Marks

Question 25 — The Software Developer's View of the Hardware (20 marks)

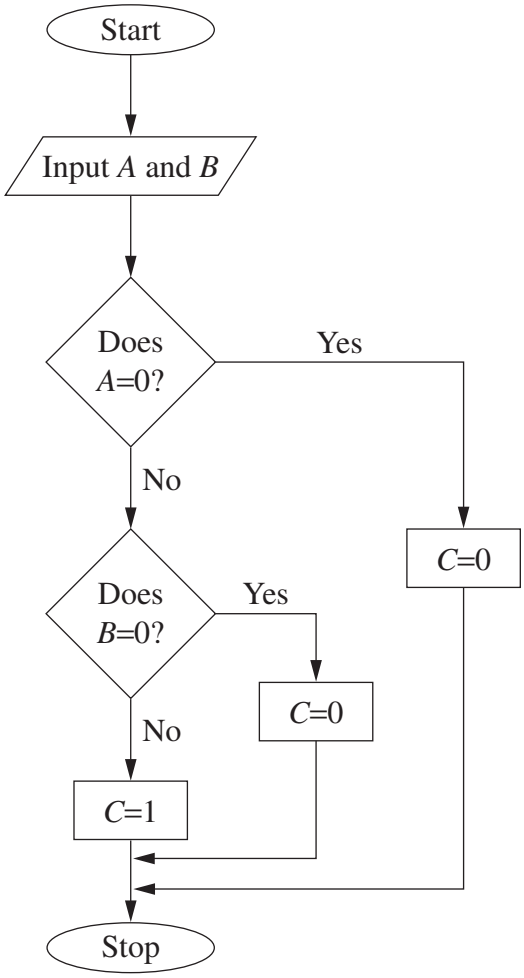
(a) (i) Explain how a fraction is represented in single precision floating point binary representation. **3**

(ii) Convert the decimal number 45 (ie 45_{10}) to a hexadecimal number. **2**

(iii) Using four-bit binary representation and two's complement, perform the following subtraction: 1110−0111. **2**

(b) (i) Describe the function of a flip-flop, and briefly explain how it achieves its purpose. You may use a diagram to illustrate your answer. **3**

(ii) **4**



The flowchart above describes the logic of an AND gate where the values of *A* and *B* are binary digits.

Use the flowchart to draw a truth table for an AND gate. Also draw a flowchart that describes the logic of an OR gate.

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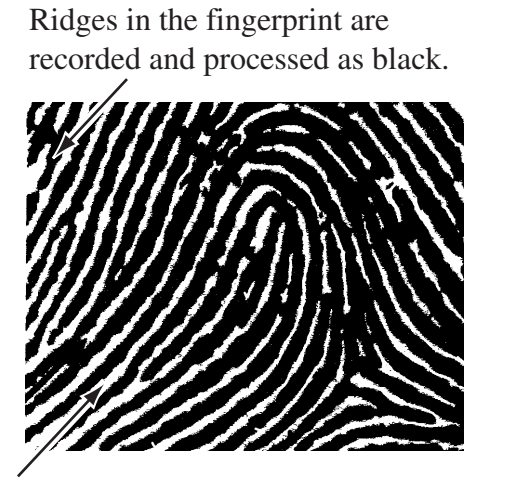
Question 25 (continued)

(c) A fingerprint scanner is used by a software development company to maintain a high level of security at its premises. The fingerprint scanner operates in black and white mode only. **6**



When employees arrive at the workplace they must:

- place their index finger on an imaging pad located at the door; and
- wait for a scan of their fingerprint to be taken.

The image produced by the scan of the fingerprint is then sent to a central computer as a data stream. It is compared to the stored set of fingerprint data records for all employees. If a match is found, the door is opened.

In each of the data packets sent from the fingerprint scanner to the central computer there is header information, data characters and trailer information.

Compare and contrast the data stream that would be sent from the scanner to the central computer with the data stream that would be sent from the central computer to the door. Make specific reference to header information, data characters and trailer information for both data streams.

End of paper

25)a) i) Using the IEEE standard, A floating point number is represented using usually 32 bits. The first for the sign, the next 8 for the exponents in excess 127 form The remainder is for the fractional part of the mantissa. an initial one is always assumed, followed by the addition of binary fractions, i.e. $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32}$ ... etc. In that order, a 1 represents the presence of that fraction and a 0 represents no fraction.

eg. $\frac{3}{4}$ is represented by $\frac{1}{2} + \frac{1}{4}$ which for the mantissa ONLY is 11 and in floating point, $\frac{3}{4}$ would be represented by

0000 0000 0110 .... (rest 0's)

sign — exponent in excess 127 — Mantissa

ii)

16	45	13	→ D
16	2	2	
	0		

$\therefore 45_{10} = 2D_{16}$

a)ii) -0111

$= 1000$ (ones comp)

$= 1001$ (2's comp)

$\therefore \quad 1110 +$

1001

0111

$\therefore 1110_2 - 0111_2 = 0111_2$

b)i) A flip-flop (or bistable multivibrator) is a bistable device used primarily for storage of bits. This can be done because the output remains stable until the inputs are changed.

Because the outputs are refed as inputs, the devices output will remain constant until a different input is supplied. This makes it useful for storage.

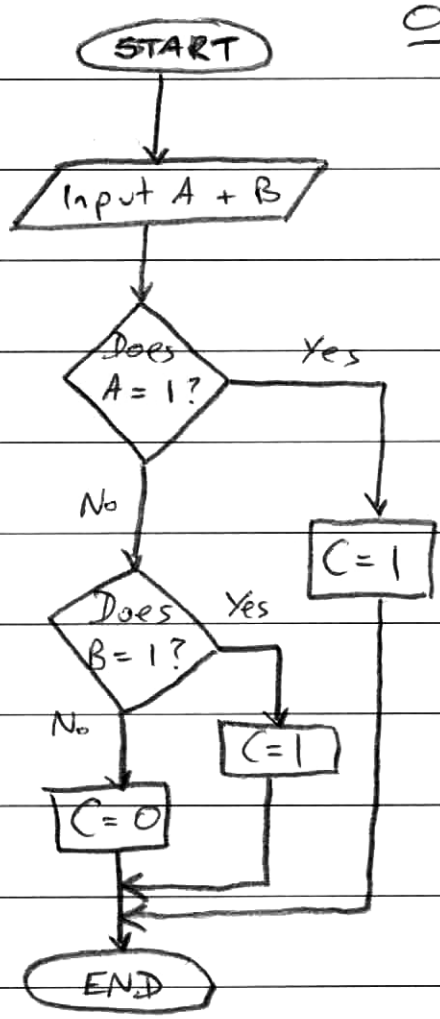
b) ii)

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

AND

~~FOR OR~~

OR



c) Both Data streams would consist of a header data and trailer. The heade in both instances would consist of an address for the device, a return address and possibly a length of the stream being sent. In the case of the scanner, the destination would be the central computer where as for the central computer, the destination would be the door.

The data streams would be completely different, and one much longer than the other. The stream sent from the scanner would consist of a boolean value for each pixel of the scanned image, because it is black and white. to be compared. This will create an increadably long stream compared to that of the central computer, which will only need to send information on opening the door, (most likely a single boolean character). Due to the length and importance of the scanner's stream, a check sum or similar should be included in the trailer of the stream

Continued in next booklet.

25)c) cont) to ensure the image sent is recieved correctly. Although not strictly nessesary, due to the high security nature of the system, a checksum or authority code should be sent in the trailer of the central computer's stream so as no confusion can be caused resulting in the door being opened by mistake, causing security risks.

When the check sum is completed, the address of the sender in the header may become relevent if their is a mistake, the reciever can request the stream to be resent.