EE 352 Homework 2
Spring 2010 Nazarian

Name: _____ **Score:**_____

Assigned: Tuesday, February 2

Due: Thursday, February 11 at 9:30am (in class)

1) **Architecture Overview:** Study the unit0 slides posted on blackboard under Course-Documents and answer the following questions. (5 pts. each)

a) **True / False**: To overcome the memory wall problem, most architectural improvements focus on reducing memory latency because it is easier to improve than bandwidth.

b) **True / False**: A primary reason for the movement toward processors with multiple simple cores is the effect of power consumption on high frequency, complex cores.

Data Representation

2) Perform the following number system conversions. Note: It may be easier to convert them to the desired base in a different order than shown here. (2 pts. per conversion)

a) $1100101.1011_2 = ?_8 = ?_{16} = ?_{10}$
b) $1A9.D_{16} = ?_8 = ?_2 = ?_{10}$
c) $617_8 = ?_{16} = ?_2 = ?_{10}$

3) What are the corresponding decimal representations for the following binary strings? (2 pts. each)

Binary String	*8-bit unsigned* format	*8-bit 2's complement* format
10110110		
11011011		

4) For each of the following decimal numbers find the corresponding 8-bit representation using the indicated systems. Note: Some numbers may NOT be representable w/ 8-bits. If this is the case, put **NA** for the answer. Also find the minimum bits needed to represent the number in the 2's complement system. (2 pts. ea.)

	Signed Mag.	2's Complement	Minimum bits needed using 2's complement
-128			
+31			
+59			
-16			

5) Each C declaration of the variable x is initialized to a value in decimal. Show that value represented in hex using the appropriate size indicated by the variable type (e.g. char = 1-byte = 2 hex digits). Do not use a calculator. (2 pts. each)

a) short int x = 13;
b) short int x = -32,767;
c) unsigned char = 246;
d) int x = -4096;
e) unsigned char x = 193;
f) int x = -1;
g) unsigned char x = 'a';
h) short int x = 40;
i) unsigned char x = 97;
j) char x = -79;

6) Convert the powers of 2 shown below to its approximate decimal value using K to represent 10^3, M for 10^6, G for 10^9, and T for 10^{12}. (e.g. $2^{12} \approx 4K$) [2 pts. each]

a) $2^{19} = ?$
   i. 9K
   ii. 512K
   iii. 512M
   iv. 256K
   v. 256M

b) $2^{36} = ?$
   i. 64M
   ii. 64G
   iii. 8M
   iv. 8G
   v. 8T

c) $2^{43} = ?$
   i. 8G
   ii. 8T
   iii. 16M
   iv. 16G
   v. 16T

d) $2^{24} = ?$
   i. 4K
   ii. 4M
   iii. 8M
   iv. 16M
   v. 16G

7) Standard gravity (acceleration due to gravity of earth) is defined as 9.80665 m/s^2. How many bits of unsigned binary are required to represent the fractional part 0.80665_{10} to within -0.01 of error (i.e. $0.79665 \leq x \leq 0.80665$), but not over 0.80665? Hint: Think about the fractional binary place values and at what point you achieve the indicated precision. (6 pts.)

a) 4
b) 5
c) 6
d) 7
e) 8

Arithmetic Operations

8) (12 pts.) Perform the following addition and subtraction problems assuming 2's complement numbers.

Submission Instructions: Enter the **8-bit** result in binary without any spaces.

a)
```
 1010 0110
+1101 1011
```

b)
```
 0010 0001
+0111 1001
```

c)
```
 1000 0010
-1010 1111
```

d)
```
 0101 1001
-1010 0101
```

9) (8 pts.) For the problems above indicated whether signed overflow occurred?

Submission Instructions: Enter 'Y' or 'N' for each problem.

a. Y / N b. Y / N c. Y / N d. Y / N

10) (12 pts.) Perform the following hexadecimal operations. *For subtraction, find the complement and add*.

Submission Instructions: Enter the **4-digit** hex result for each problem without any spaces.

i)
```
  6 F E 1
- C D 9 2
```

ii)
```
  4 B A 7
+ 3 1 6 C
```

iii)
```
  E 1 8 A
+ B C 5 5
```

iv)
```
  9 0 D 6
- F F E A
```

11) (16 pts.) For the problems above indicate whether overflow occurred if the numbers were representing signed values and then if they were representing unsigned values

Submission Instructions: Enter 'Y' or 'N' for each problem.

Result from 3.)	Signed Overflow	Unsigned Overflow
i	Y / N	Y / N
ii	Y / N	Y / N
iii	Y / N	Y / N
iv	Y / N	Y / N

Floating Point

12) (12 pts.) Translate the following IEEE Single-Precision FP numbers to their decimal equivalent.

Submission Instructions: Enter the sign (+ or -) followed by the decimal equivalent w/o any spaces between them. For infinite or NaN results, enter the sign (+/-) followed by "inf" or "nan"

a) `0xc0700000`
b) `0x41900000`
c) `0x7f800000`

For the following floating point questions assume a "shortened" IEEE standard floating point number with a total of 12 bits (sign + exponent + mantissa = 1 + 5 +6 bits). Assume Excess-15 representation of the exponent.

13) (6 pts.) Translate the following floating point numbers to decimal numbers.

Submission Instructions: Enter the sign (+ or -) followed by the decimal equivalent w/o any spaces between them.

a)

0	10111	110101

b)

1	01110	101000

14) (18 pts.) Show the following decimal numbers as floating point numbers. When you normalize show the G, R, and S bits. Then, use the "round-to-nearest" method, if needed.

Submission Instructions: Enter the binary sign field, exponent field, and fraction field separately. (e.g. sign: 1, exp.: 01110, frac.: 100011)

a) `+227`
b) `-13.625`
c) `-80.75`

15) (12 pts.) Given the indicated floating point numbers perform the following operations. For addition and subtraction, show the G,R,S bits after shifting the smaller number and after the final renormalization (if needed). Then use the "round to nearest" method if needed to show the final result.

Submission Instructions: Enter the binary sign field, exponent field, and fraction field of the result separately. (e.g. sign: 1, exp.: 01110, frac.: 100011)

a) `Add (A+B)`
b) `Subtract (A-B)`

A=	0	10000	100110

B=	0	01110	011110

16) (4 pts.) Review the Lecture notes regarding floating point exceptions and NaNs. Then for each case a – d, select the one exception that best describes the result of the operation. The five possible exceptions are listed below.

Submission Instructions: For each question a-f, select the appropriate exception option (1-5)

1. Invalid (NaN)
2. Divide by Zero
3. Overflow
4. Underflow
5. None

a) Max FP - Max FP
b) Max FP / Min FP
c) Min FP / Max FP
d) (Max FP + 1) * 0 (what will result after both operations + and * are preformed)