



# EEE4084F: Digital Systems

22 March 2012



## Quiz 2

Lectures 5-8, Ch5 pp 73-78; 88-89; 96-101

Time: 45 minutes 60 marks

Please use separate page(s) to fill out your answers.

### Question 1 [20 marks]

John von Neumann was a Hungarian mathematician who was first to write about requirements for an electronic computer that was not programmed by hard wiring circuits.

- Briefly explain the von Neumann architecture, indicating where and how the *accumulator* fits in. Provide a rough diagram to illustrate your description [10 marks].
- The input/output for a classic von Neumann was done using special instructions. Consider that an 8-bit architecture was used, which had 8-bit registers, an 8-bit port bus and 16 bit memory bus. If you wanted to output a sequence of values 0,1,2, ... 255 and cycle back to 0, what might the sequence of assembly code instructions look like? Note that you're intentionally *not* give a list of assembly code instructions – you're supposed to demonstrate your understanding of these things by using pseudocode assembly instructions that would likely correspond to real 8-bit instructions. [10 marks]

### Question 2 [20 marks]

This question relates to Flynn's taxonomy and memory structures.

- What precisely is Flynn's taxonomy used for? Explain what the terms SISD, SIMD, MISD and MIMD refer to. [10 marks].
- Consider that you are tasked to design a special-purpose computer that performs stream processing. All the computer does is simultaneously calculate the minimum, maximum and average of the data that is coming in from the input stream. Motivate which type of approach you would use: either SISD, SIMD, MISD or MIMD. [5 marks]
- Uniform Access Memory (UMA) and Non-UMA are two general classifications for memory access structures. Explain the difference between the two – you may provide a rough diagram if it would help your explanation. [5 marks]

### Question 3 [10 marks]

This question relates to Chapter 5 of the textbook.

- (a) What is meant by the term “embarrassingly parallel”? Give an application example. [5 marks]
- (b) The granularity of parallel computing solutions can be classified as ranging from fine-grained to coarse-grained solutions. Explain what is meant by the term “granularity” in this context, and what the difference is between fine-grained and coarse-grained parallel computing solutions. [5 marks]

### Question 4 [10 marks]

Two types of commonly used communication routines are: 1) the *scatter* model and 2) the *gather* model. Consider a database system for which the following tables have been defined:

Clients: (ClientID, Name, Address)

Purchases: (ClientID, Date, Item, Cost)

Payments: (ClientID, Date, Amount)

Now, if you ignore how poorly this database is designed, consider that a commonly executed operation is to find the clients who are late with their account payment (i.e. still owe money).



Describe how both the scatter and gather models of communications could be used to carry out this operation were the application implemented on a shared memory SMP platform. You may use sketches to aid your explanation. [10 marks] (example tables are shown below)

*Bonus question:* if it was running on a standard database engine (like MySQL), what SQL query would find the clients who are late with their account payment. [2 marks]

#### **Appendix A: Example tables for Q3 (c)**

Clients		
ClientID	Name	Address
1	Jo Able	2 Park Rd
2	Anne Bell	7 Hill Place
3	Bob Zed	12 Main Rd

Purchases			
ClientID	Date	Item	Cost
1	10 Jan	1x Widget A	100
2	12 Jan	2x Widget B	120
1	5 Feb	2x Widget A	200
3	8 Mar	3x Widget A	300

Payments		
ClientID	Date	Amount
1	20 Jan	100
2	1 Feb	60
3	12 Mar	300