CSE 4/521 – Introduction to Operating Systems
Summer 2018
Homework 2

Total points: 40
Submission deadline: July 20th, 2018 (Inclass)
Submission guidelines: One submission per individual
'Homework Buffer days' tally is carried over from the previous homework.
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Main Memory:

Easy: *(solve within 3 mins for each)*

1. Why are page sizes always powers of 2? **(2)**
2. Explain the difference between internal and external fragmentation. **(2+2 = 4)**
3. What is the purpose of paging the page table? **(2)**

Medium: *(solve within 5 mins)*

4. Consider a logical address space of 64 pages of 1024 words each, mapped onto a physical memory of 32 fames. **(2+2 = 4)**
   a. How many bits are there in the logical address?
   b. How many bits are there in the physical address?

Hard: *(solve within 10 mins)*

5. Assume that a system has a 32-bit virtual address with a 4-KB page size. Write a C program that is passed a virtual address (in decimal) on the command line and have it output the page number and offset for the given address. As an example, your program would run as follows: **(10)**

```
./a.out 19986
```

Your program would output:

```
The address 19986 contains:
page number = 4
offset = 3602
```

Writing this program will require using the appropriate data type to store 32 bits. You're encouraged to use unsigned data types.

Virtual Memory:

Medium: *(solve within 5 mins. However, this is a knowledge-based question - you can answer it sooner.)*

1. Discuss the hardware support required to support demand paging. **(4)**

Hard: *(solve within 15 mins)*

2. Consider a demand-paging system with the following time-measured utilizations: **(2x7 = 14)**

CPU utilization	20%
Paging disk	97.7%
Other I/O devices	5%

For each of the following, indicate whether it will (or is likely to) improve CPU utilization. Explain your answers.

a. Install a faster CPU.
b. Install a bigger paging disk.
c. Increase the degree of multiprogramming.
d. Decrease the degree of multiprogramming.
e. Install more main memory.
f. Install a faster hard disk.
g. Increase the page size.
