Data Structures and ADTs

- *Abstract Data Types (ADTs)* are user defined data types. An ADT has 2 parts:

  1. A name or type, specifying a set of data (e.g. `Dictionary`).
  2. Descriptions of all the operations (or methods) that do things with that type (e.g. `find, insert, remove`)

     The descriptions indicate *what* the operations do, not *how* they do it.

- A *data structure* is a systematic way of organizing and accessing data from a computer (e.g. array, linked list).

  Data structures are used to implement ADTs.

ADT Dictionary

`find (key)`:	returns a record with the given key, or null if no record has the given key
`insert(key,data)`:	inserts a new record with given key and data `ERROR` if the dictionary already contains a record with the given key
`remove(key)`:	removes the record with the given key `ERROR` if there is no record with the given key

Java Interface for ADT Dictionary

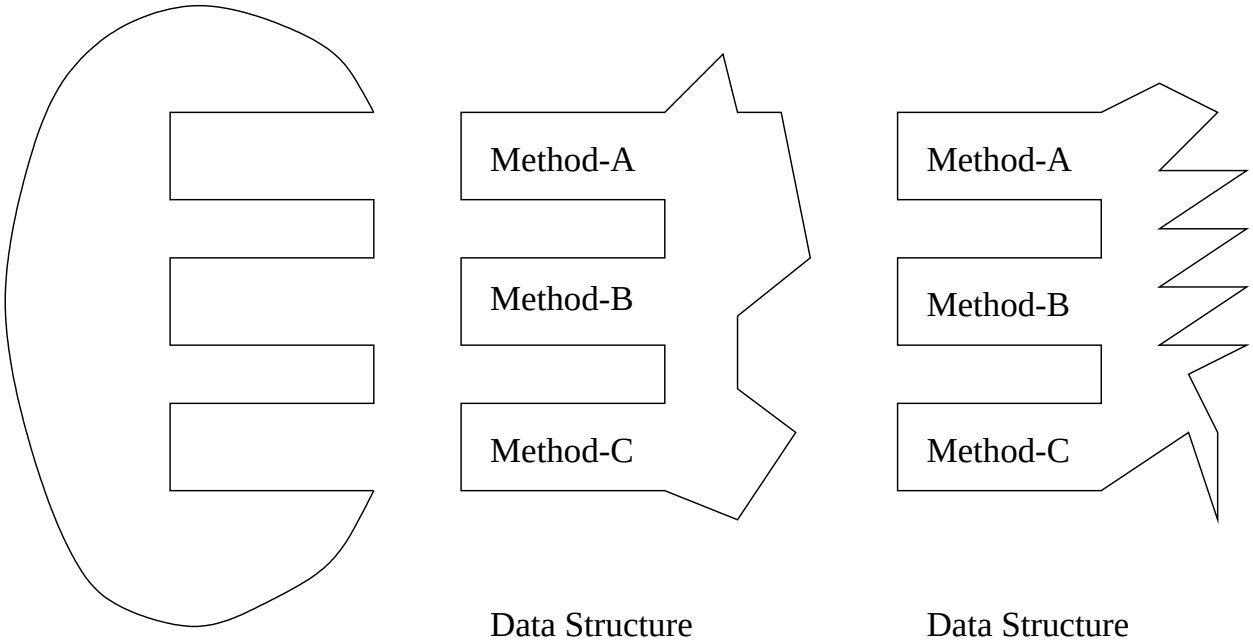
```
public interface Dictionary {

    public Object find(Object key);

    public void insert(Object key, Object data)
                    throws DuplicatedKeyException;

    public void remove(Object key)
                    throws NoKeyException;

}
```

A Java Implementation for ADT Dictionary

```
public class LinkedListDictionary implements Dictionary {

    protected int size;
    protected DNode head, tail;

    public LinkedListDictionary() {

        size = 0;
        head = new DNode(null, null,null);
        tail = new DNode(null,null,null);
        head.setNext(tail);

    }

    public Object find(Object key) {

        if (size == 0) return null;
        else {
              ⋮
        }

    }

    public void insert (Object key, Object data) throws
          DuplicatedKeyException {

        ⋮

    }
```

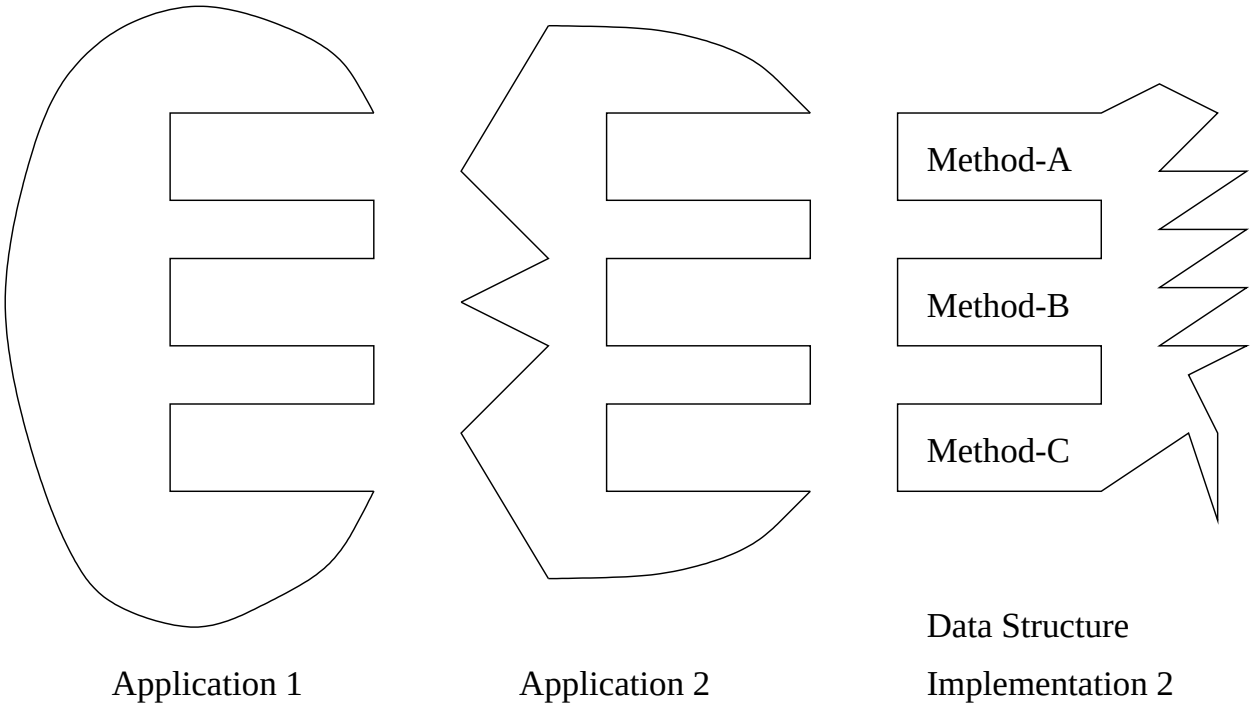
Abstract Data Types

- Preferred way of designing and implementing data structures.
- Uses 2 general principles: information hiding and re-usability.
- Information hiding:
  - User data structure should not need to know details of its implementation.
  - We should be able to change implementation without affecting applications that use it.
  - Therefore, implementation information should be hidden.



Re-usability

- Re-usability:
  - If data structure is useful for one application, it is probably useful for another.
  - Therefore, we should design it to be as re-usable as possible.



The Position ADT

`Position` is an ADT with just one operation:

`element()`: Returns the data item stored at this position.