Introduction to Operating Systems (CS-GY6233)
Fall 2020

Assignment 7
(15 points)

a) (1 point) List three main differences between paging and segmentation
b) (1 point) In memory paging, why must the page sizes be powers of 2?
c) (1 point) In a computer system that supports programs of 512 pages, 128 bytes each, what is the minimum number of bits that can represent virtual addresses of such system?
d) (1 point) In a 32-bit computer system (i.e. has 32 bits of virtual address space) and 1 KB page size, what is the page number of address 74373?
e) (1 point) In a 32-bit computer system and 8-KB page size, if a process' size is 2 MB, how many entries are in the page table for such process?

f) (10 points)

Use C, C++, python or matlab to develop a program whose main routine accepts two parameters n and k, i.e. when you invoke your program from the shell, you pass it two parameters, n and k, where n >=16 and k >=3). Your main routine shall generate a random page trace of size n, where the page numbers have values ranging from 0 to $2^k - 1$.

Develop a subroutine within your program that implements the FIFO page replacement algorithm (as a separate function within your program). The function shall accept a page trace and a parameter f for the number of frames allocated.

Your main routine shall then apply that page trace to the subroutine implementing the FIFO page replacement algorithm, multiple times (using only one trace, randomly generated), passing a parameter f (number of page frames used) that ranges from 4 to 2^k. Your main routine shall then record the number of page faults for each run (i.e. for each f).

Run your program using a page trace of length n=64, k=4 (thus f ranges from 4 to 16). Plot and submit a graph displaying the number of faults vs the number of frames allocated.

Can your outcome exhibit the Belady's anomaly?

Notes:
• For debugging, you may use the page trace given in the lectures instead of randomly generating it (with n=20, k=3 and f=3) and verify you obtained the same results as in the lectures.
• You may output into a text file (e.g. a comma separated file) and then use excel to plot.

What to hand in (using NYU Classes):

- A source file named **"lab7.c/.py/.cpp/.m"** (with appropriate comments). Do not attach project or make files.
- A .pdf file named **"lab7.pdf"**, containing:
  - Answers to HW questions.
  - Screen shot(**s**) of your terminal window showing the current directory, the command used to compile your program and the command used to run your program
  - The output plots of your program

RULES:

- You shall **use kernel version 4.x.x or above**. You shall not use kernel version 3.x.x.
- You may consult with other students about GENERAL concepts or methods, but copying code (or code fragments) or algorithms is NOT ALLOWED and is considered cheating (whether copied form other students, the internet or any other source).
- If you are having trouble, please ask your teaching assistant for help.
- You must submit your assignment prior to the deadline.