

Birkbeck
(University of London)

MSc Examination

**Department of Computer Science and Information
Systems**

Computer Systems (COIY060H7)
Credit Value: 15

Date of Examination: 03/06/2011
Duration of Paper: 10:00–12:00

There are five questions in this paper; each of them is compulsory and worth 20 marks.
The paper is not prior-disclosed.
The use of electronic calculators is not permitted.

Questions

1. (a) Describe the main idea behind pipelining and explain how it can increase machine level parallelism. (4 marks)
- (b) Describe three types of true dependencies (that cannot be removed by register renaming) and explain their effect on pipelines. (6 marks)
- (c) Summarise the main stages of the Pentium 4 pipeline. (10 marks)

2. (a) Explain why the way operands are addressed is an important issue in designing instruction sets. (4 marks)
- (b) List at least five different addressing modes and describe their advantages and disadvantages. (8 marks)
- (c) Consider the following assembly code.

```
I1: LOAD A
I2: SUB B
I3: STOR Y
I4: LOAD D
I5: MPY E
I6: ADD C
I7: DIV Y
I8: STOR Y
```

where Y is an internal register and A, B, C, D, E refer to (the value of) memory locations. Implicit addressing uses the accumulator register AC. In the case of a binary operation, the accumulator serves both as the first source operand and as the target operand. Thus the meaning of the assembly code SUB X can be described as $AC \leftarrow AC - X$.

In a similar way describe what each line means and then describe the whole computation in a single equation. (8 marks)

3. (a) Explain the three fundamental ways I/O can be performed and compare their benefits and drawbacks. (8 marks)
- (b) For each method determine how much CPU time is needed to print a 1KB document. The initial set-up takes 20 milliseconds in each case. It takes 50 microseconds to put a byte in the data register of the controller of the printer, and printing one byte takes 50 milliseconds. Assume that each interrupt service procedure needed runs for 70 microseconds and that the data register of the controller of the printer can contain only one byte. (12 marks)

4. (a) Describe the function of the medium-term (or swapper) and short-term schedulers. (6 marks)
- (b) Explain the main difference between preemptive and non-preemptive scheduling algorithms. (4 marks)
- (c) Consider the following scenario. Processes A, B, and C have priority 1, and processes D and E priority 0 (the higher the priority, the sooner the process is scheduled). Their arrival times are 0, 1, 2, 0 and 5 seconds, and their run times are 1.5, 1, 1.5, 1.5 and 1.5 seconds, respectively. Compute the average turnaround time for the five processes A to E using each of the following short-term scheduling algorithms:
- first-come-first-served
 - multiple queues (priority queueing) using round-robin on each priority level.
- (10 marks)

5. (a) Describe the main issues with IPC (interprocess communication). List at least three techniques that can be used for IPC and compare their benefits. (8 marks)
- (b) The test-and-set machine instruction is defined as follows:

```
boolean test_and_set (int i)
{
    if (i == 0)
    { i = 1;
      return true;
    }
    else return false;
}
```

It is assumed that it is implemented as an atomic instruction. Describe how test-and-set can be used to achieve mutual exclusion for n processes (e.g. by writing a mutual exclusion procedure using pseudo-code). Explain whether your solution avoids busy waiting. (12 marks)