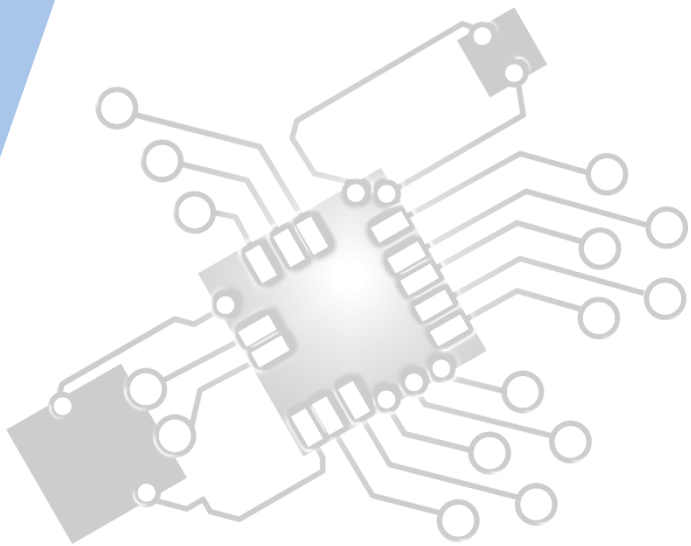
Resource Management

IB Computer Science



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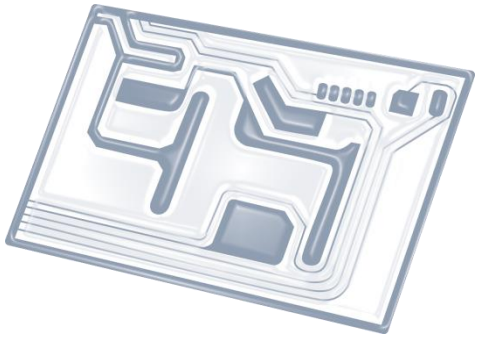
HL Topics 1-7, D1-4



1: System design

2: Computer Organisation

3: Networks

4: Computational thinking

5: Abstract data structures

6: Resource management

7: Control

D: OOP

HL only 6 Overview

System resources

6.1.1 Identify the resources that need to be managed within a computer system

6.1.2 Evaluate the resources available in a variety of computer systems

6.1.3 Identify the limitations of a range of resources in a specified computer system

6.1.4 Describe the possible problems resulting from the limitations in the resources in a computer system

Role of the operating system

6.1.5 Explain the role of the operating system in terms of managing memory, peripherals and hardware interfaces

6.1.7 Outline OS resource management techniques: scheduling, policies, multitasking, virtual memory, paging, interrupt, polling

6.1.8 Discuss the advantages of producing a dedicated operating system for a device

6.1.9 Outline how an operating system hides the complexity of the hardware from users and applications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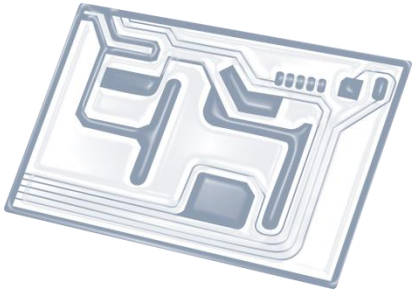
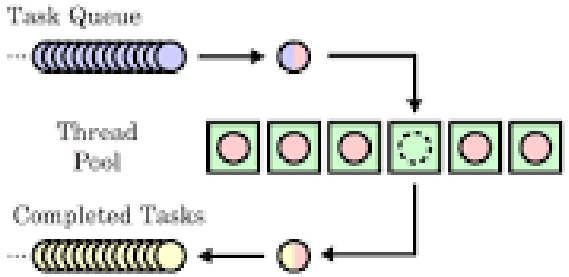


Topic 6.1.7

Outline OS resource management techniques: **scheduling**, **policies**, **multitasking**, **virtual memory**, **paging**, **interrupt**, **polling**

Scheduling

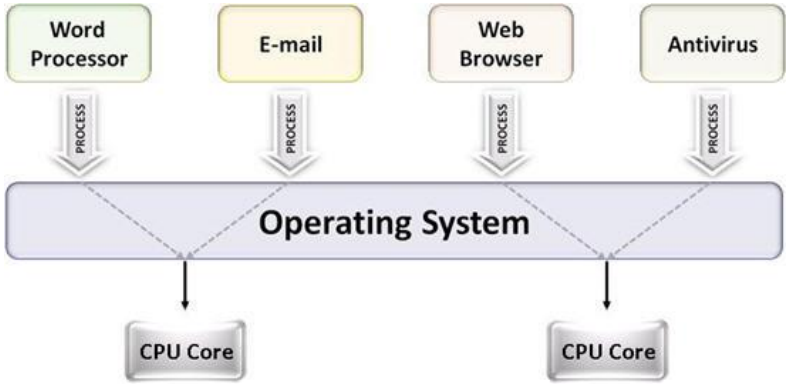


- Scheduling is the method by which work is assigned to resources that complete the work.
- The work could be processes which are in turn scheduled onto hardware resources such as processors, network links or expansion cards.
- The algorithm used may be as simple as round-robin in which each process is given equal time (for instance 1 ms, usually between 1 ms and 100 ms) in a cycling list. So, process A executes for 1 ms, then process B, then process C, then back to process A.

Policies

- The policies **what** is to be done while the mechanism specifies **how** it is to be done.
- For instance, the timer construct (limiting the time a process can use the CPU for) thereby ensuring CPU protection is mechanism.
- On the other hand, the decision of how long the timer is set for a particular user is a policy decision.
- The separation of mechanism and policy is important to provide flexibility to a system.

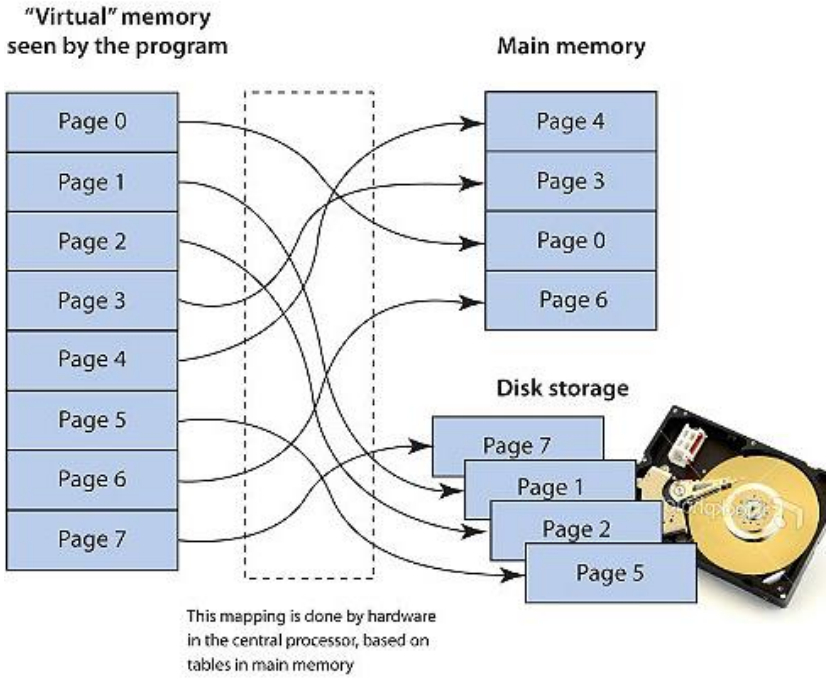
Multitasking



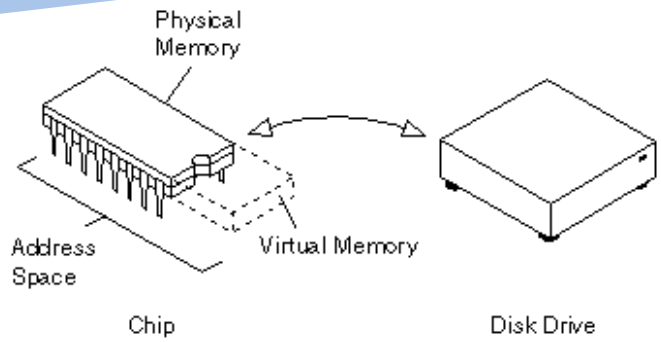
- Multitasking, in an operating system, is allowing a user to perform more than one computer task (such as the operation of an application program) at a time.
- The operating system is able to keep track of where you are in these tasks and go from one to the other without losing information.
- Almost all of today's operating systems can do this.
- When you open your Web browser and then open Word at the same time, you are causing the operating system to do multitasking.

Virtual memory

- Virtual memory is a feature of an operating system (OS) that allows a computer to compensate for shortages of physical memory by temporarily transferring pages of data from random access memory (RAM) to disk storage.
- Eventually, the OS will need to retrieve the data that was moved to temporarily to disk storage -- but remember, the only reason the OS moved pages of data from RAM to disk storage to begin with was because it was running out of RAM.



Paging



- When using virtual memory, the OS needs to retrieve the data that was moved to temporarily to disk storage; the only reason the OS moved pages of data from RAM to disk storage to begin with was because it was running out of RAM.
- To solve the problem, the operating system will need to move other pages to hard disk so it has room to bring back the pages it needs right away from temporary disk storage.
- This process is known as paging or swapping and the temporary storage space on the hard disk is called a pagefile or a swap file.
- Swapping, which happens so quickly that the end user doesn't know it's happening, is carried out by the computer's memory manager unit (MMU).
- The memory manager unit may use one of several algorithms to choose which page should be swapped out, including Least Recently Used (LRU), Least Frequently Used (LFU) or Most Recently Used (MRU).

Interrupt

- An interrupt is a signal to the processor emitted by hardware or software indicating an event that needs immediate attention.
- An interrupt alerts the OS to a high-priority condition requiring the interruption of the current code the processor is executing.
- The OS responds by suspending its current activities, saving its state, and executing a function called an interrupt handler to deal with the event.
- This interruption is temporary, and, after the interrupt handler finishes, the processor resumes normal activities.
- There are two types of interrupts:
  - *hardware interrupts*
  - *software interrupts*

Polling

- Polling is the process where the computer or controlling device waits for an external device to check for its readiness or state, often with low-level hardware.
- For example, when a printer is connected via a parallel port, the computer waits until the printer has received the next character.
- Alternative to polling?: interrupts (signals generated by devices or processes to indicate that they need attention)
- Although polling can be very simple, in many situations (e.g., multitasking operating systems) it is more efficient to use interrupts because it can reduce processor usage and/or bandwidth consumption.

For the exams: know when & why

Technique	When is it used?	Why is it used?
Scheduling		
Policies		
Multi-tasking		
Virtual memory		
Interrupts		
Polling