HW8

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Assignment: Virtual Memory

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Grading (total 4.2 points)

- Question 1: 0.3 points
- Question 2: 0.3 points
- Question 3: 3 points
  - Part A: 1 point
  - Part B: 1 point
  - Part C: 1 point
- Question 4: 0.6
  - Part A: 0.2 points
  - Part B: 0.2 points
  - Part C: 0.2 points

Question 1

- What can virtual memory do for you if you have a 32-bit ISA and 8GB of physical memory?
  A. Nothing: a 32-bit ISA can only access 4GB of memory
  B. Not needed: a 32-bit ISA can have multiple programs access more than 4GB of memory without needing virtual memory
  C. A little: you can use the physical memory beyond 4GB instead of paging to disk for a single application
  D. A lot: you need virtual memory to have multiple 32-bit applications use more than 4GB of memory together

Answer

- Select the correct option and give a brief explanation

  C, because 32 bit can only access 4GB, but can run multiple programs as long as there is no fragmentation. By writing to the physical memory, there can be more free space for more programs to run.

Question 2

- What does it mean if we have more bits for the virtual page number than we do for the physical page number?
  A. We have very large pages
  B. We have run out of physical memory
  C. We have less physical memory than our ISA supports
  D. We have more physical memory than our ISA supports

Answer

- Select the correct option and give a brief explanation

C, because some of the addresses will not be translated during the process, thus causing the need for an offset.

Question 3: Page sizing

Figure out which bits of a 32-bit virtual address are used for the Virtual Page Number (goes into the TLB for translation), the Page Offset, and how many bits of Physical Address you have.

A) 4kB pages with 64MB of RAM

#Virtual Pages:
#Bits used for Page Offset (PO):
#Bits used for Virtual Page Number (VPN):
#Bits used for Physical Address (PA):
#Physical Pages:

B) 2MB pages with 1GB of RAM

#Virtual Pages:
#Bits used for Page Offset (PO):
#Bits used for Virtual Page Number (VPN):
#Bits used for Physical Address (PA):
#Physical Pages:

C) 1GB pages with 4GB of RAM

#Virtual Pages:
#Bits used for Page Offset (PO):
#Bits used for Virtual Page Number (VPN):
#Bits used for Physical Address (PA):
#Physical Pages:

Answer

- Briefly show you calculation.

A. #Virtual Pages: 2^32 / (4 * 2^10) = 2^20
#Bits used for Page Offset (PO): 12
#Bits used for Virtual Page Number (VPN): 20
#Bits used for Physical Address (PA): 64 * 2^20 = 2^26 or 26 bits
#Physical Pages: 2^26/2^12 = 16,384

B. #Virtual Pages: 2^32 / (2 * 2^20) = 2^11
#Bits used for Page Offset (PO): 21
#Bits used for Virtual Page Number (VPN): 11
#Bits used for Physical Address (PA): 2^30 or 30 bits
#Physical Pages: 2^30/(2*2^20) = 512

C. #Virtual Pages: 2^32 / 2^30 = 4
#Bits used for Page Offset (PO): 30
#Bits used for Virtual Page Number (VPN): 2
#Bits used for Physical Address (PA): 4 * 2^30 = 2^32 or 32 bits
#Physical Pages: 4/1 = 4

Question 4: TLB sizes

- How much physical memory can be accessed without a TLB miss for the following TLBs?

A. 64 entries, 4kB pages

B. 32 entries, 2MB pages

C. 4 entries, 1GB pages

Answer

- Briefly show you calculation.

A. 64 * 4kb = 256
B. 32 * 2000kb = 64000
C. 4 * 1000000kb = 4000000