

CSCI 152.2
Fall 2004

Program 6

Due: Wed, 1 Dec

Emphasis on: Creating and using a class, Overloading Operator Functions

For program 6, you are to revisit program 2 to implement a set as a class. Your private variables will be an array of ints to represent a set and an int to store the number of values currently in the set.

You should provide public operations of:

- 1) Create and initialize an empty set (a constructor which sets size to zero)
- 2) Reset an existing set to empty (reset size to zero)
- 3) Add one value to a set
- 4) Set union
- 5) Set intersection
- 6) Set difference
- 7) Output a set

Removing duplicates, sorting, and searching could be implemented as private operations, since a client would probably not need to use those operations directly. However, you can make them public if you want to.

Your client application program will read set values from a text file as before, and your output should be the same as it was for program 2.

Program 6 Requirements:

- 1) You may not use the Standard Template set type or other predefined set functions.
- 2) You may assume that the data will be valid positive integers.
- 3) All sets should be maintained in ascending order with no duplicates.
- 4) Sets should be output as shown in the examples (values printed with a space or a comma between consecutive values and enclosed in curly braces).
- 5) The union, intersection, difference, and output functions in the class should be implemented as overloaded operator functions. If you want to implement the "Add one value to the set" operation as an operator function, overload operator+= (with return type of void) rather than operator+.

Here's a copy of the original Program 2 assignment (minus the program 2 requirements):

CSCI 152.2
Spring 2004

Program 2

Due: Thursday, 19 Feb

Emphasis on: One-Dimensional Arrays, Sorting, Searching, Input from a file

In the mathematical theory of sets, a set is defined as a collection of distinct (no two alike) items of the same type. In some programming languages, sets are a built-in data type. C++ does not have a built-in set type, though the Standard Template Library does provide a set type as an add-on to the language. We can simulate a set in any language using a one-dimensional array.

There are several operations that can be performed on sets. We will consider only three of them: union, intersection, and difference. These are binary operations requiring two sets as operands.

- The union of two sets A and B ($A + B$), is a set that contains elements that are in A or in B or in both.
- The intersection of two sets A and B ($A * B$) is a set that contains elements common to both A and B.
- The difference of two sets A and B ($A - B$) is a set that contains only the elements which are in A but not in B.

For example, if A and B are two sets of integers defined as
 $A = \{ 5, 7, 8, 10 \}$ and $B = \{ 3, 9, 10 \}$,
then their union ($A + B$) is the set $\{ 3, 5, 7, 8, 9, 10 \}$
their intersection ($A * B$) is the set $\{ 10 \}$
the difference of A and B ($A - B$) is the set $\{ 5, 7, 8 \}$
the difference of B and A ($B - A$) is the set $\{ 3, 9 \}$.

Input File

File **setdata.txt** contains an even number of lines of data. Each line represents the values to be assigned to a set. Each line contains up to 25 random positive integers with a space between consecutive integers. The integers are in no particular order, and a particular integer may appear more than once.

Example:

4 8 10 2 14 7 10 8

Processing

Write a program that repeats the following until end of file:

- 1) Read a line of data and store the input integers in set (array) A. Read another line of data and store the integers in set (array) B. Echo print both input sets.
- 2) Make sure that both arrays contain proper sets by eliminating duplicate values in each. Place set values in ascending order (while the order of set values is immaterial, the set is easier to read and more efficient to check if its values are in order, and it gives me an excuse to ask you to use a sort). You will probably find it easier to eliminate duplicates if you do the sort first.
- 3) Compute and print the union of A and B ($A + B$), the intersection of A and B ($A * B$), the difference of A and B ($A - B$), and the difference of B and A ($B - A$).

Example of the output format required:

$A = \{ 3 1 2 4 \}$

$B = \{ 8 4 6 5 3 6 4 \}$

$\{ 1 2 3 4 \} + \{ 3 4 5 6 8 \} = \{ 1 2 3 4 5 6 8 \}$

$\{ 1 2 3 4 \} * \{ 3 4 5 6 8 \} = \{ 3 4 \}$

$\{ 1 2 3 4 \} - \{ 3 4 5 6 8 \} = \{ 1 2 3 \}$

$\{ 3 4 5 6 8 \} - \{ 1 2 3 4 \} = \{ 5 6 \}$

More examples of set operations:

Set A		Set B		Resulting Set
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$\{ 1, 2, 3 \}$	+	$\{ 4, 5, 6 \}$	=	$\{ 1, 2, 3, 4, 5, 6 \}$
$\{ 1, 2, 3, 4 \}$	+	$\{ 2, 4, 6 \}$	=	$\{ 1, 2, 3, 4, 6 \}$
$\{ 1, 2, 3, 4 \}$	*	$\{ 2, 4, 6 \}$	=	$\{ 2, 4 \}$
$\{ 1, 2, 3 \}$	*	$\{ 4, 5, 6 \}$	=	$\{ \}$
$\{ 1, 2, 3, 4 \}$	-	$\{ 2, 4 \}$	=	$\{ 1, 3 \}$
$\{ 2, 4 \}$	-	$\{ 1, 2, 3, 4 \}$	=	$\{ \}$
$\{ 1, 2, 3, 4 \}$	-	$\{ 2, 4, 6 \}$	=	$\{ 1, 3 \}$
$\{ 2, 4, 6 \}$	-	$\{ 1, 2, 3, 4 \}$	=	$\{ 6 \}$
$\{ 1, 2, 3 \}$	-	$\{ 4, 5, 6 \}$	=	$\{ 1, 2, 3 \}$
$\{ 4, 5, 6 \}$	-	$\{ 1, 2, 3 \}$	=	$\{ 4, 5, 6 \}$
$\{ 1, 2, 3 \}$	-	$\{ 1, 2, 3, 4 \}$	=	$\{ \}$
$\{ 1, 2, 3, 4 \}$	-	$\{ 1, 2, 3 \}$	=	$\{ 4 \}$