Paper 1 Revision

1.1 Systems Architecture

Von Neumann Architecture is the stored program concept where instructions are moving between memory and the CPU.

Components of the CPU

- Control Unit – Oversees the FDE as well as other components of the CPU
- Arithmetic and Logic Unit – Responsible for the calculations performed by the CPU
- Cache – High speed small storage memory used for storing frequently used instructions
- Registers – Specific memory that stores data that the CPU is currently processing

Registers you need to know about:

- Program Counter – Holds the memory address of the next instruction to be carried out
- Memory Address Register – Stores the memory addresses of instructions being searched for
- Memory Data Register – Holds the data/instructions that are to be read/written to memory
- Accumulator – Holds the result of any calculations performed by the ALU

Fetch-Decode-Execute (Repeat) Cycle

Stages and Register use as follows:

1. Fetch – Instruction is fetched from the Memory Address which the Program Counter is currently holding, one this is passed over the Program Counter increases by 1
2. Decode – The Memory Address provides the location of the Memory Data to be used which is decoded by the Control Unit
3. Execute – The instruction is carried out and the result stored in the accumulator with any Memory Data Register being updated as needed.
4. The process repeats

Embedded Systems

A device with a specific purpose that is built into a larger device. These systems are built for reliability and generally use Read-Only Memory to avoid their purpose being changed.

Exam board accepts:

- Dishwasher
- Washing Machine
- MP3 Player

Computer Performance

Clock Speed

Increases performance by performing more instructions per second – measured in Hertz. Higher values of these are always preferable.

Cache Size

High speed small storage memory that holds frequently used instructions which make routine processes faster…

However, too much Cache memory is bad as you only want a small set of frequent instructions else it takes too long to search.

Number of Cores

The more cores in theory means the more instructions carried out but not every program is optimised for this and it isn't a direct doubling of speed from 2 to 4 cores.

What is a Core?

A processing unit found within the Central Processing Unit.

1.2 Memory and Storage

Primary Storage is needed to store the files that the CPU is currently accessing without primary storage there could be potentially no where to store data or relying on slower second storage

RAM (Random Access Memory) is volatile and often used to hold data/instructions that are currently being used

ROM (Read Only Memory) is non-volatile and tends to hold operating system information as well as information such as boot-up instructions

Virtual Memory is where RAM becomes full and space is used secondary storage to temporarily act as RAM

Once the need for this ends, secondary storage passes data back to the RAM until it is next called on

Secondary Storage is long term permanent storage of files, without it we would be potentially relying on volatile primary memory, which is much smaller than secondary storage in size.

Common Storage Types

Optical – This consists of CD, DVDs and Blu-ray, these are read by lasers and depending on the layout of the surface of the disk, these are then read as 1 or 0 binary values.

Magnetic – This is a magnetised disk where different areas contain different charge depending on what data they are storing, again this is put back into binary value depending on the positive or negative charge. Magnetic devices use a reader head which moves as the disk spins.

Solid State – The magical no-moving parts storage, this is very fast storage as data is kept trapped in electronic gates but it doesn't offer as much storage as magnetic devices.

Secondary Storage Characteristics

	Optical	Magnetic	Solid state
Capacity	Low	High	Medium to High
Speed	High	Medium	High
Portability	High	Low	Medium
Durability	Low	High	High
Reliability	Medium	Medium	High
Cost	Low	Low	High

Optical: Stores from 700MB to 13GB

Magnetic: Stores from 500GB to 2TB

Solid State: Stores from 100GB to 1TB

1.2 Units

Binary – Conversion to and from denary values, this will be 8 bit values but do double check the question

Hexadecimal – Conversion to and from binary/denary

0-9 are the same

10-15 are A to F

Hexadecimal is used as it is a shorter method of displaying data that is easier to remember, it still needs to be converted back to binary.

Binary Addition

Adding two values together

Overflow is always the problem, caused by having too many digits for the bits available.

Binary Shifts – The act of increasing or decreasing a value by shifting

Left shift decreases the value, halving each shift

Right shift increases the value , doubling each shift

Characters – ASCII is 7 bit, Extended ASCII is 8 bit.

Each character will take up potentially 7 or 8 bits (1 byte) per – spaces etc. are included in these calculations

Read questions carefully to identify the number of bits for ASCII that they are using!

Unicode is another character set available.

Character set is a term that refers to all the characters a computer can use, each represented by different binary values

Images – These are made up of pixels, each pixel has a binary value attached to it.

Resolution is the term for the width x height of a screen / image

For calculations you will need to times the total amount of pixels by the bit depth.

Note – 8 colours can be represented by 3 bits.

More bits available = higher quality, bigger file

Sound – Sampling is taking a measure of the height/amplitude of a wave at a set interval.

More samples = higher quality, bigger file

Lossy Compression

This can be done by removing pixels (condensing the size of the image) or removing the amount of colours available

Lossy results in permanent reductions in file size and it cannot be put back to the original size once it has been compressed.

Used on Sound/Images to make them faster to send/quicker to download online

RRRRGGRRBBBBB

Becomes

RRRGRBBB

Lossless Compression

This is a process of marking up data in a format that means it can be unpacked back into the original size later.

Generally used on software applications.

RRRRGGRRBBBBB

Becomes:

4R2G2R5B

1.3 Networks

Local Area Network covering a small geographic area using their own equipment

Wide Area Network covering multiple sites that uses third party connections (e.g. the internet) to connect to each other

Factors that impact network performance:
- Bandwidth (Maximum amount of data that can be transmitted at once)
- Number of devices connected
- Distance from Router if Wireless
- Obstacles such as walls if Wireless

Client-Server / Peer to Peer:
- Clients request services from the servers
- Servers provide them to the clients

Hardware required:
- Router – Records IP addresses, allows internet access and records destinations
- Switch – Uses MAC addresses, forwards information as needed
- WAP – Wireless Access Point, as it says!
- NIC – Network Interface Card
- Transmission Mediums – for example fibre optic cabling, this term just refers to the connecting method used.

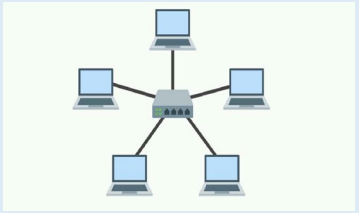
The Internet and DNS

Domain Name Servers are used to convert URL (www.google.co.uk) into an IP address

- Request to go to www.google.co.uk
- DNS checks database for IP
- If it has it – returns this to the client
- If it doesn't it asks another DNS until it finds it (and updates its own records) or returns not found

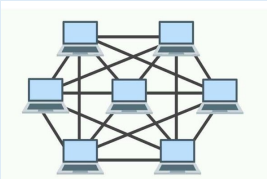
Star and Mesh Topologies (Read Question to check for context)

Star:
Switch in the middle.
+ Easy to add new devices
- Single Point of Failure

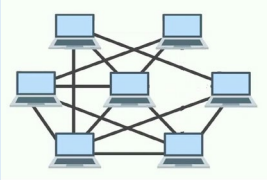


Mesh Networks:
+ Self-healing network
- Lots of cabling/redundant connections

Full Mesh:
All devices connected to each other



Partial Mesh:
Most connected to each other



Wired vs Wireless
Wired is faster and more secure but less portable than wireless.
Wireless is able to get around physical barriers and has many frequencies to allow people to connect to.

Encryption
Process of encoding text with a key to make it look jumbled up to anyone who intercepts it

IP Addressing/Mac Addressing
IP addresses (IPv4) are made up of 32 bits that are 4 series of 8 bit values (from 0 to 255) e.g. 192.168.1.3. The IP address of a device can change.
Mac addresses are physical addresses used by switches, these addresses do not change

Protocols – Govern the rules of communication between devices
- HTTP/HTTPS – For displaying websites
- SMTP – For sending e-mails
- POP/IMAP – For storing e-mails
- FTP – For sending files
- TCP/IP – Internet settings

Layering is beneficial as they each have their own specialist task and can be updated without impacting others

1.4 Network Security

Forms of Attack & Prevention

Malware – Malicious Software that is designed to prevent the victim using their device or having access to their data – often attached to phishing e-mails or spam!

- Viruses
- Spyware
- Ransomware

Prevent by:

- Training staff to recognise phishing e-mails
- Not downloading unfamiliar files

Social Engineering – Manipulating a victim into believing you are someone else or of importance and using this to get sensitive information from them

Prevent by:

- Training staff
- Checking credentials (ID etc.)

Brute-Force Attack – Repeatedly guessing passwords until eventually you are able to gain access to a system if they aren't using a strong password

Prevent by:

- Limiting password guesses
- Having a strong password (long/complex!)

Denial of Service – Spamming a server with requests until it is unable to handle them and ultimately goes offline

Prevent by:

- Having a firewall in place
- Changing your IP address

Data Interception involves using software or hardware to pose as a network point or tapping into an existing one to try and obtain any unencrypted data or passwords

Prevent by:

- Using encryption
- Not connecting to public networks

SQL Injection is where SQL code is put into text boxes on a website with code to try to retrieve information from the databases behind the website, such as customer or admin data that is not encrypted

Prevent by:

- Limiting amount of characters they can use
- Preventing symbols such as * used by SQL

Other prevention methods…

Physical Security includes

- Locking the door
- Biometrics
- CCTV
- Access cards
- Security guards

Other methods

- Firewall (stops connections)
- Anti-Malware (stops/removes malwares)
- Strong Passwords (explain meaning of strong)
- Encryption (makes interception less of an issue)
- Penetration testing (allows you to fix vulnerabilities ahead of time)
- User access levels (restricts people accessing data or files they shouldn't)

1.5 System Software

Operating System Software -

The purpose of an operating system is to:

- Provide a user interface which allows people to interact with the computer
- Manages the memory and handles interrupts and what is currently in RAM
- Manages the input/output (peripheral) devices that are connected
- To manage users and their access levels
- To allow users to save, move, rename, delete etc. files

The Operating system enables multi-tasking by effectively managing the processes on the CPU being undertaken to allow your computer to access more than one program at once – this process needs to be managed.

The key role of an operating system is to provide feedback to the user as well as allowing them to interact with the software and devices attached.

Utility Software – This is software with a specific purpose that is to support the functionality of the computer

Encryption is the process of scrambling a message using a key to make it unreadable to those who attempt to access it without the key

Compression is either lossy or lossless and used to reduce file sizes to make them smaller size on disk and quicker to send/transmit across the internet.

Lossy is permanent and reduces file size the most

Lossless can be restored back to the original

Defragmentation is where a hard-drives files become scattered around the disk so they are no longer in a continuous line. This means it takes longer for files to be found as the reader head has to move more.

Defragmentation solves this by grouping files together (OS/Utility/Apps) and then leaving all the free space at the end.

Defragmentation can be caused by files being deleted resulting in gaps appearing.

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1.6 Ethics, Legal, Cultural and Environmental Issues

Context is key – make your answer relevant to the example provided and use the bullet points mentioned as discussion points

Include BOTH positive and negative aspects

Ethics:

Is it right to replace people with technology and put them out of a job?

Is it right to potentially leave their future at the decision of a computer?

Is it right to track people online for safety reasons?

Cultural:

Is technology making communities more westernised and lose their traditions?

Is it right to have robots doing people facing roles?

Has how we communicate change and left people behind?

Does technology create a divide between rich and poor?

Environmental

Whilst we may save paper on printing – does the extra electricity cost outweigh this?

Is there too many pieces of working tech being sent to landfill because people want the latest item for fashion?

Computers are made using chemicals and metals with increasing rarity – how good is this for the environment?

Privacy Issues:

Is it fair for children to have their lives posted all over the internet by their parents before they are aware of the issues?

Do we all overshare and are expected to? Is it weird not to have social media?

Are we giving away too much information to companies to micro-target us for their own financial gain or it is helpful to make us aware of deals on products?

Legal:

Data Protection Act – Data must be

- Kept secure and used by relevant people
- Not excessive and specific for the job
- Not kept for too long or shared without permission

Computer Misuse Act – Means..

Unauthorised access to a computer is against the law, this can be via hacking or using someone's computer who has gone to make a cup of tea!

Copyright and Patents

In place to prevent work being copied and distributed under someone else's name, makes it illegal to do so

Proprietary License – Means you can sell it and people cannot legally change the source code

Open Source – Means it is free and other people are free to maintain and make upgrades

Reverse the good points to make them negative as needed.