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.

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 $1.0001 \times 2^0 = (1.0625)_{10}$

c. 00800000H = 0000 0000 1000 0000 0000 0000 0000 0000
   Sign bit 0, exponent part 1 - 127 = -126. Fraction part 0. So number is $1.0 \times 2^{-126}$

d. C7F00000H = 1100 0111 1111 0000 0000 0000 0000 0000
   Sign bit 1. Exponent part 143 – 127 = 16. Fraction part 111. So number is $(-1.111)_2 \times 2^{16} = (-1.875 \times 2^{16})_2 = -122880$.

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)