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CECS 225 – Computer Architecture
Assignment #01 Number Systems Due: 9/1/2020 (8am)
Note: Here signed binary, octal, or hex values implies usage of 2's complement encoding.

1. Convert the following decimals to 8-bit unsigned binary:

Decimal	8-bit binary equivalent							
137	1	0	0	0	1	0	0	1
56	0	0	1	1	1	0	0	0
83	0	1	0	1	0	0	1	1
222	1	1	0	1	1	1	1	0
175	1	0	1	0	1	1	1	1

$137-2^7=9;\ 9-2^3=1;\ 1-2^0=0$
$2^5=24;\ 24-2^4=8-2^3=0$
$83-2^6=19;\ 19-2^4=3;\ 3-2^1=1;\ 1-2^0=0$
$222-2^7=94;\ 94-2^6=30;\ 30-2^4=14;\ 14-2^3=6;\ 6-2^2=2;\ 2-2^1=0$
$175-2^7=47;\ 47-2^5=15;\ 15-2^3=7;\ 7-2^2=3;\ 3-2^1=1;$
$1-2^0=0$

2. Convert the following decimals to 8-bit signed binary (2's complement):

Decimal	8-bit binary equivalent							
- 49	1	1	0	0	1	1	1	1
-239	0	0	0	1	0	0	0	1
-95	1	0	1	0	0	0	0	1
-200	0	0	1	1	0	1	1	1
-101	1	0	0	1	1	0	1	1

$49-2^5=17-2^4=1-2^0=0 \Rightarrow 00110001 \Rightarrow 11001110+1$
$239-2^7=111-2^6=47-2^5=15-2^3=7-2^2=3-2^1=1-2^0=0$
$95-2^6=31-2^4=15-2^3=7-2^2=3-2^1=1-2^0=0$
$200-2^7=72-2^6=8-2^3=0$
$101-2^6=37-2^5=5-2^2=1-2^0=0$

3. Convert the following decimals to 16-bit signed hexadecimal:

Decimal	16-bit hex equivalent			
10477	2	8	E	D
23948	5	D	8	C
-33395	7	D	8	D
-2000	F	8	3	0
-10101	D	8	8	B

4. Convert the following 16-bit signed hexadecimal numbers to signed decimal:

Hex Value	Signed decimal equivalent
DE28	56,872
CCC5	52,421
543A	21,562
044F	1,103
F0F0	61,680

5. Convert the following decimals to the equivalent number in the radix given using the fewest digits.

Radix	Decimal	Radix equivalent number
8	4579	10743
4	243	3303
12	3000	18A0
6	97	241
3	100	10201

3.
   a. 10477
      i. 10477 / 16 = 654, R = 13 = D;
      ii. 654 / 16 = 40, R = 14 = E;
      iii. 40 / 16 = 2, R = 8 = 8
      iv. 2 / 16 = 0, R = 2 = 2
   b. 23948
      i. 23948 / 16 = 1496, R = 12 = C
      ii. 1496 / 16 = 93, R = 8 = 8
      iii. 93 / 16 = 5, R = 13 = D
      iv. 5 / 16 = 0, R = 5 = 5
   c. -33395
      i. 33395 / 16 = 2087, R = 3, 15 – 3 = 12 = C + 1 = D
      ii. 2087 / 16 = 130, R = 7, 15 – 7 = 8 = 8
      iii. 130 / 16 = 8, R = 2, 15 – 2 = 13 = D
      iv. 8 / 16 = 0, R = 8, 15 - 8 = 7 = 7
   d. -2000
      i. 2000 / 16 = 125, R = 0, 15 – 0 = 15 = F + 1 = 0
      ii. 124 / 16 = 7, R = 12, 15 – 12 = 3 = 3
      iii. 7 / 16 = 0, R = 7, 15 – 7 = 8 = 8
      iv. 0 / 16 = 0, R = 0, 15 – 0 = 15 = F
   e. -10101
      i. 10101 / 16 = 631, R = 5, 15 – 5 = 10 = A + 1 = B
      ii. 631 / 16 = 39, R = 7, 15 – 7 = 8 = 8
      iii. 39 / 16 = 2, R = 7, 15 – 7 = 8 = 8
      iv. 2 / 16 = 0, R = 2, 15 – 2 = 13 = D
4.
   a. DE28
      i. D = 13 * 16^3 = 53248
      ii. E = 14 * 16^2 = + 3584
      iii. 2 = 2 * 16^1 = +32
      iv. 8 = 8 * 16^0 = 8
   b. CCC5
      i. C = 12 * 16^3 = 49152
      ii. C = 12 * 16^2 = + 3072
      iii. C = 12 * 16^1 = + 192
      iv. 5 = 5 * 16^0 = + 5
   c. 543A
      i. 5 = 5 * 16^3 = 20480
      ii. 4 = 4 * 16^2 = + 1024
      iii. 3 = 3 * 16^1 = + 48
      iv. A = 10 * 16^0 = +10
   d. 044F
      i. 0 = 0 * 16^3 = 0
      ii. 4 = 4 * 16^2 = + 1024
      iii. 4 = 4 * 16^1 = + 64
      iv. F = 15 *16^0 = +15
   e. F0F0

i. $F = 15 * 16^3 = 61440$
ii. $0 = 0 * 16^2 = + 0$
iii. $F = 15 * 16^1 = + 240$
iv. $0 = 0 * 16^0 = + 0$

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a. 4579_9
i. $4579 / 8 = 572, R = 3$
ii. $572 / 8 = 71, R = 4$
iii. $71 / 8 = 8, R = 7$
iv. $8 / 8 = 1, R = 0$
v. $1 / 8 = 0, R = 1$

b. 243_4
i. $243 / 4 = 60, R = 3$
ii. $60 / 4 = 15, R = 0$
iii. $15 / 4 = 3, R = 3$
iv. $3 / 4 = 0, R = 3$

c. 3000_{12}
i. $3000 / 12 = 250, R = 0$
ii. $250 / 12 = 20, R = 10 \rightarrow A$
iii. $20 / 12 = 1, R = 8$
iv. $1 / 12 = 0, R = 1$

d. 97_6
i. $97 / 6 = 16, R = 1$
ii. $16 / 6 = 2, R = 4$
iii. $2 / 6 = 0, R = 2$

e. 100_3
i. $100 / 3 = 33, R = 1$
ii. $33 / 3 = 11, R = 0$
iii. $11 / 3 = 3, R = 2$
iv. $3 / 3 = 1, R = 0$
v. $1 / 3 = 0, R = 1$