Homework2 for CS153 (Spring 2017)

Due: Friday May 19

Instructions:
- Be brief. You will be graded for correctness, not on the length of your answers.
- Make sure to write legibly. Incomprehensible writing will be assumed to be incorrect.

Q1. In segmentation-based translation, a virtual address \((\text{segment#}, \text{offset})\) is translated into physical address using a segment table. Consider the following segment table:

\[
\begin{array}{lll}
\hline
\text{Segment} & \text{Base} & \text{Limit} \\
\hline
0 & 444 & 600 \\
1 & 1233 & 14 \\
2 & 70 & 100 \\
3 & 1300 & 880 \\
4 & 2200 & 96 \\
\hline
\end{array}
\]

a. What are the physical addresses for the following virtual addresses? (4 points)
   (i) 4,44
   (ii) 1,22

b. Briefly compare segmentation to paging. (2 points)

Q2. Consider a system with two-level paging, a 32-bit virtual address space, and a 32-bit physical address space. The page size is 4KB and the system does not have a TLB. During address translation, a page fault is generated if (1) any of the PTE during the page table walk is invalid or (2) the request access mismatches protection configuration (not used in this problem).

a. Explain the steps involved in looking up the virtual address \(0x133bf24d\), when all pages are present in memory. (4 points)

b. What is the maximum number of page faults that could be generated in response to a memory access? (2 points)
Q3. Consider a process that has been allocated 5 pages of memory: P1, P2, P3, P4, and P5. The process accesses these pages in the following order:

- P1 P2 P3 P4 P1 P2 P5 P1 P2 P3 P4 P5

a. Illustrate Belady’s anomaly by precisely describing the execution of the FIFO page eviction algorithm in two cases by comparing the number of page faults incurred in these two cases. (When the process begins executing, none of its pages are present in memory.) (4 points)

   (i) The machine has 3 pages of physical memory
   (ii) The machine has 4 pages of physical memory

b. Show how the LRU page eviction algorithm would work in the same scenarios described above. (4 points)