Exam in Operating Systems 2011-08-24

Inga hjälpmedel!

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30 out of 60p are needed to pass the exam.

1. (20p) Explain the following terms:

   (a) (2p) Multiprogramming

   Answer: *If one process needs to wait for I/O, another process is run instead. The purpose is to use the resources better, and the basic idea is very important, namely that if it is better to do something else while waiting, then you should do so, but if the waiting is shorter than the context switch time, it's better to wait.*

   (b) (2p) Dual-mode processor

   Answer: *A processor has a user mode and a supervisor mode state.*

   (c) (2p) Process

   Answer: *See book.*

   (d) (2p) Interrupt

   Answer: *An external device interrupts the processor which then switches to supervisor mode and services the interrupt.*

   (e) (2p) Exception

   Answer: *An exception is similar to an interrupt except that it is generated internally in the processor (including MMU).*

   (f) (2p) System call

   Answer: *A software initiated switch to supervisor mode in order to execute a system call which only the kernel is allowed to do.*

   (g) (2p) User credentials

   Answer: *See slides or book*

   (h) (2p) Translation lookaside buffer

   Answer: *See slides.*

   (i) (2p) Page fault

   Answer: *The data of the requested page is not in RAM and must fetced from swap.*

(j) (2p) Memory mapped file

Answer: *A memory mapped file is mapped to a virtual address. An advantage of memory mapped files over accessing them as files is that* `lseek` *system calls can be avoided.*

2. (20p) Describe a traditional UNIX file system such as EXT2, and how (and why) you would modify it to achieve the following goals:

   - faster recovery after a crash,
   - faster writes, and
   - faster reads of video streams.

   Answer: *See slides or book for a file system. The specific questions can be answered as follows:*

   - *By having a log or journal which is written as transactions, the recovery can be done by inspecting the journal instead of doing a full file system check. A full file system check includes comparing all files and directories to see that the inodes' reference count match the number of times a file is listed in directories and that the used disk blocks match the inodes and free block table.*
   - *Faster writes can be achieved by writing to a log and then copying the written data to the normal file system locations (as in EXT2). This is used by EXT3 and it makes it possible to make disk writes with minimal write-head movements since the data is written in sequence. Then, after the log has been written, the data can be copied but that copying is not time-critical.*
   - *By allocating larger blocks consisting of sequential blocks. Such large blocks can be allocated for instance using a buddy system. This is used by EXT4.*

3. (10p) Explain how a virtual memory system works including the hardware support, data structures, and what happens when a page is taken from another process.

   Answer: *See slides or book.*

4. (10p) Explain the approach taken in Solaris for the priority inversion problem.

   Answer: *See slides.*