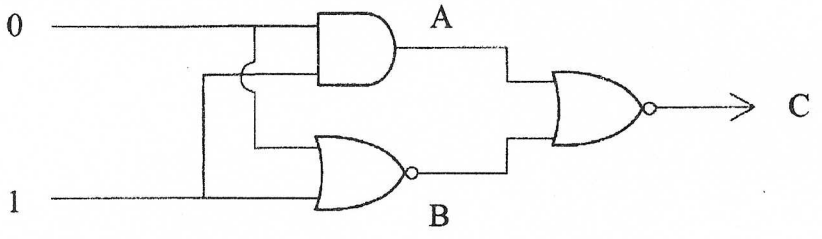
1. (6%) (a) Given the inputs, what are the values at the outputs at positions A, B, and C? (b) What Boolean operation does the circuit compute?



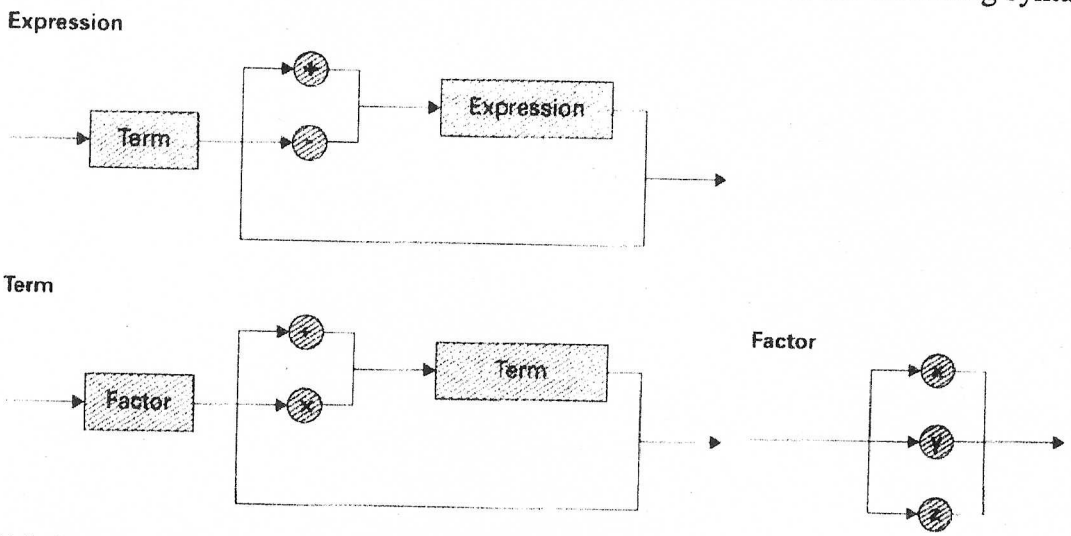
2. (19%) Consider an 8-bit computer. Its floating-point number representation is defined as follows. The leftmost bit is the sign bit. The next three bits constitute the exponent field in excess-4 notation. The remaining 5 bits are the mantissa in the **normalized** form with the radix point at the left end. Thus the byte 01101011 represents 2.75_{10}. The computer also has a fixed-point number representation, xxxxx.xxx, in two's complement. (Note the position of the radix point.)
   (a) (3%) Can the computer distinguish between 6.5_{10} and 6.625_{10} using the floating-point number presentation? Give your reasons to score points. Assume the computer will **truncate** extra bits that cannot fit into the mantissa.
   (b) (3%) Repeat (a) for the fixed-point representation.
   (c) (3%) Can the computer represent -35.25_{10} in the floating-point number representation?
   (d) (3%) Repeat (c) for the fixed-point representation.
   (e) (4%) Perform a fixed-point addition on 11110101 and 11101100 and give the result in base-ten representation.
   (f) (3%) What will be the result after performing a 3-bit arithmetic right shift on 11101100?

3. (9%) Given a PC and an OS that is stored in the hard disk, please describe briefly how the PC starts working after the power is on? Your answer should include (a) how the CPU/hardware start? (b) how the boot loader/BIOS work? and (c) how the OS is started?

4. (6%) What is the difference between multiprogramming and multitasking? Please explain it briefly.

5. (10%) Design an algorithm that, when given a permutation of the ten digits: 1,2,3,4,5,6,7,8,9,0, find a new permutation such that the new permutation is the next large value of the old permutation. Please report "no" if no such permutation exists. For example, inputting 2345678901 should have your algorithm output 2345678910. Please note that your input is stored in the array N[1::10], please put your answer in the array Q[1::10].

6. (7%) Draw the parse tree for the expression $x \times y + z$ based on the following syntax diagrams.



7. (8%) Suppose the procedure Modify is defined by

procedure Modify(Y)
$X \leftarrow 9$;
print the value of Y;

Also suppose that X is a global variable. Please answer the following questions.

(a) (4%) If parameters are passed by value, what will be printed when the following program segment is executed?

(b) (4%) If parameters are passed by reference, what will be printed when the following program segment is executed?

8. (10%) Please answer the following questions.

(a) (2%) What is inter-module coupling in software engineering?

(b) (2%) What is intra-module cohesion in software engineering?

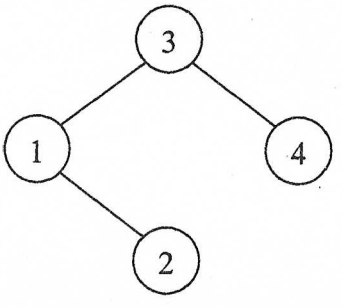
(c) (3%) In what situation would inter-module coupling most likely increase as intra-module cohesion increases?

(d) (3%) In what situation would inter-module coupling most likely decrease as intra-module cohesion increases?

9. (9%) There are three orders to visit the nodes in a binary tree. The definitions for these orders are:

Preoder	Inoder	Postorder
Visit the root	Traverse the left subtree	Traverse the left subtree
Traverse the left subtree	Visit the root	Traverse the right subtree
Traverse the right subtree	Traverse the right subtree	Visit the root

Given the tree below right, write down each order as indicated below:
(a) Preorder
(b) Inoder
(c) Postorder



10. (8%) The following table represents the contents of a partial index file. The key value column of the index file represents the largest key value in the corresponding segment number column.

Key	Segment number
13C08	1
23G19	2
26X28	3
36Z05	4

Which segment number should be searched when searching for record with the following key value?
(a) 22X17 (b) 12N67 (c) 32E75 (d) 26X28

11. (8%) Based on the relations shown below, what is the appearance of the relation **RESULT** after executing each of the instructions?

Relation A

V	W
r	2
t	4
p	6

Relation B

X	Y	Z
5	g	p
4	d	e
2	m	q
4	t	f

← Column name
← Tuples

(a) (2%) **RESULT** ← PROJECT W from A
(b) (2%) **RESULT** ← SELECT from B where X = 4
(c) (4%) **RESULT** ← JOIN A and B where A.W = B.X