Homework Lecture 3

Exercises

2.2

Convert the following numbers as indicated, using as few digits in the results as necessary:

a) $(47)_{10}$ to unsigned note parenthesis are often removed, i.e. 47_{10}
b) -27_{10} to signed magnitude
c) 213_{16} to base 10
d) 10110.101_2 to base 10
e) 34.625_{10} to base 4

2.3

Convert the following numbers as indicated, using as few digits in the results as necessary:

a) 011011_2 to base 10
b) -27_{10} to excess 32 (use 6 bits for the result)
c) 011011_2 to base 16
d) 55.875_{10} to unsigned
e) 132.2_4 to base 16

2.4

Convert 0.201_3 to decimal

2.5

Convert 43.3_7 to base 8 using no more than one octal digit to the right of the radix point. Use for rounding style: truncation.

2.6

Represent 17.5_{10} in base 3, then convert the result back to base 10. Use two digits of precision to the right of the radix point for the intermediate base 3 form.

2.7

Find the decimal equivalent of the four-bit twos complement number 1000

2.8

Find the decimal equivalent of the four-bit ones complement number 1111

2.9

For a given word width, are there more representable integers in ones complement, twos complement or are they the same?

2.15

Represent 107.15_{10} in a floating-point representation with a sign bit, seven-bit excess 64 exponent, and a normalized 24-bit mantissa in base 2. There is no hidden bit. Truncate fraction if necessary

Note: normalization in this assignment is: point on the left of first 1 (→ 0.1xxx…).
For floating numbers we only use base 2.

2.16

For the following single-precision IEEE 754 bit pattern, show the numerical value as a base 2 significand with an exponent (e.g. 1.11×2^5)

```
a) 0 10000011 01100000000000000000000
b) 1 10000000 00000000000000000000000
c) 1 00000000 00000000000000000000000
d) 1 11111111 00000000000000000000000
e) 0 11111111 11010000000000000000000
f) 0 00000001 10010000000000000000000
g) 0 00000011 01101000000000000000000
```

2.17

Show the IEEE 754 bit pattern for the following numbers:

a) $+1.1011_2 \times 2^5$ (single precision). Note the mantissa in this number is base 2 (mantissa in decimal: $1.6875_{10} \times 2^5$)
you must be able to convert between base 2 and base 10.
b) +0 (single precision)
c) $-1.00111_2 \times 2^{-1}$ (double precision); mantissa is in base 2 (mantissa in decimal: $1.21875_{10} \times 2^{-1}$)

2.18

Using the IEEE 754 single precision format, show the value (not the bit pattern) of:

a) The largest positive representable number (note: ∞ is not a number)
b) The smallest positive nonzero number that is normalized
c) The smallest positive nonzero number in denormalized format
d) The smallest normalized gap
e) The largest normalized gap
f) The number of normalized representable numbers (including 0; note: ∞ and NaN are not numbers)

Exercise 1

Give the missing representations with the minimum number of digits

Base 2	Base 8	Base 16	Base 10	Base 9
010101010101				
	123			
		A0B		
			10	
				10

Exercise 2

Give the representation of the decimal value **-154** in the following representation using 10 bits.

Sign magnitude	
Signed= twos complement= 2-complement	
ones complement= 1-complement	
Excess 155	

Exercise 3
What is the decimal value of the signed fixed point number (base 2) 1100011with point 3 position from the right

Exercise 4
Give the unsigned fixed point representation in base 3 for the decimal value 12**.**34
Use 8 digits, point 4 position from the right. Use rounding style truncation.

Exercise 5
There is not a unique floating point number system. DEC introduced a 32 bit floating point number system with the following properties (base 2):

- Fraction field: 23 bits and additional 1 hidden bit. Point is left of hidden bit
- Exponent: 8 bits in excess 128 code
- Sign bit (0 is positive, 1 is negative).
- Number is not normalized if exponent field is filled with zero's. In that case the represented value (independent of sign and fraction field) is zero.
- Rounding style is truncation.

Questions:
For a) until f) the normalized numbers:

a) Max decimal value of the mantissa (M_{max})
b) Min decimal value of the mantissa (M_{min})
c) Max decimal value of the exponent (E_{max})
d) Min decimal value of the exponent (E_{min})
e) Largest positive decimal value that can be representend (V_{max})
f) Smallest positive decimal value that can be represented (V_{min})

g) What is the smallest positive decimal numbers that can be represented?
And what is the next positive value that can be exactly represented?
h) What is the representation of $2\ ^{9}/_{16}$?
i) What is the representation of the decimal value 0.2 ?
j) What decimal value is represented with the pattern:
1 00000111 11010000000000000000001