CS2445 Introduction to Computer Systems Homework 1

Total Points: 160

Instructions:

- **You must show COMPLETE work on ALL problems to get FULL CREDIT. You will get ZERO if you do NOT show detailed solving steps.**
- Please type the solutions using a word processor such as WORD, Latex, etc., or write by hand very neatly and legibly, comparable to typing*.
- Please submit a SINGLE PDF file in Canvas.
- Please pay special attention to the due date – no late turn ins or special case consideration.

* The preferred format is typing with a word processor for the following reasons:

(1) You have a copy in your computer that you can study for exams or future use.

(2) You will learn to use a word processor (if not already learned) to do math, diagrams, etc. This will be one of the most useful things in your career.

(3) You have a backup copy in case of lost or misplaced assignment.

(4) A typed assignment helps the TA to spend less time and to be more accurate in grading. Our class is multi-national, and it is hard and time consuming to decode many different handwriting styles.

You must show COMPLETE work on ALL problems to get FULL CREDIT. You will get ZERO if you do NOT show detailed solving steps.

Q1 [20 POINTS]: Convert the following decimal numbers to their binary numbers. Note: You must show detailed solving steps.

1) 145_{10}

   145=128+17

   17=16+1

   128=2^7 16=2^4

   145=$(10010001)_2$

2) 25.25_{10}

   25=16+8+1,16=2^4, 8=2^3 25=11001_2

   .25=1/4=2^-2 =$(.01)_2$

   25.25=11001.01_2

3) 43.625_{10}

$43=32+8+2+1=100000_2+1000_2+10_2+1=110011_2$

$.625=2\wedge-1+2\wedge-3=(.101)_2$

$43.625=101011.101_2$

4) 125.125_{10}

$125=128-3=2\wedge7-3=1111101_2$

$.125=2\wedge-3=0.001_2$

So the result is 1111101.001_2

Q2 [20 POINTS]: Convert the following binary numbers to their decimal numbers. Note: You must show detailed solving steps.

1) $1010\ 1010_2$

$0101010_2 = (1 \times 2^7) + (0 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$ $10101010_2 = 128 + 0 + 32 + 0 + 8 + 0 + 2 + 010101010_2 = 170_1$

2) $1000\ 1110_2$

$$10001110_2 = (1 \times 2^7) + (0 \times 2^6) + (0 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0)$$
$$10001110_2 = 128 + 0 + 0 + 0 + 8 + 4 + 2 + 0$$
$$10001110_2 = 142_1 0$$

3) $0101\ 1010.1000\ 0000_2$

$$1011010.1_2 = (1 \times 2^6) + (0 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (0 \times 2^0) + (1 \times 2^{-1})$$
$$1011010.1_2 = 64 + 0 + 16 + 8 + 0 + 2 + 0 + 0.5$$
$$1011010.1_2 = 90 + 0.5$$
$$1011010.1_2 = 90.5_1 0$$

4) $1111\ 1110.0110\ 1100_2$

11111110.011011_2
$$= (1 \times 2^7) + (1 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0) + (0 \times 2^{-1}) + (1 \times 2^{-2}) + (1 \times 2^{-3}) + (0 \times 2^{-4}) + (1 \times 2^{-5}) + (1 \times 2^{-6})$$

11111110.011011_2
$$= 128 + 64 + 32 + 16 + 8 + 4 + 2 + 0 + 0 + 0.25 + 0.125 + 0 + 0.03125 + 0.015625$$

$$11111110.011011_2 = 254 + 0.421875$$
$$11111110.011011_2 = 254.421875_10$$

Q3 [20 POINTS]: Convert the following binary numbers to their hexadecimal numbers.
Note: You must show detailed solving steps.

1) $1010\ 1010_2$

1010	1010
A	A

Split the digits and convert as above
$$10101010_2 = AA_16$$

2) $1000\ 1110_2$

1000	1110
8	E

Split the digits and convert as above
$$10001110_2 = 8E_16$$

3) $0101\ 1010.1000\ 0000_2$

0101	1010.	1000
5	A.	8

Split the digits and convert as above
$$01011010.1_2 = 5A.8_16$$

4) $1111\ 1110.0110\ 1100_2$

1111	1110.	0110	1100
F	E.	6	C

Split the digits and convert as above
$$11111110.011011_2 = FE.6C_{16}$$

Q4 [20 POINTS]: Convert the following hexadecimal numbers to their binary numbers.
Note: You must show detailed solving steps.

1) $F7_{16}$

F	7
1111	0111

$$F7_{16} = 11110111_2$$

2) $BE.A0_{16}$

B	E	A	0
1011	1110	1010	0000

$$BE.A0_16 = 10111110.10100000_2$$

3) 123.45_{16}

1	2	3.	4	5
0001 .	0010	0011.	0100	0101

$$123.45_{16} = 000100100011.01000101_2$$

4) $A64.BC_{16}$

Convert hex to binary as below

A	6	4	B	C
1010.	0110	0100	1011	1100

$$A64.BC_{16} = 101001100100.10111100_2$$

Q5 [20 POINTS]: Convert the following decimal numbers to their hexadecimal numbers. Note: You must show detailed solving steps.

1) 145_{10}
   $145 = 9*16 + 1 = 91_{16}$

2) 25.25_{10}
   $25 = 1*16 + 9$ $0.25 = 4/16$
   The result is 19.4_{16}

3) 43.625_{10}
   $43 = 2*16 + 11$ $11 = B_{16}$
   $0.625 = 10/16$ $10 = A_{16}$
   The result is 2B.A

$$43.625_10 = 2B.A_16$$

4) 125.125_{10}

   $125 = 7*16 + 13$

   $0.125 = 2/16$

   The result is $125.125_{10} = 7D.2_{16}$

Q6 [20 POINTS]: Present the following decimal numbers in twos complements. Note: You must show detailed solving steps. You **CANNOT** use this converter in this question.

1) 25

$25=16+8+1=(11001)_2$

Under 8bit system, the inverse is 00011001, +1,

We got 00011001

2) -25

$25=(11001)_2$

Under 8bit system, the inverse is 11100110 +1

We got 11100111

3) 62.25

$62.25=32+16+8+4+2+1/4=111110.01_2$

Inverse we got 11110101110,+1

111101011.11

4) -62.25

62.25 in

Q7 [20 POINTS]: Perform twos complement arithmetic for the followings.

Note: You must show detailed solving steps. You **CAN** use this converter to get twos complement representation of each number.

1) 37 + 45
2) -17 – 31
3) 51 – 78
4) -71 + (-31)

Q8 [20 POINTS]: Present the following decimal numbers to IEEE 754 Binary 32 format as described below.

Note: You must show detailed solving steps.

Sign	Biased Exponent (+ 127)	Fraction
1 bit	8 bits	23 bits

1) 65.626
2) 129.125

3) 520.2
4) 1028.02