CSE 460 HW #3

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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
b. 42095
c. 215201
d. 650000
e. 2000001

1kb = approximately 2^10 b

Length of offset is 10 bits.

a. 3085 decimal to binary → 0000 1100 0000 1101
   Offset = 0000001101 = 13
   Page numbers = 000011 = 3
b. 42095 decimal to binary → 1010 0100 0110 1111
   Offset = 0001101111 = 111
   Page Number = 101001 = 41
c. 215201 decimal to binary → 11 0100 1000 1010 0001
   Offset = 0010100001 = 161
   Page Number = 11010010 = 210
d. 650000 decimal to binary → 1001 1110 1011 0001 0000
   Offset = 1100010000 = 784
   Page Number = 1001111010 = 634
e. 2000001 decimal to binary → 1 1110 1000 0100 1000 0001
   Offset = 0010000001 = 129
   Page Number = 11110100001 = 1953

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

a. How many bits are required in the logical address?
   4*2^10 = 2^12
   # of Offset bits = 12
   2^8 = 256
   # of Page number bits = 8
   # of Logical address bits = 12 + 8 = 20

b. How many bits are required in the physical address?
   4*2^10 = 2^12
   Total size = number of frames * size of frames
   = 64 * 2^12
   = 2^6 * 2^12
   = 2^18
   # of Physical Address bits = 18

8.28 Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

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, 7 replaced), 2(no pf, time updated), 5(pf, 3 replaced), 3(pf, 1 replaced), 4(pf, 2 replaced), 6(pf, 5 replaced), 7(pf, 3 replaced), 7(no pf, time updated), 1(pf, 4 replaced), 0(pf, 6 replaced), 5(pf, 7 replaced), 4(pf, 1 replaced), 6(pf, 0 replaced), 2(pf, 5 replaced), 3(pf, 4 replaced), 0(pf, 6 replaced), 1(pf, 2 replaced) = 18 pf's

- FIFO replacement

7(pf), 2(pf), 3(pf), 1(pf), 2(no pf), 5(pf, 2's replaced), 3(no pf), 4(pf, 3 replaced), 6(pf, 1 replaced), 7(pf, 5 replaced), 7(no pf), 1(pf, 4 replaced), 0(pf, 6 replaced), 5(pf, 7 replaced), 4(pf, 1 replaced), 6(pf, 0 replaced), 2(pf, 5 replaced), 3(pf, 4 replaced), 0(pf, 6 replaced), 1(pf, 2 replaced) = 17 pf's

- Optimal replacement

7(pf), 2(pf), 3(pf), 1(pf, 7 replaced), 2(no pf), 5(pf, 2 replaced), 3(no pf), 4(pf, 3 replaced), 6(pf, 4 replaced), 7(pf, 6 replaced), 7(no pf), 1(no pf), 0(pf, 7 replaced), 5(no pf), 4(pf, 5 replaced), 6(pf, 4 replaced), 2(pf, 6 replaced), 3(pf, 2 replaced), 0(no pf), 1(no pf)

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

page size = 4096 bytes = 2^12

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

Therefore last 3 characters are the offset

1. 0xE12C

   Page number = E

   Offset = 12C

   Physical Address = 312C

2. 0x3A9D

   Page Number = 3

   Offset = A9D

   Physical Address = AA9D

3. 0xA9D9

   Page Number = A

   Offset = 9D9

   Physical Address = 59D9

4. 0x7001

   Page Number = 5

   Offset = 001

   Physical Address = F001

5. 0xACA1

   Page Number = A

   Offset = CA1

   Physical Address = 5CA1

Page	Page Frame	Reference Bit
0	9	0
1	1	0
2	14	0
3	10	0
4	–	0
5	13	0
6	8	0

7	15	0
8	–	0
9	0	0
10	5	0
11	4	0
12	–	0
13	–	0
14	3	0
15	2	0

Figure 9.32 Page table for Exercise 9.22.

hexadecimal or decimal. Also set the reference bit for the appropriate entry in the page table.

- `0xE12C`
- `0x3A9D`
- `0xA9D9`
- `0x7001`
- `0xACA1`

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

0x4AAA
There is no page frame assigned to Page 4

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

3, A,15,5