HKN ECE 120 Midterm 1 Worksheet

Binary Representations

Problem 1

Write these conversions in decimal. Truncate if necessary.

a. Convert 100101_2 to a 6-bit unsigned integer.

b. Convert 100101_2 to a 6-bit signed magnitude integer.

c. Convert 100101_2 to a 6-bit 2's complement integer.

d. Convert 011101110_2 to a 9-bit unsigned integer.

e. Convert 011101110_2 to a 9-bit 2's complement integer.

f. Convert 100100101101_2 to a 11-bit unsigned integer.

g. Convert 100100101101_2 to a 9-bit 2's complement integer.

h. Convert 00101101_2 to a 12-bit unsigned integer.

i. Convert 10111_2 to a 16-bit signed integer.

Problem 2

Write these conversions in binary. Truncate if necessary.

a. Convert 51_{10} to a 8-bit unsigned integer.

b. Convert 51_{10} to a 8-bit signed magnitude integer.

c. Convert 51_{10} to a 8-bit 2's complement integer.

d. Convert -240_{10} to a 9-bit unsigned integer.

e. Convert -240_{10} to a 9-bit 2's complement integer.

f. Convert 1171_{10} to a 11-bit unsigned integer.

g. Convert 1171_{10} to a 11-bit 2's complement integer.

h. Convert 65_{10} to a 12-bit unsigned integer.

i. Convert -23309_{10} to a 16-bit signed integer.

Other Representations

Problem 1

Convert these binary values to hexadecimal.

a. 0010101101010110

b. 1001010010001111

c. 0011110000010010

d. 1011111011101111

e. 1111000000001101

Problem 2

Convert these hexadecimal values to binary.

a. x37A5

b. x2009

c. x1F06

d. x2FFE

e. xDEADBEEF

Problem 3

Convert these hexadecimal values to ASCII.

a. x4A

b. x2F

c. x0D

d. x4045

e. x6E6F

Problem 4

Convert these ASCII characters to binary.

a. 'h'

b. '#'

c. 'M'

d. '!'

e. "bob"

Problem 5

True or False?

a. An integer with 11 hexadecimal values is at most a 88-bit integer.

b. The shortest hexadecimal string that we can encode any 69-bit unsigned integer into is 18 characters long.

c. All uppercase letters in ASCII start with the binary string 0100.

d. All lowercase letters in ASCII start with the binary string 011.

e. There is an ASCII character that corresponds with x8A.

f. ASCII characters are usually stored as signed 8-bit integers.

g. The control characters in ASCII were originally used as special codes for teletypes, keyboards used for electrical telegraphs.

Binary Operations

Problem 1

Perform the following operations.

a. 1_2 AND 0_2

b. 1_2 OR 0_2

c. 10010010_2 AND 01111011_2

d. 001010_2 OR 111101_2

e. x8618 AND x7507

f. 1_2 XOR 1_2

g. xCA09 XOR x0990

h. NOT 1001110100110101_2

i. 1001001101_2 NAND 0110101110_2

j. 100011_2 NOR 001000_2

k. x908 NXOR xA51

Problem 2

Perform the following operations on unsigned integers. Assume the number of bits given. Indicate when there is an overflow.

a. $100100_2 + 010101_2$

b. $11011010_2 - 011010110_2$

c. $1001_2 - 1010_2$

d. $011101_2 + 111011_2$

e. $1111000_2 \ll 2$

f. $1111000_2 \gg 2$

g. $000100_2 \gg 2$

Problem 3

Perform the following operations on signed integers. Assume the number of bits given. Indicate when there is an overflow.

a. $110010_2 + 110001_2$

b. $11011010_2 + 011010110_2$

c. $1001_2 - 1010_2$

d. $011101_2 - 111011_2$

e. $1111000_2 \ll 2$

f. $1111000_2 \gg 2$

g. $000100_2 \gg 2$

Problem 4

Bitmasks.

a. Suppose you have a 6-bit unsigned integer. What does applying AND 110000_2 return? What does it indicate?

b. Suppose you have a 8-bit signed integer. What does applying AND 10000000_2 return? What does it indicate?

Suppose you have a 6-bit unsigned integer that represents 6 lights (1 = on, 0 = off).

c. What operation and what mask should we use to enable a single light?

d. What operation and what mask should we use to disable a single light?

e. What operation and what mask should we use to toggle a single light?

f. What operation can we use on these masks to form a new mask if we wanted to toggle more than one light?

K-maps and Optimization

Problem 1

Find the minimal SOP and POS expressions for the following table.

A	B	C	S
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Problem 2

Find the minimal SOP and POS expressions for the following table.

A	B	C	S
0	0	0	0
0	0	1	1
0	1	0	X
0	1	1	X
1	0	0	1
1	0	1	0
1	1	0	X
1	1	1	X

Problem 3

Find the minimal SOP and POS expressions for the following table.

A	B	C	D	S
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

Problem 4

Find the minimal SOP and POS expressions for the following table.

A	B	C	D	S
0	0	0	0	X
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	X
0	1	0	1	X
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	X
1	1	0	1	X
1	1	1	0	X
1	1	1	1	X

Problem 5

Find the area and delay heuristics for the following expressions. Do not include NOT gates.

a. $ABC + A'B'C + C'$

b. $A + B + C + D(A + B)$

c. $ABCDEFGHIJKLMNOPQRSTUVWXY + Z$

d. $(AB)'(A + B)'(CD)$

Problem 6

Implement the following expressions using AND and OR gates, then using NAND and NOR gates only.

a. $AB + C$

b. $A'B + AB' + ABC' + ABD'$

c. $(A + B + C')(A' + B + C)(A + B' + C)$

d. $(A + D)(B' + C' + A)$

IEEE 754 Floating Point

Problem 1

a. item 1

C Basics

Problem 1

a. item 1

C Programming

Problem 1

a. item 1