

THIS PAPER IS NOT TO BE REMOVED FROM THE EXAMINATION HALL



**UNIVERSITY
OF LONDON**

CO1110 ZB

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 fractional numbers?

- (A) One's complement
- (B) Unsorted excess magnitude notation
- (C) Fixed point notation
- (D) None of the above.

[2 marks]

- (ii) What is overflow 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) UTF-8 is

- (A) An encoding in the Unicode character encoding system
- (B) Compatible with ASCII as the first 128 characters are numbered the same as the ASCII character set, but with an extra leading zero
- (C) The most popular character encoding used on web pages worldwide
- (D) All of the above.

[2 marks]

- (b)
- (i) Convert 7 and -7 to 4-bit two's complement representation. [3 marks]
 - (ii) The two's complement number $A = 1011$ and the two's complement number $B = 1010$.

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 31 in normalised IEEE 754 single precision format. [7 marks]
 - (ii) The result of a calculation with IEEE 754 32-bit numbers is 1.011111×2^{-129} .

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) In addition to a source operand reference, a result operand reference and the next instruction reference, a machine instruction also contains:

- (A) An opcode
- (B) A micro-operation code
- (C) A branching instruction
- (D) None of the above.

[2 marks]

- (ii) The register which contains the memory address of the next instruction to be executed is known as:

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

[2 marks]

- (iii) What does FLOPS 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)

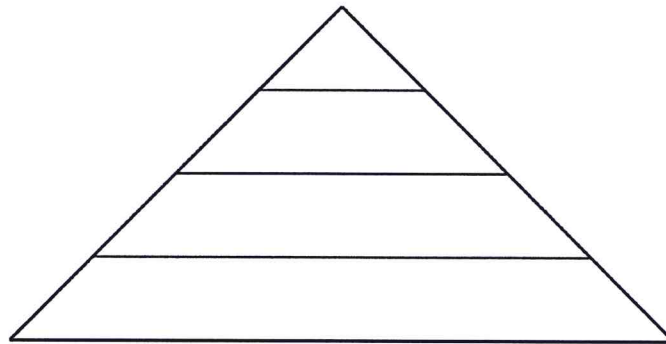
- (i) In a valid memory hierarchy speed of memory slows with increasing distance from the processor. Name one thing that grows with increasing distance from the processor, and one thing that shrinks with increasing distance from the processor.

[3 marks]

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

- Cache
- Main memory
- Hard disk
- Registers.

[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]

(A)

Tag (x bits)	Cache block index (y bits)	Offset (z bits)
--------------	----------------------------	-----------------

(B)

Tag (x bits)	Offset (y bits)
--------------	-----------------

(C)

Tag (x bits)	Set index (y bits)	Offset (z bits)
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Question 3

(a)

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

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

[2 marks]

(ii) Transistors replaced vacuum tubes in the second generation of computers. Transistors increased calculating speed because:

- (A) Transistors are faster than vacuum tubes
- (B) Transistors are a lot smaller than vacuum tubes so more can be used
- (C) Transistors are much more reliable than vacuum tubes.
- (D) All of the above.

[2 marks]

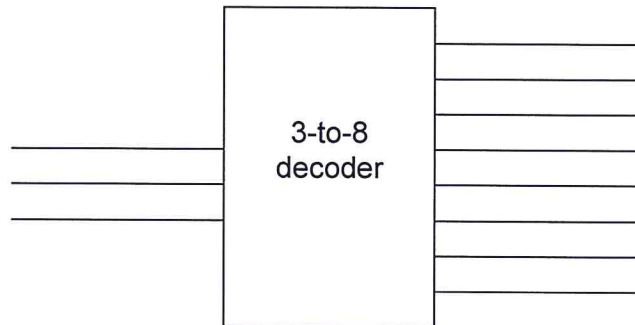
(iii) What technology replaced transistors in the third generation of computers?

- (A) Integrated circuits
- (B) Relays
- (C) Logic gates
- (D) None 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 x 8-bit RAM chips. Memory is byte addressable. There are 32 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 received by the Network Access Layer of the TCP/IP network model, journey in a particular order up through the other layers to reach their destination. This order is:
- (A) Network Access → Internet → Transport → Application
 - (B) Network Access → Transport → Internet → Application
 - (C) Network Access → Transport → Application → Internet
 - (D) None of the above.
- [2 marks]
- (ii) Which one of the following is a Transport Layer protocol?
- (A) IP
 - (B) TCP
 - (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) Protocols within layers of the TCP/IP model can only communicate with each other, or with protocols in adjacent layers
 - (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 is the purpose of the protocol field? [3 marks]
- (iii) What is the purpose of the checksum? [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) IMAP
 - (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 255.255.255.224.
- (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 223.132.129.0

A network administrator decides to subnet this network with a subnet mask of 255.255.255.248.

- (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, 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) In the context of computer security, which one of the following best describes a Trojan?
- (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) In the context of computer security what is a RAT?

- (A) Software that, once installed, gives a hacker complete control of a computer
- (B) A client / server system used by hackers to gain illicit control of computers
- (C) A particular kind of Trojan payload
- (D) All of the above.

[2 marks]

- (iii) Which one of the following is true about patents?

- (A) A patent must be applied for
- (B) A patent is automatically granted to an inventor
- (C) Patents are not time-limited
- (D) None of the above.

[2 marks]

(b)

- (i) What is a Denial of Service (DoS) attack? [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 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