

COSC 205 ASSIGNMENT

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1. Answers

(a) 331 is a positive number, complements are used for negative numbers while positive remain the same 331.

(b) $-122 = 1110000_2$

Convert it to one's complement then add one to convert it into two's complement.

0001111_2 (in one's complement)

$0001111_2 + 1 = 000010000_2$ (in 10bits).

2. Answers

- $1011011100_2 + 1101100011_2 = 1000111111_2$
(Discarding carry), negative numbers, negative answer, no overflow.
- $0001011011_2 + 1101011001_2 = 1110110100_2$
(Negative and positive numbers), Negative answer, no overflow.
- $0101100101_2 + 0101110100_2 = 1011011001_2$
(Positive numbers), negative answer, overflow.

OVERFLOW HAPPENS WHEN WE SUM UP TWO NUMBERS OF SAME SIGN BUT THE SUM HAS AN OPPOSITE SIGN. OVERFLOW CAN NOT OCCUR WHEN WE SUM UP NUMBERS OF OPPOSITE SIGNS.

3. Answers

- 00040284 to 32bits binary = 0000 0000 0000 0100 0000 0010 1000 0100₂
- 3943A19C to 32bits binary = 0011 1001 0100 0011 1010 0001 1001 1100₂
- 00035E99 to 32bits binary = 0000 0000 0000 0011 0101 1110 1001 1001₂
- FFFA2738 to 32bits binary = 1111 1111 1111 1010 0010 0111 0011 1000₂

Adding, we get;

(a) 0011 1001 0100 0111 1010 0100 0010 0000₂ (in 32bits) No overflow.

(b) 1111 1111 1111 1101 1000 0101 1101 0001₂ (in 32bits) No overflow.

4. Answers (4a)

2	147
2	73 R 1
2	36 R 1
2	18 R 0
2	9 R 0
2	4 R 1
2	2 R 0
2	1 R 0
	0 R 1

Picking the remainders from the table above (from bottom to top) $147_{10} = 10010011_2$

$$0.78125 * 2 = 1.5562$$

$$0.5562 * 2 = 1.125$$

$$0.125 * 2 = 0.25$$

$$0.25 * 2 = 0.5$$

$$0.5 * 2 = 1.0$$

Picking digits before decimal point from the Right hand side (top to bottom) $0.78125 = 110010_2$ **THEREFORE $147.78125 = 10010011.011001_2$**

Answers (4b)

2	91
2	45 R 1
2	22 R 1
2	11 R 0
2	5 R 1
2	2 R 1
2	1 R 0
	0 R 1

Picking the remainders from the table above (from bottom to top) $91 = 1011011_2$

$$0.4483 * 2 = 0.8966$$

$$0.8966 * 2 = 1.7932$$

$$0.7932 * 2 = 1.5864$$

$$0.5864 * 2 = 1.1728$$

$$0.1728 * 2 = 0.3456$$

$0.3456 * 2 = 0.6912$...("at most six places to the right of the binary point")Picking digits before decimal point from the Right hand side (top to bottom) $0.4483 = 011100_2$

THEREFORE $91.4483 = 1011011.011100_2$ [combining both]

5. **Answers (a)**

$$18.125 = 10010.001_2 \quad \text{Normalisation} = 1.0010001 * 2^4$$

$$\text{Exponent} = 4 + (16) = 4 + 16 = 20 \quad (20_{10} = 10100_2)$$

$$M = 0010001$$

SIGN	EXPONENT	MANTISSA
0	10100	00100010

Answers (b)

$$-0.23392 = 0.001110_2 \quad \text{Normalisation} = 0.01110 * 2^{-3}$$

$$\text{Mantissa} = 01110$$

$$\text{Exponent} = -3 + (16) = 13 = 1101_2$$

SIGN	EXPONENT	MANTISSA
1	01101	01110000

6. **Answers**

(a) 18.125 to binary, using method used above

$$18.125_{10} = 10010.001_2$$

$$\text{Normalised form} = 1.0010001 * 2^4$$

$$\text{Mantissa} = 0010001 \text{ (discarding the 1 before decimal point)}$$

$$\text{Exponent} = (4 + 2^7 - 1) = 131$$

$$131_{10} = 10000011_2$$

SIGN	EXPONENT	MANTISSA
0	10000011	001000100000000000000000

"Note that if the exponent does not use all the field allocated to it, there will be leading 0's while for the mantissa, the zero's will be filled at the end."

(b) -0.23392

$$-0.23392_{10} = 001110_2$$

$$\text{Normalised form} = 0.01110 \times 2^5$$

$$\text{Mantissa} = 01110$$

$$\text{Exponent} = (5 + 2^7 - 1) = 132$$

$$132_{10} = 10000100_2$$

SIGN	EXPONENT	MANTISSA
1	10000100	011100000000000000000000

7. Convert the following IEEE single precision floating point numbers to base 10:

(a) 0011 1110 0100 0000 0000 0000 0000 0000

(b) 1101 0000 0110 0000 0000 0000 0000 0000

Answers (a)

First digit is for sign, next 8-digits are for exponent, last 23-digits are for mantissa.

$$\text{Exponent} = x + (2^7 - 1)$$

$$X = \text{Exponent} - 127 \quad [\text{Where exponent is } 01111100 = 124_{10}]$$

$$X = -3$$

$$\text{Decimal} = (-1)^{\text{sign}} (1 + M) (2^X) = (-1)(1+2^{-1})(2^{-3}) = \mathbf{0.1875_{10}}$$

Answers (b)

$$X = \text{Exponent} - 127 \quad [\text{where exponent} = 10100000 = 160]$$

$$X = 160 - 127 = 33$$

$$\text{Decimal} = (-1)^{\text{sign}} (1 + M) (2^X) = (-1)(1+2^{-1}+2^{-2})(2^{33}) = -1503238554_{10}$$

8. Answers (a) 1000 0100 1001 0011 1000 0000 0000 0000

(b) 1000 0001 1110 0100 0000 0000 0000 0000

9.

Answer

$$1100\ 1010_2 = 202_{10}$$

$$202 - 140 = 62_{10}$$

It represents 62_{10}

10.

Answer

$1100\ 1010 - 1 = 110010012$ (One's complement)
Switching 0's and 1's $\rightarrow 001101102 = 54_{10}$

11.

Answer

Without any complement, it represents 42_{10}

12.

Answer

ASCII is biased to the English language. This generally creates some problems. In ASCII, only 7-bits are required to represent a character, there are only 128 ASCII characters, so Asian languages, which are word-based, rather than character-based, often have more words than ASCII can represent, this results in a difficulty the coming of UNICODE now helps in solving.

13.

Answer

$C = 67$ $A = 65$ $B = 66$
 $CAB = 676566 = 1010\ 0101\ 0010\ 1101\ 0110_2$

14.

Answers (i) $0101\ 1001\ 0111 = 597$ (ii) $010110010111_2 = 1431 - 3 = 1428$
(iii) 371 (iv) $0000\ 0101\ 1001\ 0111_2$

15.

Answer

$-4 \rightarrow 1100$
 $-3 \rightarrow 1011$
 $-2 \rightarrow 1010$
 $-1 \rightarrow 1001$
 $-0 \rightarrow 1000$
 $0 \rightarrow 0000$
 $1 \rightarrow 0001$
 $2 \rightarrow 0010$
 $3 \rightarrow 0011$
 $4 \rightarrow 0100$
 $5 \rightarrow 0101$
 $6 \rightarrow 0110$

16.

Answers (i)

	P	Q	R	S	X	Y
0	0	0	0	0	0	0
1	0	0	0	1	0	0
2	0	0	1	0	0	1
3	0	0	1	1	1	1
4	0	1	0	0	0	0
5	0	1	0	1	0	1
6	0	1	1	0	1	0
7	0	1	1	1	0	1
8	1	0	0	0	0	0
9	1	0	0	1	1	0
10	1	0	1	0	0	0
11	1	0	1	1	0	1
12	1	1	0	0	1	0
13	1	1	0	1	0	1
14	1	1	1	0	0	0
15	1	1	1	1	1	0

Boolean equations for X and Y

$$X = P'Q'RS + P'QRS' + PQ'R'S + PQR'S' + PQRS$$

$$Y = P'Q'RS' + P'Q'RS + P'QR'S + P'QRS + PQ'RS + PQR'S$$

$$\mathbf{Y \text{ simplified} = P'Q'R + Q'RS + P'QS + QR'S \text{ (simplified)}}$$

(ii) Karnaugh map for X

PQ \ RS	00	01	11	10
00			1	
01				1
11	1		1	
10		1		

$$X = PQR'S' + PQ'R'S + PQRS + P'QRS'$$

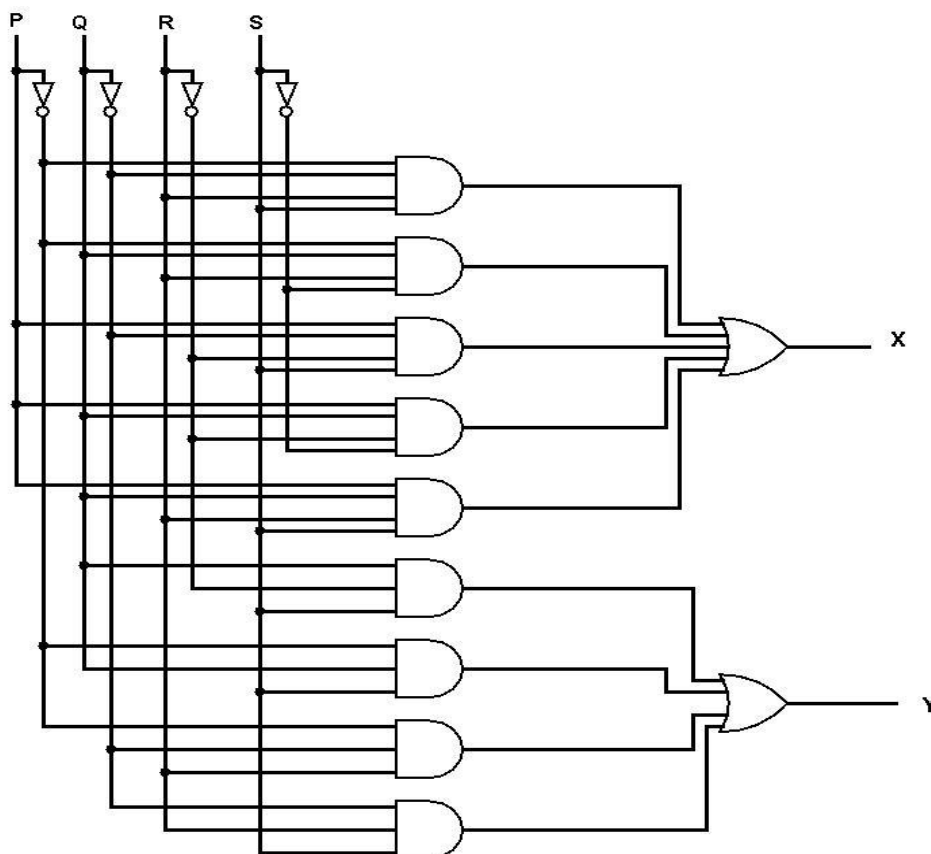
P'Q'RS

Karnaugh map for Y

PQ \ RS	00	01	11	10
00				
01		1	1	
11	1	1		1
10	1			

$$Y = QR'S + P'QS + P'Q'R + Q'RS \quad (\text{SIMPLIFIED})$$

(iii) CIRCUIT DIAGRAM FOR X AND Y



17.

Answers

	RUWAIDA	AMINA	ZAINAB	DOOR
	0	0	0	0
	0	0	1	1
	0	1	0	1
	0	1	1	1
	1	0	0	X
	1	0	1	X
	1	1	0	X
	1	1	1	X

Notation Ruwaida = R, Amina = A, Zainab = Z and when door is open = D.
 $D = R'A'Z + R'AZ' + R'AZ$

(ii) **Karnaugh Map For Door.**

	RA	00	01	11	10
Z					
0			1	X	X
1		1	1	X	X

SIMPLIFIED EQUATION FOR DOOR

$$D = A + Z$$

CIRCUIT DIAGRAM FOR DOOR

