

Coursework Part 2, 2017–2018

1. The function F is defined as $F(1) = F(2) = F(3) = 1$ and for $n \geq 3$,

$$F(n + 1) = F(n) + (F(n - 1) \cdot F(n - 2))$$

i.e., the $(n + 1)$ th value is given by the sum of the n th value and the product of the $(n - 1)$ th and $(n - 2)$ th values.

- (a) Write an assembly program for computing the k th value $F(k)$, where k is an integer bigger than 3 read from a memory location M , and storing $F(k)$ at memory location M . Use the instruction set in the Instruction Set Architecture document

<http://www.dcs.bbk.ac.uk/~szabolcs/CompSys/isa.pdf>

[15 marks]

- (b) Show the execution of your program on a superscalar processor for $k = 5$. Assume that all the decoded instructions are already loaded into an instruction window IW on board. The remaining pipeline stages are RR , EX and WB . Assume that there are two functional units (reading and writing to registers, and execution units) for each of the pipeline stages. Make your additional assumptions explicit. Explain where and why delay slots appear.

[20 marks]

Subtotal: [35 marks]

2. A file server receives requests via a network. It takes 10 ms to dispatch the requested data and do the necessary processing, assuming that the data needed are in the disk cache. When there is a cache miss, as is the case in one third of the time, 45 ms is required to read the requested data from the hard disk into main memory (during which time the thread is blocked).

- (a) How many requests/sec can the server handle if it is single threaded?

[8 marks]

- (b) How many requests/sec can the server handle if it is multithreaded (one thread popping up at each request)?

[7 marks]

Subtotal: [15 marks]

3. In a computing center there are four types of jobs according to their arrival times (in seconds), their priorities and their run times (in seconds); see the table below:

	Type 1	Type 2	Type 3	Type 4
arrival time	40	50	40	0
priority	1	1	0	0
run time	1	2	1	2

There are 20 Type 1 jobs, 40 Type 2 jobs, 60 Type 3 jobs and 80 Type 4 jobs. Compute the average turnaround time using the multilevel queues (round robin on every priority level — the higher the priority, the sooner they run) scheduling algorithm.

[Use a quantum that provides short response time.]

Subtotal: [15 marks]