

Coursework Part 1, 2018–2019

Please consult the module web page and the links therein about deadlines, late submission and plagiarism before submitting your solutions.

Your answers to these problems should contain explanations of the computations and calculations. If you make additional assumptions, state them explicitly and provide justifications for them.

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

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

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

[10 marks]

- (b) Consider a pipelined processor, where the pipeline stages are F (fetch), D (decode), R (register read), E (execute) and W (write back). Describe what happens in the pipeline stages for the various types (data movement, data processing, control) of instructions.

[10 marks]

- (c) Show the execution of your program on the above pipelined processor for $k = 5$ by drawing a diagram. Assume that the fetched and decoded instructions are stored in an instruction window IW with a capacity of 12 instructions, and that there is no resource conflict between fetching instructions and executing data transfer instructions. Explain where and why delay slots appear.

[15 marks]

Subtotal: [35 marks]

2. A computer has a cache, main memory and a hard disk. If a referenced word is in the cache, it takes 15 ns to access it. If it is in main memory but not in the cache, it takes 85 ns to load (the block containing) it into the cache (this includes the time to originally check the cache), and then the reference lookup is started again. If the word is not in main memory, it takes 10 ms to load (the block containing) it from the disk into main memory, and then the reference lookup is started again. The cache hit ratio is 0.4. In the case of a cache miss, the probability that the word is in the main memory is 0.7. Compute the average load time.

Subtotal: [15 marks]

Total: [50 marks]