The University of Nottingham

SCHOOL OF COMPUTER SCIENCE

A LEVEL 3 MODULE, SPRING SEMESTER 2011-2012

OPERATING SYSTEMS

Time allowed TWO hours

Candidates may complete the front cover of their answer book and sign their desk card but must NOT write anything else until the start of the examination period is announced

You must answer FOUR questions out of SIX
(only the FOUR nominated solutions will be marked)

Only silent, self contained calculators with a Single-Line Display are permitted in this examination.

Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted.

No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used.

DO NOT turn your examination paper over until instructed to do so

1. (a) Describe the four generations of computing and how operating systems developed as a result.

(12 Marks)

(b) There is some debate as to what will constitute a fifth generation computer. Assume such a computer becomes available. What do you think differentiates it from the computers of today? What advances do you think need to be made in order to produce a fifth generation computer?

(13 Marks)

2. (a) Describe the three most basic process states in a multi-programming operating system, the transitions possible between them and why these might occur.

(6 Marks)

(b) What is the purpose and typical contents of the operating system's process table?

(10 Marks)

(c) Describe the general actions an operating system kernel takes to context switch between processes.

(4 Marks)

(d) What is kernel mode, why is it needed and why are interrupts often implemented via an interrupt vector? How do these influence the events that need to take place to make a context switch?

(5 Marks)

3. (a) Describe the operation of *Translation Lookaside Buffers* (TLBs – also know as Current Page Registers) in a paged operating system. What is the sequence of events when

(i) a TLB is 'hit';

(ii) a TLB is 'missed' but the required page is in main memory;

(iii) a TLB is 'missed' but the required page is not in main memory.

Show clearly how the various components of the system fit together.

(17 Marks)

(b) In a simple paged system with only one level of page tables the access times are as follows.

ASSOCIATIVE MEMORY HIT:

To read associative memory	1 ns
To read main memory	5 ns

ASSOCIATIVE MEMORY MISS:

To read associative memory	1 ns
To add the page number to the page table origin register	2 ns
To read page table	5 ns
To read main memory	5 ns

(i) Calculate the effective access time for a hit rate of 92 per cent.

(3 Marks)

(ii) If the page fault service time is 1.1 ms, what is the maximum page fault rate that the system can tolerate without incurring more than a 15 per cent degradation?

(5 Marks)

4. (a) What are the objectives of process scheduling?

(5 Marks)

(b) Describe the following process scheduling algorithms: non pre-emptive, round robin, shortest job first.

(12 Marks)

(c) What is meant by *Multilevel Queue Scheduling* for processes and why is it used?

(4 Marks)

(d) Briefly describe the techniques available for the evaluation of process scheduling algorithms.

(4 Marks)

5. (a) UNIX uses a "pointers to blocks" method in the form of *inodes* to implement it's hierarchical file system. Describe how the original (non-Berkeley) UNIX does this and contrast it to another system of your choice.

(10 Marks)

(b) It has been suggested that the first part of each UNIX file be kept in the same disk block as its *inode*. What, if anything, would be the advantage of doing this and why

(5 Marks)

(c) Explain how the *Berkeley File System* increases the throughput of the original Unix by various means.

(10 Marks)

6. (a) What are the time delay factors involved in accessing data on a disk?

(3 Marks)

(b) Describe the algorithms available for simple disk scheduling along with their good and bad points.

(6 Marks)

(c) Assume a disc has 100 tracks numbered from 0 (innermost) to 99 (outermost). Consider the following time ordered list of disc I/O requests, where the value given is the track number requested and

62, 10, 42, 15, 65, 81, 82, 23, 85

Assuming all requests have arrived before accessing commences and that no more requests arrive during processing and the read/write head starts at track 62, compute the average track distance (i.e. number of tracks) the head moves per request, using

i) fist in, first out (FIFO);

(3 Marks)

ii) scan (in increasing track number to start);

(3 Marks)

iii) circular scan (in increasing track number to start).

(3 Marks)

(d) What is the purpose of a RAID (redundant array of inexpensive disks) installation? Briefly describe the basic operation of RAID levels 0 to 5.

(7 Marks)