UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

B. Sc. Examination 2014

IS51009B
Data Representation and Architecture Modelling

Duration: 2 hours 15 minutes

Date and time:

There are five questions in this paper. You should answer no more than THREE questions. Full marks will be awarded for complete answers to a total of THREE questions. Each question carries 25 marks. The marks for each part of a question are indicated at the end of the part in [.] *brackets.*

There are 75 marks available on this paper.

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FROM THE EXAMINATION ROOM

Question 1

(a) i. A computer with a 32-bit word size uses two's complement to represent numbers. The range of integers that can be represented by this computer is:

(1) -2^{32} to 2^{32}

(2) -2^{32} to 2^{31}

(3) -2^{31} to $2^{31}-1$

(4) -2^{31} to $2^{32}-1$

[2]

ii. What procedure is required to add the two two's complement numbers 01101101 and 110?

(1) take the two's complement of the smaller number and extend it

(2) pad the shorter number with 0's

(3) sign extend the shorter number

(4) shift the shorter number to the left by 5 places

[2]

iii. In which of the following two's complement addition problems does an overflow error occur?

(1) 0011+ 1010

(2) 0100 + 0100

(3) 0100 +1100

(4) none of the above

[2]

(b) i. Register A holds the 8-bit binary 11011001. Determine the B operand and the logic micro-operation to be performed in order to change the value in A to 01101101.

ii. Perform the following 8-bit two's complement calculation:

$$01110000_2 - 11101011_2.$$

iii. Does the above two's complement calculation give an overflow? Justify your answer.

[9]

(c) Assume we are using the 32-bit IEEE single precision floating point format. The mantissa has 24 bits including the hidden bit. There is one sign bit and there are eight exponent bits.

i. What decimal floating point number is represented by the following 32 bit sequence? Show your workings.

1100 0011 1000 1010 0000 0000 0000 0000

ii. How would the smallest normalised number be represented in this 32-bit format?

[10]

Question 2

(a) i. Which of the following are usually combinational logic circuits?

(1) Adder
(2) Program counter
(3) Multiplexer
(4) Memory

[2]

ii. Which one of the following statements is a correct definition of the term “virtual memory”?

(1) an extremely large main memory
(2) an extremely large secondary memory
(3) the illusion of extremely large main memory
(4) a type of memory used in super computers.

[2]

iii. Which one of the following statements is correct about the meaning of a ”page fault”?

(1) the page is corrupted by application software
(2) the page is in memory
(3) the page is not in memory
(4) division by zero error

[2]

(b) i. Explain the concept of pipelining in CPU design.

ii. Explain the concept of data and control pipelining hazards.

iii. List and explain a way to reduce pipelining stall caused by each of the hazards in (ii)

[9]

(c) i. List three advantages of the RISC based system architecture.

ii. Explain the concept of the “spatial locality” principle.

iii. Explain how the “spatial locality” principle is used by cache memory to improve performance.

[10]

Question 3

(a) i. Which one of the following storage medium has faster information retrieval?

(1) floppy disk
(2) magnetic tape
(3) optical disk
(4) hard disk

[2]

ii. What is the control unit's function in the CPU?

(1) to transfer data to primary storage
(2) to store program instruction
(3) to perform logic operations
(4) to decode program instructions

[2]

iii. Which of the following registers is used to keep track of the address of the memory location where the next instruction is located?

(1) Memory Address Register
(2) Memory Buffer Register
(3) Instruction Register
(4) Program Counter

[2]

(b) i. How many 128 x 8 RAM chips are needed to provide a memory capacity of 1024 bytes?

ii. How many lines of the address bus must be decoded for the above RAM chip selection?

iii. How many lines of the address bus must be used to access 1024 bytes of memory ?

iv. How many of these lines will be common to all RAM chips?

[9]

(c) i. Explain the concept of programmed I/O.

ii. How does the CPU deal with interrupts?

iii. How does DMA differ from programmed I/O?

[10]

Question 4

(a) i. Which class of IP address provides a maximum of $2^{16} - 2$ host addresses per network ID?

(1) class A
(2) class B
(3) class C
(4) class D

[2]

ii. Which of the following protocols belong to the Application layer of the OSI model? More than one answer may apply.

(1) IP
(2) TCP
(3) Telnet
(4) FTP

[2]

iii. Which of the following statements is false with reference to the purpose of TCP sequence numbers? More than one answer may apply.

(1) to ensure that data is delivered to the application in the order it was sent
(2) to distinguish duplicate packets
(3) to determine how much data is left to send
(4) All of the above

[2]

(b) i. Give three advantages of layering in TCP/IP.

ii. Explain how TCP/IP uses headers to implement layering.

[9]

(c) Consider a class C network with the network address 201.168.67.0. A network administrator decides to subnet this network with a subnet mask of 255.255.255.240.

i. Find the number of possible usable subnets.

ii. Find the number of possible usable hosts in each subnet.

iii. Find the address of the first subnet.

iv. What is the range of possible host addresses in the first subnet?

[10]

Question 5

(a) i. What is the ready state of a process?

(1) when process is scheduled to run after some execution
(2) when process is unable to run until some task has been completed
(3) when process is using the CPU
(4) none of the above

[2]

ii. Which of the following is not a role of a typical operating system?

(1) control the allocation of the machine's resources
(2) control access to the machine
(3) maintain records regarding files stored in mass storage
(4) assist the computer user in the task of processing digital photographs

[2]

iii. Copying a process from memory yo disk to allow space for other processes is called

(1) demand paging
(2) swaping
(3) page fault
(4) noe of the above

[2]

(b) i. Describe the differences among short-term, medium-term, and long-term scheduling.

ii. Why is it generally correct to favour I/O-bound processes over CPU-bound processes?

[9]

(c) i. Describe and state the advantages/disadvantages of the following three memory management techniques.

Swapping
Simple paging
Demand paging

ii. Under what circumstances do page faults occur? Describe the actions taken by the operating system when a page fault occurs.

[10]