Section 16.1 - Purposes of an Operating System (OS)

Layer 4: Operating System

Syllabus Content Section 16: System Software

S16.1.1 Show understanding of how an OS can maximise the use of resources

- Need for OS
  - A set of programs designed to run in the background on a computer system which
    - Controls operation of computer system
    - Provides a user interface
    - Controls how computer responds to user's requests
    - Controls how hardware communicate
    - Provides an environment in which application software can be executed
  - OS hardware is unusable without an OS, as the OS acts as an interface since it controls communication between user and hardware

S16.1.2 Describe the ways in which the user interface hides the complexities of the hardware from the user

The operating system has a number of sub-systems, each responsible for a different function of the computer. Again if we look at the file system, there is a specific set of processes that pay attention (listen) for any read requests or write requests. If an application requests to read something from a disk, the file system part of the operating system will ensure the application is authorized to make that request and then retrieve the blocks for the file and pass them to the application as a file object. The application will then organize the file object into a user-friendly image or text or document and pass that to the user.

Back to the car: you decide you want to listen to the radio. You turn on the radio and music comes out of the speaker. You aren't thinking about the electrical signals travelling from the power button to the microprocessor which then receives signal from the antenna and modulates the signal into sound wave and then passes the signal to speakers. You are just listening to music.

S16.1.3 Show understanding of process management

- The concept of multi-tasking and a process
- The process states: running, ready and blocked
- The need for scheduling and the function and benefits of different scheduling routines (including round robin, shortest job first, first come first served, shortest remaining time)
- How the kernel of the OS acts as an interrupt handler and how interrupt handling is used to manage low-level scheduling

---

- Key Management Tasks
  - (Main) Memory Management
    - Memory protection to ensure 2 programs do not try to use same memory space
    - Paging
    - Use of virtual memory
  - File Management
    - Provides file naming conventions
    - Maintains a directory structure
    - Allocates space to particular files
  - Security Management
    - Proves usernames & passwords
    - Ensures data privacy
    - Prevents unauthorized access
    - Carries out automatic backup
  - Hardware (input/output/peripherals) Management
    - Installation of appropriate driver software
    - Controls access to data sent to and from peripherals
    - Receives & handles interrupts from hardware devices
  - Processor Management
    - Enables multiprogramming and multitasking
    - Resolution of conflicts when 2 or more processes requires the same resource
    - E.g. via Round-robin method
- Utility Software
  - Disk Formatter
    - Prepares a hard disk to allow data to be stored on it
    - Deletes any existing data on disk
    - Performs formatting, process where computer ‘draws lines’ on disk surface to split it into small areas
  - Virus checker
    - Checks for and then removes any viruses found
    - Constantly checks all incoming and outgoing files
  - Defragmentation Software

        - Files can be big so have to be stored in multiple sectors, which can result in fragmentation (contents of file scattered across >2 non-contiguous sectors)
        - Fragmentation slows down disk access and thus the performance of the entire computer.
        - Defragmenting software works by physically reorganizing disk contents (files) such that they are stored in contiguous sectors.
        - This defragmentation reduces number of movements of the read/write heads require to access the disk contents, hence increasing computer performance
        - The defragmentation also creates larger contiguous free space regions
    - Disk contents analysis/disk repair software
        - Software utility for visualization of disk space usage
        - Gets size for each folder and files, and generates a graphical chart showing disk usage distribution according to folders or other user defined criteria.
        - Allows disk to report errors (e.g. “bad sector”)
        - Software will attempt to offer a solution
    - File Compression
        - Reduces file size by removing redundant data in files
        - Causes improvements in the computer’s performance by reducing the data that needs to be stored
    - Back-up Software
        - Makes copy of files on another storage medium in the event of a hard drive failure, user error, disaster or accident.
        - Should be a regular process
        - Can provide synchronization between devices
- Program Libraries
    - Pre-written code that can be linked to a software under development without any amendments
    - Can perform common or complex tasks
    - Takes the form of classes
    - Benefits:
        - Saves time: less code needs to be written
        - Smaller testing time: pre-tested and used by others
        - Library file be a complex algorithm which the user need not understand for using it
- Dynamic Link Library (DLL) files
    - Shared library file that contains code and data
    - Code saved separately from the main .EXE file, reducing the .EXE file’s size
    - Code only loaded to main memory when required
    - DDL file can be made available to several applications simultaneous, thus reducing strain on memory
    - DLL files act as modules in more complex programs, making it easier to install and run updates

S16.1.4 Show understanding of virtual memory, paging and segmentation for memory management

- The concepts of paging, virtual memory and segmentation
- The difference between paging and segmentation
- How pages can be replaced
- How disk thrashing can occur

> Method:

1. Single Contiguous

Only one thing can be in RAM at any time
If there is not enough space in RAM then it cannot run

Real stupid way
Slow
Might not be able to run everything you need

2. Fixed Partitions

Your OS splits up your RAM into different parts. These parts are called partitions
If your program can fit in one of these partitions then great.
It means you have more than one program in RAM at the same time

If your program cannot fit, then too bad, it can't run.
The size of each partition is fixed. If you need a bigger partition then you have to turn off your computer and reset the partition size in your OS. – Super annoying

3. Dynamic Partitions

So if fixed partitions had fixed partitions, what do you think dynamic partition means?
The partitions can change size. They are dynamic.
Actually it's a stupid term because there are no partitions.