



**UNIVERSITY
OF LONDON**

CO1110 ZA

BSc, CertHE and Diploma EXAMINATION

COMPUTING AND INFORMATION SYSTEMS and CREATIVE COMPUTING

Introduction to Computing and the Internet

Wednesday 15 May 2019: 10.00 – 13.00

Time allowed: 3 hours

DO NOT TURN OVER UNTIL TOLD TO BEGIN

This paper is in two parts: **PART A** and **PART B**. There are a total of **THREE** questions in each part. Candidates should answer **TWO** questions from **PART A** and **TWO** questions from **PART B**.

Full marks will be awarded for complete answers to a total of **FOUR** questions, **TWO** from **PART A** and **TWO** from **PART B**. The marks for each part of a question are indicated at the end of the part in [] brackets.

Only your first **TWO** answers from **PART A** and **TWO** from **PART B**, in the order that they appear in your answer book, will be marked.

There are 100 marks available on this paper.

A handheld calculator may be used when answering questions on this paper but it must not be pre-programmed or able to display graphics, text or algebraic equations. The make and type of machine must be stated clearly on the front cover of the answer book.

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PART A: answer TWO questions

Question 1

- (a)
- (i) Which one of the following is a way of representing integers?
- (A) One's complement
 - (B) Unsorted excess magnitude notation
 - (C) Fixed point notation
 - (D) None of the above. [2 marks]
- (ii) What is underflow in floating point numbers?
- (A) When the mantissa is too large to be expressed in the number of bits available
 - (B) When the mantissa is too small to be expressed in the number of bits available
 - (C) When the positive exponent is too large to be expressed in the number of bits available
 - (D) When the negative exponent is too large to be expressed in the number of bits available. [2 marks]
- (iii) Unicode is:
- (A) A character encoding system that is backwards compatible with ASCII character encoding
 - (B) Preferred to ASCII, as ASCII is only really suitable for displaying the English language
 - (C) A popular character encoding system widely used on web pages throughout the world
 - (D) All of the above. [2 marks]

- (b)
- (i) Convert 6 and -6 to 4-bit two's complement representation. [3 marks]
 - (ii) The two's complement number A = 1100 and the two's complement number B = 1001.

Add the two's complement numbers A and B using 4-bit two's complement arithmetic. Does the result demonstrate an overflow? Explain your answer. [3 marks]
 - (iii) Compute A + B in 6-bit two's complement arithmetic. Does the result contain an overflow? Explain your answer. [3 marks]
- (c)
- (i) Represent 63 in normalised IEEE 754 single precision format. [7 marks]
 - (ii) The result of a calculation with IEEE 754 32-bit numbers is 1.101111×2^{-128} .

Convert this number to a form that can be expressed in IEEE 754 32-bit denormalised form. You may give the exponent in decimal notation. [3 marks]

Question 2

(a)

(i) An opcode is:

- (A) A data address contained in an instruction
- (B) A micro-operation
- (C) Binary code that specifies the operation to be performed by the processor
- (D) None of the above.

[2 marks]

(ii) The register which contains the most recent instruction fetched from memory is known as:

- (A) Instruction register
- (B) Memory address register
- (C) Program counter
- (D) None of the above.

[2 marks]

(iii) What does MFLOPS stand for?

- (A) Floating point operations per second
- (B) Millions of floating point operations per second
- (C) Machine floating point operations per second / Fixed point operations per second
- (D) None of the above.

[2 marks]

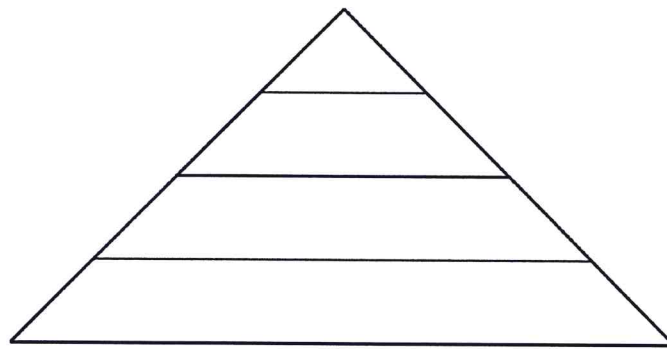
(b)

- (i) In a valid memory hierarchy storage grows with increasing distance from the processor. Name two things that decrease with increasing distance from the processor. [3 marks]

- (ii) Copy the pyramid graphic below into your answer book, and write one of the following memory items at each level such that your final graphic displays a valid memory hierarchy.

- Magnetic tape storage
- Main memory
- Hard disk
- Cache.

[3 marks]



- (iii) When a machine has an instruction cycle composed of N stages, then, without pipelining, each instruction will take N time units to execute. Hence M instructions will take $N \times M$ time units to execute. In general, what is the smallest possible number of time units it will take to execute M instructions in an N -stage pipeline? Express your answer in terms of M instructions and N stages. [3 marks]

(c)

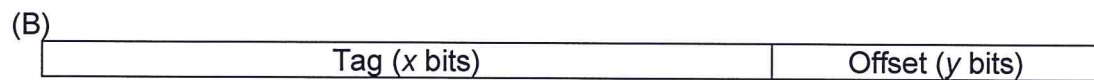
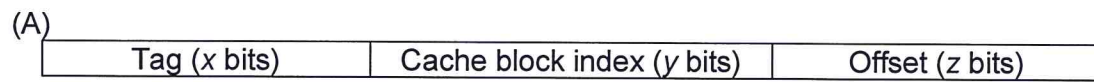
- (i) Explain the spatial locality principle and how the design of the cache implements the spatial locality principle. [5 marks]

- (ii) Consider a direct mapped cache with 4 lines. The main memory is divided into 20 blocks. Copy into your answer book the following diagram, and complete it, such that the completed diagram shows which memory blocks map to which cache lines: [2 marks]

Main memory block numbers	Cache lines
	Line 0
	Line 1
	Line 2
	Line 3

- (iii) Consider the diagrams (A), (B) and (C) below. The diagrams show the division of addresses for direct mapped, associative mapped, and set associative mapped caches. Each address below belongs to a different cache mapping. Identify which address belongs to which cache organisation.

[3 marks]



Question 3

(a)

- (i) Which one of the following lists best describes the von Neumann architecture?

(A) CPU, memory and I/O devices
(B) ALU, FPU and system bus
(C) Control unit, address decoder and cache
(D) None of the above.

[2 marks]

- (ii) The first three generations of computers are differentiated by the technology that they used. What technology distinguishes the second generation?

(A) Transistors
(B) Vacuum tubes
(C) Integrated circuits
(D) None of the above.

[2 marks]

- (iii) Which one of the following is a reason for using binary numbers in computing?

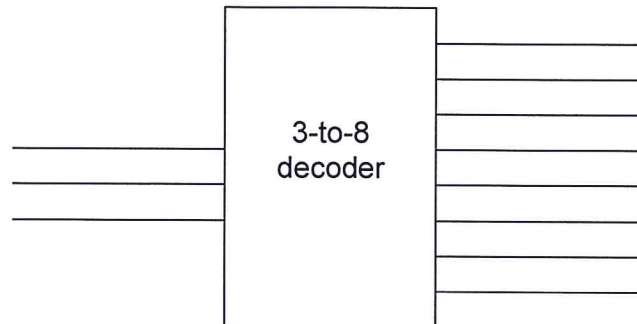
(A) A computer that has to differentiate between 2 states rather than 10 is likely to be less error prone.
(B) Hardware is easier to build, as binary requires two states rather than the 10 states required to implement decimal numbering.
(C) A transistor has two states: open and closed; and these two states correspond to 0 and 1 in the binary system, hence calculations in binary can easily be implemented with transistors, which are small, fast and reliable technology.

(D) All of the above.

[2 marks]

(b)

- (i) The graphic shows a simplified diagram of a 3-to-8 address decoder. Copy the graphic into your answer book and complete it by adding the inputs and outputs. [3 marks]



- (ii) Consider a memory composed of 256×8 -bit RAM chips. Memory is byte addressable. There are 64 chips. How many bits must memory addresses have in order for each memory location to have a unique address? Please show how you have arrived at your answer. [3 marks]
- (iii) Given the same memory as in (b)(ii) above, how many address lines are needed for chip selection? How many lines to select a memory location on a chip? Please justify your answers. [3 marks]
- (c)
- (i) Explain the concept of interrupt-driven I/O; and how it differs from programmed I/O. [7 marks]
- (ii) Describe a single disadvantage that both interrupt-driven I/O and programmed I/O have. [3 marks]

PART B: answer TWO questions

Question 4

(a)

- (i) Data packets starting their journey in the Application Layer of the TCP/IP network model, journey in a particular order through the other layers. This order is:

- (A) Application → Internet → Transport → Network Access
- (B) Application → Transport → Internet → Network Access
- (C) Application → Internet → Network Access → Transport
- (D) None of the above.

[2 marks]

- (ii) Which one of the following is a Transport Layer protocol?

- (A) UDP
- (B) IP
- (C) SGML
- (D) None of the above.

[2 marks]

- (iii) Which one of the following is true about the TCP/IP network model?

- (A) TCP/IP implements layering by dividing data packets into header and data sections
- (B) The TCP/IP model is named after its two most important protocols
- (C) Layering is a restrictive form of data encapsulation intended to reduce complexity by restricting the number of interfaces in the TCP/IP network model
- (D) All of the above.

[2 marks]

(b) Consider the IP datagram header, given below:

0	4	8	16	24	28
VERSION	HEADER LENGTH	SERVICE TYPE	TOTAL LENGTH		
IDENTIFICATION			FLAGS	FRAGMENT OFFSET	
TIME-TO-LIVE		PROTOCOL	HEADER CHECKSUM		
SOURCE IP ADDRESS					
DESTINATION IP ADDRESS					
IP OPTIONS (IF ANY)				PADDING (IF NECESSARY)	
DATA					
.					
.					
.					

- (i) The time-to-live field is a number, decremented every time the IP datagram passes through a router. What happens if the number reaches zero? [3 marks]
 - (ii) What are the possible values that could be in the version field? [3 marks]
 - (iii) What does the total length field record? [3 marks]
- (c)
- (i) Describe how the cumulative acknowledgement process of the TCP protocol works in practice. [3 marks]
 - (ii) Explain why the cumulative acknowledgement process can be inefficient when some data packets are not received the first time they are sent. [7 marks]

Question 5

(a)

- (i) Which of the following is a protocol used for email messages?

(A) SMTP
(B) HTTP
(C) FTP
(D) None of the above.

[2 marks]

- (ii) A web browser will apply formatting given by the three ways of implementing styles in CSS, in the following order of precedence:

(A) Document level; Inline; External style sheet
(B) Inline; Document level; External style sheet
(C) External style sheet; Document level; Inline
(D) None of the above.

[2 marks]

- (iii) What is the CIDR notation of the following network address and subnet mask:

201.168.67.0 with the subnet mask 255.255.255.192.

(A) 201.168.67.0/25
(B) 201.168.67.0/26
(C) 201.168.67.0/27
(D) None of the above.

[2 marks]

- (b) Consider a class C network with the network address 220.108.192.0.

A network administrator decides to subnet this network with a subnet mask of 255.255.255.240

- (i) Find the number of possible subnets. [3 marks]
- (ii) Find the number of possible usable hosts in each subnet. [3 marks]
- (iii) Give the address of the first subnet, in dotted decimal format, together with the range of host addresses for this subnet. [3 marks]

- (c)

- (i) The following three HTML code snippets labelled A, B and C, are examples of the three ways of implementing CSS in a HTML document: *Inline*; *Document level*; or *External Style Sheets*:

For each code snippet identify which CSS technique it is implementing.

(A) `<link rel="stylesheet" href="blueHeadings.css">`

(B) `<style>
h2{color:red;}
</style>`

(C) `<h2 style="color:red;">Lightbulb joke</h2>`

[3 marks]

- (ii) How does the use of CSS make it easy for organisations to have a house style for their web site, even if they have hundreds of web pages? How can CSS make it easy for organisations to change their house styles?

[7 marks]

Question 6

(a)

- (i) Which one of the following best describes a computer virus?
 - (A) Malicious code that pretends to be a legitimate program, such as a helpful utility, or a game
 - (B) A malicious self-replicating autonomous program, that spreads itself by exploiting security loopholes in a network.
 - (C) A malicious self-replicating program that attaches itself to legitimate programs
 - (D) None of the above. [2 marks]
- (ii) What is a Denial of Service (DoS) attack?
 - (A) An attempt to overwhelm a server with network requests
 - (B) An attempt to exploit features of legitimate protocols in order to tie up server resources
 - (C) An attempt to increase network traffic such that legitimate users cannot access a server
 - (D) All of the above. [2 marks]
- (iii) Which one of the following is true about copyright?
 - (A) Copyright must be applied for
 - (B) Copyright is automatically granted to an author
 - (C) Copyright is not time-limited
 - (D) None of the above. [2 marks]

(b)

- (i) In terms of computer security, what is a RAT? [3 marks]
- (ii) Distributed DoS attacks are launched by large numbers of computers simultaneously. How could a RAT be used in a distributed denial of service attack (DDoS)? [3 marks]
- (iii) Explain why DoS and DDoS attacks are so hard to defend against. [3 marks]

- (c) In most jurisdictions computer software is granted author copyright, but, in general, cannot be patented, although there can be exceptions to this.

In the United States software can, in general, be patented. Do you think that patenting software is a good idea in terms of encouraging innovation and stimulating business?

[10 marks]

END OF PAPER