Glossary

A

Access point (AP): AP stands for access point. Typically, infrastructure-based wireless networks provide access to the wired backbone network via an AP. The AP may act as a repeater, bridge, router, or even gateway to regenerate, forward, filter, or translate messages. All communication between mobile devices has to take place via the AP.

Ad hoc network: A class of wireless network architecture in which there is no fixed infrastructure or wireless access points. In ad hoc networks, each mobile station acts as a router to communicate with other stations. Such a network can exist on a temporary basis to share some resources among the mobile stations.

Animation: The abstract execution of a system model. The terms animation and simulation are barely distinguished, though animation has the sense of symbolic execution while simulation has a more general sense and may deal with performance.

ARP: Address Resolution Protocol is used to translate between IP addresses and hardware addresses. There is an arp utility found on both Microsoft and UNIX operating systems which can be used to view and modify the ARP cache.

Assets: Valuables of an organization which need to be protected.
**Boolean expression:** An expression which results in a Boolean (binary or TRUE/FALSE) value. For example $4 > 3$ is a Boolean expression. All expressions that contain relational operators like $>$, $<$, and so forth are Boolean. Logical gates and their combinations are used to implement physical representations of Boolean expressions.

**Brainstorm map:** A brainstorm map and discussion can improve students’ creative thinking and critical reasoning, communication, cooperation, and decision-making skills and provide students with various viewpoints. Students record their thoughts regarding what they already know and what they need to know on a brainstorm map.

**Broadcast domain:** Devices attached to the network that each receive a broadcast packet sent from any of these devices are said to be in a broadcast domain.

**Bus contention:** This is an erroneous condition that occurs when multiple devices attempt to put data on the data lines of the bus at the same time.

**Cache:** A small fast memory which stores recently used values so that they can be accessed faster than the bulk memory behind it.

**Cases:** Abstraction of real problems that are used for training purposes.

**Colligo software:** A commercial software package that allows users to run collaborative applications such as interactive chat, unidirectional message delivery, virtual whiteboard, and file transfer.

**Collision:** When two or more packets are simultaneously sent on a common network medium that only can transmit a single packet at a time. The packets collide and are corrupted and need to be resent.

**Collision domain:** A single physical or logical network segment using Ethernet technology through which collisions will be propagated. Devices in a collision domain communicate directly with each other and share the network medium.

**Computer hardware:** Generally refers to electronic, electrical, and mechanical components that make up a computer.

**Concept map:** A concept map is a knowledge representation commonly used in education. It is a graphical node-arc representation illustrating the relationship among concepts.
Concrete: Something that involves the immediate experience rather than an abstraction. A “concrete learner” is someone who prefers learning primarily through hands-on activities rather than by studying a theoretical model.

Constructivism: A theory of learning which regards learning as a process of developing knowledge through the construction and reconstruction of concepts and ideas, providing learners with motivation, and supporting self-directed learning.

Controls: Implementations for reduction of risk and vulnerability.

Cooperative learning: Cooperative learning focuses on student interaction. Cooperative learning exposes students to different perspectives that can enrich their understanding. Cooperative learning can enhance critical and reasoning skills and improve tolerance of and willingness to adopt new concepts.

CRC: CRC stands for cyclic redundancy check. This is a method for checking for errors in a data stream. It uses a polynomial (a pattern of ones and zeros) as a divisor in a modified division of the entire data stream. The remainder of the division is appended to the message along with the data to be used as a verification by the receiver of the data stream.

Cross-development: The process of using software development tools like compilers, linkers, and debuggers which are resident on a reprogrammable computer to produce executable programs for an embedded computer system. The executable programs must then be transferred from the reprogrammable computer (called the development system) to the embedded computer (called the target system) for testing.

Cycle-accurate: A simulator which models the operation of a processor on a cycle-by-cycle basis so that the state of the processor at the end of each cycle is correct.

D

Daisy-chaining: This is a configuration that connects the inputs of multiple devices together using a single conductor.

Data acquisition: The discipline of sampling signals from the physical world so that the data can be analyzed or processed by a computer.

Data link layer: This is the second layer of the OSI model, and it defines the pattern or purpose of the bits of a frame. Except for the physical layer, which defines the electronics behind a computer interface, it is the lowest level of the OSI model.
**Data path:** The main path along which data flows in a processor; usually extends from an instruction fetch unit to a result write-back one.

**Datagram:** A datagram is a block of data meant to be treated as a unit. If the datagram is too large to be handled by a network, it is possible to fragment it for transmission into smaller packets.

**Deep learning:** The process by which a person comes to achieve a critical awareness of a particular item of information or an idea as well as how this information can be used in the real world, why it should be used, in what ways and what situations it is applicable, and its relationship to other matters.

**Device interface:** Sometimes referred to as a transducer, it is the circuit element that converts physical phenomenon to electrical signals and eventually to digital values readable by the processor.

**DHCP:** Dynamic Host Control Protocol is used to issue and obtain IP addresses, both on local area networks and wide area networks.

**Digital logic probe:** A simple test device that is used to sense whether a binary one or a binary zero is present on a digital conductor.

**DLL:** Stands for dynamic link library. This is a library of functions that are available to the applications of an operating system at runtime. They are not required to be part of the compile process, rather they are loaded as needed when the application is executed.

**DNS:** The domain name system is a service used to map between hostnames and IP addresses and allow for resolution of hostnames to IP addresses.

**Dynamic loading:** The ability of a system to load additional software components (e.g., Java classes) as it executes.

**Dynamic routing:** A form of routing in which the routes that packets take in a network are able to change as a function of time. The routes can change as a result of node or link failures or as a result of node or link characteristics (speed, cost, etc.), including the volume of traffic that is currently being serviced.

**EEPROM:** EEPROM stands for electrically erasable ROM. This type of memory differs from ROM in that the contents can be changed if suitable voltages are applied to the memory chip.

**Embedded computer system:** Computers that are comprised of a processor (microprocessor or microcontroller), memory, and I/O devices that are
“special purpose” in that they are tightly coupled to or even architecturally a component of other systems with which they interact. Their primary I/O devices are usually not human-user-centric. Examples are regulators and controllers in domestic appliances and automotive systems, negative feedback automatic control systems in the chemical process industries, and autopilots for ships and aircraft.


**Ethernet:** A popular LAN technology that uses a shared channel and the CSMA/CD access method. Basic Ethernet operates at 10 Mbps, Fast Ethernet operates at 100 Mbps, and Gigabit Ethernet operates at 1,000 Mbps.

**Exchange:** Exchange Server 2003 is Microsoft’s latest mail server and as an enterprise server application requires significant resources in terms of processor, RAM, and disk space.

**Experiential learning:** A process through which a learner constructs knowledge, skill, and value based on direct experiences. Engage students in critical thinking, problem solving, and decision making in contexts that are personally relevant and connected to academic learning objectives by incorporating active learning.

**Experiential learning:** Learning as a continuous spiral of concrete experience, observation and reflection, development of abstract concepts, and testing in new situations.

**F**

**Firewall:** A software application running on a device that is responsible for filtering incoming and outgoing traffic.

**Formal language, formal method:** A mathematically based technique for precisely specifying and analyzing systems through abstract models. Major classes of formal methods include those based on process algebras (e.g., the LOTOS language) or on state machines (e.g., the SDL language).

**G**

**Gateway address:** Usually the address of the default route to be used to reach a network that is not specifically known.
GNU: Technically means “Gnu’s Not Unix” (a weak recursive pun). GNU is a project run by the Free Software Foundation, established to produce a free Unix-style operating system (not to be confused with Linux, even though it often comes with some GNU tools). Ethereal uses the copyright license (sometimes called “copyleft”) developed by this project.

GUI: GUI stands for graphical user interface. Most of the modern operating systems provide a GUI, which enables a user to use a pointing device, such as a computer mouse, to provide the computer with information about the user’s intentions.

H

Hazard: A situation in which a processor with multiple functional units could compute an incorrect value by using the wrong data if appropriate precautions are not taken.

Hub: A networking device that interconnects two or more workstations in a star-wired local area network and broadcasts incoming data onto all outgoing connections. To avoid signal collision only one user can transmit data through the hub at a time.

I

IBSS: Or independent basic service set. A wireless LAN configuration without access points. An IBSS is also referred to as an ad hoc mode wireless network.

IC: Stands for integrated circuit. This is the circuitry contained within a chip or component of the circuit board of a computer system.

IEEE 802.11b/a/g: Generally refers to wireless LAN standards. The IEEE 802.11b is the wireless LAN standard with a maximum bandwidth of 11 Mbps operating at 2.4 GHz. The IEEE 802.11a is the high-speed wireless LAN with a maximum bandwidth of 54 Mbps operating at 5 GHz. The IEEE 802.11g is backward compatible with the IEEE 802.11b, with a maximum bandwidth of 54 Mbps operating at 2.4 GHz.

Inert Knowledge: Knowledge that is theoretical but difficult to apply in other areas.

iNetwork Software: An interactive learning tool that teaches students about data communication and networking.
**Information assurance:** Conducting operations that protect and defend information and information systems by ensuring availability, integrity, authentication, confidentiality, and non-repudiation. This includes providing for restoration of information systems by incorporating protection, detection, and reaction capabilities.

**Infrared:** Electromagnetic waves whose frequency range is above that of microwave but below the visible spectrum. The applications of infrared technology include TV remote control and wireless LAN systems.

**Infrastructure network:** A class of wireless network architecture in which mobile stations communicate with each other via access points, which are usually linked to a wired backbone. Such a network has a fixed infrastructure and a centralized control.

**Internetwork (or internet):** A network of networks made up of separate networks connected by devices such as routers. The global Internet is the definitive example of this.

**I/O port:** A bus on the Intel 80x86 processors that uses the same address and data lines as the memory bus but different read and write control lines.

**IOS:** Internetworking Operating System. A proprietary operating system found on Cisco networking devices.

**IP address (Internet address):** A network address expressed as a 32-bit number and usually represented in dotted decimal as four decimal numbers separated by full stops. Every device connected to an internet, including the global Internet, has a unique IP address. The IP address identifies the device and the network that device is on. This form is currently the standard, but later Internet protocols define addresses in a different format.

**ISA:** Internet and Acceleration Server is Microsoft’s firewall and proxy server application. It followed Proxy Server 2.0 and was released in its first version in 2000. Another version was released in 2004.

**ISP:** ISP stands for Internet service provider. This is a company that acts as an access point for users of the Internet.

**K**

**K-maps:** This term refers to Karnaugh maps, a logical minimization method based on graphical representation of Boolean functions in which each row in the truth table of the Boolean function is represented as a box. Unlike the truth table, K-map values of input must be ordered such that the values of adjacent columns vary by one single bit.
LAN: LAN stands for local area network. A class of computer network suitable for a relatively small geographic area, for example, a room, a building, or a campus. A LAN is owned by a single organization and physically located within the organization’s premises. Ethernet is the most popular LAN architecture.

LCD displays: LCD stands for liquid crystal display, which is a flat panel display that uses liquid crystal to present information on the screen. The liquid crystal is contained between two sheets of transparent material. When an electric current passes through the crystals, they twist. This causes some light waves to be blocked and allows others to pass through, which creates the images on the screen.

LED: Stands for light-emitting diode. This is a solid-state device that glows brightly when a small current passes through it from one input to the other.

Logic minimization: Simplification of Boolean expressions with the aim of reducing the number of logical gates. This is done by reducing the number of minterms into a number of prime implicants in which as many variables as possible are eliminated. The tabular method makes repeated use of the rule \( \bar{A} + A = 1 \).

Logic gate: An electronic device (based on transistors) used for implementing logical functions. The inputs and outputs of the gate are Boolean (i.e., binary) values. Gates can be used to implement various Boolean functions. NOT gates take one input and have one output. The AND, NAND, OR, and NOR gates may take two or more inputs and have one output. XOR gates take two inputs and have one output. Logical functions are all combinational functions, that is, their output depends on the input. Gates can also be used to implement latches and flip-flops which have an internal state and are used to implement sequential logical systems.

LOGIC-Minimiser: Software package developed at the Auckland University of Technology to enhance teaching and learning minimization of Boolean expressions. The package was implemented in C programming language.

Logical topology: This refers to the way the data is sent through the network from one computer (or device) to another.

MAC address: MAC stands for Medium Access Control. The MAC address is a six-octet value that is permanently assigned to a NIC to uniquely
identify it in any network. MAC addresses are loaded into the NIC by the manufacturer and cannot be modified. The first three octets identify the manufacturer.

**Mail-Server**: an application responsible for handling incoming and outgoing emails.

**MAN**: MAN stands for metropolitan area network. A MAN is a backbone network that links multiple LANs in a large city or a metropolitan region.

**Medium**: The communications link or network that carries protocol messages.

**Message**: The structured data communicated by a protocol. Parameters of a message typically include the message type, sequence number, control flags, and user data.

**Minterms**: This term refers to the product of Boolean variables. These variables can appear either as themselves or their inverses. A minterm corresponds to exactly one row in the truth table of the Boolean function. If we have four variables A, B, C, and D, then a minterm can be something like A.B.C.D or A.B.C.D, and so forth.

**MySQL**: An open source relational database tool which is used for Web development (often used in conjunction with PHP).

**N**

**NAT**: Stands for Network Address Translation; a process of converting internal IP addresses to external ones and vice versa, establishing a sort of a “firewall” between a LAN and the rest of the network.

**Network layer**: This is the third layer of the OSI model, and it defines the means for host-to-host logical addressing across a network. In the OSI model, it is immediately above the data link layer.

**Network simulator**: A computer program that simulates the layout and behaviour of a network and enables network activity to be initiated and observed.

**NIC**: NIC stands for network interface card, which is the hardware interface that provides the physical link between a computer and a network.

**NOS**: NOS stands for network operating system. It is a complex set of computer programs that manage the common resources of a local area network. In addition, NOS performs the standard operating system services. Examples are NetWare, Linux, and MS Windows 2003.

**NTFS**: The NT File System is Microsoft’s most secure file system and is as a result supported by Windows NT, Windows 2000, Windows XP, and Windows 2003 operating systems.
**O**

**Octet:** An octet is a sequence of eight bits. The term octet is preferred over byte because the term byte has become ambiguous, oftentimes referring to the number of bits reserved for a character.

**Open source:** A software distribution model in which the source must be available to the user, and in addition anyone distributing the software must do so for free and without any restriction being placed on anyone receiving the code (apart from that defining open source).

**Optical fibre:** A type of cable which consists of one or more glass or plastic fibre cores inside a protective cladding material, covered by an outer plastic PVC jacket. Signal transmission along the inside fibres is accomplished using light pulses. The optical fibre cable is characterised by an extremely large data-carrying capacity. Optical fibre is used for undersea cables and for countrywide telecommunications backbones.

**OSI model:** This is a model for the operation of computer interfaces. It divides the needs of computer communication into levels and details what needs to be defined at each of these levels for a successful interface.

**OSPF:** Open Shortest Path First is a dynamic routing protocol used to update routing tables in routers using a more sophisticated routing algorithm.

**P**

**Packet:** A generic term used to define a unit of data including routing and other information that is sent through an internet.

**Packet forwarding:** The process by which protocol data units in a packet-based network are sent from their source to their destination.

**Packet sniffer:** Also known as packet analyzer or just sniffer. Software that captures network traffic and displays the data for analysis. The data is normally interpreted in some way so that the user does not need to manually identify the individual fields within a packet.

**PBIALS:** The instructional model of the PBIALS is similar to the instructional template proposed by Sage (2000). There are eight principal stages (excluding the questionnaire stage) in this instructional model.

**PBL:** Problem-based learning is student-centered, uses small student groups, and positions the teacher as a facilitator or guide. Life problems (real-world problems) are used as the starting point for the instructional process in
PBL. Clinical problem-solving and self-directed learning skills can then be learned via the learning process.

**Peer-to-peer network:** A class of network in which a computer can communicate with any other networked computers on an equal or peer-like basis without going through an intermediary, such as a server or a dedicated host.

**PHP:** “Hypertext Preprocessor”; a general-purpose scripting language which can be embedded in HTML, widely used for Web development. It is compatible with a variety of database management systems.

**Physical topology:** This refers to the way computers and other devices are connected within the network physically.

**PIC BASIC:** An adaptation of the BASIC computer language for use with PIC microcontrollers.

**PIC microcontroller:** PIC stands for programmable interface controller. The PIC microcontroller is an on-chip computer containing a CPU (central processing unit), RAM (random access memory), programmable ROM, timers, and input/output ports.

**PIC programming:** Generally refers to the procedures involved in creating a sequence of instructions that can be installed in and acted upon by the PIC microcontroller in order to control the operation of electrical and/or mechanical equipment.

**PIC projects:** PIC-based projects which are developed to enhance teaching and learning computer hardware concepts, as reported in chapter 12.

**Ping:** The name of a utility program used to test availability of a device on an IP network. It works by sending a small packet to the target device and then waiting for a response. The term is also now used as a verb meaning to check if a device is accessible.

**Pipeline:** An arrangement of functional models in a high-performance processor in which part of the computation is carried out in each stage of the pipeline. Data “flows” from one end of the “pipe” to the other.

**Preamble (Ethernet):** This is a string of 56 alternating binary ones and zeros (starting with a one) that is sent at the beginning of an IEEE 802.3 Ethernet frame.

**Protocol:** A protocol is a collection of rules for formatting, ordering, and error-checking data sent across a network.

**Protocol entity:** The component of a system that implements a protocol.

**PXE:** Preboot Execution Environment is a way of booting off the network card in order to connect to a server on the network.
Quine-McCluskey algorithm: Table-based reduction method for simplification of Boolean expressions. This method is quite versatile as compared with other algorithms. It can handle any number of inputs and can easily be implemented on machines. The method starts from the truth table of the Boolean function.

RAID 5: A redundant array of independent (or inexpensive) disks, level 5 is a way of employing at least three disks in combination for the purpose of performance and fault tolerance.

RAM: RAM stands for random access memory. A class of memory that is used in the computer as main memory for the storage and retrieval of data and instructions by the processor and other devices.

Remote Boot Disk Generator: The Remote Boot Disk Generator is a tool that allows users to easily produce floppy disks that can connect a client machine with a RIS server.

RFC: Request for comment. A set of documents that identifies issues, describes best common practice, and defines standards for the Internet. Published by the Internet Engineering Task Force (IETF).

RIP: Routing Information Protocol is a dynamic routing protocol used to update the routing tables in routers.

RIS: Remote Installation Service is a service that can be installed on a Windows 2000 Server or Windows Server 2003 for the purpose of deploying, usually in an automated fashion, various Microsoft operating systems to client machines.

Risk analysis: An assessment of what could go wrong (risks), determination of which risks warrant preventive or contingency actions, and development of strategies to deal with those risks.

ROM: ROM stands for read-only memory. A class of memory that is used in the computer for storing data, instructions, or information that can be read but not modified; the data is recorded permanently on the chips. ROM is nonvolatile memory, meaning its contents are not lost when power is removed from the computer.

Router: The network device that connects networks together and implements routing.
Routing: It is a process that occurs on a network when a packet is shunted from router to router along the path to the target destination. Routing is based on identifying the destination network from the IP address of the target machine.

Service: The abstract interface to a protocol. Details of how the protocol works are hidden from the service user. For example, protocol error recovery mechanisms such as retransmission on time-out are not visible in the service.

Situated learning: Situated learning argues that learning should take place in realistic settings to make learning meaningful. From this, we can infer that scientific curriculum should be incorporated into students’ experiences. Without situated learning, traditional education loses its ability to teach practical knowledge.

SQL: While SQL refers to Structured Query Language, chapter 18 refers to SQL as Microsoft’s well-known database application.

SSID: Or service set ID. A unique name that must be assigned to a service set before the wireless network can operate.

Stall: A pipeline stalls when data is prevented from flowing from one stage to the other to avoid a hazard or while waiting for a long latency operation such as a memory fetch.

Start delimiter (Ethernet): This is an octet immediately following the pre-amble of the IEEE 802.3 Ethernet frame that indicates the message starts at this point. It is always a binary pattern equal to 10101011.

State machine: An abstract model that characterizes the behavior of a system through the transitions it makes between states. Practical models have a finite number of states. An extended finite state machine has a major state that controls its main behavior and also state variables that have a smaller impact on the general operation of the system.

Static routing: A form of routing in which the routes that packets take in a network do not change as a function of time once they are configured.

Sum of product (SOP): A two-level expression which represents a sum of minterms of a logical function. It is two-level because it is implemented by two layers of logic gates. The first level represents the product of Boolean variables of the logical function and the second level represents summing the products with OR operator.
Switch: A network device that connects communication links together, enabling networks to be built that are on the same network but do not have to share the same link. This reduces collisions and improves network efficiency.

SYN flood: A form of denial-of-service attack. The attacker sends a victim an excessive number of packets that initiate the three-way handshake and then does not follow up with further responses. This leaves the target unable to deal with legitimate connection requests.

Synchronous: All operations are synchronized to a global clock.

Sysprep: Microsoft’s System Preparation Tool is a utility for the mass deployment of the Microsoft NT family of operating systems.

TCP/IP: Transmission Control Protocol/Internet Protocol is the family of protocols used for Internet communication.

Teaching hospital: A hospital that is affiliated with a medical school and provides the means for medical education to students, interns, and residents. It also functions as a formal center of learning for the training of physicians, nurses, and allied health personnel.

Threats: Potential causes of harm to assets through exploitation of vulnerabilities.

Three/five-column diagram: A form of time-sequence diagram that shows the two protocol entities and the medium (three-column) or also the two service users (five-column).

Three-way handshake: The initial exchange of messages that occurs when two devices are establishing a connection using TCP. Understanding this is essential to understanding the TCP connection and things that can potentially go wrong with the connection.

Time-sequence diagram: A graphical presentation of message exchange among communicating systems. Time flows down the page. Arrows show messages between carried from one system element to another.

Toolkit: A library of classes which model objects commonly required in animations; classes designed for reuse.

Tracert: A network diagnostic tool found on both Microsoft and UNIX operating systems. The diagnostic tool is used to track the path of network communication.

Transport layer: This is the fourth layer of the OSI model, immediately above the network layer. It provides a network-independent mechanism for
sending large blocks of data, thereby hiding the details of the network from
the services in the layers above it.

**TTL (time-to-live):** A parameter set in a data packet that defines how long that
packet can remain active on the network.

**U**

**USB:** Universal Serial Bus is a standard that supports Plug and Play and is used
for connecting peripheral devices to a PC.

**User:** The system element that employs a service. This may be a human end-
user or, more typically, a communications application that provides further
services to the end user.

**User Mode Linux:** User Mode Linux is an open source product that does the
same kinds of things as VMware but unlike VMware is limited to Linux
systems.

**V**

**Virtual PC:** Virtual PC is Microsoft’s commercial product that competes
directly with and is comparable to VMware.

**VLAN (virtual local area network):** A logical shared network created by
connecting devices to configurable switches so that the network is not
constrained by any physical boundary.

**VMware:** VMware is a commercial product that allows one simultaneously to
run a number of systems within the context of this application.

**VPN:** A virtual private network is a networking technology that involves network
tunnels being created between nodes within a public network.

**Vulnerabilities:** Weak characteristics of assets in an organization.

**W**

**WAN:** WAN stands for wide area network. A WAN covers a large geographical area (e.g., a country or a continent). Telephone networks and the
Internet are examples of WANs.

**Web server:** A software application running on a computer that is responsible
for serving Web pages on a network.
Wi-Fi: Or wireless fidelity. A trade or commercial name for wireless networking equipment using IEEE 802.11b standard.

Wi-Fi antenna: This term generally refers to an antenna used with Wi-Fi equipment to enhance the transmission and reception of the wireless signals used in the transfer of data between the sending equipment and the intended receiving equipment.

Wired LAN: This term refers to a LAN which uses cable media (e.g., UTP Cat 5e) for LAN connectivity and typically covers a limited area, such as a room, a building, or a campus.

Wireless LAN: This term refers to a LAN which uses infrared or radio frequencies rather than physical cable as the transmission medium.

Wireless link: Generally refers to a pathway for the transmission of information via a modulated unconstrained electromagnetic wave.

Workstation: An end-user computer that has its own CPU and is used as a client to access another computer, such as a file server.