# Homework Assignment #1

**Assigned**: 21/10/2022

**Due**: 30/10/2022 11:55 PM

1. Find the binary, octal, hexadecimal representations of the numbers. You can first find the binary and use it to find the others.
   1. 370

Binary: 101110010

Octal: 562

Hexadecimal: 172

* 1. 81.8125

Binary: 1010001.1101

Octal: 121.64

Hexadecimal: 51.D

* 1. 0.78125

Binary: 0.11001

Octal: 0.62

Hexadecimal: 0.C8

1. Fill in the following table

|  |  |  |  |
| --- | --- | --- | --- |
| **Decimal** | **Binary** | **Octal** | **Hexadecimal** |
| 153 | 101110010 | 562 | 172 |
| 150 | 10010110 | 226 | 96 |
| 95 | 01011111 | 137 | 5F |
| 114 | 01110010 | 162 | 72 |

1. Assume that you are using 4 digit 2’s complement binary system.
   1. Show the range of integers that can be represented in 2’s complement signed number system.

[(-2^(4-1)), (2^(4-1) -1)]

=[(-2^3), (2^3 -1)]=

=[-8, 7]

* 1. Do the following arithmetic operations and detect overflows.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 0101 |  |  | 0101 |  |  | 1101 |  |
|  | + | 0010 |  | + | 1110 |  | + | 1111 |  |
|  |  | 0111 |  |  | 0011 |  |  | 1100 |  |
| Overflow? | No | |  | Yes, carry overflow | |  | Yes, carry overflow | |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | 1010 |  |  | 0111 |  |  | 0110 |  |
|  | + | 1001 |  | + | 0110 |  | - | 1010 |  |
|  |  | 0011 |  |  | 1101 |  |  | 1100 |  |
| Overflow? | Yes, arithmetic overflow | |  | Yes, arithmetic overflow | |  |  | Yes, arithmetic overflow |  |

1. Calculate the binary equivalent of 1057/2048 using only eight (8) bits in the fraction. Then convert the resulting binary number back to decimal. What is the error in the binary representation? How many bits are needed to fully represent 1057/2048 in binary number system?

1057 / 2048 = 0,51611328125

0,51611328125\* 2 = 1,0322265625 🡪 **1**

0,0322265625\* 2 = 0,064453125 🡪 **0**

0,064453125\* 2 = 0,12890625 🡪 **0**

0,12890625\* 2 = 0,2578125 🡪 **0**

0,2578125\* 2 = 0,515625 🡪 **0**

0,515625\* 2 = 1,03125 🡪 **1**

0,03125\* 2 = 0,0625 🡪 **0**

0,0625 \* 2 = 0,125 🡪 **0**

0,125 \* 2 = 0,25 🡪 **0**

0,25 \* 2 = 0.5 🡪 **0**

0.5 \* 2 = 1 🡪 **1**

**0.10000100001 🡪 At least 11 bits are needed to fully represent the 1057/2048.**

1. Express the following function as a sum of minterms and as a product of maxterms

F(x,y,z,t) = x’y’ + yz + xz’

x’y’ + yz + xz’ = x’y’(z+z’) + (x+x’)yz + x(y+y’)z’

= x’y’z + x’y’z’ + xyz + x’yz + xyz’+xy’z’

= m1 + m0 + m7 + m3 + m6 + m4

=

1. Implement the Boolean function F(x,y,z) = xyz’ + xy′ + y′z using
   1. Only two-input NOR gates
   2. Only two-input NAND gates

Text, letter

Description automatically generated

A picture containing text, whiteboard

Description automatically generated

Diagram, schematic

Description automatically generated

1. Demonstrate the validity of y + x’z = (x’ + y)(y + z) by a truth table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| X | Y | Z | y+x’z | (x’+y)(y+z) | Is same? |
| 0 | 0 | 0 | 0 | 0 | yes |
| 0 | 0 | 1 | 1 | 1 | yes |
| 0 | 1 | 0 | 1 | 1 | yes |
| 0 | 1 | 1 | 1 | 1 | yes |
| 1 | 0 | 0 | 0 | 0 | yes |
| 1 | 0 | 1 | 0 | 0 | yes |
| 1 | 1 | 1 | 1 | 1 | yes |

Since the result is same for all conditions, the equation is valid.

1. Simplify (a + b + c′)(b′c + a’c’) to a minimum number of literals.

(a + b + c′)(b′c + a’c’) = ab’c + **aa’**c + **bb’**c + ba’c’ + **c’**b**c** + c’c’a’

= ab’c + 0.c + 0.c + a’bc’ + 0.b + a’c’

= ab’c + a’bc’ + a’c’

= ab’c + a’c’(b + 1)

= ab’c + a’c’.1

= ab’c + a’c’

1. Simplify a′b’c + ab’c′ + ab’c + a′b’c′ to a minimum number of literals.

a′b’c + ab’c′ + ab’c + a′b’c′ = a’b’(c+c’) + ab’(c’+c)

= a’b’.1 + ab’.1

= a’b’ + ab’

= b’(a’+a)

= b’.1

= b’

1. Find the dual of a + (b′ + ce’ + bd’e).

a.(b’.(c+e’).(b+d’+e))

1. Find the complement of a + (b′ + c + c’d’).

(a+(b’+c+c’d’))’

= a’.(b.c’.(c+d))

1. Draw the logic diagram of a + a′(b′c + bde).

Diagram, schematic

Description automatically generated

1. Convert F(x, y, z) = ∑(2, 3, 6) to product-of-maxterms.

F(x,y,z) = ∑(2, 3, 6)

= x’yz’ + x’yz + xyz’

F’(x,y,z) = (x+y’+z).(x+y’+z’).(x’+y’+z)

= M2+ M3 + M6

(F’)’ = F = (m0 + m1 + m4 + m5 + m7)’

= M0 + M1 + M4 + M5 + M7

=