CSC324: Principles of Programming Languages
Lecture 8
Java's Reflection

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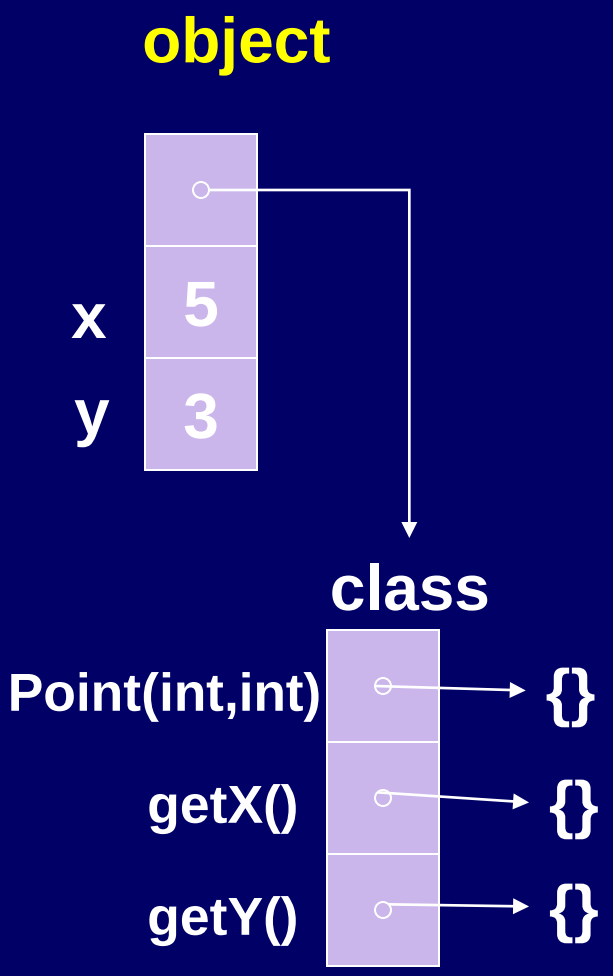
Internal Representation of .class (Java's bytecode)

```
public class Point {
  public Point(int x, int y) {
    x = 5; Y = 10;
  }
  public int getX() {
        return x;
  }
  public int getY() {
        return y;
    }
  protected int x, y;
}
```



The class Class

- Instances of the class Class store information about classes
  - Class name
  - Inheritance
  - Interfaces implemented
  - Methods, members, etc.

- Can look up instances:
  - By name
  - From an object

Discovering the type of a Class

Discovering the Methods of a class

Calling a Method using Reflection

1. Look up a method based on its signature: the name and list of parameter types

2. Specify signature as a comma-separated list of Class objects
   - Specifies the types of arguments
   - Special values for types like int and boolean

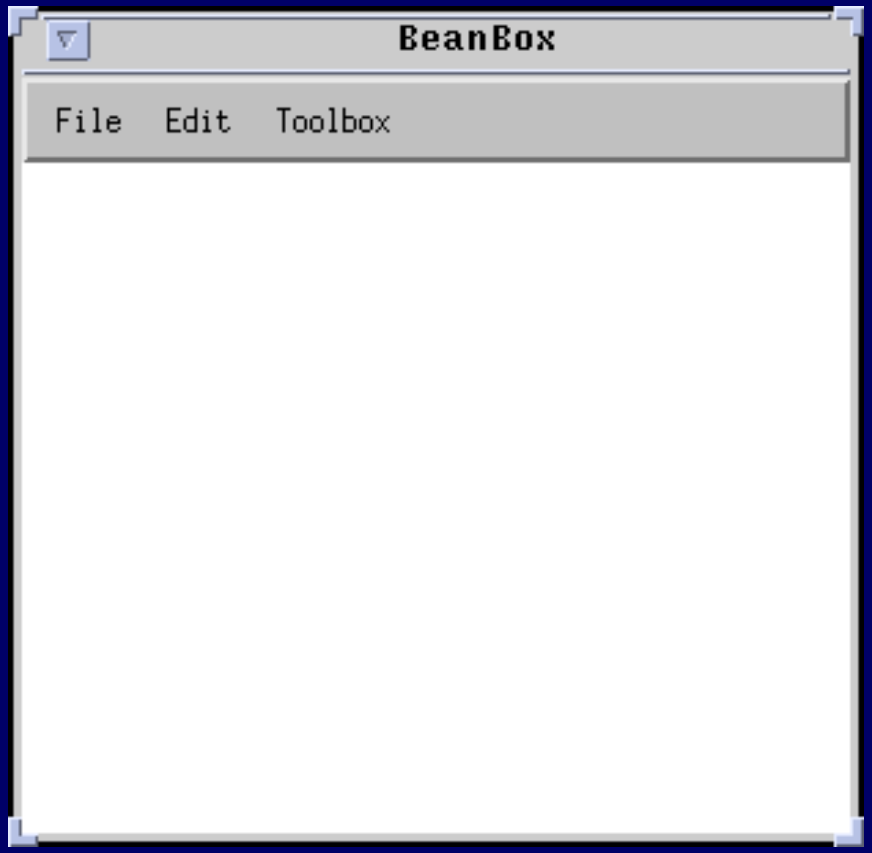
3. Call the method, passing in parameters and capturing return value

```
Class mysClass = Class.forName("Mystery");
Object o = mysClass.newInstance();

Method m = mysClass.getMethod("euclidean",
                              Double.TYPE,
                              Double.TYPE);

double result = (Double) m.invoke(o, new Double(5.0), 12.0);

Method m2 = mysClass.getMethod("play",
                               Class.forName("java.lang.String"),
                               String.class);

m2.invoke(o, "Che", "Karl");
```

Advantages of Reflection?

- Supports component based development
- Decreases control coupling by eliminating direct references to class names.
- Supports software automation

Bean Box



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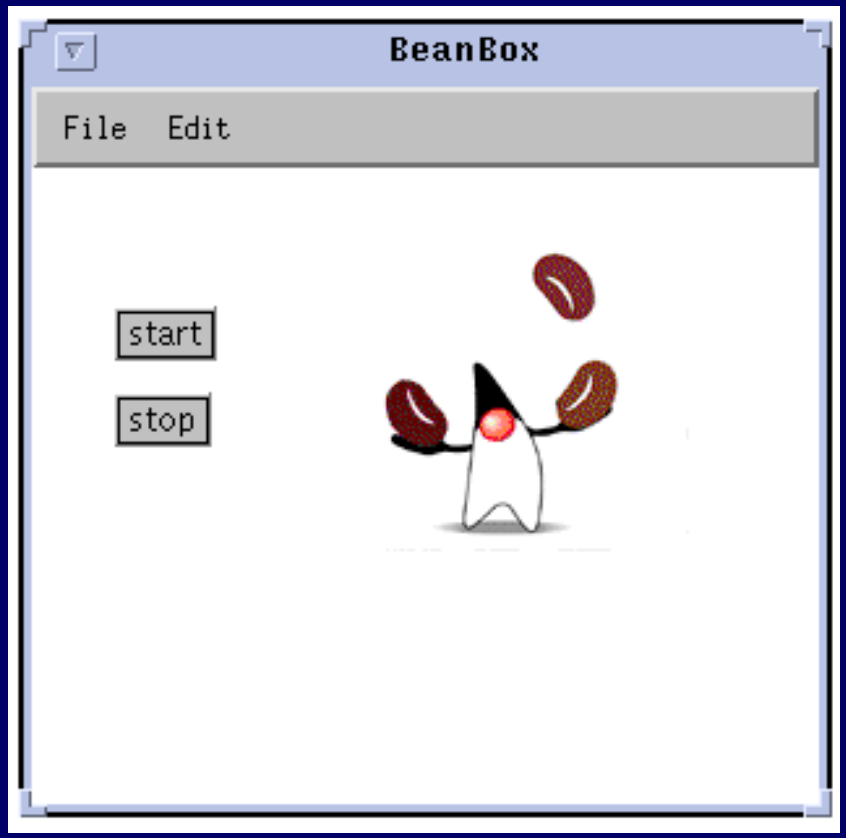

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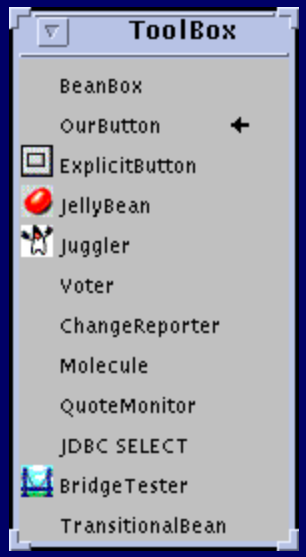
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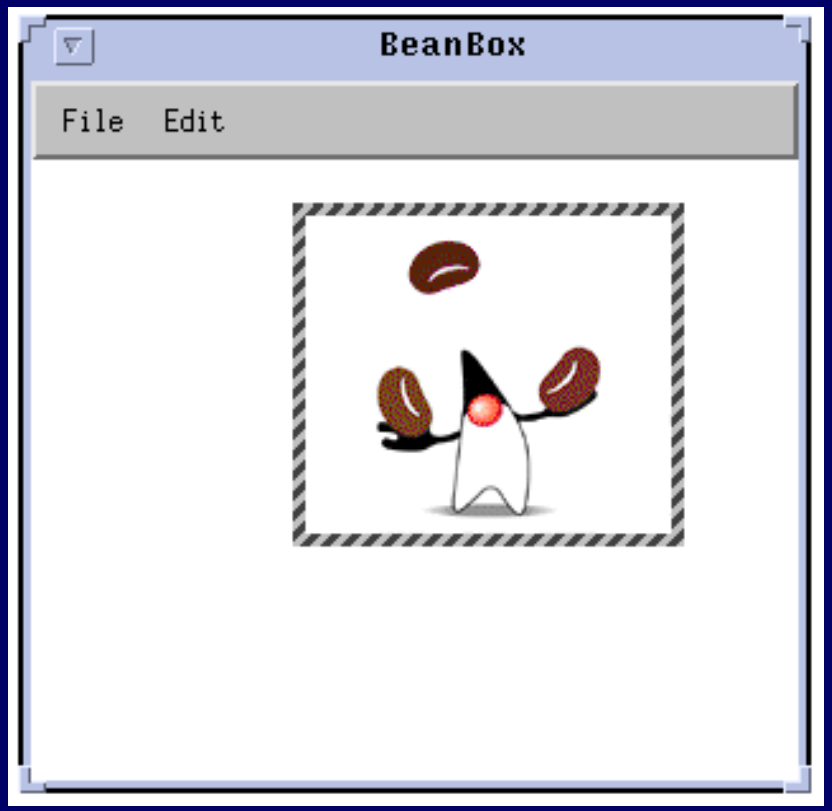
Voter
ChangeReporter
Molecule
QuoteMonitor
JDBC SELECT
BridgeTester
TransitionalBean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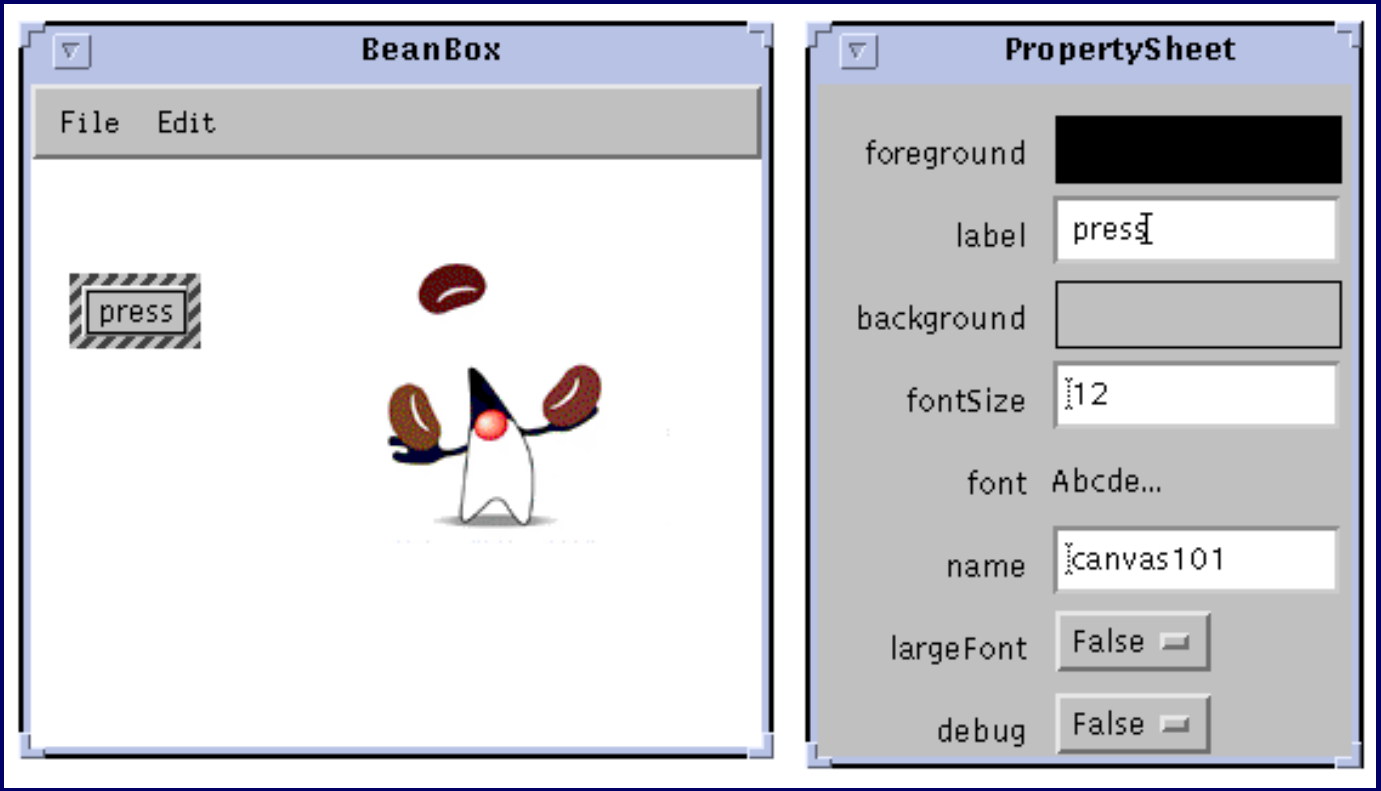
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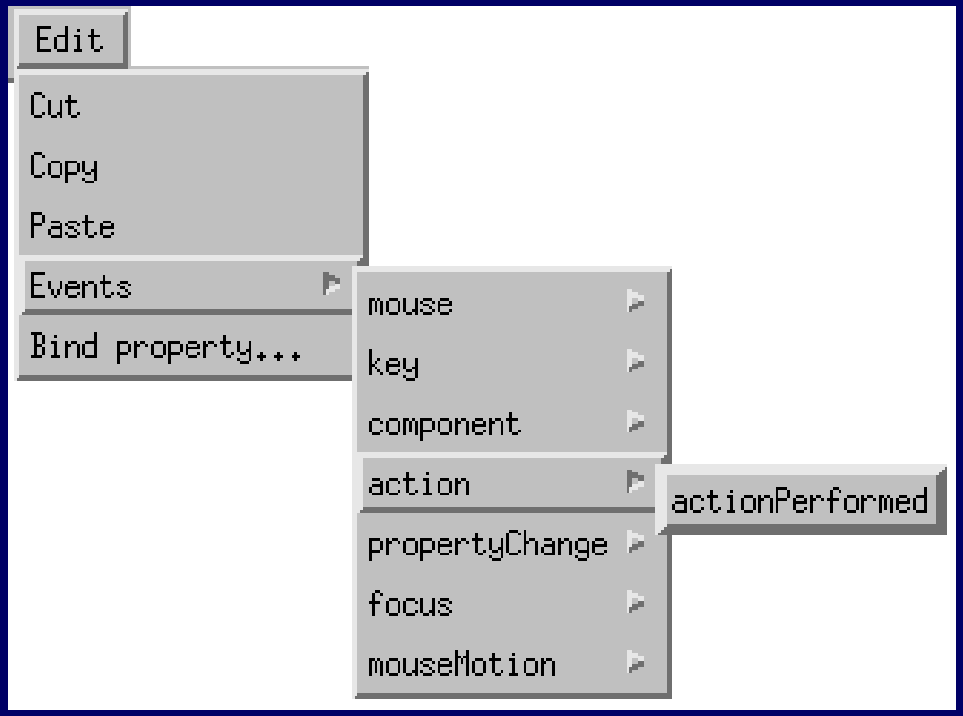
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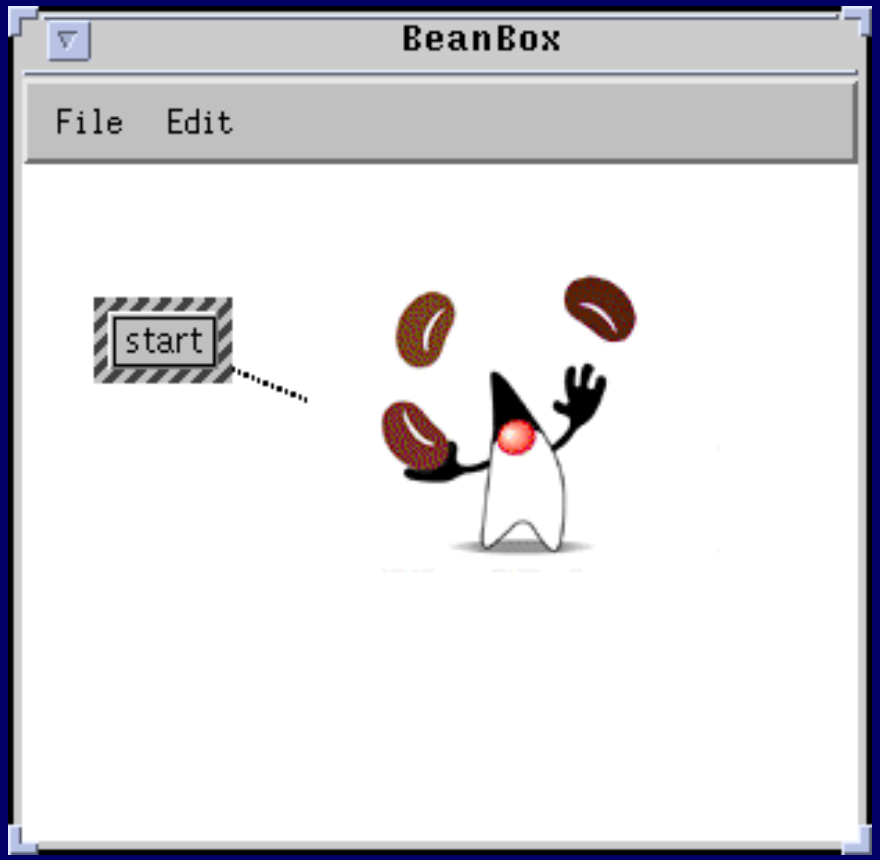

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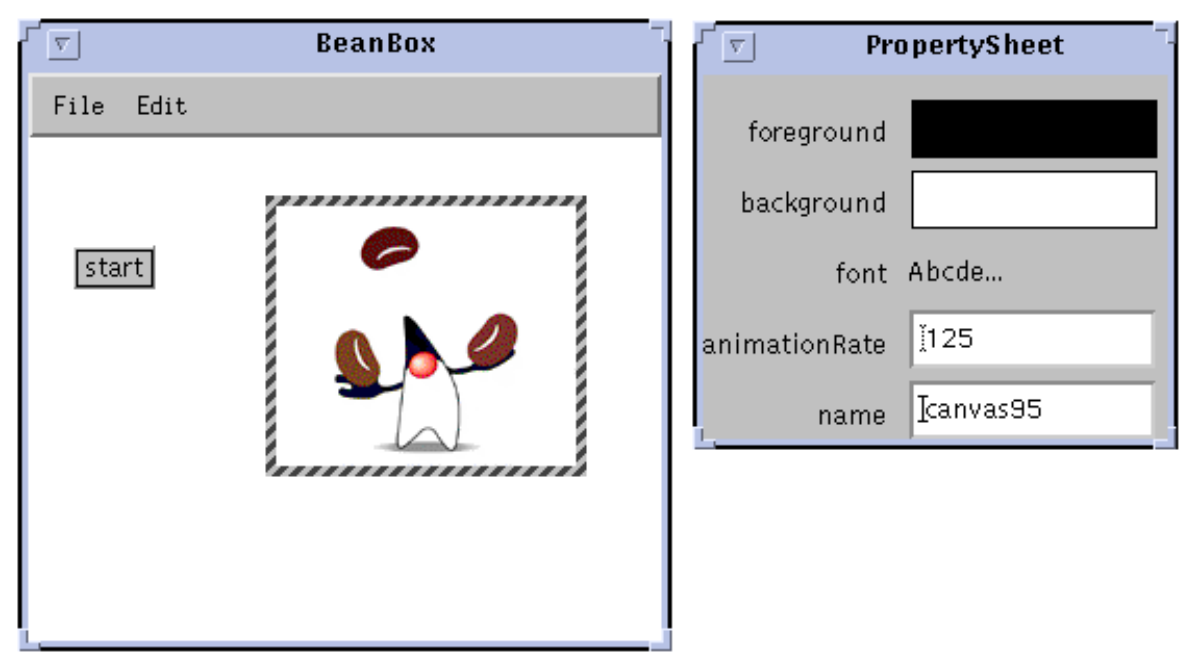
Bean Box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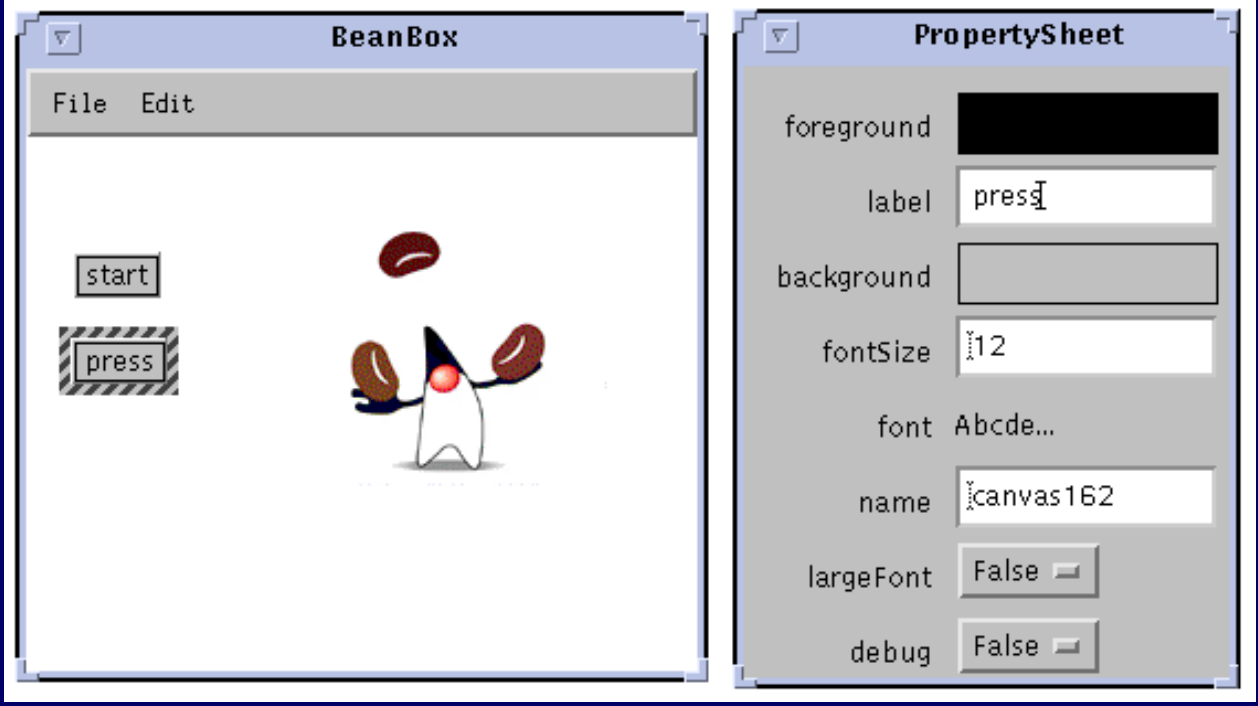
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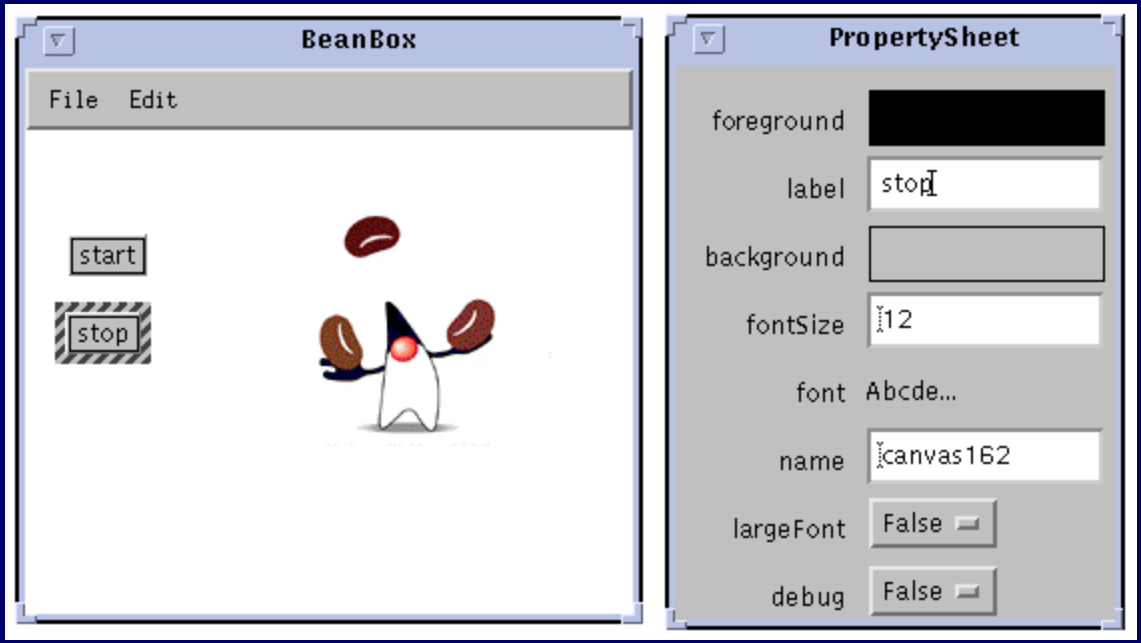
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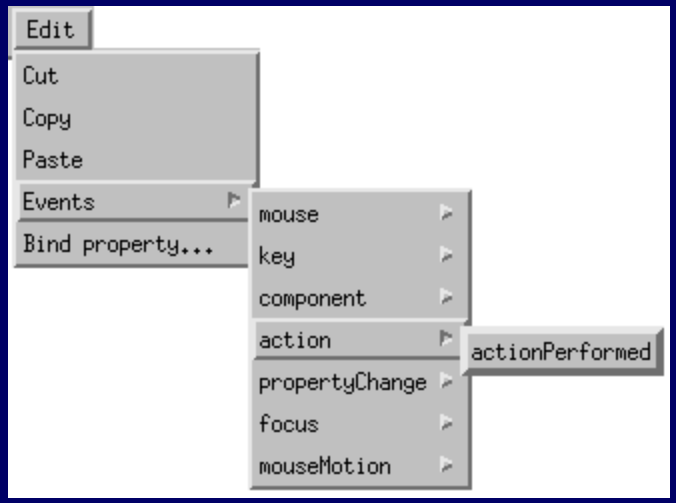
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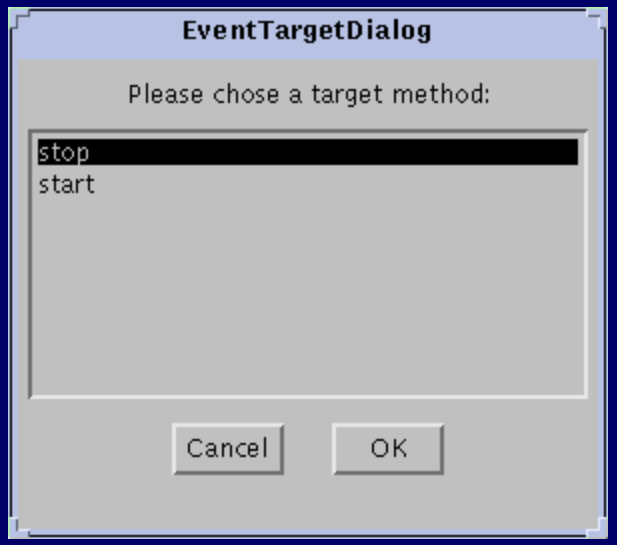
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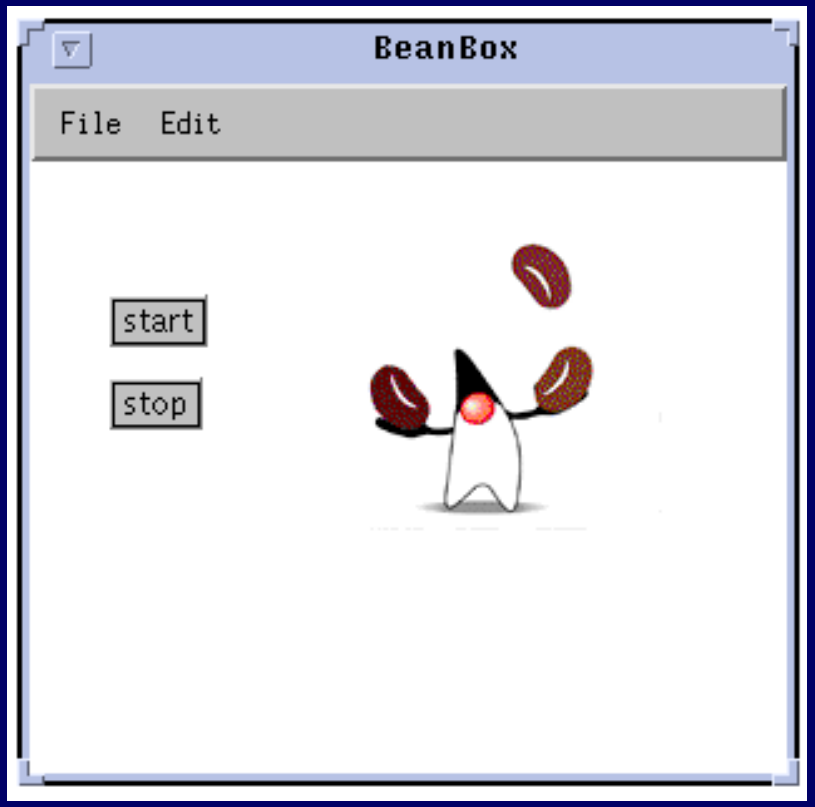


What's happening in the background

- Reflection is used to expose the internals of an object
- Methods are written in a standard agreed-upon style
  - setTarget(int newValue);
  - int getTarget( );
- Events are known from the interface(s) implemented by the class

Advantages of Reflection?

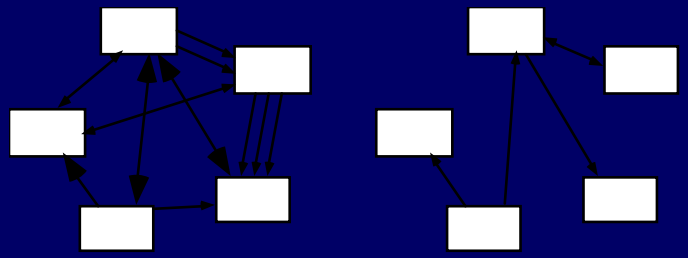
- Supports component based development

➔ Decreases Coupling by eliminating direct references to class names.

- Supports software automation

Goal: Reduce coupling where possible

- *Coupling* occurs when there are *interdependencies* between one module and another
  - When interdependencies exist, changes in one place will require changes somewhere else.
  - A network of interdependencies makes it hard to see at a glance how some component works.
  - Type of coupling:
    - Content, Common, Control, Stamp, Data, Routine Call, Type use, Inclusion/Import, External



Control coupling

- Occurs when one procedure calls another using *a 'flag' or 'command'* that explicitly controls what the second procedure does
  - To make a change you have to change both the calling and called method
  - The use of polymorphic operations is normally the best way to avoid control coupling
  - One way to reduce the control coupling could be to have a *look-up table*
    - commands are then mapped to a method that should be called when that command is issued

Example of control coupling

```
public routineX(String command)
{
   if (command.equals("drawCircle")
   {
      drawCircle();
   }
   else
   {
      drawRectangle();
   }
}
```

Advantages of Reflection?

- Supports component based development
- Decreases Coupling by eliminating direct references to class names.

➔ Supports software automation

What is Software Automation

- If a program consists of components….
- Then we would like to configure those modules anyway we like and be able to change that configuration of components later if we decide to do so…!