

Data Types

A variable's **data type** (or simply **type**) determines its possible values and operations.

Possible values

```
int course;  
course = 33;  
course = -33;
```

```
String course;  
course = "33";  
course = "-33";
```

```
course = 3.14;
```

```
course = "3.14";
```

Possible operations

```
(33 + 2) == 35
```

```
("33" + "2").equals("332")
```

```
course.equals(33)
```

Cannot call equals

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Abstract Data Types (ADTs)

Java interfaces represent the software design concept of abstract data types.

An **abstract data type** is a data type that does not specify any one implementation.

Data structures implement ADTs.

Resizable array can implement List, Stack, Queue, Deque, PQ, etc.

Linked nodes can implement List, Stack, Queue, Deque, PQ, etc.

List ADT A collection storing an ordered sequence of elements.

- Each element is accessible by a zero-based index.
- A list has a size defined as the number of elements in the list.
- Elements can be added to the front, back, or any index in the list.
- Optionally, elements can be removed.

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?: What is an example of an impossible value and an impossible operation for String?

?: Why not just use ArrayList all the time?

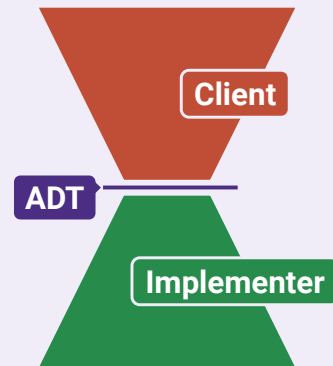
Q Hiding Program Complexity

Abstract data types hide implementation details from clients (users of ADTs).

Contract Description of an ADT's possible values and operations

What are the consequences of breaking the contract?

When might it be useful to know the implementation details of an ADT's values or operations?



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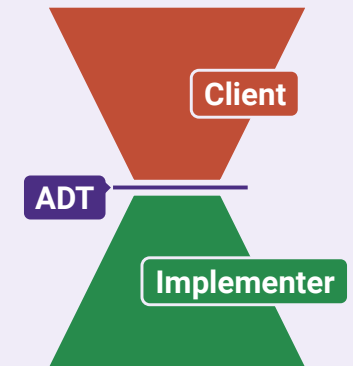
Q Representation Invariants

Abstract data types hide implementation details from clients (users of ADTs).

Contract Description of an ADT's possible values and operations

Invariant An assumption that the implementer needs to maintain

In an ArrayList, the i -th item of the list (ADT) is always stored at array index i (data structure). **Give an example of an operation that is very slow on ArrayList.**



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Q1: What are the consequences of breaking the contract?

Q1: Give an example of an operation that is very slow on ArrayList.

Q2: When might it be useful to know the implementation details of an ADT's values or operations?