CSCI 120 Introduction to Computation
Homework 4
Due 03/26/09

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PART 1: Binary System
(a) Find the decimal representation of each of the following bytes:

01010111 01101000 01100001 01110100
00100000 01100100 01101111 01100101
01110011 00100000 01101001 01110100
00100000 01110011 01100001 01111001
00111111

(b) Assuming the above message is encoded in ASCII (read about ASCII in the notes), what does it say? (you may search the Internet for ASCII code).

(c) Convert each of the following numbers to binary using either the coin algorithm or the repeated division algorithm:

7 11

16 15

33

PART 2: Addition and overflow

(a) Recall that when adding two numbers, an overflow can occur if the result is outside the range of what can be represented. For example, with a 4 bit two's complement representation, we can only represent the numbers from -8 to 7. Adding 5 and 6 will cause an overflow and, therefore, produce the wrong result (note that overflow does not mean carry). Among the following additions, identify which ones cause an overflow and which ones don't (assume two's complement representation). In both cases, determine what the result is (even if it is wrong).

$$\begin{array}{rr} & 0010 \\ + & 0100 \\ \hline \end{array} \qquad \begin{array}{rr} & 0100 \\ + & 0101 \\ \hline \end{array} \qquad \begin{array}{rr} & 0011 \\ + & 1110 \\ \hline \end{array} \qquad \begin{array}{rr} & 0100 \\ + & 1001 \\ \hline \end{array}$$

$$\begin{array}{rr} & 1100 \\ + & 0110 \\ \hline \end{array} \qquad \begin{array}{rr} & 1010 \\ + & 0101 \\ \hline \end{array} \qquad \begin{array}{rr} & 1100 \\ + & 1011 \\ \hline \end{array} \qquad \begin{array}{rr} & 1101 \\ + & 1011 \\ \hline \end{array}$$

(b) When adding two numbers as above, let the leftmost bit of the first number be x, the leftmost bit of the second number be y, and the leftmost bit of the result be z. Using x, y, and z design a circuit that outputs 1 when there is an overflow, and 0 otherwise. It will help you first to figure out the truth table for overflow:

x	y	z	$overflow?$
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

PART 3: Computer Architecture

(a) Draw the architecture of a modern computer showing all the essential components such as: main memory, cache memory, CPU, control unit, ALU, registers, bus, and I/O controllers.

(b) For each of the following operations, state which of the above components are involved:

- Instruction fetch
- Arithmetic operation
- Boolean operation
- Movement of data between registers

(c) Assume registers R0 and R1 contain the following bit patterns respectively: 00110010 and 00101011. Which memory location is changed by the following instructions? What will that memory location contain (bit pattern) after executing the instructions?

Add R0 R1 R2
Store R2 01101001
Halt

(d) How does an I/O device communicate with the CPU?

(e) How do memory and I/O devices resolve conflicts when communicating with the CPU using the same bus?

(f) What is the part of the instruction that uniquely identifies the instruction to the control unit of the CPU?