CS303 - HW1

Elif Cemre Durgut - 26493 - Elif

1.

a. Decimal: 370

Binary:

370	2	0
185	2	1
92	2	0
46	2	0
23	2	1
11	2	1
5	2	1
2	2	0
1		

$\Rightarrow (101110010)_2$

Octal: $\underbrace{101}_{5}\underbrace{110}_{6}\underbrace{010}_{2} \Rightarrow (568)_8$

Hexadecimal: $\underbrace{1}_{1}\underbrace{0111}_{7}\underbrace{0010}_{2} \Rightarrow (172)_{16}$

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b. Decimal: 81.8125

Binary:

81	2	1
40	2	0
20	2	0
10	2	0
5	2	1
2	2	0
1		

$\underbrace{}$ 1010001

$0.8125 \cdot 2 = 1.625$

$0.625 \cdot 2 = 1.25$

$0.25 \cdot 2 = 0.5$

$0.5 \cdot 2 = 1$

$\underbrace{}$ 1101

$\Rightarrow (1010001.1101)_2$

Octal: $\underbrace{1}_{1}\underbrace{010}_{2}\underbrace{001}_{1}.\underbrace{110}_{6}\underbrace{1}_{4} \Rightarrow (121.64)_8$

Hexadecimal: $\underbrace{101}_{5}\underbrace{0001}_{1}.\underbrace{1101}_{13} \Rightarrow (51.D)_{16}$

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c. Decimal: 0.78125

Binary: $0.78125 \cdot 2 = 1.5625$

$0.5625 \cdot 2 = 1.125$

$0.125 \cdot 2 = 0.250$

$0.250 \cdot 2 = 0.5$

$0.5 \cdot 2 = 1$

$\Rightarrow (0.11001)_2$

Octal: $0.\underbrace{110}_{6}\underbrace{01}_{2} \Rightarrow (0.62)_8$

Hexadecimal: $0.\underbrace{1100}_{12}\underbrace{1}_{8} \Rightarrow (0.C8)_{16}$

2.

Decimal	Binary	Octal	Hexa
153	10011001	231	99
150	10010110	226	96
95	1011111	137	5F
114	1110010	162	72

3.

a. $[-2^{4-1}, 2^{4-1}-1] = [-8, 7]$ //

b.

	0101 + 0010 = 0111	0101 + 1110 = 10011	1101 + 1111 = 11100	1010 + 1001 = 10011	0111 + 0110 = 1101	0110 + 1010 = 10000
Overflow	No	Yes	No	Yes	Yes	Yes

4.

	integer part		fraction part
$\frac{1057}{2048} \cdot 2 = \frac{1057}{1024}$	1	(1)	$\frac{33}{1024}$
$\frac{33}{1024} \cdot 2 = \frac{33}{512}$	0	(2)	$\frac{33}{512}$
$\frac{33}{512} \cdot 2 = \frac{33}{256}$	0	(3)	$\frac{33}{256}$
$\frac{33}{256} \cdot 2 = \frac{33}{128}$	0	(4)	$\frac{33}{128}$
$\frac{33}{128} \cdot 2 = \frac{33}{64}$	0	(5)	$\frac{33}{64}$
$\frac{33}{64} \cdot 2 = \frac{33}{32}$	1	(6)	$\frac{1}{32}$
$\frac{1}{32} \cdot 2 = \frac{1}{16}$	0	(7)	$\frac{1}{16}$
$\frac{1}{16} \cdot 2 = \frac{1}{8}$	0	(8)	$\frac{1}{8}$

Real $\rightarrow \frac{1057}{2048} = 0{,}516113281$

8-bit fraction version $= (0.10000100)_2$

↓ to decimal

0.515625

Error = real − 0.515625 = 0.000488... //

$\frac{1}{8} \cdot 2^{3} = 1$ ⇒ 3 more bits (11 in total) is needed to fully represent.

Full version would be $(0.10000100001)_2$ //

5. $F(x,y,z,t) = x'y' + yz + xz' \xrightarrow[\text{form}]{\text{canonical}}$

$= x'y'(z+z') + yz(x+x') + xz'(y+y')$

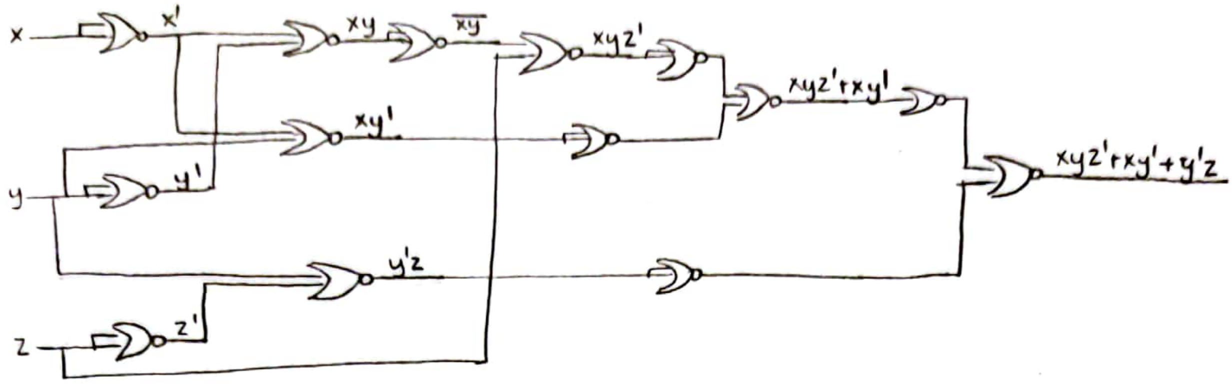
$= \underbrace{x'y'z}_{001} + \underbrace{x'y'z'}_{000} + \underbrace{xyz}_{111} + \underbrace{x'yz}_{011} + \underbrace{xyz'}_{110} + \underbrace{xy'z'}_{100}$

$= \Sigma(0,1,3,4,6,7)$ ⇒ sum of minterms

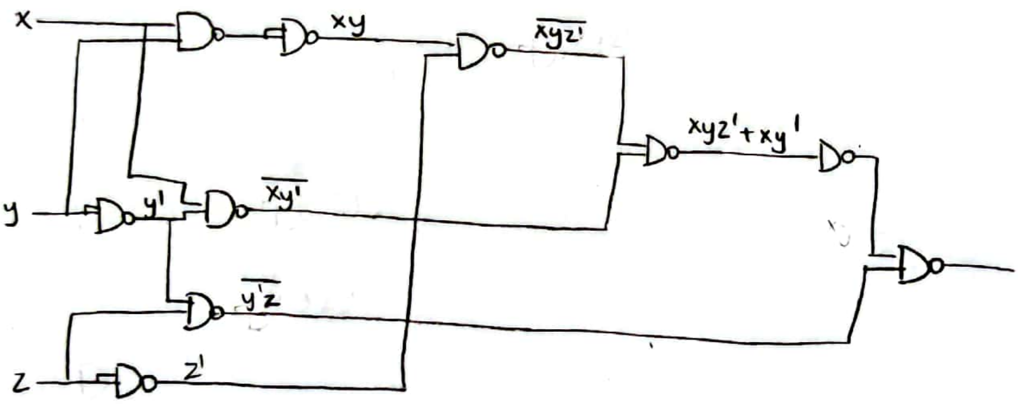
$= \Pi(2,5)$ ⇒ product of maxterms

6. $F(x,y,z) = xyz' + xy' + y'z$

a. I first drew it with AND and OR gates, then converted them to NOR gates.



b)



7. $y+x'z=(x'+y)(y+z)$

x	y	z	$y+x'z$	$x'+y$	$y+z$	$(x'+y)(y+z)$
0	0	0	0	1	0	0
0	0	1	1	1	1	1
0	1	0	1	1	1	1
0	1	1	1	1	1	1
1	0	0	0	0	0	0
1	0	1	0	0	1	0
1	1	0	1	1	1	1
1	1	1	1	1	1	1

They are the same.

8. $(a+b+c')(b'c+a'c')$

$=ab'c+\underbrace{aa'c'}_{0}+\underbrace{bb'c}_{0}+a'bc'+\underbrace{b'cc'}_{0}+a'\underbrace{c'c'}_{c'}$

$=ab'c+\underbrace{a'bc'+a'c'}_{a'c'(b+1)=a'c'}=ab'c+a'c'$ //

$a'c'(\underbrace{b+1}_{1})=a'c'$

9. $a'b'c+ab'c'+ab'c+a'b'c'$

$a'b'(\underbrace{c+c'}_{1})+ab'(\underbrace{c'+c}_{1})=a'b'+ab'$

$=b'(\underbrace{a'+a}_{1})=b'$ //

13. According to the fact in Slide 2, p.33 :

$F=\Sigma(2,3,6)=\Pi(0,1,4,5,7)$ //

10. $a+(b'+ce'+bd'e)$

Replace + with · and · with + for dual.

$=a.(b'.(c+e').(b+d'+e))$

$=a.((b'c+b'e').(b+d'+e))$

$=\underbrace{ab'c'b}_{0}+ab'cd'+ab'ce+\underbrace{ab'e'b}_{0}+ab'e'd'+\underbrace{ab'e'e}_{0}$

$=ab'(cd'+ce+e'd')$ //

11. $E=a+(\bar{b}+c+\bar{c}.\bar{d})$

$\bar{E}=\bar{a}.\overline{(\bar{b}+c+\bar{c}.\bar{d})}$

$=\bar{a}.(b.\bar{c}.(c+d))$

$=\bar{a}b\bar{c}(c+d)=\underbrace{\bar{a}b\bar{c}c}_{0}+\bar{a}b\bar{c}d$

$=a'bc'd$ //

12. $a+a'(b'c+bde)$