COP 4610 Operating Systems, Fall, 2015

Assignment 8

Due: 11:59pm, Dec. 2, 2015

General Requirements:
1. Submit a zip file on Canvas. Please name your zip Assignment8_LAST_FOUR_DIGITS_UIN.zip.
2. If this assignment includes questions from the textbook, please mark clearly your answers are to which questions.
3. If this assignment includes programming, please add sufficient comments. Note too few comments may greatly affect your grade.
4. How well your program is structured will be considered in grading. The judgment will be subjective. Here is you can do
   a. have short functions,
   b. have functions without too many parameters,
   c. have coherent functions, (if a function does two separate, it is not coherent and should be split into two.)
   d. use meaningful variable names

Assignment:

1. Given a 4 KB page size, what are the page numbers and offsets for the following addresses
   a. 2375
   b. 19366
   c. 30000
   d. 256
   e. 16385
2. Given an architecture that supports Translation Look-aside Buffer (TLB), what is the effective memory access time if 1) TLB access time is 10 nanoseconds, 2) memory access time is 200 nanoseconds, and 3) the TLB hit ratio is 95%. Assume the architecture supports one-level paging.
3. The x86-64 architecture only supports 48-bit addressable virtual memory space.
   a. Suppose a 4 MB page size used in this 48-bit virtual memory space. How many pages exist in the virtual memory space?
   b. Why does not this 64-bit architecture support 64-bit virtual memory space?
4. Given the following two programs:
   a. int sum=0;
   b. int arr[][] = new int[1024][1024];
   c. for(int i=0;i<1024;i++){
   d.   for(int j=0;j<1024;j++){
   e.   sum+=arr[i][j];
   f.   }
   g. }

   a. int sum=0;
   b. int arr[][] = new int[1024][1024];
   c. for(int i=0;i<1024;i++){
   d.   for(int j=0;j<1024;j++){
   e.   sum+=arr[j][i];
   f.   }

g. }

Suppose they run on an architecture with a 4KB page size and 12 KB physical memory space. Please find how many page faults will occur for both programs. Hint: each integer is 4 byte long.

5. Given the following utilization of CPUs and paging disk, which one may indicate thrashing?
    a. CPU (10%), paging disk (8%)
    b. CPU (90%), paging disk (8%)
    c. CPU (10%), paging disk (95%)

Please explain your selection in detail.

6. Please implement the stack-based Least Recently Used algorithm. You are given two test programs: 1) PageReplacementShortTest and 2) PageReplacementLongTest. The long test should complete within less than 100 milliseconds. If your long test does not complete within half second, there must be something wrong with your programs.