Practice Problems for the final exam

1. Briefly explain these terms: seek time, rotational latency, transfer time, and logical disk blocks.

2. Given that a disk has a rotational rate of 7200 RPM, an average seek time of 9 ms, and 400 sectors in a track on average, compute the rotational delay, the average transfer time, and the average access time.

3. Suppose that a disk has 5 platters, 512 bytes per sector, 20,000 tracks per surface, an average of 300 sectors per track. What is the capacity of the disk?

4. Briefly explain what temporal locality and spatial locality are and why cache works?

5. Given a cache of (S,E,B,m)=(4,1,2,4), decide if each of the read operations below performed in that sequence will cause cache hit or cache miss.

1) Read from address 0,
2) Read from address 1
3) Read from address 13,
4) Read from address 8,
5) Read from address 0.

6. Briefly explain the three main steps to read from a direct-mapped cache (cache-hit case).

7. With regard to cache, briefly explain the terms: write-through, write-back, write-allocate, no-write-allocate

8. When designing a cache, what are the advantages and disadvantages of the following decisions?

1) Increase the cache size
2) Increase the block size
3) Increase the associativity E

9. What are the benefits of having a smaller active data set (working set) and a smaller stride?

10. What are a page and a page table and how they are used in the virtual memory system?

11. When a page table entry is in the states as below, briefly explain what these states mean

1) Valid bit = 1:
2) Valid bit = 0 and address field = 0:
3) Valid bit = 0 and address field is not 0:

12. Explain the steps run by the kernel page fault handler to recover from a page fault.

13. How virtual addresses can be translated into physical addresses. Explain the translation in terms of PTBR, VPN, VPO, PPN, and PPO.

14. What is TLB (Translation Lookahead Buffer)?

15. In Linux system, explain how pgd in mm_struct ensures each process to have its own virtual address space?

16. In case of a page fault, how does the kernel page fault handler determine the followings? Explain using the fields of vm_area_struct.

1) Whether the virtual address is legal
2) Whether the access (read/write) is legal

17. How fork and execve construct the virtual memory space. Explain in terms of mm_struct, area structs and page tables.

18. What is the linking process?

19. What are relocatable object files, executable object files, and shared object files?

20. Explain the sections in ELF relocatable object files and ELF executable object files?

21. Symbol resolution and Relocations are two main steps of linking. Explain them.

22. Explain the two main steps of relocation.

23. What are weak symbols and strong symbols? When there are multiple symbols definitions, how the linker resolves them?

24. Given that

- A relocation entry is {r.offset = 0xf, r.symbol = sum, r.type = R_X86_64_PC32, r.addend = -4},
- ADDR(s) = ADDR(.text) = 0x4004d0, and
- ADDR(r.symbol) = ADDR(sum) = 0x4004e8.

1) What is the address we want to update (refptr)?
2) What is the value we want to update (*refptr)?

25. Suppose that a function string_length with the signature int string_length(char *str) is defined in a shared module "./libstr.so". Write a program that can dynamically load the library during the run-time and call the function string_length with the string "hello world" and unload the module. Implement the program using the functions below:

- void *dlopen(const char *filename, int flag /*RTLD_GLOBAL, RTLD_NOW, RTLD_LAZY*/);
- void *dlsym(void *handle, char *symbol);
- int dlclose(void *handle);
- const char *dlerror(void);

26. What is PIC (Position Independent Code)?

27. What is GOT (Global Offset Table) and how GOT is used in PIC data reference?

28. How PLT (Procedure Linkage Table) is used in PIC function calls?