

TDIU25 Exam

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TEN1

Admitted material

Dictionary from English to your chosen language.

Jour

Ahmed Rezine (013-281938) visiting after about one hour.

Instructions

- Fill in the exam wrapper and read the instructions on it before you start.
Read instructions and all assignments carefully and completely before you begin.
- You may answer in either English or Swedish.
- State your interpretation of the question and all assumptions you make.
- Write clearly. **Unreadable text will be ignored.**
- Be precise in your statements. **Prove your point when possible.**
Ambiguous formulations will lead to reduction of points.
- **Motivate clearly and in depth all statements and reasoning.**
Explain calculations and solution procedures.
- The exam is 40 points and graded U, 3, 4, 5 (**preliminary** limits: 21p, 30p, 35p).
Points are given for motivations, explanations, and reasoning.

Definitions

Unless you are more specific, the correcting team will interpret the following terms as follow:

memory Volatile random access memory (DRAM), about 100ns access time.

disk Permanent storage, about 10ms access time.

page A fix size region of virtual memory, possibly on disk.

frame A fix size region of physical memory (DRAM).

block A data block located on disk.

Problem 1 (12p)

Part A. Assume a paged system where logical addresses allow a process to address 16 pages of 1 KiB (2^{10} B) each.

1. What is the smallest number of bits used by such logical addresses? (2pt)
2. Assume these logical addresses are translated to physical addresses allowing for 64 different frames. What is the smallest number of bits used by such physical addresses? (1pt)
3. Using only one level of paging, what is the size of a process page table if each page table entry is 4B? (1pt) Does it make sense to use more levels of paging? (1pt)
4. Explain why such a system with 64KiB of physical memory is still able to access all its memory. (1pt)

Part B. Assume now a paged virtual memory with 32 bits logical addresses and 1MiB (2^{20} B) pages.

1. How many pages can a process address? (2pt)
2. Assume one level paging. What is the size of a process page table assuming 4 bytes page entries? (1pt)
3. How many bits of a page entry can be used for information other than the frame of the corresponding page? (1pt)
4. Give an advantage and a disadvantage of having page tables of 1MiB compared to pages of 4KiB. (2pt)

Problem 2 (4p)

1. What effect does setting the “setuid” bit have on an executable? Describe a situation where this is useful. (2pt)
2. What is the danger with setting the “setuid” bit on an executable with a buffer-overflow bug? Explain. (2pt)

Problem 3 (12p)

Assume an idle system. Consider the workload depicted in Table (1). Assume the workload is periodic with 10 time units as a period. In other words, if J_i arrived at time t_i the first time (t_1 is 0, t_2 is 1, t_3 is 3, t_4 is 6 and t_5 is 8) then it will arrive again (with the same execution time) at $10 \times n + t_i$ for each $n \geq 1$. For instance, J_1 arrives at times 0, 10, 20, 30, 40, ... etc.

1. Assume a one level scheduler using the First Come First Served (FCFS) scheduling algorithm.
 - a) Draw a Gantt diagram for processes' execution and queue contents for the first 10 time units. (2pt)
 - b) What is the average waiting time? (2pt)
2. Now assume a one level scheduler using the Preemptive Shortest Job First (Preemptive SJF) scheduling algorithm.

Job	Arrival time	Execution time
J_1	0	4
J_2	1	2
J_3	3	1
J_4	6	2
J_5	8	1

Table 1: A 10 time units periodic workload

- a) Draw a Gantt diagram for processes' execution and queue contents for the first 10 time units. (2pt)
 - b) What is the average waiting time? (2pt)
3. Assuming the processor will only deal with these jobs. Can you put a bound on the maximal size of the ready queue for each scenario? Justify (2pt)
 4. Give two advantages of FCFS over SJF? (2pt)

Problem 4 (8 p)

Assume a filesystem that uses 32-bits pointers to select logical blocks.

1. What is the largest disk size the filesystem can address if the logical blocks are 2KiB (2^{11} B) large? (2pt)
2. Assume 2KiB logical blocks again. What is the maximal size of a file if 16 block pointers (i.e. 64B) are used in each File Control Block (FCB or inode) in order to directly index the logical blocks containing the data of the file. (2pt)
3. What is the maximal size of a file if 15 block pointers are used for direct indexing and one for a single indirect indexing? (1pt)
4. What is the maximal size of a file if 14 block pointers are used for direct indexing, one for single indirect indexing, and one for double indirect indexing? (1pt)
5. Compare the advantages and disadvantages of indexed and contiguous allocation. (2pt)

Problem 5 (4p)

1. What is the main difference between access lists and capability lists? (2pt)
2. For each one of the two approaches, give an example or a scenario showing the limitation of the approach (i.e. an example or scenario where using the other approach would have been better). (2pt)