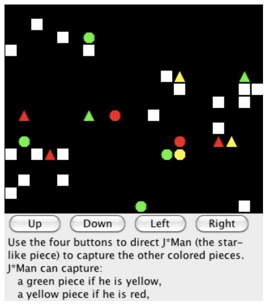
The Challenge of Making Software



Use the four buttons to direct J*Man (the star-like piece) to capture the other colored pieces.
J*Man can capture:
a green piece if he is yellow,
a yellow piece if he is red,

- Did a lot of JMan for you
  - Classes already completed
  - Detailed specifications
  - Lengthy instructions
  - You just "fill in blanks"
- The "Real World"
  - Vague specifications
  - Unknown # of classes
  - Everything from scratch
- Where do you start?

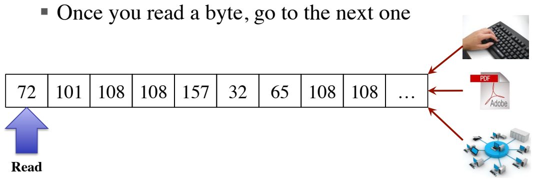
Software Patterns

- **Pattern**: reusable solution to a common problem
  - Template, not a single program
  - Tells you how to design your code
  - Made by someone who ran into problem first
- In many cases, a pattern gives you the interface
  - List of headers for the public methods
  - Specification for these public methods
  - Only thing missing is the implementation

Just like this course!

Example Pattern: I/O Streams

- **InputStream**: Read-only list of bytes (0..255)
  - Like an array, but can only read once
  - Once you read a byte, go to the next one



- **OutputStream**: Like InputStream, but write-only

Example Pattern: I/O Streams

```
public class InputStream {
  /** Yields: next byte (0..255)
   *  in stream or -1 if empty  */
  public int read() throws IOE{
    …
  }
  /** Shuts the input stream
   *  down (close file, disconnect
   *  network, etc.)  */
  public void close() throws IOE{
    …
  }
}
```

```
public class OutputStream {
  /** Writes a byte to the stream
   *  Pre: b is in range 0..255 */
  public int write() throws IOE{
    …
  }
  /** Shuts the input stream
   *  down (close file, disconnect
   *  network, etc.)  */
  public void close() throws IOE{
    …
  }
}
```

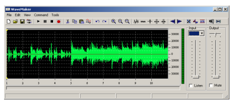
Example Pattern: I/O Streams

Challenge: want I/O stream for data other than bytes

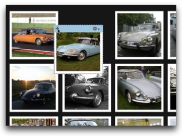
- Text:

  ABCDEFGHIJKLMN
  OPQRSTUVWXYZÀ
  abcdefghijklmnopqr
  stuvwxyzàåéîõøü&
  1234567890($£€.,!?)

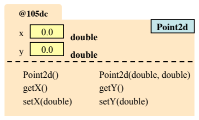
- Sound:



- Images

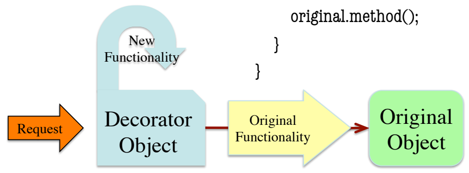


- General Objects



Example Pattern: Decorators

```
public class Decorator {
  private Object original;
  public void method() {
    doSomethingNew();
    original.method();
  }
}
```



Decorators and Java I/O

- Java I/O works this way.
  - Start with basic Input/OutputStream
  - Determined by source (keyboard, file, etc.)
  - Add decorator for type (text, images, etc.)
- You did this in the lab on File I/O

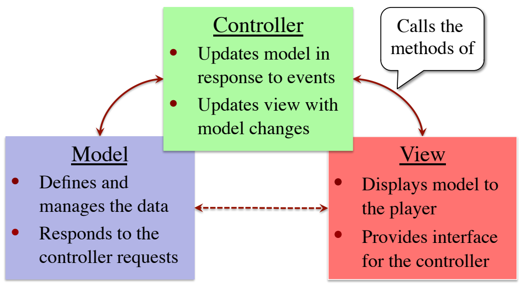
```
FileInputStream input = new FileInputStream("myfile.txt");
BufferedReader reader = new BufferedReader(input);

// Read a line of text
String line = reader.readLine()
```

Architecture Patterns

- Essentially same idea as **software pattern**
  - Template showing how to organize code
  - But does not contain any code itself
- Only difference is **scope**
  - **Software pattern**: simple functionality
  - **Architecture pattern**: complete application
- Large part of the job of a **software architect**
  - Know the best patterns to use in each case
  - Use these patterns to distribute work to your team

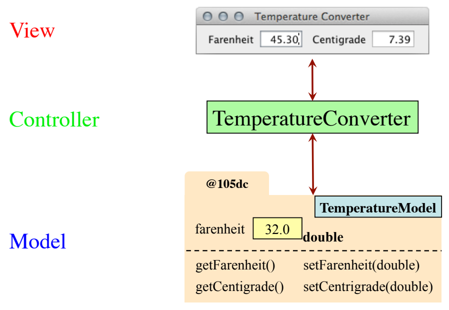
Model-View-Controller Pattern


Controller
Updates model in response to events
Updates view with model changes
Calls the methods of
Model
Defines and manages the data
Responds to the controller requests
View
Displays model to the player
Provides interface for the controller

TemperatureConverter Example

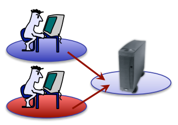
- Model: (TemperatureModel.java)
  - Stores one value: fahrenheit
  - But the methods present two values
- View: (TemperatureView.java)
  - Constructor creates GUI components
  - Recieves user input but does not "do anything"
- Controller: (TemperatureConverter.java)
  - **Main class**: instantiates all of the objects
  - "Communicates" between model and view

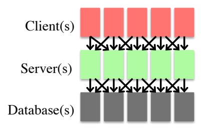
TemperatureConverter Example



Beyond Model-View-Controller

- MVC is best pattern for offline programs
  - Networked get more complex
- Client-Server
  - Client runs on your computer
  - Client connects to remoter server
- Three-Tier Applications
  - Client-Server-Database
  - Standard for web applications
- … and many others




Client(s)
Server(s)
Database(s)