HOME ASSIGNMENT
CO-2

① Explain the benfits and drawbacks of segmentation in memory managment?

A) Benefits:-

① Modularity & Isolation:- segmentation allows the logical divison of program in to diffent segments such as code, data & stack. facilating modular development & better organization of code

② Protection:- By using segment-baged memory it is easier to enfore protection & access control on diffent segments, enhancing security.

Drawbacks:-

① External fragmentation:- over time, segments of various sizes can lead to scattered free memory spaces, making it difficult to find contiguous blocks of memory.

② complexity in managment:- Managing segments is more complex compared to simpler modes like Paging. The OS need to track the base & limit of each segment.

(2) Develop a detailed discussion on Address spaces & Address translations?

A)

Address spaces:- It is range of memory address that a processor or a computer can use. Each process has its own address space, which is set of logical address it can access.

Components:- Typically includes code, data, stack & heap sections. each with own range in address space.

Isolation:- Helps in maintaining process isolation, preventing one process from accessing the memory of another.

Address translation:- converts logical address generated by a process into physical address used by hardware.

Mechanisms:- Includes Segmentation, Paging or a combination of both.

Translation lookaside Buffer:- A cache used to store recent translations of virtual memory to physical memory address to speed up process.

(3) Construct detail about Memory & Memory API code?

Ans Memory API :- Set of functions provided by OS to manage memory allocation & deallocation in a controlled & efficient manner.

Ex:- malloc(), calloc(), free(), realloc().

Memory API Code:- The API functions are wrappers around system calls that directly interact with the OS. For instance malloc() request a specific amount of memory from heap.

(4) Explain role of address translation in segmented memory system. Develop detailed how it affects?

A) In a segmented memory system, the address translation process maps logical address to physical address. A logical address contains a segment number and an offset within that segment.

It affects based on:-

1) Base & limit registers:- Each segment has a base address & a limit that define its size. Address translation involves adding the base address to the offset to obtain physical address.

(5) Illustrate a free-space Managment by embeding a free list.

A)

Defination:- A free is a data structure used to track the availble memory blocks that are free to be allocated.

Implamentation:-

* the OS maintains a linked list of memory blocks that are currently not in use.
* Each free block contains a Pointer to the next free block, forming a chain.
* when memory is allocated, a suitable block is found, & it is removed from free list. when memory is freed, is added back to free list.

(6) Explain role of splitting & coleasing in free space Managment?

A) Splitting:- when a memory request is smaller than large free block, the block can split into two. one part is allocated to request, & other parts remains free.

Coleasing:- when two adjacent free blocks are encountered, they are merged in to single large block. This helps in reducing fragmentation & improves efficiency of free space managment.

(7) Develop a detailed explanation of Paging?

A)

→ Paging divides the physical memory in to fixed-size blocks called frames & logical memory into blocks of same size called Pages.

→ Translation:- Each Page is mapped to a frame, with Page table storing the mapping information. Logic address are split into a Page number & an offset within Page.

(8) Explain how to calculate no of entries required for a single-level linear Page table?

A) Given

48-bit virtual address space

32-bit physical address space

8-KB Page size

calculations:-

Page size:- 8KB = 2^{13} byte → 13 bits for offset

Page Number bits:- 48-13 = 35 bits

Number of Entries:- 2^{35} = 34, 359, 738, 368 entries.

(9) Explain role of Page faults in Page replacement algorithms?

A)

Defination:- A Page fault occurs when a program tries to access a Page not currently mapped to physical memory.

Role:- Page Faults trigger the OS to fetch the required Page from secondary storage in to main memory. they are integral to Page replacement algorithms which decide which Pages to evict the when loading new Pages to optimize performance & minimize Page Faults.

(10) Compare Swapping & Paging in OS?

A)

Swapping:-

Involves moving entire process b/w main memory & secondary storage.

Useful for freeing up space for other process.

Paging:-

Involves moving Pages b/w main memory & secondary storage.

Allows for finer granularity & more efficient memory usage.

(11) Explain detail in concept of Page faults in OS?

A) Page Faults occurs when a program references a page not currently mapped into physical memory.

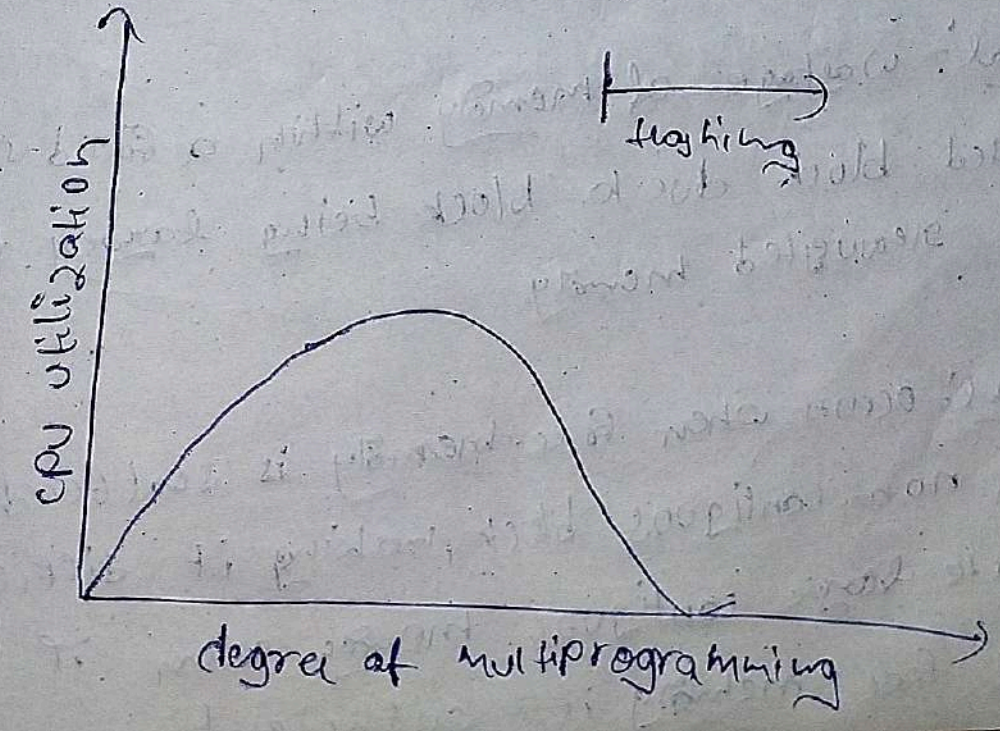
Handling :- The OS Pauses the process, fetches the unavailed page from disk, updates page table, & then resumes process.

(12) Outline causes of thrashing with neat diagram

A) :- Def :- Thrashing occurs when a system spends more time swapping pages in & out of memory than executing actual process

Causes:

Insufficient memory for working set of process.
Poorly tuned Page replacement algorithms.
High multi-programming level.



(13) Apply best fit, worst fit, first fit manly.

A)

Best-fit:- Find smallest free block that fits request size.

Ex:- Memory blocks [5kB, 10kB, 15kB], Request 8kB → Allocate 10kB.

Worst-fit:- Find largest free block to accomodate the request.

Ex:- [5kB, 10kB, 15kB], Request 8kB: Allocate 15kB

First-fit:- Allocate first free block that fits size.

Ex:- [5kB, 10kB, 15kB]; Request 8kB: Allocate 10kB.

(14) Compare the concepts of internal fragmentation & external fragmentation in memory allocation?

A)

Internal:- wastage of memory within a fixed-size allocated block due to block being larger than the requested memory.

External:- occurs when free memory is scattered into small, non-contiguous block, making it difficult to allocate large contiguous memory even if total free memory is sufficient

(5) Explain importance of memory management in OS?

A)

Memory allocation:- Efficient allocation of memory to process ensure optimal utilization of resources

Protection:- Prevents unauthorized access & modification of memory by ensuring processes are isolated.

Virtual Memory:- Provides an abstraction that gives each process the illusion of large, continuous address space, even if physical memory is limited.

(6) Experiment with page tables role in address translation?

A) Page tables store the mapping b/w virtual pages & physical frames.

They are crucial for translating virtual address into physical address, enabling the MMU to provide efficient & security memory access.

Protection?

A)

Mechanisms:- Use of base & limit registers, segmentation, Paging and access control bits in Page tables.

Example:- If a process tries to access memory outside its segment, the MMU will generate a trap, preventing the access.

(18) Explain limited direct EXCUTION.?

A) Interaction:- the OS & hardware work together, with the hardware providing support for address translation & protection.

Dynamic Relocation:- Allows process to be moved in memory without needing to update address references, using relative addressing

(19) Explain role of virtual memory?

A) virtual memory is a memory management technique that provides an idealized abstraction of the storage resources that are physically availble on a computer.

Key roles of virtual memory:- i) Isolation & Protection
ii) Use of Physical Memory
iii) Simplification of program development
iv) Enabling larger address space.
v.) Facilating Memory sharing.

(20) Analyze Advantages & Disadvantages of virtual Memory?

A) Advantages:-

*) Increase Address space:- virtual memory provides each process with its own large virtual address space, often much larger than the availble physical memory, which can be essential for applications requiring significiant Memory.

*Memory protection:- It protects prevents process from accessing or modifing memory they do not own, reducing the risk of errors.

→ Disadvantages

1) Overhead & Complexity:- Implementing virtual memory adds complexity to the OS & hardware, requiring additional components such as Page tables.

2) Performance Penalties:- If the system is frequently swapping pages in and out of memory it can lead to a significant degradation in performance, making system unresponsive.