# Object Oriented Programming and Design in Java

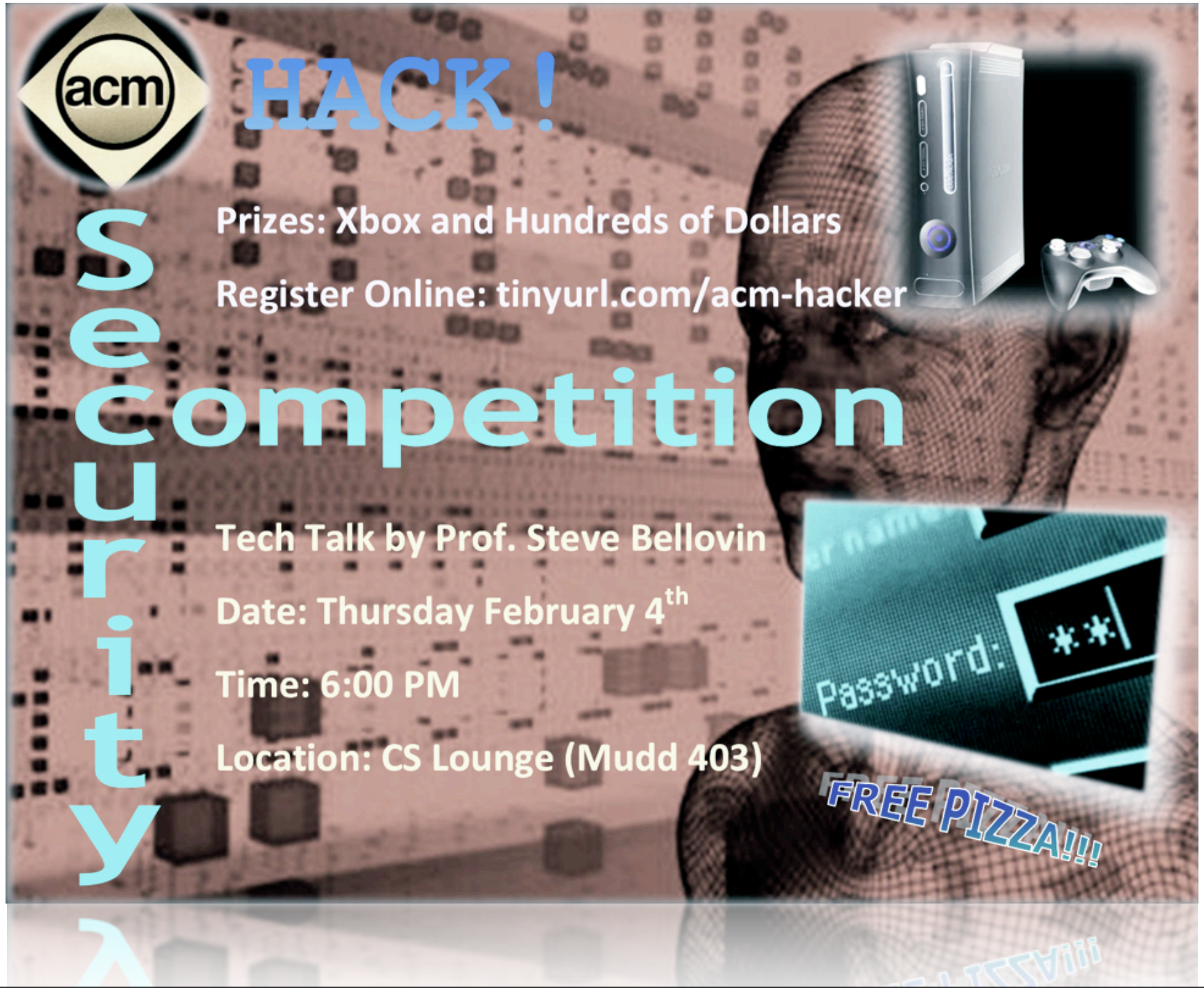
Session 4

Instructor: Bert Huang

# Announcements

- ACM competition
- Homework 1 officially out
  - due Feb. 17th 11 AM

Image inverted for projection



# Homework 1

- Battleship against computer via text interface
- Start ASAP
- Use O.H. and email to bounce design ideas off the TAs and me
- Academic honesty
- Have fun!

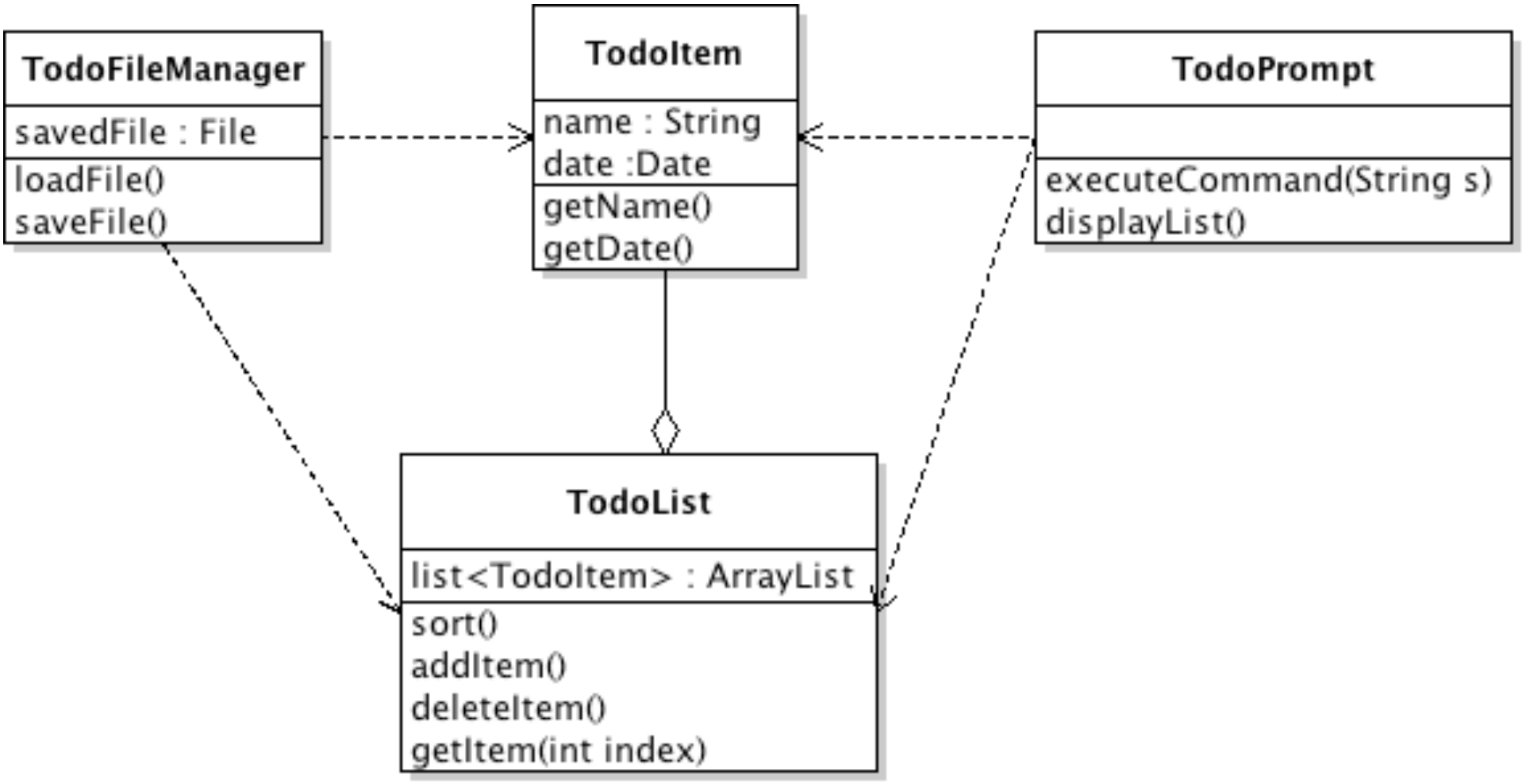
# Review

- Turning ideas into a program
  - Use cases
  - identifying classes and responsibilities
  - UML diagrams: class diagram, sequence diagram, state diagram
- Example: todo list manager
- Reading voice mail example

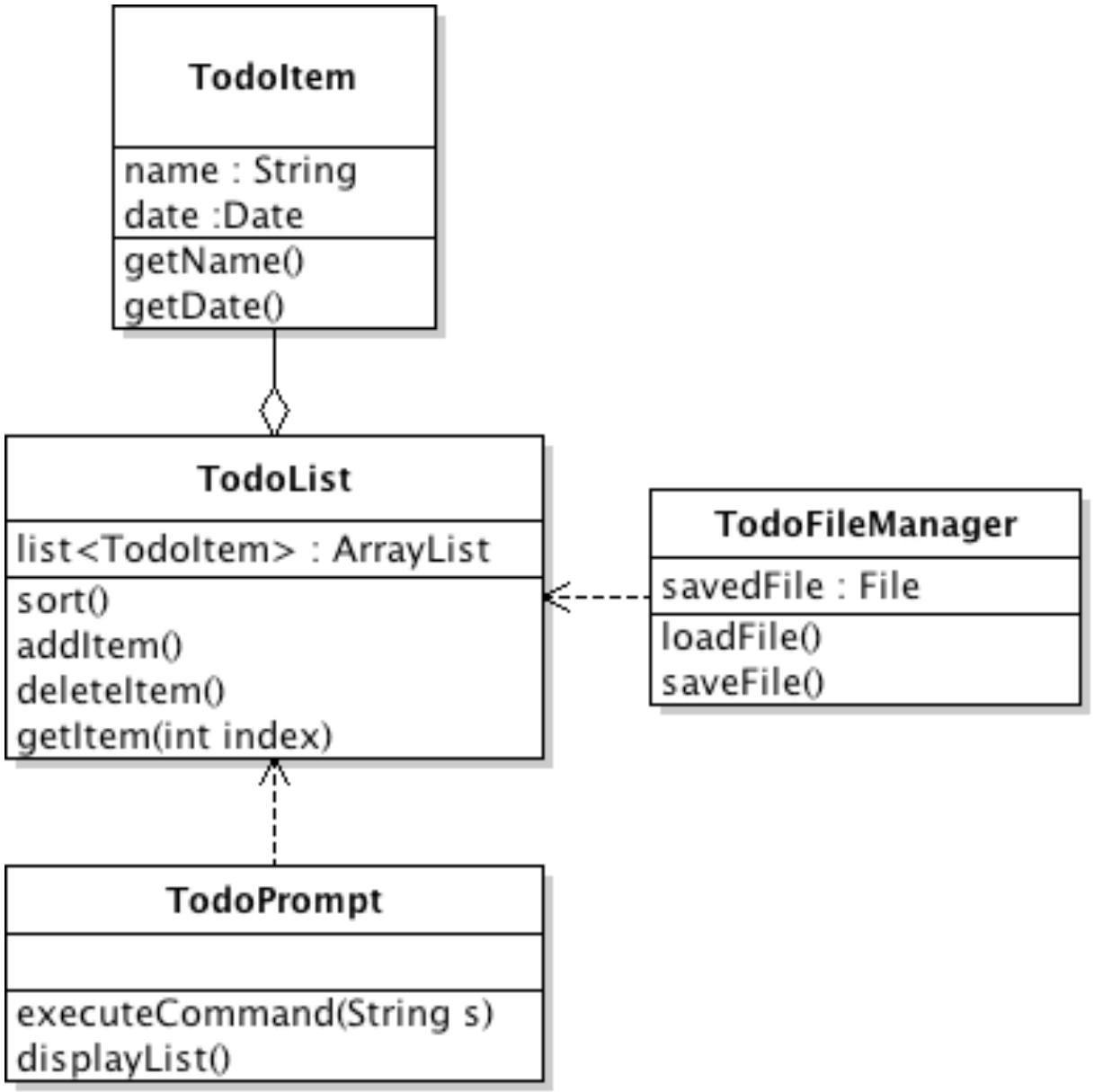
# Today's Plan

- Review example from end of last class
- Designing classes
  - encapsulation
  - accessors/mutators
  - programming by contract

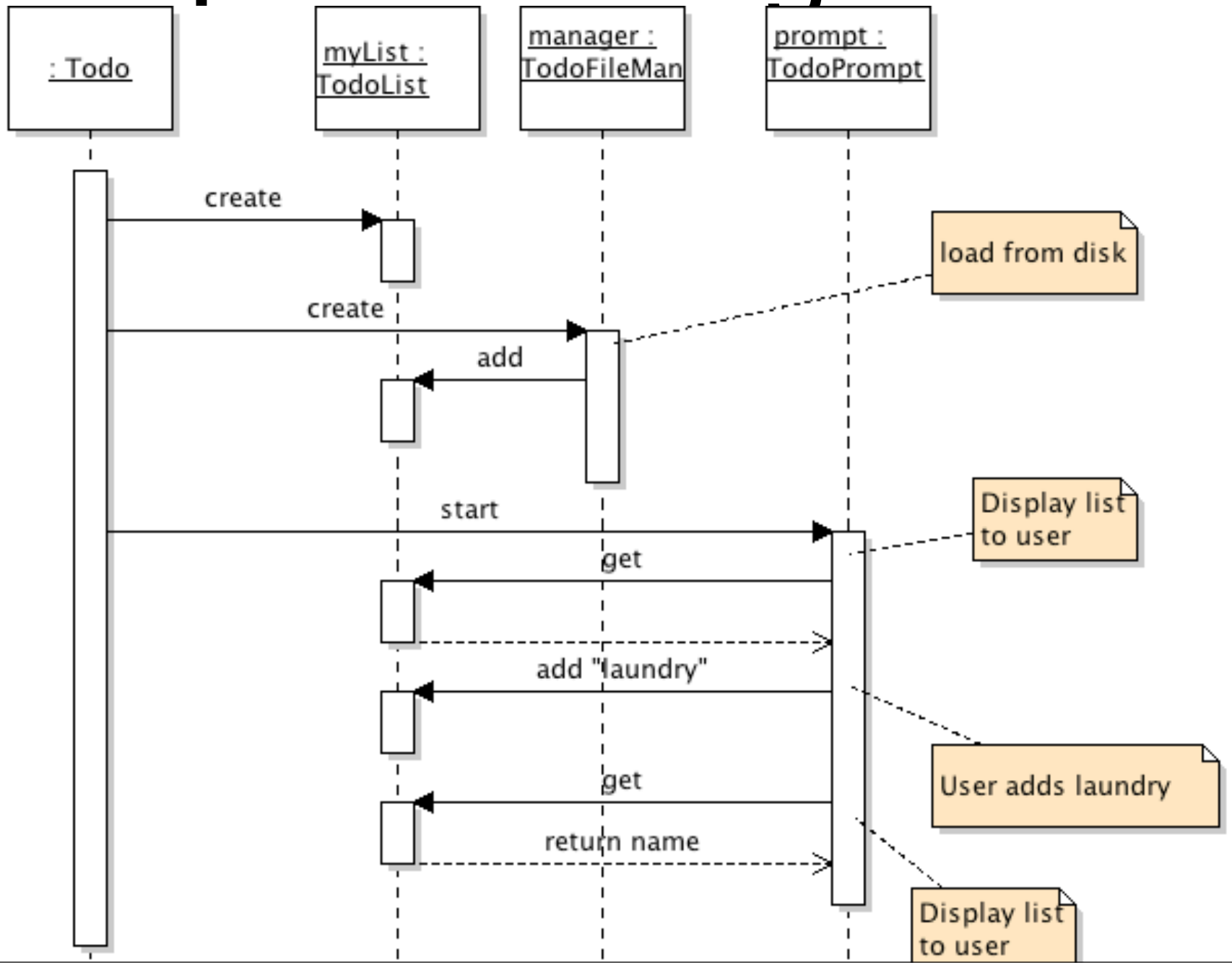
# Class Diagram



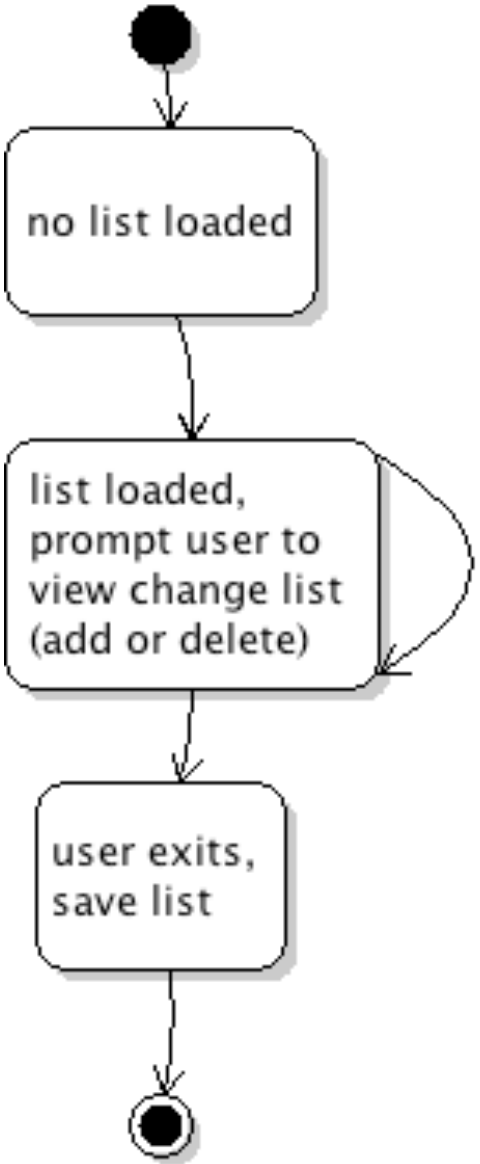
# Class Diagram



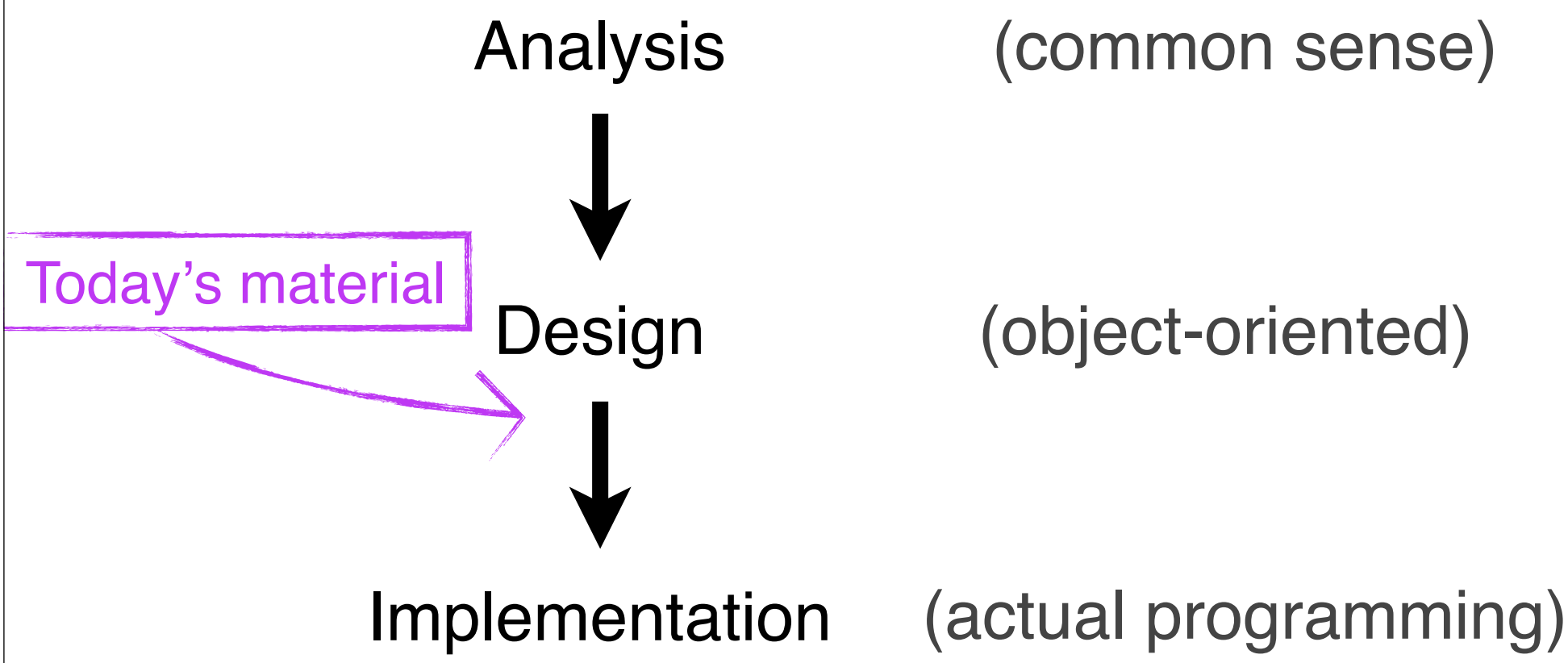
# Sequence Diagram 1



# State Diagram



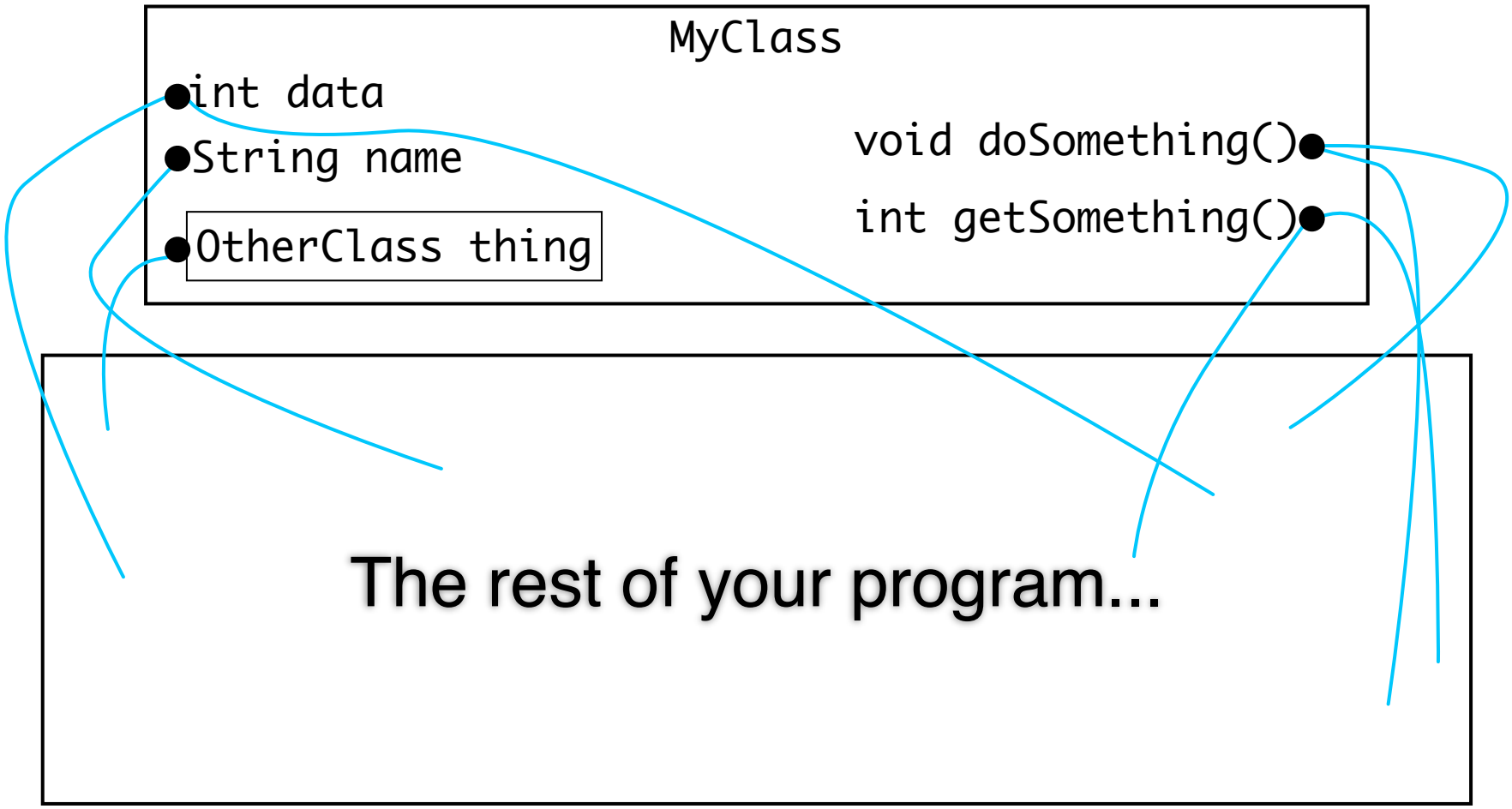
# Ideas to Programs



# Designing Classes

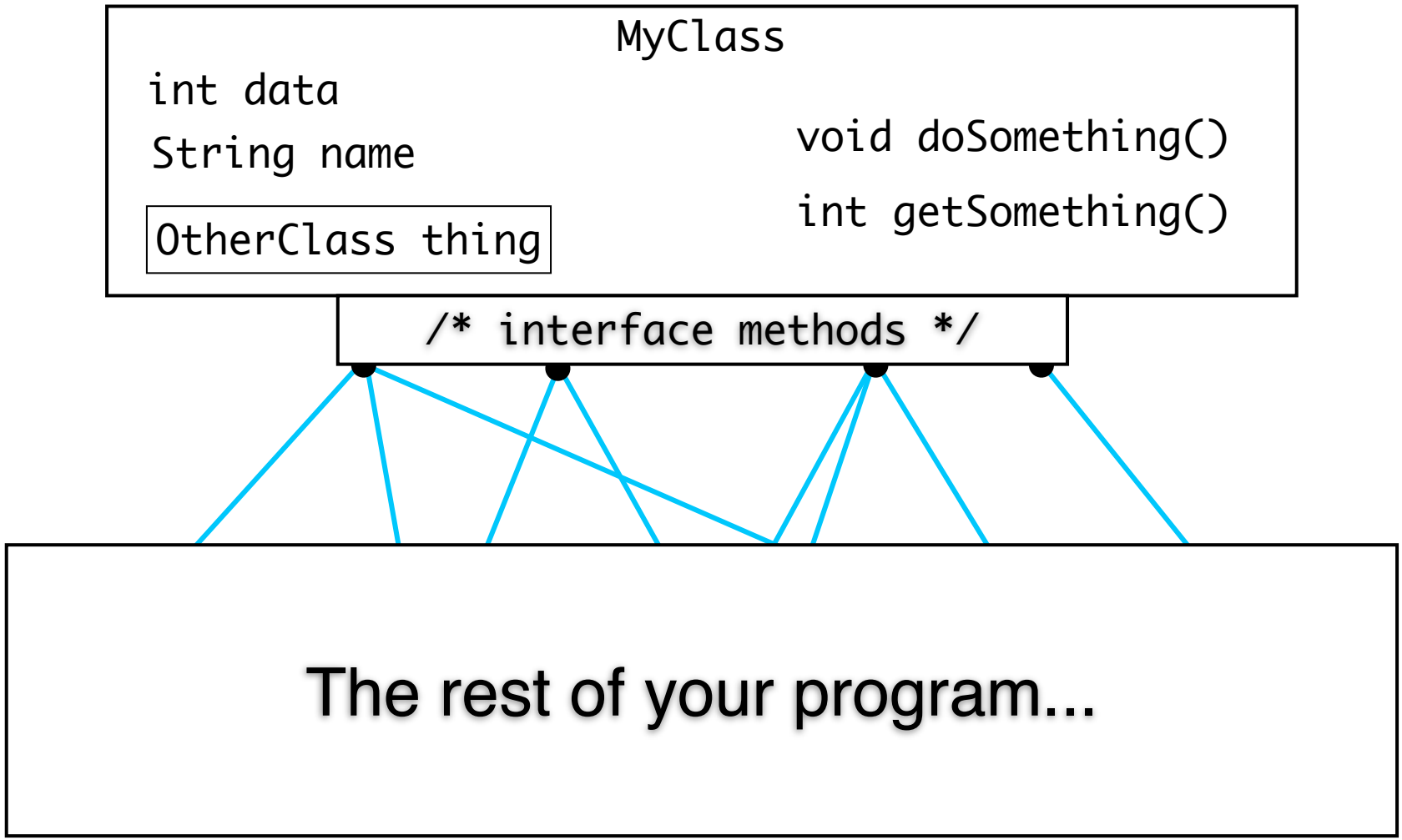
- Even simple classes have various **design** decisions:
  - How much error checking?
  - How much power should the user have?
  - How far “under the hood” can the user see?

# Why Encapsulation?




No encapsulation

# Why Encapsulation?




Encapsulation

# Why Encapsulation?

- Easier changes to implementation
- Control of inputs and outputs
- Less old code to have to maintain when updating
- When changes are made, easier to find what code is affected

# Good Interfaces

- **Cohesion** - represent only one concept
- **Completeness** - does everything you'd expect
- **Convenience** - some syntactic sugar,

```
BufferedReader(new InputStreamReader(System.in))
```

- **Clarity** - behavior of class should be easy to explain accurately
- **Consistency** - naming conventions, etc

# Accessors vs. Mutators

- Methods to handle data members
- **Accessors** for reading
- **Mutators** for writing/modifying
- Keep them separate

# Side Effects

- Avoid methods with side effects
- Calling accessors repeatedly should yield same result
  - counterexample: Scanner.nextLine()
- Mutators should change things in an obvious way

# Programming by Contract

- Another formalism to help organization
- All methods and classes have "contracts" detailing responsibilities
- Contracts expressed as **preconditions**, **postconditions**, and **invariants**

# Preconditions

- Condition that must be true before method is called
  - e.g., indices must be in range, objects must not be null
- Limits responsibilities of your method

# Assertions

- You can check preconditions before executing on bad input using assertions
- Java includes assertions via
  `assert (boolean) : “explanation”;`
- When assertions enabled, program exits and displays explanation
- java -enableassertions MyProgram

# Postconditions

- Conditions guaranteed to be true after method runs
  - e.g., after calling sort(), ToDoList elements are sorted by due date
- Useful when in addition to @return tags
  - I.e., usually involves mutators or side effects

# Invariants

- General properties of any member of a class that are always true
  - e.g., ToDoList is always sorted
- *Implementation invariants* are useful when building the class
- *Interface invariants* are useful when using the class

# Exceptions

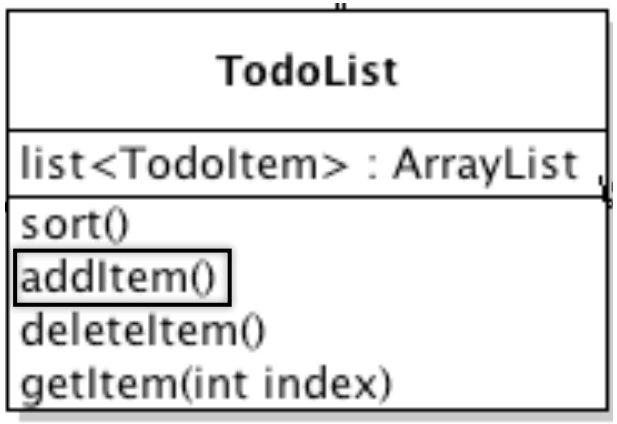
- What happens when the contract is breached? Crash?
- Exceptions are ideal for when contracts can be breached
- javadoc:
  `@throws IndexOutOfBoundsException`

```
throw new IndexOutOfBoundsException("Accessed " + i
                    + " when size = " + A.length());
```

# Law of Demeter

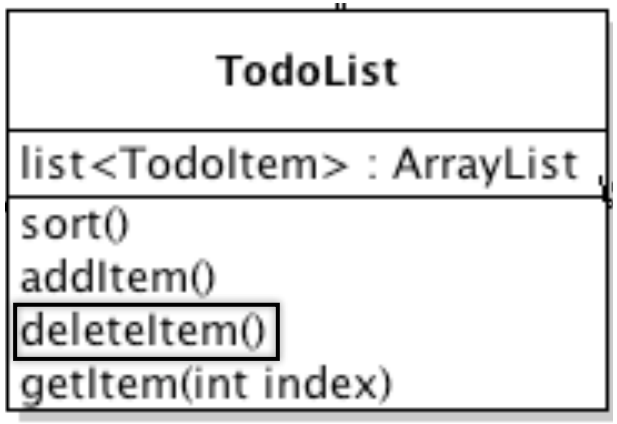
- A method should only use
  - Instance fields of its class
  - Parameters
  - Objects that it constructs with new
- Think of your programs as growing

# ToDoList.addItem()



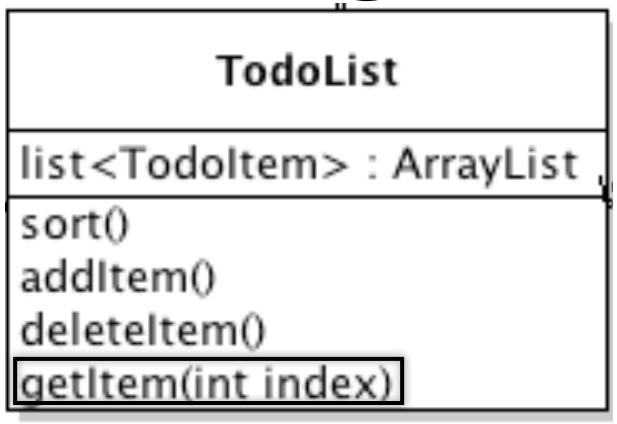

- addItem(String name, Date date)
- @precondition ArrayList is initialized
- @postcondition new item is in list
- @postcondition list is sorted
- assert list != null : “list wasn’t init’d”;

# ToDoList.deleteItem()




- deleteItem(String itemName)
- ~~@precondition list has element named itemName (?)~~
- @postcondition item no longer in list
- @postcondition list is sorted

# ToDoList.getItem()




- getItem(int index)
- @precondition 0 ≤ index < list.size()
- @postcondition list is sorted
- @throws `IndexOutOfBoundsException`
- (This design is flawed.)

# Reading

- Horstmann Ch. 3