CS 219: Homework #4

Due on September 28, 2016 at 4:00pm

Dr. Egbert

Matthew J. Berger

Problem 1

1.1.) Convert the following binary numbers to their decimal equivalents:

a) 001100
b) 000011
c) 011100
d) 111100
e) 101010

Solution:

a) 12
b) 3
c) 28
d) 60
e) 42

1.2.) Convert the following hexadecimal numbers to their decimal equivalents:

a) C
b) 9F
c) D52
d) 67E
e) ABCD

Solution:

a) 12
b) 159
c) 3410
d) 1662
e) 43981

Problem 2

2.1.) Briefly explain the following representations: Sign Magnitude, Twos Complement, Biased.

Answer:

- Sign Magnitude representation uses the most significant bit as a "sign bit" that represents the sign of the number. 1 is for a negative number or negative zero. The remaining bits stand for the absolute value of the number.
- In Two's Complement representation, negative numbers are represented by the bit pattern that you get when you take the inverse and add 1. The inverse is taken by flipping the bits to get the one's complement (inverse of the number), and then adding 1 to get the two's complement.
- In Biased representation, a pre-specified number K is used as a biasing value. Values are represented in this sytem by the unsigned number which is K greater than the actual value.

2.2.) What is the difference between the two's complement representation of a number and the two's complement of a number?

Answer:

You can get the two's complement of a number by inverting all of the bits and adding 1 to the result. This number will be different however, than the representation of that number in two's complement representation. For example, the number 7 is 0111 in binary. The inverse is: 1000. Adding 1 yields: 1001. This number is the two's complement of 7 in binary. However the two's complement representation of +7 in binary is 0111.

2.3.) What are the four essential elements of a number in floating-point notation?

Answer:

- Significand
- Base
- Radix
- Exponent

2.4.) What is the benefit of using biased representation for the exponent portion of a floating point number?

Answer:

Positive floating point numbers can be referred to as integer values for comparisons.

2.5.) What are the differences among positive overflow, exponent overflow, and significand overflow?

Answer:

- Positive Overflow uses integer representations. It refers to a number that is larger than the number of bits being used allows.
- Exponent Overflow is for floating point representations. It refers to the positive exponent value being larging than the maximum possible exponent value that can be represented by the number of available bits.
- Significand Overflow happens when two significands of the same sign result in a carry out of the most signficant bit.

Problem 2 continued on next page...

2.6.) Express the following numbers in IEEE 32-bit floating-point format:

a) -5

b) -6

c) -1.5

d) 384

e) $\frac{1}{16}$

f) $-\frac{1}{32}$

Solution:

a) 1 10000001 01000000000000000000000

b) 1 10000001 10000000000000000000000

c) 1 01111111 10000000000000000000000

d) 0 10000111 10000000000000000000000

e) 0 01111011 00000000000000000000000

f) 1 01111010 10000000000000000000000

2.7 The following numbers use the IEEE 32-bit floating-point format. What is the equivalent decimal value?

a) 1 10000011 11000000000000000000000

b) 0 01111110 10100000000000000000000

c) 0 10000000 00000000000000000000000

Answer:

a) -28

b) 0.1825

c) 2

2.8.) The text mentions that a 32-bit format can represent a maximum of 2^{32} different numbers. How many numbers can be represented in the IEEE 32-bit format?

Answer:

The IEEE 32-bit can only represent 2^{32} distinct numbers as well.