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DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Autumn Semester 2010-2011 (2 hours)

EEE6032 Operating Systems 6

Answer **THREE** questions. **No marks will be awarded for solutions to a fourth question.** Solutions will be considered in the order that they are presented in the answer book. Trial answers will be ignored if they are clearly crossed out. **The numbers given after each section of a question indicate the relative weighting of that section.**

1. a. Describe the key elements of a device driver. (4)
 Why is a device driver the preferred method of interfacing with peripherals? (3)
 Are there any major drawbacks to the installable device driver architecture? (3)
- b. What are the three main types of virtual machines? Briefly describe the area of application of each type. (6)
 How does software emulation differ from a virtual machine? (4)

2. **a.** Why is disabling all interrupts not an appropriate way of implementing synchronisation of user processes? (4)
- b.** Why are interrupts not a suitable mechanism to implement synchronisation on multiprocessor systems? (4)
- c.** Show how two processes, P_1 and P_2 , containing the following code fragments can deadlock:
- $P_1 = \dots \text{fopen}(f1, "w"); \text{fopen}(f2, "w"); \dots$
- $P_2 = \dots \text{fopen}(f2, "w"); \text{fopen}(f1, "w"); \dots$
- where the `fopen()` function opens a file handle for file `f1` or `f2`; the "w" parameter indicates the file is being opened for write access. (6)
- Will deadlock always occur when running P_1 and P_2 together? (2)
- How can the system call be modified to prevent deadlock occurring? (4)

3.
 - a. In the context of memory management, what is a *hole* and what are the consequences of holes? How can holes be eradicated? (5)
 - b. In a virtual memory system, what is the principal disadvantage of storing the page table in main memory? Explain how this disadvantage can be greatly reduced by adding suitable hardware support. (5)
 - c. In a paged memory system, pages are typically selected for replacement on the grounds of being the *least recently used* (LRU). Suggest a crude but adequate approximation to the LRU algorithm which uses only one extra bit in each the page table entry but which is much cheaper than the full LRU implementation above. Comment on the accuracy and efficiency of your approximation. (6)

As an alternative approximation to the least recently used algorithm, one possibility would be to write the frame number of every memory access to a first-in-first-out buffer (FIFO) and select for replacement the page at the head of the FIFO. Explain why this is not a good idea. (4)
4.
 - a. With reference to a graphical user interface (GUI), what is an *event* and how is it communicated to an user application? (4)
 - b. What is an *event handler* and how is it invoked? (4)
 - c. What happens if a window receives an event for which no handler is defined? (4)
 - d. In a GUI program, a user places the mouse cursor over an 'OK' button and presses the left mouse button down. The users keeps the mouse button depressed, moves the mouse cursor off the 'OK' button and releases the left mouse button. Nothing happens! The action associated with the 'OK' button is not executed. Why not? (4)
 - e. Why is an object oriented language particularly suited to programming GUI systems? (4)

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