TDIU11 Exam

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Admitted material

Dictionary from English to your chosen language.

Jour

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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: 20p, 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)

Assume a paged virtual memory with 16 bits virtual addresses. Each process can address at most 128 pages. Assume single level paging.

1. What is the size in bytes of each single page? (2pt)
2. How large is a single page table if each page entry is a 2 bytes word? (2pt)

Assume in the following physical addresses are 32 bits (i.e., 4 bytes) long. Virtual addresses are still 16 bits long and pages have still the same size as above.

1. How many bits are used in the physical address to identify a frame? (2pt)
2. What is the maximal memory size that can be supported by such a system? (2pt)
3. Is it possible for this system with 16 bits virtual addresses to simultaneously use more than one GiB of memory? Explain. (2pt)
4. Suppose the first entries of the page table of some process associate pages to frames according to table (1). What is the physical address (in binary) corresponding to the virtual address $(\texttt{0000 0100 1111 1001})_{\texttt{binary}}$? (2pt)

frame bits	valid bit	other bits	
$(\texttt{0000 0000 0000 0000 0010 000})_{\texttt{binary}}$	$(\texttt{0})_{\texttt{binary}}$	$(\texttt{0100 1100})_{\texttt{binary}}$	1^{st} page table entry
$(\texttt{0000 0000 0000 0000 0010 011})_{\texttt{binary}}$	$(\texttt{1})_{\texttt{binary}}$	$(\texttt{0100 1101})_{\texttt{binary}}$	2^{nd} page table entry
$(\texttt{0000 0000 0001 0001 0000 000})_{\texttt{binary}}$	$(\texttt{1})_{\texttt{binary}}$	$(\texttt{1101 0000})_{\texttt{binary}}$	3^{rd} page table entry
$(\texttt{0000 0000 0000 0001 0011 001})_{\texttt{binary}}$	$(\texttt{1})_{\texttt{binary}}$	$(\texttt{0101 1010})_{\texttt{binary}}$	4^{th} page table entry
$(\texttt{0000 0000 0010 0010 0010 000})_{\texttt{binary}}$	$(\texttt{0})_{\texttt{binary}}$	$(\texttt{0011 1100})_{\texttt{binary}}$	5^{th} page table entry
...	...	...	
$(\texttt{XXXX XXXX XXXX XXXX XXXX XXX})_{\texttt{binary}}$	$(\texttt{X})_{\texttt{binary}}$	$(\texttt{XXXX XXXX})_{\texttt{binary}}$	n^{th} page table entry

Table 1: Some entries of a process page table. The symbol `X` is used to mean a bit value that is not relevant for the question.

Problem 2 (4pt)

For each of the following items, state and motivate (in less than 3 sentences) if it is a representative of a capability-based approach or of an ACL-based approach to protection:

1. Accessing the B-building in Campus Valla after 18.00 with a personal access card. The card content is compared against the list of students and employees at LiU that may access the given building.
2. Attending a party where the list of invited persons is checked at the entrance.
3. Paying a bus trip in Linköping with an anonymous refill card.
4. Accessing a door protected by a digital code that is active between 07:00 and 18:00.

Job	Arrival time	Execution time
J_1	0	9
J_2	2	6
J_3	4	3
J_4	5	1

Table 2: Workload for problem 3.

Problem 3 (12p)

Assume an idle system. Consider the workload depicted in table (2).
First assume an FCFS scheduler.

1. Draw a Gantt diagram for processes' execution and queues' contents. (2pt)
2. What are the individual and the average waiting times? (2pt)

Now assume a preemptive SJF scheduler.

1. Draw a Gantt diagram for processes' execution and queues' contents. (2pt)
2. What are the individual and the average waiting times? (2pt)

General questions about the SJF scheduler algortihm:

1. What is aging in this context and why is it sometimes combined with SJF? (2pt).
2. Assume that the problem aging solves is not an issue. In addition, assume you are willing to pay the price of the increase in the number of context switches that come with SJF. What do you see then as the biggest problem when adopting the SJF scheduling algorithm? how to remedy this? (2pt).

Problem 4 (8 p)

Assume 28 bits (logical blocks') pointers and a 512GiB (i.e., 2^{39} bytes) hard drive.

1. Give the minimal size of a logical block. (2pt)
2. Assume 4KiB logical blocks. What is the size of the FAT table with 4 bytes per entry and corresponding to having a single 512GiB volume? recall that FAT is a form of linked allocation but where all links are centralized in a single table for the whole volume. (2pt)
3. Still assuming 4 bytes per FAT entry and a 512GiB volume, how large (in bytes) should a single logical block be in order to obtain a FAT table of 128 MiB (i.e., 2^{27} bytes) ? (2pt)
4. Compare advantages and disadvantages of the two logical block sizes (i.e, the block sizes adopted/obtained in questions 2 and 3). (2pt)
5. Give two advantages of FAT based allocation over sequential allocation. (2pt)

Problem 5 (4p)

1. What does it mean to "salt" passwords? explain (2pt)
2. What attacks does it protect against? explain (2pt)