) *microscopic* or *miniature model*, opposite to *theoretical model* [Honderich05], see *analog model*, *prototype*, *executive model*, *model*, *iconic model*.

physical part (fysikaalinen osa) physical elements, "parts, components, and subassemblies that ultimately implement the *product's* functions" [Ulrich95], see *functional parts*, *architecture*.

physics (fysiikka) a branch of *natural science* that deals with *matter*, *energy*, motion and force [Random House99]. Classical continuous physics includes 1) *mechanics*, including *statics* and *dynamics* 2) acoustics, 3) *thermodynamics*, 4) optics, and 5) *electromagnetism*; in addition, modern quantum physics includes 6) molecular, 7) atomic, 8) nuclear, 9) particle, and 10) solid-state physics, and *statistical mechanics*, *relativity theory*, and *quantum mechanics* are added to mechanics.

pie chart (piirakkakaavio, ympyrädiagrammi)

pilcrow sign (kappalemerkki) *paragraph sign*.

pilot (pilotti, kokeilu) pilot test, a preliminary of experimental trial or test [Random House99], see *experiment*, *quick and dirty*.

pilot test (pilotti, kokeilu) *pilot*.

pipeline (liukuhihna)

plagiarism (plagiointi, luvaton lainaus) "an unauthorized use of the language and thoughts of another author and representation of them as one's own" [Random House99], see *ethics*, *code of ethics*, *self-plagiarism*.

plan (suunnitelma) see *project*.

plant (laitos, koneisto, laitteisto; säädettävä järjestelmä) 1) a set of *equipment* [Pahl07], 2) a system to be controlled (in *control theory*), see *artefact*.

platform (alusta) a technological subsystem around which a *platform product* is built [Ulrich95].

platform product (alustatuote) a derivative *product* that is designed from a *platform* [Belliveau02], see *product family*.

plausibility (uskottavuus, vakuuttavuus) a weaker counterpart of *truthfulness* [Honderich05], see *correctness*.

plausible (uskottava, vakuuttava)

plenary session (yleisistunto, täysistunto) a common *session* to where all *conference* attendees are invited, without any other parallel sessions.

pluperfect tense (pluskvamperfekti) *past perfect tense*.

pluralism (pluralismi, moniarvoisuus)

polar coordinate system (napakoordinaaristo) see *Cartesian coordinate system*.

polynomial complexity (polynomikompleksisuus) the number of steps in the *algorithm* is a polynomial of the size of the *problem* [Dewdney04], see *linear complexity, quadratic complexity, logarithmic complexity, exponential complexity*.

polynomial-time algorithm (polynomiajassa laskettava algoritmi) an *algorithm* of *polynomial complexity*, an algorithm that can be computed in polynomial time [Dewdney04], see *tractable problem, intractable problem*.

polytechnic (ammattikorkeakoulu) institution of higher education (in Finland), see *bachelor of science*.

population (populaatio, perusjoukko) the set of entities concerning which *statistical inferences* are to be drawn, see *sample*.

portfolio (valikoima) a set of items [Belliveau02], for example *project portfolio, product portfolio, teaching portfolio*.

positive (positiivinen) affirmative, certain, sure [Arbno97].

positive knowlege (varma tieto) certain knowledge, *knowledge* provided by *experience* [Arbno97].

positivism (positivismi) referring to "positive science," a movement in *philosophy of science* according to which knowledge is permanent and universal, positivism is akin to *empirism* and *naturalism* [Honderich05]. *Knowledge* about reality can only be based on sensory *observation*. See *logical empirism, analytical philosophy of science, hermeneutics, antipositivism, constructivism, pragmatism*.

positivistic research method (positivistinen tutkimusmenetelmä) see *nomothetic research*.

postdoc (tohtorin tutkinnon suorittanut henkilö) postdoctoral *researcher*, especially as a visitor for a limited time.

poster (posteri, juliste) a placard presented in a *poster presentation* [Random House99].

poster presentation (posteriesitelmä) a *conference* presentation given in front of a *poster* in a given poster *session*, see *oral presentation*.

postgraduate (akateemisen loppututkinnon jälkeisiä jatko-opintoja koskeva) studies after the *master of science degree*, see *graduate*.

postinverse (jälki-inverssi) a partial *inverse function* that can be used only after the original *function* called *injection* [Schetzen06].

postmodern (postmoderni) emphasizing the incoherence, obscurity, and contradiction of reality, see *truth*.

postmodernism (postmodernismi) see *postmodern, scepticism, relativism*.

postulate (postulaatti, oletus) a *proposition* that requires no proof [Random House99], see *assumption, axiom, premise, presumptive knowledge*.

power (teho; potenssi) *energy* in a time unit.

pragmatic (pragmaattinen, käytännöllinen) practical, emphasizing practical utility, see *theoretical, truth theory*.

pragmatic level (pragmaattinen taso) the highest conceptual level related to *information* above the *semantic level*, refers to the *value* and the practical utility of *signs* [Skyttner06], see *values, syntactic level, economics, philosophy, axiology*.

pragmatics (pragmatiikka) the study of the relation of *signs* to their users [Honderich05].

pragmatism (pragmatismi) a movement in *philosophy of science* according to which *knowledge* is good if it is useful, see *positivism, constructivism*.

precedence (etusija) relative *priority*, see *quality of service*.

precise (täsmällinen) see *precision*.

precision (täsmällisyys) measurement precision, “the closeness of agreement between independent *measurement* results obtained under stipulated conditions” [amc03], describes the care and refinement of a measurement process, *repeatability* of the readings, and the number of significant decimal digits expressed in a measured *quantity* [Buckner97a], [Weissstein05]. Precision includes *random errors* only [amc03]. Precision is usually expressed numerically by measures of *imprecision* such as *standard deviation* [ISO Guide 99:2004], but the term imprecision is not recommended in [Taylor94]. See *granularity, resolution, trueness, accuracy, uncertainty, coverage interval, coverage probability, tolerance, instrument, significant digit, most significant bit, least significant bit*.

predictor (ennustin)

predictor variable (selittävä muuttuja) see *model, response variable, factor, level, treatment*.

prediction (ennuste, ennustaminen) forecasting, rational prediction is a form of *induction* [Honderich05], see *determinism, chance, trend, likelihood, probability*.

predictive power (ennustavuus) a quality in *theory* [Wilson99].

pre-examination (esitarkastus) an evaluation of a *manuscript* of a doctoral thesis made by two experts in the field, also called *referees*, organized by the university department.

pre-examiner (esitarkastaja) *referee* of a *doctoral thesis*.

preface (alkulause) a part of a *document*, includes for example *acknowledgment*.

preinverse (esi-inverssi) a partial *inverse function* that can be used only before the original *function* called *surjection* [Schetzen06].

prejudice (ennakkoluulo) see *objective*.

premise (premissi, lähtökohta) a *proposition* supporting or helping to support conclusions [Random House99], see *axiom, assumption, postulate*.

present (esittää)

present perfect tense (perfekti) *perfect tense*.

present tense (preesens) see *perfect tense, tense*.

presentation (esitelmä) see *present, slide presentation, oral presentation, poster presentation*.

presentation layer (esityskerros) the *layer* above the *session layer* and below the *application layer* in the *OSI model*. The layer is concerned with the *syntax* of the *data* exchanged between *application* entities. The purpose is to resolve differences in *format* and *data* presentation, an example of presentation protocols is encryption [Tanenbaum96], [Stallings91].

presenter (esiintyjä) speaker, see *present*.

presumption (oletus) *assumption*.

presumptive knowledge (oletettu tieto) *knowledge* assumed to be valid [Bock02], including *axiom, law, assumption, postulate*.

price (hinta, arvo) the sum or amount of money or its equivalent for which anything is bought [Random House99], see *cost, capital, law of supply and demand, price-quality ratio*.

price-quality ratio (hinta-laatusuhde) see *price, quality, demand, law of supply and demand*.

primary standard (primaarinormaali) the best *measurement normal*, see *secondary standard, working standard*.

prime (pilkku yläindeksinä) mark ‘, used to distinguish one character from another, to indicate minute or foot, or differentiation of a *function*, see *prime, double prime, apostrophe, comma, acute accent, grave accent*.

prime cost (omakustannusarvo (OKA), tuotantohinta) absorption cost, cost that includes *direct* and *indirect costs*, including *labor costs, social security costs, and overhead costs*, and excluding *contribution margin* and *turnover tax*, see *cost*.

primitive symbol (perussymboli, alkeissymboli) a *symbol* than cannot be defined to avoid infinite loops of *definitions* [Honderich05], see *primitive term, axiomatic system*.

primitive term (perustermi, alkeistermi) undefined *term* [Rosenberg00], meaning explained only by characterizing or pointing out examples, see *definition, primitive symbol*.

print (painos) one of the number of impressions made from the same set of type, see *edition, book, reprint*.

priority (prioriteetti, etuoikeus) the state or quality of being earlier in *time* or occurrence [Random House99], see *precedence*.

private knowledge (yksityinen tieto) *speculative knowledge*, knowledge based on one's opinions, speculation, in contrast with *scientific knowledge*.

probabilistic (satunnainen, todennäköisyys-) *statistical*, stochastic, random, see *probability*.

probabilistic explanation (todennäköisyyselitys) *statistical explanation*.

probabilistic law (todennäköisyyslaki) *statistical law*.

probabilistic model (todennäköisyysmalli) *statistical model*.

probability (todennäköisyys) see *chance, likelihood*.

probability density function (tiheysfunktio) derivative of the *distribution function*.

probability sampling (todennäköisyysotanta) *sampling method* that includes *random sampling, systematic sampling, and stratified sampling, see nonprobability sampling*.

probe (mittapää) see *instrument*.

*problem (ongelma) a question proposed for *solution* or *discussion* [Random House99], a question, complaint, or *requirement* [Bock02], see *objective, product requirement, hypothesis, well-defined problem, ill-defined problem, divide and conquer, iterative improvement*.

problem statement (ongelmanasettelu) problem description, see *problem*.

procedure (proseduuri, menettelytapa) the act or manner of proceeding in any action or *process, conduct* [Random House99], see *mechanism, method*.

process (prosessi, tapahtumasarja) a sequence of *events* with some sort of unity or unifying principle [Honderich05], see *dynamic structure, flowchart, applied research, development, organization, order, function*.

produce (tuottaa) to make or *manufacture*.

producer (tuottaja) see *product, cause*.

producer-product relation (tuottaja-tuotesuhde) a *teleological relation* used in the *systems approach*, opposite to *cause-effect relation, see final cause*.

*product (tuote) a *thing produced* by labor [Random House99], all goods, services, and knowledge sold by an enterprise to its *customer* [Belliveau02], final result of *engineering, see service, process, applied research, artefact, consumer need, customer need, product requirement, product concept, product specification, platform product, architecture, design, partitioning, upgrade, reuse, benchmarking, alpha prototype, beta prototype, gamma test*.

product architecture (tuotearkkitehtuuri) "the way in which the *functional parts* are assigned to the physical *chunks* of a *product* and the way in which those physical chunks interact to perform the overall function of the product" [Belliveau02], see *architecture*.

product concept (tuotekonsepti) "a clearly written and possibly visual description of the new *product idea* that includes its primary *features* and consumer benefits, combined with a broad understanding of the *technology* needed" [Belliveau02], see *proof of concept*.

product definition (tuotemäärittely) product specification [Belliveau02].

product design (tuotesuunnittelu) a part of *product development*, the definition of the physical form of a *product* to best meet customer needs [Ulrich95], definition of *product specifications* from *product requirement*, includes 1) *engineering design* and 2) *industrial design, see industry*.

product development (tuotekehitys) "the overall *process* of *strategy, organization, concept generation, product and marketing plan creation, execution, and evaluation, and commercialization* of a new *product*" [Belliveau02], converting *product requirements* into a working *product*. The phases of

product development include 1) *product requirements*, 2) *product concept*, 3) *product specifications*, 4) *implementation*, 5) *manufacturing*, 6) *marketing*, and 7) *operation*. See *virtual product development, product design, research, creativity, industry*.

product family (tuoteperhe) "the set of *products* that have been derived from a common product *platform*" [Belliveau02].

production (tuotanto, valmistus)

production factor (tuotannontekijä) the classical production factors include *material*, *capital*, and *labor*, a new production factor is *knowledge* [Arbno97], see *resource*.

product requirement (tuotevaatimus) translation of *customer needs* into technical terms, statement of the *problem* to be solved, a precise description of the necessary or desirable attributes of the *product* to be *developed*, as well as *information* about how achievement of the attributes will be *verified* through *testing*, without defining a *product concept*. Product requirement describes 1) *environment*, 2) *functions* to be satisfied, 2) *constraints* to be respected, 3) *interfaces* to be used, 4) *system size*, execution speed, *performance*, etc., each requirement consists of a *metric* and a target *value* for that metric, see *performance metric, performance requirement, performance value, product specification, verification, validation, certification, objective*.

product specification (tuotespesifikaatio, tuotemääritys) a complete description of a *product* to be designed which operates in the *environment* specified in the *product requirements* using 1) *functional*, 2) *behavioral*, and 3) *executive models*. The phases included are 1) *environment analysis and modelling*, 2) *delimitation of system inputs and outputs, describing system's functional relations with the environment*, 3) *functional specifications*, 4) *operational (behavioral) specifications*, and 5) *technological (implementation) specifications*. Product specifications are based on a *product concept* and give quantitative target values for its *parameters*. See *goal*.

profession (professio, akateeminen ammatti) in contrast with *occupation*, see *competence*.

professional journal (ammattilehti) see *journal*.

professor (professori) a university teacher of the highest rank in a particular branch of learning, ranking above an *associate professor*, see *adjunct professor, docent, research professor, tenure*.

profit (voitto) positive *reward*, see *loss*

progressive (progressiivinen, etenevä, kehittyvä)

progress report (väliraportti, tilanneraportti) *status report*, see *project, research report*.

project (projekti, hanke) something that is planned or devised, a specific task or investigation [Random House99], see *plan, status report, final report, technical report, deliverable, timing plan, Gantt chart, PERT chart, critical path, risk*.

project manager (projektipäällikkö) person who is responsible for *project* estimating, planning and management.

project organization (projektiorganisaatio) an *organization* where organizational links are primarily among those who work on the same *project* [Ulrich95], see *matrix organization, functional organization*.

project plan (projektsuunnitelma) "a formal approved document used to guide both *project* execution and control" [Belliveau02], see *research plan, proposal*.

project team (projektitimi) "a multifunctional group of individuals chartered to plan and execute a new project" [Belliveau02], see *team*.

proof (sivuedos, taittovedos) *page proof*.

proof (todistus) evidence; *deductive* derivation of a *conjecture* from a set of *definitions* and *axioms*. Proofs in *mathematics* include *existence proofs* and *constructive proofs* where the object is constructed mathematically [Pagels88], see *axiomatic system, prove, circular reasoning, Gödel's theorem, logic*.

proof of concept (tuotekonseptin oikeellisuuden osoitus) see *product concept, prototype*.

proofreader (oikolukija) see *page proof*.

proofreading (oikoluku) see *page proof*.

property (ominaisuus) an *attribute* that *things* are acknowledged to have [Honderich05], see *quality, class, part, measurement, thing, system*.

proposal (rahoitushakemus, ehdotus) 1) research proposal, *funding application submitted to a customer*; 2) *thesis proposal*, see *timing plan*.

proposition (väite) a formal statement of either truth to be demonstrated or an operation to be performed [Random House99], see *corollary, axiomatic system, thesis, theorem*.

protocol (protokolla, yhteyskäytäntö) a set of rules governing the format of messages that are exchanged between computers [Random House99], see *telecommunications, algorithm*.

prototype (prototyyppi) approximation of a *product*, the first *physical model* of a new *product concept* from which other forms are copied or *developed*. A prototype may be 1) a *comprehensive prototype*, or 2) a *focused prototype* [Ulrich95]. See *theoretical model, alpha prototype, beta prototype, demonstration, breadboard, development, proof of concept*.

prototyping (prototyointi) *process of developing a prototype*, see *rapid prototyping*.

prove (todistaa) to derive a *theorem deductively* from a set of *axioms*, see *proof*.

pseudo-problem (näennäisongelma) a *metaphysical problem* that is impossible to solve because it does not present anything *empirical* to resolve [Arbno97].

pseudo-science (pseudotiede, näennäistiede) nonscience that is distinguished from *science* by *falsifiability*, for example astrology.

psychology (psykologia) a branch of *behavioral science*.

publication (julkaisu) a *document* that is published, usually after a *peer review*, especially a *book, periodical, conference proceedings, or scientific paper*.

public defence (väitöstilaisuus) a public meeting where a published *manuscript* submitted as a *doctoral thesis* is evaluated by *opponents*, see *custos, pre-examiner*.

public domain (teokset, jonka tekijänoikeussuoja on rauennut) work free for all to use, all *copyrighted works* finally enter the public domain [Chicago93].

publicity (julkisuus) see *transparent, values*.

publisher (julkaisija, kustantamo) *commercial publisher* or *scientific society*.

punctuation (välimerkkien käyttö) see *complex sentence, period, ellipsis, comma, colon, semicolon, dash, em dash, en dash, hyphen, swung dash, slash, backslash, exclamation mark, question mark, quotation mark, single quotation mark, apostrophe, ditto mark, parenthesis, square bracket, brace, angle bracket, acute accent, grave accent, circumflex, tilde, macron, breve, caret, asterisk, dagger, section mark, parallels, paragraph mark, diaeresis, asterism*.

punishment (rangaistus) see *reward, behaviourism*.

purpose (tarkoitus) see *final cause, meaning*.

quadratic complexity (toisen asteen kompleksisuus) *polynomial complexity* of second order.

qualitative (kvalitatiivinen, laadullinen) see *quality*.

quality (kvaliteetti, laatu, hyvyys) a *performance metric* that is an arithmetic combination of several *benefits* [Bock01], see *payoff, quantity, price-quality ratio, convert*.

quality control (tarkastus, laadunvalvonta)

quality of service (palvelun laatu) quality of service parameters include *throughput, delay, reliability, and precedence*, see *service, quality, error rate*.

quantitative (kvantitatiivinen, määrällinen) see *quantity*.

quantile (kvantiili) a *value* below which a certain percentage of a given set is, see *median*.

quantity (määrä, suure) 1) amount, 2) the *property of magnitude* involving comparability with other magnitudes [Random House99], see *base quantity, derived quantity, quality, variable, transform*.

quantity value (suureen arvo) value of quantity, *value*, magnitude of a quantity represented as a product of a *numerical quantity value* (or more briefly a number) and a *unit* [ISO Guide 99:2004], see *peak value*, *peak to valley value*, *measuring range*.

quantum communications (kvanttitieliikenne) *teleportation* of quantum states.

quantum computing (kvanttilaskenta) computing that uses the ability of particles to exist in more than one *state* at the same time [Kurzweil99], quantum computing is expected to solve *intractable problems* that are not *unsolvable problems* [Dewdney04], see *qu-bit*.

quantum entanglement (kvanttilojen lomittuminen) quantum interaction of two distant particles

quantum mechanics (kvanttimekaniikka) quantum theory, a part of *mechanics* in modern *physics*, "a theory in which the properties of atoms and subatomic particles are represented by wave functions and mathematical operators that allow prediction of the probability but not the exact value of observable events" [Barbour97], see *indeterminism*.

quantum theory (kvanttiteoria) *quantum mechanics*.

qu-bit (kubit) quantum bit that is both zero and one at the same time [Kurzweil99].

question mark (kysymysmerkki) interrogation mark, mark ?.

questionnaire (kyselylomake, kyselytutkimus)

questionnaire study (kyselytutkimus) a *research method* in *social sciences*, see *population*, *sample*.

queuing theory (jonotusteoria) theory concerning optimization of arrangements under conditions of crowding [Bertalanffy98], see *network information theory*.

quick and dirty (nopeasti tehty huono ratkaisu) see *pilot*, *rapid prototyping*.

quota sampling (kiintiötanta) a *nonprobability sampling* method.

quotation (lainaus) citation.

quotation mark (lainausmerkki) marks "...", see *punctuation*, *single quotation mark*.

quote (lainata) cite, refer, original author's exact words are used in *quotation marks* and the *reference* is given [McCuen96], see *copyright*, *paraphrase*.

random (satunnainen) *statistical*, stochastic, probabilistic, formless, shapeless, unpredictable [Baeyer05], not *deterministic*, see *chance*, *information*.

random error (satunnaisvirhe) see *precision*, *error*, *systematic error*.

randomness (satunnaisuus) opposite to *determinism*.

random sampling (satunnaisotanta) *Monte Carlo method*, stochastic sampling, a *probability sampling* method.

range (arvojoukko) image, the *set* of all *values* that a *function* can take as its *argument* varies over the *domain* [Weisstein05].

range of indication (näyttämän alue) the range limited by extreme values, see *instrument*.

rapid prototyping (nopea prototyyppi) *prototypes* used to test quickly the *product's* technical feasibility or *consumer* interest [Belliveau02], see *quick and dirty*.

rate (suhde, tahti, nopeus, aste) see *ratio*.

rated operating conditions (nimelliset käyttöolosuhteet) conditions where the specified properties of an *instrument* should be within certain limits, see *limiting conditions*, *reference conditions*.

ratio (suhde, suhdeluku) see *rate*.

rational (rationaalinen, järjen mukainen, järkevä)

rationalism (rationalismi) a view emphasizing the role or importance of *reason*, usually including *intuition*, in contrast to sensory *experience*, the feelings, or *authority* [Honderich05], contrasted with *empirism*, see *enlightenment*, *logical empirism*.

ratio scale (suhdeasteikko) an *ordinal scale* where the groups have a meaningful numerical separation, and a true zero point as its origin, used for example in Mach number and *coefficient of variation* [McCuen96].

raw error (raakavirhe) the difference between the *result* and the *reference value* [Bock02], see *error, uncorrected result*.

raw material (raaka-aine) see *material*.

real (reaalinen, todellinen)

realism (realismi) inc. *classical realism* and *critical realism*, opposite to *antirealism* and *nominalism*, see *conceptualism, scepticism, idealism*.

reality (todellisuus) see *model*.

reason (syy) beliefs and desires that have a logical connection to *actions* which are then *effects*, different from a *cause* [Rosenberg08].

reasoning (päättely, perustelu) searching for *reasons* [Honderich05], see *inference, intuition, circular reasoning, argument, logic*.

reciprocity (resiprookkisuus, vastavuoroisuus) see *system*.

reconfigurability (rekonfiguroitavuus) see *adaptability, flexibility*.

recruiting (rekrytointi, työhönotto) see *organization*.

recursion (rekursio) see *algorithm, recursive, iteration, logic*.

recursive (rekursiivinen, palautuva) pertaining to or using a rule or *procedure* that can be applied repeatedly [Random House99], can be either time recursive or order recursive [Proakis01], see *iterative*.

recycling (kierrätys)

reduce (alentaa, pienentää, vähentää, pelkistää, sieventää) to bring down to a smaller size, amount, price, etc. [Random House99].

reduced theory (erityisempi teoria) less universal *theory* [Rosenberg00], see *intertheoretical reduction*.

reducing theory (yleisempi teoria) more universal *theory* [Rosenberg00], see *intertheoretical reduction*.

reduction (reduktio, luokittelu, erittely; pelkistäminen, sieventäminen) inc. 1) *methodological reduction*, 2) *ontological reduction* 3) *epistemological reduction* [Honderich05], [Barbour97], see *reduce, reductionism, systems analysis, irreducible, V-model, divide and conquer, serial hierarchical system, modular architecture, layered architecture, sequential order, unity of science*.

*reductionism (reduktionismi) theory that every complex *phenomenon* can be explained by analyzing separately the simplest, most basic physical mechanisms that are in operation during the phenomenon [Random House99], opposite to *holism*, see *scientific approach, reduction, systems analysis, top-down, bottom-up, idealization, upwards causality, forwards causality*.

reductionist (reduktionisti, reduktionistinen) see *reductionism*.

reductive approach (reduktiivinen lähestymistapa) *analytical approach*.

reductive method (reduktiivinen menetelmä) *divide and conquer*, a *research method* based on *methodological reduction*, see *experimental-inductive method, iterative improvement*.

redundancy (redundanssi, ylimäärä) the *output* of a source is said to possess redundancy if its output *symbols* are not equally likely or if they are not statistically independent [Sklar01], see *source coding, channel coding*.

refer (viitata) cite, *quote*, see *reference*.

referee (esitarkastaja) an expert in a field [Young02], a *peer* to the *author* who, usually anonymously to the *authors*, gives a *referee report* to the *editor* or *selection committee* as requested by a *review organizer*, in a *peer review* process, see *competence*.

refereeing (tarkastaminen)

referee practice (esitarkastus) *peer review* process.

referee process (esitarkastus) *peer review* process.

referee report (tarkastajan lausunto, katselmointiraportti) review report, opinion of a *referee* given to the *selection committee* of a *conference* or to the *editor* of a *journal* by using a *paper review form*, including his or her opinion about the *manuscript* and a recommendation about the *acceptance* or *rejection* of the manuscript for possible publication.

reference (lähde, viite) citation, a *publication* which the *author* is using during the preparation of the *manuscript*, see *quote*, *paraphrase*, *bibliographical data*, *literature search*, *citation database*.

reference conditions (perusolosuhteet) conditions defined to guarantee the comparability of *measurement results*, see *rated operating conditions*, *limiting conditions*.

reference book (hakuteos) compilation of data, much broader subject than in a *monograph* [Day98], for example *encyclopedia*, *handbook*, *bibliography*, see *language, book*.

reference quantity value (vertailuarvo) *reference value*.

references (lähteet, viitteet) a numbered list of *references* in a *document*, numbers often given in *square brackets*, see *bibliography*.

reference system (vertailujärjestelmä) a benchmark against which all other systems are rated, either an *industry standard* or an obvious solution to the problem [Ulrich95], see *benchmarking*, *reference value*.

reference value (vertailuarvo) reference quantity value, baseline [Bock01], see *conventional true value*, *accepted reference value*.

reference value scale (referenssiasteikko) see *reference value, scale*.

refinement (jalustus) the procedure for going one description *level* to another towards more detail, opposite to *abstraction* [Calvez93], see *ontological reduction*, *top-down*, *outline*.

reflection (heijastuminen, peilaus) mirroring, see *inversion -x*, *glide*.

reflective (ajatteleva, harkitseva) see *actor*.

refutable (kumottavissa oleva) *falsifiable*.

refutation (kumoaminen) *falsification*.

refute (kumota, osoittaa vääräksi) *falsify*.

registered sign (rekisteröity tavaramerkki) mark ®, officially certified *trademark* [Random House99].

registration (rekisteröinti, ilmoittautuminen) see *conference*.

regression analysis (regressioanalyysi) examines the relation of a dependent variable to specified independent variables using a *regression model*, see *statistical analysis*, *coefficient of determination*, *alpha coefficient*, *beta coefficient*.

regression curve (regressiokäyrä)

regression model (regressiomalli) a *model* that includes a *deterministic* and *random* part, see *deterministic model*, *statistical model*, *linear model*, *logistic model*.

regular (säännöllinen) lawful, not capricious [Checkland99], see *natural law*, *scientific law*.

regularity (säännöllisyys) see *regular, continuity*.

regular session (normaalisessio, normaali-istunto) a *session* for *oral presentations* except the *plenary session*, see *conference*.

regulation (säätö, sääntely, sääntö, määräys, asetus) *control*; a rule, ordinance, or law by which conduct, etc. is regulated [Random House99].

reinforce (vahvistaa) opposite to *weaken*, see *reward*.

relation (relaatio, suhde, yhteys) relationship, see *interrelationship*, *thing*, *system*, *algebra*.

relationship (suhde, yhteys) *relation*.

relative error (suhteellinen virhe) *error* divided by the *true value*.

relativism (relativismi) a view that there are no general *truths*, see *postmodernism*, *scepticism*.

relativity theory (suhteellisuusteoria) theory of relativity, relativistic *mechanics* for very great speeds, a part of modern *physics*, inc. special and general relativity theory. Relativity is based on two postulates, inc. that 1) the speed of light in a vacuum is constant and independent of the source or the observer, and that 2) the mathematical forms of the laws of physics are invariant in all inertial systems [Kurzweil99].

relevance (relevanssi, merkitys) *significance*.

reliability (luotettavuus) 1) repeatable true, a test to use to establish the quality of empirical research, demonstrates that the research operations can be *reproduced* with the same results, trustworthiness, dependability, see *external validity*; 2) probability that the system operates correctly during a certain period defined by the mean time between failures (MTBF). See *quality of service*, *verification*, *validation*, *validity*, *confidence*.

repeatability (toistettavuus, toistuvuus, toistokyky) the same results are obtained in the same laboratory [amc03], see *reproducibility*, *repeatable*, *precision*.

repeatable (toistettava) something that can be done again.

repair (korjata)

report (raportti) see *technical report*.

reprint (uusi painos, uusintapainos, jälkipainos, eripainos, lisäpainos) offprint, separately printed *journal paper* supplied to authors, usually for a fee [Day98], see *print*.

reproduce (uusia)

reproducibility (uusittavuus) the same results are obtained in different laboratories [amc03], see *repeatability*.

requirement (vaatimus) see *product requirement*, *performance requirement*, *objective*.

*research (tutkimus) careful study or investigation to discover new *scientific knowledge* or *concepts*, inc. 1) *basic* research and 2) *applied research* [Jain97], see *creativity*, *idea*, *focus*, *development*, *investing*, *industry*, *feasibility study*, *case study*, *notebook*.

research approach (tutkimusote) principle how research is done, more abstract than *research method*, see *methodological approach*, *research design*.

research center (tutkimuskeskus) see *industry*, *research institute*.

research culture (tutkimuskulttuuri) a special culture in a research organization that covers objective elements as research *laboratory* facilities and *equipment* and subjective elements as *ethos*, *values* and *norms*. Scientific *discoveries* are subjected to *impersonal* judgments and scientists *critically* evaluate scientific *ideas* and discoveries [Jain97]. See *research method*, *literature*, *scientific paper*, *seminar*, *gatekeeper*, *infrastructure*.

research design (tutkimussuunnittelu) selection of *research approach* and design of *research method*, see *research plan*.

researcher (tutkija) a person with graduate training, high aptitude, socialized to work autonomously, tolerant to *ambiguity*, and show considerable initiative [Jain97], see *research*.

research institute (tutkimuslaitos) see *research organization*, *research professor*, *technology transfer*.

research method (tutkimusmenetelmä) a *scientific method* used in *research*, more concrete than *research approach*, inc. 1) *nomothetic research*, 2) *constructive research*, and 3) *idiographic research* [Iivari91], see *methodological approach*, *research design*.

research organisation (tutkimusorganisaatio) an organization whose basic elements are 1) *ideas*, 2) *researchers*, 3) *funds*, and 4) *research culture* [Jain97], see *organization*, *university*, *research institute*, *research center*, *dual hierarchy*, *triple hierarchy*, *matrix organization*, *information transparency*.

- research plan (tutkimussuunnitelma) see *research proposal, project plan, research design*.
- research problem (tutkimusongelma) a *problem* that is a starting point of *research*, see *hypothesis*.
- research professor (tutkimusprofessori) a *professor* especially in a *research institute* without teaching duties, ranking above a *leading scientist*.
- research program (tutkimusohjelma)
- research proposal (rahoitushakemus) see *proposal*.
- research report (tutkimusraportti) a final report given to a *foundation* after the *scholarship* period, see *progress report*.
- research scientist (tutkija) a *researcher* ranking below a *senior research scientist*.
- residual error (jännösvirhe)
- resolution (resoluutio, erottelu, erotuskyky) the capability of distinguishing between two separate but adjacent parts or objects, the smallest observable difference in *indications*, reciprocal of *granularity* [Bock01], see *precision, tolerance*.
- resource (resurssi, voimavara) basic resources include *material, energy, and information*, see *production factor, efficiency, performance, time*.
- resource plan (resurssisuunnitelma) *budget and timing plan* [McCuen96]
- respondent (vastaaja) see *interviewee*.
- response (vaste) the *output* signal for a given input signal in a system.
- response time (vasteaika) see *delay, latency, tracking error*.
- response variable (vastemuuttuja) output variable, see *model, predictor variable, factor, level, treatment*.
- restriction (rajoitus) see *limitation*
- result (tulos) see *conclusive knowledge*.
- results (tulokset) a part of an *original scientific paper* usually describing novel results, for example the *performance* of the *system*, see *system model, graph, correlation, causality*.
- retention (säilyttäminen)
- return (tuotto) the income derived from an investment, revenue, see *reward*.
- reuse (uudelleenkäyttö) see *product*.
- reverse solidus (kenoviiva) *backslash*.
- reversed virgule (kenoviiva) *backslash* [Webster's Third New93].
- reverse engineering (käänteistekniikka) a study or *analysis* of a *device* to learn details of *design, construction, and operation*, as to produce a copy or an improved version [Random House99], opposite to *engineering*.
- review (arviointi, tarkastus, katselmointi) see *referee report*.
- reviewer (esitarkastaja) *referee* [Smith90].
- review organizer (esitarkastuksen organisoiija) in a *conference* an expert who selects the *referees* for a given set of *manuscripts*, see *selection committee, peer review*.
- review paper (katsausjulkaisu, katsaus) survey, a paper including a *literature review*, written for experts in the field [Smith90], see *tutorial paper, original paper, monograph*.
- review report (tarkastajan lausunto, katselmointiraportti) *referee report*.
- revise (tarkistaa, korjata, parannella)
- revision (korjattu versio) new, corrected version of a *manuscript*.
- revolutionary science (vallankumouksellinen tiede) *science* that produces a *paradigm shift*, opposite to *normal science*, see *scientific revolution, paradigm*.

revolve (kiertää, pyöriä) 1) to move in an orbit, 2) to move around an axis, see *rotate*.

reward (palkkio) 1) award; 2) difference between *return* and *expenses*, positive reward is *profit* and negative reward is *loss*, see *punishment*, *behaviourism*, *risk-reward theory*.

rhetoric question (retorinen kysymys)

ring above (yläpuolinen ympyrä) mark °, for example in å, see *dot above*.

risk (riski, uhka) "an *event* or condition that may or may not occur, but if it does occur will impact the ability to achieve a *project's* objectives" [Belliveau02].

risk aversion (riskiaversio, riskin kaihtaminen)

risk-reward theory (riskien ja palkkioiden teoria) a financial theory for minimizing the risks while maximizing the reward, related to *utility theory*.

roadmap (kehityspolku) a *science* and *technology* roadmap, "an extended look at the future of a chosen field of inquiry composed from the collective *knowledge* and imagination of the brightest drivers of change in that field, roadmaps communicate *visions*, attract resources from business and government, stimulate investigations, and monitor progress" [Kostoff01], see *futurology*, *trend*.

roadmapping (kehityspolun ennustaminen) [Belliveau02]

robot (robotti)

robotics (robotiikka) combination of *artificial intelligence* and mechanical engineering.

robust (robusti, häiriönsietoinen, varmatoiminen) a robust *system* remains *operational*, either completely or in degraded *mode*, even in the presence of unforeseen *faults* or *events* coming from the *environment* [Calvez93], see *tolerance*.

robustness (robustisuus, häiriönsietokyky, varmatoimisuus) ruggedness.

roman an upright type style that is not *italic* or *boldface*, see *letter*.

root mean square value (tehollisarvo) see *standard deviation*, *mean-square error*.

rotate (kiertyä, pyöriä) 1) translate around an axis, 2) move around an axis, revolve, spin.

rotation (kierto, pyöriminen) 1) *translation* around an *axis* (in mathematics), 2) movement around an axis, revolution, spin (in physics), see *function*, *twist*, *twirl*, *rotoinversion*, *spiral similarity*.

rotoinversion (rotoinversio, kiertoinvertio) improper rotation, *rotation* and *inversion* [Weisstein05].

royalty (rojalti, lisenssimaksu, patenttimaksu, tekijänpalkkio) *license fee*, a compensation or portion of the proceeds paid to the owner of a right, as a *patent*, for the use of it [Random House99].

Russell's paradox (Russellin paradoksi) an ambiguity in *set theory*.

rule (sääntö) see *law*, *algorithm*, *protocol*.

safety (turvallisuus) includes *reliability* and availability [Pahl07]

sample (otos, näyte) a *subject* chosen from a *population* of investigation, see *mathematical statistics*, *specimen*.

sample mean (otoksen keskiarvo) *average*, *arithmetic mean*.

sample size (otoksen koko)

sampling (näytteenotto, näytteistys, otanta)

sampling method (otantamenetelmä) *method* to select *respondents* from target *population*. Sampling methods include 1) *nonprobability sampling* and 2) *probability sampling*. See *questionnaire study*.

scalar (skalaari) a real or complex *number*.

scale (skaala, asteikko) ordered *scale marks* in the *displaying device*. Measurement scales include *nominal scale*, *ordinal scale*, *interval scale*, and *ratio scale*. See *instrument*, *linear scale*, *reference value scale*.

scale division (askel, asteikon askel) the interval between two consecutive *scale marks*, see *instrument, scale, scale spacing*.

scale interval (askelarvo) difference of *quantity values* corresponding to the *scale division*, see *instrument, scale spacing, scale division*.

scale mark (asteikkomerkki) see *index*.

scale spacing (askelpituus) the distance between two consecutive *scale marks*, see *instrument, scale interval, scale division*.

scaling (skaalaus, mittakaavan muutos) [Weisstein05], see *function, expansion, geometric contraction, stretch, shrink, swirl*.

scaling factor (skaalauskerroin, mittakaavatekijä)

scatter diagram (sirontakuvi, pistediagrammi) a *diagram* showing measured relation between two variables [McCuen96]

scenario (skenaario, tulevaisuuden näkymä) "an imagined sequence of *events*, especially any of several detailed plans or possibilities" [Random House99], see *vision*.

scepticism (skeptisismi, skeptisyys, epäilevyys) a view that a human being cannot acquire any knowledge, see *postmodernism, relativism, realism*.

scheduling (aikataulutus, ajoittaminen)

scholarship (apuraha) grant, fellowship.

school (koulu, yliopisto, korkeakoulu, koulukunta, oppisuunta)

school of economics (kauppakorkeakoulu) see *university of technology, university of art and design*.

science (luonnontiede, tiede) 1) *natural science*, 2) *knowledge* ascertained by *observation* and *experiment*, critically tested, systematized, and brought under general principles [Webster's Dictionary02], 3) a branch of such knowledge, inc. 1) *formal*, 2) *natural*, 3) *behavioural*, and 4) *social science*, and 4) *humanities*, in contrast with *art* [Wilson99], [Rosenberg00]. Features of science include 1) *reproducibility*, 2) *parsimony*, 3) *measurement*, 4) *heuristics*, and 5) *coherence* [Wilson99]. Properties of scientific theories include 1) agreement with data, 2) *coherence*, 3) *generality*, and 4) fertility [Barbour97]. Scientific knowledge is logically coherent, *universal*, *falsifiable*, logically *precise*, and it has *implicative* structure [Pagels88]. See *values, normal science, scientific revolution*.

Science and Technology Studies (STS) the study of how social, political, and cultural values affect scientific research and technological innovation, and how these in turn affect society, politics, and culture.

science fiction (tieteiskirjallisuus)

science of complexity (kompleksisuustiede) complexity science, *science* of combining knowledge on *complexity* from different fields [Skyttner06].

science politics (tiedepolitiikka)

scientific approach (tieteellinen lähestymistapa) *analytical approach*, an *approach* based on *reductionism*, in contrast with *systems approach* [Checkland99], [Arbno97].

scientific computing (tieteellinen laskenta) a numerical approximation method where *mathematical models* are used on *computers* [Wolfram02], see *systems theory*.

scientific explanation (tieteellinen selitys) explanation used in *science*, including *deductive*, *statistical*, *teleological*, and *genetic explanations* [Nagel79], see *scientific law, theory*.

scientific induction (tieteellinen induktio) *induction*, see *complete induction, mathematical induction*.

scientific journal (tieteellinen lehti) *archival journal*.

scientific knowledge (tieteellinen tieto) *knowledge* that has been *experimentally* tested, public knowledge, in contrast with *private knowledge*.

scientific law (tieteellinen laki) our best estimate as to a *natural law* [Rosenberg00]. Scientific laws are 1) *sequential*, 2) *functional*, or 3) *statistical laws* [Nagel79]. See *scientific explanation, theory, presumptive knowledge*.

scientific method (tieteellinen menetelmä) *method*, includes the problems of *discovery* and *verification* [Honderich05], a *research method*, in which a *problem* is identified and broken down by *reduction*, relevant *data* are gathered by *experiment* and *observation*, *competing hypotheses* are formulated for example by *induction* or *abduction*, and the hypotheses are experimentally tested for *verification* [Random House99], [Rosenberg00], [Wilson99]. Classical *science* is based on either *linear causal* chains (two-variable problems, one *cause* and one *effect*) leading to *systems theory*, or unorganized complexity leading to *statistics* [Bertalanffy98]. Scientific method includes *concept formation* and *theory construction* [Niiniluoto02]. See *strong inference, experimental-inductive method, empirical-inductive method, hypothetico-deductive method, criticism, interview, case study, chaos theory, organized complexity, three-body problem*.

scientific paper (tieteellinen julkaisu) an *original* or *review paper* printed and made available to the public, especially to other *scientists*, see *journal paper, conference paper*.

scientific realism (tieteellinen realismi) *realism*.

scientific revolution (tieteellinen vallankumous) a period in *science* when the old *paradigm* is in a crisis and will be replaced by a new one [Honderich05], see *normal science*.

scientific society (tieteellinen seura) a nonprofit scientific *organization*, having a certain *code of ethics*, publishing *scientific books, journals, and conference proceedings*, and supporting the organizers of *scientific conferences*, see *section, chapter, publisher, commercial publisher, academy*.

scientist (tiedemies) an expert in *science*, see *engineer, researcher*.

scope (rajaus, alue, kattavuus) *area*, extent or range of view [Random House99], defined in the *introduction* of a *publication*.

s-curve (s-käyrä) see *Verhulst law*.

scrambler (muokkain) see *synchronization*.

screening (seulonta) "the process of evaluating and selecting new *ideas* or *concepts* to put into the *project portfolio*" [Belliveau02].

search engine (hakukone) see *browser*.

secondary standard (sekundaarinormaali) a *measurement standard* whose value is defined by comparing with the *primary standard*.

section (kohta, kappale; osasto) a distinct part of a *paper* or a subdivision of a *chapter*, consists of *subsections* and *paragraphs*.

section sign (pykälämerkki) mark §.

selection committee (valintakomitea) a part of the *technical programme committee* in a *conference* that selects the papers to be accepted to the *conference proceedings* on the basis of *referee reports*, which are asked by *review organizers*.

selectivity (selektiivisyys) "ability to separate closely spaced signals" [Ziemer02], see *sensitivity*.

self-deception (itsepetos) see *ethics*.

self-maintaining structure (itseään ylläpitävä rakenne) simple *biological system*, basic element of *life*, for example cell [Arbno97], [Checkland99], see *self-organizing system*.

self-organization (itseorganisoituminen) mathematical models are used to understand natural systems that spontaneously organize themselves to produce definite structures [Wolfram02], see *artificial life, systems theory*.

self-organizing system (itseorganisoituva järjestelmä) genetic system, a lower growing and reproducing organism, a *biological system* where *adaptation* and structural *changes* are important, using positive *feedback* and *learning*, for example plant [Arbno97], [Checkland99], see *self-maintaining structure*.

self-plagiarism (oman työn plagiointi) *plagiarism* where the *author* uses his own earlier text without a *reference* as if it were new. Manuscripts that contain crossover of more than 25% with another journal manuscript by the same authors may incur sanctions [IEEE-SP]. See *code of ethics*.

self-regulated machine (itsesäätyvä kone) self-regulating system, control system, a *machine* which has autonomous control over its own *behaviour* [Checkland99].

self-regulating system (itsesäätyvä järjestelmä) *self-regulated machine*.

seminal paper (uraauurtava julkaisu) *landmark paper*.

semantic information (semanttinen informaatio) *information* on the *semantic level*, not to be mixed with *syntactic information*.

semantic information theory (semanttinen informaatioteoria) opposite to *statistical information theory* [Checkland99], see *semantics, information theory, systems theory*.

semantic level (semanttinen taso) the second conceptual level related to *information* above the *syntactic level* and below the *pragmatic level*, refers to the meaning of *signs* [Skyttner06], see *semantics*.

semantics (semantiikka, merkitysoppi) study of the relation of *signs* to the *things* they represent [Honderich05], study of the interpretation of signs, in particular sentences or words in a language, a branch of *semiotics*, see *presentation layer, frame problem, context*.

semicolon (puolipiste) mark ;.

seminar (seminaari) see *workshop*.

semiotics (semiotiikka) the general study of *signs*, divided into 1) *syntactics*, 2) *semantics*, and 3) *pragmatics* [Honderich05].

semiotic triangle (semioottinen kolmio) inc. 1) *object*, 2) *term*, and 3) *concept* [Niiniluoto02].

senior assistant (yliassistentti) roughly corresponds to an *assistant professor*.

senior member (kokenut jäsen) a member of a *scientific society* ranking above a member and below a *fellow*, given by the society for significant performance in *research* in a specific field for at least five years.

senior research scientist (erikoistutkija) a *researcher* ranking above a *research scientist* and below a *leading scientist*.

sensitivity (herkkyys) 1) the change in the *response* of an *instrument* divided by the change in the corresponding *stimulus* [SFS-käsikirja 19]; 2) "ability to detect weak signals" [Ziemer02], often expressed in watts. See *discrimination, selectivity, tolerance, robustness*.

sensitivity analysis (herkkyysanalyysi)

sensing element (tuntoelin) the part of a *sensor* on which the *quantity* affects.

sensor (sensori, anturi) a mechanical device sensitive to light, temperature, radiation level, or the like, that transmits a *signal* to a measuring or control instrument [Random House99], see *actuator, instrument, sensing element, measuring transducer*.

sentence (lause) a part of a *complex sentence*.

sequence (sekvenssi, sarja, jono)

sequential (sekventiaalinen, peräkkäinen, asteittainen) characterized by regular sequence of *parts* [Random House99].

sequential order (peräkkäisjärjestys) temporal order where *time* is included to describe successive changes. A sequential order can be *reduced* to a *timeless order*, but a *generative order* cannot due to inherent dynamism [Bohm92]. See *waterfall model, reduction*.

sequential machine (sekvenssikone, tilakone) *state machine*.

sequential law (sekventiaalinen laki) a *scientific law* that shows the *relation* between a *sequence of events*, including 1) *causal laws* and 2) *developmental laws* [Nagel79], see *theory*.

serendipity (onnekas sattuma) see *creativity*.

serial (sarjamuotoinen, sarja-) opposite to *parallel*.

serial hierarchical system (sarjamuotoinen hierarkkinen järjestelmä) a *system* which has a top and bottom [Pagels88], opposite to *parallel network system*, see *hierarchy, reduction*.

serial processing (sarjakäsittely)

server (palvelin) see *client*.

service (palvelu) an act of helpful activity [Random House99], see *application layer, quality of service, applied research, development, product*.

session (sessio, istunto) a single continuous meeting within a *conference*, including *plenary, poster, and regular sessions*.

session layer (yhteysjaksokerros) the *layer* above the *transport layer* and below the *presentation layer* in the *OSI model*. The layer provides the mechanism for controlling the dialogue between applications in end systems. A session might be used to allow a *user* to log into a remote timesharing system or to transfer a file between two machines [Tanenbaum96], [Stallings91].

set (joukko) a collection of *objects* or *elements* classed together, in contrast to a *system*, see *class*.

set theory (joukko-oppi) a branch of *formal sciences*, identical to *mathematics* [Pagels88].

setting (asetus) see *parameter*.

share (jakaa)

shear (leikkaus, viistoutus) shearing, a *transformation* in which all points along a given line remain fixed while other points are shifted parallel to the line by a distance proportional to their perpendicular distance from the line [Weisstein05], see *function, translation, twist*.

shearing strain (leikkausmuodonmuutos, liukuma) shear strain, see *shear*.

shrink (kutistaminen) *geometric contraction*, see *function, expansion, stretch*.

sign (merkki, symboli, tunnus) "a conventional *mark, figure, or symbol* used as an abbreviation for the *word* or words it represents" [Random House99], see *signal, semiotics, symbol, equation, mark*.

signal (signaali) "a *function of time* that is varied in such a way as to convey *information*" [Random House99], see *sign, bandwidth, noise*.

signal-to-noise ratio (signaali-kohinasuhde) 1) the ratio of *signal power* and *noise power*, 2) The ratio of symbol *energy* and noise power spectral density. See *dynamic range*.

significance (merkittävyys) importance, *meaning* [Random House99], includes *generality* and *fruitfulness*, see *original paper, impact*.

significance level (merkitsevyytaso) *level of significance*.

significant digit (merkitsevä numero) see *precision*.

simulatable (simuloitavissa oleva) unsimulatable *systems* cannot be simulated and the system itself must be used, see *simulation*.

simulation (simulointi) the imitation or representation of the *behaviour* or characteristics of a *system* through the use of a computer [Random House99], usually using a *mathematical model*, see *measurement, deduction, systems engineering, virtual reality*.

simulator (simulaattori) "a program that models and represents an activity or environment on a computer system" [Kurzweil99].

single spacing (pienin riviväli) see *double spacing*.

single quotation mark (puolilainausmerkki) marks '...', see *quotation mark, apostrophe*.

[Sitra](#) (Sitra, Suomen itsenäisyyden juhlarahasto) Finnish Innovation Fund, an independent public fund which under the supervision of the Finnish Parliament promotes the welfare of Finnish society, see *Academy of Finland, Tekes, funding agency*.

situated learning (tilannesidonnainen oppiminen) a *paradigm of learning* based on situationalist theories, learning is becoming able to participate communities of practice.

- situationalist theory (tilannesidonnaisen oppimisen teoria) see *situated learning*.
- skewness (vinous) see *statistical analysis*.
- skill (taito, ammattitaito) see *ability, expertise*.
- slash (vinoviiva, jakoviiva, kauttaviiva) solidus, crossbar, diagonal line, mark /, separating alternative words or referring to *division*, see *backslash*.
- slant (vinoviiva) *slash*, virgule [Webster's Third New93]
- slide (kalvo) transparency, viewgraph, see *slide presentation*.
- slide presentation (kalvoesitys) see *presentation, handout*.
- slide show (kalvoesitys) *slide presentation*.
- smart (älykäs) see *artificial intelligence*.
- snowball sampling (lumipallo-otanta) a *nonprobability sampling* method.
- social (sosiaalinen)
- social science (sosiaalitiede, yhteiskuntatiede) a branch of *science*, inc. 1) anthropology, 2) sociology, 3) *economics*, and 4) *political science* [Wilson99], see *behavioural science, humanities*.
- social security (sosiaaliturva)
- social security costs (sosiaalikulut) *indirect costs* for social security, added to the *labor costs*, see *prime cost*.
- social system (sosiaalinen järjestelmä, yhteiskuntajärjestelmä) *value-laden system*.
- society (yhteiskunta, yhteisö, yhdistys, seura) see *scientific society*.
- socio-cultural system (sosiokulttuurinen järjestelmä) *value-laden system* [Abrnor97].
- soft decision (pehmeä päätös) opposite to *hard decision*.
- software (ohjelmisto, ohjelma) see *hardware, middleware*.
- solidus (vinoviiva, jakoviiva) *slash*.
- soliton (solitoni) a solution of a nonlinear equation. A solitary wave that retains its shape as it moves along in the *state space* [Pagels88]. Soliton equations lead to a property similar to *linearity* [Wolfram02]. See *nonlinear dynamics*.
- solution (ratkaisu) an answer to a *problem*, see *goal, hypothesis, product specification*.
- sound (ääni, äänne) see *letter*.
- source coding (lähdekoodaus) *coding* for reducing *redundancy* in the message *symbols* for efficient use of the channel *capacity*, a part of *application layer*, see *information theory, channel coding*.
- space (avaruus, tila, paikka, välilyönti) the unlimited three-dimensional realm or expanse in which all *material objects* are and all *events* occur; an interval or blank area in text [Random House99], see *complex sentence*
- spacing (riviväli; harvennus)
- spacing out (harvennus) see *italicization, bold-facing, underlining*.
- span (nimellisarvojen leveys) the difference between the maximum and minimum values of the *nominal range*.
- speaker (puhuja) see *presenter, keynote speaker, talk*.
- special issue (erikoisnumero) an issue of a *journal* devoted to a special topic, see *deadline*.
- specialist (spesialisti, asiantuntija) *expert*, in contrast to *generalist*.
- specification (spesifikaatio, erittely, määrittely) see *product specification*.
- specimen (näyte, näytekappale) see *sample*.

speculative knowledge (spekulatiivinen tieto) *knowledge* based on unsubstantiated belief or authoritarian ontological or moral statements [Bock02], including *opinion*, *dogma*.

spelling (oikeinkirjoitus) see *word*, *copy editor*.

spiral model (spiraalimalli) a *timing plan* of a *project* where the whole *process* is repeated and each time the result improves [Leppälä03], [Calvez93], see *waterfall model*, *iterative model*, *generative order*.

spiral similarity (spiraalinen similariteettikuvaus) combination of *central dilation* and *rotation* about the same center, see *function*, *axis*.

sponsor (sponsori, tukija, rahoittaja) *funding* source of a *project*.

spreadsheet (taulukkolaskenta, laskentataulukko)

square bracket (hakasulku) marks [...], see *bracket*, *angle bracket*, *brace*, *parenthesis*.

stability (stabiilius, stabiilisuus) resistance to sudden change or deterioration [Random House99], the ability of an *instrument* to preserve its properties with time. A system is stable with respect to certain of its *parameters* if these parameters tend to remain within defined *limits* [Hall62]. See *system*, *feedback*, *drift*, *equilibrium*, *steady state*.

standard (standardi, normi, vakiomitta) *norm*, officially approved document for defining rules, instructions or *definitions* for *properties* of industrial *products*, *manufacturing* and testing methods, scientific *quantities* and *units*, *terminology*, etc. A standard is published as a *technical report*. See *literature*, *alliance*, *forum*, *measurement standard*, *working standard*.

standard deviation (keskihajonta) positive square root of *variance*, see *precision*, *coverage interval*, *standard uncertainty*, *mean-square error*, *root mean square value*, *variation coefficient*.

standard uncertainty (normaaliepävarmuus) *uncertainty* represented with an estimated *standard deviation*.

state (tila) property of a *state machine* which relates the inputs to the output in such a way that knowledge of the inputs after and including a certain time and the state at the same time completely determines the output for all later time instants. The state characterizes the memory of the *machine*, and the machine may include *feedback* [Fletcher80]. See *state space*.

state machine (tilakone) a sequential *machine* whose output is dependent on a sequence of inputs, in contrast with a combinational system without any memory [Fletcher80], see *state*, *state space*, *system*.

state of the art (tieteen, tekniikan ja taiteen nykyinen taso) current *technology* [IEEE Computer Society], "the latest and the most sophisticated or advanced stage of technology, *art*, or *science*" [Random House99].

state space (tila-avaruus) phase space, an abstract space where the different *states* of the *state machine* are located [Pagels88].

state variable (tilamuuttuja)

static (staattinen, muuttumaton; muistiton) showing little or no *change* [Random House99]; memoryless (*system*); opposite to *dynamic*, see *mechanic system*.

statical law (staattinen laki) a form of *functional laws* which show an interdependence between *magnitudes* of *quantities* so that a variation in any of them is concurrent with variations in the others, not a *causal law*, for example Boyle's law [Nagel79], see *dynamical law*.

static measurement (staattinen mittaus) *measurement* where the *quantity* does not change, see *dynamic measurement*.

statics (statiikka, tasapaino-oppi) see *dynamics*, *physics*.

static structure (staattinen rakenne) a *structure* that does not *change* with *time*, opposite to *dynamic structure* [Bohm92], see *order*, *timeless order*, *taxonomy*.

statistic (tunnusluku) "a numerical datum computed from a *sample*" [Random House99], for example *average*, *standard deviation*, see *estimation theory*, *sufficient statistic*.

statistical (statistinen, tilastollinen) *stochastic*, see *inductive-statistical (I-S) model*.

statistical analysis (tilastollinen analyysi) analysis used for *data reduction* based on *statistical methods*, 1) analysis of *distributions*, including *mean*, *mode*, *variance*, *skewness*, 2) statistical comparison of groups, including *t-test*, *F-test*, *chi-square test*, *analysis of variance (ANOVA)*, and 3) dependency between *variables*, including *correlation* and *regression analysis*, see also *factor analysis*.

statistical conclusion validity (tilastollisen johtopäätöksen valideetti) *conclusion validity*.

statistical complexity (tilastollinen kompleksisuus) the size of the memory needed to predict the next state of a system [Baeyer05], see *complexity*.

statistical explanation (tilastollinen selitys) probabilistic explanation, a form of *scientific explanation* based on a *statistical model*, not *deductive*, not *deterministic*, not *causal* [Nagel79], see *inductive-statistical (I-S) model*.

statistical inference (tilastollinen päättely) see *inductive-statistical (I-S) model*.

statistical information theory (tilastollinen informaatioteoria) Shannon's information theory, opposite to *semantic information theory* [Checkland99], see *information theory*.

statistical law (tilastollinen laki) probabilistic law, a form of *scientific laws* based on *statistical explanation*, not a *causal law* [Nagel79], opposite to *deterministic law*.

statistical machine (tilastollinen kone) a *machine* the fine detail of whose *behaviour* is not *deterministic*, for example in quantum mechanics [Checkland99].

statistical mechanics (tilastollinen mekaniikka) a branch of *mechanics*, approaches systems from a microscopic, or atomic-scale, point of view, see *thermodynamics*, *systems theory*.

statistical model (tilastollinen malli) probabilistic model, a *model* that includes a statistical part, see *probability*, *chance*, *deterministic model*, *regression model*.

statistics (tilastotiede) *mathematical statistics*.

status report (tilanneraportti) progress report, a *report* defining the administrative and technical status of a *project*.

steady state (jatkuva tila) see *equilibrium*, *stability*, *transient*.

stimulus (heräte) see *input*, *response*.

stipulative definition (sopimuksenvarainen määritelmä) definition by agreement [Honderich05], see *definition*.

stipulative knowledge (sopimuksenvarainen tieto) *knowlegde* that has been agreed [Bock02], including *fact*, *convention*, and *definition*.

stochastic (stokastinen, satunnainen) *statistical*, probabilistic, *random*, see *chance*.

stochastic sampling (satunnaisotanta) *Monte Carlo method*, random sampling.

strategy (strategia) the definition of the main goals and operating principles in order to satisfy the *mission* of an *organization* [Kamensky00], see *technology strategy*, *competitive strategy*, *business idea*.

stratification (ositus)

stratified sampling (ositettu otanta) a *probability sampling* method, the *population* is divided into subpopulations for sampling.

stratum, pl. strata (osite), a homogeneous sub-population, see *cluster*, *population*.

stretch (venytys) expansion in one or two dimensions [Weisstein05], see *function*, *shrink*.

stroke (viiva, poikkiviiva)

strong emergence (vahva emergenssi) *emergence* that cannot even in principle be *explained* from *parts* and their *relations*, opposite to *weak emergence*.

strong inference (vahva päättely) *inference* based on *competing hypotheses*, an approximation of *abduction* [Wilson99], [Platt64], see *scientific method*, *abduction*.

strong programme (vahva ohjelma) Edinburgh school, a *constructivist* method of *historiography* that proposes that both “true” and “false” scientific theories should be treated the same way, i.e., symmetrically.

structural model (rakenteellinen malli) *functional model*.

structure (rakenne) “the manner in which the *elements* of anything are organized or interrelated” [Random House99]; *order*, arrangement, connection, and *organization* of simpler elements or *parts*, see *static structure*, *dynamic structure*, *process*, *form*, *architecture*, *system*, *morphology*.

student member (opiskelijajäsen) a *university* student who is a member of a *scientific society*, see *member*, *graduate student member*

study (tutkimus) *survey*, *research*.

study area (tutkimusalue) *area under study*.

style (tyyli) see *copy editor*, *stylebook*.

stylebook (tyyliopas) style guide, style manual, “book containing the rules of use in *punctuation*, *typography*, and the like” [Random House99].

subject (subjekti, aihe, tutkimuskohde) topic; that which thinks, feels, perceives, intends, etc. as contrasted with the *objects* of thought, feeling, etc., see *actor*.

subjective (subjektiivinen, puolueellinen) biased, opposite to *objective*.

submit (lähettää hyväksyttäväksi, jättää (hakemus), esittää) send to the *editor in chief* or *selection committee* for a *peer review* process, see *withdraw*.

submission (hyväksyttäväksi lähettäminen) see *submit*.

subordinate clause (sivulause) a secondary *sentence* that is a part of a *complex sentence*.

subtraction (vähennyslasku, vähentäminen, vähennys) see *addition*, *inversion* –*x*.

subscribe (tilata) see *newspaper*, *periodical*.

subscript (alaindeksi) see *equation*, *superscript*, *index*.

subsection (alakohta) see *section*.

substance (substanssi, aine, materiaali) “that of which a *thing* consists” [Random House99], physical *matter* or *material*, see *attribute*.

subsystem (alijärjestelmä) a *system* contained within a larger system [Checkland99], *nested hierarchy*.

summary (yhteenvedo) “a comprehensive recapitulation of *things* previously stated” [Random House99], see *abstract*.

sufficient (riittävä, tyhjentävä) see *necessary*, *estimator*.

sufficient statistic (tyhjentävä tunnusluku) *statistic* that includes all available *information* for making a decision or *estimate*, see *sufficient*.

supercomputer (supertietokone) the fastest and most powerful computer available at any given time [Kurzweil99].

superposition (superpositio) having the same effect on a sum as on each part of a sum, see *linear*, *interfere*.

superscript (yläindeksi) see *equation*, *subscript*, *index*.

supervisor (valvoja) thesis supervisor, an official responsible *professor* or *docent* who watches a student or checks what he or she has done to make sure that work is done properly, see *adviser*.

supply (tarjonta) “the amount of commodity or *products* available for purchase at a given *price*” [Random House99], see *demand*, *industry*, *law of supply and demand*.

suspension points (ellipsi) *ellipsis* [Webster’s Third New93].

surjection (surjektio) *onto*, a *function* that is *onto* but not *one-to-one*, for any *object* in the *range* of the function, there is a corresponding object in the *domain* of the function [Mathworld], a surjection has a *preinverse*, see *bijection*, *injection*.

surplus value (lisäarvo) added *value*, additional value, see *value chain*.

survey (tutkimus, kysely, katsaus) *study*, *questionnaire study*; *review paper*.

swung dash (aaltoviiva) *tilde*, mark ~.

symbol (symboli) a manufactured *sign*, a *mark* used in place of something that is not present, or to identify it as a topic [Honderich05], see *word*, *variable*, *value*, *equation*.

symbolic model (symbolimalli) mathematical or logical *model*.

symbolic system (symbolijärjestelmä) a *system* of *symbols*.

symmetry (symmetria) see *duality*, *analogy*.

symposium (symposiumi) a small *conference* organized for the discussion of some particular subject, see *workshop*.

synchronization (synkronointi) causing to agree in *time* or rate of speed, see *physical layer*, *scrambler*.

synergy (synergia) the interaction of *elements* that when combined produce a total effect that is greater or less than the sum of individual elements, contributions, etc. [Random House99], [Arnor97], see *emergence*, *systems approach*.

synonym (synonyymi) identical in meaning, opposite to *antonym*, see *thesaurus*.

synonymous (synonyyminen, samanmerkityksinen) see *synonym*.

syntax (syntaksi, muotosäännöt) the relation of *signs* to other signs [Honderich05], see *grammar*, *presentation layer*.

syntactic information (syntaktinen informaatio) *information* on the *syntactic level*, not to be mixed with *semantic information*.

syntactic level (syntaktinen taso) the lowest conceptual level related to *information* below the *pragmatic level*, refers to relations of *signs* [Skyttner06], see *complexity*.

syntactics (syntaktiikka) the study of *syntax*, a branch of *semiotics*, see *grammar*.

synthesis (synteesi) opposite to *analysis*, the process of making a *whole* by putting together its separate component *parts* [Webster's News World01], see *systems engineering*, *induction*, *theory construction*, *dialectic methodology*.

synthesizer (syntetisaattori) a device that computes signals in real time [Kurzweil99].

*system (systeemi, järjestelmä, kokonaisuus) a set of parts with relationships between the parts and between their properties [Hall62, p. 60], a set or arrangement of *things* so related or connected as to form a unity or organic *whole* in contrast with a *set*, a system is characterized in terms of *hierarchical structure*, *emergent properties*, *communication*, and *control* [Checkland99]. Systems are divided into 1) *mechanical*, 2) *biological*, 3) *self-organizing*, and 4) *value-laden systems* [Arbnor97]. In more detail, systems can also be divided hierarchically according to *complexity* into 1) *static structures*, 2) *dynamic systems* (mechanical *deterministic machines*, for example clocks), 3) *self-regulating systems* (*control systems*), 4) biological *self-maintaining structures*, 5) self-organizing *genetic systems* (plants), 6) animals, 7) human beings, 8) *social systems*, and 9) *transcendental systems* [Checkland99], [Arbnor97]. See *machine*, *systems engineering*, *environment*, *boundary*, *interface*, *input*, *output*, *open system*, *closed system*, *energy*, *material*, *information*, *waste*, *bootstrapping*, *sensor*, *actuator*, *state*, *function*, *architecture*, *block diagram*, *modular*, *parallel*, *concurrent*, *circuit*, *component*, *quality of service*, *measurement*, *performance*, *complexity*, *cost*, *price*, *linear*, *nonlinear*, *impulse response*, *transfer function*, *dynamic range*, *stability*, *bandwidth*, *channel*, *distortion*, *noise*, *simulatable*, *serial hierarchical system*, *parallel network system*, *adaptability*, *flexibility*, *reciprocity*, *plant*.

systematic (systemaattinen, järjestelmällinen) see *system*, *order*.

systematic error (systemaattinen virhe) the difference between the average of the measurement results and the *true value* of the *quantity*, see *trueness*, *error*, *random error*.

systematics (systematiikka) see *taxonomy*.

systematic sampling (systemaattinen otanta) a *probability sampling* method where the starting point is selected randomly.

system model (systeemimalli, järjestelmämalli) a part of a *document* within the *materials and methods section*, see *model, system*.

systems analysis (systeemianalyysi) "an *engineering* technique that breaks down complex technical, social, etc. *problems* into basic elements whose *interrelations* are evaluated and programmed, with the aid of *mathematics*, into a complete and integrated *system*" [Webster's New World02], see *analysis, synthesis, reduction, systems engineering, scientific method*.

systems approach (systeemijattelu, systeeminen lähestymistapa) holistic approach, an approach based on *holism* [Checkland99], a *methodological approach* where unlike in the *analytical approach* a *whole* differs from the sum of its *parts*, the *environment* has an important role, and *knowledge* is independent of *observer*, interested in *producer-product* relations and *final causes* [Arbno97], see *approach, explain, understand, positivism, synergy, emergence*.

systems engineering (systeemitekniikka) "a branch of *engineering* using especially *information theory, computer science, and systems analysis* to design integrated operational systems for specific complexes" [Webster's New World02], see *system, systems analysis, systems science*.

systems science (systeemitiede) applied form of *systems theory*, including *cybernetics, systems engineering, and operational research* [Bertalanffy98].

systems theory (systeemiteoria) classical systems theory is based on assumptions of linear causal relations (two-variable problems) and weak interactions between parts [Bertalanffy98], see *scientific method, general systems theory, dynamical systems theory, nonlinear dynamics, cybernetics, control theory, information theory, network information theory, semantic information theory, statistical mechanics, thermodynamics, game theory, decision theory, detection theory, estimation theory, simulation, experimental mathematics, scientific computing, set theory, artificial intelligence, artificial life, self-organization, bionics, topology, graph theory, factor analysis, queuing theory, compartment theory, evolution theory, complexity theory, chaos theory, catastrophe theory, fractal geometry, scientific computing, nanotechnology*.

table (taulukko) see *document, caption, tabular data*.

table of contents (sisällysluettelo) see *document*.

tabula rasa (tyhjä taulu) blank writing-tablet, statement that mind at birth is blank and there is nothing in the mind that was not previously in senses [Honderich05].

tabular data (taulukkoitu tieto) data in a *table*.

tacit assumption (hiljainen oletus) implied assumption.

tacit knowledge (hiljainen tieto) unconscious, implied or silent *knowledge*, existing for example in a working *prototype*, not in any *document*, opposite to articulated or *explicit* knowledge [Leppälä03].

talk (puhe) see *speaker*.

target value (tavoitearvo) *nominal value*.

task force (työryhmä) group of *experts*.

taxonomy (taksonomia, luokitus, systematiikka) "systematic *classification* of things into hierarchical groups" [Random House99], see *class, timeless order, static structure, systematics*.

teacher (opettaja) instructor.

teaching (opettaminen) instruction, see *learning, pedagogy*.

teaching portfolio (opetusportfolio) a portfolio of *teaching* experience, written by an *applicant* of a teaching position, especially at a *university*.

team (tiimi) a small group of about 6-8 researchers, see *project team, organization*.

team leader (tiimipäällikkö)

technical programme committee (tekninen ohjelmakomitea) the committee that creates the program of a *conference*, see *selection committee*.

technical report (tekninen raportti) see *patent, standard, thesis, dissertation*.

technical term (ammattisana) see *term*.

technique (tekniikka) a rule for using various *tools* to discover *knowledge* in practice. A technique is turned to a *method* by using a *methodological procedure*. Each technique can be used in more than one *methodological approach* [Arbner97].

technology (teknologia) "application of *knowledge* for practical ends using the results of *mathematics* and *natural sciences*, the sum of the ways in which the society provides itself with the *products* and *services*" [Random House99], "an evolving process of tool creation to shape and control the environment" [Kurzweil99]. Technologies include example agriculture, medicine, and *engineering*, see *s-curve, nanotechnology*.

technology strategy (teknologiastrategia) the focus of *research* and *development* and the ways to do them well [Kamensky00], see *strategy*

technology transfer (teknologiansiirto) "the process of converting *scientific* findings from research laboratories into useful *products*" [Belliveau02]

technology vision (teknologiavisio) assumption of technologies needed in the future [Kamensky00], see *vision*

[Tekes](#) (Tekes, Teknologian ja innovaatioiden kehittämiskeskus) Finnish Funding Agency for Technology and Innovation, operates within the Ministry of Employment and the Economy, see *Academy of Finland, Sitra, funding agency*.

telecommunications (tietoliikenne) "*science* of transmitting *information*, as words, sounds, or images, over great distances, in the form of electromagnetic *signals*" [Random House99], see *information theory, estimation theory, protocol, channel, transmission, ansible, teleportation, telepresence, virtual reality*.

teleconference (telekonferenssi, etänevottelu) a meeting at a distance by using a telecommunication network, for example telephone network or Internet.

teleological cause (teleologinen syy) purpose, see *final cause, finality*.

teleological explanation (teleologinen selitys) one form of *scientific explanations* based on purposefulness, but suspected in *natural sciences*, "directed toward an end, goal, or purpose" [Barbour97].

teleology (teleologia) purposefulness, see *finality*.

teleportation (teleportaatio) (in *science fiction*) "ability to move people or objects from one place to another by matter transmission, i.e., using scientific equipment to transmit items in the form of information-carrying waves, which at the destination are reconstructed into matter" [Clute95], see *telecommunications, quantum communications, telepresence, virtual reality*

telepresence (etäläsnäolo) a form of *virtual reality* [Skyttner05], presence in an existing *environment* for example as a *hologram*; no glasses are needed, but it needs a material (for example water vapor) to which the hologram is projected, see *teleportation, holodeck*.

template (pohja, malli) see *outline*.

temporal (ajallinen)

temporal order (aikajärjestys) *sequential order*.

tense (aikamuoto) tempus. Tenses include *present tense, past tense* or imperfect tense, *perfect tense* or present perfect tense, *past perfect tense* or pluperfect tense, *future tense*, and *future perfect tense*. In general the recommend tense in a scientific document is the present tense, but past tense may be needed to emphasize historical aspects in a *literature review* or in the *conclusions section* or in a *summary* when specifying actions [Higham98]. See *document*.

tenure (virassapysymisoikeus) "status granted to an employee indicating that the position is permanent" [Random House99], see *professor*.

tenure track (virkaoporaat, joissa odotetaan pysyvää virkaa) see *assistant professor, associate professor, professor*.

term (termi, oppisana) "a *word* or phrase used as the name of an *object*, especially one used in a particular type of *language*" [Random House99], see *universal, semiotic triangle, concept, primitive term, technical term, terminology, language, ambiguity*.

terminology (terminologia, termistö, erikoissanasto) see *term, jargon*.

test (testi, koe) trial, see *experiment, destructive test, nondestructive test, t-test, F-test, chi-square test*.

testability (testattavuus) suitability of a design to be efficiently tested, includes understandability, controllability, and measurability [Calvez93], see *test*.

testing (testaaminen)

textbook (oppikirja) a book used for teaching of students [Day98], see *tutorial paper*.

theorem (teoreema, väittäjä) a *proposition* that is derived *deductively* from a set of *axioms* in an *axiomatic system* [Honderich05], see *lemma, conjecture, conclusive knowledge, proof*.

theoretical (teoreettinen) opposite to *pragmatic*, see *theory*.

theoretical model (teoreettinen malli) a theoretical description of the *regularities* in reality, introducing simplifying assumptions, which are adjusted or removed in the light of model's predictive successes [Honderich05]. The model is usually a *conceptual* or *mathematical model*, opposite to *physical model*. See *model, symbolic model, presumptive knowledge*.

*theory (teoria) "a coherent group of general *propositions* used as principles of *explanation* for a class of *phenomena*" [Random House99]. Theories are either 1) *axiomatic systems* or 2) sets of *theoretical models* [Honderich05], [Rosenberg00]. The four qualities in theory are 1) *generality*, 2) *parsimony*, 3) *coherence*, and 4) *predictive power* [Wilson99]. Theories are ideally presented as *deductive* and *causal* structures [Nagel79], but some theories are *statistical* and many theories such as evolution theory are not tightly integrated deductively [Honderich05]. See *model, antirealism, realism, truth theory, scientific method, scientific explanation, scientific law, presumptive knowledge, deductive-nomological (D-N) model, inductive-statistical (I-S) model*.

theory construction (teorianmuodostus) *theory* formation, corresponds to *synthesis* [Hall62, p. 110], see *concept formation, induction, scientific method*.

theory formation (teorianmuodostus) *theory construction*.

theory of knowledge (tietoteoria) *epistemology*.

theory of science (tieteenteoria) *philosophy of science*.

thermodynamics (termodynamiikka) a branch of *physics*, approaches *statistical* systems from a macroscopic, or large-scale, point of view, "the study of heat flow and changes in energy and order in closed and open systems" [Barbour97], see *statistical mechanics, systems theory*.

thesaurus (thesaurus, synonyymisanakirja) a *dictionary* of *synonyms* and *antonyms* [Random House99].

thesis (opinnäyte; väite) a formal *technical report* "incorporating original research on a subject, especially one presented by a candidate for a degree, as a master's degree" [Random House99], see *dissertation, literature, proposal, monograph, thesis–antithesis–synthesis*.

thesis advisor (opinnäytteen ohjaaja) *advisor* of a *thesis*.

thesis–antithesis–synthesis (väite–vastaväite–synteesi) phases of the *dialectic methodology* in the *actors approach*.

thesis proposal (opinnäytesuunnitelma)

thesis supervisor (opinnäytteen valvoja) *supervisor* of a *thesis*.

*thing (olio) entity, being, item whose existence is acknowledged by a system of *ontology*, often interchangeable with an *object* and stands in opposition to such *terms* as *property, relation, and event* [Honderich05], see *substance*.

thought experiment (ajatuskoe) controlled exercises of the imagination, employed to examine the *implications* of *theories* and to explore the boundaries of *concepts* [Honderich05].

three-body problem (kolmen kappaleen ongelma) a problem of three bodies in *physics*. The problem cannot be solved with the classical *scientific method*, no closed-form solution exists [Bertalanffy98], may result in chaotic solutions. See *chaos theory*, *two-body problem*.

threshold criterion (kynnyskriteeri) "the minimum acceptable *performance* targets for any *project* being proposed or considered" [Belliveau02].

throughput (läpäisykyky) "the amount of *material*, *data*, etc. put through a *process* in a given period" [Random House99], see *performance*.

tilde (tilde, aaltoviiva, "mato") mark $\tilde{}$, for example \tilde{n} , indicates nasalization; *swung dash* [Random House99], see *circumflex*.

time (aika) dimension of *change* [Honderich05], see *event*, *synchronization*.

timeless (ajaton, ikuinen) see *time*.

timeless order (ajaton järjestys) an *order* that does not change with *time*, in contrast to *sequential* and *generative order* [Bohm92], see *taxonomy*, *static structure*.

timing plan (ajoituskaavio) time line, time budget [McCuen96], see *Gantt chart*, *PERT chart*, *waterfall model*, *V-model*, *spiral model*, *iterative model*, *proposal*, *milestone*.

title (otsikko, nimeke, dokumentin nimi) "the distinguishing name of a work", as a *book*, *paper* or *technical report* [Random House99], should be usually less than ten words, see *heading*, *informative*, *abstract*.

tolerance (toleranssi, sietokyky) see *precision*, *resolution*, *sensitivity*, *robust*.

tool (työkalu) 1) physical or conceptual means, for example *instrument*, *computer*; 2) mathematical *concepts*, whose use is defined by a *technique* [Arbno97], see *method*, *approach*.

top-down (analyttinen, jäsentävä, osittava, ylhäältä alaspäin etenevä) downwards, "organized or proceeding from the larger structure to smaller, more detailed units" [Random House99], opposite to *bottom-up*, see *analysis*, *refinement*, *ontological reduction*, *deduction*, *downwards causality*.

topic (aihe) *subject of research*.

topic sentence (johtolause) opening sentence, a *complex sentence* introducing a *paragraph*.

topology (topologia) 1) a part of *geometry* where continuous *transformations* with one-to-one correspondence are allowed, for example bending, *stretching*, or *twisting*, but excluding tearing, a special case of *affine geometry* [Medawar84]; 2) topography of an entity, a schema of a structural entity reflecting a division into distinct areas having a specific relation to one another, see *graph*, *functional model*.

torsion (torsio, kiertyminen, vääntyminen) *twist operation*.

total uncertainty (kokonaisepävarmuus)

total quality management (laatujohtaminen) TQM, "a business improvement philosophy that comprehensively and continuously involves all of an *organization's functions* in improvement activities" [Belliveau02].

traceability (jäljitettävyys) see *calibration*.

track (reitti, väylä) a sequence of *sessions* in a *conference*.

tracking (seuranta, jäljitys) see *acquisition*.

track record (ansioluettelo) *curriculum vitae*.

tractable problem (matemaattisesti hallittavissa oleva ongelma) a problem is mathematically tractable if a *polynomial-time algorithm* exists to solve the problem [Dewdney04], see *intractable problem*.

trade book (yleistajuinen kirja) scientific trade book, a *book* about *science* written for general public, sold primarily by book trade [Day98].

trademark (tavaramerkki, tuotemerkki) brand, mark TM, "a word, name, symbol, or device which is used in trade with goods to indicate the source of the goods and to distinguish them from goods of others" [US-PTM]. A trademark cannot be used to prevent others from making the same goods or from

selling the same goods or services under a clearly different mark. See *registered mark, intellectual property, patent, copyright*.

trade-off (vaihtokauppa, kompromissi) exchange of one *thing* for another of more or less equal *value*, especially to effect a compromise [Random House99].

trade off (vaihtaa)

tradition (traditio, perinne)

transaction (transaktio, toimitus) transference of *matter* or *energy* [Skyttner05], see *communication*.

transcendental (transkendenttinen, yliluonnollinen) supernatural, see *naturalism*.

transfer delay (siirtoviive) *delay* between the transmission of the first bit of a packet and the reception of the last bit of the packet, includes *latency* and *transmission delay*.

transfer function (siirtofunktio) the Fourier transform of the *impulse response* of a *linear* system.

transform (muuntaa) to change in *quantity*, see *convert*

transformation (transformaatio, muunnos) see *function*.

translation (siirto, siirros) a *transformation* consisting of a constant offset with no *rotation* [Weisstein05], see *function, twist, glide*.

transmission (siirto) see *telecommunications, channel*.

transmission delay (lähety sviive) time needed for the transmission of a packet from the first bit to the last bit, see *latency, transfer delay, throughput*

transparent (läpinäkyvä, avoin, peittelemätön, julkinen) all *information* is visible to all participants [Leppälä93], see *publicity*.

transparency (kalvo; läpinäkyvyys, avoimuus, julkaisuus; kuormittamattomuus) viewgraph, *slide*; openness; the property of an *instrument* not to affect the *measurement quantity*.

transport (kuljetus)

transport layer (kuljetuskerros) the layer above the *network layer* and below the *session layer* in the *OSI model*, the layer ensures that data units are delivered error-free, in sequence, with no losses or duplications [Tanenbaum96], [Stallings91], see *reliability*.

treasurer (rahastonhoitaja) see *conference*.

treatment (käsittely) one particular value of an independent *variable* in an *experiment* where the independent variable or *factor* is changed and other independent variables are controlled at a fixed *level* during the experiment [Wohlin99], see *conclusion validity, model, predictor variable, response variable*.

trend (trendi, kehityssuunta) see *anomaly, law, developmental law, history*.

trial (koe) *test*.

trial and error (yritys ja erehdys) *iterative improvement*, an *iterative problem solving* method based on random tests, see *heuristic, empirical, experimental*.

trigonometry (trigonometria) a branch of *mathematics*.

triple ladder (kolmoisportaikko) *triple hierarchy*, see *double ladder*.

triple hierarchy (kolmijakoinen hierarkia) triple ladder, a *hierarchy* in a *research organization* providing three different advancement opportunities, inc. 1) management hierarchy, 2) professional hierarchy, and 3) a third hierarchy occupied by professionals who have key administrative jobs and well as regular professional duties [Jain97], see *dual hierarchy, matrix organization*.

TRIZ theory inventive problem solving (in Russian) [Belliveau02].

true (tosi) opposite to *false*, see *truth theory*.

trueness (todenmukaisuus) "the closeness of agreement between the average value obtained from a large series of *measurement* results and the accepted *reference value*" [amc03], equivalent to absence

of *bias*, inversely related to *systematic errors* only, cannot be expressed as a numerical value [ISO Guide 99:2004], see *precision, accuracy, uncertainty, coverage interval, coverage probability, calibration, instrument, certification*.

true value (suureen tosiarvo) the *quantity value* that could be obtained with perfect *measurement*, see *reference value, conventional true value, relative error*.

truth (totuus) see *verification, truth theory, deduction, induction, paradox, postmodern, relativism*.

truthfulness (totuudenmukaisuus) see *correctness, plausibility, truth theory*.

truth theory (totuusteoria) truth theories include 1) *consensus*, 2) *pragmatism*, 3) *coherence*, and 4) *correspondence* [Honderich05].

t-test (t-testi) a statistical test that compares the means of two groups, see *F-test, statistical analysis*.

turbulence (turbulenssi, pyörre, pyörreliike) see *chaos*.

Turing machine (Turingin kone) a simple abstract model of a computing machine [Kurzweil99], see *computer*.

Turing test (Turingin testi) a procedure for determining whether or not a computer has achieved human-level intelligence [Kurzweil99], see *artificial intelligence*.

turnover tax (liikevaihtovero) see *prime cost*.

tutor (tutor, opinto-ohjaaja) *mentor, advisor*.

tutoring (tutorointi, opinto-ohjaus)

tutorial paper (tutoriaali, opetuskäyttöön tehty katsaus) a *review paper* written for students [Smith90], see *textbook, survey*.

twirl (skaalaava kierto) *rotation and scaling* [Weisstein05].

twist (kiertymä, vääntymä) twist of a ribbon measures how much it twists around its axis [Weisstein05].

twist map (kiertyminen, vääntyminen) *shear* around an *axis*, torsion [Weisstein05], see *function, rotation, warping*.

two-body problem (kahden kappaleen ongelma) a problem of two bodies in *physics*, a closed-form solution exists [Bertalanffy98], see *three-body problem*.

type I error (tyypin I virhe) false positive, *false alarm, null hypothesis* is rejected when it is true [Skolnik01], see *level of significance*.

type II error (tyypin II virhe) false negative, *missed detection, null hypothesis* is accepted when it is false [Skolnik01].

typographical error (typografinen virhe)

typography (typografia, painoasu) see *document*.

ubiquitous computing (sulautettu tietotekniikka) pervasive computing, see *ambient intelligence*.

umlaut (vokaalinmukaus) the mark "̈" placed over a vowel to indicate a change in pronunciation for example in German and Finnish, for example ä and ö, see *dieresis*.

unbiased (biasoimaton, harhaton) without a *bias*.

uncertainty (epävarmuus) measurement uncertainty, uncertainty of measurement, parameter that characterizes the dispersion of the quantity values that are being attributed to a measurement, based on the information used, includes systematic and random errors [ISO Guide 99:2004]. Uncertainty is the most appropriate means of expressing the *accuracy* [amc03]. It is expressed for example with *standard uncertainty, combined standard uncertainty, expanded uncertainty, or coverage interval and coverage probability*. Uncertainty is usually expressed after the systematic errors are removed, see *bias, standard deviation, mathematical statistics*.

uncertainty of measurement (mittausepävarmuus) *uncertainty* [ISO Guide 99:2004].

uncorrected result (korjaamaton mittaustulos) see *corrected result, raw error*.

uncorrelatedness (korreloimattomuus) uncorrelatedness is weaker than *independence*, see *correlation*.

underdetermination (alideterminaatio) the view that no one *theory's truth* can be determined by *experimental data* [Rosenberg00], see *induction*, *falsification*.

undergraduate (akateemista välitutkintoa edeltävä) studies before the *bachelor of science degree*.

underlining (alleiviivaus) see *italicization*, *bold-facing*, *spacing out*.

understand (ymmärtää)

understanding (ymmärrys) answer to the question "why", complementary to *explanation*, an aim in the *actors approach* and partially in the *systems approach* [Arbno97], see *meaning*, *description*, *hermeneutics*.

unit (yksikkö, mittayksikkö) *measurement unit*, unit of measurement, scalar *quantity* with which other quantities of the same kind are compared in order to express their *magnitudes* [ISO Guide 99:2004], see *measure*, *quantity*.

unit of measurement (mittayksikkö) *unit* [ISO Guide 99:2004].

unity (yhtenäisyys) see *consilience*.

unity of science (tieteiden yhtenäisyys) foundationalism, arrange *science hierarchically*, with *theories* at the highest levels dependent on and to be explained by those below. All sciences are claimed to be reducible to *physics*. Unity of science is opposite to *diversity of science* [Honderich05]. According to one interpretation the sciences from bottom up include *physics*, *chemistry*, *biology*, *psychology*, *sociology*, *economics*, and *history* [Checkland99]. See *interdisciplinary reduction*, *reduction*.

universal (universaalinen, yleispätevä) true for everyone and everything [Pagels88].

universal (universaali) a general *term* or *concept* [Random House99], see *nominalism*.

university (yliopisto, korkeakoulu) see *school*, *research institute*, *college*, *professor*, *bachelor of science*, *master of science*, *doctor of philosophy*.

university of art and design (taideteollinen korkeakoulu) see *school of economics*, *university of technology*.

university of technology (teknillinen korkeakoulu, teknillinen yliopisto) see *school of economics*, *university of art and design*.

unorganized complexity (järjestäytymätön kompleksisuus) chaotic complexity, opposite to *organized complexity* [Checkland99], see *statistics*.

unsolvable problem (ongelma, joka on mahdoton ratkaista) a well-defined *problem* with a unique answer that can be shown to exist, but that can never be computed by any machine [Kurzweil99], a form of *intractable problems* [Dewdney04], see *Church-Turing thesis*.

upgrade (parannus tuotteeseen) see *product*.

upper case letter (iso kirjain, suuraakkonen, versaali) capital letter, see *letter*.

upwards causality (ylöspäin suuntautuva kausaalisuus) *bottom-up causality* from *parts* to the *whole* [Honderich05], see *downwards causality*, *forwards causality*, *reductionism*.

user (käyttäjä) *customer*, "any person who uses a *product* or *service* to solve a *problem* or obtain a *benefit*" [Belliveau02].

utilitarianism (utilitarismi, hyötyoppi) philosophy which argued that the right act was that which would cause "the greatest happiness of the greatest number"

utility (hyöty) a metric in *game theory*.

utility theory (hyötyteoria) a financial theory for making decisions under uncertainty, see *risk-reward theory*.

validation (validointi, kelpuutus, hyväksyminen, hyväksyntä) "confirmation through examination of a given item and provision of objective evidence that it fulfils the *requirements* for a stated intended

use" [ISO Guide 99:2004]. Strictly speaking validation implies *verification* of the *product requirements* with *field trials*. See *certification, V-model, reliability, user*.

validity (valideetti, kelpoisuus, oikeellisuus, pätevyys, paikkansapitävyys) validity is divided into 1) *conclusion validity*, 2) *internal validity*, 3) *construct validity*, and 4) *external validity* [Wohlin99]. See *validation*.

valley value (pohja-arvo) minimum value of a *signal*, see *peak value, peak to valley value*.

value (arvo) 1) *thing* or *quality* having intrinsic worth, a set of general principles that are not questioned, guiding all activities in an *organisation* [Kamensky00], examples include *criticism, integrity, publicity, freedom, equality*. See *axiology, norm, mission, strategy, intrinsic value, instrumental value*. 2) A point in the *range* of a *function* [Random House99], see *quantity value, quantile*.

values (arvot)

value chain (arvoketju) "the chain that indicates the relative amount of *value* added to a *product* at each step in the *manufacturing* and *delivery* process" [Belliveau02], see *surplus value, raw material, customer*.

value-laden system (arvopohjainen järjestelmä) *social system, socio-cultural system, a self-organizing system* which has a *culture* and a set of basic *values* [Arbnor97].

value of quantity (suureen arvo) *quantity value* [ISO Guide 99:2004].

value theory (arvoteoria) *axiology*.

variable (muuttuja) see *equation, symbol, parameter*.

variance (variassi) see *mean, standard deviation, root mean square, mean-square error*.

variation coefficient (variaatiokerroin) coefficient of variation, *standard deviation* divided by the *mean*, see *ratio scale*.

V-cycle (V-jakso) see *V-model*.

V-model (V-malli) a *timing plan* of a *project* where the specification and design procedure is globally *top-down* and the implementation and test phase is globally *bottom-up* [Calvez93], see *waterfall model, iterative model, verification, validation, certification, sequential order, generative order, reduction*.

vector (vektori) a *quantity* possessing both *magnitude* and direction [Random House99], see *matrix, equation*.

vendor (toimittaja, myyjä) "a person or agency that sells" [Random House99].

Verhulst law (Verhulstin laki) S curve, law of growth with limited resources [Bertalanffy98], see *Malthusian law*.

verification (verifiointi, varmennus, varmistus, varmistaminen, todentaminen, vahvistus, koestus, vakaus) 1) confirmation, justification, see *validation*; establishing the *truth* of a *hypothesis*, usually by *observation* or *experiment* [Rosenberg00]. Verification is in practice unattainable since it implies *inductive* reasoning. See *scientific method, experiment, discovery, reliability, fact*. 2) "confirmation through examination of a given item and provision of objective evidence that it fulfils specified *requirements*" [ISO Guide 99:2004], see *certification, measurement standard, calibration, adjustment*.

vertical bar (pystyviiva) vertical line, mark |, see *parallels, broken bar, horizontal bar*.

vertical line (pystyviiva) *vertical bar*.

Vienna circle (Wienin piiri) a group of people in Vienna who developed *logical empirism* [Honderich05].

viewgraph (kalvo) transparency, *slide*.

virgule (vinoviiva) *slash, slant* [Webster's Third New93].

virtual library (virtuaalikirjasto) *digital library*.

virtual product development (virtuaalinen tuotekehitys) paperless *product development* where all *design* and *analysis* is *computer-based* [Leppälä03].

virtual reality (virtuaalitodellisuus) "a realistic *simulation* of an *environment* or sequence of events, including three-dimensional graphics, by a *computer* system using interactive software and hardware" [Random House99], "a simulated environment in which you can immerse yourself" [Kurzweil99]. Someone using special equipment (glasses, dress) may view virtual reality and interact with a seemingly physical way. See *telepresence*, *holodeck*, *multisense interaction*, *haptic interaction*.

virtual team (virtuaalitiimi) "geographically dispersed *teams* that communicate and work primarily electronically" [Belliveau02].

vision (visio, tulevaisuudenkuva) the most desirable, ultimate state of a *product* or *organisation* [Kamensky00], see *technology vision*, *market vision*, *scenario*, *roadmap*, *futureology*.

visual (visuaalinen, näköön liittyvä) see *audio*, *audio-visual*.

vitalism (vitalismi) a *holistic* view according to which *life* cannot be explained only by physical and chemical *processes*, suspected in *natural sciences*.

vitalist (vitalisti)

vocabulary (sanasto) see *dictionary*, *encyclopedia*.

vocation (ammatti) see *profession*, *occupation*, *career*.

voice (verbin pääluokka) see *active voice*, *passive voice*, *first person*, *document*.

volume (vuosikerta, nide)

voluntarism (voluntarismi) principle of doing something by voluntary *action*, opposite to *determinism*, see *free will*.

warping (kiertyminen, kieroutuminen, vääristyminen, vääntyminen) see *twist operation*.

waste (jäte) any useless *output* of a system to the *environment* in any form, such as *material* or *energy*, for example sewage, heat, acoustic or electromagnetic *noise* or *interference*.

waterfall model (vesiputousmalli) *timing plan* of a *project* where the project is described as a series of steps. If corrections are needed, the previous step may be revised [Leppälä03], [Calvez93]. See *spiral model*, *iterative model*, *sequential order*, *generative order*.

weak emergence (heikko emergenssi) *emergence* that at least in principle can be *explained* from the *parts* and their *relations*, opposite to *strong emergence*.

weaken (heikentää) opposite to *reinforcing*, see *punishment*.

well-defined problem (hyvin määritelty ongelma) opposite to *ill-defined problem* [Honderich05], see *problem*, *definition*, *unsolvable problem*.

white paper ("valkoinen kirja", hallituksen kannanotto, komiteamietintö; suunnitelma) 1) an official government report, an authoritative report [Random House99]; 2) a preliminary plan for a *project*, etc.

whole (kokonaisuus) *system*, see *holism*, *mereology*, *part*.

wider system (laajempi järjestelmä) a *system* containing the object system [Checkland99], see *subsystem*, *nested hierarchy*.

withdraw (peruuttaa, perua, vetäytyä, perääntyä) see *submit*.

word (sana) "principal carrier of meaning" [Random House99], see *symbol*, *term*, *keyword*, *letter*, *compound*, *complex sentence*, *spelling*.

work (työ) see *energy*, *machine*.

working range (toiminta-alue, mittausalue) see *instrument*.

working standard (käyttönormaali) a *measurement standard* that is used for *calibration* and *verification*.

workshop (workshop, työpaja, käytännön kurssi) a *seminar* or series of meetings, usually smaller and not so formal as a *symposium* and *conference*.

World Wide Web (WWW) (WWW, www) an Internet service system with which users can read files placed on the Internet.

zero error (nollapistevirhe) see *error*.

zero-sum game (nollasummapeli) see *game theory*.

ABBREVIATIONS

[ACM](#) Association for Computing Machinery, www.acm.org
ANOVA analysis of variance
[APS](#) American Physical Society
Arpanet Advanced Research Project Agency Network
ASIC application-specific integrated circuit
[BibTeX](#) TeX format for bibliographies, www.iui.se/staff/jonasb/bibedit
CDMA code division multiple access
CD-ROM compact disk - read only memory
CFS customer feedback system
CMOS complementary metal-oxide semiconductor
[COMPENDEX](#) Computerized Engineering Index, see EI and www.engineeringvillage2.org
DAB digital audio broadcasting
D-N deductive nomological
DNA deoxyribonucleid acid
[DOAJ](#) Directory of Open Access Journals, www.doaj.org
DSP digital signal processor
DVB digital video broadcasting
DVD digital versatile disc
ECTS European Credit Transfer System
[EI](#) Engineering Index, www.ei.org
ENIAC Electronic Numerical Integrator and Computer
[ETSI](#) European Telecommunication Standards Institute, www.etsi.org
FM frequency modulation
GPS Global Positioning System
GSM Global System for Mobile Communications
[IEC](#) International Electrotechnical Commission, www.iec.org
IEE Institution of Electrical Engineers (UK), now [IET](#)
[IEEE](#) Institute of Electrical and Electronics Engineers (USA), www.ieee.org
[IEL](#) IEEE/IET Electronic Library, ieeexplore.ieee.org,
http://www.ieee.org/products/onlinepubs/prod/iel_overview.html
IEM industrial engineering and management
[IET](#) Institution of Engineering and Technology, includes former IEE and IIE, www.theiet.org
IIE Institution of Incorporated Engineers, now [IET](#)
IMRAD introduction, methods, results, and discussion [Day98]
[INSPEC](#) Information Services in Physics, Electrotechnology, Computers and Control, see IET and www.engineeringvillage2.org
[IPA](#) International Phonetic Accociation, International Phonetic Alphabet
I-S inductive-statistical
[ISI](#) Institute for Scientific Information, now Thomson Scientific, www.isinet.com
[ISO](#) International Stardards Organization, official name International Organization for Standardization, www.iso.ch
[ITU](#) International Telecommunication Union, www.itu.int
[JCR](#) ISI Journal Citation Reports, see [ISI](#) and isi01.isiknowledge.com/portal.cg
[J-STAGE](#) Japan Science and Technology Information Aggregator, Electronic, www.jstage.jst.go.jp
[LaTeX](#) typesetting system developed by R. Lammport, based on TeX, www.latex-project.org
LCD liquid crystal display
LED light emitting diode
LSI large scale integration
LTS large technological system
MAC media access control, medium access control
[MATINE](#) Maanpuolustuksen tieteellinen neuvottelukunta
[MIT](#) Massachusetts Institute of Technology

MS-DOS Microsoft Disk Operating System
MTBF mean time between failures
NDA nondisclosure agreement
NMT Nordic Mobile Telephone
NP nondeterministic polynomial time
OA open access, see [DOAJ](#)
OKA omakustannusarvo, prime cost
OSI Open Systems Interconnection [Tanenbaum96], [Stallings91]
PC personal computer
PCM pulse-code modulation
PDF portable document format
PERT program evaluation and review technique
Ph.D. Philosophiae Doctor, Doctor of Philosophy
[PMI](#) Project Management Institute
q.e.d. quod erat demonstrandum (in Latin), that which was to be demonstrated
[SCI-Expanded](#) Science Citation Index Expanded, see [ISI](#) and isi01.isiknowledge.com/portal.cg
SCOT social construction of technology
[Sitra](#) Suomen itsenäisyyden juhlarahasto
[SPIE](#) International Society for Optical Engineering, www.spie.org
STS Science and Technology Studies
[Tekes](#) Teknologian ja innovaatioiden kehittämiskeskus
TeX typesetting system invented by D. Knuth, see [LaTeX](#)
TQM total quality management
TRIZ theory inventive problem solving (in Russian)
TTL transistor-transistor logic
VHDL VHSIC hardware description language
VHSIC very high speed integrated circuit
VHS Video Home System
VLSI very large scale integration
WLAN wireless local area network
[VTT](#) Valtion teknillinen tutkimuskeskus
WWW World Wide Web

ACKNOWLEDGMENT

I have used extensively definitions from many references. Much of the terminology of analytical, systems, and actors approach is unified in [Arbnor97]. A short vocabulary of systems approach is included in [Checkland99]. The encyclopedia of philosophy [Hoderich05] covers also philosophy of science, and a short vocabulary is included in [Rosenberg00]. A vocabulary of product development is in [Belliveau02], and a vocabulary of scientific writing is in [Young02]. Extensive discussions with Dr. Kari Leppälä from Provisec are acknowledged.

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SPECIAL CHARACTERS

| Mark | Unicode name | Name in Finnish | ISO meaning | ISO meaning in Finnish | Example or note | Code |
|-------|-----------------------------------|----------------------------------|--|---|--|---------------|
| ' | acute accent | akuutti-korkomerkki | | | é | 00B4/ 0301 |
| ≈ | almost equal to | likimain yhtä suuri kuin | approximately equal to | likimain yhtä suuri kuin | $\pi \approx 3.14$ | 2248 |
| & | ampersand | et-merkki | | | | 0026 |
| ⟨...⟩ | angle brackets | kulmasulkeet | angle brackets, mean value, ordered pair, ordered n -tupet | kulmasulkeet, keskiarvo, järjestetty pari, järjestetty n -jono | ⟨ a ⟩ , ⟨ a, b ⟩ , ⟨ a_1, a_2, \dots, a_n ⟩ | 3008/ 3009 |
| ' | apostrophe | heittomerkki | | | 5'3", as an apostrophe use 2018 (') | 0027 |
| ≈ | approximately equal to | | | | Not defined in ISO 31. Use the sign "≈". | 2245 |
| * | asterisk, star (on phone keypads) | asteriski, tähti | (complex) conjugate, complex conjugate matrix | konjugaatti, liittoluku, matriisin konjugaatti, konjugoitu matriisi | z^*, A^* | 002A |
| * | asterisk operator | asteriskioperaattori | convolution | konvoluutio | $x(t) * y(t)$ | 2217 |
| ≈ | asymptotically equal to | asymptoottisesti yhtä suuri kuin | asymptotically equal to | asymptoottisesti yhtä suuri kuin | | 2243 |
| ˘ | breve | lyhyysmerkki | | | ă | 02D8/ 0306 |
| | broken bar | katkopystyviiva | | | | 00A6 |
| • | bullet | luetelmapallo | | | | 2022 |
| ^ | caret | poisjäätimerkki | | | | 2038 |

| | | | | | | |
|-------|------------------------|---------------------------------|----------------------------|---|--|---------------|
| ˇ | caron | hattu, ylösalainen sirkumfleksi | | | š ž č | 02C7/ 030C |
| ┌ ┐ | ceiling | kattofunktio | | | $\lceil x \rceil = \text{ent } x$ | 2308/ 2309 |
| ˆ | circumflex accent | sirkumfleksi | | | â | 02C6/ 0302 |
| ¸ | cedilla | sedilji | | | ç | 00B8 |
| ✓ | check mark | tarkistusmerkki | | | | 2713 |
| : | colon | kaksoispiste | | | | 003A |
| ⋮ | colon equals | | by definition equal to | määritelmän mukaan yhtä suuri kuin | $p := mv$ | 2254 |
| , | comma | pilkku | comma, decimal sign | pilkku, desimaalimerkki | In English a dot is used as a decimal sign | 002C |
| @ | commercial at, at sign | ät-merkki | | | | 0040 |
| © | copyright sign | tekijänoikeus | | | © Wiley | 00A9 |
| ¤ | currency sign | valuutta | | | | 00A4 |
| {...} | curly brackets, braces | aaltosulkeet | braces, set | aaltosulkeet, joukko | $\{x_1, x_2, x_3\}$ | 007B/ 007D |
| † | dagger | risti | Hermitian conjugate matrix | matriisin adjungaatti, Hermiten konjugoitu matriisi | $A^\dagger = A^H$, Wilson † | 2020 |
| ° | degree sign | aste | degree sign | aste | 36°30' N, 12 °C | 00B0 |
| ¨ | diaeresis | treema, ä:n pisteet | | | ë, ä, ö, ü | 00A8/ 0308 |
| „ | ditto mark | toistomerkki | | | | 3003 |
| ÷ | division sign | jakomerkki | | | | 00F7 |
| / | division slash | jakoviiva | division sign, divided by | jakoviiva, jaettuna | $a/(b + c)$ | 2215 |
| ˙ | dot above | yläpuolinen piste | derivative | derivaatta | $\dot{e}, \dot{g}(x) = g'(x)$ | 02D9/ 0307 |
| ¨ | double acute accent | kaksoisakuutti-korkomerkki | | | ő | 02DD/ 030B |
| ⸏ | double low line | kaksinkertainen alaviiva | | | ⸏ | 2017/ 0333 |

| | | | | | | |
|-------|---------------------------------------|---|---------------------------------|-------------------------------------|------------------------------------|---------------|
| = | double overline | kaksinkertainen yläviiva | | | \bar{x} | 033F |
| ‡ | double dagger | kaksoisristi | | | Watson ‡ | 2021 |
| '' | double prime | kaksinkertainen yläpuolinen indeksointipilkku | second derivative | toinen derivaatta | $g''(x) = g^{(2)}(x)$ | 2033 |
| "..." | double quotation marks | kokolainausmerkit | | | | 201C/ 201D |
| ↓ | downwards arrow | nuoli alaspäin | | | | 2193 |
| ... | horizontal ellipsis | kolme pistettä vaakasuunnassa, ellipsi | | | "omitting words ..." | 2026 |
| — | em dash | m-viiva, pitkä ajatusviiva | | | "sudden break—" | 2014 |
| - | en dash | n-viiva, lyhyt ajatusviiva | | | non-von Neumann, pp. 38–45 | 2013 |
| ■ | end of proof, q.e.d. | todistuksen loppu | | | | 220E |
| ≐ | equal to by definition | määritelmän mukaan yhtä suuri kuin | by definition equal to | määritelmän mukaan yhtä suuri kuin | $p \stackrel{\text{def}}{=} mv$ | 225D |
| = | equals sign | yhtä suuri kuin, yhtäsuuruusmerkki | equal to | yhtä suuri kuin | | 003D |
| ↔ | equivalence | ekvivalenssi, yhtäpitävyys | equivalence | ekvivalenssi | $p \Leftrightarrow q$ | 21D4 |
| ≅ | estimates, corresponds to | vastaavuusmerkki | corresponds to | vastaa | $1 \text{ cm} \cong 10 \text{ km}$ | 2259 |
| ! | exclamation mark | huutomerkki | factorial | kertoma | $n!$ | 0021 |
| ⌊ ⌋ | floor | lattiafunktio | | | $\lfloor x \rfloor$ | 230A/ 230B |
| . | full stop, dot, period, decimal point | piste | dot, decimal point (in English) | piste, desimaalipiste (englannissa) | | 002E |
| ` | grave accent | gravis-korkomerkki | | | è | 0060/ 0300 |
| > | greater than | suurempi kuin | greater than | suurempi kuin | | 003E |
| ≥ | greater-than or equal to | suurempi tai yhtä suuri kuin | greater than or equal to | suurempi tai yhtä suuri kuin | | 2265 |

| | | | | | | |
|---|-----------------------------|-------------------------------------|--|--|---|---------------|
| – | horizontal bar | vaakapalkki | | | | 2015 |
| - | hyphen-minus | tavuviiva-miinusmerkki, yhdysmerkki | | | non-negligible, non-real-time mode | 002D |
| ≡ | identical to | identtisesti yhtä suuri kuin | identity | identiteetti | $1 \equiv 1$ | 2261 |
| ↔ | image of | | | | $x(t) \leftrightarrow X(f)$ | 22B7 |
| ⇒ | implication | implikaatio | implication | implikaatio | $p \Rightarrow q$ | 21D2 |
| Δ | increment | delta | (finite) increment, Laplacian | (äärellinen) lisäys, Laplacen operaattori | Δx | 2206 |
| ↔ | left right arrow | nuoli vasemmalle ja oikealle | | | $x(t) \leftrightarrow X(f)$ | 2194 |
| ← | leftwards arrow | nuoli vasemmalle | | | | 2190 |
| < | less than | pienempi kuin | less than | pienempi kuin | | 003C |
| ≤ | less-than or equal to | pienempi tai yhtä suuri kuin | less than or equal to | pienempi tai yhtä suuri kuin | | 2264 |
| – | low line, underscore | alaviiva | | | \underline{x} | 005F/ 0332 |
| ˉ | macron, overline, overbar | pituusmerkki | | | \bar{a} | 02C9/ 0304 |
| · | middle dot, middle point | rivinkeskinen piste | dot half high, half-high dot, multiplied by, scalar product of vectors | korotettu piste, vektorien skalaaritulo, pistetulo | $3 \cdot 10^8 \text{ m/s}, a \cdot b$ | 00B7 |
| … | midline horizontal ellipsis | rivinkeskinen ellipsi | | | | 22EF |
| ± | minus-or-plus sign | miinus plus, miinus tai plus | minus or plus | miinus plus, miinus tai plus | | 2213 |
| – | minus sign | miinusmerkki | minus | miinus | | 2212 |
| ≫ | much greater than | paljon suurempi kuin | much greater than | paljon suurempi kuin | | 226B |
| ≪ | much less than | paljon pienempi kuin | much less than | paljon pienempi kuin | | 226A |
| × | multiplication sign | kertomerkki | cross, multiplied by, Cartesian product, vector | risti, kertaa, joukkojen karteesinen tulo, | $3 \times 10^8 \text{ m/s}, a \times b, A \times B, a \times b$ | 00D7 |

| | | | | | | |
|------|---|------------------------------------|--|--|--|---------------|
| | | | product | vektoritulo, ristitulo | | |
| ≠ | not equal to | erisuuri kuin | not equal to | erisuuri kuin | | 2260 |
| # | number sign, pound sign, hash, crosshatch, octothorpe | ristikkomerkki, ruutu | | | | 0023 |
| — | overline | yläviiva | mean value, (complex) conjugate | keskiarvo, konjugaatti, liittoluku | $\bar{x}, \bar{z} = z^*$ | 203E/ 0305 |
| ↔ | original of | | | | $x(t) \leftrightarrow X(f)$ | 22B6 |
| ø, Ø | o with stroke | o ja vinoviiva yli, tanskalainen ö | | | | 00F8/ 00D8 |
| ∥ | parallel to | yhdensuuntainen | parallel to, magnitude of a vector, norm of a matrix | yhdensuuntainen, vektorin pituus, matriisin normi | $AB \parallel CD, \ a\ , \ A\ $ | 2225 |
| (..) | parentheses | kaarisulkeet | parentheses, argument, derivative, ordered pair, ordered n -tuple, open interval, binomial coefficient, matrix | (kaari)sulkeet, argumentti, järjestetty pari, järjestetty n -jono, avoin väli, binomikerroin, matriisi | $f(x), f^{(2)}(x), (a, b), (a_1, a_2, \dots, a_n), \binom{n}{p}, A = (A_{ij})$ | 0028/ 0029 |
| % | percent sign | prosenttimerkki | percent sign | prosenttimerkki | 3 % | 0025 |
| ‰ | per mille sign | promillemerkki | | | Not recommended in ISO 31-0. | 2030 |
| ⊥ | perpendicular, orthogonal to | kohtisuorassa | perpendicular to | kohtisuorassa | $AB \perp CD$ | 27C2 |
| ¶ | pilcrow sign, paragraph sign | kappaleen merkki | | | | 00B6 |
| ± | plus-minus sign | plus miinus, plus tai miinus | plus or minus | plus miinus, plus tai miinus | | 00B1 |
| + | plus sign | plusmerkki | plus | plus | | 002B |
| ' | prime | yläpuolinen indeksointipilkku | derivative | derivaatta | $g'(x) = dg(x)/dx$ | 2032 |
| ∝ | proportional to | verrannollinen | proportional to | verrannollinen | $a \propto b$ | 221D |

| | | | | | | |
|-------------------|-----------------------------------|----------------------------------|--|---|---|---------------|
| $\stackrel{?}{=}$ | questioned equal to | | | | | 225F |
| ? | question mark | kysymysmerkki | | | | 003F |
| " | quotation mark | lainausmerkki | | | 5'3", as quotation marks, use double and single quotation marks | 0022 |
| : | ratio | suhde | | | | 2236 |
| ® | registered trade mark sign | rekisteröity tavaramerkki | | | | 00AE |
| \ | reverse solidus, backslash | kenoviiva | difference between two sets, minus | kahden joukon erotus, miinus | $A \setminus B$ | 005C |
| → | rightwards arrow | nuoli oikealle | tends to, vector | lähestyy arvoa, vektori | $f(x) \rightarrow 0, \overset{!}{a} = a$ | 2192 |
| ° | ring above | yläpuolinen ympyrä | | | â | 02DA/ 030A |
| ◦ | ring operator, composite function | | circle, composite function | pallo, yhdistetty funktio | $(g \circ f)(x) = g(f(x))$ | 2218 |
| § | section sign | pykälämerkki | | | | 00A7 |
| ; | semicolon | puolipiste | | | | 003B |
| ß | sharp s | kaksois-s, saksalainen kaksois-s | | | Gauß, Gauss | 00DF |
| '...' | single quotation marks | puolilainausmerkit | | | "William 'Buffalo Bill' Cody", 1990's | 2018/ 2019 |
| / | solidus, slash, virgule | vinoviiva | divided by | jaettuna | a/b | 002F |
| | space | välilyönti | space | välike | 12 V | 0020 |
| [...] | square brackets | hakasulkeet | square brackets, closed interval, matrix | hakasulkeet, suljettu väli, matriisi | $[a, b], A = [A_{ij}]; [x]$ is ambiguous | 005B/ 005D |
| ~ | small tilde | pieni tilde, pieni aaltoviiva | transpose matrix | matriisin transpoosi, transponoitu matriisi | $\tilde{a}, \tilde{A} = A^T$ | 02DC/ 0303 |
| ~ | tilde | tilde, aaltoviiva | proportional to | verrannollinen | $a \sim b$ | 007E |
| ™ | trade mark sign | tavaramerkki | | | Matlab™ | 2122 |
| ↑ | up down arrow | nuoli ylöspäin ja alaspäin | | | | 2195 |
| ü, Ü | u with diaeresis | u ja treema, saksalainen y | | | | 00FC/ 00DC |

| | | | | | | |
|---|--------------------------------|-------------------------|---|--|--|------|
| ↑ | upwards arrow | nuoli ylöspäin | | | | 2191 |
| ⋮ | vertical ellipsis | pystysuuntainen ellipsi | | | | 22EE |
| | vertical line, vertical bar | pystyviiva | proposition, absolute value, magnitude, modulus, determinant of a matrix | ehto, itseisarvo, moduuli, vektorin pituus, matriisin determinantti | $\{x \mid x \leq 5\}, z = \text{abs } z,$ $ a , \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}$ | 007C |

You can see the location of each character by selecting the sign in the table above and by selecting Insert > Symbol. For a more complete list and a partial list of the the Finnish translations, see [\[Unicode\]](#) and [\[Eurooppalaisen04\]](#). See especially the code charts [by script](#) and code charts for [symbols and punctuation](#), including [mathematical operators](#) and technical symbols. The names and use of the characters are explained in the notes there. The codes given in the tables are hexadecimal. The Unicode standard defines over 100000 characters. The availability of the characters depends on the selected font. The largest character set is probably available in the Arial Unicode MS font. In Microsoft Word the characters and their names can be seen by selecting Insert > Symbol > Arial Unicode MS. There are almost 40000 characters in this font, including Latin characters, mathematical operators, miscellaneous technical characters, International Phonetic Alphabet (IPA) extensions, and Arabic, Chinese, Cyrillic, Greek, Hebrew, etc. alphabets. In the common Times New Roman font there are 1418 characters.