Object Oriented Programming

Week 11 Part 1
Applet Programming

Lecture

- What are Applets
- Hello World Applet
- Applet States
- Deploying an Applet

What are Applets

Applets

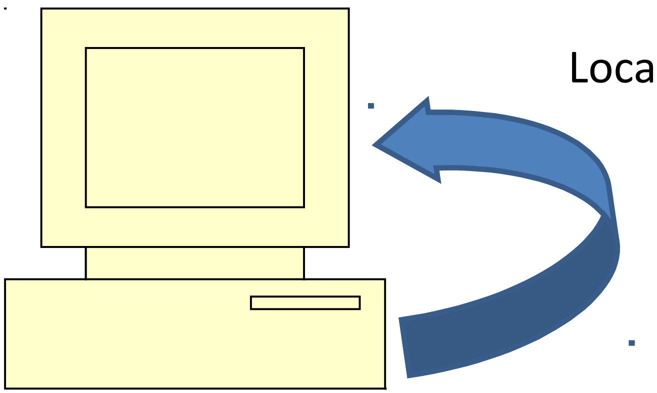
- Applets encapsulate a GUI to be delivered to a remote computer
  - Usually delivered via the Web to a browser
- Applet are rarely used any more
  - The interface is old
  - The security model is weak
  - HTML5 does no support the applet tag
  - JavaScript is not more consistent than the applet tag

Applet Use

- Display dynamic material on a web page
  - Currently done using JavaScript
- Display Flash outputs
  - Currently done using HTML canvas tag
- Make a Program accessible on the Web
  - Currently done using Java Web Start

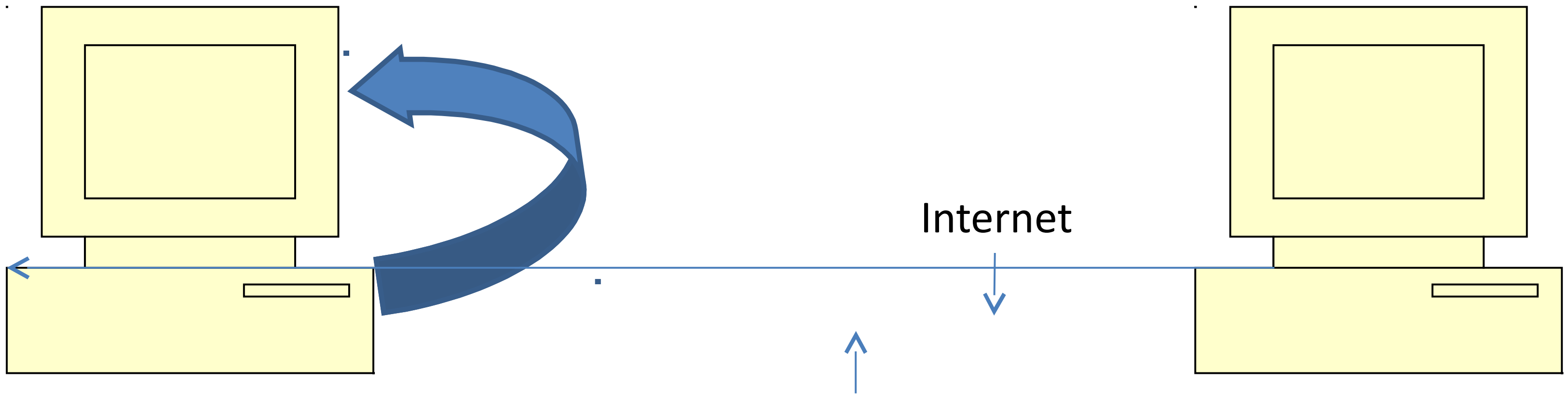
Applet Types

- Local Applet
  - Runs in a container on the local computers
  - Usually used for development
- Remote Applet
  - Runs in a container on a remote computer
  - Usually run in web browser



Local Applet

Local Computer



Internet

Local Computer
(client)

Remote applet

Remote Computer
(server)

Embedding applets

- Applets can be embedded in web pages
  - Some browsers can run Applets
    - The Netscape Plugin Application Programming Interface (NPAPI) allows browsers to run plugins.
    - Applets are a plugin
  - As of April 2015 Chrome no longer supports NPAPI
  - NPAPI is deprecated due to age and security issues
- Applets are embedded using either the <applet> tab (pre-HTML5) or <embed> or <object> (HTML5)

Sandbox

- The sandbox keeps applets downloaded from the internet from running malicious code
- Applets are signed using public key encryption ensuring the author of the code
  - Unsigned applications run int the sandbox by default
  - Signed application run outside the sandbox by default
  - Security setting in the browser may further restrict what applets may do

Sandbox Restrictions

- Cannot access client resources such as files, executables, system clipboard, printer, etc.
- Cannot connect to third party servers
- Cannot load native libraries
- Cannot change the SecurityManager
- Cannot create a Class Loader
- Cannot read some system properties.

How Applets Run in a Browser

- Java Plug-in software creates a worker thread for each Java applet in the browser
- It launches the Applet in an instance of the JRE (Java Runtime Environment)

The Applet Class

- The Applet class is the superclass of all applets
  - Applet superclasses
    - java.awt.Panel
    - java.awt.Container
    - java.awt.Component
  - Applet interfaces
    - ImageObserver
    - MenuContainer
    - Serializable
    - Accessible

Abstract Window Toolkit (AWT)

- Original platform-dependent windowing, graphics and UI widget toolkit
- Standard API for GUI before Swing was developed
- Provides windowing, events and layout manager

Swing

- Most Java application use Swing to implement GUIs
- Applets may be built from Swing components
  - Class: java.swing.JApplet

Serializable Interface

- Allows Java classes to be sent over a byte stream.
- Requires a serialVersionUID
  - Declared private static final long
  - Updated each time the class is updated
  - Allows program to determine compatibility of classes loaded from files or downloaded from Internet

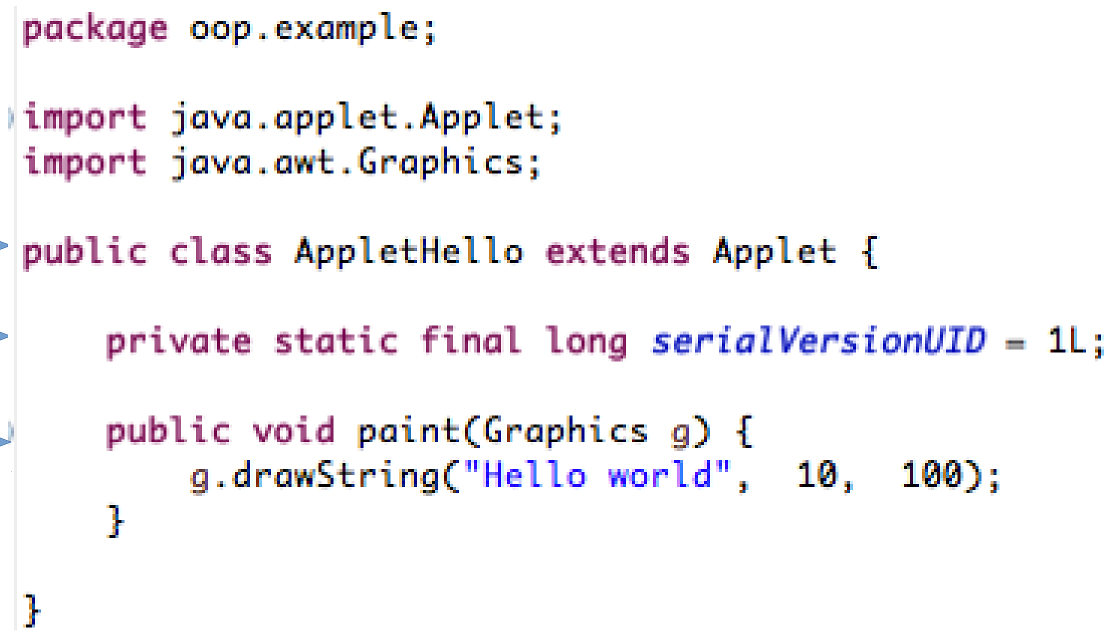
Hello World Applet

Example Applet: AppletHello

Subclass of Applet

Serializable: serialVersionUID

Output: paint “Hello world”

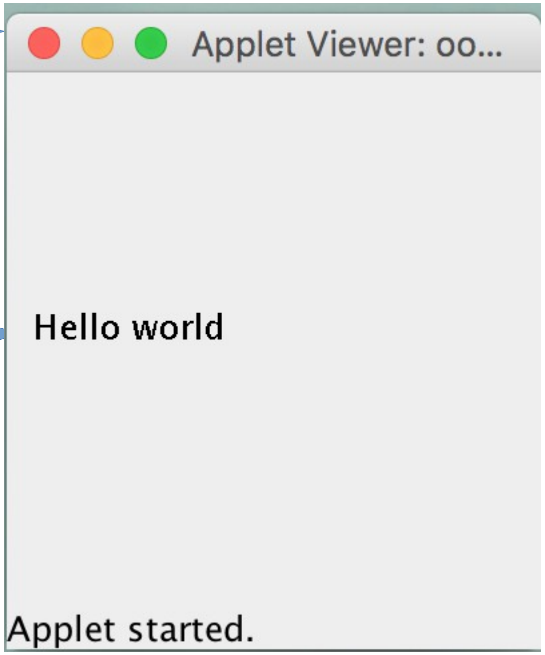


```
package oop.example;

import java.applet.Applet;
import java.awt.Graphics;

public class AppletHello extends Applet {

    private static final long serialVersionUID = 1L;

    public void paint(Graphics g) {
        g.drawString("Hello world",  10,  100);
    }

}
```

Example Applet: Output

Creates new window

Output: paint “Hello world”



```
Hello world
```

Applet started.

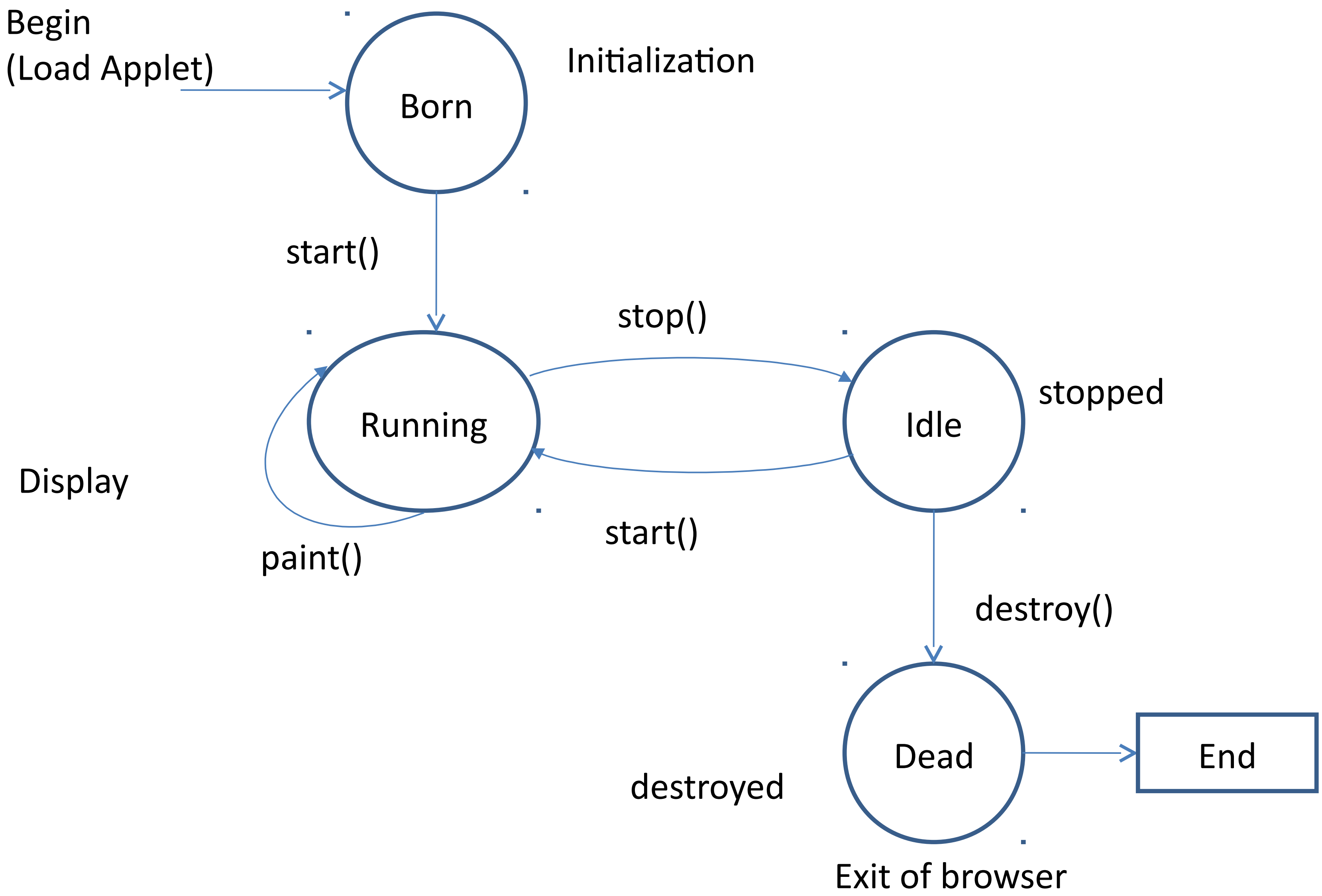
Run as Java Applet from Eclipse

Applet Lifecycle

Applet Lifecycle

- The Applet Lifecycle
  - The applet is loaded into the container
  - When start() is called, it is running
    - Each time paint() is called, it updates the display.
  - When stop() is called, it become idle until start() is called again.
  - If destroy() is called, it dies.

Applet life cycle



Begin
(Load Applet)

Born

Initialization

start()

stop()

Running

Idle

stopped

Display

start()

paint()

destroy()

Dead

End

destroyed

Exit of browser

Major Applet Events

- Initialization: init()
  - Like a constructor
  - True constructors are rare for Applets
- Start: start()
- Stop: stop()
- Terminate: destroy()
  - Like a destructor
  - Allows applet to clean up before termination

Example: Applet Events

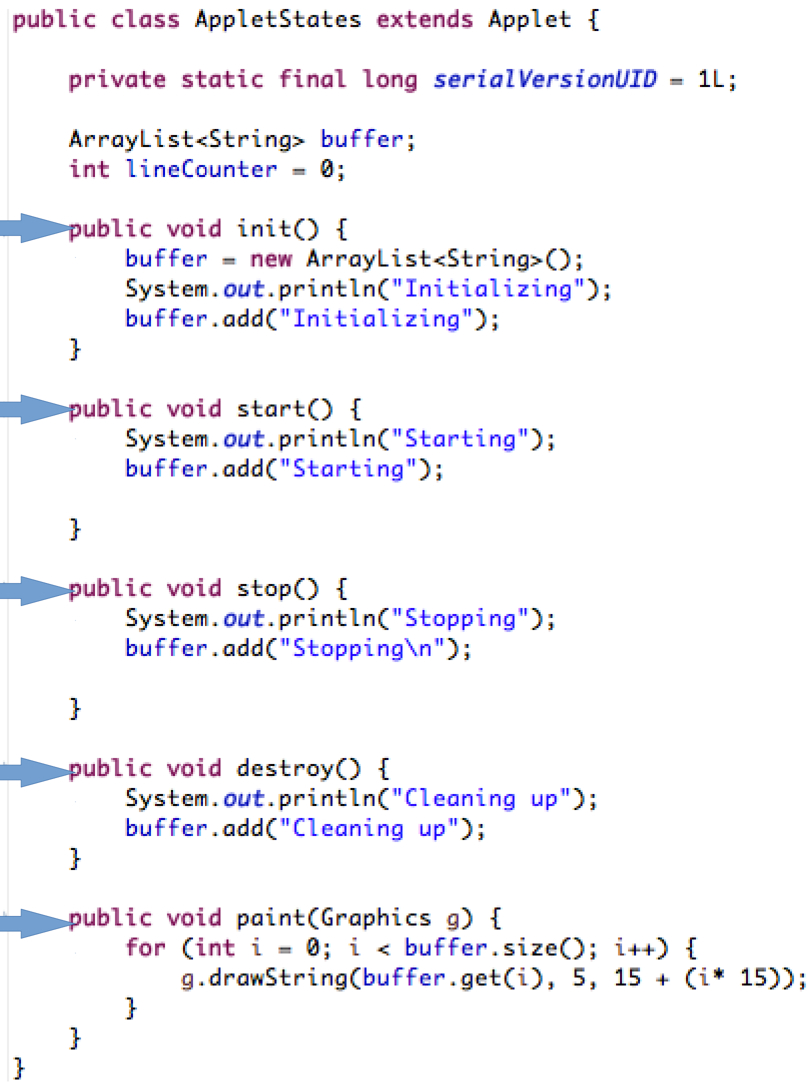
Run once when applet is first loaded

Run whenever the applet starts

Run whenever the applet stops

Run before the applet is unloaded

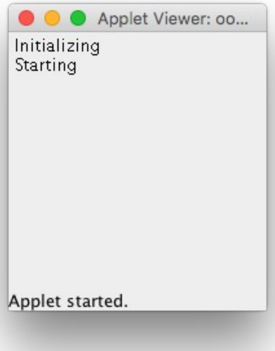
Run when the applet outputs to screen



```
public class AppletStates extends Applet {

    private static final long serialVersionUID = 1L;

    ArrayList<String> buffer;
    int lineCounter = 0;

    public void init() {
        buffer = new ArrayList<String>();
        System.out.println("Initializing");
        buffer.add("Initializing");
    }

    public void start() {
        System.out.println("Starting");
        buffer.add("Starting");

    }

    public void stop() {
        System.out.println("Stopping");
        buffer.add("Stopping\n");

    }

    public void destroy() {
        System.out.println("Cleaning up");
        buffer.add("Cleaning up");
    }

    public void paint(Graphics g) {
        for (int i = 0; i < buffer.size(); i++) {
            g.drawString(buffer.get(i), 5, 15 + (i* 15));
        }
    }
}
```

Example: Applet Events Output

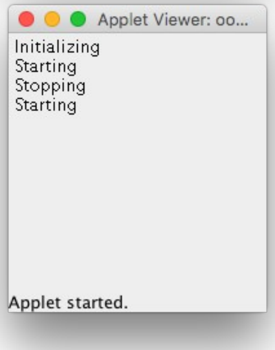
After running as Java Applet



```
Initializing
Starting
```

Applet started.

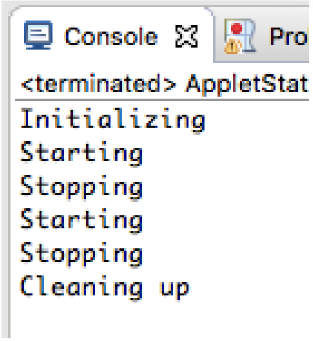
After minimizing and restoring



```
Initializing
Starting
Stopping
Starting
```

Applet started.

Console output after termination



```
<terminated> AppletStat
Initializing
Starting
Stopping
Starting
Stopping
Cleaning up
```