Embedded Real-Time Systems (AME 3623)
Homework 2

February 18, 2005

This homework assignment is due on Thursday, March 3rd at 5:00pm. It must be handed in using the blackboard digital dropbox (use the "send file" option) in either postscript or pdf format.

This assignment must be done individually: do not share your answers with others or look at the answers of others.

Question 1

Consider the following binary number:

$0b01001101$

1. What is the decimal equivalent?
2. What is the octal equivalent?
3. What is the two's complement of the number (in binary)?

Question 2

Consider the following binary number:
$0b10110001$

1. Assuming that this is a two's complement number, what is the decimal equivalent?
2. What is the binary result of multiplying this number by 2?
3. Assuming that this is an unsigned number, what is the decimal equivalent?
4. What is the binary result of multiplying this number by 2? State any assumptions that you must make.

Question 3

Given the following two numbers in two's complement:

$X = 0xCF$ and $Y = 0x42$

1. What is the binary equivalent of X?
2. The binary equivalent of Y?
3. What is the binary result of adding X and Y? (show your work)
4. What is the decimal equivalent?
5. What is the binary equivalent of subtracting Y from X? (show your work)
6. What is the hex equivalent?

Question 4

Given the following decimal number: 53

1. What is the binary equivalent of this number?
2. What is the hexadecimal result of subtracting 053 from this number?

Question 5

Assume a "black-box" N-bit adder. Design a circuit that multiplies a number "X" by 3.

Question 6

In class we designed a 3-bit ripple counter (yes, the ripple counter, not the sequential counter).

1. Modify the circuit so that the counter counts down with each downward edge of the clock.

2. Modify the circuit to add one additional "control" input bit. When $C = 0$, the counter must count up with every clock cycle; when $C = 1$, the counter must count down. You may use any macro-level components that we designed in class (i.e., you do not need to restrict yourself to using basic gates).

Question 7

In class, we designed a circuit that added two N-bit binary numbers which was composed of N 1-bit adders. Design a similar circuit that takes as input a 3-bit number and produces as output the two's complement of the number.

1. For the 1-bit case, show the truth table.

2. Show the corresponding Karnaugh map.

3. Show the 1-bit circuit.

4. Assuming that this 1-bit circuit is a "black box," show the 3-bit circuit.

Question 8

How much time did you spend on this homework assignment?