CSE 460 HW #3

Exercises 8.20, 8.23, 8.28, 9.21, 9.22

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**8.20**

Assuming a 1-KB page size, what are the page numbers and offsets for the following address references (provided as decimal numbers):

a. 3085

Binary:0000 1100 0000 1101

Offset = 13

Page numbers = 3

b. 42095

binary 1010 0100 0110 1111

Offset = 111

Page Number= 41

c. 215201

Binary 11 0100 1000 1010 0001

Offset = 161

Page Number = 210

d. 650000

Binary 1001 1110 1011 0001 0000

Offset = 784

Page Number = 634

e. 2000001

Binary = 1 1110 1000 0100 1000 0001

Offset = 129

Page Number = 953

**8.23**

Consider a logical address space of 256 pages with a 4-KB page size, mapped onto a physical memory of 64 frames.

1. How many bits are required in the logical address?

4\*2^10 = 2^12

Offset = 12

Page number =2^8 = 256 -> 8 bits

Logical address = 12 + 8 = 20 bits

2. How many bits are required in the physical address?

4\*2^10 = 2^12

= 64 \* 2^12 -> 2^6 \* 2^12 -> 2^18

Physical Address bits = 18

**8.28**

What are the physical addresses for the following logical addresses?

Physical address = Base address + Logical Address

a. 0,430

219 + 430 = 649

b. 1,10

2300 + 10 = 2310

c. 2,500

segmentation error because 500 is bigger than length 100

d. 3,400

1327 + 400 = 1727

e. 4,112

segmentation error because 112 is bigger than the length 96

**9.21**

Consider the following page reference string:

7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1

Assuming demand paging with three frames, how many page faults would occur for the following replacement algorithms?

LRU replacement:

7(pf), 2(pf), 3(pf), 1(pf), **2(no pf)**, 5(pf), 3(pf), 4(pf), 6(pf), 7(pf), **7(no pf)**, 1(pf,), 0(pf), 5(pf), 4(pf), 6(pf), 2(pf), 3(pf), 0(pf), 1(pf) = **18 pf**

FIFO replacement

7(pf), 2(pf), 3(pf), 1(pf), **2(no pf)**, 5(pf), **3(no pf)**, 4(pf), 6(pf), 7(pf), **7(no pf)**, 1(pf), 0(pf), 5(pf), 4(pf), 6(pf), 2(pf), 3(pf), 0(pf), 1(pf) = **17 pf**

Optimal replacement

7(pf), 2(pf), 3(pf), 1(pf), **2(no pf)**, 5(pf), **3(no pf)**, 4(pf), 6(pf), 7(pf), **7(no pf)**, **1(no pf)**, 0(pf), **5(no pf)**, 4(pf), 6(pf), 2(pf), 3(pf), **0(no pf)**, **1(no pf)** = **13 pf**

**9.22**

The page table shown in Figure 9.32 is for a system with 16-bit virtual and physical addresses and with 4,096-byte pages. The reference bit is set to 1 when the page has been referenced. Periodically, a thread zeroes out all values of the reference bit. A dash for a page frame indicates the page is not in memory. The page-replacement algorithm is localized LRU, and all numbers are provided in decimal.

a. Convert the following virtual addresses (in hexadecimal) to the equivalent physical addresses. You may provide answers in either hexadecimal or decimal. Also set the reference bit for the appropriate entry in the page table.

page size = 4096 bytes = 2^12

page offset = log2(2^12) = 12 bits

Therefore last 3 characters are the offset

* 0xE12C

Page number = E = 14 ->Page #14 -> Page Frame 3

Offset = 12C

Physical Address = 312C

* 0x3A9D

Page Number = 3 -> Page#10->Page Frame 10-> A

Offset = A9D

Physical Address = AA9D

* 0xA9D9

Page number = A = 10 ->Page #10 -> Page Frame 5

Offset = 9D9

Physical Address = 59D9

* 0x7001

Page Number = 5

Offset = 001

Physical Address = F001

* 0xACA1

Page Number = A

Offset = CA1

Physical Address = 5CA1

b. Using the above addresses as a guide, provide an example of a logical address (in hexadecimal) that results in a page fault.

0xC9AC

c. From what set of page frames will the LRU page-replacement algorithm choose in resolving a page fault?

5 15 3 A