CS 221 Answers to Problem Set 1

Part 1:
1.
a. The largest (greatest magnitude) positive and negative numbers that can be entered.
Excel: 9.99999999999999E+307, -9.99999999999999E+307
Matlab: -1.79769e+308, 1.79769e+308 (see: realmax)

b. The largest (greatest magnitude) positive and negative numbers that can result from a computation.
Excel: 1.7976931348623158e+308, -1.7976931348623158e+308
[Note: in some versions: Largest Neg: -1E+307]
Matlab: -1.79769e+308, 1.79769e+308

c. The smallest positive and negative numbers that can be entered.
Excel: 2.2251E-308, -2.2251E-308
[In some versions it is :

Smallest Pos: 9.99999999999999E-307
Smallest Neg: -9.99999999999999E-307]

Matlab: 2.22507e-308, -2.22507e-308 (see realmin)
d. The smallest positive and negative numbers that can result from a computation.
Excel: 2.2251E-308, -2.2251E-308
Matlab: 2.22507e-308, -2.22507e-308

2.
a.1.23457E+16
b.1.23457E+16
c. Excel has 15 significant digits (precision). The maximum difference in magnitude of numbers to be added must be less than 10^15.
d. 1.2346e+016
1.2346e+016
e. 1.2346e+017

3. Convert the following (decimal) numbers to binary. (See the slides from Tuesday 6 September lecture for instructions if you don't know how.) **Show the steps of your work to get credit**.

a. $592_{10} = 1001010000_2$

2_9	512	1	592 - 512 = 80
2_8	256	0	(80 < 256)
2_7	128	0	(80 < 128)
2_6	64	1	80 - 64 = 16
2_5	32	0	(16 < 32)
2_4	16	1	16 - 16 = 0
2_3	8	0	
2_2	4	0	
2_1	2	0	
2_0	1	0	(since 16 is a power of 2, the rest are all zeroes)

b. $1{,}333_{10} = 10100110101_2$

n (Power)	2^n	Bit	Remainder
			1333
10	1024	1	309
9	512	0	309
8	256	1	53
7	128	0	53
6	64	0	53
5	32	1	21
4	16	1	5
3	8	0	5
2	4	1	1
1	2	0	1
0	1	1	0

c. $2{,}777{,}981_{10} = 1010100110001101111101_2$

(Solved in Excel, same method as above)

n (Power)	2_n	Bit	Remainder
			2,777,981
21	2,097,152	1	680,829
20	1,048,576	0	680,829
19	524,288	1	156,541
18	262,144	0	156,541
17	131,072	1	25,469
16	65,536	0	25,469
15	32,768	0	25,469
14	16,384	1	9,085
13	8,192	1	893
12	4,096	0	893
11	2,048	0	893
10	1,024	0	893
9	512	1	381
8	256	1	125
7	128	0	125
6	64	1	61
5	32	1	29
4	16	1	13
3	8	1	5
2	4	1	1
1	2	0	1
0	1	1	0

4. What decimal numbers do the following 16-bit (positive) binary numbers represent? **Show the derivation of your answer to get credit.**

a. 1000001011100011 = $33{,}507_{10}$

String remainder	2_n	Sig Bit	2_n = ?	Value
1000001011100011	15	1	32,768	32,768
000001011100011	14	0	16,384	0
00001011100011	13	0	8,192	0
0001011100011	12	0	4,096	0
001011100011	11	0	2,048	0
01011100011	10	0	1,024	0
1011100011	9	1	512	512
011100011	8	0	256	0
11100011	7	1	128	128
1100011	6	1	64	64
100011	5	1	32	32
00011	4	0	16	0
0011	3	0	8	0
011	2	0	4	0
11	1	1	2	2
1	0	1	1	1
			SUM:	33,507

b. 0000011111110010 = $2{,}034_{10}$

String remainder	2_n	Bit	2_n = ?	Value
0000011111110010	15	0	32,768	0
000011111110010	14	0	16,384	0
00011111110010	13	0	8,192	0
0011111110010	12	0	4,096	0
011111110010	11	0	2,048	0
11111110010	10	1	1,024	1,024
1111110010	9	1	512	512
111110010	8	1	256	256
11110010	7	1	128	128
1110010	6	1	64	64
110010	5	1	32	32
10010	4	1	16	16
0010	3	0	8	0
010	2	0	4	0
10	1	1	2	2
0	0	0	1	0
			Sum =	2,034