Software deployment

Software deployment is all of the activities that make a software system available for use.The general deployment process consists of several interrelated activities with possible transitions between them. These activities can occur on the producer side or on the consumer side or both. Because every software system is unique, the precise processes or procedures within each activity can hardly be defined. Therefore, "deployment" should be interpreted as a general process that has to be customized according to specific requirements or characteristics.

Software design

Software design is the process by which an agent creates a specification of a software artifact intended to accomplish goals, using a set of primitive components and subject to constraints. Software design may refer to either "all the activity involved in conceptualizing, framing, implementing, commissioning, and ultimately modifying complex systems" or "the activity following requirements specification and before programming, as ... [in] a stylized software engineering process."Software design usually involves problem-solving and planning a software solution. This includes both a low-level component and algorithm design and a high-level, architecture design.

Software development

Software development is the process of conceiving, specifying, designing, programming, documenting, testing, and bug fixing involved in creating and maintaining applications, frameworks, or other software components. Software development involves writing and maintaining the source code, but in a broader sense, it includes all processes from the conception of the desired software through to the final manifestation of the software, typically in a planned and structured process. Software development also includes research, new development, prototyping, modification, reuse, re-engineering, maintenance, or any other activities that result in software products.

Software development process

In software engineering, a software development process is a process of dividing software development work into smaller, parallel, or sequential steps or sub-processes to improve design and/or product management. It is also known as a software development life cycle (SDLC). The methodology may include the pre-definition of specific deliverables and artifacts that are created and completed by a project team to develop or maintain an application.Most modern development processes can be vaguely described as agile. Other methodologies include waterfall, prototyping, iterative and incremental development, spiral development, rapid application development, and extreme programming.

Software engineering

Software engineering is a systematic engineering approach to software development.A software engineer is a person who applies the principles of software engineering to design, develop, maintain, test, and evaluate computer software. The term programmer is sometimes used as a synonym, but may also lack connotations of engineering education or skills.

Software framework

In computer programming, a software framework is an abstraction in which software, providing generic functionality, can be selectively changed by additional user-written code, thus providing application-specific software. It provides a standard way to build and deploy applications and is a universal, reusable software environment that provides particular functionality as part of a larger software platform to facilitate the development of software applications, products and solutions.

Software interrupt

In digital computers, an interrupt (sometimes referred to as a trap) is a request for the processor to interrupt currently executing code (when permitted), so that the event can be processed in a timely manner. If the request is accepted, the processor will suspend its current activities, save its state, and execute a function called an interrupt handler (or an interrupt service routine, ISR) to deal with the event. This interruption is often temporary, allowing the software to resume normal activities after the interrupt handler finishes, although the interrupt could instead indicate a fatal error.Interrupts are commonly used by hardware devices to indicate electronic or physical state changes that require time-sensitive attention. Interrupts are also commonly used to implement computer multitasking, especially in real-time computing. Systems that use interrupts in these ways are said to be interrupt-driven.
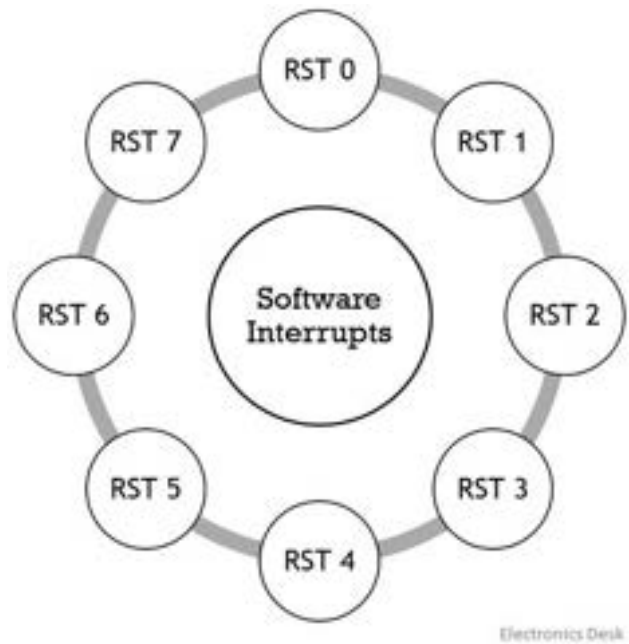
Software maintenance

Software maintenance in software engineering is the modification of a software product after delivery to correct faults, to improve performance or other attributes.A common perception of maintenance is that it merely involves fixing defects. However, one study indicated that over 80% of maintenance effort is used for non-corrective actions. This perception is perpetuated by users submitting problem reports that in reality are functionality enhancements to the system. More recent studies put the bug-fixing proportion closer to 21%.

Software platform

A computing platform or digital platform is an environment in which a piece of software is executed. It may be the hardware or the operating system (OS), even a web browser and associated application programming interfaces, or other underlying software, as long as the program code is executed with it. Computing platforms have different abstraction levels, including a computer architecture, an OS, or runtime libraries. A computing platform is the stage on which computer programs can run.

Software portability

A computer program is said to be portable if there is very low effort required to make it run on different platforms. The pre-requirement for portability is the generalized abstraction between the application logic and system interfaces. When software with the same functionality is produced for several computing platforms, portability is the key issue for development cost reduction.
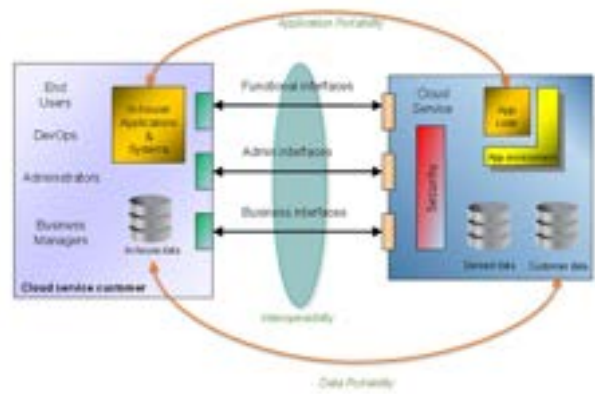
Elements of Interoperability and Portability for Cloud Services

Software quality

In the context of software engineering, software quality refers to two related but distinct notions:

Software repository

A software repository, or repo for short, is a storage location for software packages. Often a table of contents is also stored, along with metadata. A software repository is typically managed by source or version control, or repository managers. Package managers allow automatically installing and updating repositories, sometimes called "packages".
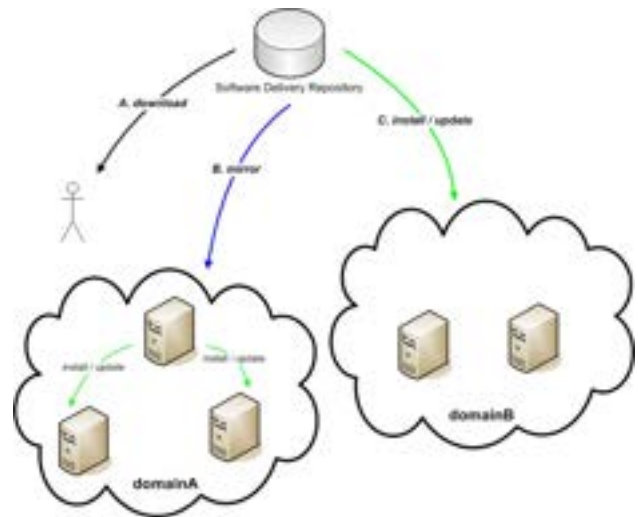
Solaris (operating system)

Solaris is a proprietary Unix operating system originally developed by Sun Microsystems. After the Sun acquisition by Oracle in 2010, it was renamed Oracle Solaris.Solaris superseded the company's earlier SunOS in 1993, and became known for its scalability, especially on SPARC systems, and for originating many innovative features such as DTrace, ZFS and Time Slider.

Solid modeling

Solid modeling (or solid modelling) is a consistent set of principles for mathematical and computer modeling of three-dimensional shapes (solids). Solid modeling is distinguished from related areas of geometric modeling and computer graphics, such as 3D modeling, by its emphasis on physical fidelity. Together, the principles of geometric and solid modeling form the foundation of 3D-computer-aided design and in general support the creation, exchange, visualization, animation, interrogation, and annotation of digital models of physical objects.
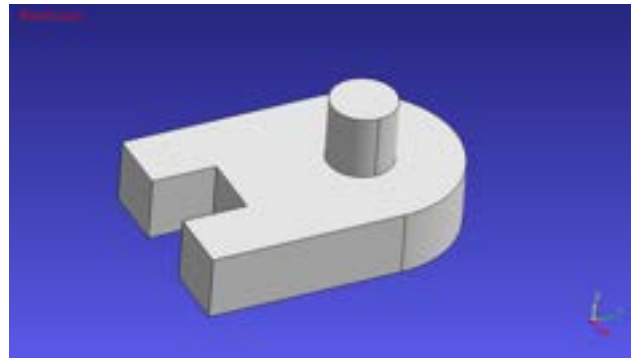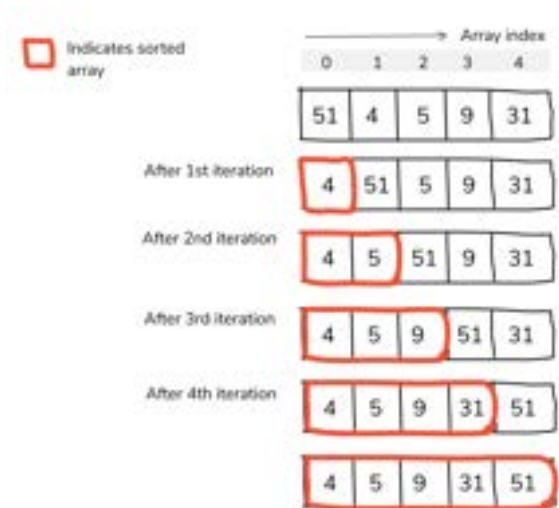
Solid state drives

A solid-state drive (SSD) is a solid-state storage device that uses integrated circuit assemblies to store data persistently, typically using flash memory, and functioning as secondary storage in the hierarchy of computer storage. It is also sometimes called a semiconductor storage device, a solid-state device or a solid-state disk, even though SSDs lack the physical spinning disks and movable read?write heads used in hard disk drives (HDDs) and floppy disks. SSD also has rich internal parallelism for data processing.In comparison to hard disk drives and similar electromechanical media which use moving parts, SSDs are typically more resistant to physical shock, run silently, and have higher input/output rates and lower latency. SSDs store data in semiconductor cells. As of 2019, cells can contain between 1 and 4 bits of data. SSD storage devices vary in their properties according to the number of bits stored in each cell, with single-bit cells ("Single Level Cells" or "SLC") being generally the most reliable, durable, fast, and expensive type, compared with 2- and 3-bit cells ("Multi-Level Cells/MLC" and "Triple-Level Cells/TLC"), and finally quad-bit cells ("QLC") being used for consumer devices that do not require such extreme properties and are the cheapest per gigabyte (GB) of the four. In addition, 3D XPoint memory (sold by Intel under the Optane brand) stores data by changing the electrical resistance of cells instead of storing electrical charges in cells, and SSDs made from RAM can be used for high speed, when data persistence after power loss is not required, or may use battery power to retain data when its usual power source is unavailable.

Sorting algorithm

In computer science, a sorting algorithm is an algorithm that puts elements of a list into an order. The most frequently used orders are numerical order and lexicographical order, and either ascending or descending. Efficient sorting is important for optimizing the efficiency of other algorithms (such as search and merge algorithms) that require input data to be in sorted lists. Sorting is also often useful for canonicalizing data and for producing human-readable output.

Indicates sorted array

Array index

	0	1	2	3	4
	51	4	5	9	31
After 1st iteration	4	51	5	9	31
After 2nd iteration	4	5	51	9	31
After 3rd iteration	4	5	9	51	31
After 4th iteration	4	5	9	31	51
	4	5	9	31	51

Sperry Rand

Sperry Corporation was a major American equipment and electronics company whose existence spanned more than seven decades of the 20th century. Sperry ceased to exist in 1986 following a prolonged hostile takeover bid engineered by Burroughs Corporation, which merged the combined operation under the new name Unisys. Some of Sperry's former divisions became part of Honeywell, Lockheed Martin, Raytheon Technologies, and Northrop Grumman.

Spooling

In computing, spooling is a specialized form of multi-programming for the purpose of copying data between different devices. In contemporary systems, it is usually used for mediating between a computer application and a slow peripheral, such as a printer. Spooling allows programs to "hand off" work to be done by the peripheral and then proceed to other tasks, or to not begin until input has been transcribed. A dedicated program, the spooler, maintains an orderly sequence of jobs for the peripheral and feeds it data at its own rate. Conversely, for slow input peripherals, such as a card reader, a spooler can maintain a sequence of computational jobs waiting for data, starting each job when all of the relevant input is available; see batch processing. The spool itself refers to the sequence of jobs, or the storage area where they are held. In many cases, the spooler is able to drive devices at their full rated speed with minimal impact on other processing.

Stack machine

In computer science, computer engineering and programming language implementations, a stack machine is a computer processor or a virtual machine in which the primary interaction is moving short-lived temporary values to and from a push down stack. In the case of a hardware processor, a hardware stack is used. The use of a stack significantly reduces the required number of processor registers. Stack machines extend push-down automata with additional load/store operations or multiple stacks and hence are Turing-complete.

Star system

A star system or stellar system is a small number of stars that orbit each other, bound by gravitational attraction. A large group of stars bound by gravitation is generally called a star cluster or galaxy, although, broadly speaking, they are also star systems. Star systems are not to be confused with planetary systems, which include planets and similar bodies (such as comets).

Statistics

Statistics (from German: Statistik, orig. "description of a state, a country") is the discipline that concerns the collection, organization, analysis, interpretation, and presentation of data. In applying statistics to a scientific, industrial, or social problem, it is conventional to begin with a statistical population or a statistical model to be studied. Populations can be diverse groups of people or objects such as "all people living in a country" or "every atom composing a crystal". Statistics deals with every aspect of data, including the planning of data collection in terms of the design of surveys and experiments.When census data cannot be collected, statisticians collect data by developing specific experiment designs and survey samples. Representative sampling assures that inferences and conclusions can reasonably extend from the sample to the population as a whole. An experimental study involves taking measurements of the system under study, manipulating the system, and then taking additional measurements using the same procedure to determine if the manipulation has modified the values of the measurements. In contrast, an observational study does not involve experimental manipulation.

Status message

A status message is a function of some instant messaging applications whereby a user may post a message that appears automatically to other users if they attempt to make contact. A status message can tell other contacts the user's current status, such as being busy or what the user is currently doing. It is analogous to the voice message in an answering machine or voice mail system. However, status messages may be displayed even if the person is present. They are often updated much more frequently than messages in answering machines, and thus may serve as a means of instant, limited "publication" or indirect communication.

"We should all start to live before we get too old. Fear is stupid. So are regrets."

Status register

A status register, flag register, or condition code register (CCR) is a collection of status flag bits for a processor. Examples of such registers include FLAGS register in the x86 architecture, flags in the program status word (PSW) register in the IBM System/360 architecture through z/Architecture, and the application program status register (APSR) in the ARM Cortex-A architecture.The status register is a hardware register that contains information about the state of the processor. Individual bits are implicitly or explicitly read and/or written by the machine code instructions executing on the processor. The status register lets an instruction take action contingent on the outcome of a previous instruction.

Format of the status register
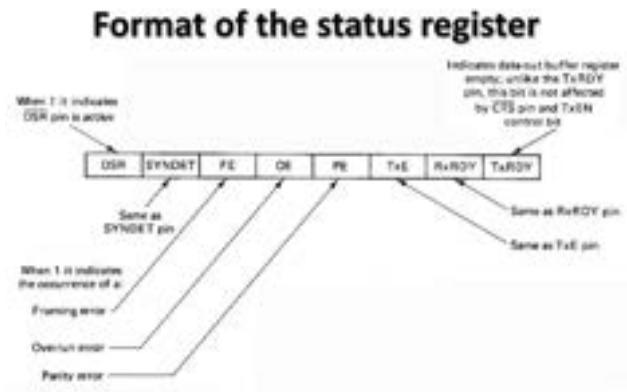
Stephanie Forrest

Stephanie Forrest (born circa 1958) is an American computer scientist and director of the Biodesign Center for Biocomputing, Security and Society at the Biodesign Institute at Arizona State University. She was previously Distinguished Professor of Computer Science at the University of New Mexico in Albuquerque. She is best known for her work in adaptive systems, including genetic algorithms, computational immunology, biological modeling, automated software repair, and computer security.

Steve Jobs

Steven Paul Jobs (February 24, 1955 ? October 5, 2011) was an American entrepreneur, business magnate, industrial designer, media proprietor, and investor. He was the co-founder, chairman, and CEO of Apple; the chairman and majority shareholder of Pixar; a member of The Walt Disney Company's board of directors following its acquisition of Pixar; and the founder, chairman, and CEO of NeXT. He is widely recognized as a pioneer of the personal computer revolution of the 1970s and 1980s, along with his early business partner and fellow Apple co-founder Steve Wozniak.

Sun Microsystems

Sun Microsystems, Inc. (Sun for short) was an American technology company that sold computers, computer components, software, and information technology services and created the Java programming language, the Solaris operating system, ZFS, the Network File System (NFS), and SPARC microprocessors. Sun contributed significantly to the evolution of several key computing technologies, among them Unix, RISC processors, thin client computing, and virtualized computing. Notable Sun acquisitions include Cray Business Systems Division, Storagetek, and Innotek GmbH, creators of VirtualBox. Sun was founded on February 24, 1982. At its height, the Sun headquarters were in Santa Clara, California (part of Silicon Valley), on the former west campus of the Agnews Developmental Center.

Supercomputer

A supercomputer is a computer with a high level of performance as compared to a general-purpose computer. The performance of a supercomputer is commonly measured in floating-point operations per second (FLOPS) instead of million instructions per second (MIPS). Since 2017, there have existed supercomputers which can perform over 1017 FLOPS (a hundred quadrillion FLOPS, 100 petaFLOPS or 100 PFLOPS). For comparison, a desktop computer has performance in the range of hundreds of gigaFLOPS (1011) to tens of teraFLOPS (1013). Since November 2017, all of the world's fastest 500 supercomputers run on Linux-based operating systems. Additional research is being conducted in the United States, the European Union, Taiwan, Japan, and China to build faster, more powerful and technologically superior exascale supercomputers.Supercomputers play an important role in the field of computational science, and are used for a wide range of computationally intensive tasks in various fields, including quantum mechanics, weather forecasting, climate research, oil and gas exploration, molecular modeling (computing the structures and properties of chemical compounds, biological macromolecules, polymers, and crystals), and physical simulations (such as simulations of the early moments of the universe, airplane and spacecraft aerodynamics, the detonation of nuclear weapons, and nuclear fusion). They have been essential in the field of cryptanalysis.Supercomputers were introduced in the 1960s, and for several decades the fastest were made by Seymour Cray at Control Data Corporation (CDC), Cray Research and subsequent companies bearing his name or monogram. The first such machines were highly tuned conventional designs that ran more quickly than their more general-purpose contemporaries.

Supercomputer operating system

A supercomputer operating system is an operating system intended for supercomputers. Since the end of the 20th century, supercomputer operating systems have undergone major transformations, as fundamental changes have occurred in supercomputer architecture. While early operating systems were custom tailored to each supercomputer to gain speed, the trend has been moving away from in-house operating systems and toward some form of Linux, with it running all the supercomputers on the TOP500 list in November 2017. In 2021, top 10 computers run for instance Red Hat Enterprise Linux (RHEL), or some variant of it or other Linux distribution e.g. Ubuntu.

Supervised learning

Supervised learning (SL) is a machine learning paradigm for problems where the available data consists of labeled examples, meaning that each data point contains features (covariates) and an associated label. The goal of supervised learning algorithms is learning a function that maps feature vectors (inputs) to labels (output), based on example input-output pairs. It infers a function from labeled training data consisting of a set of training examples. In supervised learning, each example is a pair consisting of an input object (typically a vector) and a desired output value (also called the supervisory signal). A supervised learning algorithm analyzes the training data and produces an inferred function, which can be used for mapping new examples. An optimal scenario will allow for the algorithm to correctly determine the class labels for unseen instances. This requires the learning algorithm to generalize from the training data to unseen situations in a "reasonable" way (see inductive bias). This statistical quality of an algorithm is measured through the so-called generalization error.

Supervisor mode

In computer science, hierarchical protection domains, often called protection rings, are mechanisms to protect data and functionality from faults (by improving fault tolerance) and malicious behavior (by providing computer security).
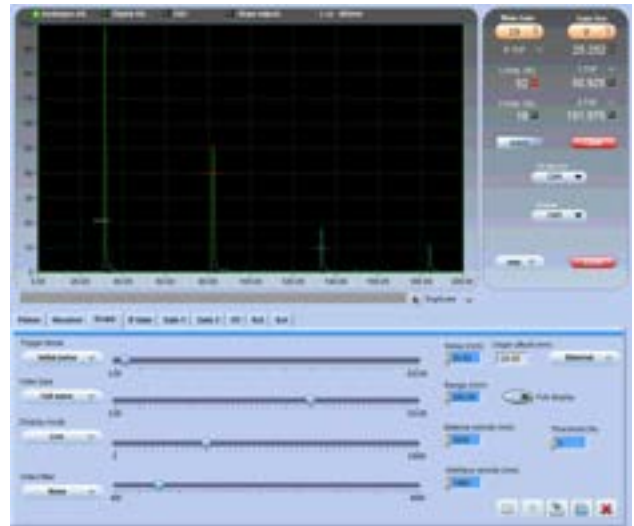
Syllable Desktop

Syllable Desktop is a discontinued free and open-source operating system for Pentium and compatible processors. Its purpose is to create an easy-to-use desktop operating system for the home and small office user. It was forked from the stagnant AtheOS in July 2002.

Symbian

Symbian is a discontinued mobile operating system (OS) and computing platform designed for smartphones. It was originally developed as a proprietary software OS for personal digital assistants in 1998 by the Symbian Ltd. consortium. Symbian OS is a descendant of Psion's EPOC, and was released exclusively on ARM processors, although an unreleased x86 port existed. Symbian was used by many major mobile phone brands, like Samsung, Motorola, Sony Ericsson, and above all by Nokia. It was also prevalent in Japan by brands including Fujitsu, Sharp and Mitsubishi. As a pioneer that established the smartphone industry, it was the most popular smartphone OS on a worldwide average until the end of 2010, at a time when smartphones were in limited use, when it was overtaken by iOS and Android. It was notably less popular in North America.

Synthography

Synthography is the method of generating digital media synthetically using machine learning. This is distinct from other graphic creation and editing methods in that synthography uses artificial intelligence art text-to-image models to generate synthetic media. It is commonly achieved by prompt engineering text descriptions as input to create or edit a desired image.Text-to-image models, algorithms, and software are tools used in synthography that are designed to have technical proficiency in creating the resulting artificial intelligence art output based on human input. Synthography typically uses text-to-image models to synthesize new images as a derivative of the training, validation, and test data sets on which the text-to-image models were trained. Another technique is to fine-tune an already trained model on an image dataset to teach it a specific concept.
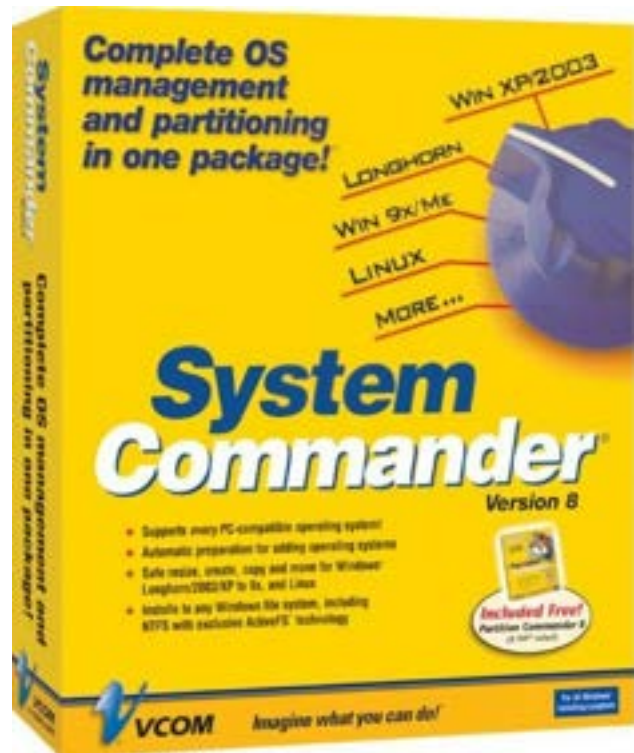
System

A system is a group of interacting or interrelated elements that act according to a set of rules to form a unified whole. A system, surrounded and influenced by its environment, is described by its boundaries, structure and purpose and expressed in its functioning. Systems are the subjects of study of systems theory and other systems sciences.

System Commander

System Commander (SC for short) is a graphical boot manager/loader software application developed by VCOM. The software allowed for multiple operating systems to be installed onto a machine at once, providing a menu from which the user selected the operating system they wished to boot from. Other software with similar functionality includes NTLDR, LILO, GRUB, and Graphical Boot Manager. One of its components was named Partition Commander.
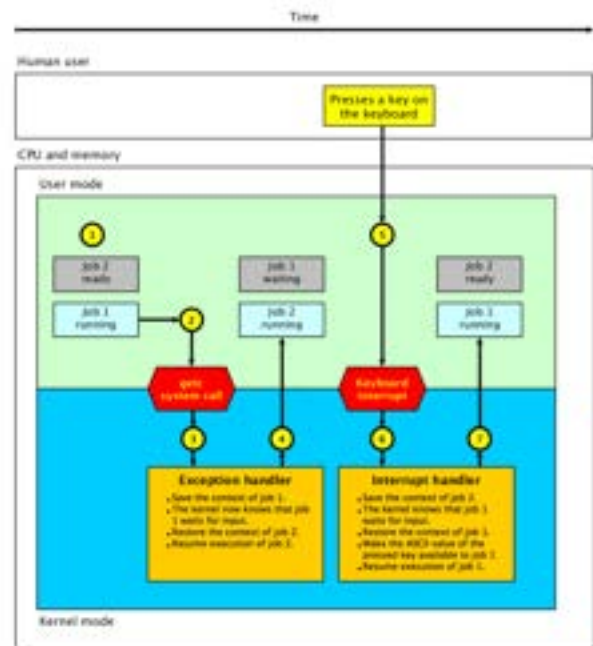
System V

Unix System V (pronounced: "System Five") is one of the first commercial versions of the Unix operating system. It was originally developed by AT&T and first released in 1983. Four major versions of System V were released, numbered 1, 2, 3, and 4. System V Release 4 (SVR4) was commercially the most successful version, being the result of an effort, marketed as Unix System Unification, which solicited the collaboration of the major Unix vendors. It was the source of several common commercial Unix features. System V is sometimes abbreviated to SysV.
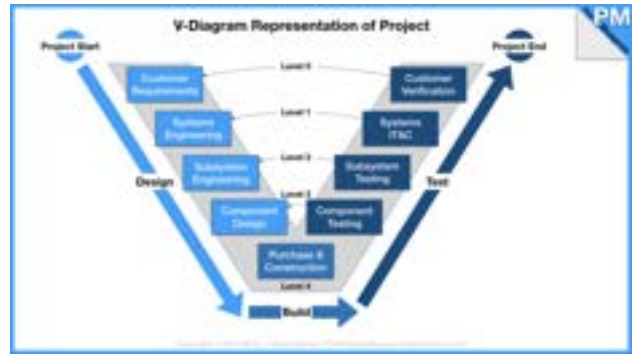
System call

In computing, a system call (commonly abbreviated to syscall) is the programmatic way in which a computer program requests a service from the operating system on which it is executed. This may include hardware-related services (for example, accessing a hard disk drive or accessing the device's camera), creation and execution of new processes, and communication with integral kernel services such as process scheduling. System calls provide an essential interface between a process and the operating system.

System dynamics

System dynamics (SD) is an approach to understanding the nonlinear behaviour of complex systems over time using stocks, flows, internal feedback loops, table functions and time delays.
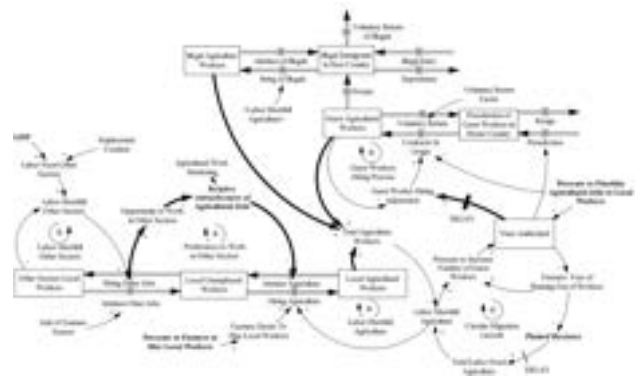
System image

In computing, a system image is a serialized copy of the entire state of a computer system stored in some non-volatile form such as a file. A system is said to be capable of using system images if it can be shut down and later restored to exactly the same state. In such cases, system images can be used for backup.

System library

In computer science, a library is a collection of non-volatile resources used by computer programs, often for software development. These may include configuration data, documentation, help data, message templates, pre-written code and subroutines, classes, values or type specifications. In IBM's OS/360 and its successors they are referred to as partitioned data sets.A library is also a collection of implementations of behavior, written in terms of a language, that has a well-defined interface by which the behavior is invoked. For instance, people who want to write a higher-level program can use a library to make system calls instead of implementing those system calls over and over again. In addition, the behavior is provided for reuse by multiple independent programs. A program invokes the library-provided behavior via a mechanism of the language. For example, in a simple imperative language such as C, the behavior in a library is invoked by using C's normal function-call. What distinguishes the call as being to a library function, versus being to another function in the same program, is the way that the code is organized in the system.Library code is organized in such a way that it can be used by multiple programs that have no connection to each other, while code that is part of a program is organized to be used only within that one program. This distinction can gain a hierarchical notion when a program grows large, such as a multi-million-line program. In that case, there may be internal libraries that are reused by independent sub-portions of the large program.

System of measurement

A system of measurement is a collection of units of measurement and rules relating them to each other. Systems of measurement have historically been important, regulated and defined for the purposes of science and commerce. Systems of measurement in use include the International System of Units or SI (the modern form of the metric system), the British imperial system, and the United States customary system.


US measurement system

Length
12 inches = 1 foot
3 feet = 1 yard
22 yards = 1 chain
10 chains = 1 furlong
8 furlongs = 1 mile
5280 feet = 1 mile
1760 yards = 1 mile

Area
144 square inches = 1 square foot
9 square feet = 1 square yard
4840 square yards = 1 acre
640 acres = 1 square mile or = 1 section

A 12 x 12 inch large floor tile has an area of 144 square inches or 1 square foot.

Weight
16 ounces = 1 pound
14 pounds = 1 stone
100 pounds = 1 hundredweight
2,000 pounds = 1 ton
20 hundredweight = 1 ton

US egg sizes:
Small 1.5 oz, Large 2 oz, Jumbo 2.5 oz.

Volume
1728 cubic inches = 1 cubic foot
27 cubic feet = 1 cubic yard

This 1 inch block has a volume of 1 cubic inch, 1 in³.
So this cube made from 1,728 blocks has a volume of 1,728 cubic inches, or 1 cubic foot, 1 ft³.

Fluid Volume
8 fluid ounces = 1 cup
16 fluid ounces = 1 pint
2 pints = 1 quart
8 pints or 4 quarts = 1 gallon

1 gallon = 4 quarts, 8 pints, 16 cups, 128 fluid ounces

Category	°F
Freezing point of water	32°
Boiling point of water	212°
Human body temperature	98.6°

Temperature
The Fahrenheit scale (°F).

98.6°F

also known as US Standard units, US Standard system, Imperial or English sytem or just US units

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System on a chip

A system on a chip or system-on-chip (SoC ; pl. SoCs) is an integrated circuit that integrates most or all components of a computer or other electronic system. These components almost always include a central processing unit (CPU), memory interfaces, on-chip input/output devices, input/output interfaces, and secondary storage interfaces, often alongside other components such as radio modems and a graphics processing unit (GPU) ? all on a single substrate or microchip. It may contain digital, and also analog, mixed-signal, and often radio frequency signal processing functions (otherwise it may be considered only an application processor).
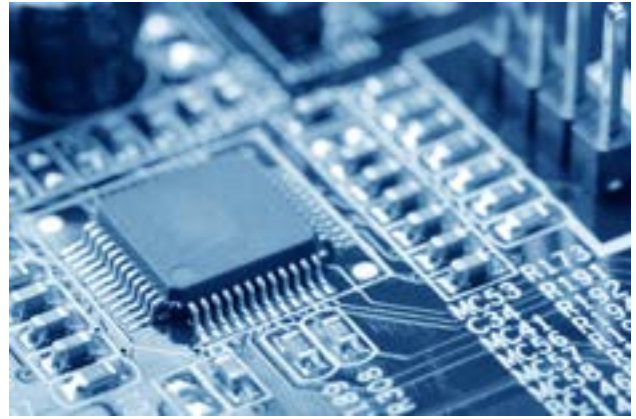
System resource

In computing, a system resource, or simple resource, is any physical or virtual component of limited availability within a computer system. All connected devices and internal system components are resources. Virtual system resources include files (concretely file handles), network connections (concretely network sockets), and memory areas.
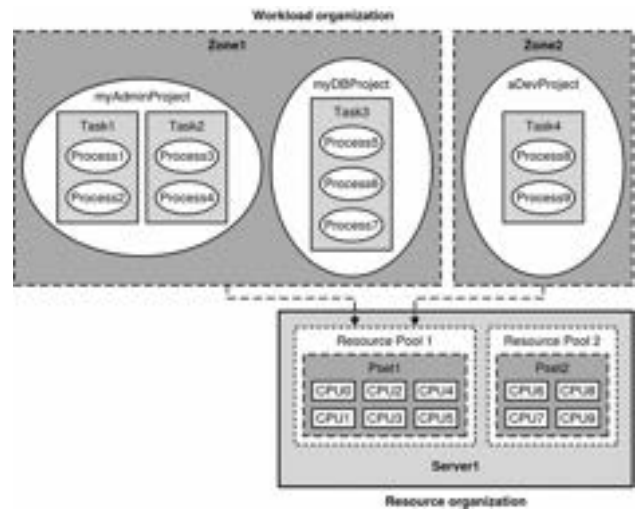
System software

System software is software designed to provide a platform for other software. Examples of system software include operating systems (OS) like macOS, Linux, Android and Microsoft Windows, computational science software, game engines, search engines, industrial automation, and software as a service applications.Application software is software that allows users to do user-oriented tasks such as create text documents, play or develop games, create presentations, listen to music, draw pictures or browse the web.In the late 1940s, the early days of computing, most application software was custom-written by computer users to fit their specific hardware and requirements. System software was usually supplied by the manufacturer of the computer hardware and was intended to be used by most or all users of that system.

Systemics

In the context of systems science and systems philosophy, systemics is an initiative to study systems. It is an attempt at developing logical, mathematical, engineering and philosophical paradigms and frameworks in which physical, technological, biological, social, cognitive and metaphysical systems can be studied and modeled.The term "systemics" was coined in the 1970s by Mario Bunge and others, as an alternative paradigm for research related to general systems theory and systems science.

Systems Network Architecture

Systems Network Architecture (SNA) is IBM's proprietary networking architecture, created in 1974. It is a complete protocol stack for interconnecting computers and their resources. SNA describes formats and protocols but, in itself, is not a piece of software. The implementation of SNA takes the form of various communications packages, most notably Virtual Telecommunications Access Method (VTAM), the mainframe software package for SNA communications.

Systems analysis

Systems analysis is "the process of studying a procedure or business to identify its goal and purposes and create systems and procedures that will efficiently achieve them". Another view sees system analysis as a problem-solving technique that breaks down a system into its component pieces, and how well those parts work and interact to accomplish their purpose.The field of system analysis relates closely to requirements analysis or to operations research. It is also "an explicit formal inquiry carried out to help a decision maker identify a better course of action and make a better decision than they might otherwise have made."The terms analysis and synthesis stems from Greek, meaning "to take apart" and "to put together," respectively. These terms are used in many scientific disciplines, from mathematics and logic to economics and psychology, to denote similar investigative procedures. The analysis is defined as "the procedure by which we break down an intellectual or substantial whole into parts," while synthesis means "the procedure by which we combine separate elements or components to form a coherent whole." System analysis researchers apply methodology to the systems involved, forming an overall picture.
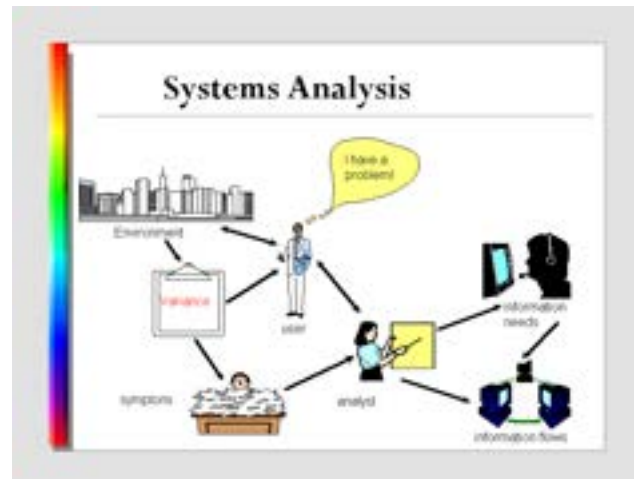
Systems art

Systems art is art influenced by cybernetics, and systems theory, that reflects on natural systems, social systems and social signs of the art world itself.Systems art emerged as part of the first wave of the conceptual art movement extended in the 1960s and 1970s. Closely related and overlapping terms are anti-form movement, cybernetic art, generative systems, process art, systems aesthetic, systemic art, systemic painting, and systems sculptures.

Systems biology

Systems biology is the computational and mathematical analysis and modeling of complex biological systems. It is a biology-based interdisciplinary field of study that focuses on complex interactions within biological systems, using a holistic approach (holism instead of the more traditional reductionism) to biological research.Particularly from the year 2000 onwards, the concept has been used widely in biology in a variety of contexts. The Human Genome Project is an example of applied systems thinking in biology which has led to new, collaborative ways of working on problems in the biological field of genetics. One of the aims of systems biology is to model and discover emergent properties, properties of cells, tissues and organisms functioning as a system whose theoretical description is only possible using techniques of systems biology. These typically involve metabolic networks or cell signaling networks.
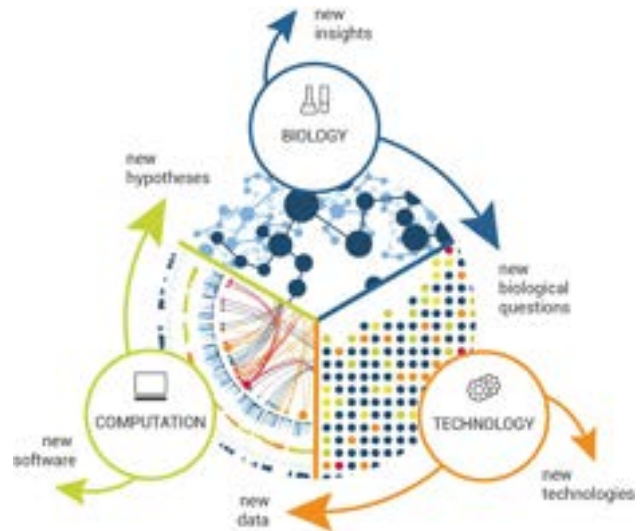
Systems ecology

Systems ecology is an interdisciplinary field of ecology, a subset of Earth system science, that takes a holistic approach to the study of ecological systems, especially ecosystems. Systems ecology can be seen as an application of general systems theory to ecology. Central to the systems ecology approach is the idea that an ecosystem is a complex system exhibiting emergent properties. Systems ecology focuses on interactions and transactions within and between biological and ecological systems, and is especially concerned with the way the functioning of ecosystems can be influenced by human interventions. It uses and extends concepts from thermodynamics and develops other macroscopic descriptions of complex systems.
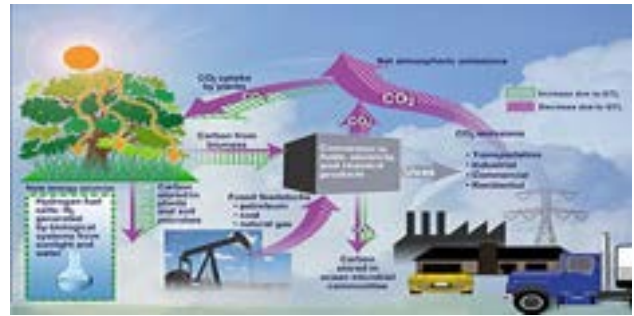
Systems engineering

Systems engineering is an interdisciplinary field of engineering and engineering management that focuses on how to design, integrate, and manage complex systems over their life cycles. At its core, systems engineering utilizes systems thinking principles to organize this body of knowledge. The individual outcome of such efforts, an engineered system, can be defined as a combination of components that work in synergy to collectively perform a useful function.

Systems neuroscience

Systems neuroscience is a subdiscipline of neuroscience and systems biology that studies the structure and function of neural circuits and systems. Systems neuroscience encompasses a number of areas of study concerned with how nerve cells behave when connected together to form neural pathways, neural circuits, and larger brain networks. At this level of analysis, neuroscientists study how different neural circuits analyze sensory information, form perceptions of the external world, make decisions, and execute movements. Researchers in systems neuroscience are concerned with the relation between molecular and cellular approaches to understanding brain structure and function, as well as with the study of high-level mental functions such as language, memory, and self-awareness (which are the purview of behavioral and cognitive neuroscience). Systems neuroscientists typically employ techniques for understanding networks of neurons as they are seen to function, by way of electrophysiology using either single-unit recording or multi-electrode recording, functional magnetic resonance imaging (fMRI), and PET scans. The term is commonly used in an educational framework: a common sequence of graduate school neuroscience courses consists of cellular/molecular neuroscience for the first semester, then systems neuroscience for the second semester. It is also sometimes used to distinguish a subdivision within a neuroscience department in a university.
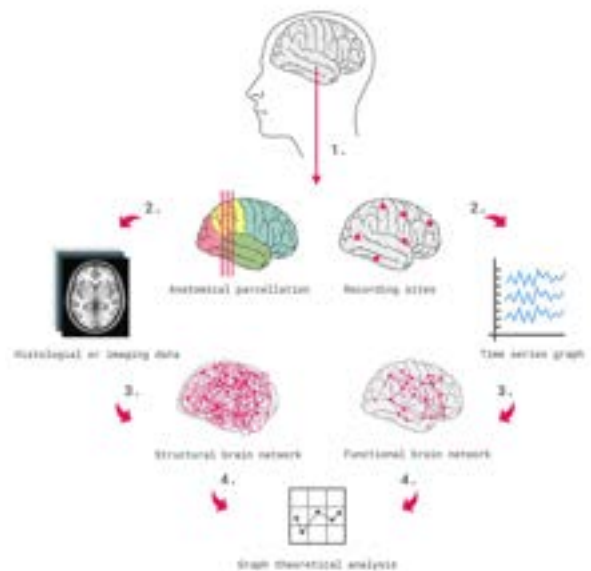
Systems pharmacology

Systems pharmacology is the application of systems biology principles to the field of pharmacology. It seeks to understand how drugs affect the human body as a single complex biological system.
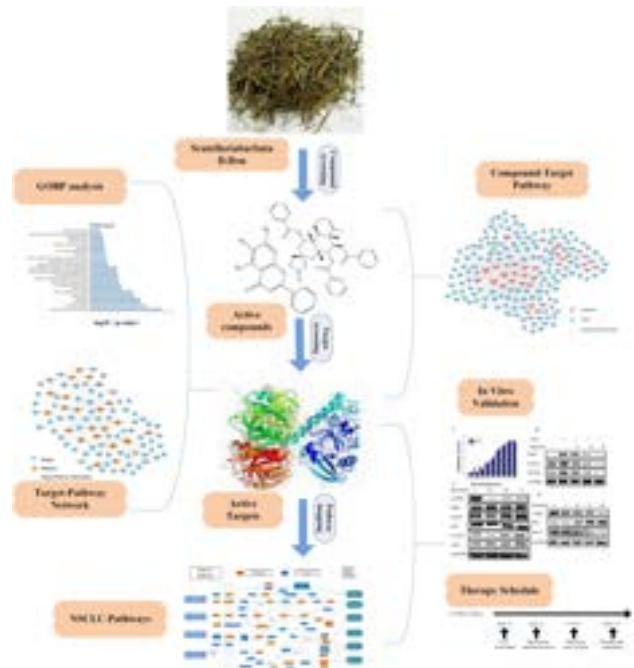
Systems philosophy

Systems philosophy is a discipline aimed at constructing a new philosophy (in the sense of worldview) by using systems concepts. The discipline was first described by Ervin Laszlo in his 1972 book Introduction to Systems Philosophy: Toward a New Paradigm of Contemporary Thought. It has been described as the "reorientation of thought and world view ensuing from the introduction of "systems" as a new scientific paradigm".

Individual Responsibility

Each individual person of the Company shall enrich humanity and enhance technological capability to provide customers with the best services.

Corporate Responsibility

We shall create a company where employees trust each other and work with a sense of assurance and satisfaction.

Social Responsibility

We shall create a company that is trusted by customers, investors and shareholders as well as needed by society.

We are determined to fulfill the following three responsibilities.

Systems psychology

Systems psychology is a branch of both theoretical psychology and applied psychology that studies human behaviour and experience as complex systems. It is inspired by systems theory and systems thinking, and based on the theoretical work of Roger Barker, Gregory Bateson, Humberto Maturana and others. Groups and individuals are considered as systems in homeostasis. Alternative terms here are "systemic psychology", "systems behavior", and "systems-based psychology".
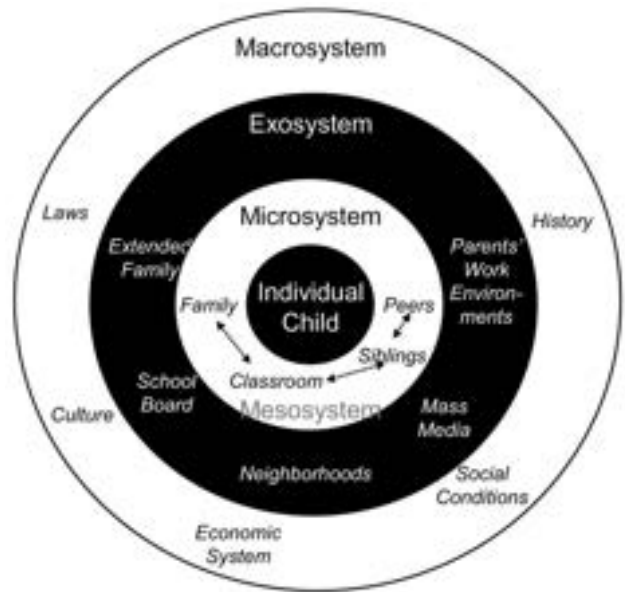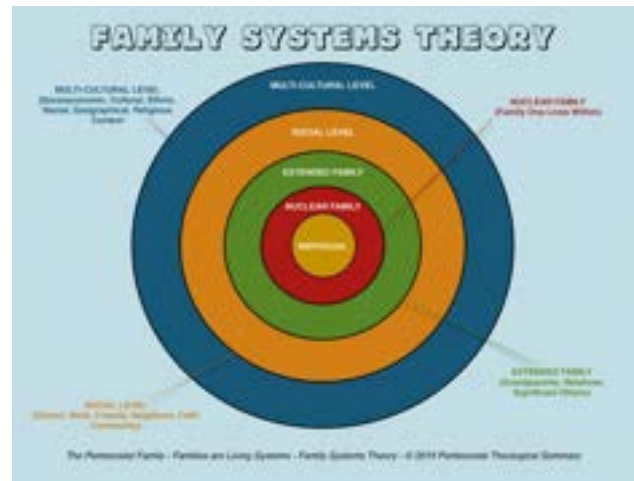
Systems science

Systems science, also referred to as systems research, or, simply, systems, is an interdisciplinary field concerned with understanding systems?from simple to complex?in nature, society, cognition, engineering, technology and science itself. The field is diverse, spanning the formal, natural, social, and applied sciences.
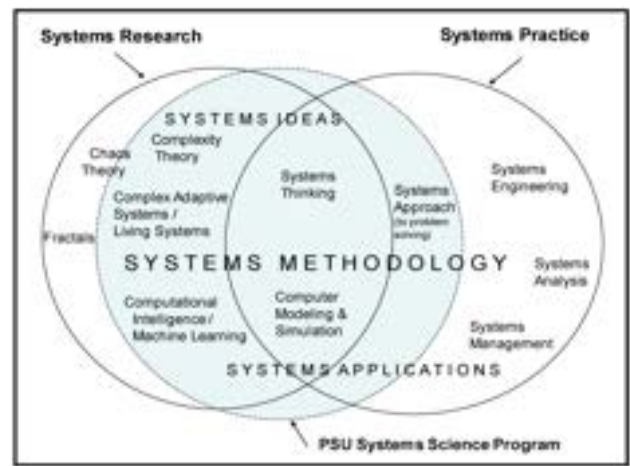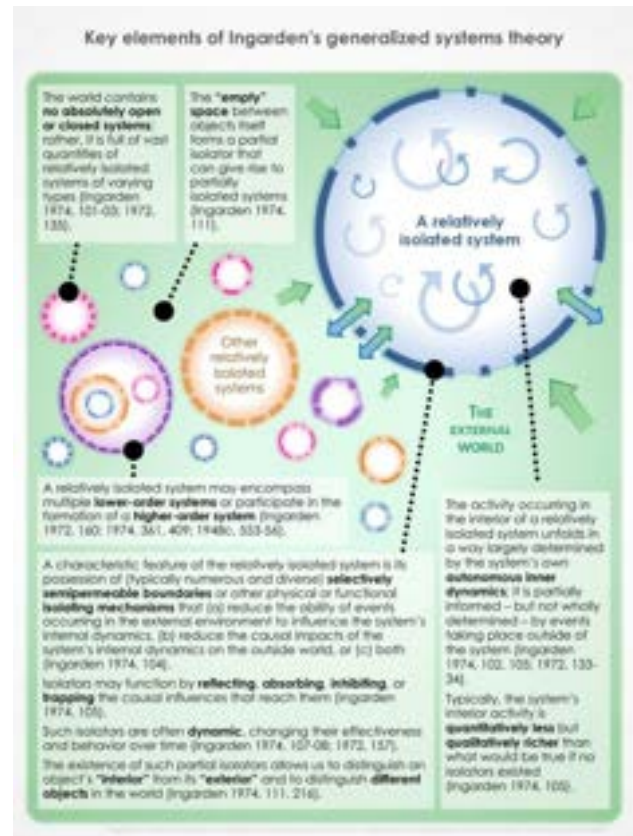
Systems theory

Systems theory is the interdisciplinary study of systems, i.e. cohesive groups of interrelated, interdependent components that can be natural or human-made. Every system has causal boundaries, is influenced by its context, defined by its structure, function and role, and expressed through its relations with other systems. A system is "more than the sum of its parts" by expressing synergy or emergent behavior.

Systems theory in anthropology

Systems theory in anthropology is an interdisciplinary, non-representative, non-referential, and non-Cartesian approach that brings together natural and social sciences to understand society in its complexity. The basic idea of a system theory in social science is to solve the classical problem of duality; mind-body, subject-object, form-content, signifier-signified, and structure-agency. System theory suggests that instead of creating closed categories into binaries (subject-object); the system should stay open so as to allow free flow of process and interactions. In this way the binaries are dissolved.

Key elements of Ingarden's generalized systems theory

Systems theory in archaeology

Systems theory in archaeology is the application of systems theory and systems thinking in archaeology. It originated with the work of Ludwig von Bertalanffy in the 1950s, and is introduced in archaeology in the 1960s with the work of Sally R. Binford & Lewis Binford's "New Perspectives in Archaeology" and Kent V. Flannery's "Archaeological Systems Theory and Early Mesoamerica".
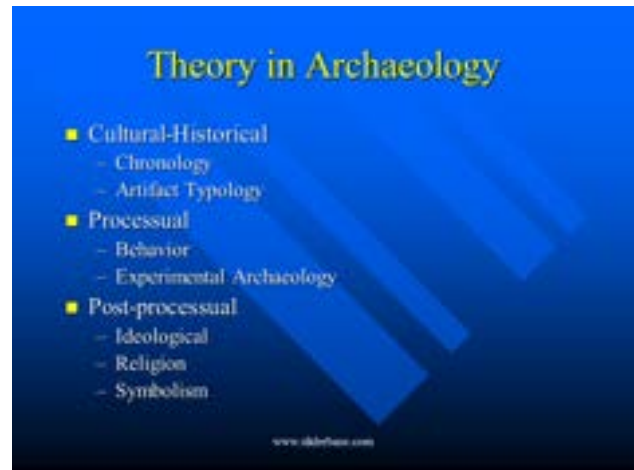
Systems theory in political science

Systems theory in political science is a highly abstract, partly holistic view of politics, influenced by cybernetics. The adaptation of system theory to political science was conceived by David Easton in 1953.

Systems thinking

Systems thinking is a way of making sense of the complexity of the world by looking at it in terms of wholes and relationships rather than by splitting it down into its parts. It has been used as a way of exploring and developing effective action in complex contexts, enabling systems change. Systems thinking draws on and contributes to systems theory and the system sciences.

TOPS-10

TOPS-10 System (Timesharing / Total Operating System-10) is a discontinued operating system from Digital Equipment Corporation (DEC) for the PDP-10 (or DECsystem-10) mainframe computer family. Launched in 1967, TOPS-10 evolved from the earlier "Monitor" software for the PDP-6 and PDP-10 computers; this was renamed to TOPS-10 in 1970.

TOPS-20

The TOPS-20 operating system by Digital Equipment Corporation (DEC) is a proprietary OS used on some of DEC's 36-bit mainframe computers. The Hardware Reference Manual was described as for "DECsystem-10/DECSYSTEM-20 Processor" (meaning the DEC PDP-10 and the DECSYSTEM-20).TOPS-20 began in 1969 as the TENEX operating system of Bolt, Beranek and Newman (BBN) and shipped as a product by DEC starting in 1976. TOPS-20 is almost entirely unrelated to the similarly named TOPS-10, but it was shipped with the PA1050 TOPS-10 Monitor Calls emulation facility which allowed most, but not all, TOPS-10 executables to run unchanged. As a matter of policy, DEC did not update PA1050 to support later TOPS-10 additions except where required by DEC software.

TOS/360

Disk Operating System/360, also DOS/360, or simply DOS, is the discontinued first member of a sequence of operating systems for IBM System/360, System/370 and later mainframes. It was announced by IBM on the last day of 1964, and it was first delivered in June 1966. In its time, DOS/360 was the most widely used operating system in the world.

TSS/360

The IBM Time Sharing System TSS/360 is a discontinued early time-sharing operating system designed exclusively for a special model of the System/360 line of mainframes, the Model 67. Made available on a trial basis to a limited set of customers in 1967, it was never officially released as a supported product by IBM. TSS pioneered a number of novel features, some of which later appeared in more popular systems such as MVS. TSS was migrated to System/370 and 303x systems, but despite its many advances and novel capabilities, TSS failed to meet expectations and was eventually canceled. TSS/370 was used as the basis for a port of UNIX to the IBM mainframe. TSS/360 also inspired the development of the TSS/8 operating system.

Tablet computer

A tablet computer, commonly shortened to tablet, is a mobile device, typically with a mobile operating system and touchscreen display processing circuitry, and a rechargeable battery in a single, thin and flat package. Tablets, being computers, do what other personal computers do, but lack some input/output (I/O) abilities that others have. Modern tablets largely resemble modern smartphones, the only differences being that tablets are relatively larger than smartphones, with screens 7 inches (18 cm) or larger, measured diagonally, and may not support access to a cellular network. Unlike laptops (which have traditionally run off operating systems usually designed for desktops), tablets usually run mobile operating systems, alongside smartphones.

Talcott Parsons

Talcott Parsons (December 13, 1902 ? May 8, 1979) was an American sociologist of the classical tradition, best known for his social action theory and structural functionalism. Parsons is considered one of the most influential figures in sociology in the 20th century. After earning a PhD in economics, he served on the faculty at Harvard University from 1927 to 1973. In 1930, he was among the first professors in its new sociology department. Later, he was instrumental in the establishment of the Department of Social Relations at Harvard.

Tandem

Tandem, or in tandem, is an arrangement in which a team of machines, animals or people are lined up one behind another, all facing in the same direction.The original use of the term in English was in tandem harness, which is used for two or more draft horses, or other draft animals, harnessed in a single line one behind another, as opposed to a pair, harnessed side by side, or a team of several pairs. The tandem harness allows additional animals to provide pulling power for a vehicle designed for a single animal.

TempleOS

TempleOS (formerly J Operating System, LoseThos, and SparrowOS) is a biblical-themed lightweight operating system (OS) designed to be the Third Temple prophesied in the Bible. It was created by American programmer Terry A. Davis, who developed it alone over the course of a decade after a series of manic episodes that he later described as a revelation from God.
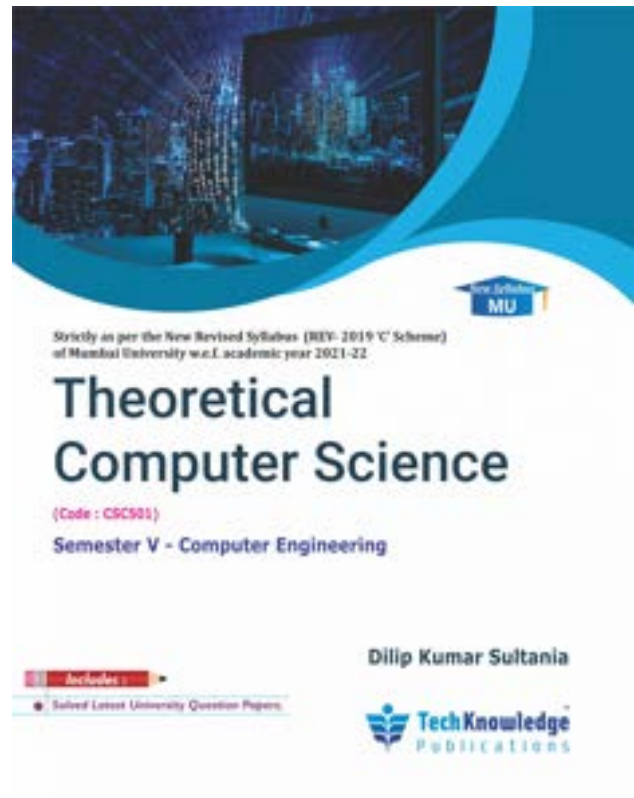
The Open Group

The Open Group is a global consortium that seeks to "enable the achievement of business objectives" by developing "open, vendor-neutral technology standards and certifications." It has over 840 member organizations and provides a number of services, including strategy, management, innovation and research, standards, certification, and test development. It was established in 1996 when X/Open merged with the Open Software Foundation.

Theoretical computer science

Theoretical computer science (TCS) is a subset of general computer science and mathematics that focuses on mathematical aspects of computer science such as the theory of computation, lambda calculus, and type theory.

Strictly as per the New Revised Syllabus (REV- 2019 'C' Scheme) of Mumbai University w.e.f. academic year 2021-22

Theoretical Computer Science

(Code : CSC501)

Semester V - Computer Engineering

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● Solved Latest University Question Papers

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Theory of computation

In theoretical computer science and mathematics, the theory of computation is the branch that deals with what problems can be solved on a model of computation, using an algorithm, how efficiently they can be solved or to what degree (e.g., approximate solutions versus precise ones). The field is divided into three major branches: automata theory and formal languages, computability theory, and computational complexity theory, which are linked by the question: "What are the fundamental capabilities and limitations of computers?".In order to perform a rigorous study of computation, computer scientists work with a mathematical abstraction of computers called a model of computation. There are several models in use, but the most commonly examined is the Turing machine. Computer scientists study the Turing machine because it is simple to formulate, can be analyzed and used to prove results, and because it represents what many consider the most powerful possible "reasonable" model of computation (see Church?Turing thesis). It might seem that the potentially infinite memory capacity is an unrealizable attribute, but any decidable problem solved by a Turing machine will always require only a finite amount of memory. So in principle, any problem that can be solved (decided) by a Turing machine can be solved by a computer that has a finite amount of memory.
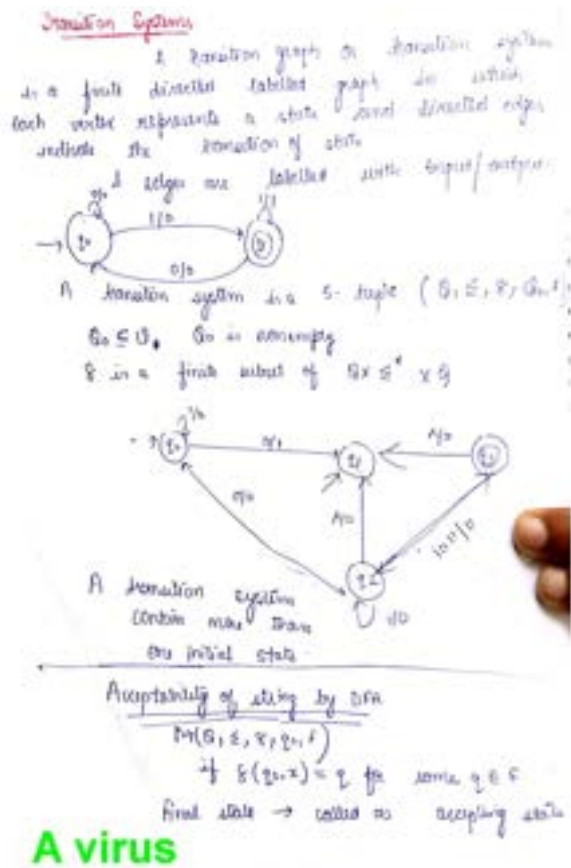
Thomas E. Anderson

Thomas E. Anderson (born August 28, 1961) is an American computer scientist noted for his research on distributed computing, networking and operating systems.

Thread (computing)

In computer science, a thread of execution is the smallest sequence of programmed instructions that can be managed independently by a scheduler, which is typically a part of the operating system. The implementation of threads and processes differs between operating systems. In Modern Operating Systems, Tanenbaum shows that many distinct models of process organization are possible. In many cases, a thread is a component of a process. The multiple threads of a given process may be executed concurrently (via multithreading capabilities), sharing resources such as memory, while different processes do not share these resources. In particular, the threads of a process share its executable code and the values of its dynamically allocated variables and non-thread-local global variables at any given time.

Tim Berners-Lee

Sir Timothy John Berners-Lee, (born 8 June 1955), also known as TimBL, is an English computer scientist best known as the inventor of the World Wide Web. He is a professorial research fellow at the University of Oxford and a professor emeritus at the Massachusetts Institute of Technology (MIT). Berners-Lee proposed an information management system on 12 March 1989, then implemented the first successful communication between a Hypertext Transfer Protocol (HTTP) client and server via the Internet in mid-November.Berners-Lee is the director of the World Wide Web Consortium (W3C), which oversees the continued development of the Web. He co-founded (with his then-wife-to-be Rosemary Leith) the World Wide Web Foundation. He is a senior researcher and holder of the 3Com founder's chair at the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL). He is a director of the Web Science Research Initiative (WSRI) and a member of the advisory board of the MIT Center for Collective Intelligence. In 2011, he was named as a member of the board of trustees of the Ford Foundation. He is a founder and president of the Open Data Institute and is currently an advisor at social network MeWe.He devised and implemented the first Web browser and Web server, and helped foster the Web's subsequent explosive development. He currently directs the W3 Consortium, developing tools and standards to further the Web's potential. In April 2009, he was elected as Foreign Associate of the National Academy of Sciences.In 2004, Berners-Lee was knighted by Queen Elizabeth II for his pioneering work. He was named in Time magazine's list of the 100 Most Important People of the 20th century and has received a number of other accolades for his invention.

Time slice

In computing, preemption is the act of temporarily interrupting an executing task, with the intention of resuming it at a later time. This interrupt is done by an external scheduler with no assistance or cooperation from the task.:?153? This preemptive scheduler usually runs in the most privileged protection ring, meaning that interruption and resuming are considered highly secure actions. Such a change in the currently executing task of a processor is known as context switching.

Time-sharing

In computing, time-sharing is the sharing of a computing resource among many users at the same time by means of multiprogramming and multi-tasking.Its emergence as the prominent model of computing in the 1970s represented a major technological shift in the history of computing. By allowing many users to interact concurrently with a single computer, time-sharing dramatically lowered the cost of providing computing capability, made it possible for individuals and organizations to use a computer without owning one, and promoted the interactive use of computers and the development of new interactive applications.
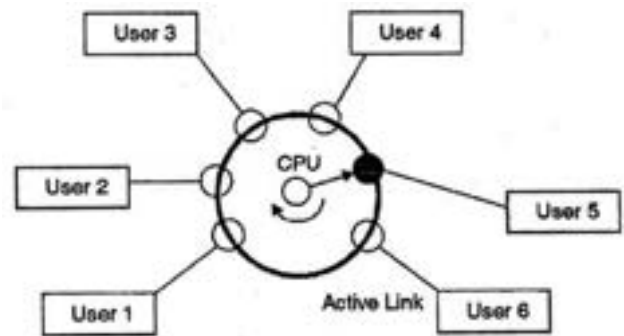
Timeline of operating systems

This article presents a timeline of events in the history of computer operating systems from 1951 to the current day. For a narrative explaining the overall developments, see the History of operating systems.

Transaction Processing Facility

Transaction Processing Facility (TPF) is an IBM real-time operating system for mainframe computers descended from the IBM System/360 family, including zSeries and System z9.

Trusted Computer System Evaluation Criteria

Trusted Computer System Evaluation Criteria (TCSEC) is a United States Government Department of Defense (DoD) standard that sets basic requirements for assessing the effectiveness of computer security controls built into a computer system. The TCSEC was used to evaluate, classify, and select computer systems being considered for the processing, storage, and retrieval of sensitive or classified information.The TCSEC, frequently referred to as the Orange Book, is the centerpiece of the DoD Rainbow Series publications. Initially issued in 1983 by the National Computer Security Center (NCSC), an arm of the National Security Agency, and then updated in 1985, TCSEC was eventually replaced by the Common Criteria international standard, originally published in 2005.

Trusted Computer System Evaluation Criteria (TCSEC)

- D – žiadna ochrana
- C – diskrétne riadenie prístupu
  - C1 – nepovinná vzájomná ochrana používateľov
  - C2 – voliteľné riadenie prístupu
- B – povinné riadenie prístupu
  - B1 - povinné riadenie prístupu
  - B2 – štruktúrovaná ochrana
  - B3 – bezpečnostné domény
- A – verifikovaný návrh
  - funkčná zhoda s B3 + formálne preveriteľné vlastnosti

Trusted operating system

Trusted Operating System (TOS) generally refers to an operating system that provides sufficient support for multilevel security and evidence of correctness to meet a particular set of government requirements.

Security Models and Designing a
Trusted Operating System

MANIKANDAN SUBBU

Tux (mascot)

Tux is a penguin character and the official brand character of the Linux kernel. Originally created as an entry to a Linux logo competition, Tux is the most commonly used icon for Linux, although different Linux distributions depict Tux in various styles. The character is used in many other Linux programs and as a general symbol of Linux.

Twelve leverage points

The twelve leverage points to intervene in a system were proposed by Donella Meadows, a scientist and system analyst who studied environmental limits to economic growth.
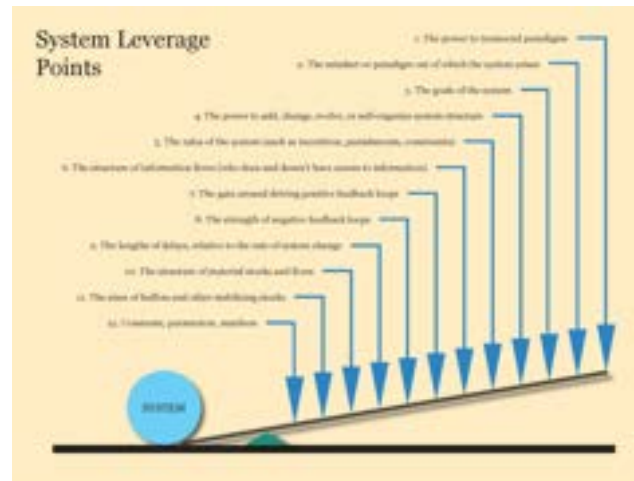
UNIVAC

UNIVAC (Universal Automatic Computer) was a line of electronic digital stored-program computers starting with the products of the Eckert?Mauchly Computer Corporation. Later the name was applied to a division of the Remington Rand company and successor organizations.

UNIVAC 1108

The UNIVAC 1100/2200 series is a series of compatible 36-bit computer systems, beginning with the UNIVAC 1107 in 1962, initially made by Sperry Rand. The series continues to be supported today by Unisys Corporation as the ClearPath Dorado Series. The solid-state 1107 model number was in the same sequence as the earlier vacuum-tube computers, but the early computers were not compatible with the solid-state successors.

UNIX

Unix (; trademarked as UNIX) is a family of multitasking, multiuser computer operating systems that derive from the original AT&T Unix, whose development started in 1969 at the Bell Labs research center by Ken Thompson, Dennis Ritchie, and others.Initially intended for use inside the Bell System, AT&T licensed Unix to outside parties in the late 1970s, leading to a variety of both academic and commercial Unix variants from vendors including University of California, Berkeley (BSD), Microsoft (Xenix), Sun Microsystems (SunOS/Solaris), HP/HPE (HP-UX), and IBM (AIX). In the early 1990s, AT&T sold its rights in Unix to Novell, which then sold the UNIX trademark to The Open Group, an industry consortium founded in 1996. The Open Group allows the use of the mark for certified operating systems that comply with the Single UNIX Specification (SUS).

UNIX System Services

z/OS UNIX System Services (z/OS UNIX, or informally USS) is a base element of z/OS. z/OS UNIX is a certified UNIX operating system implementation (XPG4 UNIX 95) optimized for mainframe architecture. It is the first UNIX 95 to not be derived from the AT&T source code. Through integration with the rest of z/OS, additional Time Sharing Option (TSO) commands are available alongside the usual UNIX services, making it possible to process UNIX files using ISPF. Extensions in JCL make it possible to use these files in batch processing.
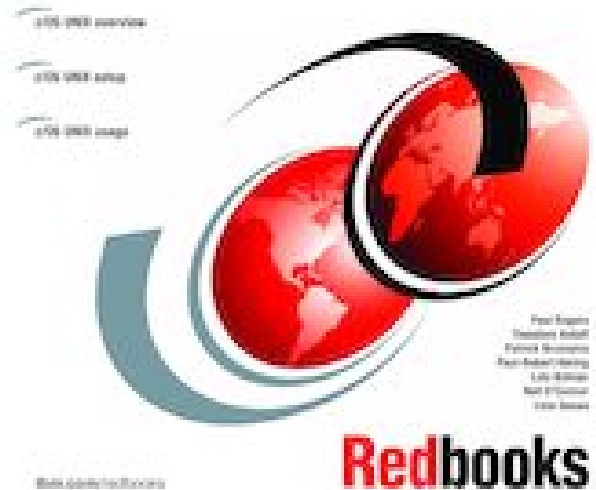
USB flash drive

A USB flash drive (also called a thumb drive in the US, or a memory stick in the UK) is a data storage device that includes flash memory with an integrated USB interface. It is typically removable, rewritable and much smaller than an optical disc. Most weigh less than 30 g (1 oz). Since first appearing on the market in late 2000, as with virtually all other computer memory devices, storage capacities have risen while prices have dropped. As of March 2016, flash drives with anywhere from 8 to 256 gigabytes (GB) were frequently sold, while 512 GB and 1 terabyte (TB) units were less frequent. As of 2018, 2 TB flash drives were the largest available in terms of storage capacity. Some allow up to 100,000 write/erase cycles, depending on the exact type of memory chip used, and are thought to physically last between 10 and 100 years under normal circumstances (shelf storage time).

Ubiquitous computing

Ubiquitous computing (or "ubicomp") is a concept in software engineering, hardware engineering and computer science where computing is made to appear anytime and everywhere. In contrast to desktop computing, ubiquitous computing can occur using any device, in any location, and in any format. A user interacts with the computer, which can exist in many different forms, including laptop computers, tablets, smart phones and terminals in everyday objects such as a refrigerator or a pair of glasses. The underlying technologies to support ubiquitous computing include Internet, advanced middleware, operating system, mobile code, sensors, microprocessors, new I/O and user interfaces, computer networks, mobile protocols, location and positioning, and new materials.

Ubuntu (operating system)

Ubuntu ((listen) uu-BUUN-too) is a Linux distribution based on Debian and composed mostly of free and open-source software. Ubuntu is officially released in three editions: Desktop, Server, and Core for Internet of things devices and robots. All of the editions can run on a computer alone, or in a virtual machine. Ubuntu is a popular operating system for cloud computing, with support for OpenStack. Ubuntu's default desktop changed back from the in-house Unity to GNOME after nearly 6.5 years in 2017 upon the release of version 17.10.Ubuntu is released every six months, with long-term support (LTS) releases every two years. As of October 2022, the most-recent release is 22.10 ("Kinetic Kudu"), and the current long-term support release is 22.04 ("Jammy Jellyfish").

Unikernel

A unikernel is a specialised, single address space machine image constructed by using library operating systems. A developer selects, from a modular stack, the minimal set of libraries which correspond to the OS constructs required for the application to run. These libraries are then compiled with the application and configuration code to build sealed, fixed-purpose images (unikernels) which run directly on a hypervisor or hardware without an intervening OS such as Linux or Windows.

Unisys

Unisys Corporation is an American multinational information technology (IT) services and consulting company founded in 1986 and headquartered in Blue Bell, Pennsylvania. The company has offices globally and provides digital workplace, cloud applications & infrastructure, enterprise computing and business process services to the world?s leading organizations.

United States Department of Defense

The United States Department of Defense (DoD, USDOD or DOD) is an executive branch department of the federal government charged with coordinating and supervising all agencies and functions of the U.S. government directly related to national security and the United States Armed Forces. The DoD is the largest employer in the world, with over 1.34 million active-duty service members (soldiers, marines, sailors, airmen, and guardians) as of June 2022. The DoD also maintains over 778,000 National Guard and reservists, and over 747,000 civilians bringing the total to over 2.87 million employees. Headquartered at the Pentagon in Arlington, Virginia, just outside Washington, D.C., the DoD's stated mission is to provide "the military forces needed to deter war and ensure our nation's security".The Department of Defense is headed by the secretary of defense, a cabinet-level head who reports directly to the president of the United States. Beneath the Department of Defense are three subordinate military departments: the Department of the Army, the Department of the Navy, and the Department of the Air Force. In addition, four national intelligence services are subordinate to the Department of Defense: the Defense Intelligence Agency (DIA), the National Security Agency (NSA), the National Geospatial-Intelligence Agency (NGA), and the National Reconnaissance Office (NRO).

Universal Disk Format

Universal Disk Format (UDF) is an open, vendor-neutral file system for computer data storage for a broad range of media. In practice, it has been most widely used for DVDs and newer optical disc formats, supplanting ISO 9660. Due to its design, it is very well suited to incremental updates on both recordable and (re)writable optical media. UDF was developed and maintained by the Optical Storage Technology Association (OSTA).

Universal Disk Format (UDF)
José Urich y Abraham Santana

Universal Turing machine

In computer science, a universal Turing machine (UTM) is a Turing machine that can simulate an arbitrary Turing machine on arbitrary input. The universal machine essentially achieves this by reading both the description of the machine to be simulated as well as the input to that machine from its own tape. Alan Turing introduced the idea of such a machine in 1936?1937. This principle is considered to be the origin of the idea of a stored-program computer used by John von Neumann in 1946 for the "Electronic Computing Instrument" that now bears von Neumann's name: the von Neumann architecture.In terms of computational complexity, a multi-tape universal Turing machine need only be slower by logarithmic factor compared to the machines it simulates.
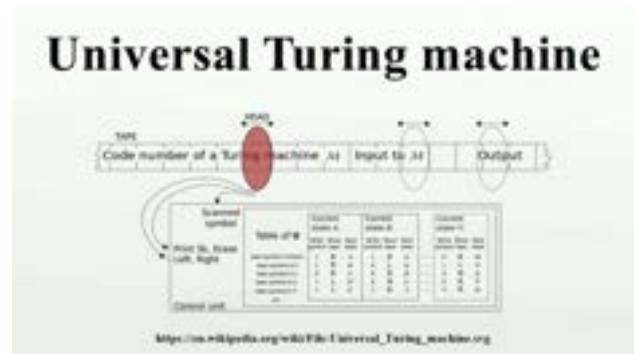
University of California, Berkeley

The University of California, Berkeley (UC Berkeley, Berkeley, Cal, or California) is a public land-grant research university in Berkeley, California. Established in 1868 as the University of California, it is the state's first land-grant university and the founding campus of the University of California system. Its fourteen colleges and schools offer over 350 degree programs and enroll some 32,000 undergraduate and 13,000 graduate students. Berkeley ranks among the world's top universities.A founding member of the Association of American Universities, Berkeley hosts many leading research institutes dedicated to science, engineering, and mathematics. The university founded and maintains close relationships with three national laboratories at Berkeley, Livermore and Los Alamos, and has played a prominent role in many scientific advances, from the Manhattan Project and the discovery of 16 chemical elements to breakthroughs in computer science and genomics. Berkeley is also known for political activism and the Free Speech Movement of the 1960s.Berkeley's athletic teams, which compete as the California Golden Bears primarily in the Pac-12 Conference, have won 107 national championships, and its students and alumni have won 223 Olympic medals (including 121 gold medals).Among its alumni, faculty and researchers, Berkeley has more Nobel laureates (107), Turing Award winners (25), Fields Medalists (14), and Wolf Prize winners (30) than any other public university in the nation; it is affiliated with 34 Pulitzer Prizes, 19 Academy Awards, and more MacArthur "Genius Grants" (108) and National Medals of Science (68) than any other public institution.

Unix

Unix (; trademarked as UNIX) is a family of multitasking, multiuser computer operating systems that derive from the original AT&T Unix, whose development started in 1969 at the Bell Labs research center by Ken Thompson, Dennis Ritchie, and others.Initially intended for use inside the Bell System, AT&T licensed Unix to outside parties in the late 1970s, leading to a variety of both academic and commercial Unix variants from vendors including University of California, Berkeley (BSD), Microsoft (Xenix), Sun Microsystems (SunOS/Solaris), HP/HPE (HP-UX), and IBM (AIX). In the early 1990s, AT&T sold its rights in Unix to Novell, which then sold the UNIX trademark to The Open Group, an industry consortium founded in 1996. The Open Group allows the use of the mark for certified operating systems that comply with the Single UNIX Specification (SUS).

Unix-like

A Unix-like (sometimes referred to as UN*X or *nix) operating system is one that behaves in a manner similar to a Unix system, although not necessarily conforming to or being certified to any version of the Single UNIX Specification. A Unix-like application is one that behaves like the corresponding Unix command or shell. Although there are general philosophies for Unix design, there is no technical standard defining the term, and opinions can differ about the degree to which a particular operating system or application is Unix-like.
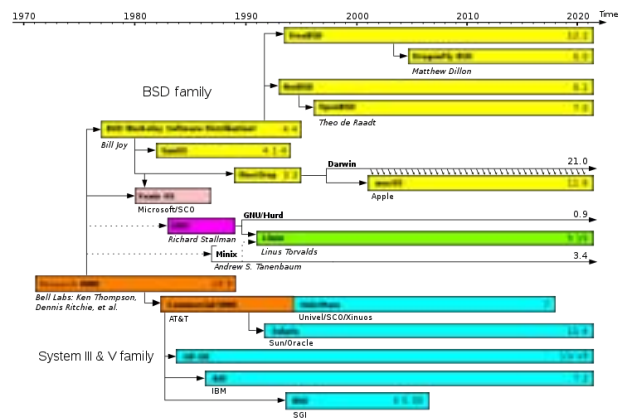
Unsupervised learning

Unsupervised learning is a type of algorithm that learns patterns from untagged data. The goal is that through mimicry, which is an important mode of learning in people, the machine is forced to build a concise representation of its world and then generate imaginative content from it.
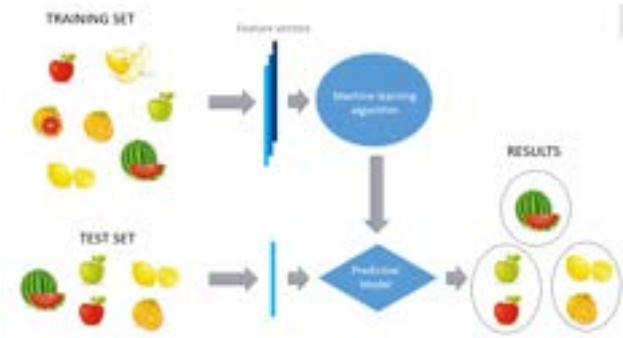
Urban metabolism

Urban metabolism is a model to facilitate the description and analysis of the flows of the materials and energy within cities, such as undertaken in a material flow analysis of a city. It provides researchers with a metaphorical framework to study the interactions of natural and human systems in specific regions. From the beginning, researchers have tweaked and altered the parameters of the urban metabolism model. C. Kennedy and fellow researchers have produced a clear definition in the 2007 paper The Changing Metabolism of Cities claiming that urban metabolism is "the sum total of the technical and socio-economic process that occur in cities, resulting in growth, production of energy and elimination of waste." With the growing concern of climate change and atmospheric degradation, the use of the urban metabolism model has become a key element in determining and maintaining levels of sustainability and health in cities around the world. Urban metabolism provides a unified or holistic viewpoint to encompass all of the activities of a city in a single model.