1. Which function increases the total number of page tables in the system? (Choose zero or more.)  
    a) fork b) exec c) thread\_create d) mutex\_lock
2. (RO/RW) On most operating systems, are pages pointing at executable code marked read-only or read-write.
3. (Virtual/Physical) This is in my application code. Is it a virtual or physical address?  
    char \*ptr = (char \*)1234567;
4. My computer has 1G of RAM. Each process has an address space that starts at virtual address 0, and goes to virtual address 1 megabyte. There are 20 processes in the system. The page size is 2K. How many page table entries are in EACH page table?
5. Assume that nothing is in RAM. There is space to hold TWO pages. You are using LRU. The sequence of requests is 1,2,3,3,2,1. How many times must you bring in a page from the disk?
6. What is the LEAST/SMALLEST number of times one would need to read from the disk to satisfy that sequence of requests if one could look into the future? (Hint: Do Belady’s Min or figure it out some other way)
7. Which system call likely has improved performance because of copy-on-write?  
    open() // open some file on the local hard drive  
    sqrt() or sin() // compute the square root or sine of a number  
    write() // write to some network socket connected to TikTok

fork() // fork the program

1. (True/False) In C++, if one thread of a program sets a **local** variable, the other thread can see that new value.
2. My program uses 8 threads. I have only 4 cores/CPUs. (choose one)

My program crashes/fails/errors

My program could work

1. Suppose I mmap in some huge file, access the last byte of the mapped region, and close the file. How much disk access will this cause?  
    The whole file A small part of the file None of the file
2. (True/False) When I first start an Chrome on Linux or Windows, the operating system fetches essentially all the code from the hard drive?
3. When your process needs to bring in data from the hard drive into RAM because of paging, what is the CPU doing most of the time

It’s working on getting that data from the hard drive  
 It’s clearing RAM to make room to insert the data  
 It’s running some other part of the requesting process  
 It’s running some other process

1. What is a working set?
2. On a page table, What does it mean if the dirty bit is set.  (Circle all that apply, or zero)
   1. The page is not in RAM but swapped out to disk.
   2. The page is shared among several processes.
   3. The process does not have permission to write to that page .
   4. The page has been changed since it was read from the disk.

PAGE SIZE = 1024

|  |  |  |
| --- | --- | --- |
| Index | Frame # | Valid |
| 0 | 0 | Y |
| 1 | 2 | N |
| 2 | 5 | N |
| 3 | 1 | N |
| 4 | 5 | N |
| 5 | 100 | Y |

1. What is the physical address corresponding to virtual address 0?