

Sergio E. Garcia Tapia

*Algorithms* by Sedgewick and Wayne (4th edition) [SW11]

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## 3.5: Applications

**Exercise 1.** Implement `SET` and `HashSet` as "wrapper class" clients of `ST` and `HashST`, respectively (provide dummy values and ignore them).

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex01`.

**Exercise 2.** Develop a `SET` implementation by starting with the code for `SequentialSearchST` and eliminating all the code involving values.

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex02`.

**Exercise 3.** Develop a `SET` implementation `BinarySearchSET` by starting with the code for `BinarySearchST` and eliminating all the code involving values.

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex03`.

**Exercise 4.** Develop classes `HashSTint` and `HashSTdouble` for maintaining sets of keys of primitive `int` and `double` types, respectively. (Convert generics to primitive types in the code of `LinearProbingHashST`).

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex04`.

**Exercise 8.** Modify `LinearProbingHashST` to keep duplicate keys in the table. Return *any* value associated with the given key for `get()`, and remove *all* items in the table that have keys equal to the given key for `delete()`.

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex08`.

**Exercise 9.** Modify `BST` to keep duplicate keys in the tree. Return *any* value associated with the given key for `get()`, and remove *all* items in the table that have keys equal to the given key for `delete()`.

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex09`.

**Exercise 12.** Modify `LookupCSV` to associate with each key all values that appear in key-value pairs with that key in the input (not just the most recent, as in the associative-array abstraction).

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex12`.

**Exercise 13.** Modify `LookupCSV` to make a program `RangeLookupCSV` that takes two key values from the standard input and prints all key-value pairs in the `.csv` file such that the key falls within the range specified.

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex13`.

**Exercise 14.** Develop and test a static method `invert()` that takes as argument an `ST<String, Bag<String>>` and produces as return value the inverse of the given symbol table (a symbol table of the same type).

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex14`.

**Exercise 15.** Write a program that takes a string on standard input and an integer  $k$  as command-line argument and puts on standard output a sorted list of the  $k$ -grams (substrings of length  $k$ ) found in the string, each followed by its index in the string.

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex15`.

**Exercise 16.** Add a method `sum()` to `SparseVector` that takes a `SparseVector` as argument and returns a `SparseVector` that is the term-by-term sum of this vector and the argument vector. *Note:* You need `delete()` (and special attention to precision) to handle the case when an entry becomes 0.

**Solution.** See `com.segarciat.algs4.ch3.sec5.ex16`.

**Exercise 17.** *Finite mathematical sets.* Your goal is to develop an implementation of the following API for processing finite mathematical sets:

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```
public class MathSET<Key>
MathSet(Key[] universe)    // Create the empty set (using given universe)
void add(Key key)          // put key into the set
MathSET<Key> complement()  // set of keys in the universe that
    are not in this set.
void union(MathSET<Key> a)  // put any keys from a into the set that are
    not
// already there.
void intersection(MathSET<Key> a) // remove any keys from this set that are
    not in a.
void delete(Key key)        // remove key from the set
boolean contains(Key key)   // is key in the set?
boolean isEmpty()           // is the set empty?
int size()                  // number of keys in the set
```

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**Solution.** See `com.segarciat.algs4.ch3.sec5.ex17`.

## References

- [SW11] Robert Sedgewick and Kevin Wayne. *Algorithms*. 4th ed. Addison-Wesley, 2011.  
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