CS221 HW3

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1. Consider a circuit with three inputs: A, B and Ctrl. When Ctrl input is 0, the output of the circuit should be the same as the A input. When Ctrl is 1, the output of the circuit is the same as the B input. So, the Ctrl input selects either A or B to go to the output.

1. Build a truth table for this circuit.

|  |  |  |  |
| --- | --- | --- | --- |
| A | B | CTRL | F |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

1. Write a formula in DNF for this formula.

DNF = (A’BC) + (AB’C’) + (ABC’) + (ABC)

1. Use a K-map to simplify the function.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| C\AB | 00 | 01 | 11 | 10 |
| 0 |  |  | 1 | 1 |
| 1 |  | 1 | 1 |  |

F = BC (green) + AC’ (orange)

2. Create the following circuits together in one file. The circuits should share their inputs A, B and Ctrl.

1. Implement the formula from 1b using AND, OR and NOT gates.
2. Implement the simplified formula from part 1c.
3. Using two Controlled Buffers and a NOT gate, implement an equivalent function.

3. Perform the following unsigned base conversions:

1. 84 from decimal to binary.

84 = 1\*2^6 + 1\*2^4 + 1\*2^2

So: binary: 001010100

1. 10110001 from binary to decimal.

decimal: 2^0 + 2^4 + 2^5 + 2^7 = 177

1. 163 from base 7 to decimal.

decimal: 3\*7^0 + 6\*7^1 + 1\*7^2 = 3 + 42 + 49 = 94

1. 132 from decimal to base 5.

132 / 5 = 26 2

26 / 5 = 5 1

5 / 5 = 1 0

1 / 5 = 0 1

Base-5: 1012

1. 0xDAB from hexadecimal to binary.

binary: 1101 1010 1011

1. 110011 from binary to octal.

octal: 63

1. 1110101110 from binary to hexadecimal.

hexadecimal: 3AE

4. Convert the following binary numbers from 8-bit 2’s complement to decimal.

1. 11111000

11111000: flip = 0000 0111 + 1 = 0000 1000

decimal = - (2^3) = - 8

1. 00011011

decimal = 2^0 + 2^1 + 2^3 + 2^4 = 1 + 2 + 8 + 16 = 27

1. 10110101

10110101: flip = 0100 1010 + 1 = 0100 1011

decimal = - (2^0 + 2^1 + 2^3 + 2^6) = - (1 + 2 + 8 + 64) = - 75

1. 10000000

1000 0000: flip = 0111 1111 + 1 = 127 + 1

decimal = - (127 + 1) = - 128

5. Convert the following decimal values to 8-bit 2’s complement binary.

a. 9

binary: 9 = 0000 1001 (2^3 + 2^0)

b. -98

binary: 98 = 0110 0010 (2^6 + 2^5 + 2^1)

-98 = 0011101 + 1 = 10011110

c. -11

binary: 11 = 0000 1011 (2^3 + 2^1 + 2^0)

-11 = 1111 0100 + 1 = 1111 0101

6. What hexadecimal values represent the string “Hello!” encoded in ASCII?

H = 48

e = 65

l = 6C

o = 6F

! = 21

“Hello!” = 48 65 6C 6C 6F 21