Chalmers Un. of Technology and Gothenburg Un. Comp. Science and Engineering Department

Operating Systems
DIT 400, EDA092

Exam 2013-04-02

Date, Time, Place: Tuesday 02/4 2013, 8:30-12:30, X building

Course Responsible: Marina Papatriantafilou Tel: 772 5413

Auxiliary material: You may have with you
- An English-Swedish, Swedish-English dictionary.
- No other books, notes, calculators, PDA's etc.

Grade-scale ("Betygsgränser"):
CTH:3:a 30-38 p, 4:a 39-47 p, 5:a 48-60 p
GU: Godkänd 30-47p, Väl godkänd 48-60 p

Instructions

- Do not forget to write your personal number, if you are a GU or CTH student and at which program ("linje").
- Start answering each assignment on a new page; number the pages and use only one side of each sheet of paper.
- Write in a **clear manner** and **motivate** (explain, justify) your answers. If it is not clear what is written, your answer will be considered wrong. If it is not explained/justified, even a correct answer will get **significantly** lower (possibly zero) marking.
- If you make any assumptions in answering any item, do not forget to clearly state what you assume.
- The exam is organized in groups of questions. The credit for each group of questions is mentioned in the beginning of the respective group. Unless otherwise stated, all questions in a group have equal weight.
- Please answer in English, if possible. If you have large difficulty with that and you think that your grade can be affected, feel free to write in Swedish.

Good luck !!!!

1. (10 p)

   (a) Describe the SCAN scheduling method for optimizing head movement in disk memories. (2p)

   (b) Describe how starvation could occur when using a SCAN algorithm to optimize the head movement in a disk memory. (1p)

   (c) Describe an improved version of SCAN that is free from starvation. (2p)

   (d) Assume that one disk in a RAID array becomes useless. Which measures need to be taken to recover full access to the data if using
   i. RAID 1 (1p)
   ii. RAID 5 (1p)

   (e) A file consists of 4 disk blocks. Which disk operations are needed to modify one block in the file if the file system uses RAID 5? (2p)

   (f) Mention two types of errors that RAID do not protect against. (1p)

2. (10 p)

   (a) A method to keep track of used blocks in a filesystem is FAT (File Allocation Table). Describe how the FAT method works. (3p)

   (b) In what type of memories are FAT in common use today? (1p)

   (c) File system operations in UNIX use a VFS (Virtual File System) layer for calling the actual file system code. Describe how the VFS interface works. (2p)

   (d) How is a file system directory implemented in a UNIX file system? (1p)

   (e) Why do UNIX hard links not generate cycles in the file system graph? (1p)

   (f) In almost all operating systems the first block in a disk partition is reserved for a special purpose. Which purpose? And is it necessary to reserve the block for this purpose? (2p)

3. (10 p)

   (a) The Andrew filesystem uses a consistency semantics called *Session Semantics*. Explain how *Session Semantics* works. 1(p)

   (b) Why is *location independent* internal file identifiers used in the Andrew filesystem? (1p)

   (c) Give one advantage and one disadvantage with using a stateless file server. (2p)

   (d) Explain the difference between a type 1 hypervisor and a type 2 hypervisor. (1p)

   (e) Give two examples of why a programmer might want to run an operating system in a virtual machine. (2p)

   (f) Explain why virtualization complicates the handling of virtual memory and how the problem is usually solved. (3p)

4. (10 p)

   (a) Describe the LRU and the Clock algorithm as solutions to the page replacement problem. (4p)

   (b) What are the advantages of using the Clock algorithm for page replacement as compared with implementing LRU directly? (3p)

   (c) Why are segmentation and paging sometimes combined into one scheme? (3p)

5. (10 p)

   (a) Describe the two main methods for load balancing on an SMP (Symmetric Multi Processor). (2p)

   (b) Explain the term *processor affinity*. (1p)

   (c) Why can load balancing sometimes be in conflict with processor affinity? (1p)

   (d) When a program is executed it is represented as a process in the operating system. A process can be in different states. Describe different process states and explain when transitions occur between the states. Include basic states as well as states related to virtual memory management. (2p)

   (e) A tricky issue in multiprocessor scheduling is how to design the ready queue. Describe this problem and its common solutions. (2p)

   (f) In scheduling, the concept of **aging** is sometimes used. What does it mean and what problem does it try to solve? (2p)

6. (10 p)

   (a) What is a deadlock? What are the necessary conditions for a deadlock to occur? (3p)

   (b) Describe using pseudocode a solution to the dining philosophers problem. You may use sempahores and read/write variables. Explain how this solution satisfies the requirements for exclusion (between neighbouring philosophers) and no-deadlock. Discuss the fairness properties of your solution. (4p)

   (c) Describe how it is possible to devise a solution to the mutual exclusion problem using the TestAndSet hardware primitive. Argue about the correctness and other properties of the solution. (3p)