Homework 1

BASICS OF COMPUTING
(CSCE 101, SPRING 2007)
URL: `http://my.unl.edu`

Due on 1st February, 2007

16th January, 2007

Name :
Course No : **CSCE101**

Instructions:

- All work must be written neatly, with answers and the steps you used to obtain the answer clearly marked. If the grader cannot understand how you obtained your answer, points will be deducted. If your answers take more than one page, **staple** your homework. Failure to do so may result in portions of the homework being lost.
- You must **show all steps of your work for full credit**. Do not simply write final answers for a problem if it involves intermediate steps. In most cases, you will show your work in the same manner that you would for a math class. Writing a short essay describing how you solved the problem is unnecessary.
- The only way to submit your homework is in class at the beginning of the class when it is due.

1. (6 points)

   (a) Devangari script uses 36 consonant sounds, with a possibility of 12 vowel modifiers and one modification that will exclude a vowel sound. Thus, there is a possibility of 468 unique combinations for a consonant/vowel pair. Can these be represented using ASCII? Explain your answer.

   (b) What is the minimum number of bits we need to encode the consonent/vowel pairs?

2. (8 points) Consider a color picture that is stored as a bitmap containing 800 columns and 600 rows of pixels. Suppose that each pixel is represented with 3 color components (red, blue, and green), and that each color component is encoded with 1 byte.

   (a) How many pixels does the picture contain?

   (b) How much memory do we need to store the picture? Express your answer in both bits and KB.

   (c) How many 3.5 in. floppy disks would we need to store the picture? (A typical 3.5 in. floppy disk can hold 1.44 MB)

   (d) Suppose we want to improve the quality of the picture and increase the number of bits used to represent each color component from 8 to 16. How many floppy disks are now needed to store the picture?

3. (8 points) Suppose that we have a song that we would like to store on a computer. The song lasts 15 minutes and 34 seconds[1] and we sample the song at a rate of 44,100 samples per second. Further, assume the numeric value of each sample is between 0 and 65536.

   (a) How many samples do we need to take to record the entire song?

   (b) How many bits are necessary to store each sample?

   (c) How much memory do we need to store the entire song? Express your answer in terms of both bytes and MB.

   (d) How many 3.5 in. floppy disks would we need to store the song?

4. (5 points) Write the binary bit pattern that represents the following sentence using the ASCII character encoding standard. Separate each 8-bit character representation with some white space for ease of grading.

   Go Big Red!

   What is the equivalent hexadecimal representation?

[1] "Rapper's Delight", Sugarhill Gang.

5. (4 points) Convert the following hexadecimal strings to binary.

   (a) A3

   (b) 02

   (c) 79

   (d) D4

6. (4 points) Convert the following base-10 (decimal) numbers to unsigned binary.

   (a) 32

   (b) 45

   (c) 1023

   (d) 222

7. (4 points) Convert the following base-10 (decimal) numbers to 2's complement format.

   (a) -12

   (b) 8

   (c) 0

   (d) -41

8. (8 points) Solve each of the following problems by translating the values into 2's complement notation (using patterns of 5 bits), converting any subtraction problem to an equivalent addition problem, and performing that addition.

   (a)
   ```
     7
   +1
   ```

   (b)
   ```
    12
   –5
   ```

   (c)
   ```
     8
   -7
   ```

   (d)
   ```
     5
   +11
   ```

9. (10 points) Perform each of the following additions assuming the bit strings represent values in two's complement notation. Identify each case in which the answer is incorrect because of overflow.

(a)
```
  00101
+ 01000
-------
```

(b)
```
  01010
+ 00011
-------
```

(c)
```
  10111
+ 11010
-------
```

(d)
```
  01010
+ 10101
-------
```

(e)
```
  00111
+ 01100
-------
```

10. (4 points) Convert the following excess 32 representations to base-10.

    (a) `100000`

    (b) `011010`

    (c) `101101`

    (d) `001011`

11. (6 points) What range of integers can be represented with a 15 bit binary string? Answer this question for the (a) unsigned binary, (b) two's complement, and (c) excess notation.

12. (5 points) Express each of the following values in binary notation:

    (a) $5\frac{3}{4}$

    (b) $\frac{3}{16}$

    (c) $7\frac{5}{8}$

    (d) $6\frac{27}{32}$

    (e) $1\frac{3}{4}$

13. (6 points) What answer would be given to each of the following problems by a machine using the eight bit floating-point format described in Figure 1.26 in the book?

    (a) $1\frac{1}{2} + \frac{3}{16}$

    (b) $3\frac{1}{4} + 1\frac{1}{8}$

    (c) $2\frac{1}{4} + 1\frac{1}{8}$

14. (6 points) In each of the following addition problems, interpret the bit patterns using the eight-bit floating-point format presented in Figure 1.26, add the values represented, and encode the answer in the same floating-point format. Identify those cases in which truncation errors occur.

    (a)
    ```
      01011100
    +01101000
    ```

    (b)
    ```
      01111000
    +00011000
    ```

    (c)
    ```
      01101010
    +00111000
    ```

15. (6 points) The three bit patterns `01101000`, `10000010`, and `00000010` are representations of the same value in two's complement, excess, and the eight-bit floating-point format presented in figure 1.26, but not necessarily in that order. What is the common value, and which pattern is in which notation?

16. (6 points) Which of the following bit patterns are not valid representations in an excess 16 notation system?

    (a) `01001`

    (b) `101`

    (c) `010101`

    (d) `00000`

    (e) `000000`

    (f) `1111`

17. (4 points) What is the best approximation to the value one-tenth that can be represented using the eight-bit floating-point format described in Figure 1.26?