

Engineering 101

Homework 4

Name: _____ uname: _____ Lab section _____

This assignment is due March 9th either in class or in the course “box” by noon. Late homework is not accepted.

You are to turn in these pages as part of your assignment (rather than using separate sheets), though you are welcome to use additional sheets of paper as needed. All pages must be stapled. This is an individual assignment; all of the work should be your own. Assignments that are unstapled or are difficult to read will lose at least 50% of the possible points and we may not grade them at all.

This assignment is worth about 1% of your grade in the class and is graded out of 50 points. Remember you may drop one homework assignment.

Working in other bases

Perform the following operations: [4]

$$\begin{array}{r} 10001_2 \\ + 11011_2 \\ \hline \hline \hline \end{array}$$

$$\begin{array}{r} 101111_2 \\ + 101110_2 \\ \hline \hline \hline \end{array}$$

$$\begin{array}{r} 3270_8 \\ + 2716_8 \\ \hline \hline \hline \end{array}$$

$$\begin{array}{r} 1FE3_{16} \\ + 4FA9_{16} \\ \hline \hline \hline \end{array}$$

$$\begin{array}{r} 10001_2 \\ - 01011_2 \\ \hline \hline \hline \end{array}$$

$$\begin{array}{r} 101111_2 \\ - 011010_2 \\ \hline \hline \hline \end{array}$$

$$\begin{array}{r} 7270_8 \\ + 6716_8 \\ \hline \hline \hline \end{array}$$

$$\begin{array}{r} FFE3_{16} \\ + 4FA9_{16} \\ \hline \hline \hline \end{array}$$

Fixed representation

What is the range of representation of the following [6]:

1. 6-bit unsigned?
2. 6-bit signed-magnitude
3. 8-bit unsigned
4. 8-bit signed-magnitude
5. 4-bit 2's complement
6. 8-bit 2's complement

Which of the following operations would have a result that is out-of-range for an 8-bit 2's complement number? [2]

1. 32+64
2. -2*8
3. 127+2
4. -127-1

Convert the following representations. If there is no representation for a given value, simply say “no such value [10]

| Number | 4-bit unsigned | 6-bit signed-magnitude | 4-bit 2's complement | 6-bit 2's complement |
|--------|----------------|------------------------|----------------------|----------------------|
| 12 | | | | |
| -12 | | | | |
| 4 | | | | |
| 0 | | | | |
| -32 | | | | |

Perform the following additions on 8-bit 2's complement numbers resulting in an 8-bit 2's complement number. Note if overflow has occurred. Even if it has, show what the result would be. [4]

| | | | |
|--|--|--|--|
| $\begin{array}{r} 10001001 \\ + 01011101 \\ \hline \hline \end{array}$ | $\begin{array}{r} 10111111 \\ + 10111001 \\ \hline \hline \end{array}$ | $\begin{array}{r} 10101001 \\ + 01100000 \\ \hline \hline \end{array}$ | $\begin{array}{r} 00000001 \\ + 11111111 \\ \hline \hline \end{array}$ |
|--|--|--|--|

Basic logic [8]

The following is a truth table for $A * B$ (recall “*” is AND, “+” is OR and “’” is NOT) :

| A | B | $A * B$ |
|---|---|---------|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

Complete the following truth tables:

| A | B | $(A * B) + (A' * B)$ |
|---|---|----------------------|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

| A | B | $(A + B) * (A' + B)$ |
|---|---|----------------------|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

| A | B | C | $(A' + B * C') * (A + B)$ |
|---|---|---|---------------------------|
| 0 | 0 | 0 | |
| 0 | 0 | 1 | |
| 0 | 1 | 0 | |
| 0 | 1 | 1 | |
| 1 | 0 | 0 | |
| 1 | 0 | 1 | |
| 1 | 1 | 0 | |
| 1 | 1 | 1 | |

Using the AND, OR and NOT logic gates draw a circuit which represents the following logic statement:
 $(A' + B * C') * (A + B)$ [4]

Machine operation

Using the machine code from lecture 18, convert the following into 16-bit instructions:
[4]

| | |
|-----------|--|
| add 1 3 | |
| addi 5 -1 | |
| beq 5 0 | |
| print 18 | |

Write a program in assembly (again using the assembly language of lecture 18) which sums the numbers from one to “N” where “N” is a value stored in a memory location (you can chose which location to use). N will be less than or equal to 9. [8]