System Development:

Linear/Waterfall (Cascade) - Sequential design process before development. More solid/sound product and less prone to feature creep but slower and more expensive.

Iterative/Rapid Application Development (RAD) - Cyclic process of prototyping, testing, and design. Faster and cheaper development process but prone to feature creep.

System Manual - Information on how the system works

User Manual - Information on how the user uses the system

SDLC (PADDIEM):
Preliminary Analysis:
• Problem definition

• Feasibility study - Demand (need for product?), Budget (Is there sufficient finance to install business requirements), and Legality (Does the product conflict with legal requirements?)

Analysis:
• Model of current system

• Requirements of the new system

Design:
• Logical (DFD/ERD) and Physical (Network layout) designs

Development:
• Acquire software and hardware

• Construction and testing

Implementation:
• Direct cut - Cheapest and fastest but users may struggle to adapt to change so rapidly

• Phased - Implement the system piece by piece over time, users adapt better but slower and more expensive

• Pilot - Portion of users use the software, users understand the system before it's implemented but it is slower and more expensive

• Parallel - Dual system usage allows users to decide which system to use, holds customers used to a certain system while also implementing a new one but it's more expensive

Evaluation and Maintenance:
• Performance evaluation

• Fault finding and correction

• Internal (comments and system manual) and external (user manual and troubleshooting guide) documentation

Data gathering techniques - Surveys, Interviews, Observations, Sample forms, Sample of volume run through the current system

Project management tools - They make a guide to make sure a project stays within scope and budget.

Hardware and Software:

Fetch-Execute Cycle:

Fetch - The control unit gets the instruction from memory

Decode - The CU makes sense of the instruction and directs the instructions to the ALU

Execute - The ALU performs the necessary arithmetic or logic operations

Store - The result is stored into memory

Standard Operating Environment (SOE) - A specification of hardware and software uniformly used across a business/institute. Allows for easier troubleshoot and maintenance but limits flexibility and users from specialising.

Primary Storage - Memory that is directly accessible by the processor (Eg - RAM, ROM).

Secondary Storage - Data not directly accessible by the processor and has to be routed to the main memory for processing.

Roles of Operating System:
- Managing Devices - Managing the internal hardware and peripheral devices through the use of drivers so that they can interact with the system and other hardware devices
- Managing Memory - Manages the locating, monitoring and movement of data from the main memory and when to remove it once it's served it's purpose
- Managing Concurrency - Managing simultaneous executions of tasks
- Scheduling - It manages and organises the instructions to be run in a certain order and handles the removal and selection of other processes that are run through the CPU.

Types of OS:
- Embedded OS - Basic OS that performs smalls tasks in devices (microwaves, AC wall panel)
- Server OS - It's specifically designed for running servers
- Stand Alone OS - A complete OS that works on desktop computers

Types of Processing:
- Distributed - It performs operations over multiple computers connected over a remote network
- Parallel - It perform processes simultaneously with another CPU
- Sequential - Performs process in order of which they are received
- Multi-Core - A single CPU with multiple core that can perform tasks independently as well as in conjunction with each other.

Parts of the CPU:
- Arithmetic Logic Unit - Performs all arithmetic and logical computations
- Control Unit - It directs all operations within the CPU
- Registers - High speed storage within the CPU
- Program Counter - A register that contains the address of the instruction being executed
- System Clock - A signal that syncs the devices in the CPU
- Data Bus - Sends data to the memory or receives data from the memory
- Control Bus - Transfers control information within the CPU
- Address Bus - Sends information about where data needs to go by sending an address to the memory. Sends from CPU to RAM.

Drivers - Software that lets the OS communicate with hardware

Operating System - Lets the user interact with the hardware to perform tasks

Space Management - The way in which data is organised on to a computer

Directories (folders) - The location of data, used to group specific files in a centralised placed.

File Name - The name of the file.

Benchmarking - A relative performance grade on how it can run through a controlled and consistent tasks. Test results for hardware, application and OS are types of benchmarking.

RAID (Redundant Array of Independent Disks) - A storage platform which redundantly stores information so that in the cause of a drive failing information can still be restored by being taken off a mother disk.

RAID 0 - Data is striped (strip set) across multiple disks without parity or fault tolerance.

RAID 1 - All data is mirrored on to another drive thus providing fault tolerance if one drive was to fail.

RAID 10 - All data is striped on to 2 drives and then those 2 drives are mirrored so that data can be written faster as well as providing fault tolerance.

UPS (Uninterrupted Power Supply) - Provides devices with a limited use of power, if a power outage was to occur, allowing devices to safely save and turn off their devices.

Online storage - Storing data over a network that is connected to multiple disks.

Full backup - It completely backs up all data from a database

Incremental backup - After a full back up has been completed it incrementally updates the backup with changes that have been made to the database.

Virtualisation - Creating virtual machines that are able to utilise the unused hardware of a single computer.

Storage virtualisation - Grouping multiple storage disks and represent them to look like a single storage device.

Platform virtualisation - Creating virtual machines to utilise the unused hardware that a single OS cannot, allowing multiple computers to exist whilst only existing on the one physical platform. This is also how **server virtualisation** is achieved

Desktop virtualisation - Software technology that separates the desktop environment and associated application software from the physical client device that is used to access it.

Cloud Computing - Ability to store, access and process data over a network/the internet. Accessible and mobile but requires constant network connection and may infer unpredicted costs.

Databases:

Types of databases:

• Local - Held onto an individual computer or attached storage

• Online - Accessed from a network

Centralised - A database located and maintained in a single location. Greater accessibility and less complex to back up but there is performance degradation and may not be able to handle all traffic coming through

Distributed - A database maintained and located over multiple different geographic locations. Faster data access and allows for growth but greater costs in maintaining and security of all locations.

Data warehouse - The capture of data from diverse sources for reporting a data analysis

Data mart - A subject orientated archive that stores and uses the set of information to assist and support the requirements involved within a particular business function or department.

Data mining - An analytical process designed to explore large amount of data to discover patterns and relationships in the data.

Data dictionary - The metadata of data inputted into a field, the rules that guide how data should be inputted and the type of information it should be.

Data duplication - The necessary duplication of data (people with the same last or first name)

Data redundancy - Unnecessary duplication of data across a database

Data security - Digital privacy measures taken to prevent unauthorised access to the database.

Data manipulation - Changing data in a database

Data integrity - The overall correctness and accuracy of the data

Entity integrity - Making sure all tables have a unique primary key and is not null

Referential integrity - Making sure all foreign keys correspond to a primary key of another table and that the validity of the relationship is fine.

Domain integrity - Making sure the data inputted is following the rules defined through the data dictionary.

Update anomalies - Updating information within a database but it does not change across the whole database

Deletion anomalies - Deleting information but it not being deleted across the whole database

Insertion anomalies - Data cannot be inserted in to a database without the presence of certain fields

SQL:
SELECT [Field]
FROM [Table]
WHERE [Conditions]

1st Normalisation:
- Data is atomic (can't be broken down further)
- Every record is uniquely identified
- No repeating fields with similar types of data
- Each field is unique

2nd Normalisation:
- Non-key fields must depend on every part of the primary key (Eg - Not putting a 'customer name' field in a table about cars)
- In 1st Normal Form

3rd Normalisation:
- There are no non-key fields that depend on another non key fields; will have no loops in an ERD. (Eg - suburb depends on postcode, so don't bother having them together in the same table)
- In 2nd Normal Form

Indexing - A data structure that improves the speed of data retrieval.

Database Design Considerations:
- Readability

- Navigation

- Logical Order

- Inclusivity

Programming:

Network (per seat) license - A software license based on the number of users who have access to the software.

Enterprise license - A software site license that is issued to a large company. It typically allows unlimited use of the program throughout the organisation, although there may be restrictions and limitations.

Proprietary license - Software that is copyrighted and bears limits against use, distribution and modification that are imposed by its publisher.

Developing Software Considerations:

• User needs - Both the outcomes sought and functionality required to achieve those outcomes

• User Interface - Making it easier/more convenient for the user

• Processing Efficiency - Designing the software based upon how much processing power there is

• Development time - Time management and meeting deadlines

• Technical Specifications - The hardware that the software will be compatible with

Software Development Cycle (SDC) - AD/CD/T/DIE:

• Analyse detailed requirements

• Design data and algorithms

• Code data structures and instructions

• Debug syntax and logic errors

• Test to meet specifications

• Document internally and externally

• Implement and test with live data

• Evaluate performance of the program

Modularisation - Importing modules into a program to lessen the size/ iteration of code making it easier for teams to work on larger projects and debugging the code.

Module - A small program run inside a larger program; made up of procedures or functions

Function - Performs calculations and returns a value

Procedure - Runs a piece of code without returning a value (may still contain calculations)

Parameter - Input variable for the module or a domain to run on real numbers. They can be passed by reference (will return a value) or passed by value (the value is not altered)

Data Types (simple):

• Integers - Whole numbers (1, 53, 100, etc)

• Real numbers (floating point numbers) - Any value (78.23, -9.4, etc)

• Boolean - Can only return 2 values (True/False)

• Characters - Single symbol (a, A, ?, #)

Data Types (complex):

• Strings - Multiple characters and/or integers combined together

• One dimensional array - A list of variables assigned within one variable (Animals = [lion, bird, giraffe])

• Record - Databases combining multiple fields

Programming Concepts:

• Constants - A value that does not change throughout the program

• Local Variable - Only used within a module

• Global Variable - Used in all areas of the program

• Parameter variables - Values passed between he main program and a module, or between a module and module

Control Structures - The manipulation of flow of a program

Types of Control Structures:

• Sequence - Following lines of code in order

• Iteration - loop or repeat certain sections of code

• Selection - Testing a condition then running a section of code accordingly depending on the return value (true/false)

Stubs - Section of code used as a place holder to allow other parts of the program to work

CASE Statements:
CASE [variable being checked] of
      [potential value of variable being checked]: [code to be run if true]
      [repeat line above for as many values you have]
END CASE

Eg - CASE DeliveryType of
         "standard": Charge = 5
         "fast": Charge = 10
         "priority": Charge = 15
    END CASE

External Documentation - Documents that inform end-users about the system and how to operate it (Eg - User manuals, Troubleshoot Guide)

Internal Documentation - Documents that explain how the system works (Eg - System manuals, comments in the program)

Types of code:

• Source code - The code written by people in a programming language.

• Byte code - Form of instructions run by a virtual machine rather than the CPU, it can run faster and more effectively than source code. This code is more compatible and mobile allowing it to be executed on more platforms than source code.

• Executable code - A language that the computer reads (binary) and carries out the instruction out on the hardware.

Interpreters - Translates one line of code at a time and then executes it. This takes less time to analyse but longer to execute, requires less memory and translates until it encounters an error making it easier to debug.

Compilers - It scans the whole code and then converts it into executable code, this requires more memory and takes longer to analyse but executes the program much faster. The error message is shown at the end making it harder to debug.

Types of Programming Errors:
• Syntax - An error in the notation of the language

• Run-Time - An error that commands the program to do something not possible

• Logical - An error in the logic of the program, where the program may run and return values but not the desired ones.

Data Validation - Making sure reasonable, complete and within the accepted boundary data is inputted into the program. This reduces the number of errors put into the code by comparing input data against a set of rules.

Types of data validation:
• Range Check - Numerical values are within a range (currency, integer, etc)

• Type Check - Ensures correct data type is entered into the field

Networks:

Network Devices:

- Router - Connects two networks together regardless of the protocol in use

- Switch - A device that connects local nodes and other devices together, it allows for efficient transfer of data between devices between connected to it by finding the best possible path for data to travel.

- Firewall - It prevents unauthorised access into the network by checking all data entering and leaving the network and only allowing data that matches the security criteria to leave or enter, all other data is 'burned'.

- Modem - Turns analog signal into digital and vice versa.

- Network Interface Card (NIC) - A piece of hardware installed into a computer that will allow it to connect to a network. May be used for both wired and wireless.

- Wireless Access Point (WAP) - A device that allows devices to connect through a wireless standard

- Bridge - It connects two LANs with the same protocol together, allowing large locations to use this device to send data more efficiently through the network. It stores MAC addresses so that when data is being transferred, the bridge forwards the data until the bridge with the stored MAC address receives it, it will then reach the recipient.

- Gateway - A device that acts as an entrance to another network. A router would be considered a gateway.

- Repeater - It regenerates or replicates a signal that has been distorted by transmission loss. Analog repeaters amplify the signal, where as digital repeaters reconstruct a signal to near its original quality.

Types of Network Storage:

- Storage Area Network (SAN) - An independent, high speed network that presents shared pools of storage devices to multiple computers.

- Network Attached Storage (NAS) - A dedicated file storage device that provides LAN nodes (anything connected to the network) with file-based shared storage through a standard ethernet connection. The NAS itself is connected to the LAN and has it's own IP address. It provides multiple clients with the same data.

Types of Wireless Transmission Media:

- Broadcast Radio - Great flexibility and easy connectivity but potential security threats

- Cellular - Robust and low transmission power but has black spots and is expensive

- Microwave - Multiple channels available and wide bandwidth but signal absorption and expensive

- Satellite - High bandwidth and reaches rural areas but propagation delay and noise interference

Types of Wired Transmission Media:

- Unshielded Twisted Pair (UTP) - Cheap, and compatible but susceptible to noise and sends data short distances

- Shielded Twisted Pair (STP) - Same as UTP but less susceptible to noise

- Fibre Optic - Single-mode send one ray of light which can travel long distances but less bandwidth, multi-mode sends more than one ray of light and has a much larger bandwidth but a much smaller range. Overall extremely large bandwidth and virtually unsusceptible to noise.

TCP/IP (Transmission Control Protocol/ Internet Protocol) - A two layer protocol where:
- TCP (upper layer) disassembles the message into packets and reassembles it on the receiving end.
- IP (lower layer) manages the addresses of each packet and controls it to the correct destination.

DoD Model Layers:

Application - Enables the applications to communicate with each other and use to lower services to send information to each other

Transport - Manages the transportation of data and allows the application layer communicate with the layers below it

Internet - Handles the packaging, routing and addressing of data

Network Interface - Provides the physical and data transfer capabilities and deals with connecting to the NIC and transmission media. It deals with MAC (Media Access Control - physical devices) and IP addresses (logical connections)

Types of Error Detection/Correction Method:
- Parity bit - A single bit added to a binary transmission (1 byte/8 bits) used to indicated if whether an even or odd number of 1's within that data. The single bit (parity bit) is used in parity error checking to find errors that may occur during transmission. It is limited and cannot detect if data is changed due to electrical noise.
    Eg - If an even number of 1's is expected but an odd number is received it will check the parity bit and conclude there is an error and request a retransmission.

- Checksum - The bits within the byte are run through a checksum algorithm to gain a numerical value, when the byte is sent the received byte is run through the same checksum algorithm and should achieve the same numerical value, if not then the data is incorrect and a retransmission is requested.

Carrier Sense Multiple Access (CSMA) - A set of rules that govern how we send signals

Types of Carrier Sense Multiple Access (CSMA):

CSMA/Collision Detection - Determines what happens when signal collide on the network, if two signals collide they will be sent back to the sender, after a random time interval for each the senders will try again. Used in wired ethernet standard (802.3)

CSMA/Collision Avoidance - Aims to prevent collisions, it contributes to network traffic as before any real data is transmitted it has to broadcast a signal on the network in order to listen for collision scenarios and to tell other devices not to broadcast. Used in wireless standard 802.11

Types of Communication Protocols and Standards:

Wireless:
- Bluetooth
- Ethernet 802.11x
- Radio Frequency Identification (RFID)
- Wireless Application Protocol (WAP)

Wired:
- Ethernet 802.3

TCP/IP (IPv4 and IPv6) - IPv6 addresses are 128-bit and is written in hexadecimal whereas IPv4 is 32-bit where each number, of 4 numbers to make up an IP address, can be between 0 and 255. IPv6 has greater security and can produce more IP address (in which we were running out of in IPv4) but the struggle is to implement it world-wide where IPv4 is still widely used.

Dynamic Host Configuration Protocol (DHCP) - A client/server protocol that automatically provides an IP host with an IP address and other such information such as it's subnet mask and default gateway. It maintains a pool of IP addresses and leases them to clients on a network. As the IP addresses are dynamic (constantly changing) rather than static (permanently assigned), addresses no longer used are returned to the pool to be reallocated. Without it IP addresses would need to be configures manually.

Domain Name Service (DNS) - An internet service that translate domain names to IP addresses. Domain names are alphabetic (eg - google.com) they are easier to remember, so DNS allows us to easily find the IP address based websites easier.

Factors that affect the performance of a network:
• Bandwidth

• Network Design

• Collisions

• Excess Broadcast Traffic

Types of way to secure a network:
• Firewalls

• Anti-virus Software

• Password and Network User Policies

• Authentication

• Encryption

Types of ways to damage a network:
• Denial of Service - Overloading the sever with too many requests or sending a request the server cannot process will cause the server to crash thus denying service to everyone.

• Back Doors - An entry point that by-passes all security mechanisms.

• Phishing - Tricking the victim into sending their sensitive information by masquerading as an official, trustworthy person/company.

• IP Spoofing - Mimicking the IP address of another person, so that when the victim sends private information to the IP address it is send to the mimicked edition not the original. The attacker would have first had to breach into the victims router for this to work.