King Abdulaziz University

Faculty of Engineering

Department of Electrical and Computer Engineering

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EE463 – Operating System

Homework: # 06

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Q1:

a. 3085:

Page number = 3085 / 1024 = 3 (integer division)
Offset = 3085 % 1024 = 13

b. 42095:

Page number = 42095 / 1024 = 41
(integer division) Offset = 42095 % 1024 = 111

c. 215201:

Page number = 215201 / 1024 = 210 (integer division)
Offset = 215201 % 1024 = 161

d. 650000:

Page number = 650000 / 1024 = 634 (integer division)
Offset = 650000 % 1024 = 764

e. 2000001:

Page number = 2000001 / 1024 = 1953 (integer division)
Offset = 2000001 % 1024 = 129

Q2:

a. 220 entries.

b. 512 K K/4K = 128K entries.

Q3:

Internal fragmentation is within allocated memory blocks, where unused space exists, while external fragmentation refers to fragmentation in the free memory space caused by scattered small gaps between allocated blocks.

Q4:

First-fit algorithm

P1 allocated to F4 with remaining space of 205-200 = 5MB.

P2 allocated to F1 with remaining space of 100-15= 85MB

P3 allocated to F5 with remaining space of 300-185= 115MB.

P4 allocated to F1 with remaining space of 85-75= 10MB

P5 allocated to F6 with remaining space of 185-175=10MB

P6 allocated to F2 with remaining space of 170-80= 90MB

Best-fit algorithm

P1 allocated to F4 with remaining space of 205-200 = 5MB.

P2 allocated to F3 with remaining space of 40-15= 85MB

P3 was allocated to F6 but is entirely occupied, so no remaining space will be there

P4 allocated to F1 with remaining space of 100-75= 25MB

P5 allocated to F5 with remaining space of 300-175= 125MB

P6 allocated to F5 with remaining space of 125-80=45MB.

Worst-fit Algorithm

P1 allocated to F5 with remaining space of 300-200 = 100MB.

P2 allocated to F4 with remaining space of 205-15=190MB P3 allocated to F4 with the remaining space of 190-185= 5MB.

P4 allocated to F6 with remaining space of 185-75=110MB.

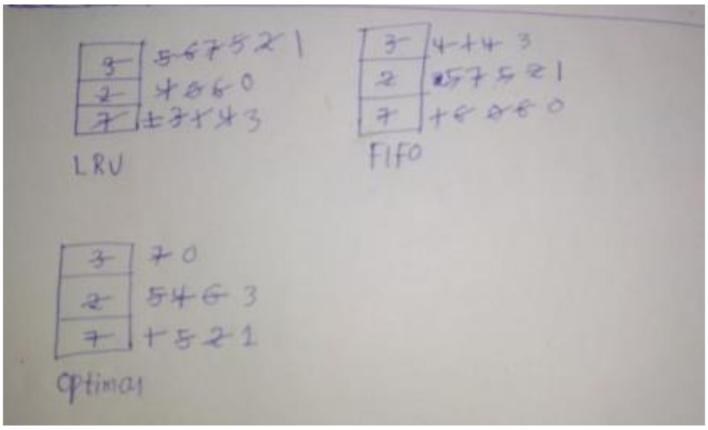
P5 does not contain any memory available spaces.

P6 allocated to F2 with remaining space of 170-80= 90MB.

According to this, the best-fit algorithm located and manages the memory very well whereas the worst-fit algorithm does not allocate the memory properly.

Q5: paging the page tables in a computer system improves memory management efficiency, optimizes memory utilization.

Q6:



Q7:

• TLB miss with no page fault page has been brought into memory,

but has been removed from the TLB

• TLB miss and page fault page fault has occurred

• TLB hit and no page fault page is in memory and in the TLB. Most

likely a recent reference

• TLB hit and page fault cannot occur. The TLB is a cache of the page

table. If an entry is not in the page table, it will not be in the TLB.

Q8:

The virtual memory system allows the computer to provide a larger virtual address space (232 bytes) than the available physical memory (222 bytes). Paging divides the virtual memory space into fixed-size pages (4096 bytes in this case) and maps them to physical memory. The software (operating system) manages the page table and performs the necessary address translations, while the hardware (MMU) assists in the address translation process during memory access operations.

Q9:

In a system where the mapping of user-level threads to kernel threads is many to one, if one user thread incurs a page fault while accessing its stack, the other user threads belonging to the same process will also be affected by the page fault. This behavior is due to the fact that the kernel thread, being responsible for managing the virtual memory of the entire process, cannot continue executing any of the user threads until the required page is brought into physical memory. Therefore, all user threads of the same process must wait for the page fault to be resolved before they can continue their execution.

Q10:

The following page faults take place: page fault to access the instruction, a pagefault to access the memory location that contains a pointer to the targetmemory location, and a page fault when the target memory location isaccessed. The operating system will generate three page faults with the thirdpage replacing the page containing the instruction. If the instruction needs tobe fetched again to repeat the trapped instruction, then the sequence of pagefaults will continue indefinitely. If the instruction is cached in a register, thenit will be able to execute completely after the third page fault.