ZNOTES // A-LEVEL SERIES

visit www.znotes.org

Updated to 2017-19 Syllabus

CIE AS-LEVEL INFO. TECHNOLOGY 9626

SUMMARIZED NOTES ON THE THEORY SECTION

TABLE OF CONTENTS

2 CHAPTER 1
Data, Information, Knowledge & Processing

4 CHAPTER 2
Hardware & Software

9 CHAPTER 3
Monitoring & Control

9 CHAPTER 4
E-safety and Health & Safety

11 CHAPTER 5
The Digital Divide

11 CHAPTER 6
Using Networks

14 CHAPTER 7
Expert Systems

14 CHAPTER 8
Spreadsheets

15 CHAPTER 9
Database & File Concepts

16 CHAPTER 10
Sound & Video Editing

NOTES

1. Data, Information, Knowledge and Processing

1.1 Data, Information and Knowledge

- **Data:** A collection(string) of text, numbers, symbols, images or sound in raw or unorganized form that has no meaning on its own.
- **Information:** Data that has been processed and given context and meaning and can be understood on its own.
- **Knowledge:** The acquisition by a person or medium of information such as facts, or of information which requires understanding such as how to solve problems.
- **Knowledge base:** the amount of information a person or medium knows that often expands over time with the addition of new information.

1.2 Sources of Data

- **Static data:** data that does not normally change and remains constant.
- **Dynamic data:** data that changes automatically without user intervention.
- **Direct data source:** Data collected first-hand for a specific purpose.
- Collected data will be relevant to purpose.
- Original source is verified.
- May take a long time to collect and taking large samples of data is difficult.
- Data will be up to date.
- Data collected can be presented in required format.
- Data is more likely to be unbiased.
- **Indirect data source:** data collected from a secondary source; originally collected for a different purpose.
- Required data may not exist or Additional and irrelevant data may exist which requires sorting.
- Original source is not verified.
- Data is immediately available and large samples for statistical analysis more likely to be available.
- Data may not be up to date.
- Data is likely to be biased due to unverified source.
- Extraction may be difficult if in different format.
- **Static information source:** Sources where information does not change on a regular basis.
- Information can go out of date quickly.
- Information can be viewed offline since no live data is required.
- More likely to be accurate since information will be validated before information.
- **Dynamic information source:** Information is automatically updated when source data changes.
- Information most likely to be up to date.
- An internet/network connection to source data is required.
- Data may be less accurate since it is produced very quickly so may contain errors.

1.3 Quality of information

- **Accuracy:** Data must be accurate.
- **Relevance:** Information must be relevant to its purpose.
- **Age:** Information must be up to date.
- **Level of detail:** Good quality information required the right amount of information.
- **Completeness:** All information required should be present.

1.4 Coding, encoding and encrypting data

- **Coding:** representing data by assigning a code to it for classification or identification.
- **Advantages of coding data:**
- Data can be presented in small space
- Less storage space is required
- Speed of input increases
- Data can be processed faster
- Validation becomes easier
- Increases confidentiality
- Increases consistency
- **Disadvantages of coding data:**
- Limited number of codes
- Interpretation may be difficult
- Similarity may lead to errors (O and 0)
- Efficiency decreases if user does not know the code
- Some information may get lost during coding
- **Encoding:** Storing data in a specific format
- Text can be encoded with numbers that is then represented by a binary number.
- **ASCII (American Standard Code for Information Interchange)** is a common method for encoding text.
- Images are encoded as bitmaps through various parameters (such as width/height, bit count,

compression type, horizontal/vertical resolution and raster data.)

- Images are often encoded into file types such as:
  - JPEG/JPG (Joint Photographic Experts Group)
  - GIF (Graphics Interchange Format)
  - PNG (Portable Network Graphics)
  - SVG (Scalable Vector Graphics)
- Sound is encoded by storing the sample rate, bit depth and bit rate.
- When sound is recorded, it is converted from analogue to digital format, which is broken down into thousands of samples per second.
- The Sample rate or frequency, is the number of audio samples per second. Measure in Hertz (Hz)
- The bit depth is the number of bits (1s and 0s) used for each sound clip.
- The bit rate is the number of bits processed every second.
- bit rate= sample rate x bit depth x number of channels
- bit rate is measured in kilobits per second (kbps)
- Uncompressed encoding uses WAV (Waveform Audio File Format)
- **There are two types of compression:**
- lossy compression: reduces files size by reducing bit rate, causing some loss in quality
- lossless compression: reduces the file size without losing any quality but can only reduce the file size to about 50%
- Video encoding requires storage of both Images and sound.
- Images are stored as frames with standard quality video normally having 24 frames per second(fps) while High definition (HD) uses 50-60fps on average.
- fps is directly proportional to quality and storage space required.
- HD video will have an image size of 1920px wide and 1080px high. Image size is also proportional to storage space.
- The bit rate for videos combines both the audio and frames that need to be processed every second.
- Higher frame rate requires higher bit rate.
- Lossy Compression of video usually involves reducing:
  - resolution
  - image size
  - bit rate
- MP4 is a common lossy compression format, which is a codec made by MPEG (Moving Pictures Expert Group).
- Digital video (DV) is a lossless compression method.
- Advantages of encoding data include reduced file size and enabling different formats to be used.
- Disadvantages of encoding data include the variety of encoding methods which results in a large variety of file types meaning more codecs need to be installed and compatibility issues.
- **Encryption:** the scrambling of data so it cannot be understood without a decryption key so that it is unreadable if intercepted. Encryption is a type of encoding.
- **Cipher:** A secret way of writing/code. It is a special type of algorithm which defines a set of rules to follow to encrypt a message.
- **Caesar Cipher:** A.k.a shift cipher because it selects replacement letters by shifting along the alphabet.
- **Symmetric encryption:** requires both the sender and receiver to possess the secret encryption and decryption key(s). Requires the secret key to bent to the recipient.
- **Asymmetric encryption:** A.k.a public-key cryptography. Includes a public key which is available to anyone sending data, and a private key that is known only to the recipient. The key is the algorithm required to encrypt and decrypt the data.
- **Secure Sockets Layer(SSL)** is the security method used for secure websites; **Transport Layer Security(TLS)** has superseded SSL but they are both referred to as SSL. Asymmetric encryption is used for SSL, and once SSL has established an authenticated session, the client and server will create symmetric keys for faster secure communication.
- Disk encryption is used in hard disks and other storage media such as backup tapes and Universal Serial Bus(USB) flash memory. It encrypts every single bit of data stored on a disk, and data is usually accessed through a password or using a registered fingerprint.
- **HTTPS - Hypertext Transfer Protocol Secure** is the encryption standard used for secure web pages and uses SSL or TLS to encrypt/decrypt pages and information sent and received by web users.
- When a browser requests a secure page, it will check the digital certificate to ensure that it is trusted, valid and that the certificate is related to the sire which it originates. The browser then uses a public key to encrypt a new symmetric key that is sent to the web server. The browser and web server can then communicate using a

symmetric encryption key, which is much faster than asymmetric encryption.

- Email encryption uses asymmetric encryption. Encrypting an email will also encrypt any attachments.
- Encryption only scrambles the data so that if it is found, it cannot be understood. It does not stop the data from being intercepted, stolen or lost.

1.5 Checking the accuracy of data

- **Validation:** the process of checking data to make sure it matches acceptable rules.
- **Proof reading:** checking information manually.
- **Presence check:** used to ensure that data is entered(present).
- **Limit check:** ensures that data is within a defined range. contains one boundary, either the highest possible value or the lowest possible value.
- **Range check:** ensures that data is within a defined range. contains two boundaries, the lower boundary and the upper boundary.
- **Type check:** ensures that data must be of a defined data type.
- **Length check:** ensures data is of a defined length or within a range of lengths.
- **Format check:** ensures data matches a defined format.
- **Lookup check:** rests to see if data exists in a list. Similar to referential integrity.
- **Consistency check:** compares data in one field with data in another field that already exists within a record, to check their consistency.
- **Verification:** the process of checking whether data entered into the system matches the original source.
- **Visual checking:** Visually checking the data if it matches the original source, by reading and comparing, usually by the user.
- **Double data entry:** Data is input into the system twice and checked for consistency by comparing.
- By using both validation and verification, the chances of entering incorrect data are reduced.

2. HARDWARE AND SOFTWARE

2.1 Hardware

- **Hardware:** A physical component of a computer system.
- **Device:** a hardware component of a computer system consisting of electronic components.
- **Output Devices:** a device used to communicate data or information from a computer system.
- **Input Device:** a device that allows data to be entered to a computer system.
- **Storage Device:** a device used to store data on a storage medium.
- **Storage medium:** a medium on which data is stored.
- **Central Processing Unit (CPU):** the CPU carries out the calculations, executes instructions and processes data. The CPU consists of an **ALU (Arithmetic Logical Unit)** and the **CU (Control Unit)**.
- **Arithmetic Logical Unit (ALU):** Performs Calculations and logical operations.
- **Control Unit:** The CU runs the fetch-execute cycle which fetches instructions from memory and executes them.
- **Motherboard:** Printed circuit board (PCB) that connects the main components of a computer.
- **RAM (Random Access Memory):** Memory used to store currently active programs and volatile data.
- **ROM (Read-Only Memory):** The memory that, once written to cannot be removed and can only be read (involatile). ROMs usually store the BI/OS of a system.
- **Graphics Card:** A.k.a Video card/graphics adapter. A PCB that controls the output to a display screen.
- **Sound Card:** an expandable component that enables the use of audio components in a computer.
- **HDD (Hard Disk Drive):** Most common form of secondary storage for a computer due to its relatively low cost per MB (megabyte). Data stored on an HDD is non-volatile. The drive includes a read-write head which sits at the end of an access arm and magnetizes sectors on the disk (platter). Moving parts increase chance of failure
  - Cheapest cost per MB
  - Requires constant supply of electricity when the disk is spinning.
  - Speed of access depend on SATA connection used.
- HDDs be Internally connected to the computer using a Serial Advanced Technology Attachment (SATA) or Integrated Drive Electronics (IDE) cable.

- **SSD (Solid State Drive):** Contains no moving parts and data is stored onto flash memory(non-volatile). Non-magnetic and largely unsusceptible to damage.
  - More expensive per MB than a hard disk
  - Does not require constant source of power as only needed when in use.
  - More than 20% faster access speed than HDD.
- **Cloud computing:** refers to anything where computer services are hosted over the internet and not in the same physical location as the computer being used. Data stored on banks of servers are accessed remotely.
  - Costs are usually a subscription charge that varies depending on supplier.
  - Running sots are included within the subscription charge
  - Speed depends on broadband bandwidth of user and that offered by supplier.
- **Pen drive:** nickname for a thumb sized USB flash drive that stores data on flash memory and includes an integrated USB interface. Portability means that they may get damaged and need replacing.
  - Designed for portability so cost per MB varies on size.
  - Power only when in use.
  - Speed depends on whether the drive uses a USB.20 or USB 3.0 port. USB 3.0 is faster.
- **Monitor:** Output device. Connected to the computer using a graphics card port.
- **Keyboard:** consists of a number of buttons, which are used to input text or to control parts of an interface. Its main limitation is the number of keys available.
- **Mouse:** A pointing device, which allows objects to be selected and manipulated on the screen. The mouse controls a pointer which is displayed on the screen.
- **Printer:** A printer produces a hard copy(printout) from a computer usually onto paper.
- **Laser printer:** Laser printers negatively charges a cylindrical drum which then attracts electrically charged toner (powdered ink). The toner is then heated so that it melts onto the paper.
  - Fastest of all printers ranging from 50-200ppm (pages per minute)
  - Typically, twice the cost of a similar featured inkjet printer
  - Toner cartridges are expensive but last longer and have less cost per page.
  - Highest quality of all printers
  - Used for: Letters, bulk printing, general office and home printing
- **Inkjet printer:** Cartridges full of ink in four different colours: black, cyan, magenta, yellow(CMYK) are used to 'squirt' ink onto the paper to form the required printout.
  - Speeds of 15-20 ppm in monochrome but colour speeds are slower.
  - Cheapest of all printer types available.
  - Inkjet cartridges vary in price but compatible version can be bought for cheaper than manufacturer versions.
  - Good quality but ink can show through thin paper and smudges can occur.
  - Used for: Photographs, charts, small maps, general office and home printing.
- **Dot matrix printer:** A type of impact printer, which uses a set of pins being driven onto a ribbon, which then transfers its ink to the paper.
  - Very slow compared to other printers.
  - Used to be very cheap but now expensive because they are not mass produced.
  - Very low running costs as the ink ribbon lasts a long time.
  - Quality is usually poor.
  - Used for: Invoices or receipts **r**equiring duplicate or triplicate paper such as ATMs.
- **Plotter:** Used to create vector drawings on large sheets of paper by moving the paper backwards and forwards and drawing using pens. Today, plotters are mainly Inkjet printers designed to be used with large sheets of paper, (A2, A1 and A0).
  - Time per page to print is slow due to large area.
  - Most expensive type of printer.
  - Same running costs as an Inkjet printer.
  - Same running costs as an inkjet printer. If pens are used, Quality of line drawings are high.
  - Used for: Architectural drawings, large maps, canvas prints and signs.
- **CMYK:** refers to the format of four inks used in color printing: cyan, magenta, yellow, and key (black).
- Light-emitting diode (LED) plotters are used for faster black and white printouts.
- **Speaker:** used to provide sound output from a computer. These can be as simple as a pair of stereo speakers to full surround sound.
- **Camera:** used to capture still or moving images (movies).

NOTES

- A digital still camera is optimized for capturing still images but can also capture movies.
- A digital video camera is optimized for capturing movies but can also capture still images.
- **Webcam:** a camera connected to the computer for the purpose of capturing still or moving images while using a computer. Usually not as high quality as dedicated digital camera or digital video camera.
- **Scanner:** A scanner is used to capture two dimensional (2D) documents in the form of an image. Similar to a digital camera but are specifically designed to take close-up images of 2D documents.
- **Optical character reader (OCR):** a device that enables characters on a document to be identified and understood by the computer as letters, numbers, characters and words.
- Optical character reader is not really a device in itself, but is a scanner combined with software that performs optical character recognition (also OCR).
- **Optical mark reader (OMR):** detects the marks that are made on a multiple-choice document such as a multiple choice answer paper for an examination.
- **Magnetic ink character reader (MICR):** magnetic ink is used to print numbers at the bottom of checks and the numbers are printed using the MICR E-13B or CMC-7 font.
- **Barcode reader:** used to detect the width of lines and gaps that form a barcode using a laser and a photodiode.
- **Blu-ray disc:** an optical storage medium the same shape and size as a compact disc (CD) and digital versatile disc (DVD) and also stores more data than both.
- **Memory card:** flash memory on a small card typically used in digital cameras, digital video cameras and phones. Most common formats include Secure Digital (SD) and microSD.

2.2 System, application and user interface software

- **Software:** Programs, which give instructions to the computer.
- **User interface:** communication between the user and the computer system.
- **System software:** Programs that are designed to maintain or operate a computer system are known as system software.
  - Operating system is the software that operates the computer hardware.
  - Programs that are used to maintain a computer system are known as utility system.
- Operating systems manage hardware by:
  - allocating memory to software
  - sending data and instructions to output devices.
  - responding to input devices such as when a key is pressed.
  - opening and closing files on storage devices.
  - giving each running task a fair share of processor time
  - sending error/status messages to apps or users.
  - Dealing with user logons and security.
- **Device drivers:** software that comes with external hardware components and sends customized instructions to those specific components.
- **Application software:** Programs intended for productivity or to carry out a task for the user.
- **Word processors:** primary function to process words and word processing software features include:
  - Tables
  - Headers and footers
  - Footnotes and endnotes
  - Sections
  - Formatting text
  - Styles
  - Spellchecker
  - Bullets and automatic numbering
  - Automatic contents page
  - Tracking changes
  - Frames for images
  - Text alignment
  - Test wrap
  - Indentation and tabs
- **Spreadsheet software:** mainly used for performing calculations and modelling like handling financial and statistical information.
  - Contain cells which form the intersection of rows and columns.
  - Work on the basis of –input-process-output whereby formulas allow output to change depending on input.
- **Database management software (DBMS):** used for viewing and editing data within a database. A DBMS features:
  - Data entry screens/input forms
  - Filters and queries

- Reports
- Graphs
- Security features
- Relationships to link related tables

- **Graphics manipulation software:** designed to manipulate graphics of either bitmap or vector format. Features include:
  - Drawing shapes
  - Changing canvas size
  - Resizing images
  - Adding layers
  - Adding text
  - Selecting colour based on picking an existing colour
- Features of Bitmap graphics manipulation software can include:
  - Filling an area with a colour
  - Moving part of the image
  - Resizing part of the image
  - Erasing parts of an image
- Features of Vector graphics manipulation software can include:
  - Filling a shape with colour
  - Changing features of the border of a shape such as thickness and colour
  - Combining shapes together into a group
  - Moving a shape or groups of shapes
  - Resizing a shape or group of shapes
  - Aligning objects
- **Photo editing software:** a specific type of graphics manipulation software focused on editing photographs. Features include:
  - Cropping parts of the photo
  - Changing colour balance
  - Adjusting the brightness or contrast
  - Red eye correction
  - Cloning parts of the photo
  - Resizing the canvas
  - Effects and filters
  - Softening (blurring) and sharpening
  - Identifying common areas of an image
- Recorded videos are known as 'raw' video files (footage).
- **Video editing software:** software focused on editing videos. Features include:
  - Importing or capturing raw video
  - Clipping the beginning/end or sections of a video
  - Adding titles and credits
  - Changing speed
  - Rotating footage.
  - Using more than one video track
  - PIP (picture in picture)
  - Transitions
  - Adding extra sounds
- **Communications software:** cover a range of tasks including instant messaging, audio conferencing, video conferencing and email.
- Audio conferencing uses VOIP (Voice over internet protocol)
- An Email client usually features:
  - Address book of contacts
  - Send and receive emails
  - Signatures
  - Prioritization
  - Delaying delivery of emails
  - Delivery and read receipts
  - Adding attachments
  - Calendar integration
  - encrypted messages
  - multiple account support
  - email specific rules
- **Web authoring software:** use for creation and editing of websites. Features include:
  - common navigation bar
  - preview web pages
  - ability publish individual files or sites to a webserver.
  - Basic HTML (Hypertext Markup Language) features
  - Metadata management
  - Forms and form fields and their validation
  - Templates
  - Interactive features
  - WYSIWYG (What You See Is What You Get) or HTML Code view or both
- **Control software:** Control software is used for controlling devices not part of the computer system.
- **Measuring software:** used to measure values from sensors including but not limited to:
  - pressure
  - moisture
  - temperature
  - wind speed
  - distance
  - pH (acid/alkaline) levels
  - lights

NOTES

- motors
- sound
- heating

- **Apps:** another name for a program. A piece of software that can run on a desktop computer/phone or over the internet.
- **Applets:** a small program that is designed to carry out a specific task. Cannot be run on its own and must be executed from within another piece of software. Often known as add-ons or extensions.
- An interface is the boundary between two systems.
- User Interface (UI) is the boundary between the user and the computer system.
- **Command line interface (CLI):** allows users to enter text commands to which the computer system will respond by producing results in text.
  - use very little memory
  - can carry out complex operations
  - can be difficult to learn and use
- **Graphical user interface (GUI):** most common type of interface and includes Windows, Icons, Menus, Pointers (abbreviated to WIMP)
  - Uses more memory depending on complexity of the GUI
  - Intuitive, so easy to learn
  - Restrictive for technical users
- **Dialogue interface:** using spoken word to communicate to a computer system.
  - hands-free
  - ability to recognize and understand spoken word will vary and can be limited.
  - Require users to know what commands are understood by the interface.
- **Gesture-based interface:** recognizes human motion, which may include eyeball/lips tracking, identifying hand signals or whole-body movement.
  - Provides more mobility but may be hard to control
  - Accuracy problems
- When designing UI, it is important to ensure that it is accessible and efficient for the user. Important things to consider include:
  - Colour
  - Layout
  - Font size
  - Quantity of information
  - Controls
- **Mental model:** a person's understanding of how something works which may differ from person to person.

2.3 Utility Software

- **Utility software:** software that performs some sort of maintenance on the computer system
- Two main functions of an **Anti-virus:**
  - **Anti-virus monitor** continually monitors the system for viruses and malware.
  - Check for viruses or malware that may already be on the system, this is known as scanning.
- Backup utilities create a second copy of data and programs that are in storage.
- **Data compression:** reduces the original size of files so they use up less storage space.
- **Disc defragmentation:** defragments and reorganizes fragmented gaps of files left after usage on a drive so that each file is contiguous.
- **Formatting:** the process of organizing the tracks on the disc into sectors. When a used disc is formatted, all data is erased.
- File-copying utilities allow users to have more control over which files are copied and how they are copied.
- Deleting utilities can overcome restrictions set by an operating system and enable permanent deletion of files.

2.4 Custom written software and off-the-shelf software

- **Custom-written:** software that is written to meet the requirements of a client.
  - Expensive because entire development cost is covered by client
  - Takes longer time to develop
  - Requirements of the client can be met precisely
  - Developers will ensure compatibility with the client's hardware, software and data
  - Bugs are likely since it is not used widely
  - Client will have access support from the developer company
- **Off-the-shelf:** general purpose software available to a large market.
  - Development cost spread between all the customers who purchase it at a specific price, reducing overall cost
  - Immediately available

NOTES

- User requirements may not be precise/unnecessary features
- May have compatibility issues
- Large number of users means lesser bugs due to patches released after identification of bugs
- Wide range of support both from the developing company and externally

2.5 Compiler and interpreter

- **Compiler:** translates a program written in a high-level programming language (HLL) into machine code.
  - Translates code all at once in advance of execution
  - Compiled code will only work on the operating system it has been compiled for
  - Object code ready to be executed without delay
  - Compiling takes a lot of time
  - Not for on-the-fly testing
- **Interpreter:** also translate a program from HLL into machine code.
  - Translates code one line at a time
  - Source code can be translated into object code for more than one operating system
  - Object code has to be generated, so additional time is added to the execution time.
  - Only the required code needs to be interpreted
  - Efficient for on-the-fly testing
- The file with the machine code is known as the executable file or the object file.
- The original HLL file is known as the source file.
- **Linker:** combine different object files within a program together to form a single executable file.

3. MONITORING AND CONTROL

3.1 Sensors

- **Sensor:** An input device that records data about the surrounding physical environment.
- **Input device:** a device that allows data to be entered into a computer system.
- **Microprocessor:** an integrated circuit used in monitoring and control technologies.
- **Actuator:** this is a type of motor that controls a mechanism or system.
- **Infrared:** a wave of light emitted by an object that is invisible to the naked human eye.
- **Microwave:** an electromagnetic wave of energy.
- **Piezoresistance:** a specific level of electrical charge that is linked to a specific level of resistance or pressure.
- **Humidity:** the amount of water in the atmosphere.
- **Photoresistor:** a light controlled resistor.
- **Motion sensors:** detects movement.
- Passive motion sensors read the energy in its surrounding environment and detects changes caused by movement. (Infrared sensor)
- Active motion sensors emit energy into the surrounding environment to detect any movement. (Microwave sensor)
- **Pressure sensors:** measure pressure, normally of a liquid or a gas. The measure is of pressure is based upon the force it takes to stop a liquid or gas from expanding. Most modern pressure sensors use a principle called Piezoresistance.
- **Moisture and humidity Sensors:** monitor and measure the humidity in the air. The percentage of moisture present in the air at a certain temperature is expressed as the level of humidity.
- **Capacitive measurement:** Moisture collects on a non-conducting film between two electrical conductors and changes the level of voltage between the electrical conductors and the measurement of the change in voltage is converted into a measurement of humidity.
- **Temperature sensors:** monitor and measure the temperature of an environment by measuring the heat present in the surroundings.
- **Light sensors:** monitor and measure light.
- **Photoresistor:** measures intensity of light by changing its resistance when light is exposed.
- Monitoring systems are continual and also removes possibility of human error in measurements.

4. E-SAFETY AND HEALTH AND SAFETY

4.1 E-safety

- **Malicious code:** code that is intended to harm the computer.
- **Phishing:** when an unauthorized person attempts to gather personal data masquerading as a trustworthy person or organization.
- **Pharming:** when a person phishes a user by installing malicious code into a system or server that redirects the user to a fraudulent, but legitimate looking, replica website, without their consent.

- **Smishing:** SMS Phishing, similar to phishing but carried out using SMS text messaging rather than email.
- **Vishing:** Voice phishing. The act of using a telephone call to try and scam a user into divulging personal data with the scammer usually pretending to be a legitimate business calling the victim.
- **Trojan Horse:** a malicious computer program that disguises itself as another application which will delete/corrupt files when the application is run.
- **Worms:** a small computer program that uses computer networks and finds security holes to replicate itself
  - Can exploit a security hole in a piece of software or operating system
  - Often clogs up bandwidth when replicating and make things run slowly
- **Spyware:** covers a broad range of malware refers to any technology used to gather data about a person without their knowledge.
  - A key logger records key presses from a keyboard and will allow the person who installed it to gather personal data about the person.
- **Adware:** Adware is short for advertising-supported-software and used to display adverts that are targeted at the user.
- **Rootkit:** A computer program that enables a person to gain administrator access to a victim's computer.
- A bot is an application that is automated and used to carry out simple and repetitive tasks. Malicious bots include:
  - SPAM bots which bombard people's email inboxes with spam emails.
  - Chatter bots will pretend to be humans on sites such as social networking and dating sites.
  - Zombie bots/Sleeper bots are used to create bot networks and each bot will lay dormant on a computer until an attack I launched, in which case the computer will be connected with lots of other computers that have been compromised by zombie bots to launch a large-scale attack on an organization.
- **Ransomware:** a type of malware that encrypts and restricts a user's access to their computer system and files. The ransomware usually demands a user to pay a ransom in order to regain access to their computer, and usually imitates a law enforcement agency.

4.2 Health and safety

- **Repetitive strain injury (RSI):** pain, numbness or weakness that occurs in the hands, arms, shoulders and neck.
  - Caused by repetitive movements and actions. Can be triggered by poor posture.
  - Good posture, avoiding doing the same action without taking regular breaks and usage of wrist rests can help prevent RSI.
- **Carpal tunnel syndrome:** pain, numbness, tingling sensation in the hands or fingers.
  - Caused by compression of a major nerve in the hand that passes over the carpal bones in the hand. Due to repetitive and continual movements.
  - Similar preventive actions to RSI
- **Back ache and muscle spasms**
  - caused by poor posture and from sitting in the same position for long periods of time
  - preventive measures include sitting on an adjustable chair to correct position.
- **Eye strain:** causes sore, tired eyes or blurred vision.
  - Caused by looking at a monitor for long periods of time.
  - Regularly looking away from the screen, sitting at the correct distance, and usage of monitors with eye care protection settings can help reduce eye strain.
- **Deep vein thrombosis:** when blood clots occur, usually in a user's legs.
  - Caused by sitting in a chair that puts pressure on the back of a user's legs, behind the knees.
  - Preventive measures include regularly standing and moving around when using a computer for long periods of time.
- **Fatigue:** when a user feels very tired and lethargic. Often alongside stress.
  - Caused by overworking
  - Taking regular breaks and working for shorter periods of time when working can reduce levels of stress and fatigue.
- Fire can occur when computers overheat or due to an overloaded plug socket.
  - A computer should be used in a ventilated and fairly cool room.
  - In case of fire occurring, a CO2 fire extinguisher should be in any room that has a computer.

NOTES

- Plug sockets should not have too many devices plugged into them, especially devices that require a lot of power.
- Trailing wires, could cause a safety concern possibly making people trip.
  - Make sure wires are secured in some way, such as by cable management system.
- Spilt drinks can cause shorts and food stuck between keyboards can cause difficulties.
  - Eating and drinking at a computer should be avoided where possible.
  - Spill proof keyboards or covers should be used.

5. The Digital Divide

- **Demographic:** a particular section of population
- **Broadband:** a method of faster data transmission that can carry several channels at once.
- **Bandwidth:** the amount of data that can be transmitted at one time.
- The digital divide refers to the technology gap between different countries, demographic groups and economic areas and is a technical, social and economic issue, which covers the difference in availability and use of modern technology and can depend on many factors such as age, status and geographic location.
- Access to E-commerce, education, employment opportunities and entertainment experiences are all affected by the digital divide.
- A divide can occur between areas as small as two different houses to entire countries.

6. Using Networks

- **Network:** a set of computers and devices connected together so they can communicate and share resources.
- **Network architecture:** the design of a network.
- Advantages:
  - Users can share their data
  - Users can access their data from different computers
  - File servers can be used to store data.
  - Application software can be used to store software in a central location.
  - Internet connections and other hardware peripherals can be shared.
- Disadvantages:
  - Setting up a larger network can be expensive, especially with cabling.
  - Security risks
  - High amount of traffic may cause a network to run slowly and cause delays.
  - A whole network could fail if one element of the network fails.

6.1 Network types

- **Local Area Network (LAN):** a network that covers a small geographical area
  - Data transfer speeds up to 1 Gb per second
  - Fewer data transmission errors as data packet are sent over short distances
  - Connection restricted to within a small location.
  - Security is relatively high as it can be easier to implement over a small number of devices and connections.
  - Mostly owned by individuals or individual organizations.
- **Wide area Network (WAN):** a network that covers a large geographical area
  - Data transfer rates often restricted to less than 200Mb per second.
  - Data transmission errors increase as packets are sent over longer distances
  - Connection expanded to a wider location.
  - Security comparatively low as security is difficult to implement across a higher number of devices and connections.
  - Elements of the network often use communication infrastructure owned by others.
- Server: a computer on a network which provides resources that can be used by client devices.
- Client: a computer that is connected to a server.
- Peer: a computer in a network that is not connected to a server and does not control another computer.
- Network server features:
  - Storing a database of usernames and passwords to control user access
  - Data storage
  - Security
  - Assigning levels of access that determine what resources a user may access
  - Monitoring network traffic
  - Hosting of shared applications
  - Managing an internet connection
  - Scheduling and running back-ups
  - Email services

- Printing jobs on network printers
- Domain name services

- A client-server network uses a dedicated computer to store data, manage resources and control user access.
  - Has at least one server and several clients.
  - Dedicated computer controls whole network
  - Centralized database of users, usernames and passwords
  - Centralized data storage
  - Suited to large networks
- A peer-to-peer network has no central server to manage the network. Each computer shares its data and resources with all the others and no computer has control over another.
  - Each computer is known as a peer.
  - No centralized database
  - Relies on users remembering to back-up individual computers.
  - Data is stored on individual computers.
  - Suited to small networks.
- Advantages of client-server network
  - Centralized database provides login security
  - User data kept more private
  - Levels of access can be applied to resources
  - Users do not have to worry about security as a network manager handles the network
  - Backups are centralized
  - Several servers can be used for different function on larger networks to maintain network efficiency.
- Disadvantages of client-server network
  - Expensive to set up and maintain
  - Failure of central server may make the whole network fail
  - Requires specialist technical staff to maintain
- Advantages of peer-to-peer network
  - Cheap to set up and maintain. Does not require expensive servers.
  - Failure of an individual per only removes access to the resources and data which that peer handles. The rest of the network remains unaffected.
  - Does not require specialist technical staff to maintain.
- Disadvantages of peer-to-peer network
  - No centralized database of users, and login credentials makes it harder to maintain security
  - Users have to worry about making backups as no centralized backup service exists.
  - The more computers there are on a peer-to-peer network, the slower it will run.
- Tunneling protocol: a tunnel between two points on a network that is governed by a set of rules
- A VPN (Virtual private network) is a method of allowing a remote computer to connect securely to a private network using external resources.
- An intranet is a privately-owned network that uses internet technologies for internal use within an organization.
  - Usually use client-server architecture with several servers
  - VLE (Virtual Learning Environment) is an intranet.
  - Used to increase efficiency because all information is stored centrally and can be readily accessed.
  - An extranet is an intranet that has been opened up to allow external user access. Usually through VPNs.
- The internet is a global network made up of interconnected networks and individual computers. This global network allows user to access online facilities.
- Packet switching: data that is broken down into packets is sent through different routes and reassembled by the recipient
- TCP/IP: a communication protocol used by the internet/
- Internet Service Provider (ISP): a company that provides access to the internet.
- The Internet Corporation for Assigned Names and Numbers (ICANN) regulates domain names and their suffixes.
- The Internet Engineering Task Force (IEFT) devises and administers internet standards, such as protocols that govern communication
- The World Wide Web Consortium (W3C) attempts to enforce agreement from organizations to adopt new standards
- Telecommunications companies own the infrastructure that the internet uses for communication.
- The lack of authority on the internet means that information on the internet is of mixed value and the information may not be useful or correct. It can also be inaccurate, outdated or completely false. Some information is deliberately designed to mislead.
- Advantages of the internet:
  - Information
  - Global audience
  - Immediate transmission of information

NOTES

- Immediate availability of services
- International ecommerce
- Entertainment
- Free education
- Social networking
- Up-to-date news
- Reduced costs to businesses and organizations
- Ability to receive Feedback
- Big data
- New communication applications

- Disadvantages of the internet:
  - False information
  - Unsavory behavior
  - Hacking
  - Viruses
  - Identity theft/phishing/pharming
  - Unsuitable material
  - Spamming
  - Online addiction
- Hyperlink: a link that can be clicked to locate another place in a document, or a different document entirely.
- Web browser: a software application for retrieving and presenting information on the world wide web.
- Internet describes the physical, global network of computers. The internet does not actually contain any information and is just the physical infrastructure.
- The world wide web is an information system comprising od documents, images, videos and sounds among other files and uses the internet as its base.
- Instant messaging (IM) is a form of communication that allows real-time text transmission over a network often the internet.
- Voice over Internet protocol (VOIP) technologies allow users to have voice communications, just like a telephone. And costs less.
- Cell (mobile network): the geographical area covered by a radio transmitter
- A mobile network is a wireless WAN that uses radio to transmit and receive communications from portable devices such as smartphones.
  - Broken down into small areas called cells, where there is a radio base station at the heart of each cell. The base stations connect to public telecommunications services allowing access to the internet.
  - Picocells cover an area of less than 200m
  - Microcells cover an area up to 2km
  - Macrocells cover larger areas
- 1G networks: first generation mobile networks that used analogue signals.
  - Largely limited to voice and text message communications
- 2G networks: second generation mobile networks switched from analogue to digital improving signal quality.
  - 2G networks were able to connect to each other allowing a phone to use other networks
- 3G networks: third generation mobile networks increased data transmission speeds up to 2 mbps, allowing internet access, video transmission and online gaming.
- 4G networks: fourth generation networks are the current generation.
  - In theory allow data transmission speeds up to 1Gbps.
- Advantages of mobile networks
  - Enable users to communicate with others and access the internet on the move
  - Cells allow for lower power radio transmitters to be used, increasing energy and cost efficiency
  - Frequencies can be split up among neighboring cells ad reused in distant cells, increasing the number of communications that can take place at the same time.
  - several, low power transmitters are used to cover a wider area. And multiple transmitters mean a more robust network.
- Disadvantages of mobile networks
  - Quality of reception can vary and can be poor towards the edge of a cell.
  - Use of frequency must be carefully planned to avoid interference between cells

6.2 Video and web conferencing

- Basic requirements to set up video conferencing:
  - A desktop computer or laptop
  - A webcam
  - A microphone
  - Speakers
  - Network (and the internet)
  - Video conferencing software
- Video and web conferencing requires a reasonable data transmission speed.
- Integrated Services Digital Network (ISDN): a networking technology that allows data to be transmitted digitally over analogue copper wire.

NOTES

- Transmission speeds of up to 64kbps per channel. With two channels used in parallel up to 128kbps
- Asynchronous Digital Subscriber Line (ADSL): also known as broadband, most common type of connection to the internet.
  - Typical transmission speeds of around 100Mbps.
  - ADSL download speeds ear far greater than upload speeds
- Synchronous Digital Subscriber Line (SDSL): same data transmission technology as ADSL.
  - Download speeds and upload speeds are balanced
- Video conferencing software use various codecs to compress the video to allow for faster transmission.
- Teleworking: working from home using technologies to keep in contact with an employer.

7. Expert systems and other types of processing

- **Diagnosis:** identifying a problem or illness by analysis of the symptoms
- **Artificial intelligence:** computer systems that perform tasks that normally require human intelligence.
- **Chaining:** combining together instructions
- **Transaction:** a collection of data that is exchanged
- **Field:** an individual item of data in a database, for example a first name.
- An expert system is a computerized system that attempts to reproduce the decision-making process of an expert human being. They are designed to try and replicate the judgement of a human that has expert knowledge in a certain field. By doing this they can be used to replace or assist a human expert.
  - Expert systems use a knowledge base and a set of rules to provide a diagnosis or a recommended course of action.
  - Gathers data by asking the user questions about the problem.
- Building an expert system is known as knowledge engineering and is composed of three main components:
  - **The knowledge base:** a database that allows the storage and retrieval of the knowledge provided by a collection of experts and contains knowledge about the specific area for which the expert system can be used.
  - **The inference engine:** the part of the expert system that makes judgement and reasoning using the knowledge base and user responses and is designed to produce reasoning based on a set of rules.
  - **The user interface:** the way the user interacts with the expert system. Often GUI.
- A batch processing system is a system that processes batches of data at set time intervals. Data is collected from inputs and stored together in what is known as batches. These batches of data are stored until a set time when they will be processed and an output(s) are created.
- An online processing system is a type of processing system that deals with data in transactions. A certain amount of data is input as a transaction. This amount of data is usually small. Once the data for the transaction is collected it is processed and the next transaction can occur.
- Real-time processing systems process data as soon as it has bene input. They are used when the immediacy of the data is vital.
- **Master file:** a collection of fields that store data which are more permanent in nature.
- **Transaction file:** the data stored in a transaction file is used to update the master file, and is more temporary in nature.

8. Spreadsheets

- Spreadsheets are used to manipulate numbers, perform calculations, present summary data and make predictions.
- **Cell:** a rectangle within a spreadsheet where data can be positioned.
- **Range:** a set of one or more cells.
- **Worksheet:** a set of rows and columns.
- A workbook may contain a number of worksheets.
- **Formula:** a mathematical calculation using +, -, x or /
- **Orientation:** the direction of text, for example, horizontal or vertical.
- **Alignment:** positioning text so that it is in line, for example on the left, right or center.
- **Function:** a ready-made formula representing a complex calculation. Example =PRODUCT(D10:E10)
- **Validation:** the process of checking data matches acceptable rules.
- The four different types of test data include:
  - **Valid (normal/acceptable data):** Data that should pass the validation rule.

- **Invalid (erroneous/unacceptable data):** Data that should generate an error message.
- **Extreme valid:** Data that will only just pass the validation rule because it is on the boundary of acceptable data.
- **Extreme invalid:** Data that will only generate an error message because it is on the boundary of unacceptable data.

- A model is a computer representation of a real-world process. A model is created through mathematical analysis of the real-world process. Modelling software is used to create a model. Spreadsheets can be used to create computerized models, but there are also custom-written solutions that are used to model specific processes.
- Modelling software usually feature:
  - the ability to change variables within the software
  - asking what-if questions to see what the result of changing variables might be
  - formulae and functions to carry out the mathematical calculations that form the basis of the model.
  - Automatic recalculation of formulae and functions
  - Rules that define how the model behaves
  - Layers of abstraction so that different parts of the model can be viewed and analyzed separately.
- **Simulation:** the use of a computerized model to predict how a real-life system might behave.
  - As with modelling, simulations can be used for training, forecasting and construction.
- Advantages include:
  - Removes the need for creating expensive prototypes
  - Changes to the model can be made rapidly and the effects can be seen just as quickly
  - Alternative models and designs can be used simultaneously much easier to see how they react differently
  - Unusual situations can be tested without the need to wait for them in real life.
  - No loss, wear and tear or damage to equipment when tested or experimented with
  - Dangerous situations can be simulated safety without endangerment
  - Effects of extended periods of time can be tested by speeding up the simulation
- Disadvantages:
  - A simulation is only as good as the model it is based upon
  - Simulation software and equipment can be very expensive
  - Requires training to use simulation software and equipment
  - Complex models take a long time to develop depending on how realistic the simulation is
  - It is near-impossible to simulate a perfect representation of a real-world process.

9. DATABASE AND FILE CONCEPTS

- **Database:** a structured method for storing data in sets of tables.
- **Table:** a set of similar data.
- **Record:** a common word for entity.
- **Entity:** a set of data about one thing.
- Field: common word for attribute.
- Database management software: software used to manage a database.
- Relationship: the way which two entities in two different tables are connected.
- **Primary Key:** a field that contains a unique identifier for a record.
- **Foreign key:** a field in a table that refers to the primary key in another table.
- **Normal form:** the extent to which a database has been normalized.
- **Index:** a list of keys or keywords which identify a unique record and can be used to search and sort records more quickly.
- **Flat file:** a database stored in a single file.
- **Compound key:** two or more fields that form the primary key.
- **Referential integrity:** data in the foreign key of the table on the many side of a relationship must exist in the primary key of the table on the one side of the relationship.
- **Query:** a question used to retrieve data from a database.
- **Parameter:** data used within the criteria for query.
- Data types include:
  - **String (text)**
  - **Numeric**
  - **Boolean**
  - **Date/time**
- Generic file formats enable data to be transferred between software.

NOTES

- They do not include any formatting and only include essential data.
- .txt and .csv are generic file formats

- Indexed sequential(serial) access: data is accessed based on the sequential order it is sorted in.
- Direct file access: Data is stored in a random order based on a hashing algorithm that determines its storage location and the same is used to locate it during access.
- Data dictionary: a document/file that describes the structure of the data held within the database, known as metadata.
- Management information system (MIS): collects data from a database and present it in the form of reports and charts. These reports and charts can be produced within the database system itself or they may be part of an additional piece of software that is used to analyze the data.
- An MIS' essential features:
  - Data is collated from databases and other sources
  - Data is interconnected from different sources
  - Data is analyzed to provide the data that is required
  - Summary reports and charts
- When additional software is used to collate data from more than one database, it is often referred to as an Executive information system (EIS).
- **Data integrity:** The level of accuracy and reliability of data.
- **Data redundancy:** Data that is unnecessary.
- **Normalization:** Organizing data in a database to reduce data redundancy and increase data integrity.
- **Unnormalized data:** Data that is unnormalized may have repeated entries and fields that are not atomic.
- **1NF:** A database that is in 1NF will not have any repeating fields and all the fields in the database will be atomic.
- **2NF:** A database in 2NF will have the characteristics of 1NF. In addition, fields that are related will be separated into different tables, dependent on the primary key of the table.
- **3NF:** A database in 3NF will have the characteristics of 2NF. In addition, any fields that are not directly related to each other are given further separation into tables that only contain fields that are directly related.

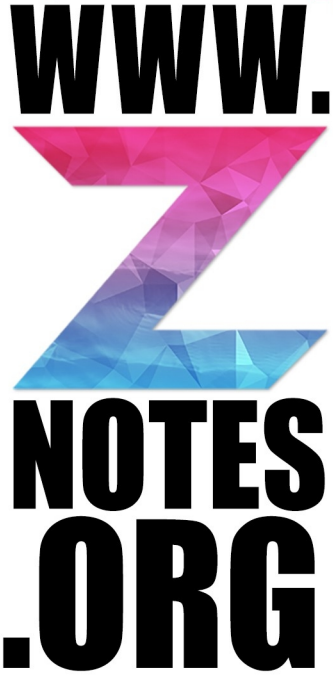
10. Sound and Video editing

- **Pixel:** a very small square area of one colour that is illuminated on a display screen. These are combined to create a bitmap image.
- **Frame:** a single still image in a video file
- **Rendering:** combining the effects created in a video file to create an output video file
- **Transition:** The movement from one clip to the next
- **Filters:** an effect, often colour related, that can be applied to a clip.
- **Track:** a single audio section in a sound or video file.
- **Pitch:** the highness or lowness of a tone.
- **Aspect ratio:** the ratio of width to the height if a screen.

NOTES

CIE AS-LEVEL INFO. TECHNOLOGY//9626

© Copyright 2017 by ZNotes
First edition © 2017, by Anand Sankar for the 2017-19 syllabus.

This document contain images and excerpts of text from educational resources available on the internet and printed books. If you are the owner of such media, text or visual, utilized in this document and do not accept its usage then we urge you to contact us and we would immediately replace said media.
No part of this document may be copied or re-uploaded to another website without the express, written permission of the copyright owner. Under no conditions may this document be distributed under the name of false author(s) or sold for financial gain; the document is solely meant for educational purposes and it is to remain a property available to all at no cost. It is currently freely available from the website www.znotes.org

This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.