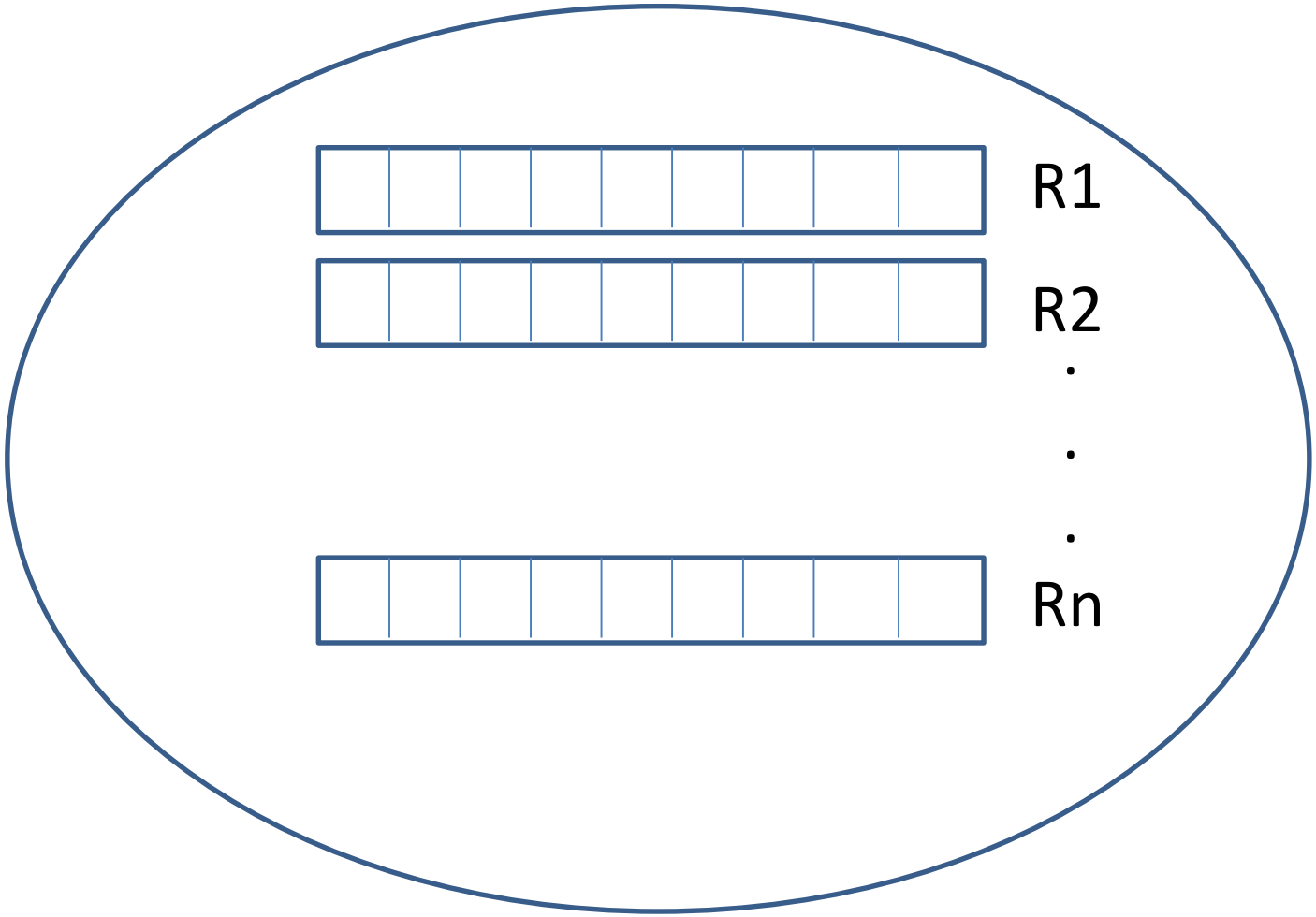
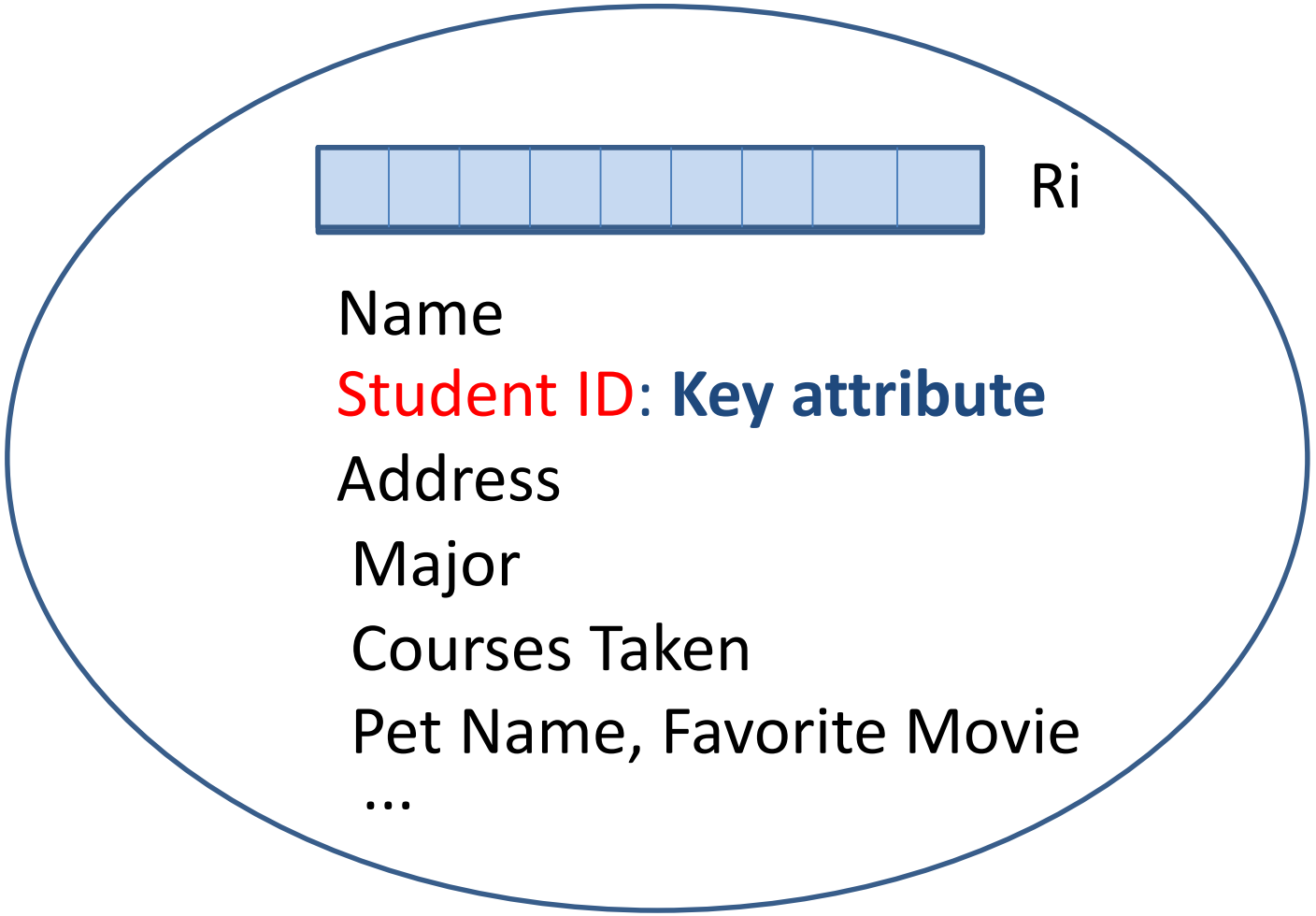
UWO Student Information System

Data: Set of student records.



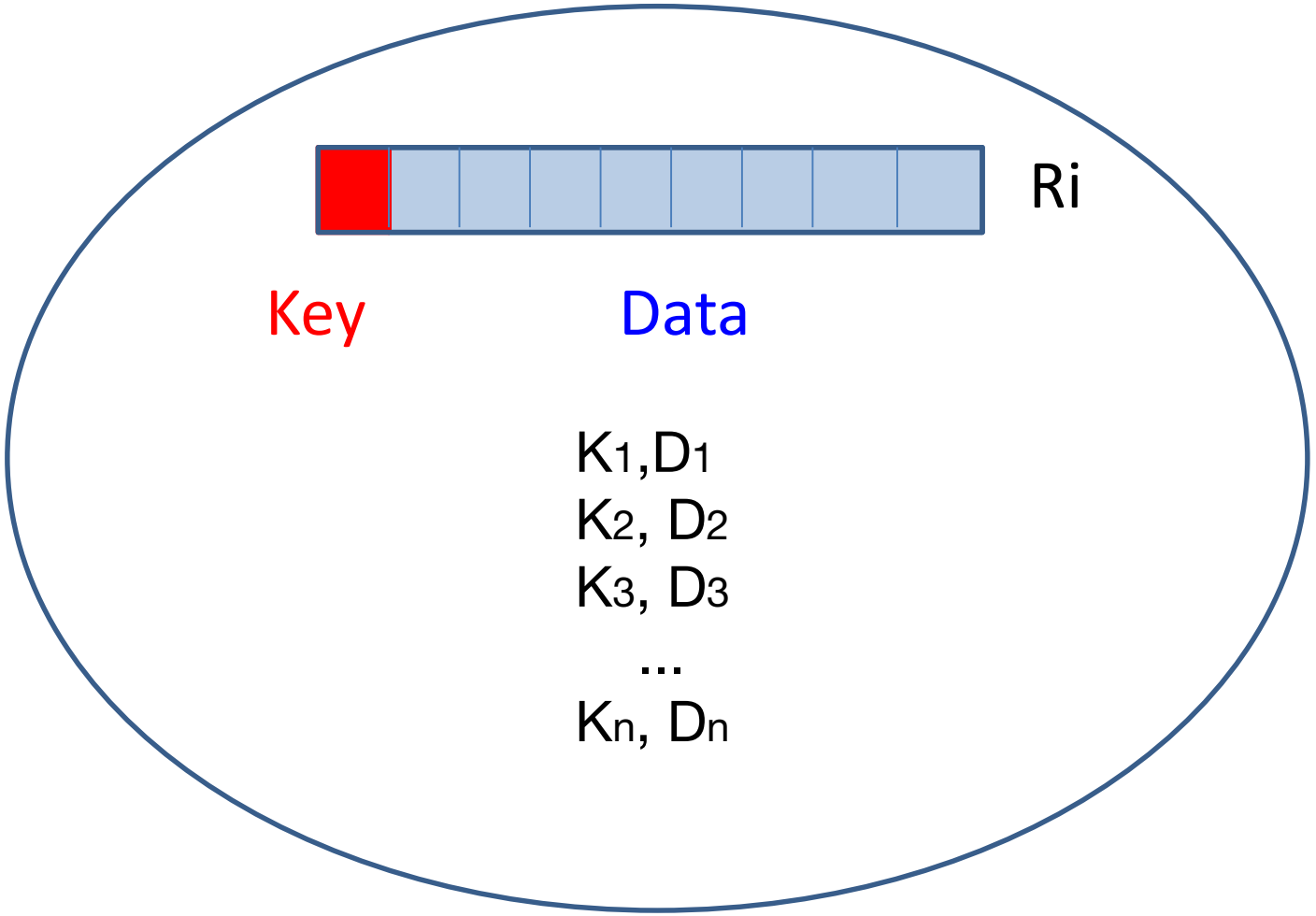
Student Information System

Each record has a unique key attribute.



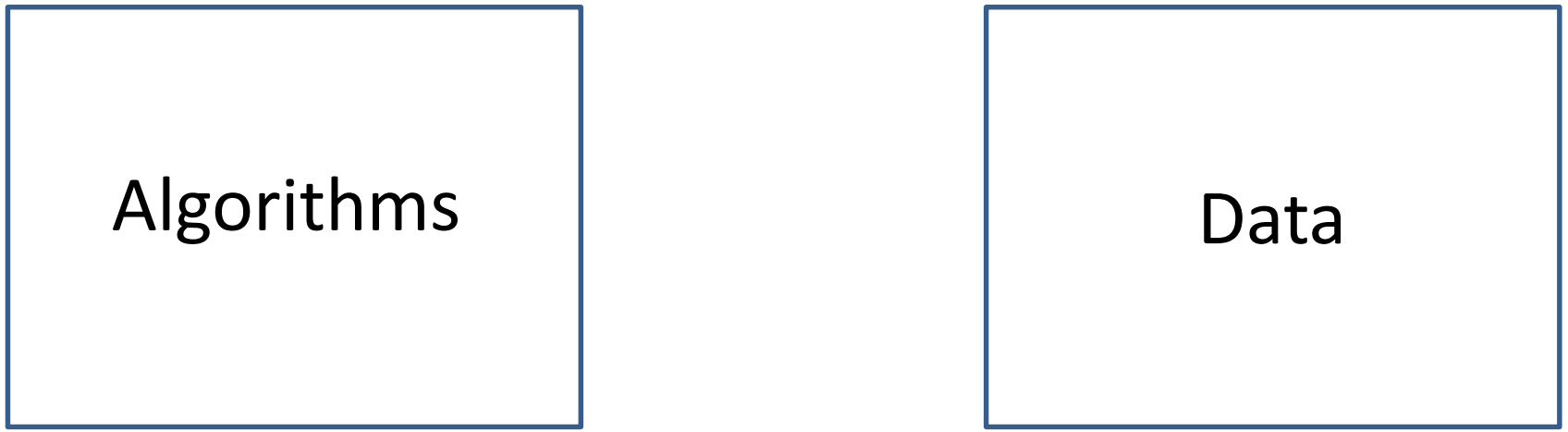
Student Information System

So we can view a record as a pair (key,data)



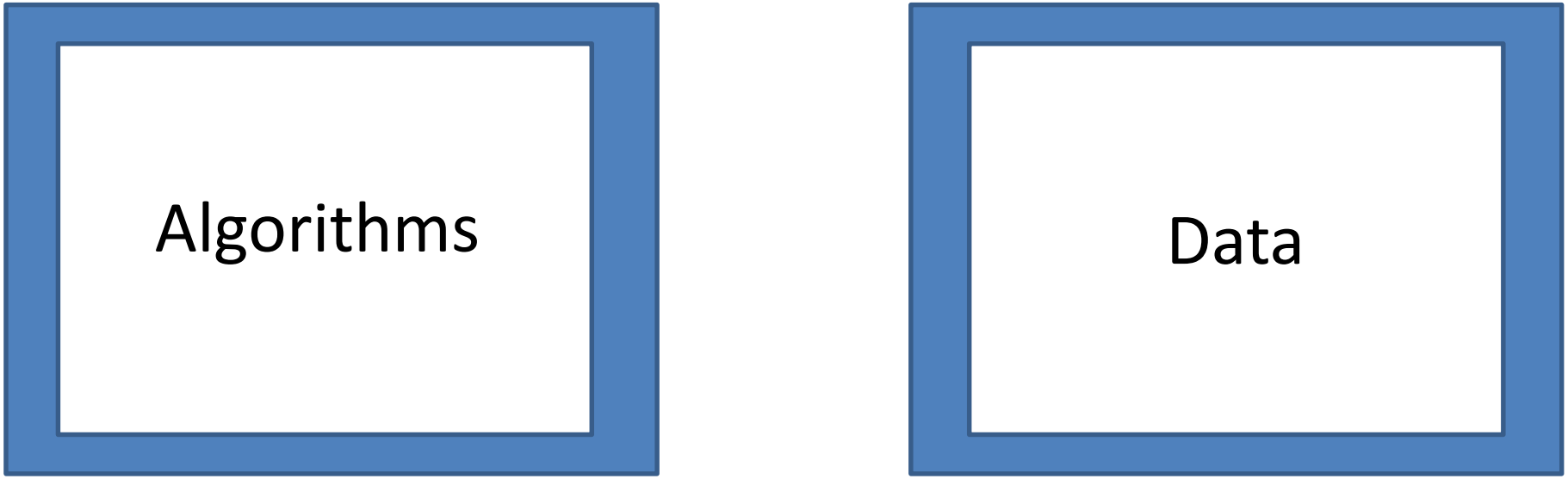
Organization of a Program

When we design a program we organize it into modules



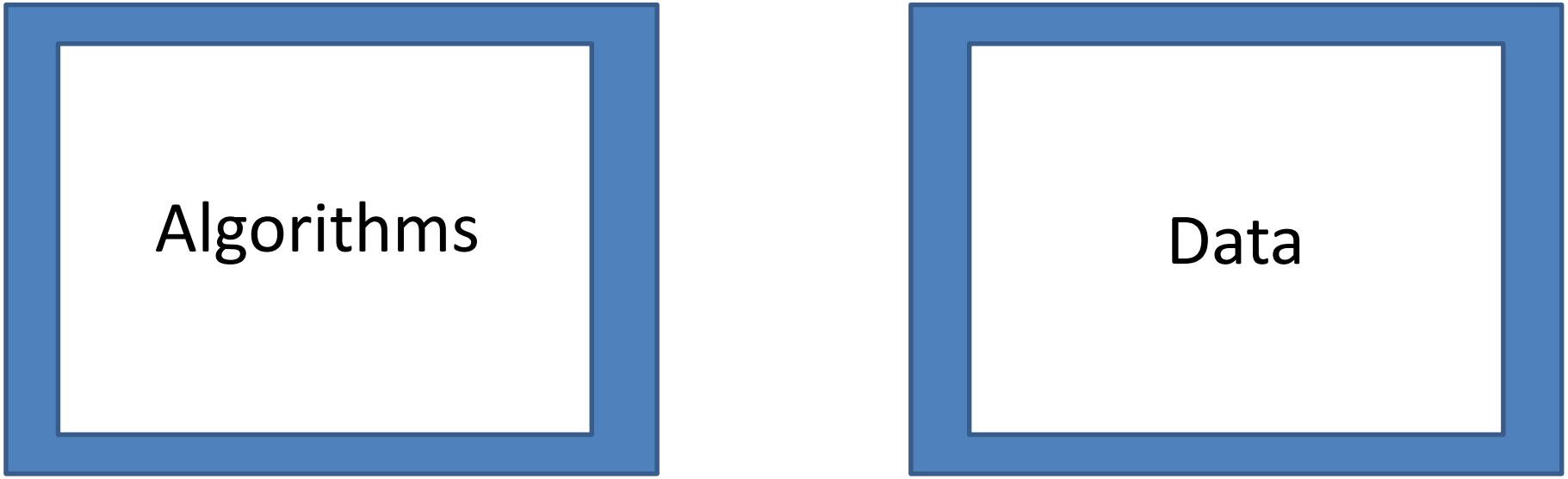
Organization of a Program

We wish to keep the information inside a module private



Organization of a Program

Assume we are asked by the University to design a system to print student records, store information for new students, and discard information from students who have graduated.



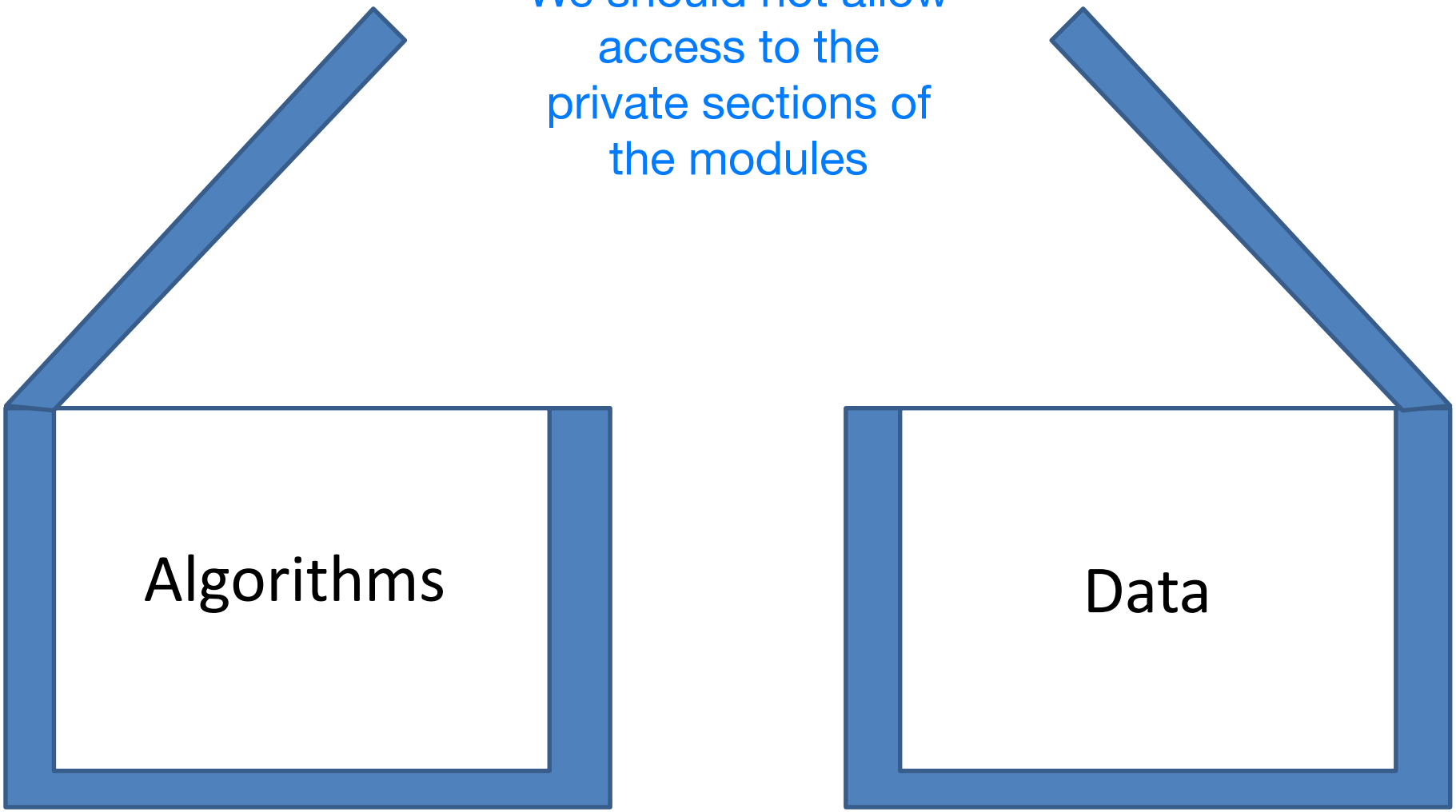
UWO Student Information System

```
Algorithm InformationSystem ()
Display user interface (UI)
While there are more operations to process do {
    Read next operation from the UI
    If operation is ADD then
        Read student information from UI: ID, data
        Put new record (ID,data) in the data module
    else if operation is REMOVE then {
        Read ID from UI
        Remove record with key ID from data module
    }
    else if operation is TRANSCRIPT then {
        Read ID from UI
        Get record from data module with given student ID
        Print transcript
    }
}
```

The parts red in of this algorithm red interact with the data module.

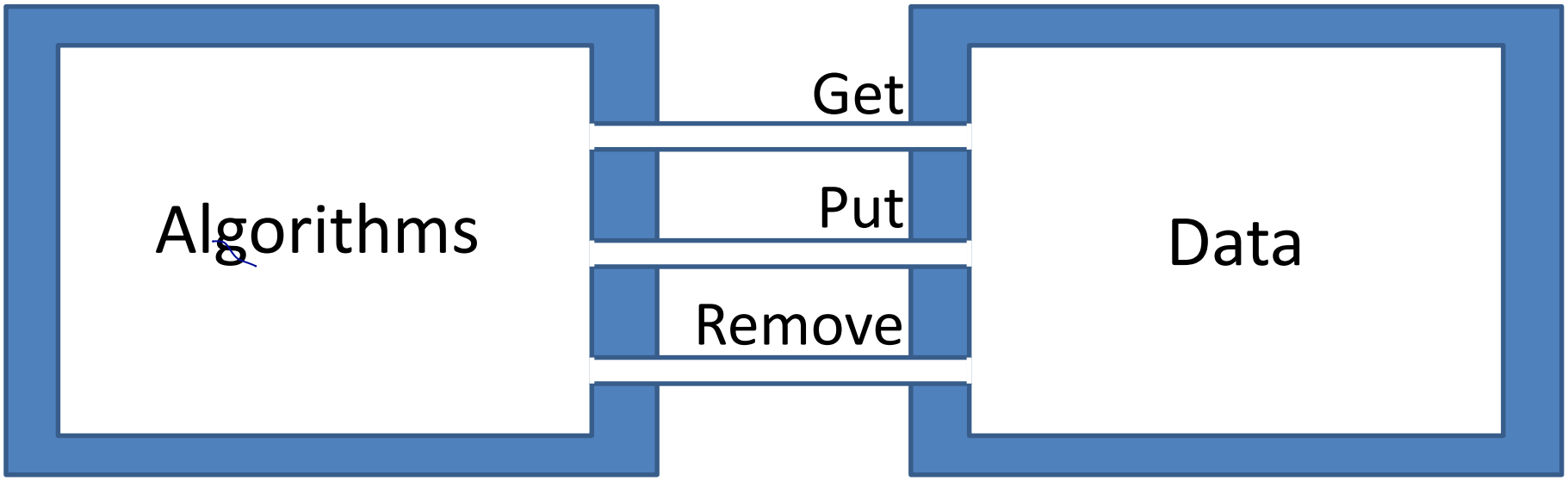
Organization of a Program

We should not allow access to the private sections of the modules



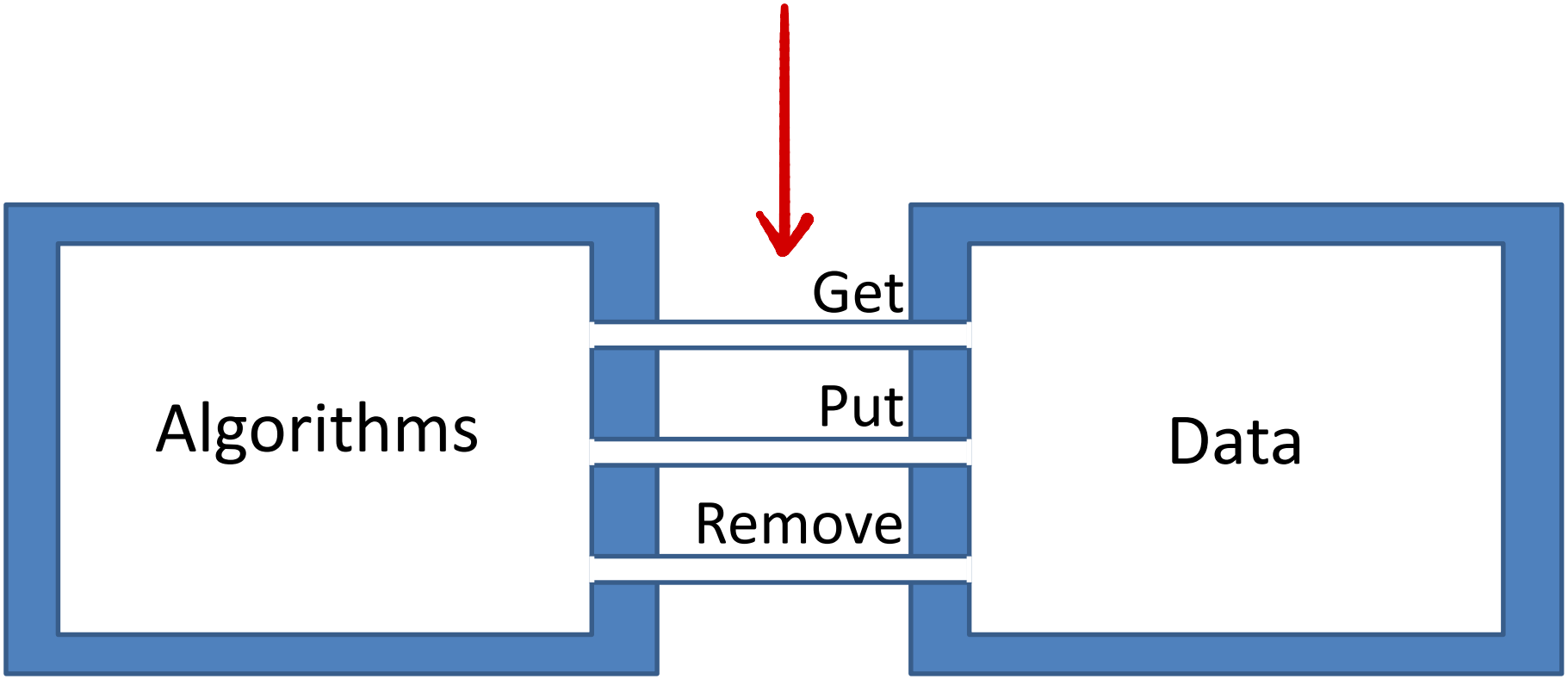
Organization of a Program

Instead, we provide controlled access to the data module



Organization of a Program

Interface
(An interface defines an
Abstract Data Type)



Data Structures and ADTs

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

- A name or type, specifying a set of data (e.g. Dictionary or Map).
- Descriptions of all the operations (or methods) that manipulate that type (e.g. get, put, remove)

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

ADT Dictionary or Map

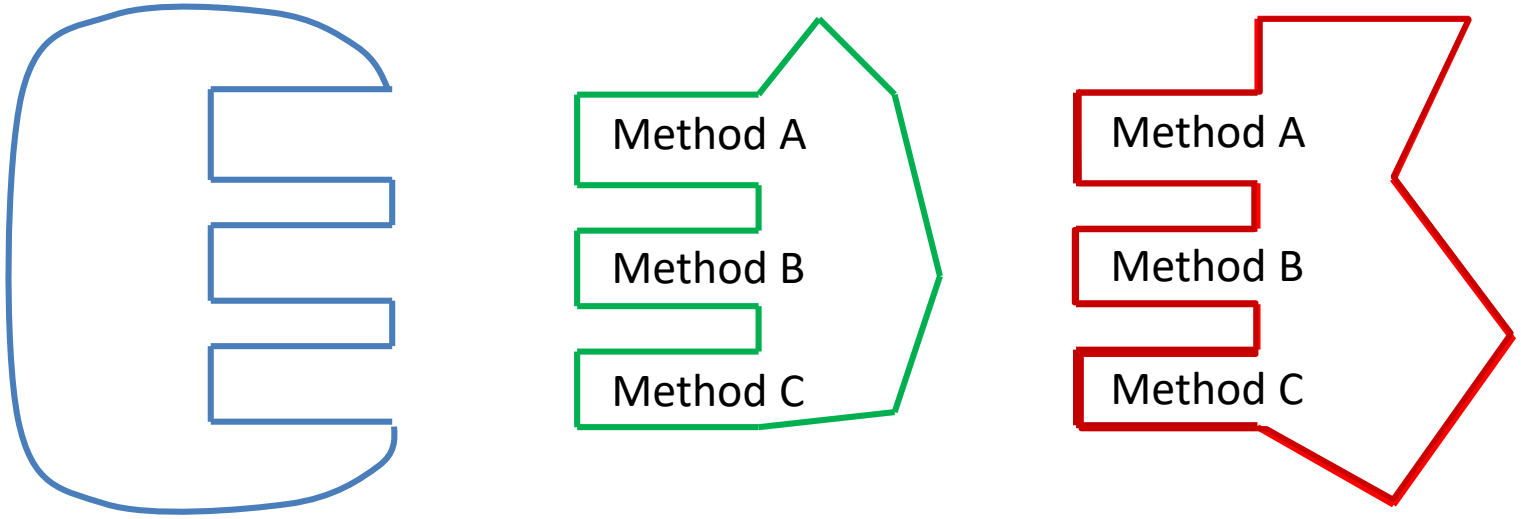
- **get (key):** returns the data associated with the given key, or
  null if no record has the given key
- **put(key,data):** inserts a new record with given key and data, or
  ERROR if the dictionary already contains a record with the given key
- **remove(key):** removes the record with the given key, or *ERROR* if there is no record with the given key

Abstract Data Types

- Preferred way of designing and implementing data structures.
- Uses 2 general principles: information hiding and reusability.

Information Hiding

- The application that uses the data structure should not need to know details of its implementation.
- We should be able to change implementation without affecting applications that use it, so implementation information should be hidden.



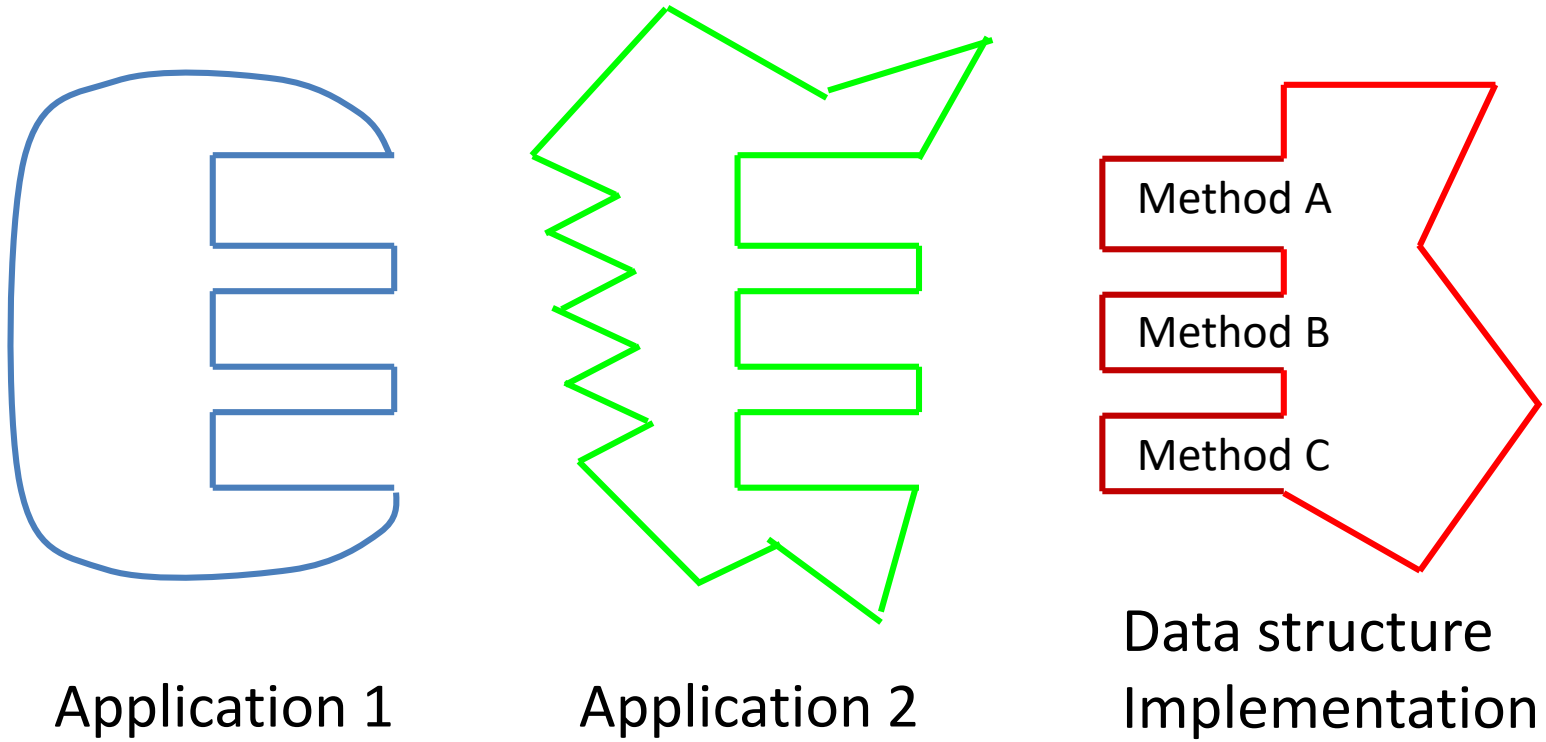
Application

Data structure Implementation 1

Data structure Implementation 2

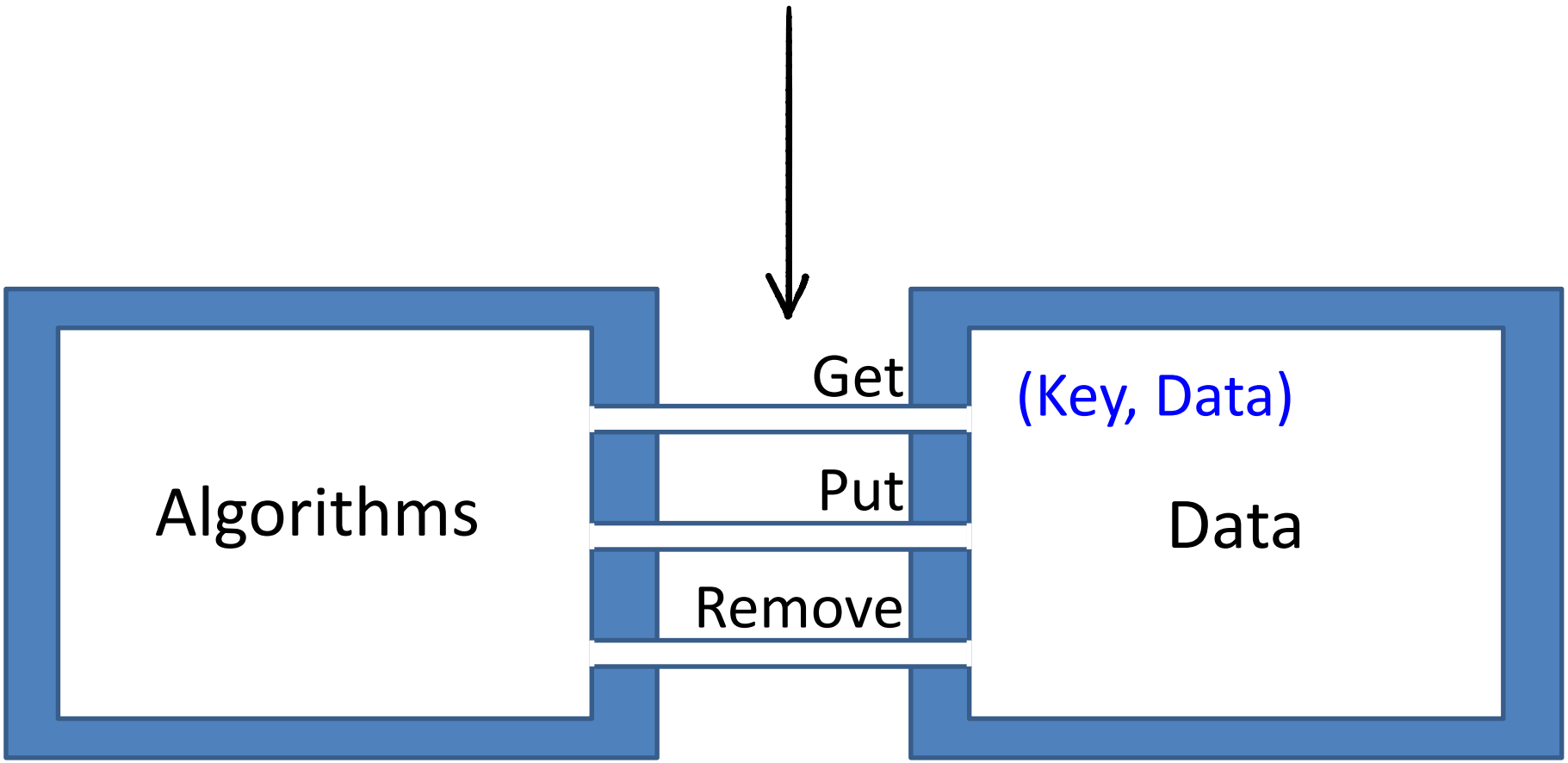
Re-usability

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



Organization of a Program

We will study now the ADT that provides these 3 operations



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Java Interface for ADT Dictionary

```
public interface Dictionary <K,V>{
    public V get(K key);
    public void put(K key, V data) throws
                                        DuplicatedKeyException;
    public void remove(K key) throws NoKeyException;
}
```

Java Implementation for ADT Dictionary

```
public class LinkedListDictionary <K,V> implements Dictionary {
    private int size;
    private DNode head, tail;
    public LinkedListDictionary() {
        size = 0;
        head = new DNode(null, null,null);
        tail = new DNode(null,null,null);
        head.setNext(tail);
    }
public V get(K key) {
    if (size == 0) return null;
    else { ... }
...
```