Tutorial 2

1. a. 10110_2
$(2+2^2+2^4)=22$

b. 10010101_2
$(1+2^2+2^4+2^7)=149$

c. 1101011_2
$(1+2+2^3+2^5+2^6)=107$

d. 100100001001_2
$(1+2^3+2^8+2^{11})=2313$

e. 100101100_2
$(2^2+2^3+2^5+2^8)=300$

3. a. $77_{10}=1001101_2$

64	32	16	8	4	2	1
2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	0	0	1	1	0	1

b. $96_{10}=1100000_2$

64	32	16	8	4	2	1
2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	0	0	0	0	0

c. $205_{10}=11001101_2$

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	0	0	1	1	0	1

d. $1040_{10}=10000010000_2$

1024	512	256	128	64	32	16	8	4	2	1
2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	0	0	0	0	0	1	0	0	0	0

e. $3216_{10}=110010010000_2$

2048	1024	512	256	128	64	32	16	8	4	2	1
2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	0	0	1	0	0	1	0	0	0	0

5. a) $743_{16}=(7\times16^2)+(4\times16)+(3\times1)=1859$
b) $2000_{16}=(2\times16^3)=8192$
c) $7FF_{16}=(15\times1)+(15\times16)+(7\times16^2)=2047$
d) $ABCD_{16}=(13\times1)+(12\times16)+(11\times16^2)+(10\times16^3)=43981$
e) $165_{16}=(5\times1)+(6\times16)+(1\times16^2)=357$

2. a. 77_{10}

2	77
2	38 - 1
2	19 - 0
2	9 - 1
2	4 - 1
2	2 - 0
2	1 - 0
	0 - 1

1001101_2

b. 96_{10}

2	96
2	48 - 0
2	24 - 0
2	12 - 0
2	6 - 0
2	3 - 0
	1 - 1

1100000_2

c. 205_{10}

2	205
2	102 - 1
2	51 - 0
2	25 - 1
2	12 - 1
2	6 - 0
2	3 - 0
	1 - 1

11001101_2

d. 1040_{10}

2	1040
2	520 - 0
2	260 - 0
2	130 - 0
2	65 - 0
2	32 - 1
2	16 - 0
2	8 - 0
2	4 - 0
2	2 - 0
	1 - 0

10000010000_2

e. 3216_{10}

2	3216
2	1608 - 0
2	804 - 0
2	402 - 0
2	201 - 0
2	100 - 1
2	50 - 0
2	25 - 0
2	12 - 1
2	6 - 0
2	3 - 0
	1 - 1

110010010000_2

4. a. 1305.375_{10}

2	1305
2	652 - 1
2	326 - 0
2	163 - 0
2	81 - 1
2	40 - 1
2	20 - 0
2	10 - 0
2	5 - 0
	2 - 1
	1 - 0

$0.375\times2=0.75$
$0.75\times2=1.50$
$0.50\times2=1.00$

10100011001.011_2

6. a) $59_{10}=3B_{16}$

16	59
16	3 - 11 (B)
	0 - 3

b) $1024_{10}=400_{16}$
c) $2313_{10}=909_{16}$
d) $65536_{10}=10000_{16}$
e) $919_{10}=397_{16}$

7. a) $56_8=(5\times8)+(6\times1)=46_{10}$
b) $467_8=311_{10}$
c) $1000_8=512_{10}$
d) $2341_8=1249_{10}$
e) $314568=13102_{10}$

b. $111.3375_{10}=1101111.0101_2$

2	111
2	55 - 1
2	27 - 1
2	13 - 1
2	6 - 1
2	3 - 0
	1 - 1

$0.33\times2=0.66-0$
$0.66\times2=1.32-1$
$0.32\times2=0.64-0$
$0.64\times2=1.28-1$

d. $164.875_{10}=10100100.111_2$

2	164
2	82 - 0
2	41 - 0
2	20 - 1
2	10 - 0
2	5 - 0
2	2 - 1
	1 - 0

$0.875\times2=1.75-1$
$0.75\times2=1.5-1$
$0.5\times2=1.00-1$

c. $301.12_{10}=100101101.0001_2$

2	301
2	150 - 1
2	75 - 0
2	37 - 1
2	18 - 1
2	9 - 0
2	4 - 1
2	2 - 0
	1 - 0

$0.12\times2=0.24-0$
$0.24\times2=0.48-0$
$0.48\times2=0.96-0$
$0.96\times2=1.92-1$

e. $1000.01_{10}=1111101000.0000_2$

2	1000
2	500 - 0
2	250 - 0
2	125 - 0
2	62 - 1
2	31 - 0
2	15 - 1
2	7 - 1
2	3 - 1
	1 - 1

$0.01\times2=0.02-0$
$0.02\times2=0.04-0$
$0.04\times2=0.08-0$
$0.08\times2=0.16-0$

8. a) $59_{10} = 73_8$

8 | 59
8 | 7-3
0-7

b) $1024_{10} = 2000_8$

c) $2313_{10} = 4411_8$

d) $65536_{10} = 200000_8$

e) $919_{10} = 1627_8$

9. When a large decimal number is to be converted to binary, it is **sometimes** easier to convert it to hex and then from hex to binary. Try this procedure for 3216_{10} and compare it with the procedure used in Question (2).

$3216_{10} = C90_{16}$

16 | 3216
16 | 201-0
12-9

$C90_{16} = 1100\ 1001\ 0000_2$

10. 10110_2

a. 0001 0110 b. 010 110

1 6 2 6

16_{16} 26_8

b. 10010101_2

1001 0101 b. 010 010 101

9 5 2 2 5

95_{16} 225_8

C. 1101011_2

a. 0110 1011 b. 001 101 011

6 11 2 5 3

$6B_{16}$ 253_8

11. a) 1011101010010.101

hex: $5D4.A_{16}$

Oc: 2724.5_8

b) 1000001101111.01

hex: $106F.2_{16}$

Oc: 10157.2_8

d. 1001000001001_2

1001 0000 1001 100 100 001 001

9 0 9 4 4 1 1

909_{16} 44118

e. 100101100_2

0001 0010 1100 100 101 100

1 2 12 4 5 4

$12D_{16}$ 454_8

12. BCD a) $77_{10} = 0111\ 0111_2$

b) $96_{10} = 1001\ 0110_2$

c) $205_{10} = 0010\ 0000\ 0101_2$

d) $1040_{10} = 0001\ 0000\ 0100\ 0000_2$

e) $3216_{10} = 0011\ 0010\ 0001\ 0110_2$

13. a) 0010 0101 1101 0101 0010

2 6 13(error) 5 2

b) 0101 0101 0101

5 5 5 555_{10}

c) 0111 0111 0111 0101

7 7 7 5 7775_{10}

14 a) 0110 1011 0011 0001

6 11 3 1 (Invalid)

b) 1001 1100 0000 1000

9 12 0 8 (Invalid)

c) 0000 0000 0000

0 0 0 (valid)

15. What is the largest BCD-encoded decimal value that can be represented in three bytes?

7

16. For the question below please refer to the ASCII table.

a. What is the most significant nibble of the ASCII code for letter E?

b. Represent the statement "X = 3 × Y" in ASCII code. Attach each character values with even parity bit.

c. The following bytes (shown in hex) represent a person's name as it would be stored in the computer's memory. Determine the name of each person.

i. 42 72 61 64 20 50 69 74 74

ii. 41 6E 67 65 6C 69 6E 61

a) 69 = 01000101

= 0100 0101

c) Brad Pitt

ii) Angelina

b. X = 88 = 01011000 = 10011000

= = 61 = 00111101 = 10011101

3 = 51 = 00110011 = 00110011

x = 215 = 11010111 = 01101011

Y = 89 = 01011001 = 00101001

17. Calculate the lower and upper bound of signed number for 7-bit number system using the representation of

a. sign and magnitude

b. 1's complement

c. 2's complement

a) lower : $-(2^6-1) = -63$ upper $= 2^6-1 = 63$

b) lower $= -(2^6-1) = -63$ upper $= 2^6-1 = 63$

c) lower $= -2^6 = -64$ upper $= 2^6-1 = 63$

18. Calculate the binary signed values in the representation format of (i) sign and magnitude, (ii) 1's complement and 2's complement using 8-bit number system.

a. $+55_{10}$

b. $+127_{10}$

b. -87_{10}

c. -128_{10}

a) i) 01101111 ii) 01101111 iii) 01101111

b) i) 01111111 ii) 01111111 iii) 01111111

c) i) 11010111_2 ii) 10101000_2 iii) 10101001_2

d) i) 11000000 ii) 10111111_2 iii) 11000000_2

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19. Given a number system specification: **size of a number is 6 bit, including the sign bit AND signed numbers using 2's complement**

Calculate and show your working for the arithmetic operations below.

a. 18 + 3

b. -18 + 3

c. 18 – 3

d. -18 - 3

a) $18 = 10010_2$

$3 = 11_2$

10101_2

b) $-18 = 10111_2$

$3 = 11_2$

11000_2

c) $18 = 010010_2$

$-3 = 111101_2$

001111_2

d. $-18 = 10111_2$

$-3 = 111101_2$

101011_2 - out of range

Textbook

1. $3 \times 10^1 + 4 \times 10^0$ is
   (a) 0.34 (b) 3.4 (c) 34 (d) 340
2. The decimal equivalent of 1000 is
   (a) 2 (b) 4 (c) 6 (d) 8
3. The binary number 11011101 is equal to the decimal number
   (a) 121 (b) 221 (c) 441 (d) 256
4. The decimal number 21 is equivalent to the binary number
   (a) 10101 (b) 10001 (c) 10000 (d) 11111
5. The decimal number 250 is equivalent to the binary number
   (a) 11111010 (b) 11110110 (c) 11111000 (d) 11111011
6. The sum of 1111 + 1111 in binary equals
   (a) 0000 (b) 2222 (c) 11110 (d) 11111
7. The difference of 1000 − 100 equals
   (a) 100 (b) 101 (c) 110 (d) 111
8. The 1's complement of 11110000 is
   (a) 11111111 (b) 11111110 (c) 00001111 (d) 10000001
9. The 2's complement of 11001100 is
   (a) 00110011 (b) 00110100 (c) 00110101 (d) 00110110
10. The decimal number +122 is expressed in the 2's complement form as
    (a) 01111010 (b) 11111010 (c) 01000101 (d) 10000101
11. The decimal number −34 is expressed in the 2's complement form as
    (a) 01011110 (b) 10100010 (c) 11011110 (d) 01011101
12. A single-precision floating-point binary number has a total of
    (a) 8 bits (b) 16 bits (c) 24 bits (d) 32 bits
13. In the 2's complement form, the binary number 10010011 is equal to the decimal number
    (a) −19 (b) +109 (c) +91 (d) −109
14. The binary number 10110011100101010100001 can be written in octal as
    (a) 5471230_8 (b) 5471241_8 (c) 2634521_8 (d) 23162501_8
15. The binary number 1000110101000101101111 can be written in hexadecimal as
    (a) $AD467_{16}$ (b) $8C46F_{16}$ (c) $8D46F_{16}$ (d) $AE46F_{16}$
16. The binary number for $F7A9_{16}$ is
    (a) 1111011110101001 (b) 1110111110101001
    (c) 1111111010110001 (d) 1111011010101001
17. The BCD number for decimal 473 is
    (a) 111011010 (b) 110001110011 (c) 010001110011 (d) 010011110011
18. Refer to Table 2–7. The command STOP in ASCII is
    (a) 10100111010100100111110100000 (b) 10100101001100100111010100000
    (c) 10010101101101100111010100001 (d) 10100111010100100111011001000
19. The code that has an even-parity error is
    (a) 1010011 (b) 1101000 (c) 1001000 (d) 1110111

27. Determine the decimal value of each signed binary number in the 1's complement form:
    (a) 10011001 (b) 01110100 (c) 10111111

a) 01100110 = -102 b) +116 c) 01000000 = -64

1. What is the weight of 7 in each of the following decimal numbers?
   (a) 1947 (b) 1799 (c) 1979

a) 1 b) 100 c) 10

9. How many bits are required to represent the following decimal numbers?
   (a) 5 (b) 10 (c) 15 (d) 20
   (e) 100 (f) 120 (g) 140 (h) 160

a) 3 bits b) 4 bits c) 4 bits d) 5 bits e) 7 bits
f) 7 bits g) 8 bits h) 8 bits

19. What are two ways of representing zero in 1's complement form?

all 0s and all 1s

23. Express each decimal number in binary as an 8-bit sign-magnitude number:
    (a) +29 (b) −85 (c) +100 (d) −123

a) 00011101 b) 11010101 c) 01100100 d) 11111011

25. Express each decimal number as an 8-bit number in the 2's complement form:
    (a) +12 (b) −68 (c) +101 (d) −125

a) 00001100 b) 11000101 c) 01100101 d) 11111110

b) 68 = 1000100
-68 = -(01000100)
= 10111011
= 10111100

d) 125 = 01111101
-125 = -(01111101)
= 10000010
= 10000011

31. Convert each pair of decimal numbers to binary and add using the 2's complement form:
    (a) 33 and 15 (b) 56 and −27 (c) −46 and 25 (d) −110 and −84

33 = 100001 56 = 111000
15 = 001111 -27 = 00101
110000 111101

011011
100100
100101