Queen Mary
University of London

Student Number :	.....
First Name :	.....
Last Name :	.....
Calculator Model Name :	.....

Midterm 2019–2020 Wednesday 6th November 2019, 11.00

ECS404U Computer Systems and Networks **Duration: $1\frac{1}{2}$ hours**

YOU ARE NOT PERMITTED TO READ THE CONTENTS OF THIS QUESTION PAPER UNTIL INSTRUCTED TO DO SO BY AN INVIGILATOR.

Instructions:
This paper contains FOUR questions. **Answer ALL questions**.

Calculators are permitted in this examination. Please state on your answer book the name and type of machine used.

COMPLETE ALL ROUGH WORKINGS IN THE ANSWER BOOK AND CROSS THROUGH ANY WORK WHICH IS NOT TO BE ASSESSED.

IMPORTANT NOTE:
THE *ACADEMIC REGULATIONS* STATE THAT POSSESSION OF UNAUTHORISED MATERIAL AT ANY TIME WHEN A STUDENT IS UNDER EXAMINATION CONDITIONS IS AN ASSESSMENT OFFENCE AND CAN LEAD TO EXPULSION FROM QMUL.

PLEASE CHECK NOW TO ENSURE YOU DO NOT HAVE ANY NOTES, MOBILE PHONES OR UNATHORISED ELECTRONIC DEVICES ON YOUR PERSON. IF YOU HAVE ANY THEN PLEASE RAISE YOUR HAND AND GIVE THEM TO AN INVIGILATOR IMMEDIATELY. PLEASE BE AWARE THAT IF YOU ARE FOUND TO HAVE HIDDEN UNAUTHORISED MATERIAL ELSEWHERE, INCLUDING TOILETS AND CLOAKROOMS IT WILL BE TREATED AS BEING FOUND IN YOUR POSSESSION. UNAUTHORISED MATERIAL FOUND ON YOUR MOBILE PHONE OR OTHER ELECTRONIC DEVICE WILL BE CONSIDERED THE SAME AS BEING IN POSSESSION OF PAPER NOTES. MOBILE PHONES CAUSING A DISRUPTION IS ALSO AN ASSESSMENT OFFENCE.

EXAM PAPERS MUST NOT BE REMOVED FROM THE EXAM ROOM.

ALL MOBILE PHONES MUST BE SWITCHED OFF AND STORED IN YOUR BAGS.
Write your answers on the question paper.
If the box for a solution is too small, use the blank page opposite.
Basic calculators are allowed, but not ones that do binary conversion.

Examiners:
Dr A Khouzani and Prof E Robinson

1. This question is about Computer Architecture

   (a) (5 points) Give two reasons why a mobile phone should be regarded as a computer. The first should be *functional* and the second in terms of its constructional architecture.

   (5 points)

   (b) (5 marks) Define the concept of **latency**. Use it to explain why computers with solid state disks are more responsive than those with traditional hard disks. (5 marks)

   (c) (7 marks) i. What is the function of a *capacitor* as an electrical component of a circuit?

   ii. What are the electrical components used to construct DRAM? (Give an indication of how they are used).

   iii. What are the electrical components of SRAM?

   iv. Why do you think it is relatively easy to include SRAM on the chip that holds a cpu and not DRAM? Justify your answer.

   (7 marks)

   (d) (8 marks) Figure 1 depicts a logic circuit.

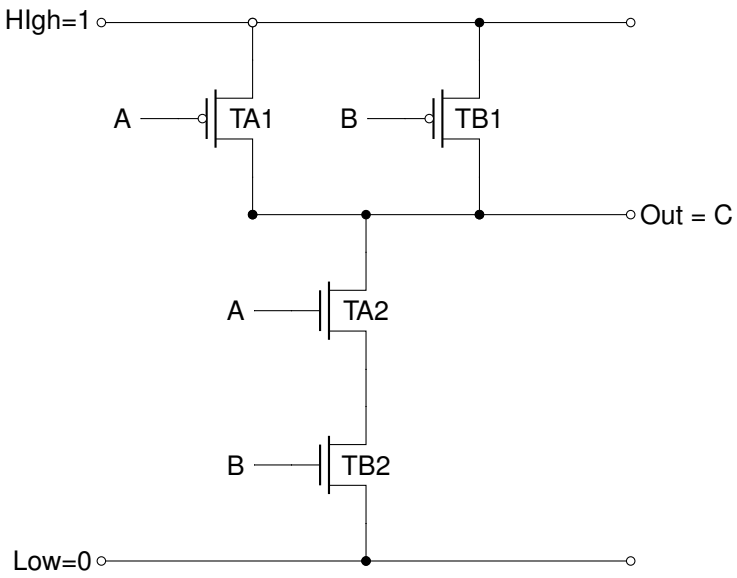

Figure 1: A logic circuit

   i. Complete the following table to show whether the circuits across TA1 and TA2 are open or closed for different potentials at A:

A	TA1	TA2
1		
0		

   ii. Complete the following table to give the output at C for the following inputs at A and B:

A	B	C
1	1	
1	0	
0	1	
0	0	

iii. Explain your answer for the case when A=1 and B=0.

iv. Which of the following connectives does the gate compute. Explain your answer:

A	B	A and B	A or B	A implies B	A nand B	A nor B	A xor B
T	T	T	T	T	F	F	F
T	F	F	T	F	T	F	T
F	T	F	T	T	T	F	T
F	F	F	F	T	T	F	F

(8 marks)

2. This question is about forms of digital representation.

   (a) (8 marks) This part is about the binary representation of (unsigned) numbers, and addition and multiplication in binary.

      i. The following bit sequences represent unsigned integers in binary form. Translate them to standard decimal explaining your reasoning:
         - `0101 1001`
         - `0010 1101`

      ii. Using the standard *binary long addition* algorithm, compute the *sum* of `0101 1001` and `0010 1101` as unsigned binary integers. Your answer should also be an unsigned binary integer.

      iii. Using the standard *binary long multiplication* algorithm, compute the *product* of `0101 1001` and `0010 1101` as unsigned binary integers. Your answer should also be an unsigned binary integer.

   (8 marks)

   (b) (5 marks) This part is about binary representation of signed integers.

      i. Compute the 8-bit 2's complement representations of
         - -43
         - 11

      ii. Add these together using unsigned long addition.

      iii. Explain what number is represented by the result.

   (5 marks)

   (c) (5 marks) This part is about the representation of floating point numbers.

   32-bit IEEE floating point uses the first bit as the sign of the number, and then the next 8 bits contains the exponent. This is in the form of *exponent* + *bias*, where in this case *bias* $= 127$. The final 23 bits contain the binary digits of the significand, stripped of the leading one. Given the 32-bits representing a floating point number:

   $$10101001\ 11010101\ 11101010\ 11000011$$

   Write down:

   - the sign bit, and indicate whether the number is positive or negative
   - the eight bits that represent the exponent in the IEEE representation, and give the exponent
   - the 23 bits that represent the significand.

   (5 marks)

   (d) (7 marks) This part of the question is about text representation.

      i. The unicode code point for the character 'a' is U+0061, and the bit pattern that represents 'a' in UTF-8 is `0110 0001`. Explain the link between the code point and the bit pattern.

      ii. The unicode code point for the character 'ê' is U+00EA, while the bit pattern that represents 'ê' in UTF-8 is `1100 0011 1010 1010`. Explain why UTF-8 uses a different number of bits to represent 'a' and 'ê', and why the bit pattern for 'ê' has a more complex relationship to the code point than is the case for 'a'.

   (7 marks)

End of questions