

CSC112                      Fall 2010  
Fundamentals of Computer Science  
Lab 3

In this lab we have two goals. First, we will work on fixing your VirtualBox/Ubuntu working environment. Secondly, we will explore some of the bit operations recently discussed in class.

**Additions to Virtual Box Software**

1. As you may recall, the user named “root” in UNIX systems is a user with elevated privileges. For this user, there is no such thing as a “permission denied” error message. Use with caution. First, we will need to set a root password. Boot into Ubuntu and open a terminal.

```
sudo /bin/tcsh
  << enter your password >>
passwd root

  << enter a root password >>
```

2. Insert the CD-ROM disc marked “VBox Additions”. The disc should mount automatically in 30 seconds or so.
3. Follow along with in-lab instructions.

**Using bit operations in C++ programs**

Create a directory named Lab3. Keep all of your source and compiled programs in the directory Lab3.

In this Lab, we will learn to use the bits in an unsigned integer to represent sets. In this case, we will represent a set of lower case letters. The low order bit represents the letter 'a'; the next higher order bit represents the letter 'b', and so forth down to 'z'. There are 32 bits (4 bytes) in a C++ type **unsigned int**, so there are more than enough bits to represent all 26 letters of the alphabet. For example, the number 3, in 32-bit binary:

00000000000000000000000000000011

represents the set { 'a', 'b' }. The number 41, in 32-bit binary:

0000000000000000000000000000101001

represents the set { 'a', 'd', 'f' }.

0. Write a C++ program that reads in two numbers, and stores those numbers as type “unsigned int”. Your program should then:
- (a) Print the sets corresponding to the two numbers.
  - (b) Use a bit-wise logical operator to compute the set union of the two sets. Print your result.
  - (c) Use a bit-wise logical operator to compute the set intersection of the two sets. Print your result.
  - (d) Use a bit-wise logical operators to compute the set difference. Print your result. Note: Given two sets  $A$  and  $B$ , the set difference, denoted  $A - B$  is defined as all the elements that are in  $A$ , but not in  $B$ .

Test your program with input 53208257 and 8904049. You should get the sets:

```
{ a g h k n o p q r t v y z }    and    { a e f g i k l m o p q r s x }
```

1. Write a C++ program that reads a sequence of lower case letters (up to the end-of-line) and computes the numerical representation (unsigned int described above) of the set. Output the unsigned int as a number. Your program should check that the input sequence consists of ONLY lower case letters. If some other character other than 'a' through 'z' is found before the end of line, your program should print an error message and exit. Use your program from part 0 to verify that this part is working correctly.

**Turn in:** Change to the directory containing the sub-directory “Lab3” Create a file named “lab3.tar” using the command:

```
tar cf lab3.tar Lab3
```

Upload the file “lab3.tar” to your account on telesto.