Försättsblad till skriftlig tentamen vid Linköpings universitet

Datum för tentamen	2018-03-16
Sal (2)	TER4(83) TERE(1)
Tid	14-18
Kurskod	TDIU11
Provkod	TEN1
Kursnamn/benämning **Provnamn/benämning**	Operativsystem Skriftlig tentamen
Institution	IDA
Antal uppgifter som ingår i tentamen	5
Jour/Kursansvarig Ange vem som besöker salen	Ahmed Rezine
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Tillåtna hjälpmedel	Ordbok, engelska till valfritt språk.
Övrigt	
Antal exemplar i påsen	

TDIU11 Exam

Ahmed Rezine

2018-03-16 kl:14-18

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: 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 fixed size region of virtual memory, possibly on disk.

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

block A data block located on disk.

Problem 1 (10pt)

Assume an architecture with 32 bits addresses (both physical and logical addresses are 32 bits). The architecture can be configured to use either 4 KiB (2^{12}B) or 1 MiB (2^{20}B) page sizes. Assume each page entry takes up 4 bytes.

1. How many pages can a process address in each of the two cases? (2pt)
2. Suppose we adopt 1MiB pages.
   a) How many page table levels are needed? Explain. (2pt)
   b) What is the smallest size taken by all the page tables of a process that has access to one valid page from which it can read and write data. (1pt)
3. Suppose we adopt 4KiB pages.
   a) How many page table levels are needed? Explain. (2pt)
   b) What is the smallest size taken by all the page tables of a process that has access to one valid page from which it can read and write data. (1pt)
4. What information is cached in the TLB (translation look-aside buffer) for this system? (1pt)
5. Draw a diagram that describes how a TLB can be combined with one of the above designs (choose one) in order to speed up the translation of a logical address to a physical address. (1pt)

Problem 2 (12pt)

A system state is described as follows:

- The system is idle with an empty ready queue
- Process P1 is waiting for keyboard input. Its next CPU burst is 2 ticks.
- Process P2 is waiting for disk data. Its next CPU burst is 5 ticks.
- Process P3 is waiting for network data. Its next CPU burst is 4 ticks.

The following list of events will take place starting at time 0:

Tick	Event
0	Disk data is delivered.
1	Network data is delivered.
2	Keyboard input is delivered.

Table 1: Events in the system.

1. What is the difference between a "ready queue" and a "waiting queue"? (2pt)
2. Use preemptive shortest job first (preemptive SJF):
   a) show, from tick 0 to tick 11, which process is running (if any) and the contents of ready- and wait-queues (3pt)
   b) What is the waiting time of each process (1pt)

c) Between tick 0 and tick 1 some process is running on the CPU (not the kernel). This process could continue until completion, but instead it might get preempted by the kernel upon, for example, the arrival of a new event. Observe the kernel was not running at that time. Name a mechanism that can allow the kernel to regain control of the CPU in order to preempt the running process, and explain how it is used by the OS. (2pt)

3. Use non-preemptive shortest job first (non-preemptive SJF):
   a) show, from tick 0 to tick 11, which process is running (if any) and the contents of ready- and wait-queues (3pt)
   b) What is the waiting time of each process (1pt)

Problem 3 (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. Each meeting has a list of personally invited guests. The list is checked each time a guest arrives at the meeting.
2. Access to some buildings in Campus Valla after 17.00 requires using a personal access card that is presented each time a building is accessed. The card content is compared against the list of students and employees at LiU that may access the given building.
3. Cars have to have visible parking tickets. The parking tickets can be obtained by using cash to pay the parking fee without entering a registration number or any other identifier.
4. All technicians that have a special tool can open given smartphone models.

Problem 4 (10 p)

Assume 28 bits (logical blocks) pointers and a 1TiB (i.e., 2^{40} bytes) hard drive.

1. Give the minimal size of individual logical block in order for the pointers to be able to access any logical block of the the hard drive (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 1TiB 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 1TiB 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 one advantage and one disadvantage of using FAT based allocation compared to indexed allocation. (2pt)

Problem 5 (4p)

1. Describe a "dictionary password attack". (2pt)
2. In this context, what is "salt" and how can it help make such an attack harder? (2pt)