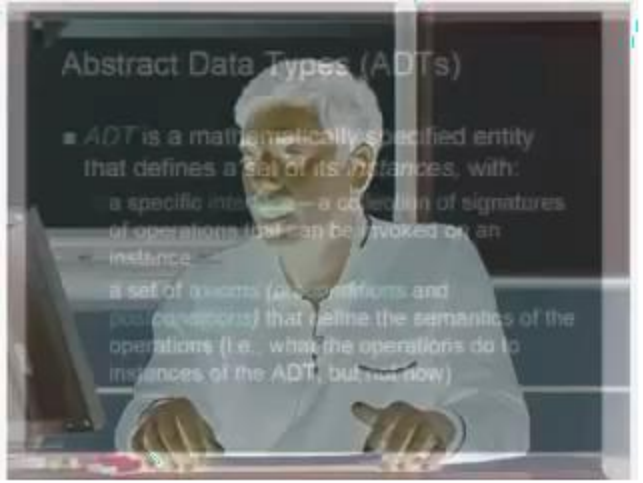
Stacks

- Abstract Data Types (ADTs)
- Stacks
- Interfaces and exceptions
- Java implementation of a stack
- Application to the analysis of a time series
- Growable stacks
- Stacks in the Java virtual machine


Abstract Data Types (ADTs)
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a specific interface – a collection of signatures of operations that can be invoked on an instance
a set of axioms (preconditions and postconditions) that define the semantics of the operations (i.e., what the operations do to instances of the ADT, but not how)

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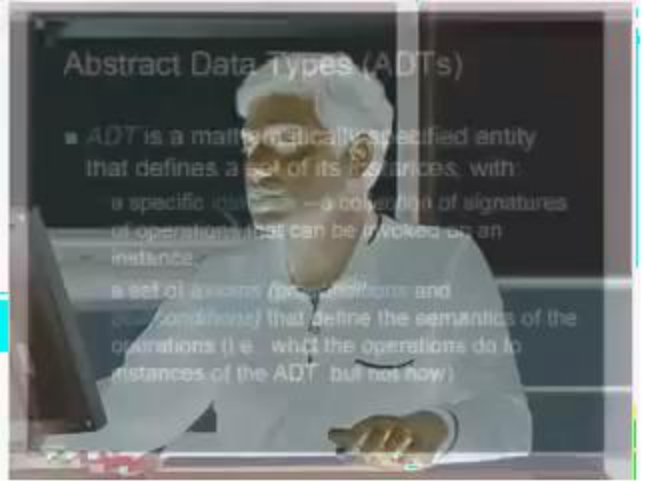
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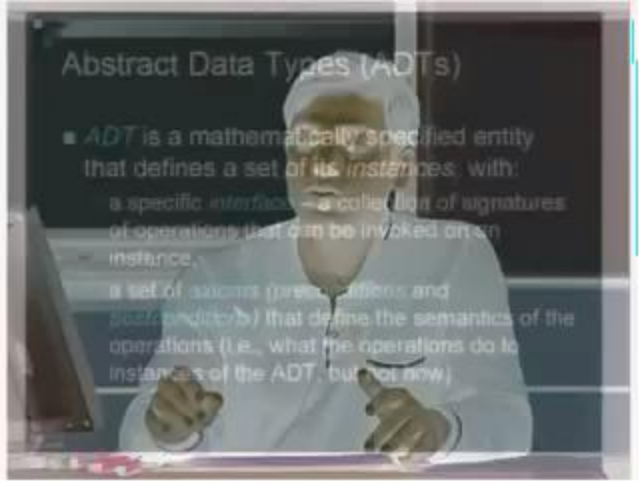
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Abstract Data Types (ADTs)

Types of operations:

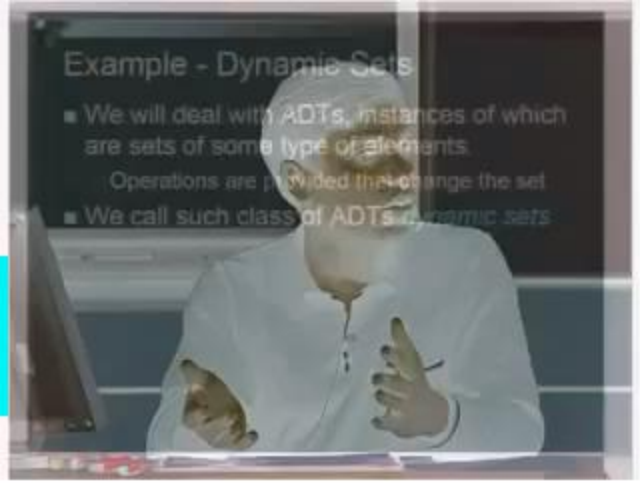
- Constructors
- Access functions
- Manipulation procedures

Abstract Data Types

- Why do we need to talk about ADTs in a DS course?
  - They serve as *specifications* of *requirements* for the building blocks of solutions to algorithmic problems
  - Provides a language to talk on a higher level of abstraction
  - ADTs encapsulate *data structures* and algorithms that *implement* them
  - Separate the issues of *correctness* and *efficiency*

Example - Dynamic Sets

- We will deal with ADTs, instances of which are sets of some type of elements.
  - Operations are provided that change the set
- We call such class of ADTs *dynamic sets*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Dynamic Sets (2)

- An example dynamic set ADT
  - Methods:
    - **New()**:*ADT*
    - **Insert(S**:*ADT*, **v**:*element*)**:***ADT*
    - **Delete(S**:*ADT*, **v**:*element*)**:***ADT*
    - **IsIn(S**:*ADT*, **v**:*element*)**:***boolean*
  - **Insert** and **Delete** – *manipulation* operations
  - **IsIn** – *Access method* method

Dynamic Sets (2)

- An example dynamic set ADT
  - Values: finite subsets of some type of elements
  - Operations are provided that change the set
    - New():*ADT*
    - Insert(S:*ADT*, v:*element*):*ADT*
    - Delete(S:*ADT*, v:*element*):*ADT*
    - IsIn(S:*ADT*, v:*element*):*boolean*
  - **Insert** and **Delete** – *manipulation* operations
  - **IsIn** – *Access method* method
- We call such class of ADTs *dynamic sets*

Dynamic Sets (3)

- Axioms that define the methods:
  - **IsIn(New(), v)** = *false*
  - **IsIn(Insert(S, v), v)** = *true*
  - **IsIn(Insert(S, u), v)** = **IsIn(S, v)**, *if v ≠ u*
  - **IsIn(Delete(S, v), v)** = *false*
  - **IsIn(Delete(S, u), v)** = **IsIn(S, v)**, *if v ≠ u*