Homework 4 Solution

Appendix A

1. ***Convert the following numbers to binary: 1984, 4000, 8192.***
   Solution: 11111000000, 111110100000, 10000000000000.

2. ***What is 1001101001 in decimal? In octal? In Hexadecimal?***
   Solution: In decimal it is 617, in octal it is 1151, and in hex it is 269.

3. ***Which of the following are valid hex numbers? BED, CAB, DEAD, DECADE, ACCEDED, BAG, DAD.***
   Solution: BED – yes, CAB – yes, DEAD – yes, DECADE – yes, ACCEDED – yes, BAG – no, DAD – yes.

4. ***Express the decimal number 100 in all radices from 2 to 9.***
   Solution: 1100100, 10201, 1210, 400, 244, 202, 144, 121

7. Perform the following calculations on 8 bit two's complement numbers.

Solution:

(00101101 + 01101111) = 10011100

(11111111 + 11111111) = 11111110

(00000000 – 11111111) = (00000000 + 00000001) = 00000001

(11110111 – 11110111) = (111110111 + 00001001) = 00000000

8. Repeat the above calculations in one's complement.

Solution:

(00101101 + 01101111) = 10011100

(11111111 + 11111111) = 11111111

(00000000 – 11111111) = (00000000 + 00000000) = 00000000

(11110111 – 11110111) = (111110111 + 00001000) = 11111111

14.Multiply 0111 and 0011 in binary.

Solution:

10101 (just do normal multiplication)

Appendix B

B.1 Convert the following numbers to IEEE single precision format. Give the results as eight hexadecimal digits.

Solution:

a. 9

9.0 = (1001.0) = 1.001 * 2^3. So exponent part is (127+3) = $(130)_{10}$ = $(10000010)_2$ and the fraction part is $(001)_2$. Sign bit is 0. So the number is $(0100\ 0001\ 0001\ 0000\ 0000\ 0000\ 0000\ 0000)_2$. In hex, the number is (41100000H)

b. 5/32 = 0.15625 = $(0.00101)_2$ = (1.01 * 2^{-3}). So fraction is (01). Exponent = (127-3) = $(124)_{10}$ = $(01111100)_2$. Sign bit 0. So the number is $(0011\ 1110\ 0010\ 0000\ 0000\ 0000\ 0000\ 0000)_2$ = (3E200000H)

c. -5/32 = similar to b. except the sign bit is 1 here. So binary representation is $(1011\ 1110\ 0010\ 0000\ 0000\ 0000\ 0000\ 0000)_2$ = (BE200000H)

d. 6.125. Do in the above way. result is (40C40000H)

B.2. Convert the following IEEE single precision floating point numbers from hex to decimal.

Solution:

a. 42E48000H = 0100 0010 1110 0100 1000 0000 0000 0000
   Sign bit 0. Exponent part = 133 -127 = 6. Fraction part = $(11001001)_2$ So the number is 1.11001001 * 2^6 = $(1110010.01)_2$. = $(114.25)_{10}$

b. 3F880000H = 0011 1111 1000 1000 0000 0000 0000 0000

Sign bit 0, exponent part 127-127 = 0, fraction 0001. So number is $1.0001 * 2^0 = (1.0625)_{10}$

c. 00800000H = 0000 0000 1000 0000 0000 0000 0000 0000
   Sign bit 0, exponent part 1 - 127 = -126. Fraction part 0. So number is $1.0 * 2^{-126}$
d. C7F00000H = 1100 0111 1111 0000 0000 0000 0000 0000
   Sign bit 1. Exponent part 143 – 127 = 16. Fraction part 111. So number is $(-1.111)_2 * 2^{16} = (-1.875 * 2^{16})_2 = -122880$.

B.4. The following binary floating point numbers consist of a sign bit, an excess 64, radix 2 exponent, and a 16 bit fraction. Normalize them.

Solution:

To normalize, we have to perform left shift operation on the fraction part until we get an 1 at the leftmost bit, and add 1 to the exponent at each step.

(a) 0 0111101 1010100000001000

(b) 0 0111001 1111111111000000

(c) 0 1000011 1000000000000000 (it is already normalized)