Week 7: PROCESS MANAGEMENT PT1

Processes, threads, piping and redirection:

- **What are programs vs processes?**
    - Processes are programs in execution. Every time a program is run, a new process is created.
- **What are system processes, services and background tasks?**
    - **Processes** are all the related activities inside the system that work together to make it function
    - **Services** are different kinds of services to both the user and to the programs as well. Examples include user interface, program execution, file system manipulation, etc.
    - **Background tasks** is a computer process that runs behind the scenes and without user intervention. Examples include logging, system monitoring, scheduling and user notification
- **What is process management?**
    - The role of the computer is to run the program, in which process management is how the OS handles this step by
        - Starting processes
        - Managing running processes
        - Performing interprocess communication
        - Terminating processes

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- **What are ways that operating systems make it look like programs can run concurrently?**
    - Run one program at a time
        - Single tasking - eg. traditional embedded systems
        - Batch processing - eg. ancient mainframe
    - Concurrent processing
        - Multiprogramming - eg. windows 3
        - Multitasking - all modern operating systems
        - Multithreading - most modern operating systems pentium 4+
        - Multiprocessing - multi core CPUs, dual/quad CPU
- **What's single tasking vs batch processing?**
    - **Single Tasking** allows the user to perform only one task at a time. Functions like printing a document, downloading images etc
    - **Batch Processing** is the process by which a computer completes batches of jobs, often simultaneously, in non-stop, sequential order
- **What's concurrent processing?**
    - A computing model in which multiple processors execute instructions simultaneously for better performance
- **What is multi-programming, multi-tasking, multi-threading, and multi-processing?**
    - **Multi-programming -** one or multiple programs can be loaded into its main memory for getting to execute.
    - **Multi-tasking -** the running of two or more programs in one computer at the same time. Used to keep all of a computer's resources at work as much of the time as possible

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- **Multi-threading** - The ability of a CPU to provide multiple threads of execution concurrently.
- **Multi-processing** - the running of two or more programs or sequences of instructions simultaneously by a computer with more than one central processor

- **What are the various process states? Can you explain them and how they interact?**
  - **1. Created** (ie. loaded into memory)
  - **2. Waiting** to be run by CPU
  - **3.** O/S **runs** the process
  - **4.** If process needs a resources, **"blocked"** (ie: waiting) until it gets the resources
  - **5.** It then **waits** again until the OS re-starts the process
  - **6.** When finished, O/S **stops** the process
- **What are 'interruptions'?**
  - The O/S runs processes continuously until interrupted
  - Interruptions come from
    - **Hardware -** eg. Ctrl-Alt-Delete keystroke, move mouse, network
    - **Programs** - eg. runtime error, pause for input, wait for block of data to load from disk
  - O/S will force current running processes into **"blocked"** state, and runs a special **"interrupt handler"**
- **What is process scheduling?**
  - **Scheduling** is how the O/S decides when to run each process on which CPU
  - Various types of scheduling exist but most use a **"queue"**

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- **What is 'inter-process communication?' What are some things that allow IPC? How do 1-way and 2-way IPC work?**
    - **IPC** - how processes communicate with each other
    - O/S allow communication between processes via file sharing, shared memory, signals, sockets, messages, pipes, semaphores, locks
    - **IPC one way example: Pipes**
        - Process A sends data to process Process B, in which Process B accepts the data
        - **Example:** Bash "pipe" operator → output of one command becomes the input of another command
    - **IPC two way**
        - Process can communicate in both directions
            - **Shared memory** - bit of memory which acts as like a file
            - **Named pipe -** special 2 way pipe, acts like a file
            - **Socket** - either a network or internal interface
            - **Message queue/Message passing -** special programming interface, passes data like internal messages/SMS
            - **Semaphore -** Special flag/file which controls access to resources

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WEEK 7: PROCESS MANAGEMENT PT2

- **What is resource management? What are some examples of 'resources**
    - Resources are things that processes might need to run eg. files, network, human interface devices
    - The kernel manages all other system resources eg. interrupts, I/O, system devices
    - Many resources requires mutually exclusive access
        - If one process is using the resource, no other process can use it until the first process is done
- **What is resource contention? What are some solutions to it?**
    - **Resource Contention -** 2 processes want to alter the same resource at the same time
    - Types of resources: Memory, files, hardware
    - **Solutions to this:**
        - **Semaphores -** a flag held by the process changing the memory
        - **Lock** files - a file is not readable/writeable while data is being written to it
- **What is a deadlock? What are the conditions of a deadlock? How can deadlocks be dealt with?**
    - **Deadlock** occurs if the resource will never get released for one or another person eg. 2 users try to edit the same file at the same time
    - Deadlock occurs if all of the following conditions hold simultaneously
        - **Mutual exclusion -** there exists a resource, that can be accessed by only one process at a time

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        - **Hold and wait -** there exists a process, that hold at least one resource and is waiting for another resource
    - **Dealing with deadlocks**
        - **Avoidance/Prevention -** O/S decides which processes may use resources, and when
        - **Detection/Management -** allows deadlocks to form; then finds and breaks them

WEEK 7: PROCESS MANAGEMENT PT3

- **What is memory management?**
    - Allows the O/S to:
        - Run more processes than we can fit into physical memory
        - Optimise use of expensive RAM
        - Keep track of processes 'owning' blocks of memory
        - Provide access control to memory
        - Decide where processes is loaded into memory
        - Handle allocation/deallocation of memory
- **What are physical and logical addresses?**
    - **Physical addresses -** access a particular storage cell of main memory, or a register of memory mapped I/O device
    - **Logical addresses -** the address at which an item appears to reside from the perspective of an executing application program

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- **How do os translate logical addresses to physical addresses?**
    - During execution of an process, the same logical address may be mapped to many different physical addresses as data and programs are paged out and paged in to other locations
    - The **logical address space** is larger than the physical address space (RAM) if we have virtual memory available
- **What is virtual memory? How is it different to RAM?**
    - Is a concept which is related to, but distinct from the memory hierarchy
    - Virtual memory makes part of the hard disk like main memory to the process
    - Virtual memory is **much** slower than RAM
- **What is vm, swap files, pages, page table, paging, page faults and thrashing?**
    - **VM -** the logical address space. Physically: RAM + Disk
    - **Swap file -** part of disk used for VM
    - **A page** - the amount of data that can swap between RAM and Disk at a given time
    - **Page table -** maps **"logical addresses"** to either to physical or virtual memory
    - **Paging -** the action of swapping a page between RAM and DISK
    - **Page fault -** When data to be access is not in RAM and needs to be swapped back from Disk
    - **Thrashing -** When OS spends more time paging, than running applications

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WEEK 8: COMPUTER ARCHITECTURE PT1

- **Can you give a brief history of computers?**

History of computing

Charles Babbage (1791-1871)

- English mathematician, inventor and reformer
- Designed the analytic engine - the first modern computer

Luigi Menabrea (1809-1896)

- Italian mathematician and politician
- Extended and published Babbage's design

Lady Ada Lovelace (1815-1852)

- Daughter of English poet Lord Byron
- Translated and extended Menabrea's paper
- Helped secure funding toward the construction of analytic engine

- **What is a computer?**

Definition of Computer from Shelly/Cashman

"*An electronic machine operating under the control of* ***instructions*** *stored in its own* ***memory****, that can accept* ***data****, manipulate the data according to specified rules, produce* ***results*** *and* ***store*** *the results for future use*"

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- **What is memory? What's the difference between RAM and ROM?** Computer memory or random access memory (RAM) is your system's short-term data storage; it stores the information your computer is actively using so that it can be accessed quickly.

ROM: Read Only Memory

Permanent information

RAM: Random access memory

Computer forgets it when its off

Programs change the contents

- **What are examples of input/output/network/storage devices?**

Input: Keyboard, Computer mouse, Graphic/drawing tablet.

Output: Computer display, Printer, Projector, Speaker.

Storage devices: Floppy disk drive, Flash drive, Disk drive, or CD/DVD drive.

Input/Output: Modem, Network interface controller (NIC)

- **What are the components of a cpu? What does ALU, CU and registers do?**

CPU: Central processing unit

The central processing unit (CPU) consists of three main parts:

➔ Arithmetic Logic Unit (ALU)

- ◆ Performs arithmetic and logical operations

➔ Control Unit

- ◆ Sets up ALU with instructions and data from memory
- ◆ Often use cache for faster memory access

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➔ Registers

- ◆ Small, fast memory in the CPU
- ◆ Loaded by the control unit
- ◆ Accessible by the ALU

- **How processors execute instructions?**

The processor executes instructions on data using a **Fetch-Execute** cycle:

FETCH → **DECODE** (raw data into executable data) → **READ** memory (not always needed) → **EXECUTE** (instruction)

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WEEK 8: DATA REPRESENTATION PT2

- **What is character encoding? What are some common examples?**

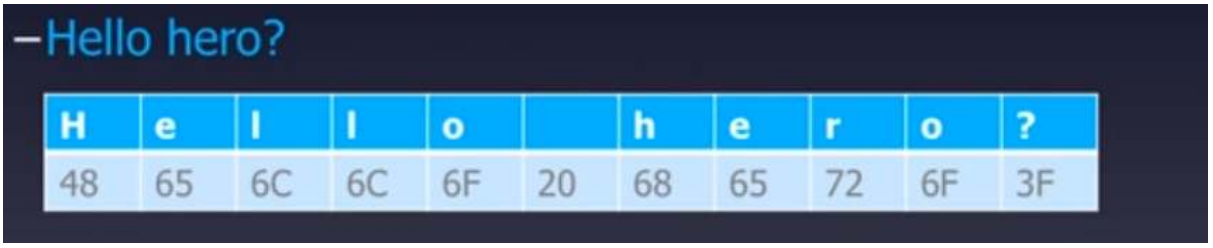
O/S designers invented character encoding to represent alphabets, digits and symbols.

e.g A-Z, a-z, 0-9, !@#$%^&(*

UNICODE which is an expanded **ASCII:** Was indeed originally a 7-bit code, 128 different characters

ISO-8856: Extension of ASCII to include Latin alphabet e.g German

- **How much storage space is used for writing various strings?**



- **How are images/movies/documents encoded?**

Images: GIF, JPEG, TIFF etc

Movies: AVI, MOV

Documents: DOCX, PDF, DOC

WEEK 8: NUMBER SYSTEMS PT3

- **What is a numeral/base number system?**

A numeral system is a way of representing information, sometimes called a number system. Important numeral systems implemented on computers include binary, decimal, and hexadecimal.

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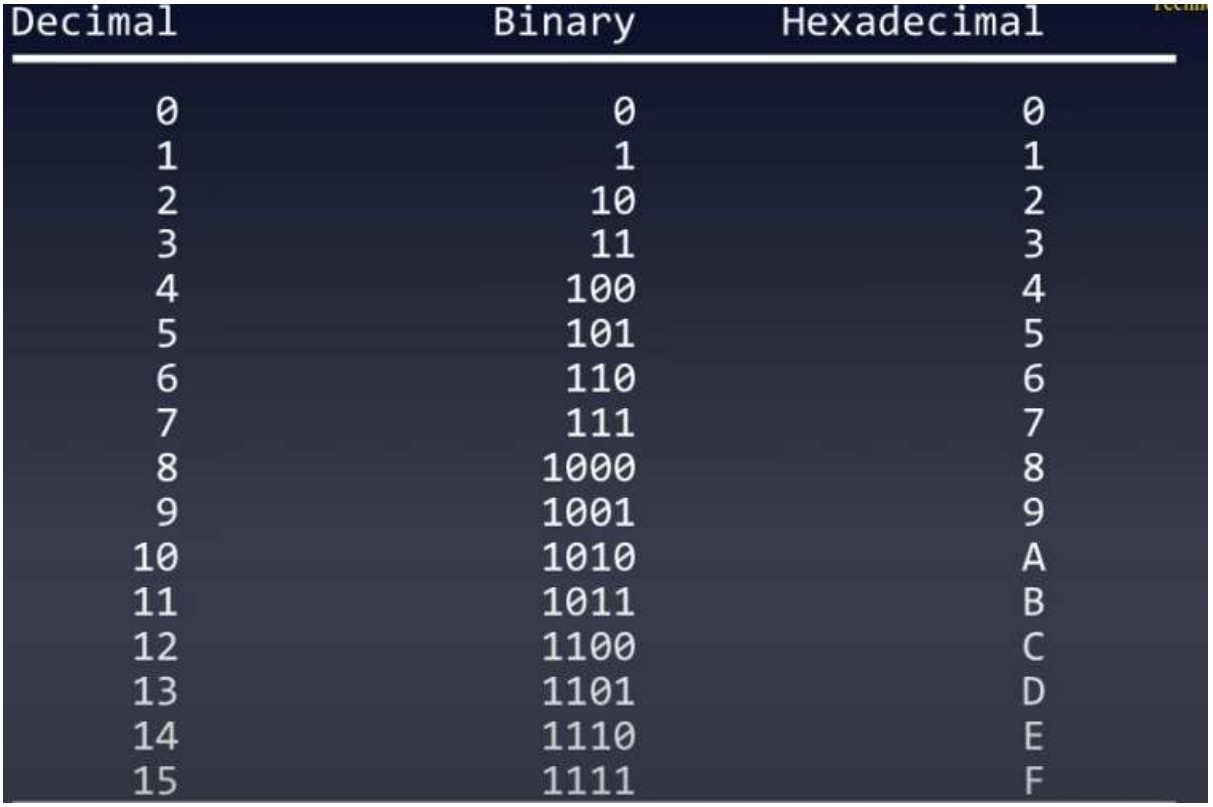
- **Number conversions**



Decimal	Binary	Hexadecimal
0	0	0
1	1	1
2	10	2
3	11	3
4	100	4
5	101	5
6	110	6
7	111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

WEEK 9: INTRO TO LOGIC

- **Boolean algebra**
    - A system that contains only 2 values, either **TRUE** or **FALSE**
- **Operators**

Three Basic Operations: AND, OR and NOT

We also look at the Boolean XOR operation, it is relevant to Binary Addition.

Every Boolean operation has inputs and outputs;

- **NOT** operations have 1 input and 1 output.
- **AND** and **OR** operations have 2 or more inputs and 1 output.

- **Maths & java notations**

Boolean Operators in Java

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- The **&&** operator is an **AND** Operator in Java
  - In Java, the statement (a && b) has value true only when a and b are both **true**
- The || operator is an **OR** Operator in Java
  - In Java the statement (a || b) has value **true** when either a or b (or both) are **true**
- The ! Operator is a **NOT** Operator in Java
  - The statement (!a) has the value true only when a is false

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- **Truth tables**
    - A **truth table** shows all combinations of inputs and resulting outputs.

Inputs: A	B	Output: A and B
False	False	False
True	False	False
False	True	False
True	True	True

The output only becomes **"TRUE"** when **BOTH** inputs are **"TRUE"**

Inputs: A	B	Output: A or B
False	False	False
True	False	True
False	True	True
True	True	True

The **OR** operation outputs **TRUE** when **either or both** of its inputs is **TRUE**

Inputs: A	B	Output: A xor B
False	False	False
True	False	True
False	True	True
True	True	False

e**X**clusive **OR**

Equal to the operation

- (A OR B) AND NOT(A AND B)

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- **Other representations**
  - **AND**
    - x ∧ y
    - x . Y
  - **OR**
    - x ∨ y
    - x + y
  - **NOT**
    - ¬ x
    - ! x
- **Laws**

Associativity - **AND** and **OR** are both associative operation

(x **AND** y) **AND** z = x **AND** (y **AND** z)

(x **OR** y) **OR** z = x **OR** (y **OR** z)

Distributivity

AND distributes over **OR**: (x **OR** y) **AND** z = (x **AND** z) **OR** (y **AND** z)

OR distributes over **AND**: (x **AND** y) **OR** z = (x **OR** z) **AND** (y **OR** z)

Complement/Identity

X OR TRUE = TRUE

X OR FALSE = X

X AND TRUE = X

X AND FALSE = FALSE this implies X AND not(X) = FALSE

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De Morgan's Law

not (P) OR not (Q) = not (P AND Q)

not (P) AND not (Q) = not (P OR Q)

WEEK 10 PT 1: THE INTERNET

- **What's a 'network'?**

A network is a collection of computers and devices connected together to allow sharing of resources between users.

- **What are some device types on a network? What do they do?**

Example 1: Network File System

Part of a remote disk can be made to appear as another hard drive on the local PC. The physical location of disk storage is transparent to users.

Example 2: Printer Sharing

One printer used by several PCs

- **What's the difference between a switch and a hub?**

Switch	Hub
A switch looks at the MAC addresses (burned-in physical address of the Network Interface Card) in the messages. - Provides a direct physical connection between hosts when they want to	A hub can connect more than 2 hosts. - Strengthens the signal. - Not concerned with the meaning of data. - Broadcasts the message to all of its ports.

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communicate. - More intelligent than a hub	

- **What's the difference between a physical and logical topologies?**

Physical topology (how the data actually is transmitted)

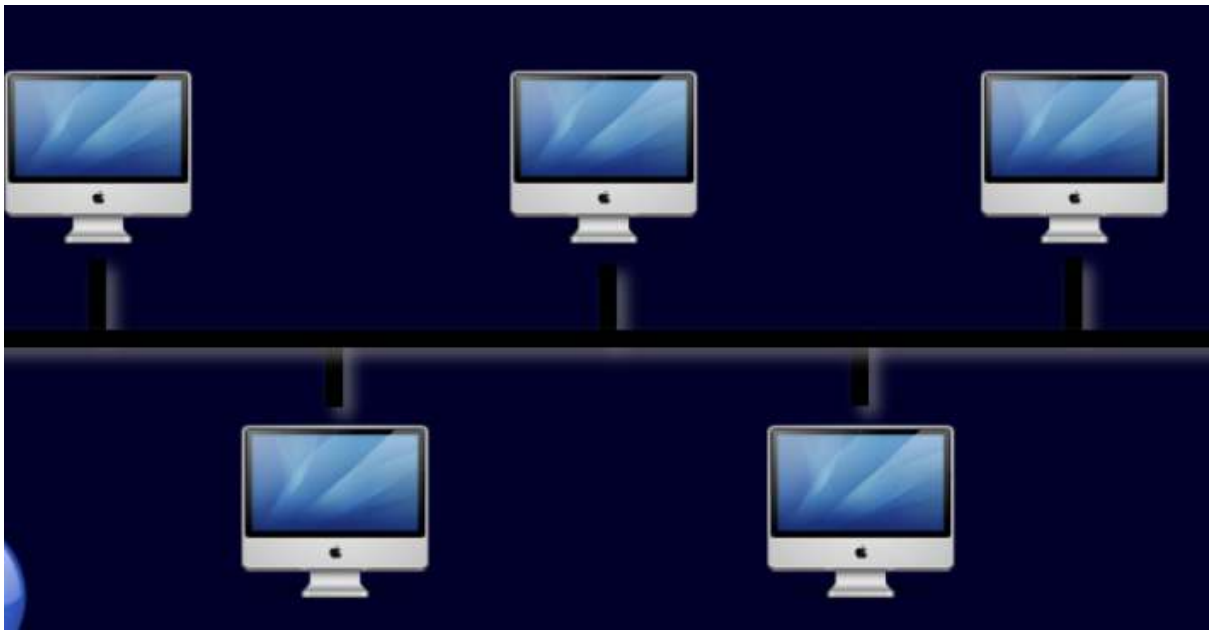
Physical network topologies include: Bus, Ring, Star.

Logical topology (only concerned about where the data ends up – the "black box" analogy)

Logical network topologies include: Bus, Ring

- **Draw the layouts of bus/ring/star physical topologies**

Bus: all the computers or devices directly connect to a common communication medium.



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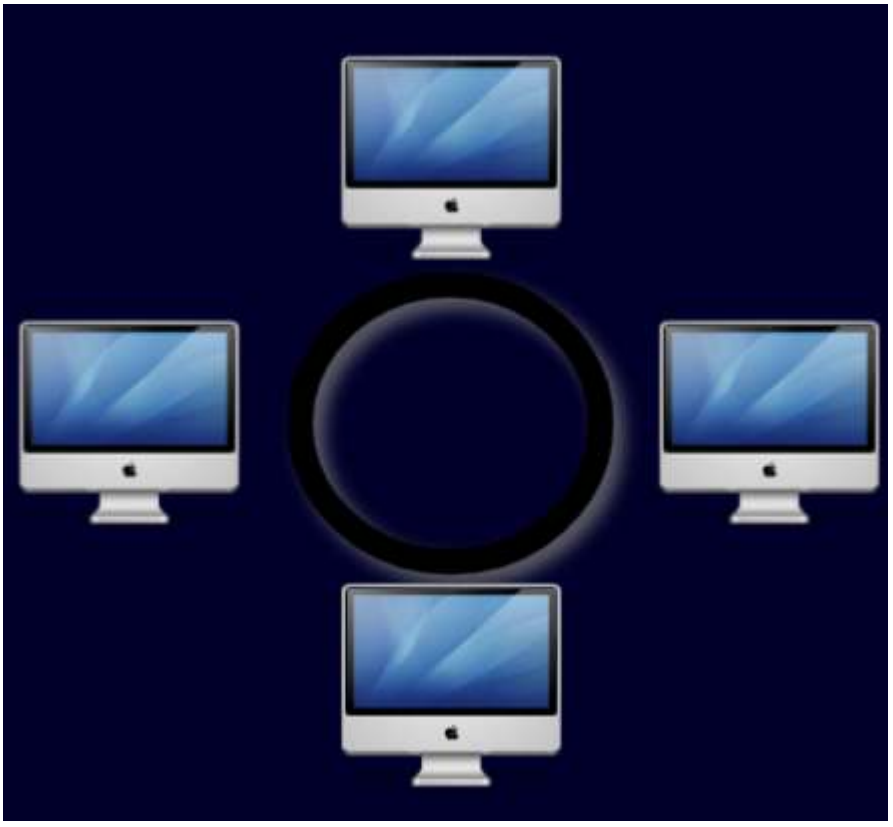
Ring: all the computers or devices in the network form a closed ring or loop.



Star: all the computers or devices in a network connect to a central computer or hub.

- **Describe/draw bus and ring logical topologies**

Logical topology: Token Ring

➔ To avoid collision, hosts take turns to transmit data.

➔ Permission to transmit is called a token. The token is passed from one host to another according to a set of rules.

➔ Often, connected physically in a bus or star topology

➔ But computers see this logical topology as a "ring"

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Logical topology: Bus (ethernet)

- ➔ All hosts have permission to transmit all the time.
- ➔ When a collision occurs, wait a random amount of time and try again.
- ➔ If a collision occurs again, double the wait and try again.
- ➔ As is typical of Ethernet - the network often has a star physical topology.

- **What's the difference between LAN, WAN and mans?**

WAN: A wide area network (WAN) is a network that covers a large geographic area.

LAN: A local area network (LAN) is a network that connects computers and devices in a geographically limited area.

- **What does a router do, how do they work?**
  - ➔ it looks at the IP address in the messages.
  - ➔ A Router decides on the next destination of a message (a packet)
  - ➔ A simple router could be your home ADSL router (which is technically a router + a modem)
  - ➔ Larger routers can be found in ISP's

- **What's a 'fat' client vs a 'thin' client?**

Fat client: where most of the processing is done at the client side. Just the data is on the server. E.g. Microsoft Access, SQL server

Thin client: where just the presentation is done at the client and the processing is at the server side. E.g. Browser, Web Server

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WEEK 10 PT 2: NETWORKING & INTERNET

- **What is an internet protocol?**
    - Every client/server application has a set of commands and responses eg. HTTP
- **What is a url?**
    - **Uniform Resource Locator** allows the identification of resources on the internet
    - It is made up of Protocol/Scheme, Userinfo, Host, Port, Path, Query
- **What port does http and telnet use? Can you list other ports-protocols?**
    - **HTML** connects to 138.25.16.22 at the port specified by the protocol, 80/tcp
    - **Telnet** allows you to login remotely to other networks on the internet
        - Runs on port 23
- **How do you converse with a mail server?**
    - **SMPT** allows for transfer of email between mail servers

1.telnet marcie.it.uts.edu.au 25

2. HELO it.uts.edu.au

3. MAIL FROM: user@it.uts.edu.au

4. RCPT TO: user@hotmail.com

5. DATA - *Then write your message on a line by itself means "all done"*

6. QUIT

- **What does pop3 and imap do?**
    - **POP3** allows you to retrieve mail remotely
    - **IMAP** leavers you mail on the server

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- **What is mime?**
    - **M**ulti-Purpose **I**nternet **M**ail **E**xtensions - allows for sending of binary data in emails
        - SMTP is a text only protocol
- **What is xml?**
    - E**x**tensible **M**arkup **L**anguage - share data in a structured way so it can be easily parsed without ambiguity

PREV EXAM QUESTION:

If we were to connect the 7 billion people in the world, it appears that there is only 6 degrees of separation between everyone.

Which of the following is the best explanation for this six degrees of separation?

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