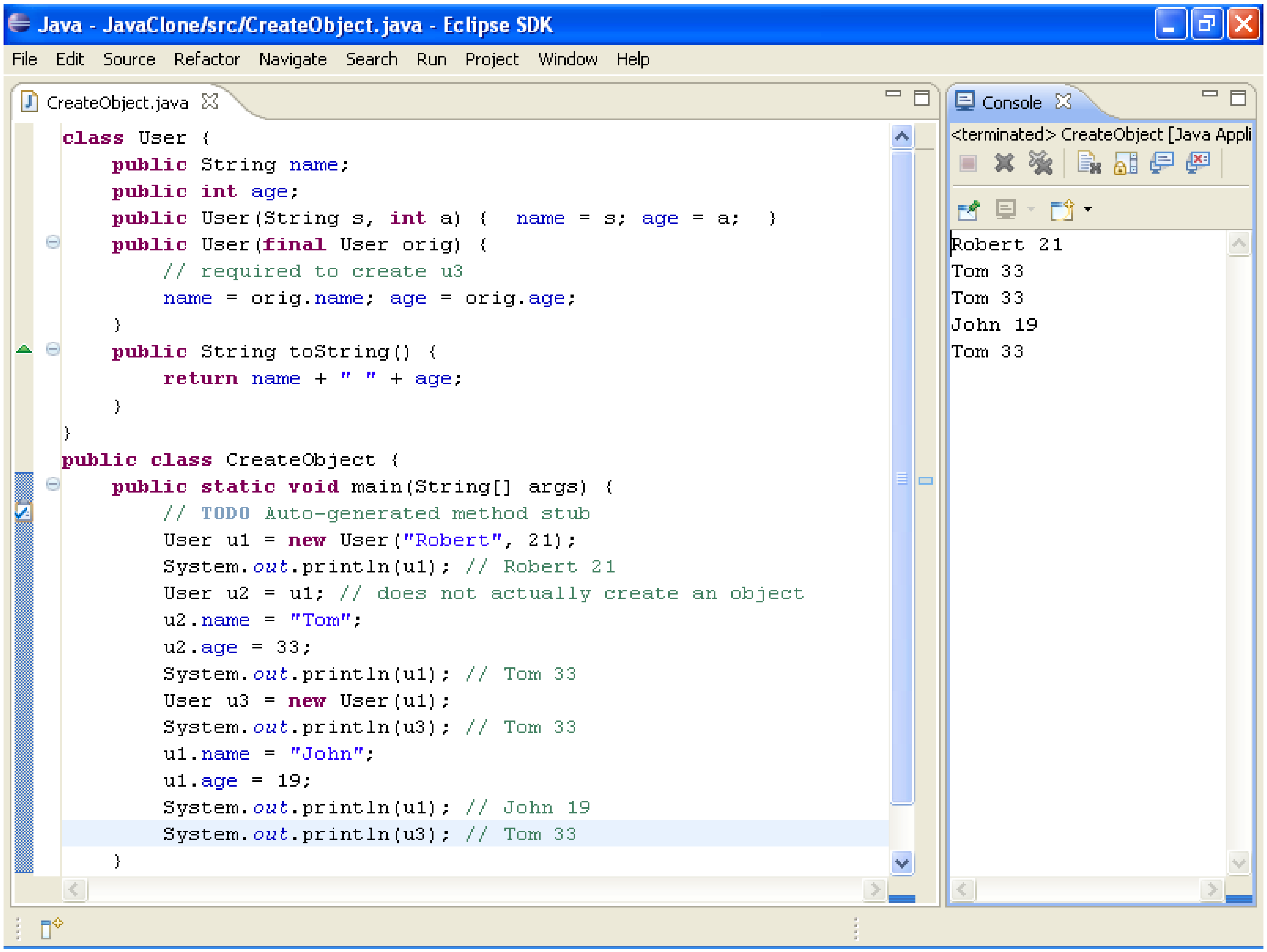
# ECE 462
# Object-Oriented Programming using C++ and Java

## Static Members and Sharing in Java

Yung-Hsiang Lu
yunglu@purdue.edu


Java - JavaClone/src/CreateObject.java - Eclipse SDK
File Edit Source Refactor Navigate Search Run Project Window Help
CreateObject.java
Console
<terminated> CreateObject [Java Appli

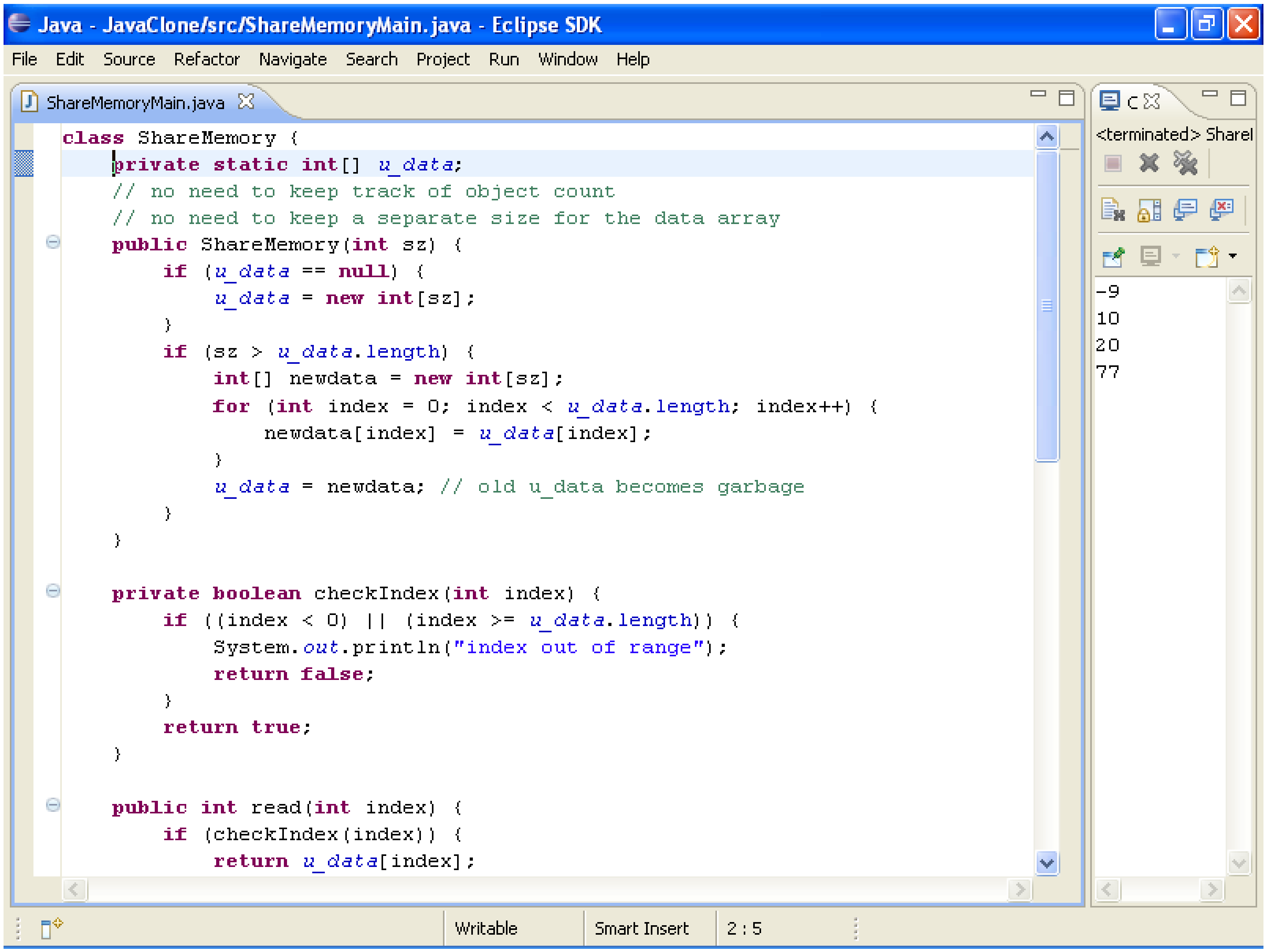
```
class User {
    public String name;
    public int age;
    public User(String s, int a) {  name = s; age = a;  }
    public User(final User orig) {
        // required to create u3
        name = orig.name; age = orig.age;
    }
    public String toString() {
        return name + " " + age;
    }
}
public class CreateObject {
    public static void main(String[] args) {
        // TODO Auto-generated method stub
        User u1 = new User("Robert", 21);
        System.out.println(u1); // Robert 21
        User u2 = u1; // does not actually create an object
        u2.name = "Tom";
        u2.age = 33;
        System.out.println(u1); // Tom 33
        User u3 = new User(u1);
        System.out.println(u3); // Tom 33
        u1.name = "John";
        u1.age = 19;
        System.out.println(u1); // John 19
        System.out.println(u3); // Tom 33
    }
```

```
Robert 21
Tom 33
Tom 33
John 19
Tom 33
```

## Object Creation in Java

- Java does not automatically create copy constructors.
- Objects must be created using **new**; therefore, u2 is not a separate object.
- Objects, once created, do not share attributes. Changing one does not affect another.
- Java does not allow operator overloading by programmers. Hence, it is not possible to redefine operator =.
- In Java, operator = does not perform copy. It creates "alias". The previous object becomes garbage.

## Static Member and Memory Sharing


Java - JavaClone/src/ShareMemoryMain.java - Eclipse SDK
File Edit Source Refactor Navigate Search Project Run Window Help
ShareMemoryMain.java
<terminated> ShareI
Writable
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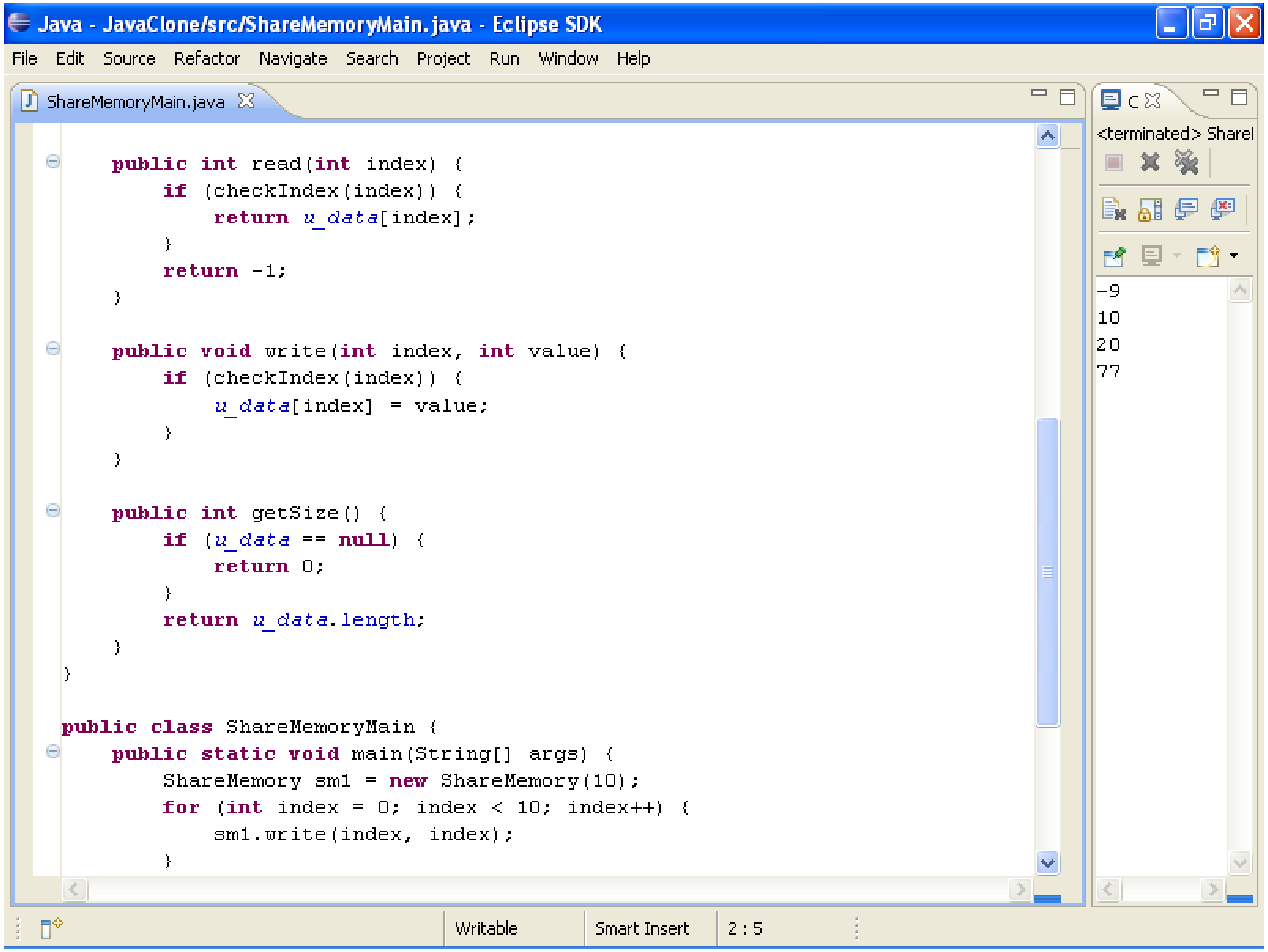
2 : 5

```
class ShareMemory {
    private static int[] u_data;
    // no need to keep track of object count
    // no need to keep a separate size for the data array
    public ShareMemory(int sz) {
        if (u_data == null) {
            u_data = new int[sz];
        }
        if (sz > u_data.length) {
            int[] newdata = new int[sz];
            for (int index = 0; index < u_data.length; index++) {
                newdata[index] = u_data[index];
            }
            u_data = newdata; // old u_data becomes garbage
        }
    }

    private boolean checkIndex(int index) {
        if ((index < 0) || (index >= u_data.length)) {
            System.out.println("index out of range");
            return false;
        }
        return true;
    }

    public int read(int index) {
        if (checkIndex(index)) {
            return u_data[index];
```

```
-9
10
20
77
```


Java - JavaClone/src/ShareMemoryMain.java - Eclipse SDK
File Edit Source Refactor Navigate Search Project Run Window Help
ShareMemoryMain.java
<terminated> ShareI
Writable
Smart Insert
2 : 5

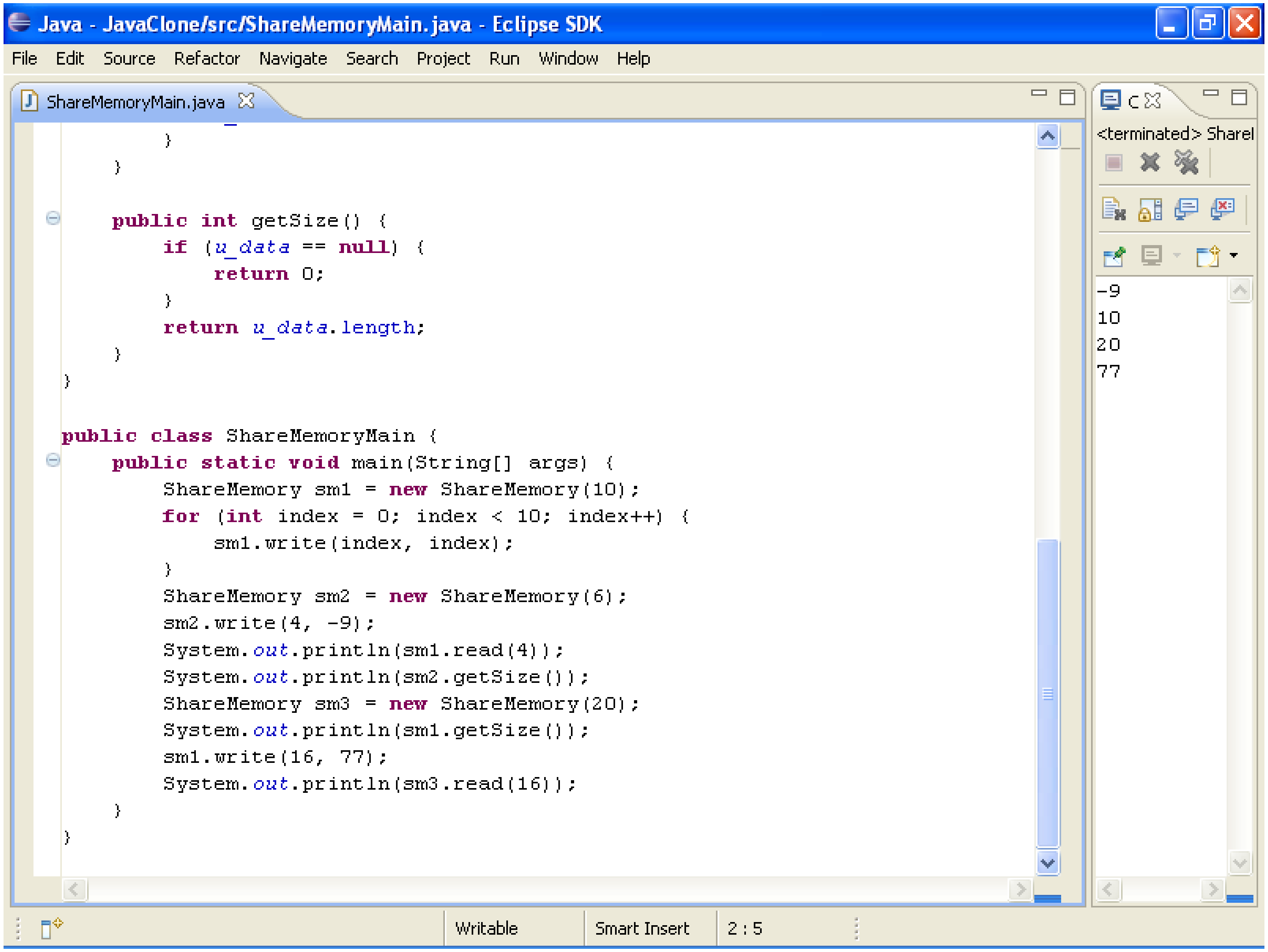
```
    public int read(int index) {
        if (checkIndex(index)) {
            return u_data[index];
        }
        return -1;
    }

    public void write(int index, int value) {
        if (checkIndex(index)) {
            u_data[index] = value;
        }
    }

    public int getSize() {
        if (u_data == null) {
            return 0;
        }
        return u_data.length;
    }
}

public class ShareMemoryMain {
    public static void main(String[] args) {
        ShareMemory sm1 = new ShareMemory(10);
        for (int index = 0; index < 10; index++) {
            sm1.write(index, index);
        }
```

```
-9
10
20
77
```



Java - JavaClone/src/ShareMemoryMain.java - Eclipse SDK

```
            }
        }

    public int getSize() {
        if (u_data == null) {
            return 0;
        }
        return u_data.length;
    }
}

public class ShareMemoryMain {
    public static void main(String[] args) {
        ShareMemory sm1 = new ShareMemory(10);
        for (int index = 0; index < 10; index++) {
            sm1.write(index, index);
        }
        ShareMemory sm2 = new ShareMemory(6);
        sm2.write(4, -9);
        System.out.println(sm1.read(4));
        System.out.println(sm2.getSize());
        ShareMemory sm3 = new ShareMemory(20);
        System.out.println(sm1.getSize());
        sm1.write(16, 77);
        System.out.println(sm3.read(16));
    }
}
```

<terminated> ShareI

```
-9
10
20
77
```

## Self Test

# ECE 462
# Object-Oriented Programming using C++ and Java

## Game Programs

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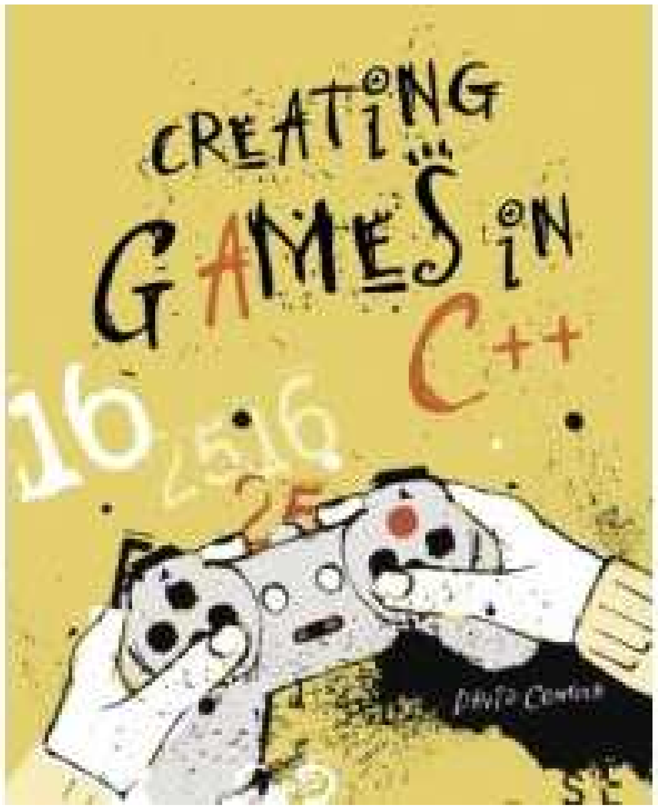
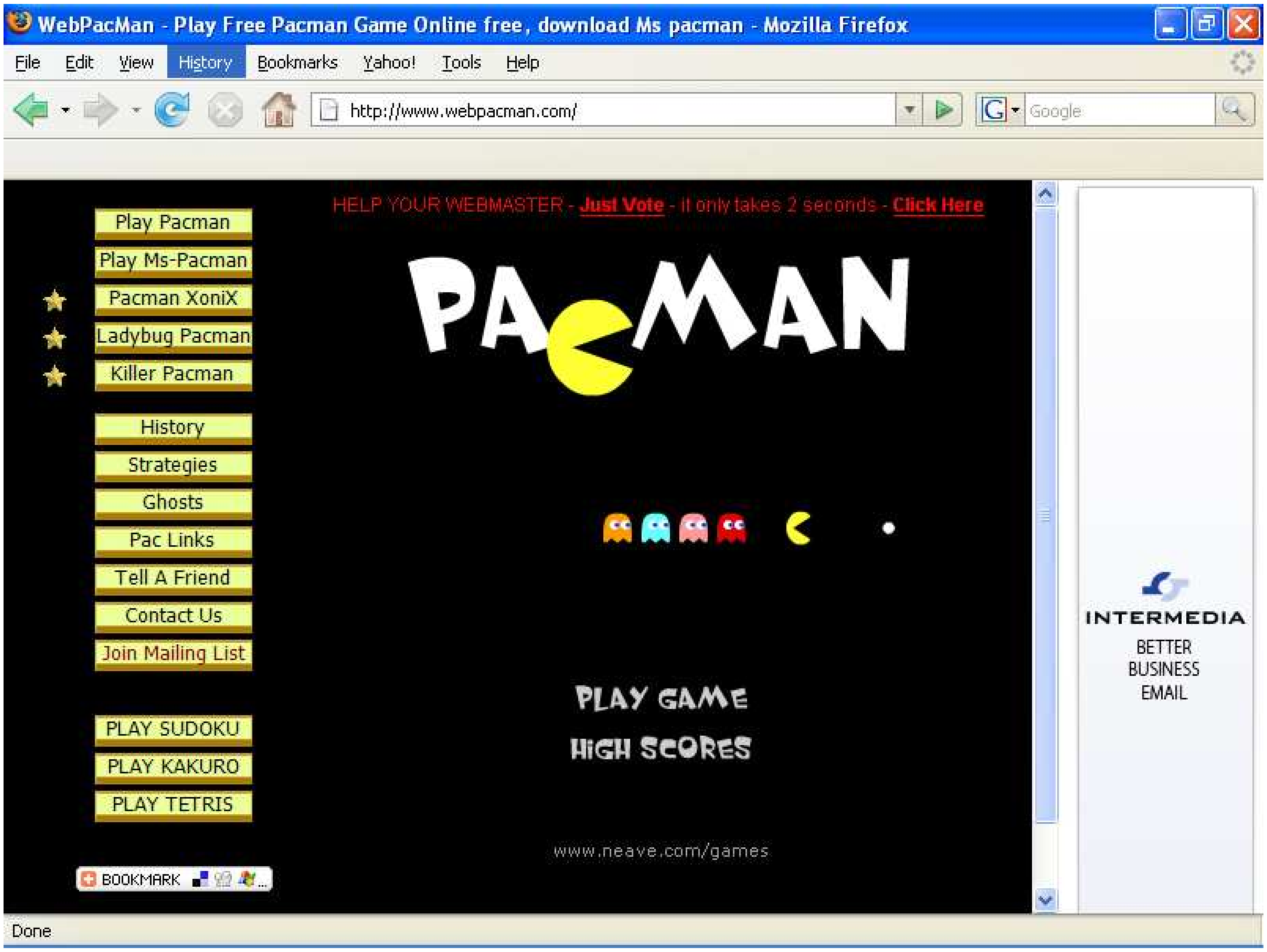
## Developing Complex Programs
### (Using Games as Examples)



## Java Games

- Applet games: running through web browser
  - + no installation needed, easy upgrade (the web version is always the latest)
  - – security restrictions, cannot save game status
- Window games:
  - + no restrictions like applets
  - – players may be distracted by other windows
- Full-screen games:
  - + no other program can appear to distract players
  - – do not allow players to engage in other activities (such as instant messaging)

## Applet Game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File
Edit
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Yahoo!
Tools
Help
http://www.webpacman.com/
Google
HELP YOUR WEBMASTER - Just Vote - It only takes 2 seconds - Click Here
Play Pacman
Play Ms-Pacman
Pacman XoniX
Ladybug Pacman
Killer Pacman
History
Strategies
Ghosts
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Join Mailing List
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PLAY KAKURO
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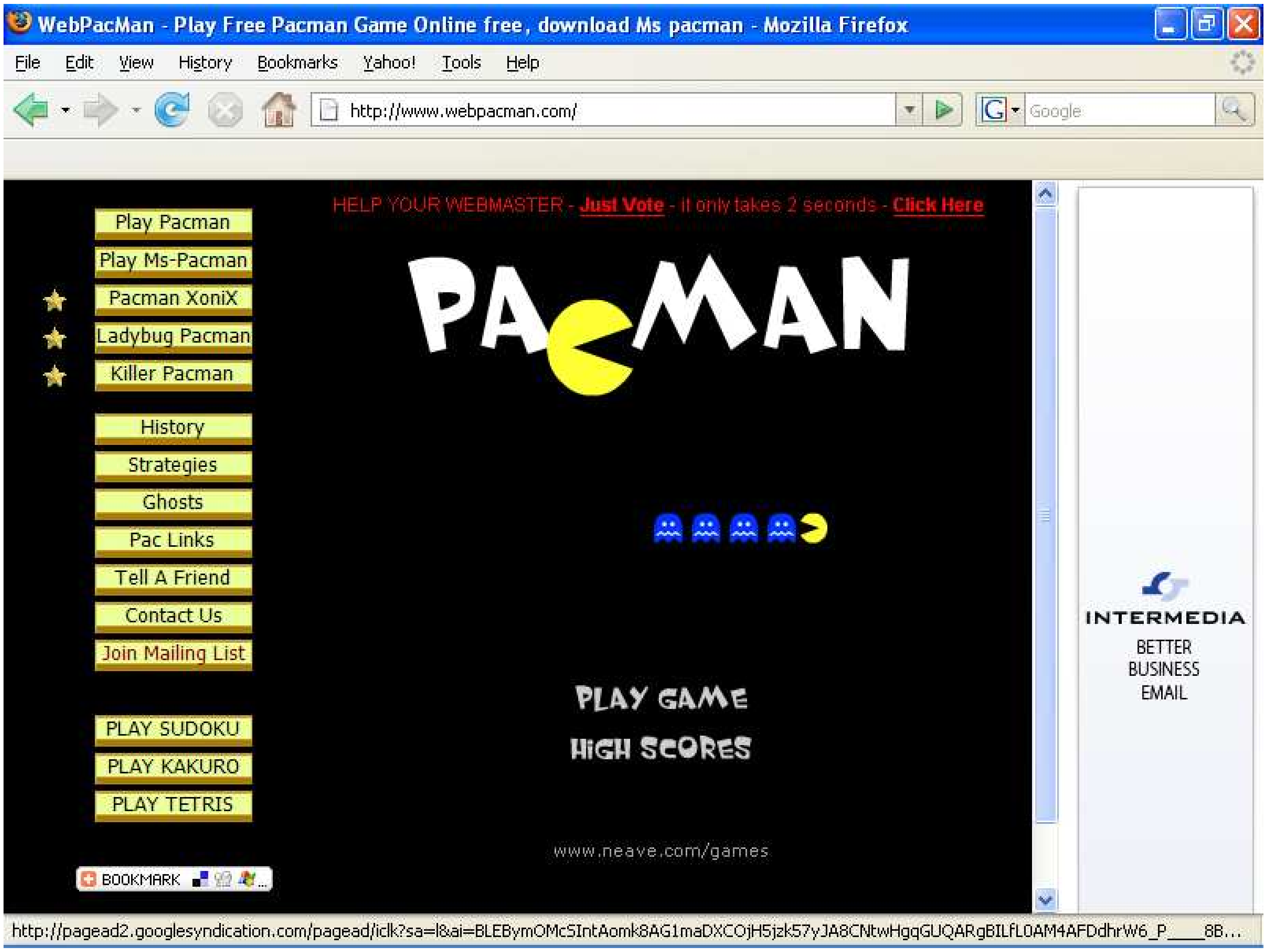
Done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Play Pacman
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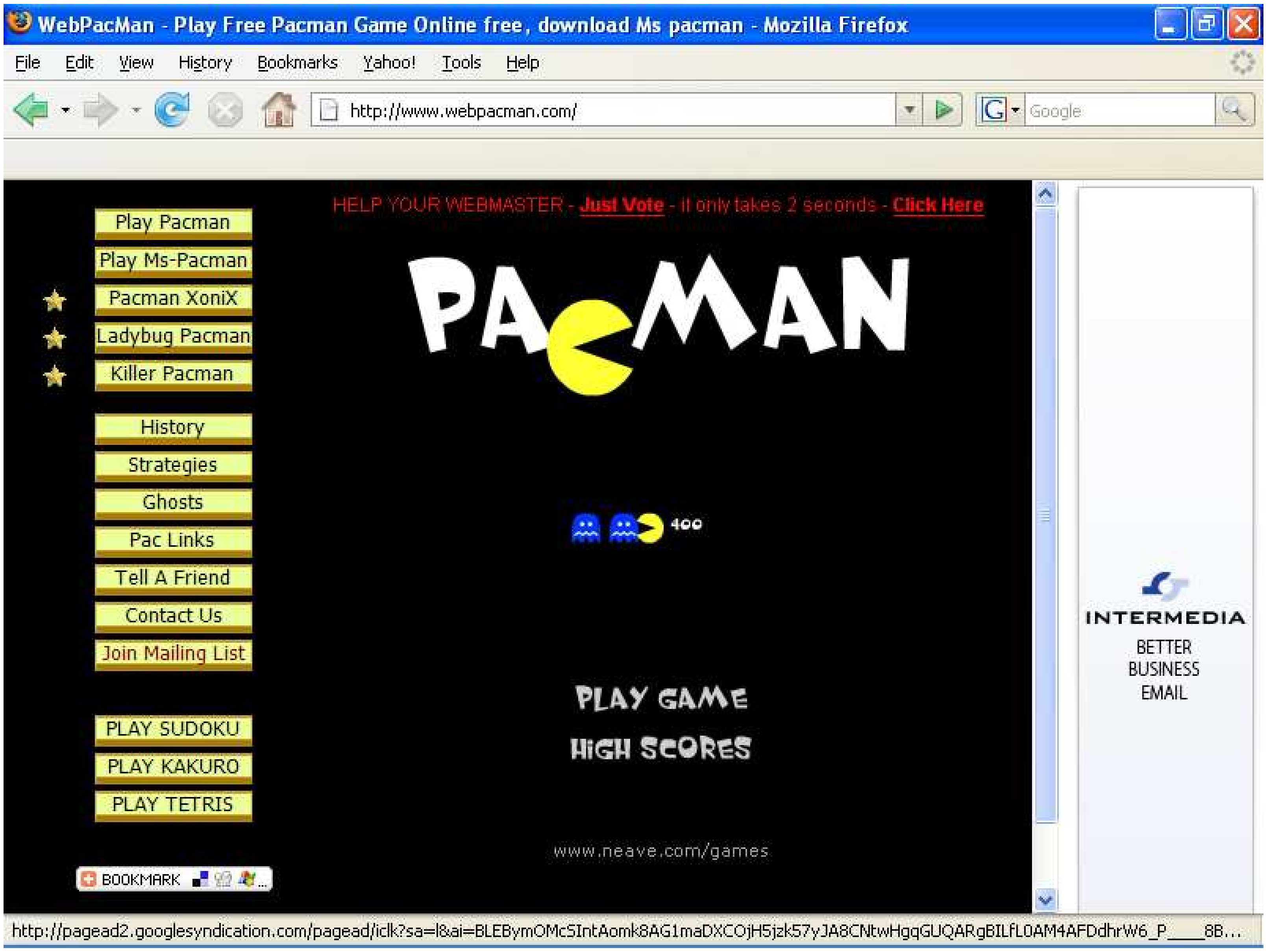
http://pagead2.googlesyndication.com/pagead/iclk?sa=l&ai=BLEBymOMcSIntAomk8AG1maDXCOjH5jzk57yJA8CNtwHgqGUQARgBILfL0AM4AFDdhrW6_P____8B...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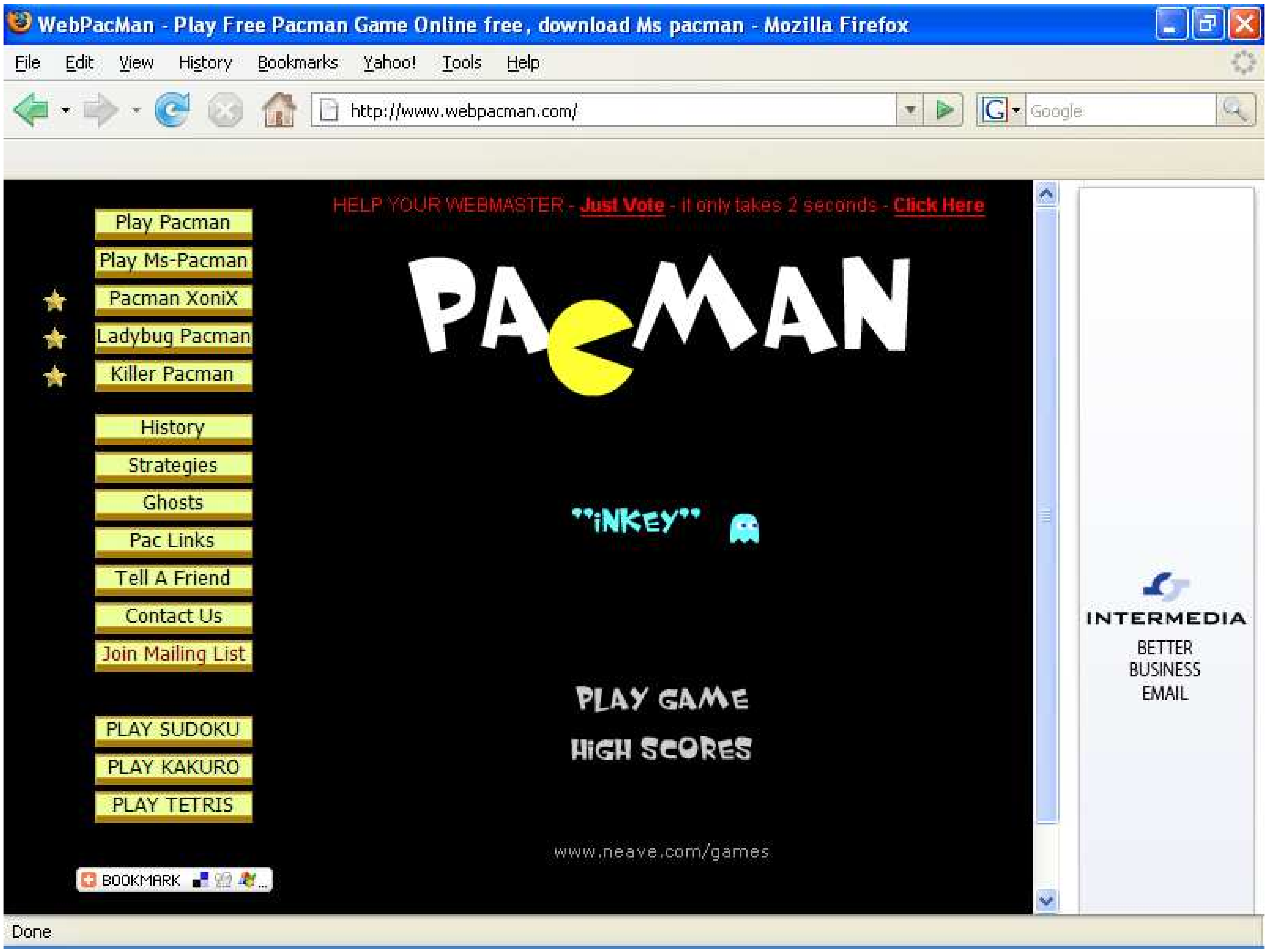
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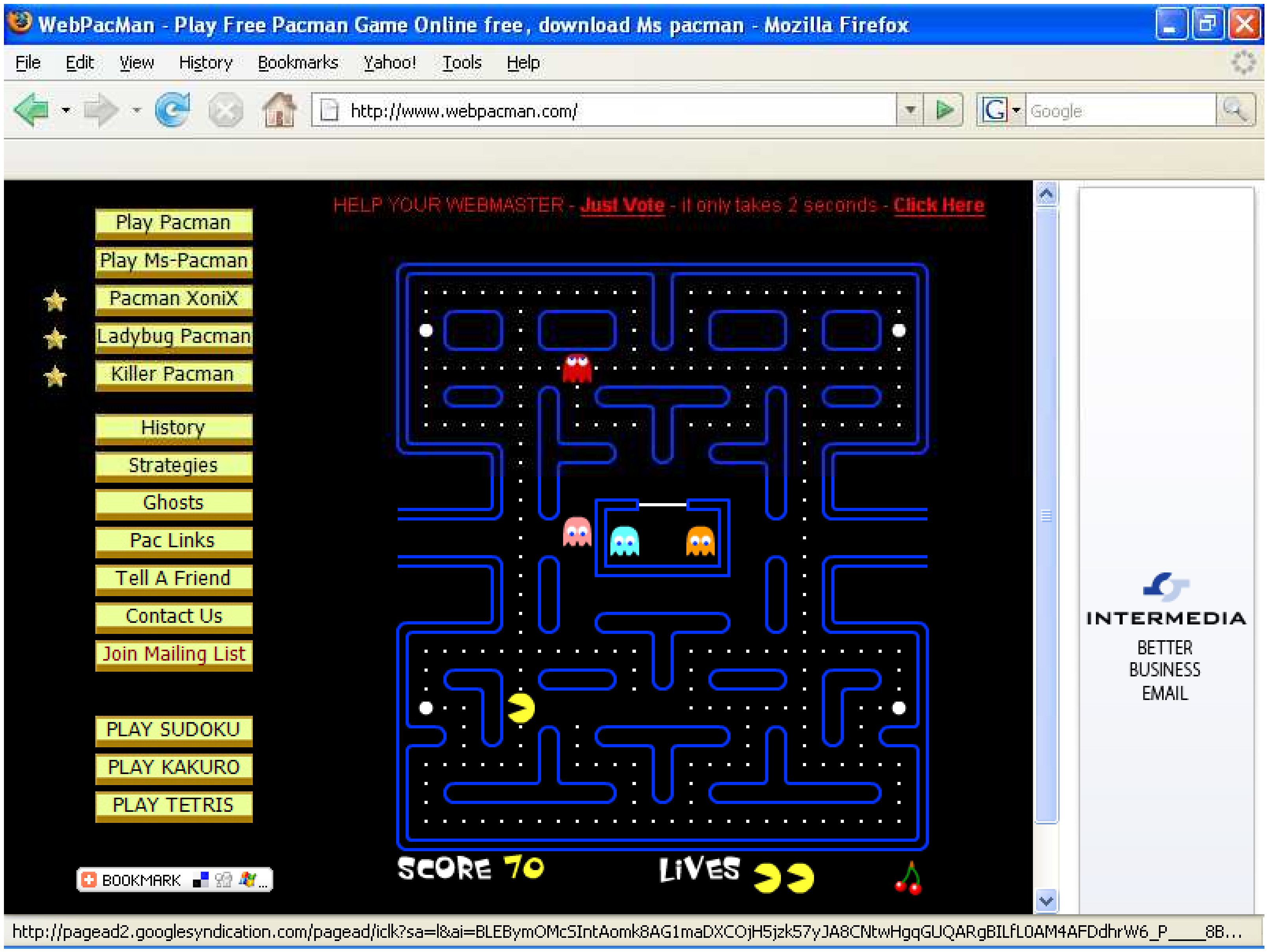
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PLAY KAKURO
PLAY TETRIS
BOOKMARK
SCORE 70
LIVES
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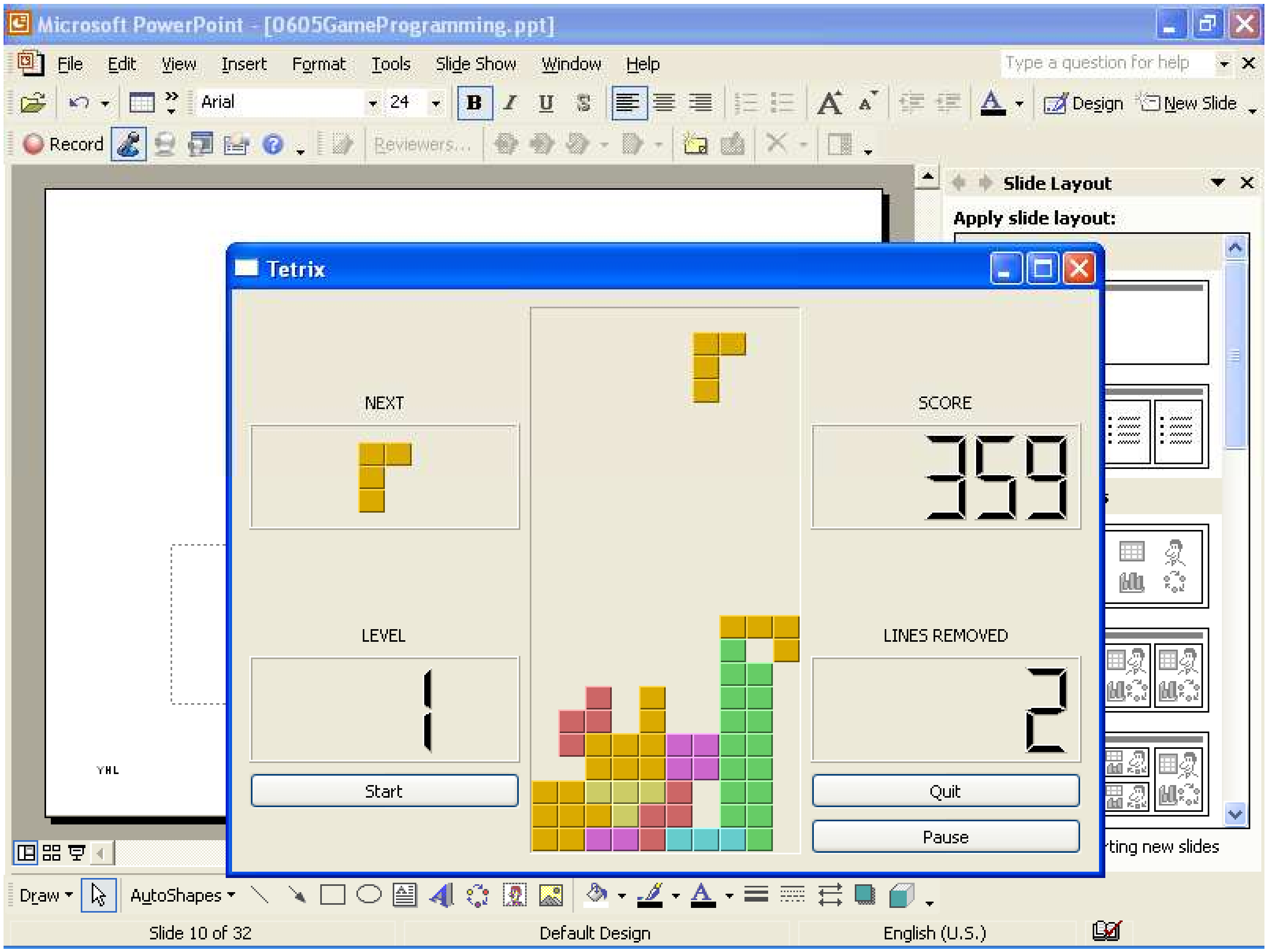
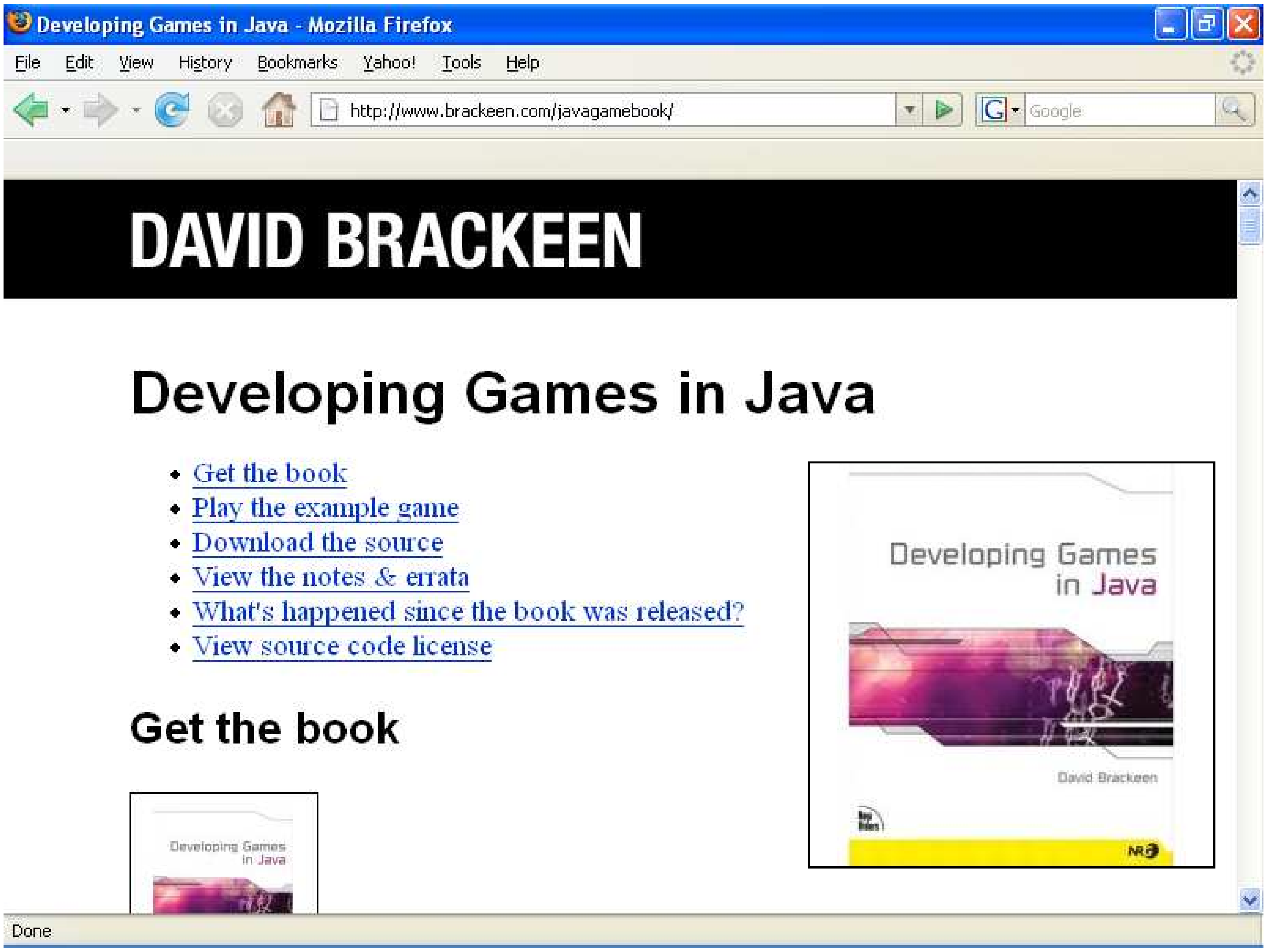
http://pagead2.googlesyndication.com/pagead/iclk?sa=l&ai=BLEBymOMcSIntAomk8AG1maDXCOjH5jzk57yJA8CNtwHgqGUQARgBILfL0AM4AFDdhrW6_P____8B...

## Window Game


Microsoft PowerPoint - [0605GameProgramming.ppt]
File Edit View Insert Format Tools Slide Show Window Help
Type a question for help
Arial 24
Design New Slide
Record Reviewers...
Slide Layout
Apply slide layout:
Tetrix
NEXT
SCORE
359
LEVEL
1
LINES REMOVED
2
Start
Quit
Pause
YHL
ting new slides
Draw AutoShapes
Slide 10 of 32
Default Design
English (U.S.)

## Full Screen Game


Developing Games in Java - Mozilla Firefox
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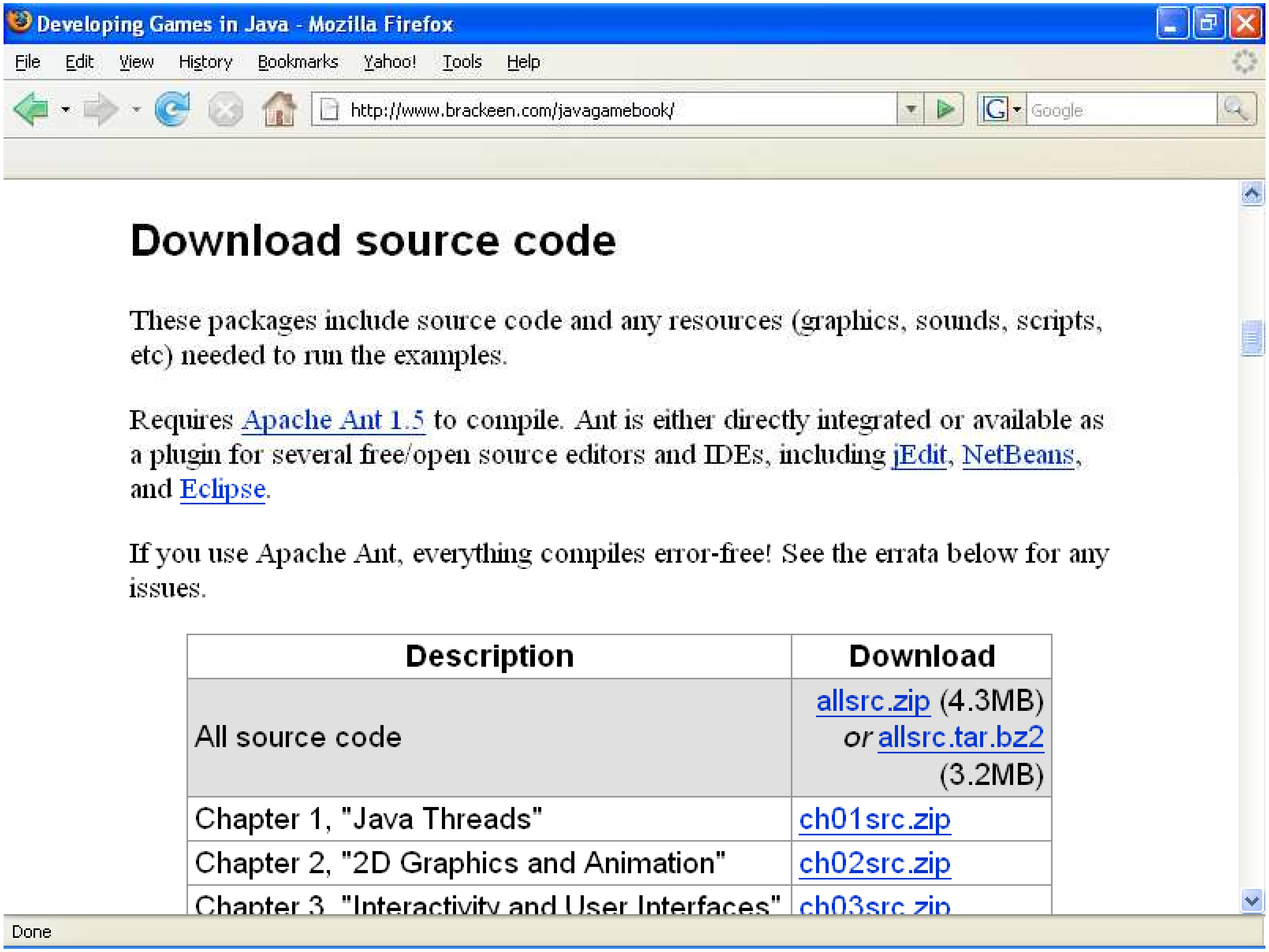
DAVID BRACKEEN

Developing Games in Java

- Get the book
- Play the example game
- Download the source
- View the notes & errata
- What's happened since the book was released?
- View source code license

Get the book

Developing Games in Java
David Brackeen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http://www.brackeen.com/javagamebook/
Google
Done

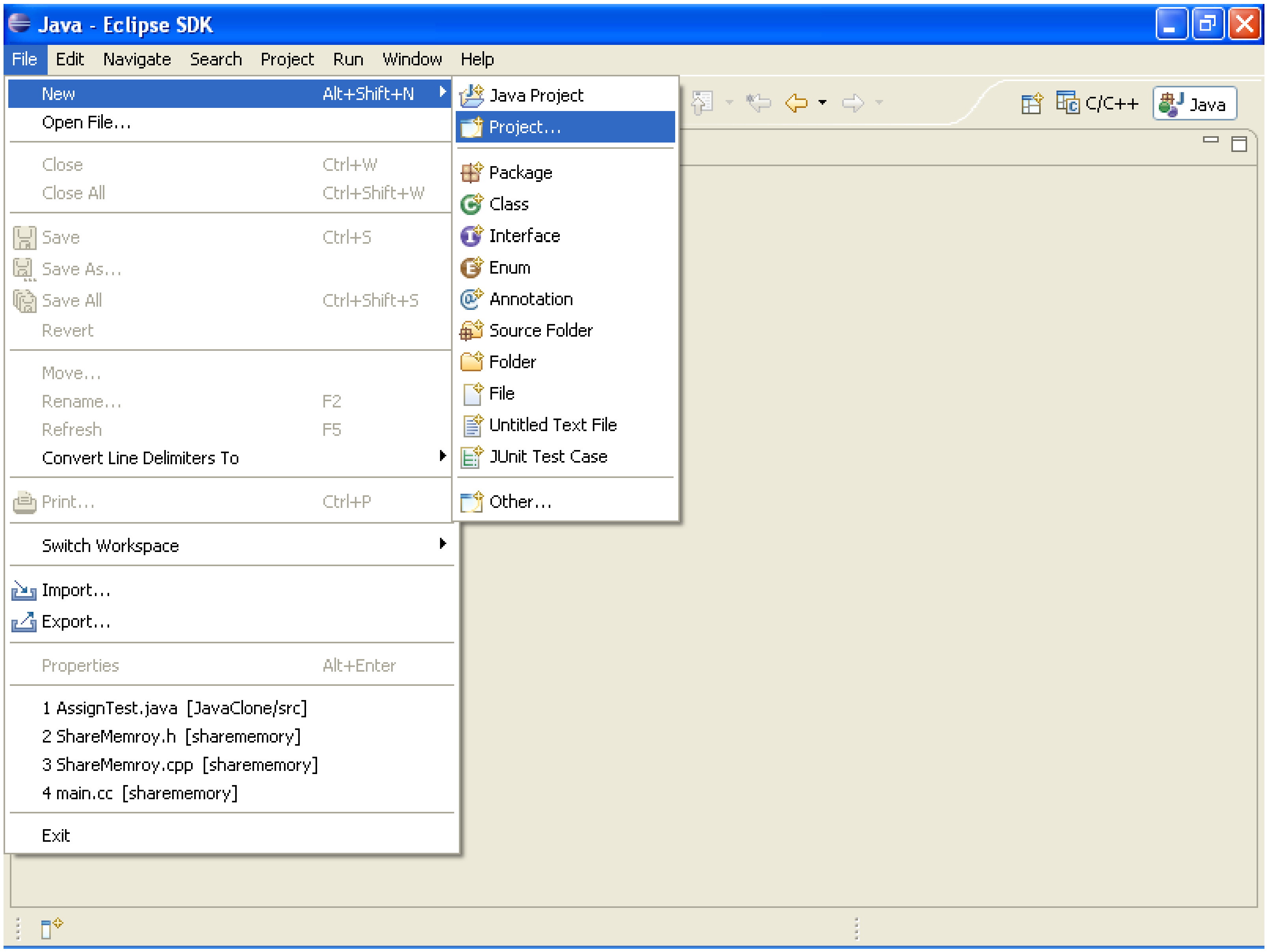
## Download source code

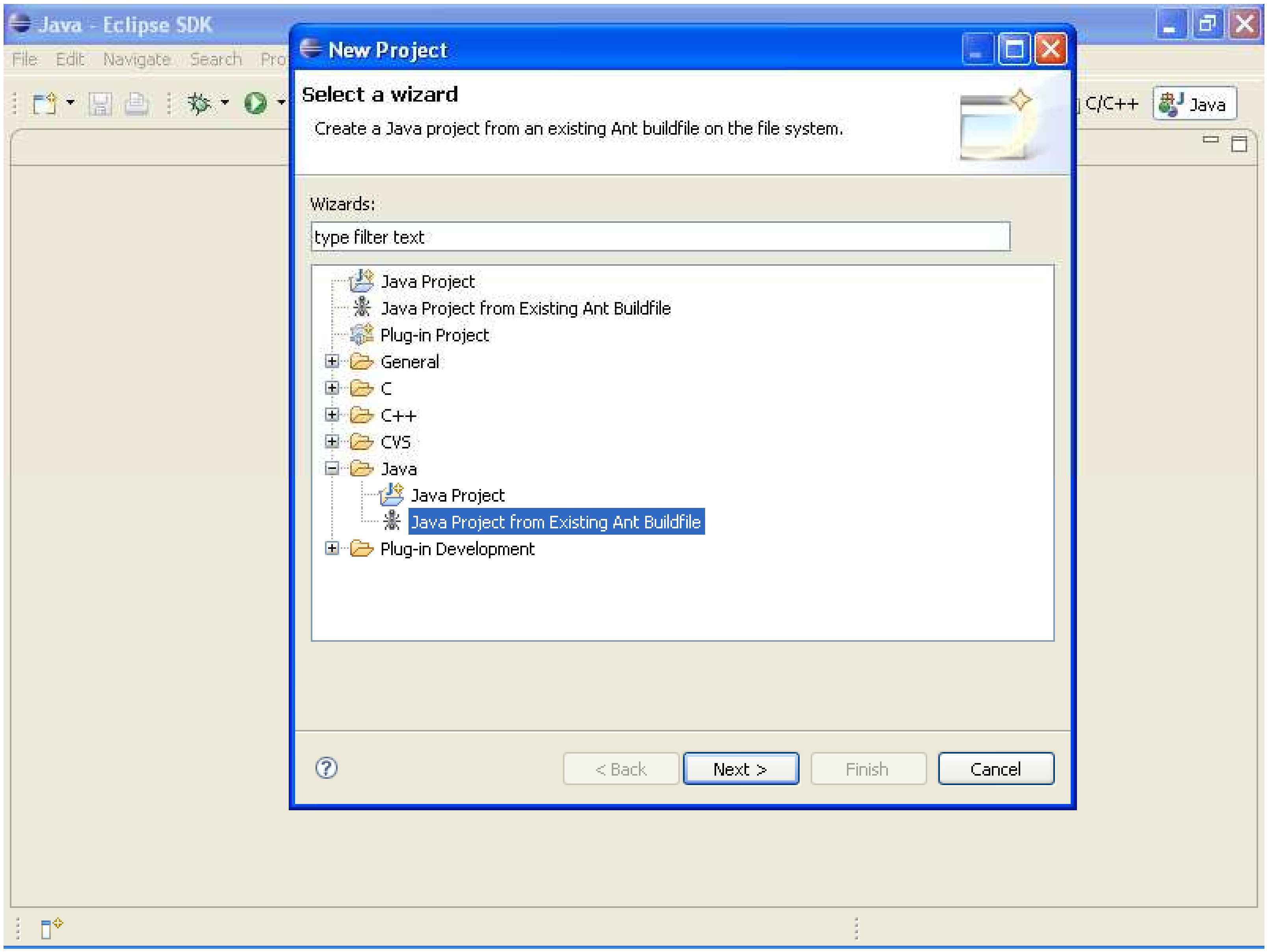
These packages include source code and any resources (graphics, sounds, scripts, etc) needed to run the examples.

Requires Apache Ant 1.5 to compile. Ant is either directly integrated or available as a plugin for several free/open source editors and IDEs, including jEdit, NetBeans, and Eclipse.

If you use Apache Ant, everything compiles error-free! See the errata below for any issues.

| Description | Download |
|---|---|
| All source code | allsrc.zip (4.3MB) *or* allsrc.tar.bz2 (3.2MB) |
| Chapter 1, "Java Threads" | ch01src.zip |
| Chapter 2, "2D Graphics and Animation" | ch02src.zip |
| Chapter 3, "Interactivity and User Interfaces" | ch03src.zip |


Java - Eclipse SDK
File
Edit
Navigate
Search
Project
Run
Window
Help
New Alt+Shift+N
Open File...
Close Ctrl+W
Close All Ctrl+Shift+W
Save Ctrl+S
Save As...
Save All Ctrl+Shift+S
Revert
Move...
Rename... F2
Refresh F5
Convert Line Delimiters To
Print... Ctrl+P
Switch Workspace
Import...
Export...
Properties Alt+Enter
1 AssignTest.java [JavaClone/src]
2 ShareMemroy.h [sharememory]
3 ShareMemroy.cpp [sharememory]
4 main.cc [sharememory]
Exit
Java Project
Project...
Package
Class
Interface
Enum
Annotation
Source Folder
Folder
File
Untitled Text File
JUnit Test Case
Other...
C/C++
Java



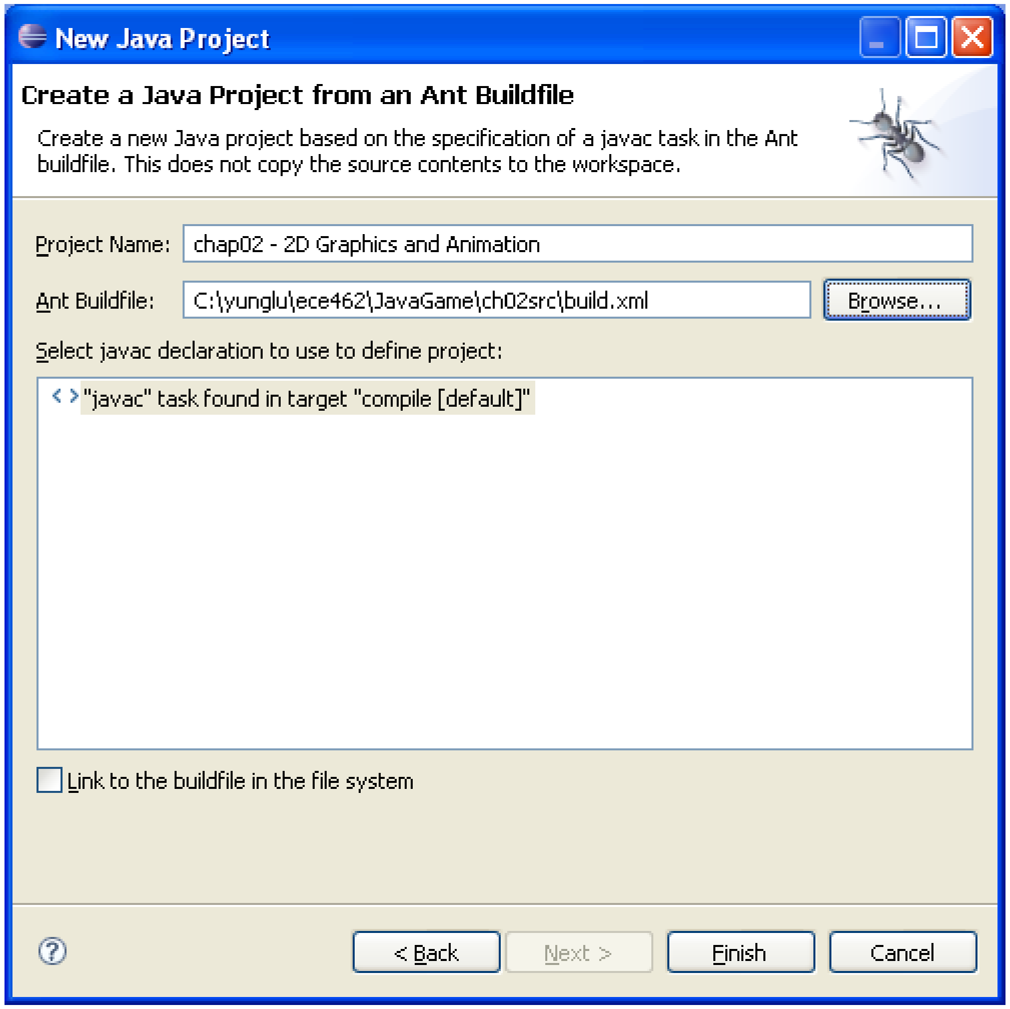
Select a wizard

Create a Java project from an existing Ant buildfile on the file system.

Wizards:

type filter text

- Java Project
- Java Project from Existing Ant Buildfile
- Plug-in Project
- General
- C
- C++
- CVS
- Java
  - Java Project
  - Java Project from Existing Ant Buildfile
- Plug-in Development



**Create a Java Project from an Ant Buildfile**

Create a new Java project based on the specification of a javac task in the Ant buildfile. This does not copy the source contents to the workspace.

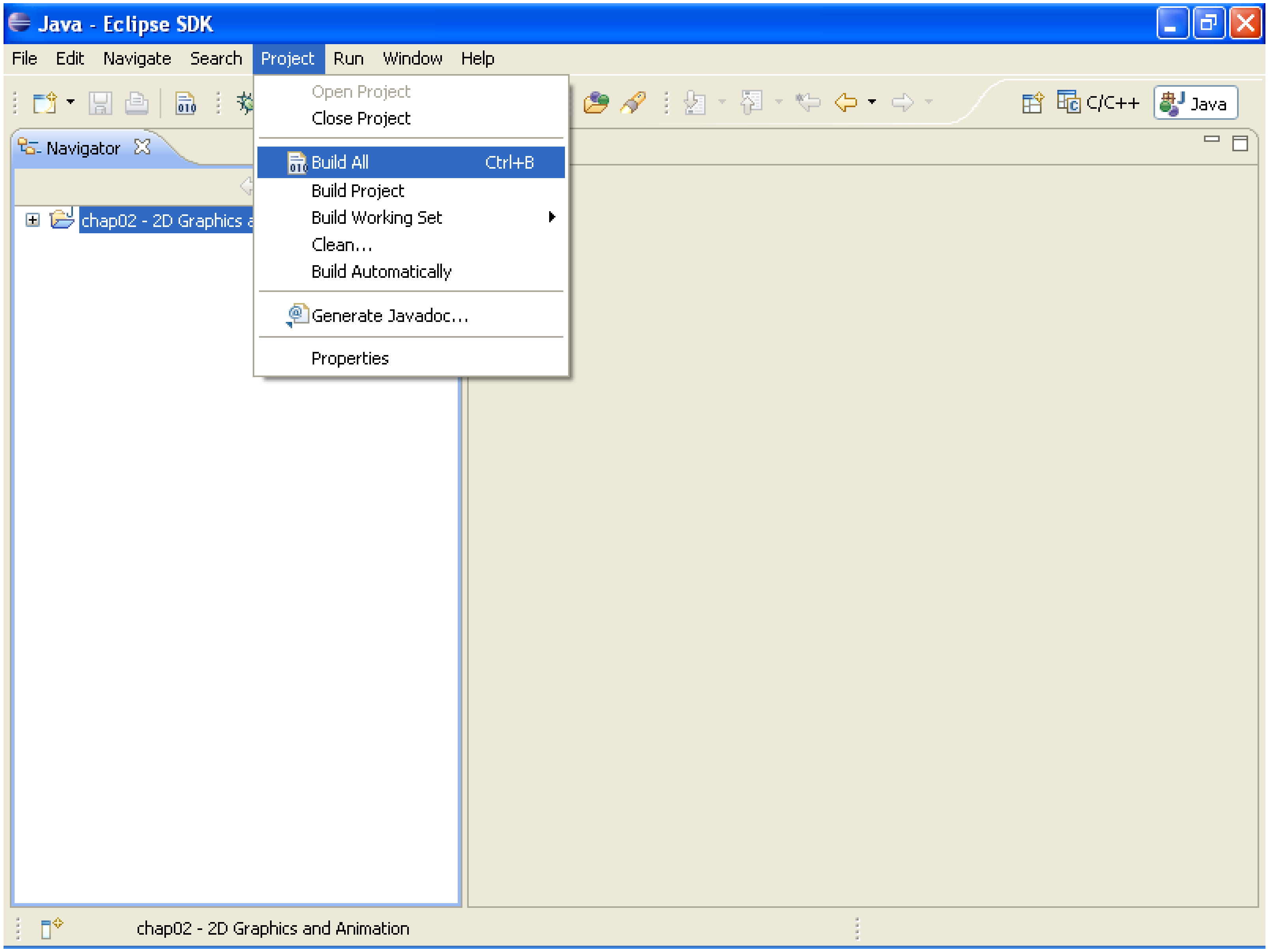
Project Name: chap02 - 2D Graphics and Animation

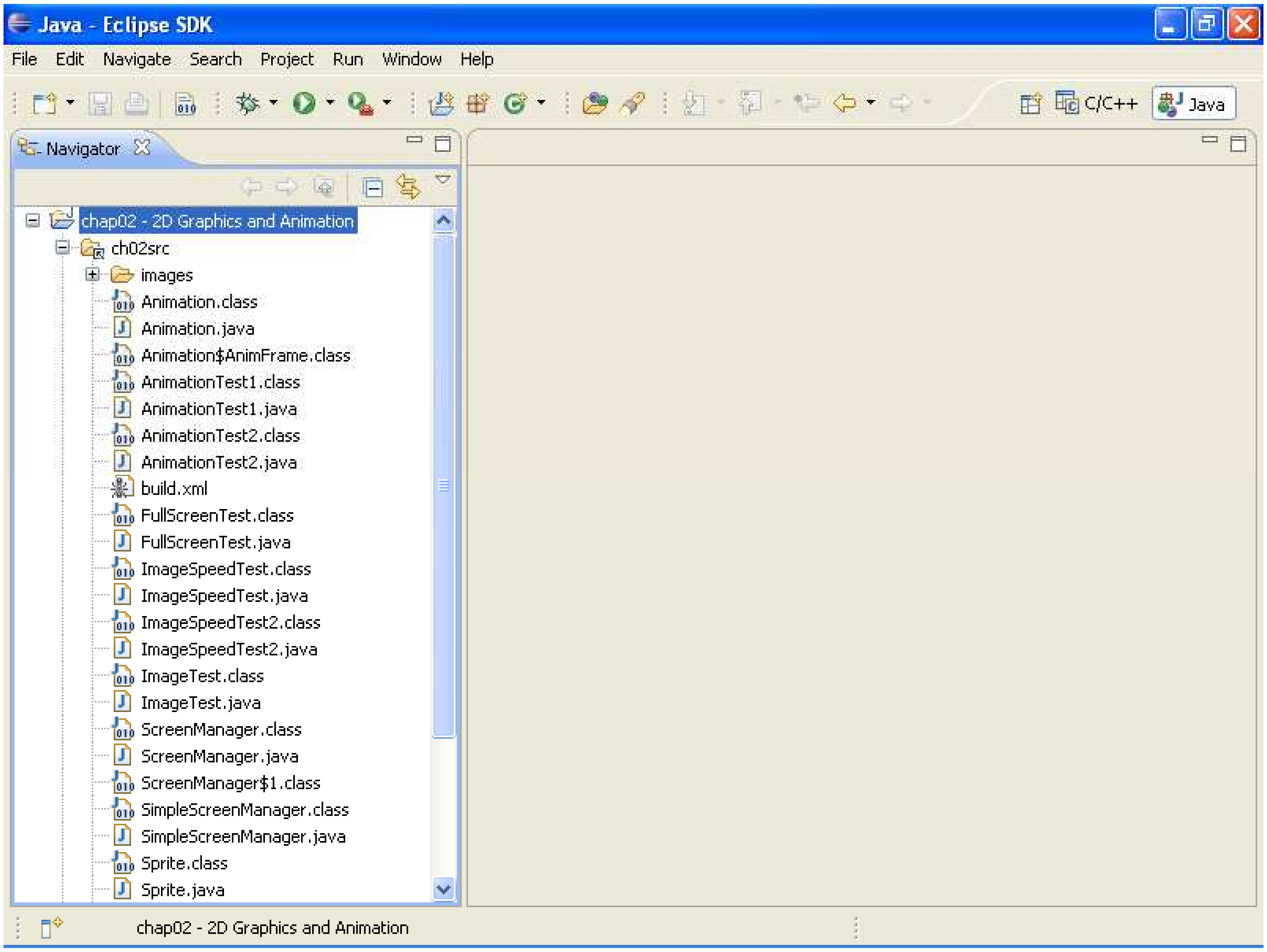
Ant Buildfile: C:\yunglu\ece462\JavaGame\ch02src\build.xml

Select javac declaration to use to define project:

"javac" task found in target "compile [default]"

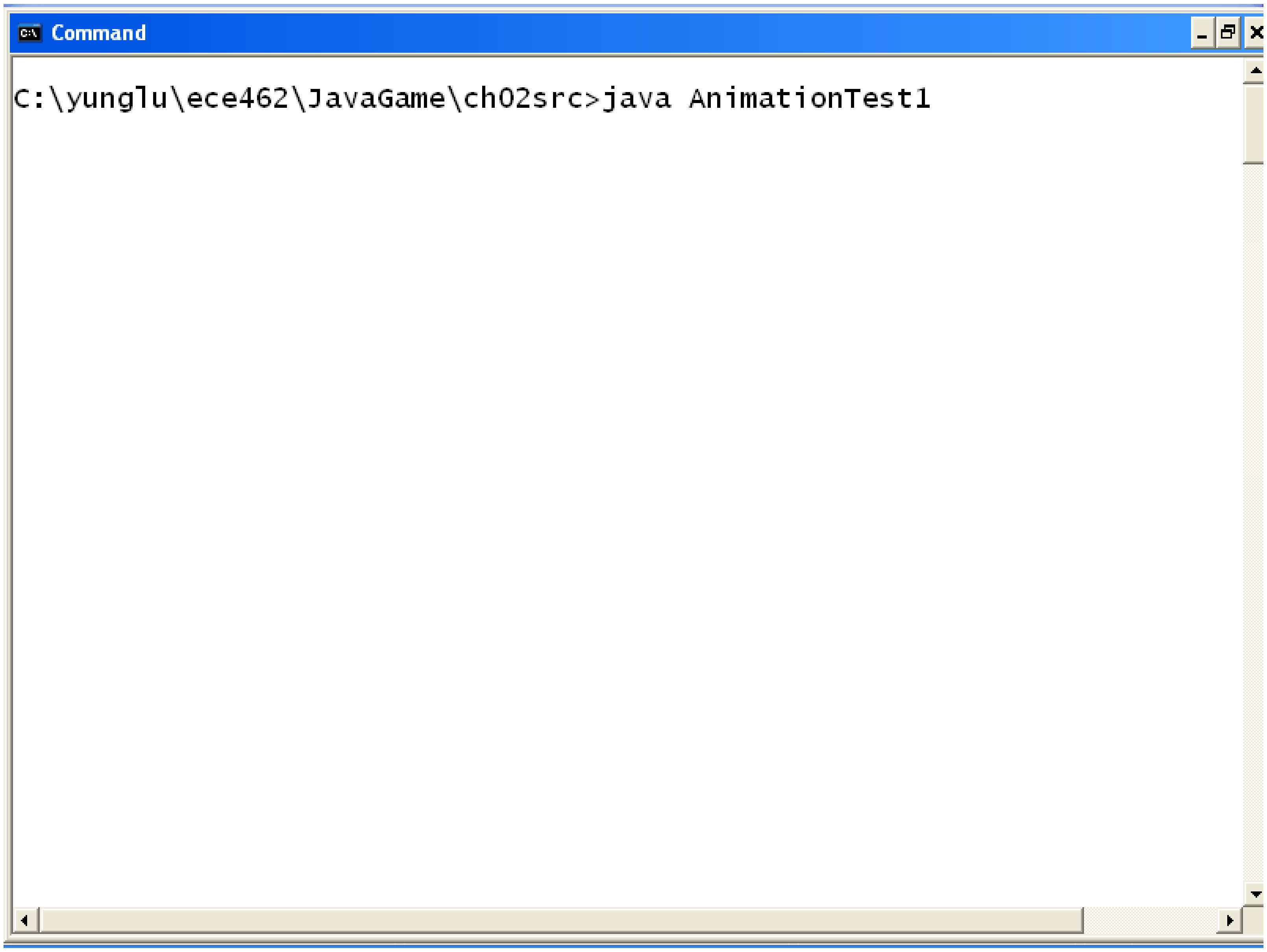
☐ Link to the buildfile in the file system


Java - Eclipse SDK
File Edit Navigate Search Project Run Window Help
Open Project
Close Project
Build All Ctrl+B
Build Project
Build Working Set
Clean...
Build Automatically
Generate Javadoc...
Properties
Navigator
chap02 - 2D Graphics a
C/C++
Java
chap02 - 2D Graphics and Animation



```
chap02 - 2D Graphics and Animation
  ch02src
    images
    Animation.class
    Animation.java
    Animation$AnimFrame.class
    AnimationTest1.class
    AnimationTest1.java
    AnimationTest2.class
    AnimationTest2.java
    build.xml
    FullScreenTest.class
    FullScreenTest.java
    ImageSpeedTest.class
    ImageSpeedTest.java
    ImageSpeedTest2.class
    ImageSpeedTest2.java
    ImageTest.class
    ImageTest.java
    ScreenManager.class
    ScreenManager.java
    ScreenManager$1.class
    SimpleScreenManager.class
    SimpleScreenManager.java
    Sprite.class
    Sprite.java
```

chap02 - 2D Graphics and Animation



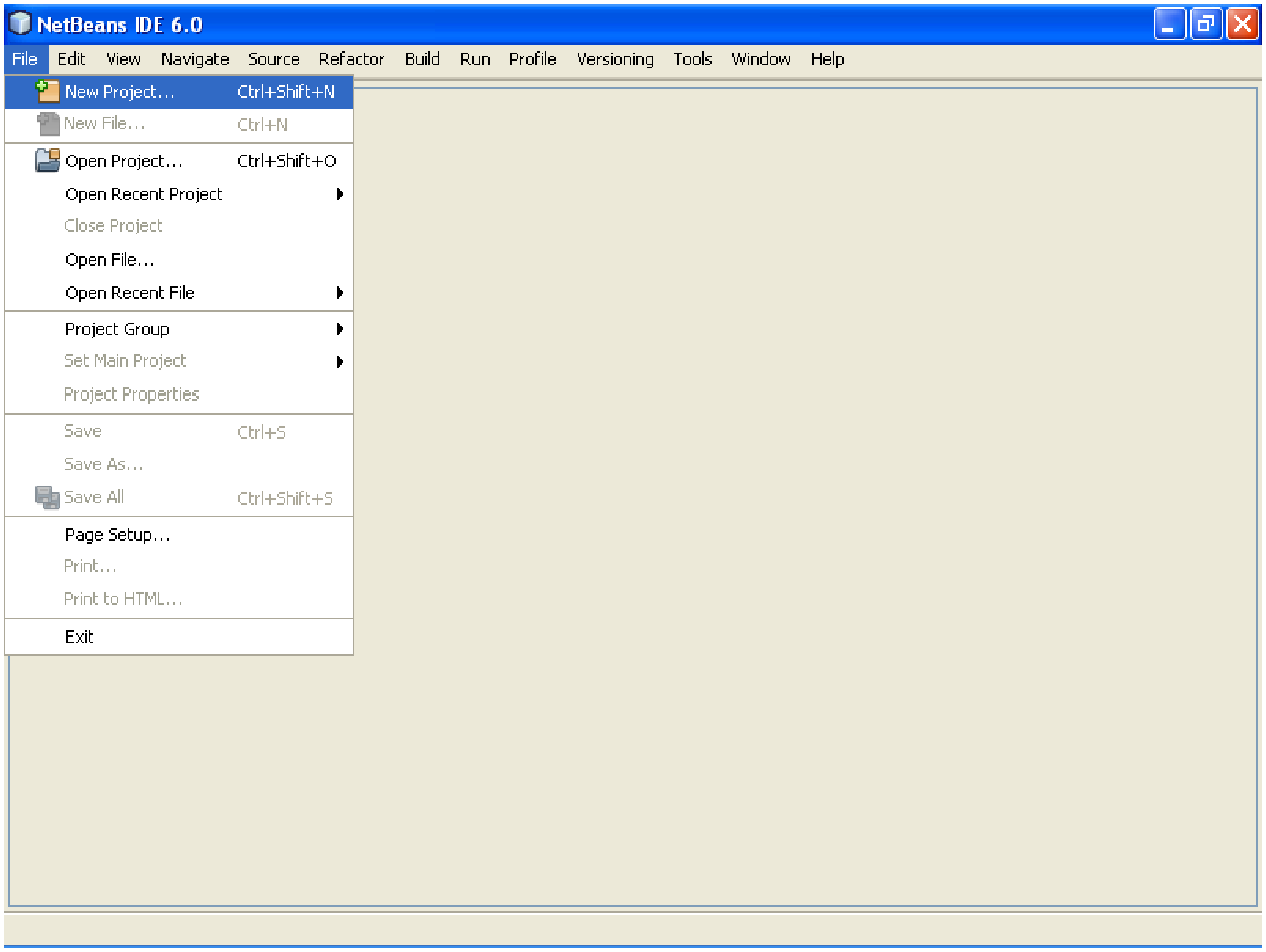
```
C:\yunglu\ece462\JavaGame\ch02src>java AnimationTest1
```

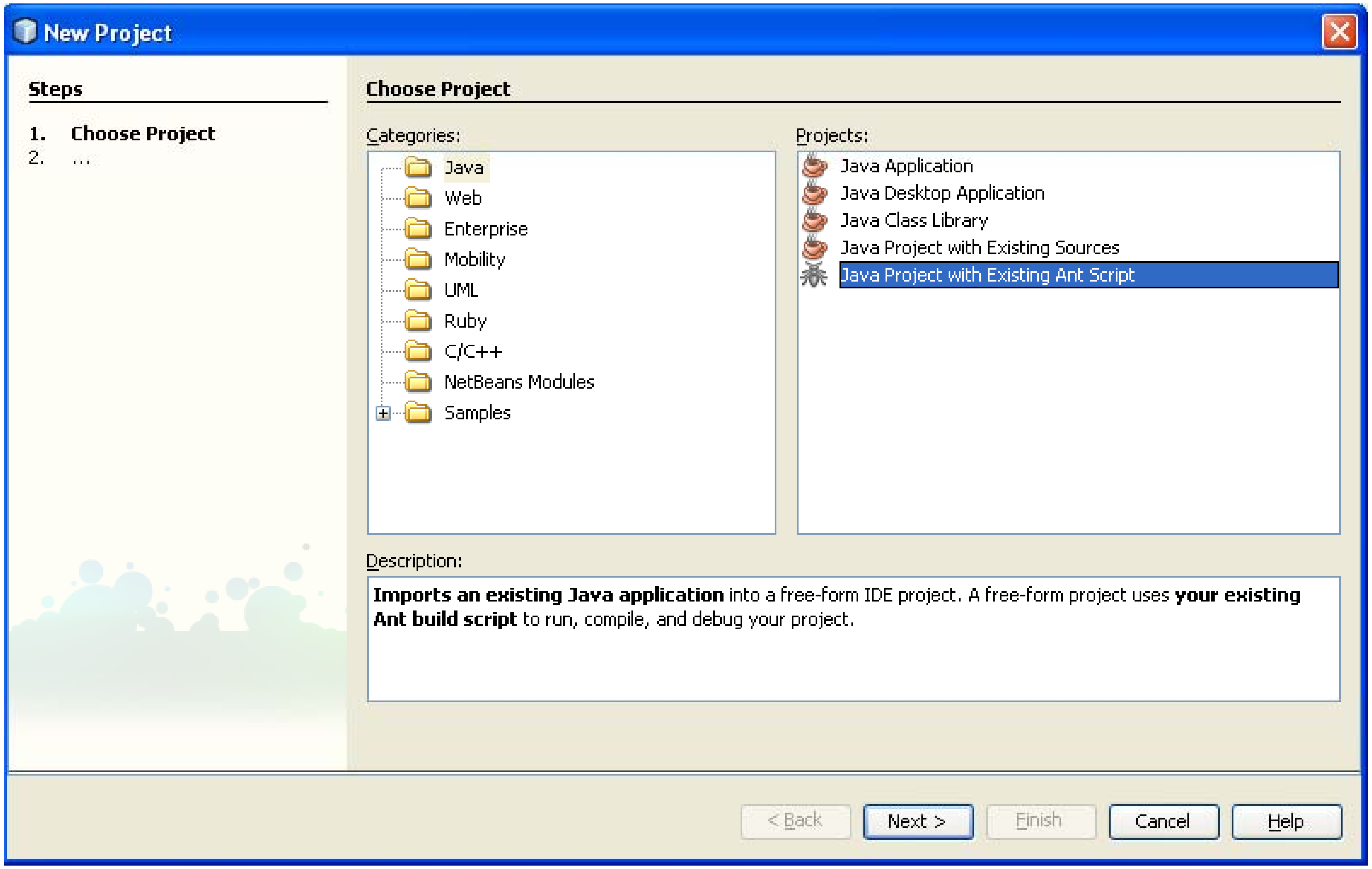
# ECE 462 Object-Oriented Programming using C++ and Java

# Full-Screen Games

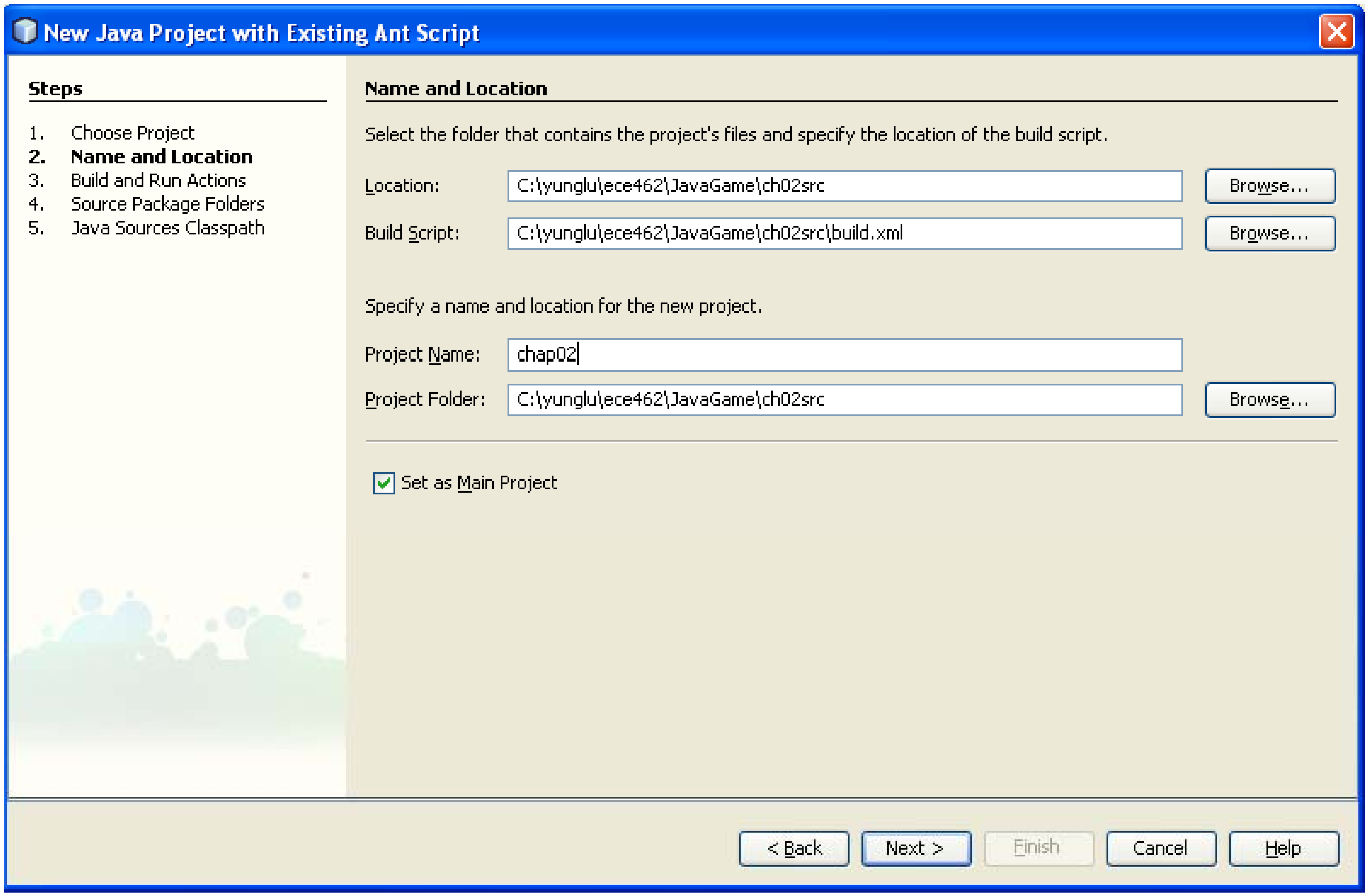
Yung-Hsiang Lu
yunglu@purdue.edu

## Create a Java Project in Netbeans using Existing Code


NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
New Project... Ctrl+Shift+N
New File... Ctrl+N
Open Project... Ctrl+Shift+O
Open Recent Project
Close Project
Open File...
Open Recent File
Project Group
Set Main Project
Project Properties
Save Ctrl+S
Save As...
Save All Ctrl+Shift+S
Page Setup...
Print...
Print to HTML...
Exit



**Imports an existing Java application** into a free-form IDE project. A free-form project uses **your existing Ant build script** to run, compile, and debug your project.


New Java Project with Existing Ant Script

Steps

1. Choose Project
2. **Name and Location**
3. Build and Run Actions
4. Source Package Folders
5. Java Sources Classpath

**Name and Location**

Select the folder that contains the project's files and specify the location of the build script.

Location: C:\yunglu\ece462\JavaGame\ch02src

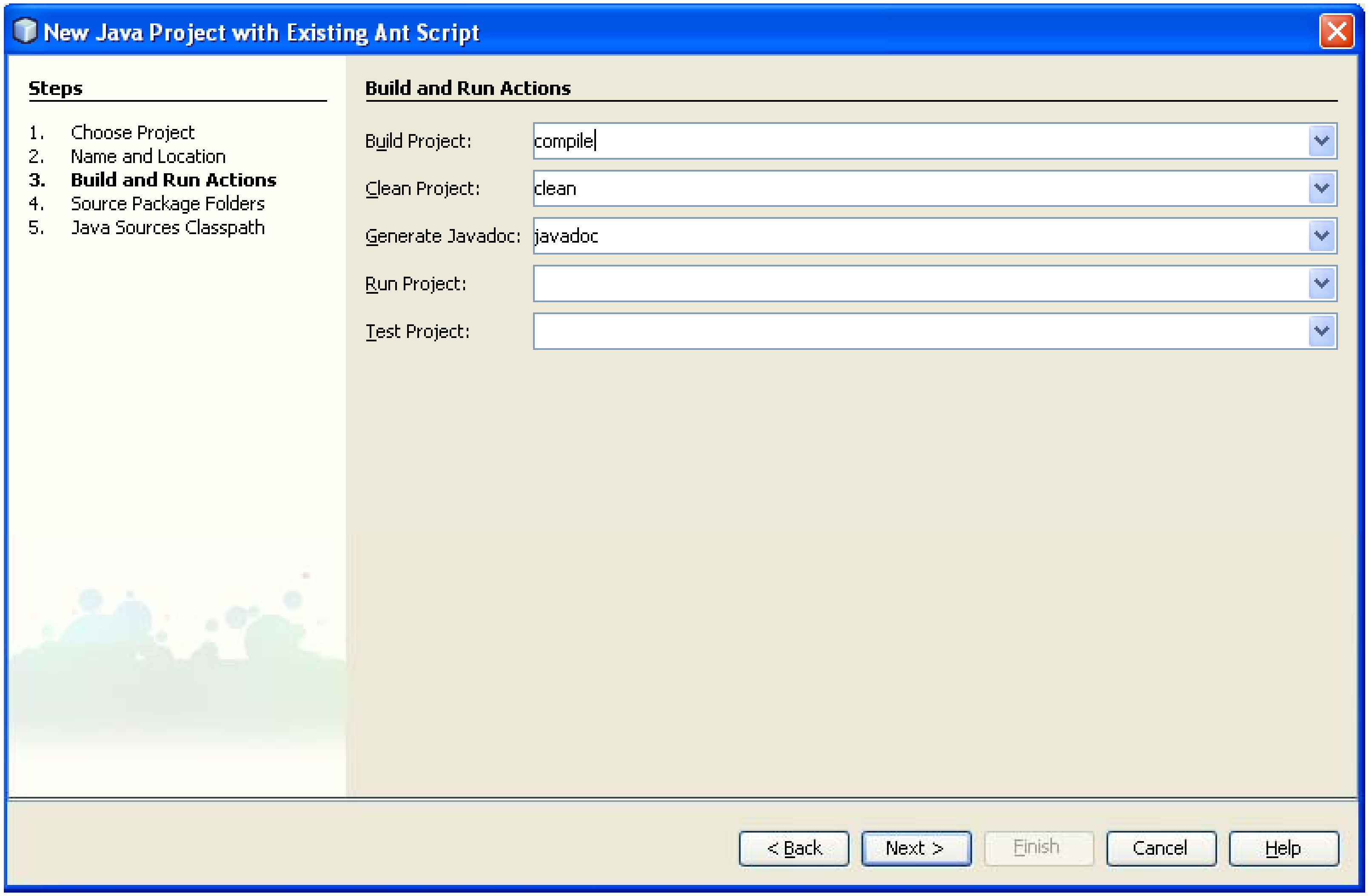
Build Script: C:\yunglu\ece462\JavaGame\ch02src\build.xml

Specify a name and location for the new project.

Project Name: chap02

Project Folder: C:\yunglu\ece462\JavaGame\ch02src

Set as Main Project: ✓

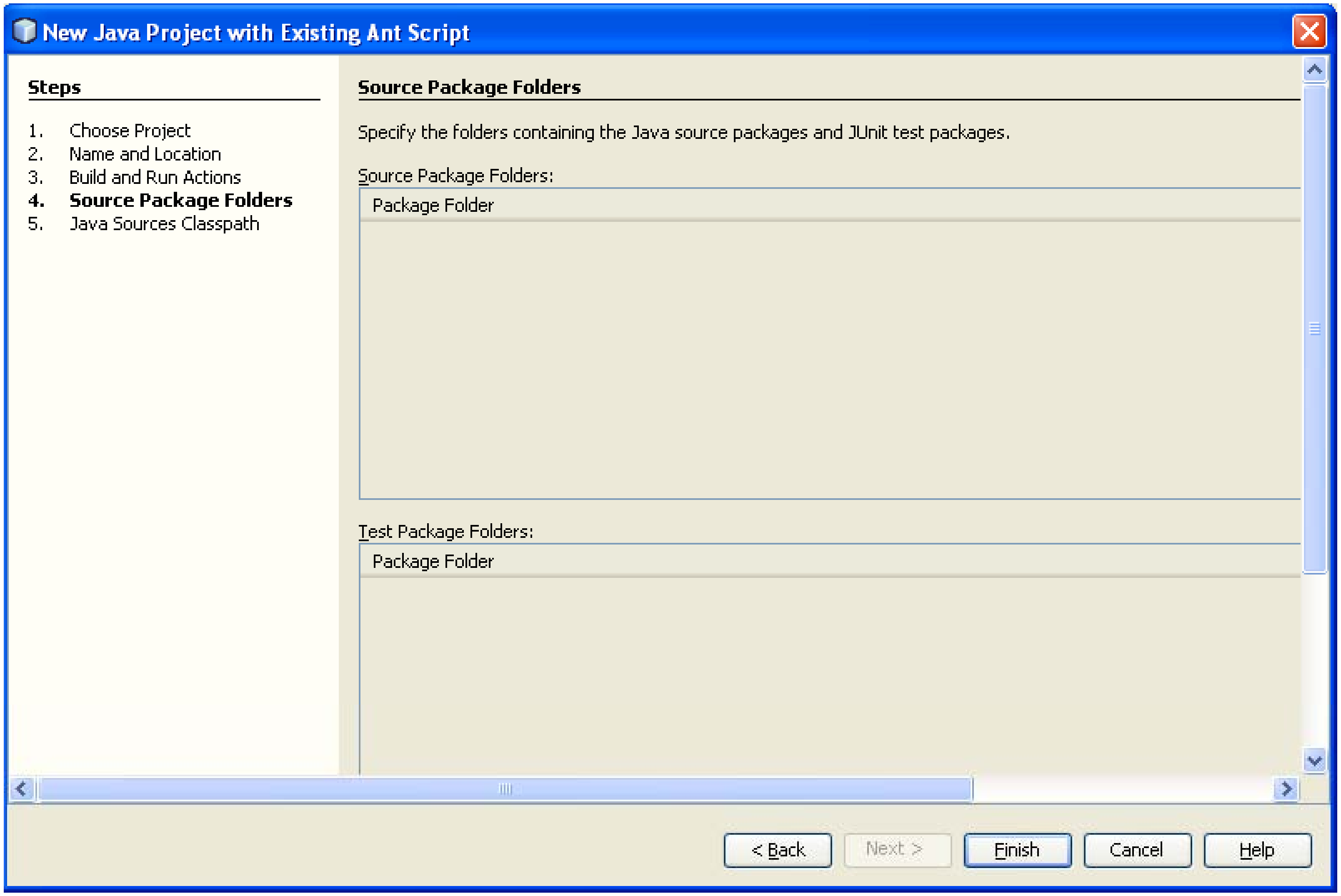

New Java Project with Existing Ant Script

**Steps**

1. Choose Project
2. Name and Location
3. **Build and Run Actions**
4. Source Package Folders
5. Java Sources Classpath

**Build and Run Actions**

| | |
|---|---|
| Build Project: | compile |
| Clean Project: | clean |
| Generate Javadoc: | javadoc |
| Run Project: | |
| Test Project: | |



**Steps**

1. Choose Project
2. Name and Location
3. Build and Run Actions
4. **Source Package Folders**
5. Java Sources Classpath

**Source Package Folders**

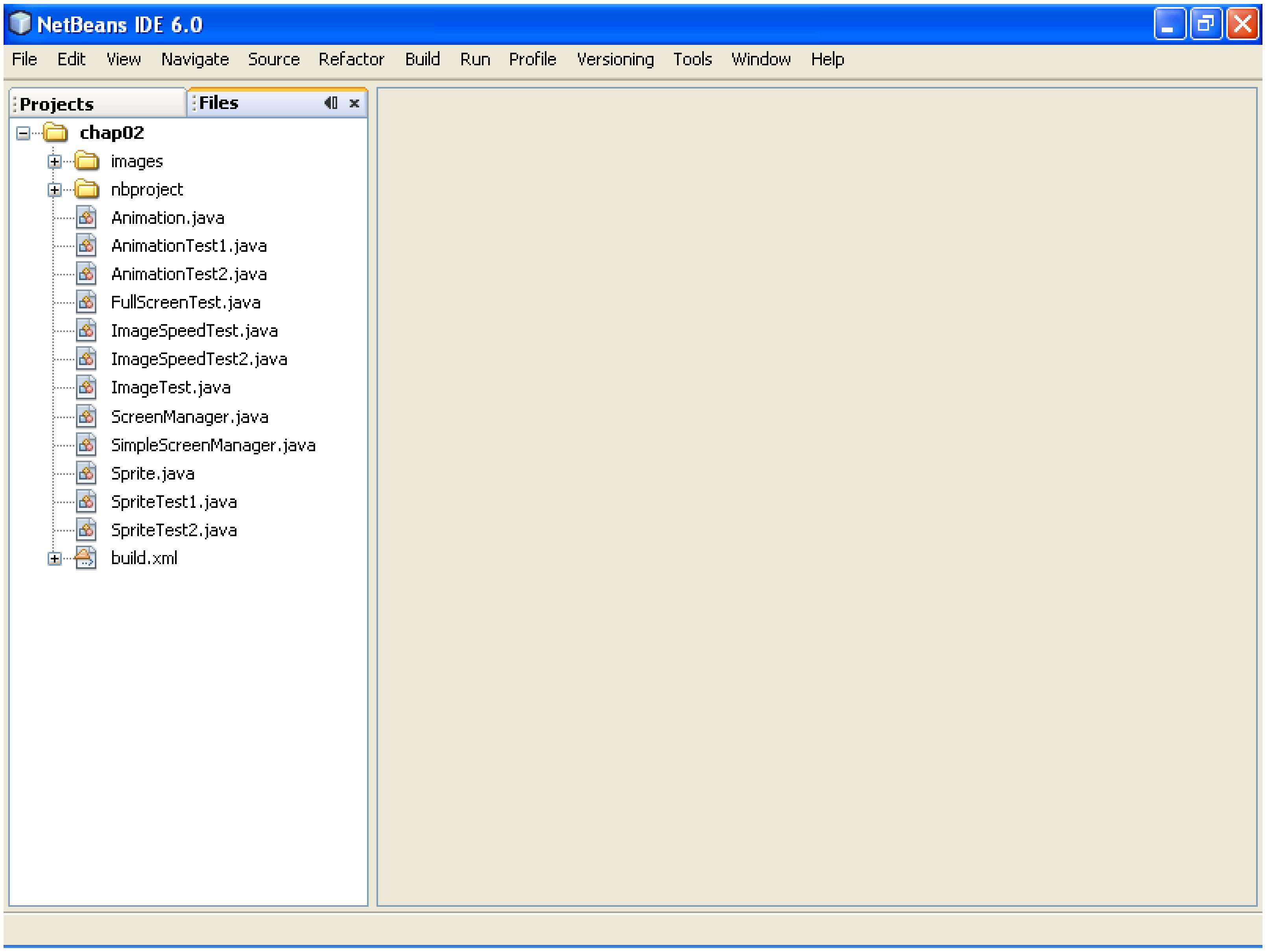
Specify the folders containing the Java source packages and JUnit test packages.

Source Package Folders:

| Package Folder |
|---|

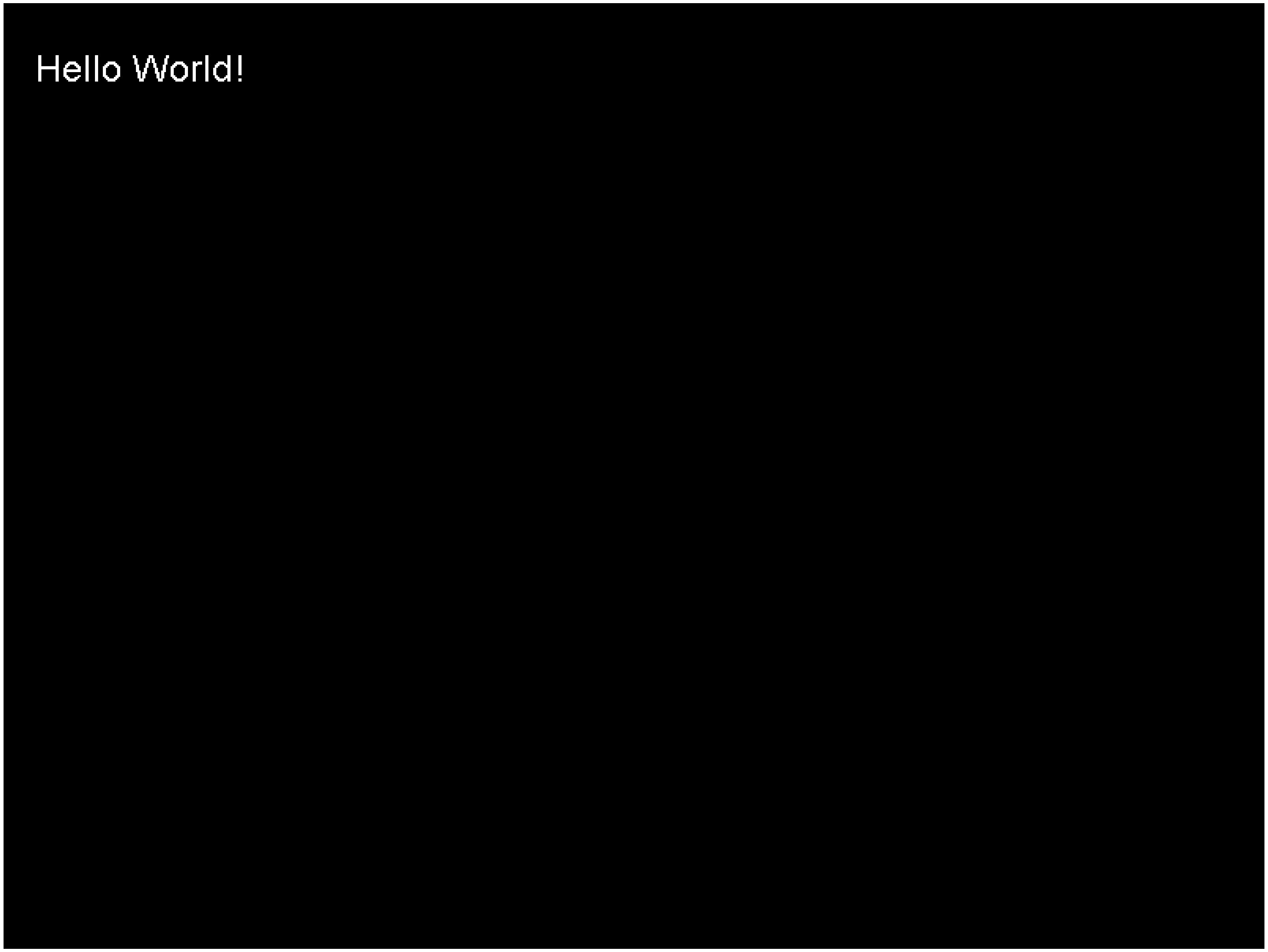
Test Package Folders:

| Package Folder |
|---|

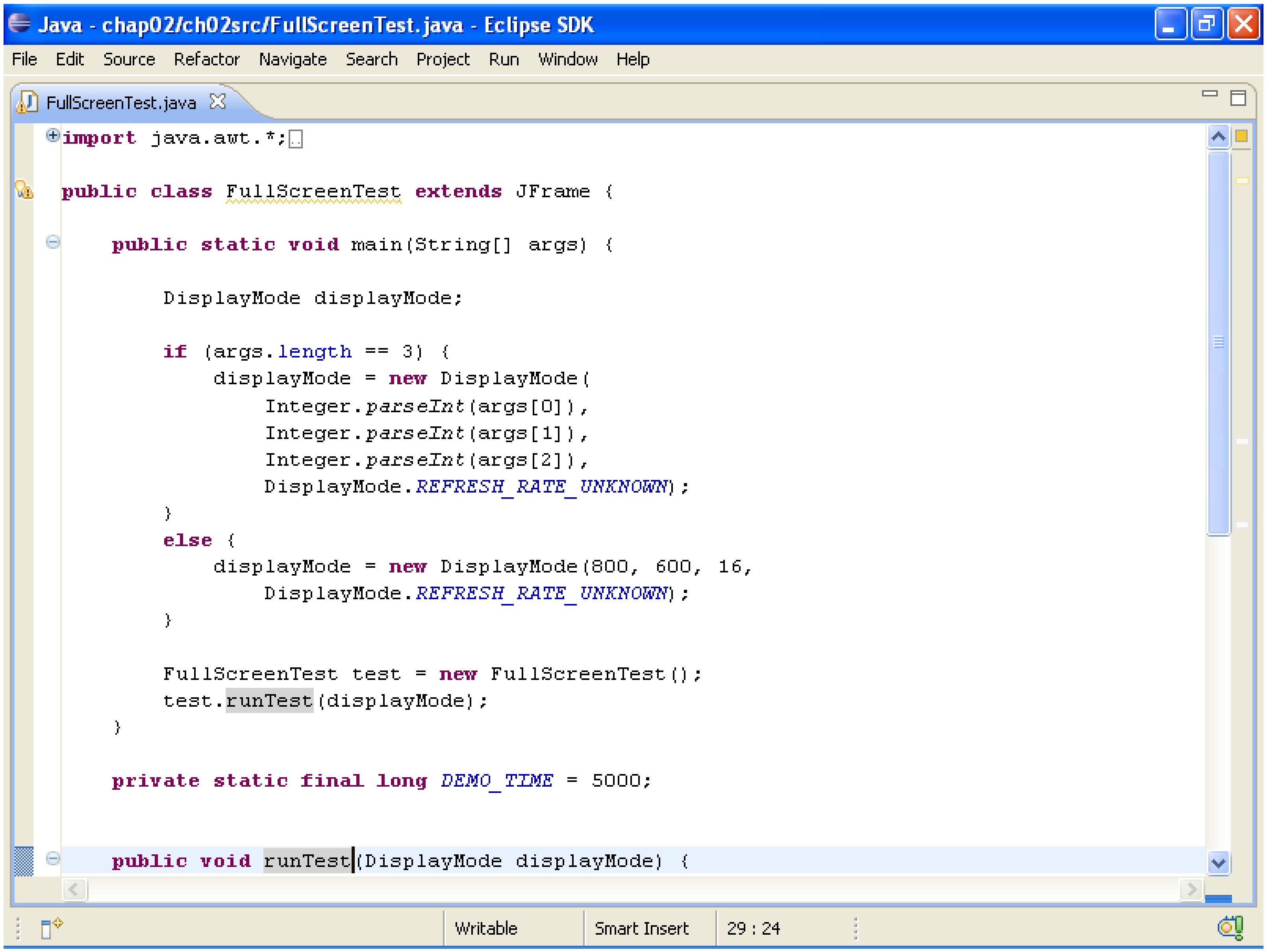

NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
Projects
Files

```
chap02
    images
    nbproject
    Animation.java
    AnimationTest1.java
    AnimationTest2.java
    FullScreenTest.java
    ImageSpeedTest.java
    ImageSpeedTest2.java
    ImageTest.java
    ScreenManager.java
    SimpleScreenManager.java
    Sprite.java
    SpriteTest1.java
    SpriteTest2.java
    build.xml
```

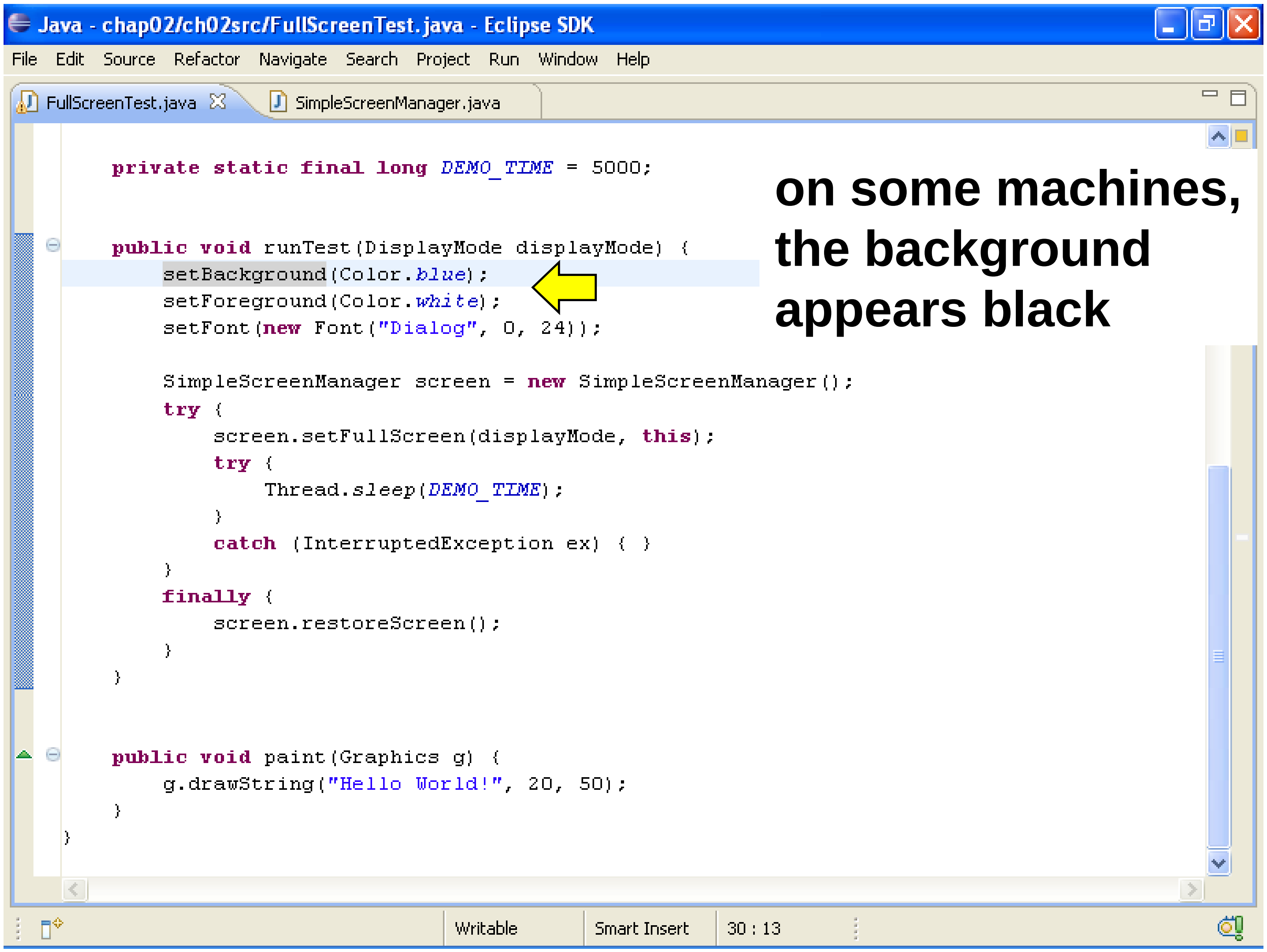
## Full Screen Test



```
Hello World!
```

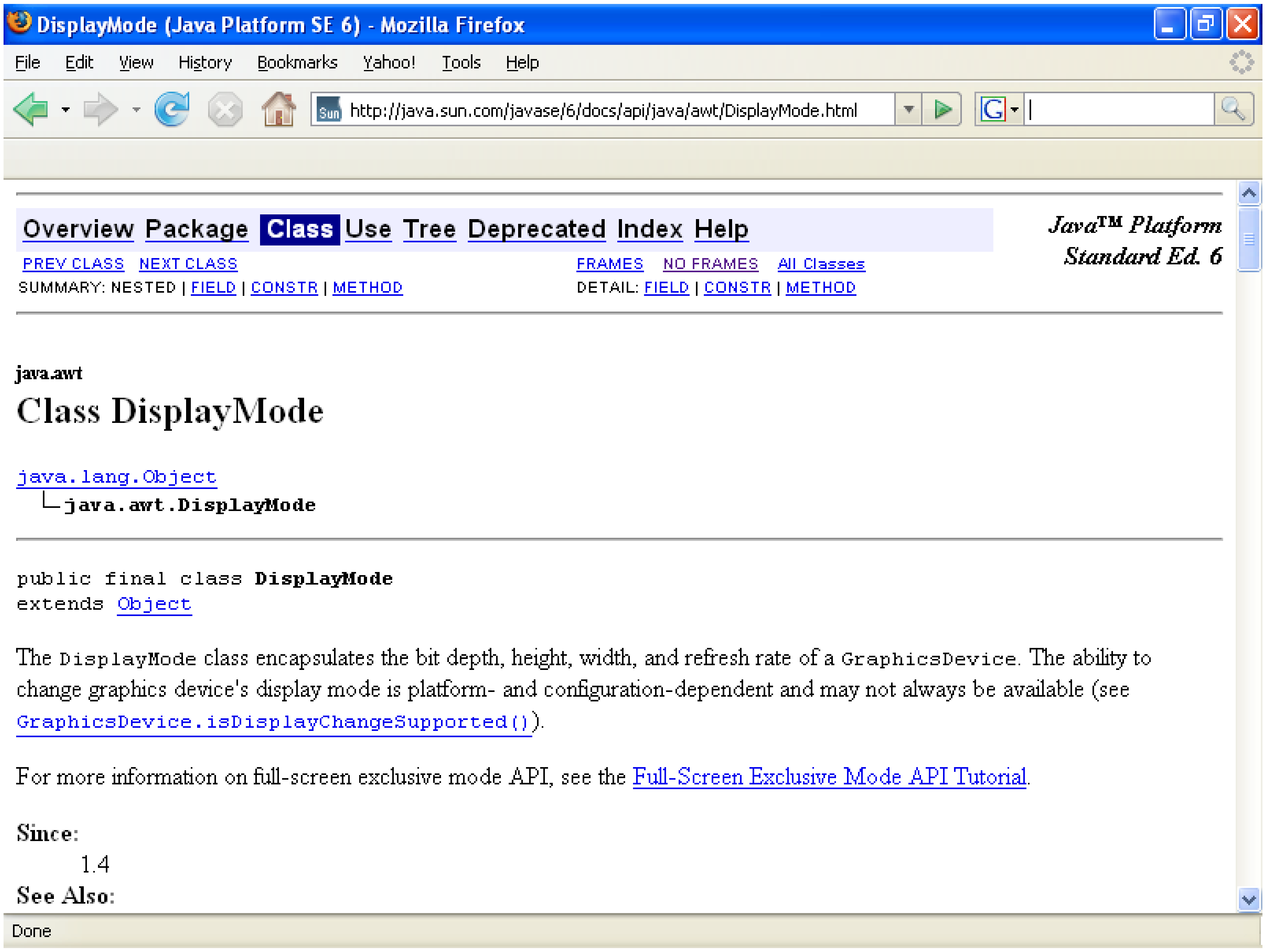

Java - chap02/ch02src/FullScreenTest.java - Eclipse SDK
File Edit Source Refactor Navigate Search Project Run Window Help
FullScreenTest.java
Writable
Smart Insert
29 : 24

```java
import java.awt.*;

public class FullScreenTest extends JFrame {

    public static void main(String[] args) {

        DisplayMode displayMode;

        if (args.length == 3) {
            displayMode = new DisplayMode(
                Integer.parseInt(args[0]),
                Integer.parseInt(args[1]),
                Integer.parseInt(args[2]),
                DisplayMode.REFRESH_RATE_UNKNOWN);
        }
        else {
            displayMode = new DisplayMode(800, 600, 16,
                DisplayMode.REFRESH_RATE_UNKNOWN);
        }

        FullScreenTest test = new FullScreenTest();
        test.runTest(displayMode);
    }

    private static final long DEMO_TIME = 5000;


    public void runTest(DisplayMode displayMode) {
```


Java - chap02/ch02src/FullScreenTest.java - Eclipse SDK
File Edit Source Refactor Navigate Search Project Run Window Help
FullScreenTest.java
SimpleScreenManager.java
Writable
Smart Insert
30 : 13

```
    private static final long DEMO_TIME = 5000;


    public void runTest(DisplayMode displayMode) {
        setBackground(Color.blue);
        setForeground(Color.white);
        setFont(new Font("Dialog", 0, 24));

        SimpleScreenManager screen = new SimpleScreenManager();
        try {
            screen.setFullScreen(displayMode, this);
            try {
                Thread.sleep(DEMO_TIME);
            }
            catch (InterruptedException ex) { }
        }
        finally {
            screen.restoreScreen();
        }
    }


    public void paint(Graphics g) {
        g.drawString("Hello World!", 20, 50);
    }
}
```

**on some machines, the background appears black**


DisplayMode (Java Platform SE 6) - Mozilla Firefox
File Edit View History Bookmarks Yahoo! Tools Help
http://java.sun.com/javase/6/docs/api/java/awt/DisplayMode.html
Overview Package Class Use Tree Deprecated Index Help
Java™ Platform Standard Ed. 6
PREV CLASS NEXT CLASS
FRAMES NO FRAMES All Classes
SUMMARY: NESTED | FIELD | CONSTR | METHOD
DETAIL: FIELD | CONSTR | METHOD
Done

java.awt

Class DisplayMode

```
java.lang.Object
  └java.awt.DisplayMode
```

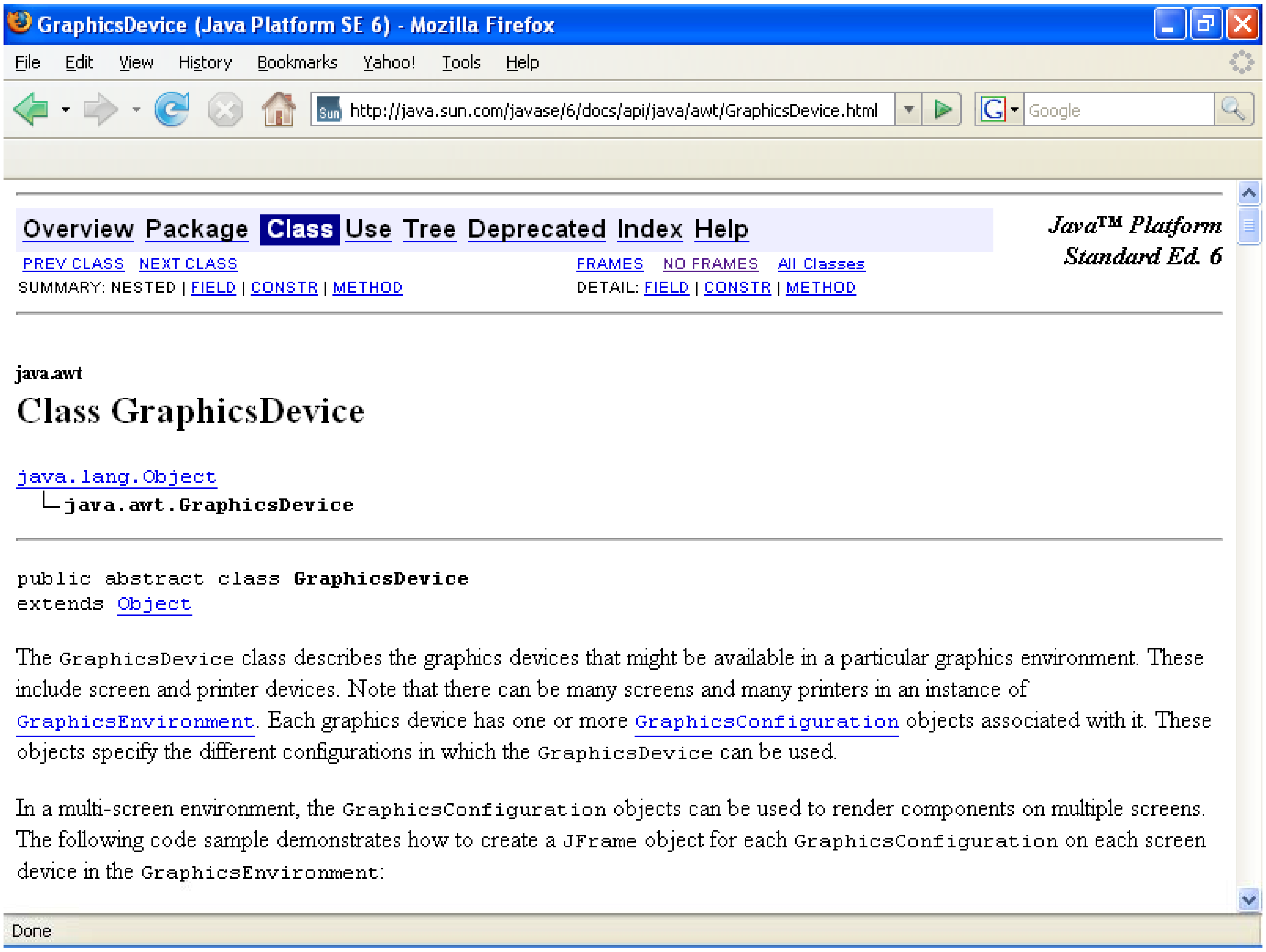
```
public final class DisplayMode
extends Object
```

The `DisplayMode` class encapsulates the bit depth, height, width, and refresh rate of a `GraphicsDevice`. The ability to change graphics device's display mode is platform- and configuration-dependent and may not always be available (see `GraphicsDevice.isDisplayChangeSupported()`).

For more information on full-screen exclusive mode API, see the Full-Screen Exclusive Mode API Tutorial.

**Since:**
1.4

**See Also:**


GraphicsDevice (Java Platform SE 6) - Mozilla Firefox
File Edit View History Bookmarks Yahoo! Tools Help
http://java.sun.com/javase/6/docs/api/java/awt/GraphicsDevice.html
Google
Overview Package Class Use Tree Deprecated Index Help
Java™ Platform Standard Ed. 6
PREV CLASS NEXT CLASS
FRAMES NO FRAMES All Classes
SUMMARY: NESTED | FIELD | CONSTR | METHOD
DETAIL: FIELD | CONSTR | METHOD
Done

java.awt

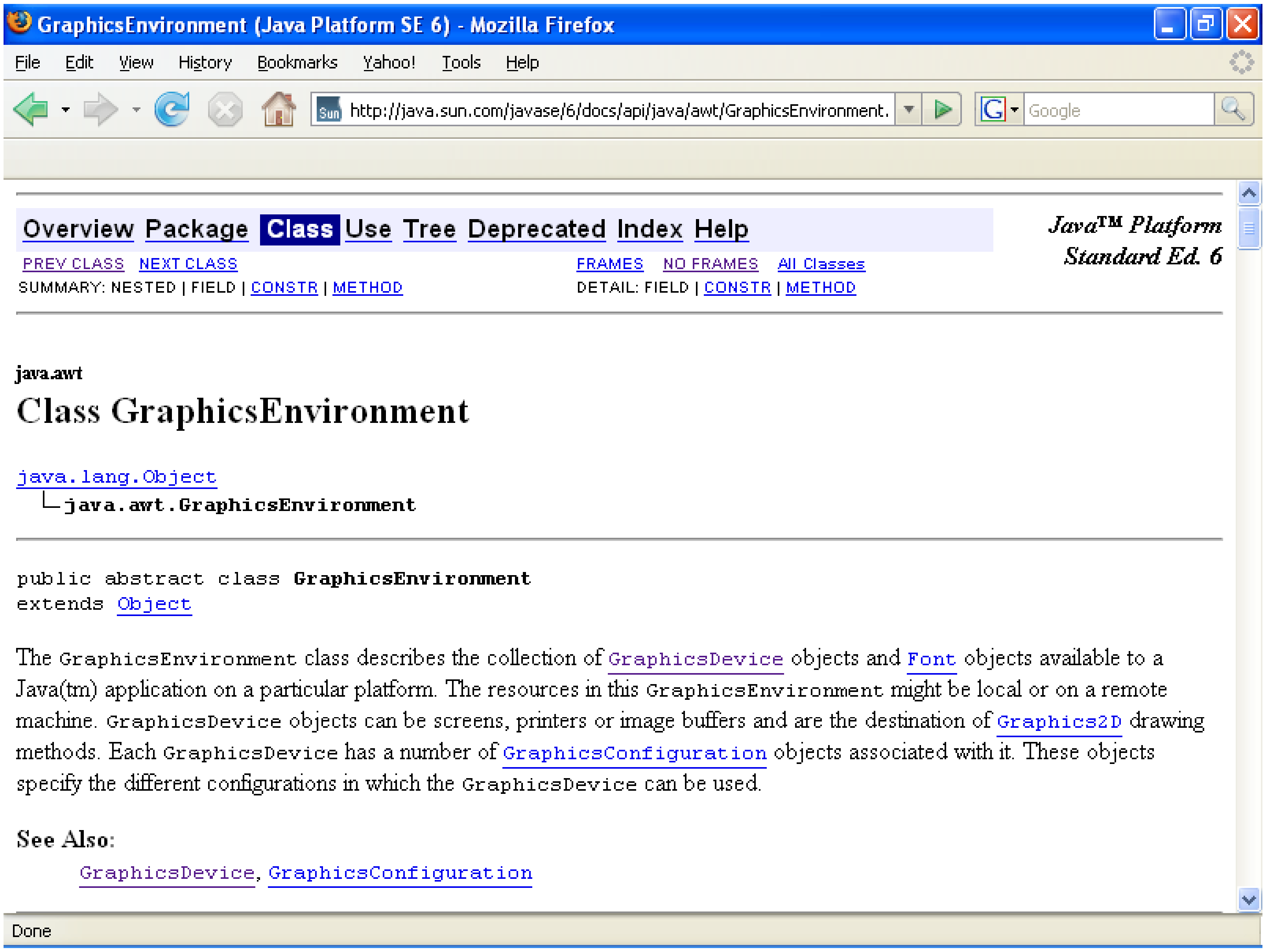
Class GraphicsDevice

```
java.lang.Object
  └java.awt.GraphicsDevice
```

```
public abstract class GraphicsDevice
extends Object
```

The `GraphicsDevice` class describes the graphics devices that might be available in a particular graphics environment. These include screen and printer devices. Note that there can be many screens and many printers in an instance of `GraphicsEnvironment`. Each graphics device has one or more `GraphicsConfiguration` objects associated with it. These objects specify the different configurations in which the `GraphicsDevice` can be used.

In a multi-screen environment, the `GraphicsConfiguration` objects can be used to render components on multiple screens. The following code sample demonstrates how to create a `JFrame` object for each `GraphicsConfiguration` on each screen device in the `GraphicsEnvironment`:


GraphicsEnvironment (Java Platform SE 6) - Mozilla Firefox
File Edit View History Bookmarks Yahoo! Tools Help
http://java.sun.com/javase/6/docs/api/java/awt/GraphicsEnvironment.
Google
Overview Package Class Use Tree Deprecated Index Help
PREV CLASS NEXT CLASS
FRAMES NO FRAMES All Classes
SUMMARY: NESTED | FIELD | CONSTR | METHOD
DETAIL: FIELD | CONSTR | METHOD
Java™ Platform Standard Ed. 6
Done

java.awt

**Class GraphicsEnvironment**

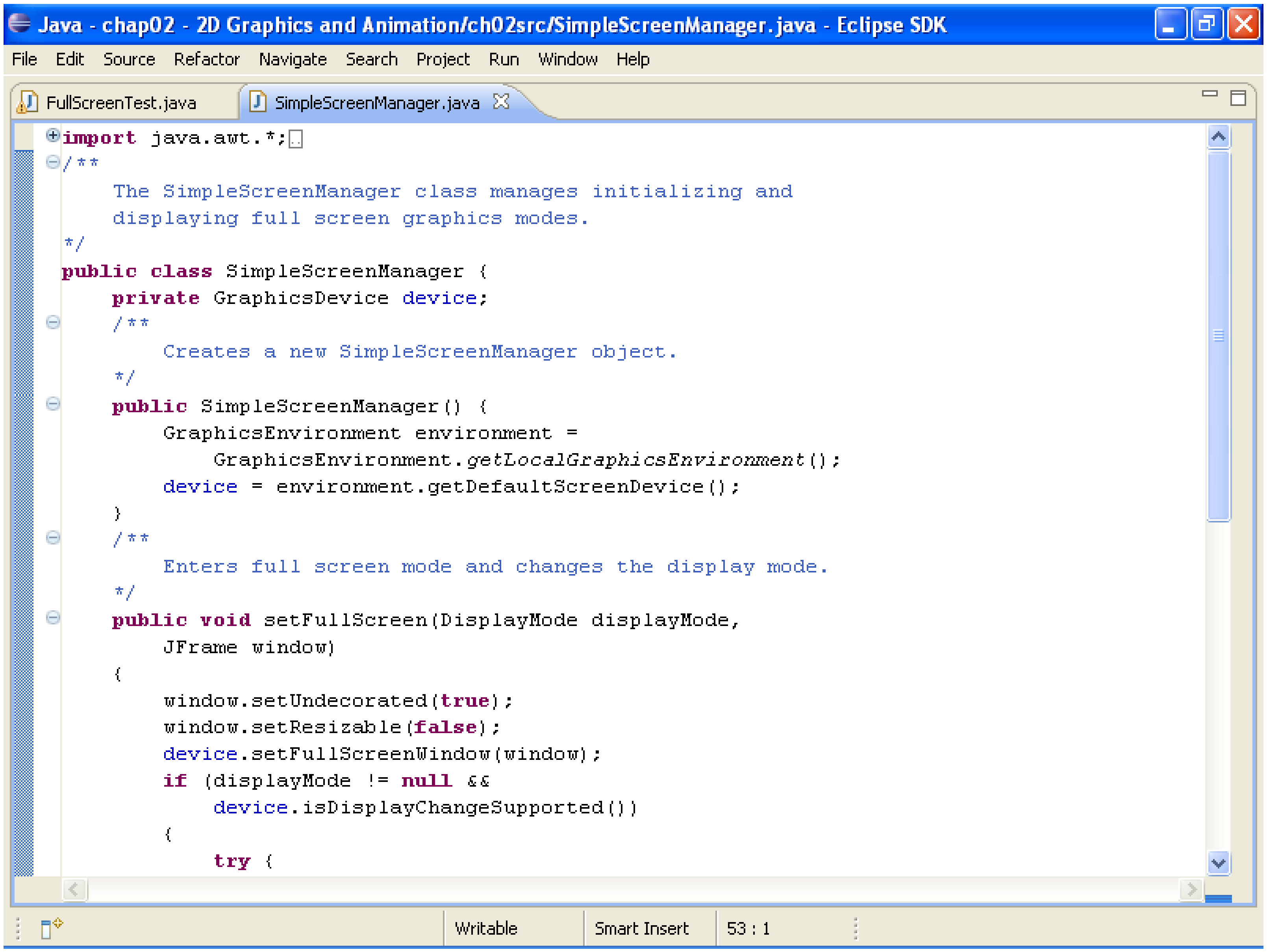
```
java.lang.Object
  └java.awt.GraphicsEnvironment
```

```
public abstract class GraphicsEnvironment
extends Object
```

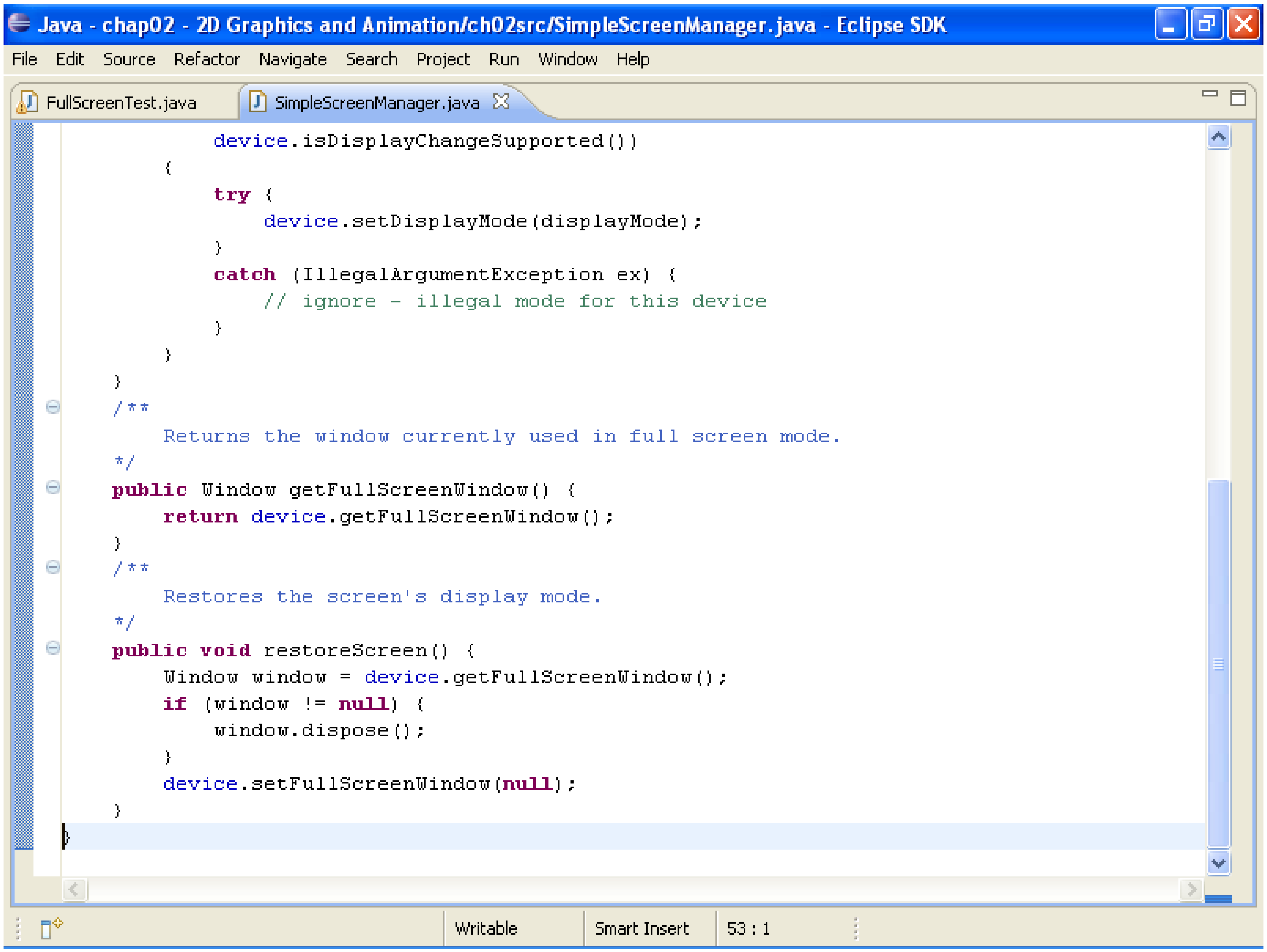
The `GraphicsEnvironment` class describes the collection of `GraphicsDevice` objects and `Font` objects available to a Java(tm) application on a particular platform. The resources in this `GraphicsEnvironment` might be local or on a remote machine. `GraphicsDevice` objects can be screens, printers or image buffers and are the destination of `Graphics2D` drawing methods. Each `GraphicsDevice` has a number of `GraphicsConfiguration` objects associated with it. These objects specify the different configurations in which the `GraphicsDevice` can be used.

**See Also:**

`GraphicsDevice`, `GraphicsConfiguration`

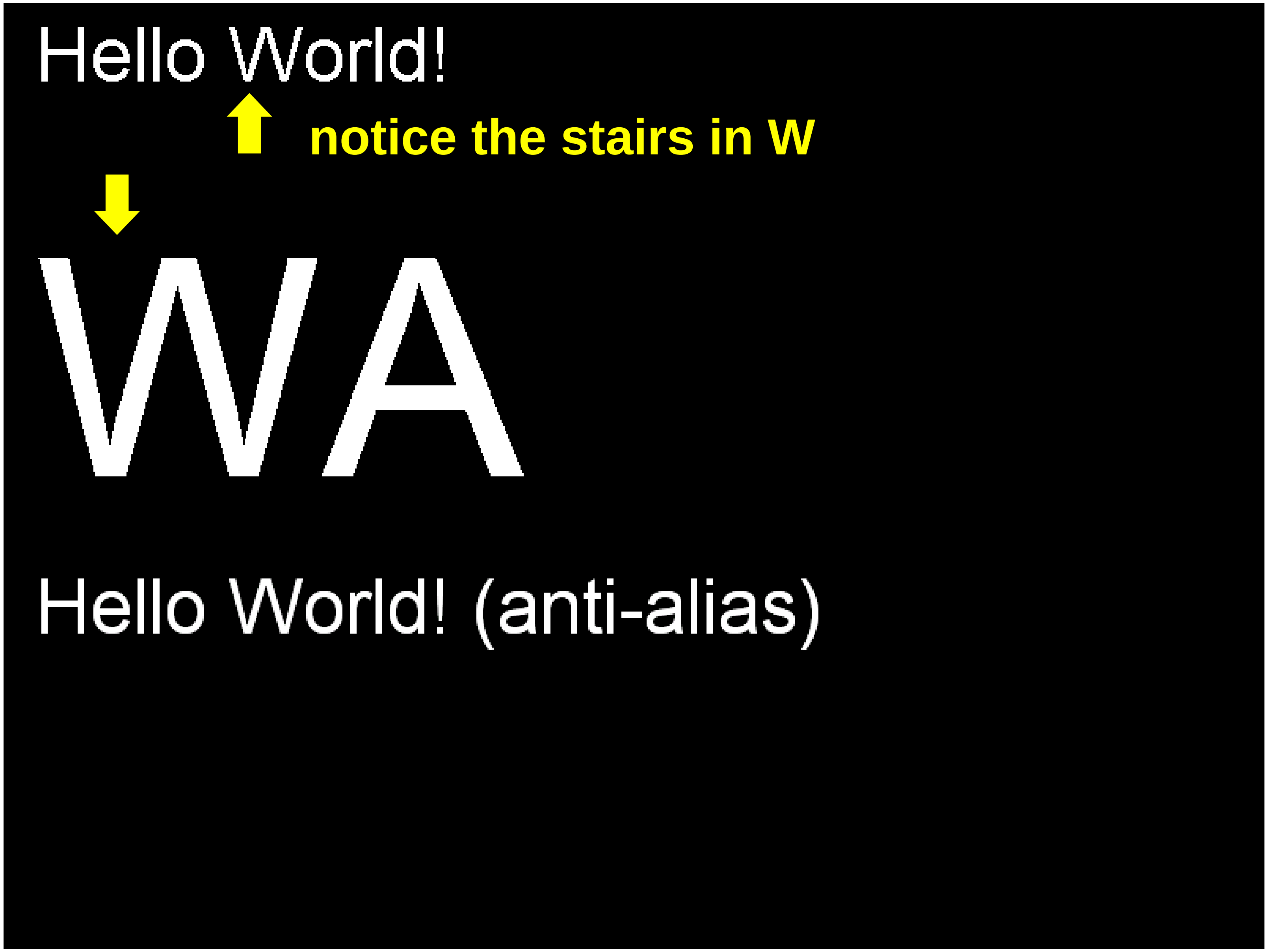

Java - chap02 - 2D Graphics and Animation/ch02src/SimpleScreenManager.java - Eclipse SDK
File Edit Source Refactor Navigate Search Project Run Window Help
FullScreenTest.java
SimpleScreenManager.java
Writable
Smart Insert
53 : 1

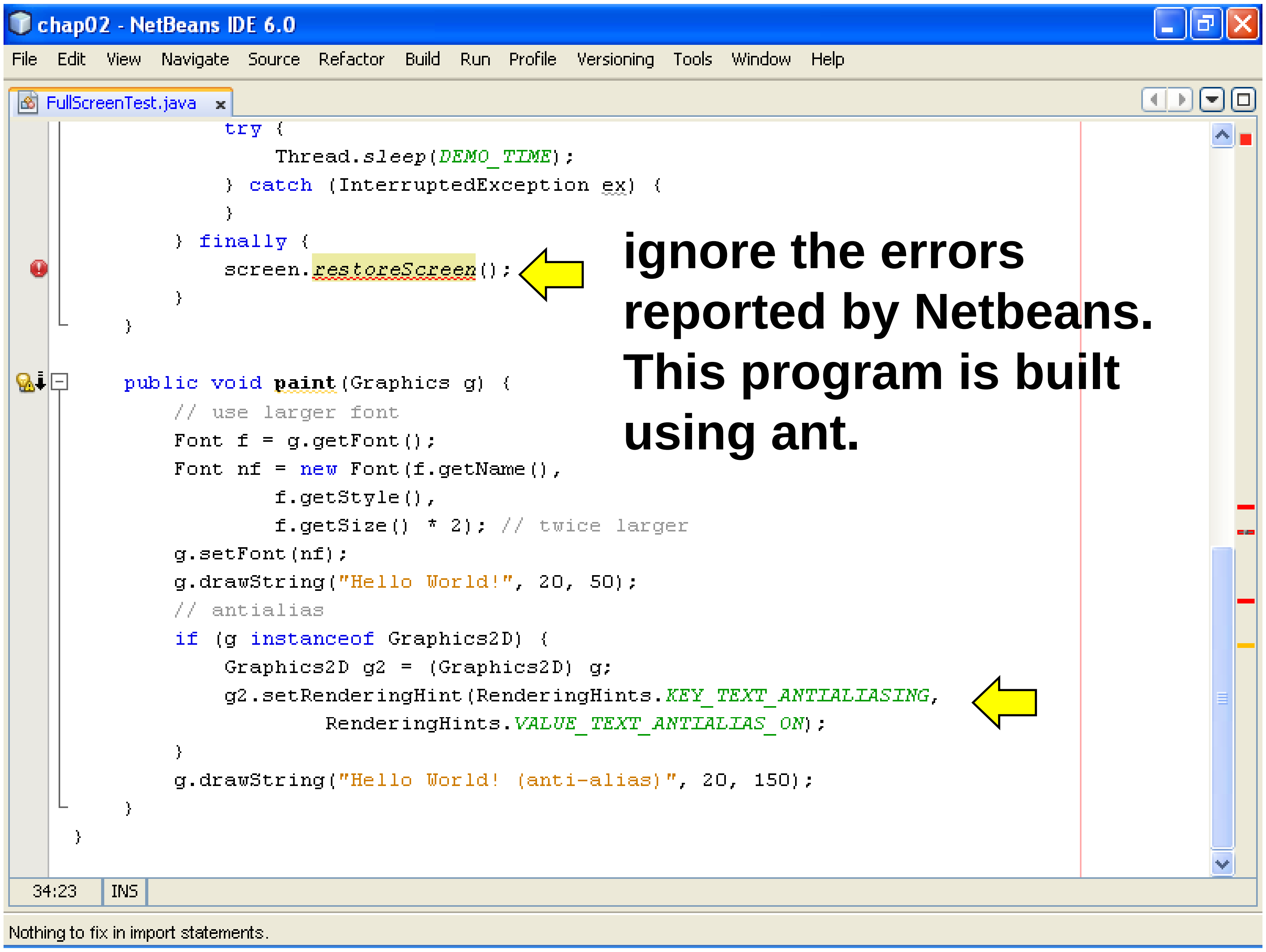
```java
import java.awt.*;
/**
    The SimpleScreenManager class manages initializing and
    displaying full screen graphics modes.
*/
public class SimpleScreenManager {
    private GraphicsDevice device;
    /**
        Creates a new SimpleScreenManager object.
    */
    public SimpleScreenManager() {
        GraphicsEnvironment environment =
            GraphicsEnvironment.getLocalGraphicsEnvironment();
        device = environment.getDefaultScreenDevice();
    }
    /**
        Enters full screen mode and changes the display mode.
    */
    public void setFullScreen(DisplayMode displayMode,
        JFrame window)
    {
        window.setUndecorated(true);
        window.setResizable(false);
        device.setFullScreenWindow(window);
        if (displayMode != null &&
            device.isDisplayChangeSupported())
        {
            try {
```


Java - chap02 - 2D Graphics and Animation/ch02src/SimpleScreenManager.java - Eclipse SDK
File Edit Source Refactor Navigate Search Project Run Window Help
FullScreenTest.java
SimpleScreenManager.java
Writable
Smart Insert
53 : 1

```
            device.isDisplayChangeSupported())
        {
            try {
                device.setDisplayMode(displayMode);
            }
            catch (IllegalArgumentException ex) {
                // ignore - illegal mode for this device
            }
        }
    }
    /**
        Returns the window currently used in full screen mode.
    */
    public Window getFullScreenWindow() {
        return device.getFullScreenWindow();
    }
    /**
        Restores the screen's display mode.
    */
    public void restoreScreen() {
        Window window = device.getFullScreenWindow();
        if (window != null) {
            window.dispose();
        }
        device.setFullScreenWindow(null);
    }
}
```

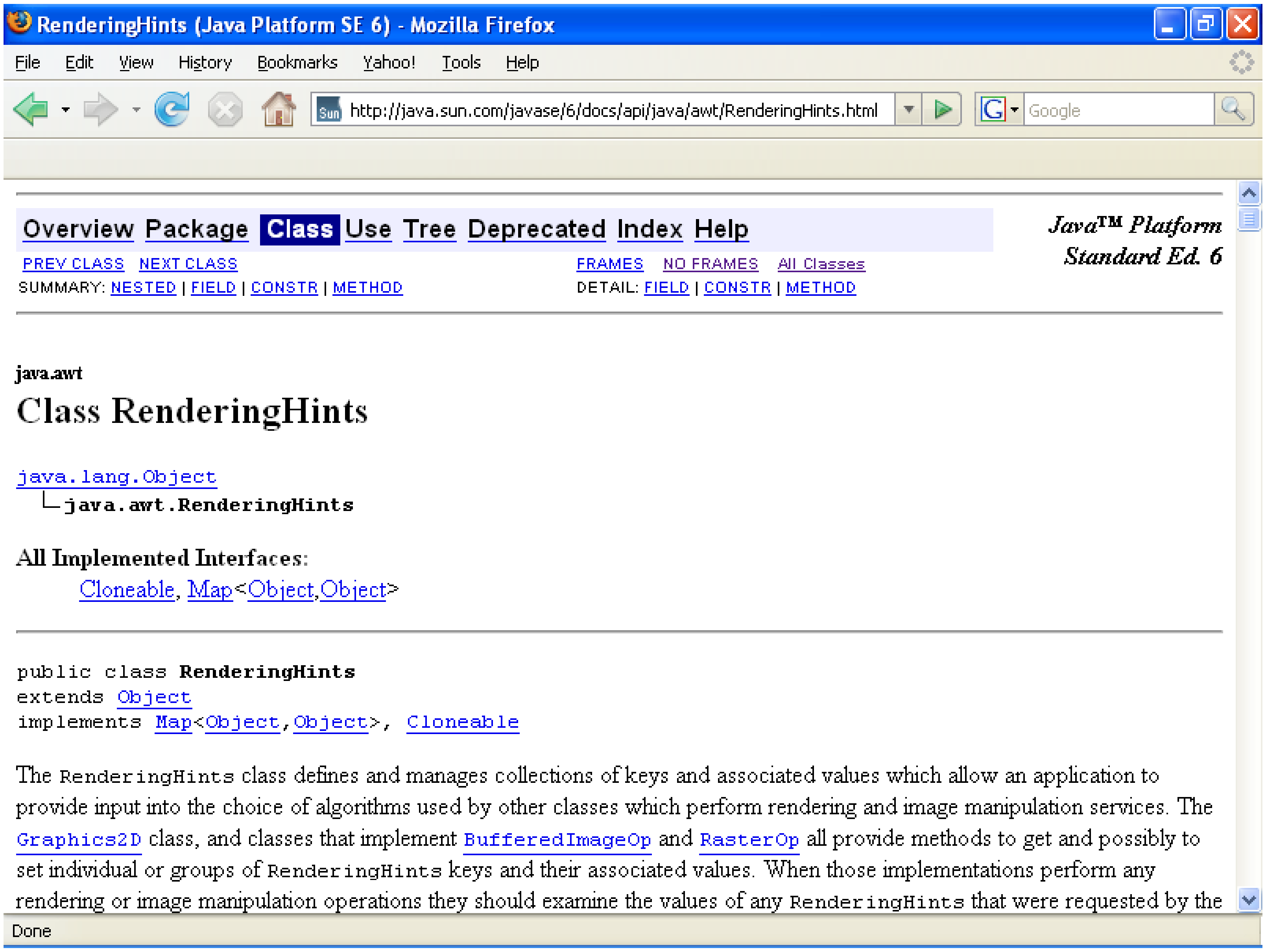
## Anti Alias


Hello World!
notice the stairs in W
WA
Hello World! (anti-alias)


chap02 - NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
FullScreenTest.java
34:23
INS
Nothing to fix in import statements.

```
                try {
                    Thread.sleep(DEMO_TIME);
                } catch (InterruptedException ex) {
                }
            } finally {
                screen.restoreScreen();
            }
        }

        public void paint(Graphics g) {
            // use larger font
            Font f = g.getFont();
            Font nf = new Font(f.getName(),
                    f.getStyle(),
                    f.getSize() * 2); // twice larger
            g.setFont(nf);
            g.drawString("Hello World!", 20, 50);
            // antialias
            if (g instanceof Graphics2D) {
                Graphics2D g2 = (Graphics2D) g;
                g2.setRenderingHint(RenderingHints.KEY_TEXT_ANTIALIASING,
                        RenderingHints.VALUE_TEXT_ANTIALIAS_ON);
            }
            g.drawString("Hello World! (anti-alias)", 20, 150);
        }
    }
```

**ignore the errors reported by Netbeans. This program is built using ant.**


RenderingHints (Java Platform SE 6) - Mozilla Firefox
File Edit View History Bookmarks Yahoo! Tools Help
http://java.sun.com/javase/6/docs/api/java/awt/RenderingHints.html
Google
Overview Package Class Use Tree Deprecated Index Help
Java™ Platform Standard Ed. 6
PREV CLASS NEXT CLASS FRAMES NO FRAMES All Classes
SUMMARY: NESTED | FIELD | CONSTR | METHOD DETAIL: FIELD | CONSTR | METHOD
Done

java.awt

Class RenderingHints

```
java.lang.Object
  └java.awt.RenderingHints
```

**All Implemented Interfaces:**

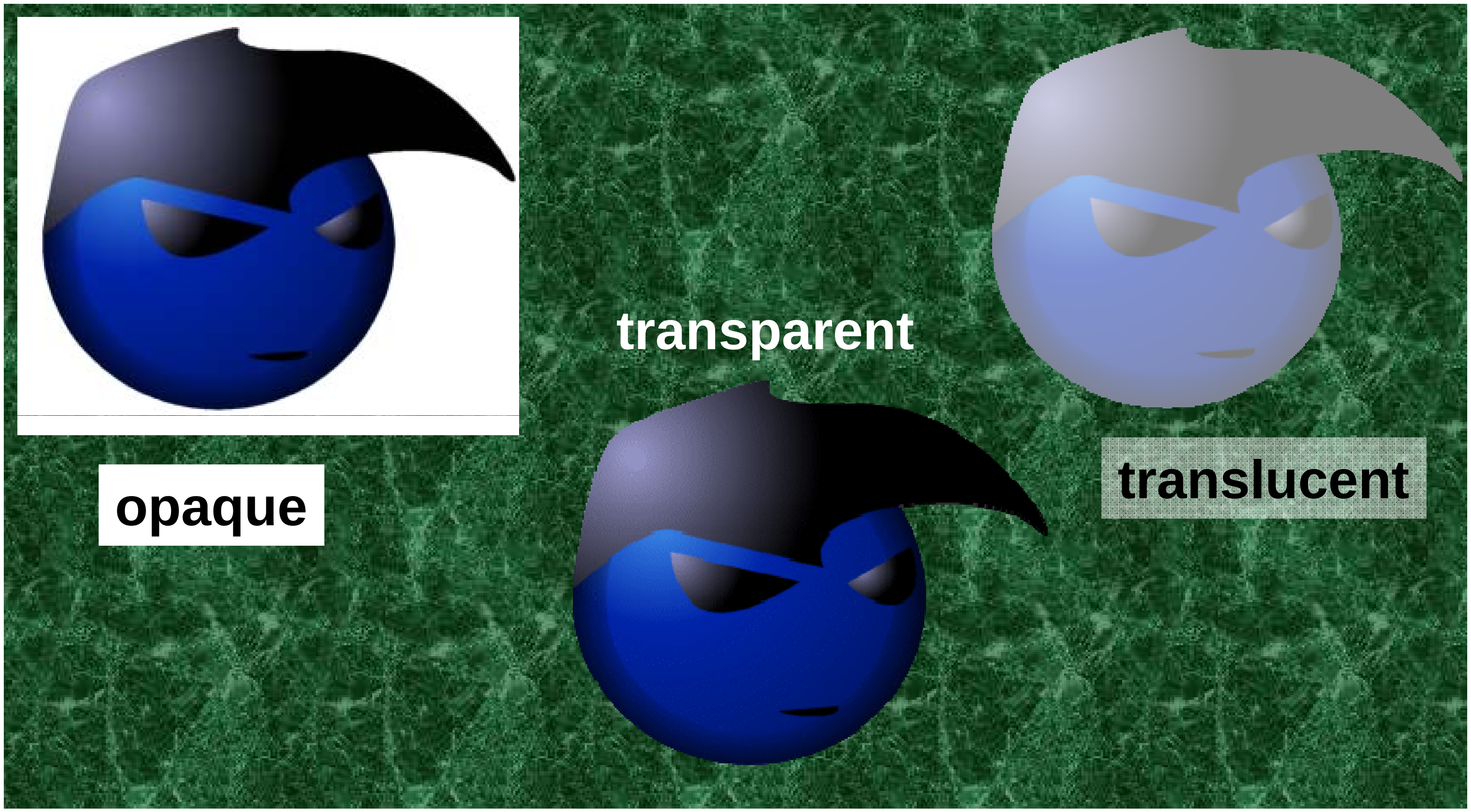
Cloneable, Map<Object,Object>

```
public class RenderingHints
extends Object
implements Map<Object,Object>, Cloneable
```

The `RenderingHints` class defines and manages collections of keys and associated values which allow an application to provide input into the choice of algorithms used by other classes which perform rendering and image manipulation services. The `Graphics2D` class, and classes that implement `BufferedImageOp` and `RasterOp` all provide methods to get and possibly to set individual or groups of `RenderingHints` keys and their associated values. When those implementations perform any rendering or image manipulation operations they should examine the values of any `RenderingHints` that were requested by the

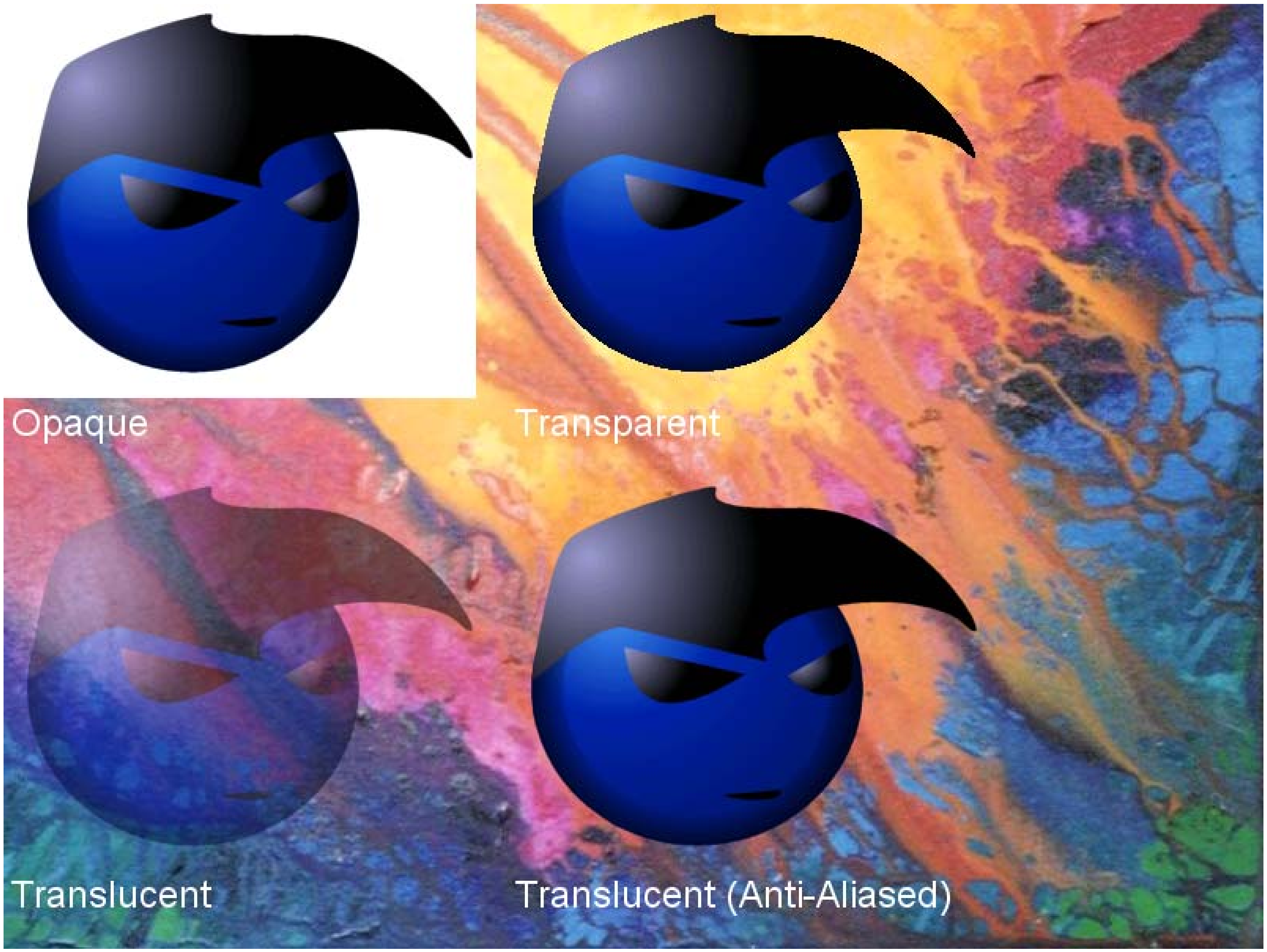
## Display Images

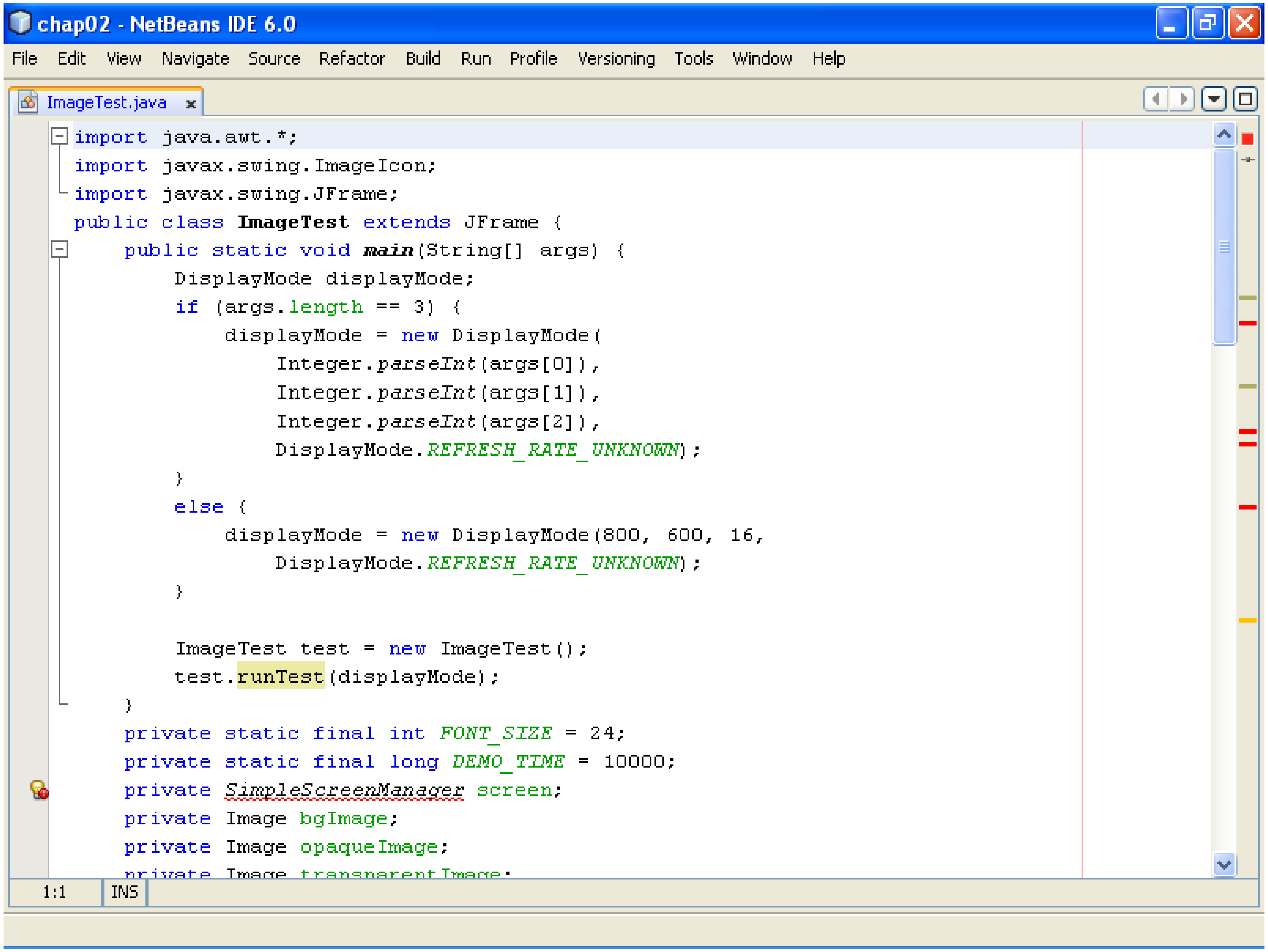
# Image Types



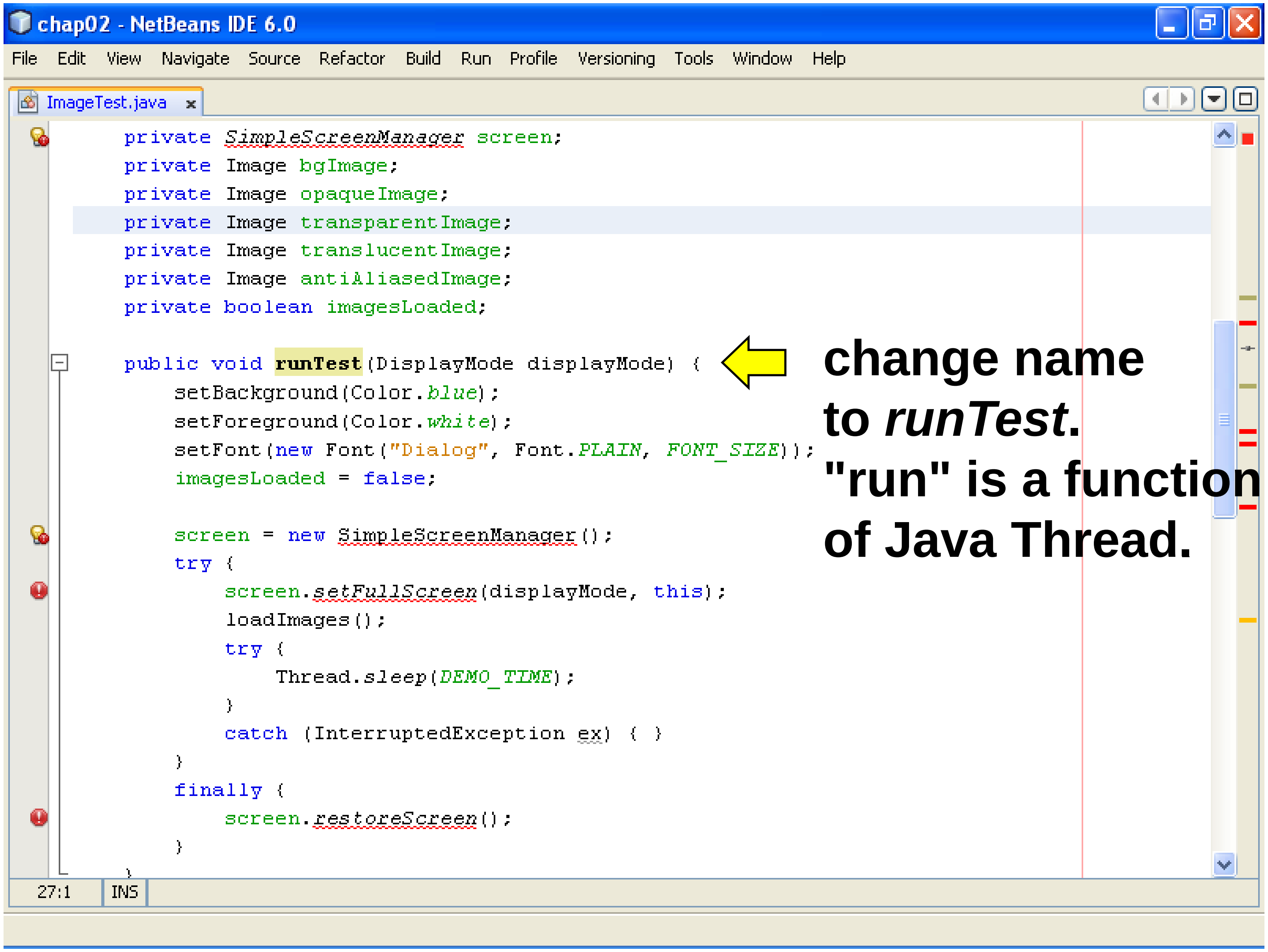
## Load and Display Images

Loading Images...


Opaque
Transparent
Translucent
Translucent (Anti-Aliased)

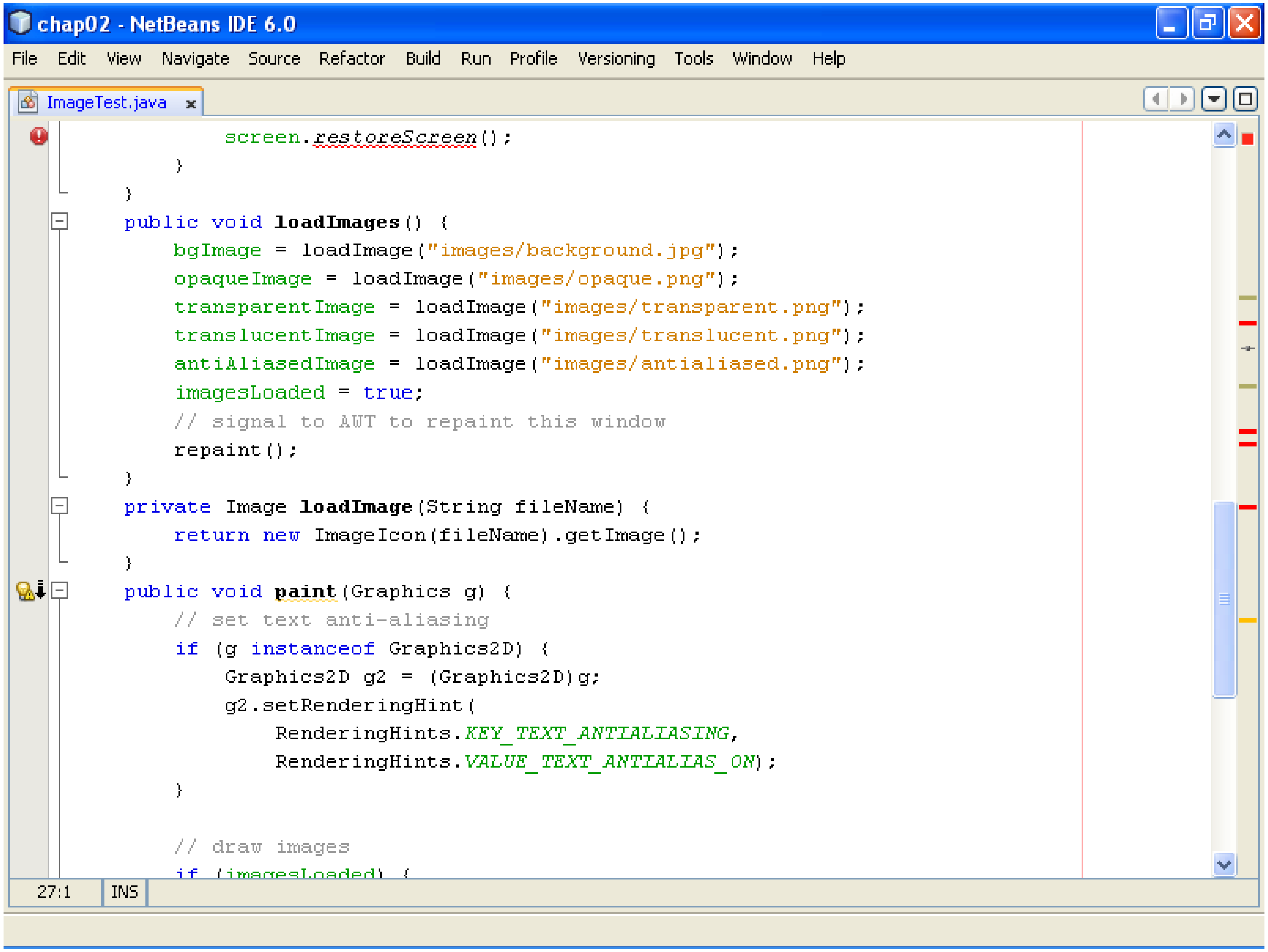

chap02 - NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
ImageTest.java
1:1
INS

```java
import java.awt.*;
import javax.swing.ImageIcon;
import javax.swing.JFrame;
public class ImageTest extends JFrame {
    public static void main(String[] args) {
        DisplayMode displayMode;
        if (args.length == 3) {
            displayMode = new DisplayMode(
                Integer.parseInt(args[0]),
                Integer.parseInt(args[1]),
                Integer.parseInt(args[2]),
                DisplayMode.REFRESH_RATE_UNKNOWN);
        }
        else {
            displayMode = new DisplayMode(800, 600, 16,
                DisplayMode.REFRESH_RATE_UNKNOWN);
        }

        ImageTest test = new ImageTest();
        test.runTest(displayMode);
    }
    private static final int FONT_SIZE = 24;
    private static final long DEMO_TIME = 10000;
    private SimpleScreenManager screen;
    private Image bgImage;
    private Image opaqueImage;
```

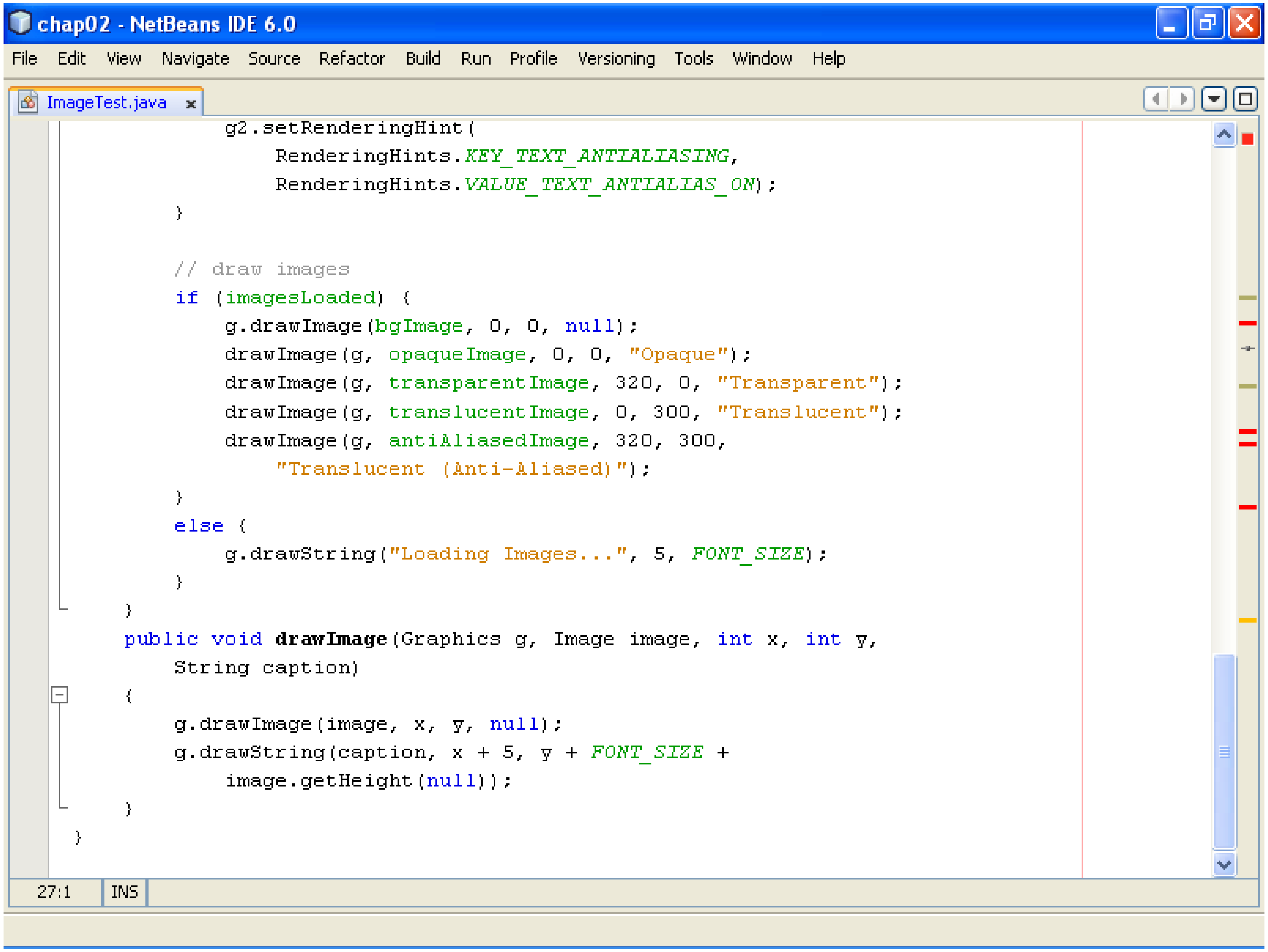

chap02 - NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
ImageTest.java
27:1
INS

```java
    private SimpleScreenManager screen;
    private Image bgImage;
    private Image opaqueImage;
    private Image transparentImage;
    private Image translucentImage;
    private Image antiAliasedImage;
    private boolean imagesLoaded;

    public void runTest(DisplayMode displayMode) {
        setBackground(Color.blue);
        setForeground(Color.white);
        setFont(new Font("Dialog", Font.PLAIN, FONT_SIZE));
        imagesLoaded = false;

        screen = new SimpleScreenManager();
        try {
            screen.setFullScreen(displayMode, this);
            loadImages();
            try {
                Thread.sleep(DEMO_TIME);
            }
            catch (InterruptedException ex) { }
        }
        finally {
            screen.restoreScreen();
        }
    }
```

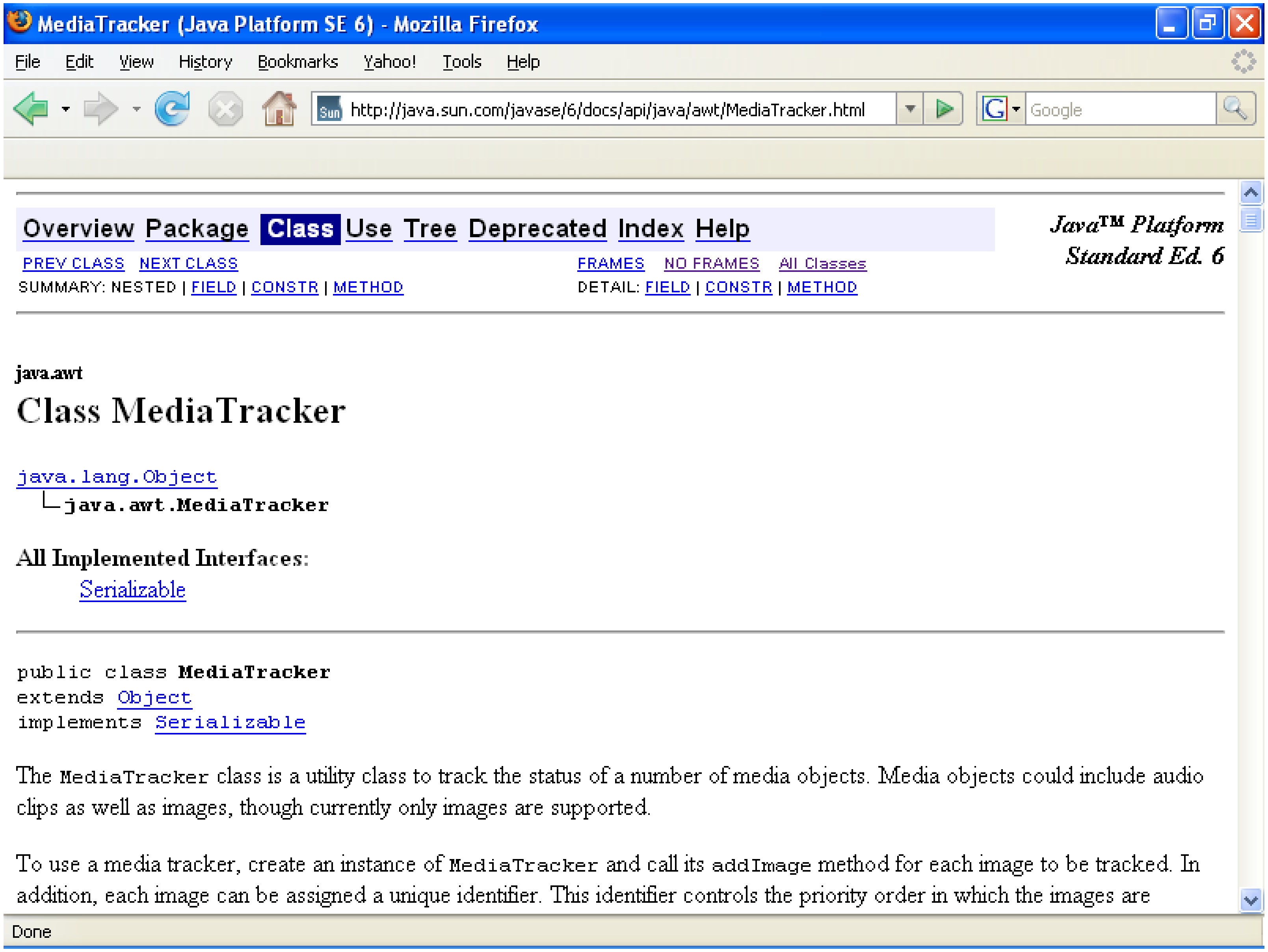
**change name to *runTest*. "run" is a function of Java Thread.**


chap02 - NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
ImageTest.java
27:1 INS

```
                screen.restoreScreen();
            }
        }
        public void loadImages() {
            bgImage = loadImage("images/background.jpg");
            opaqueImage = loadImage("images/opaque.png");
            transparentImage = loadImage("images/transparent.png");
            translucentImage = loadImage("images/translucent.png");
            antiAliasedImage = loadImage("images/antialiased.png");
            imagesLoaded = true;
            // signal to AWT to repaint this window
            repaint();
        }
        private Image loadImage(String fileName) {
            return new ImageIcon(fileName).getImage();
        }
        public void paint(Graphics g) {
            // set text anti-aliasing
            if (g instanceof Graphics2D) {
                Graphics2D g2 = (Graphics2D)g;
                g2.setRenderingHint(
                    RenderingHints.KEY_TEXT_ANTIALIASING,
                    RenderingHints.VALUE_TEXT_ANTIALIAS_ON);
            }

            // draw images
            if (imagesLoaded) {
```


chap02 - NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
ImageTest.java
27:1
INS

```
            g2.setRenderingHint(
                RenderingHints.KEY_TEXT_ANTIALIASING,
                RenderingHints.VALUE_TEXT_ANTIALIAS_ON);
        }

        // draw images
        if (imagesLoaded) {
            g.drawImage(bgImage, 0, 0, null);
            drawImage(g, opaqueImage, 0, 0, "Opaque");
            drawImage(g, transparentImage, 320, 0, "Transparent");
            drawImage(g, translucentImage, 0, 300, "Translucent");
            drawImage(g, antiAliasedImage, 320, 300,
                "Translucent (Anti-Aliased)");
        }
        else {
            g.drawString("Loading Images...", 5, FONT_SIZE);
        }
    }
    public void drawImage(Graphics g, Image image, int x, int y,
        String caption)
    {
        g.drawImage(image, x, y, null);
        g.drawString(caption, x + 5, y + FONT_SIZE +
            image.getHeight(null));
    }
}
```


MediaTracker (Java Platform SE 6) - Mozilla Firefox
File Edit View History Bookmarks Yahoo! Tools Help
http://java.sun.com/javase/6/docs/api/java/awt/MediaTracker.html
Google
Overview Package Class Use Tree Deprecated Index Help
PREV CLASS NEXT CLASS FRAMES NO FRAMES All Classes
SUMMARY: NESTED | FIELD | CONSTR | METHOD DETAIL: FIELD | CONSTR | METHOD
Java™ Platform Standard Ed. 6
Done

java.awt

Class MediaTracker

```
java.lang.Object
  └java.awt.MediaTracker
```

**All Implemented Interfaces:**

Serializable

```
public class MediaTracker
extends Object
implements Serializable
```

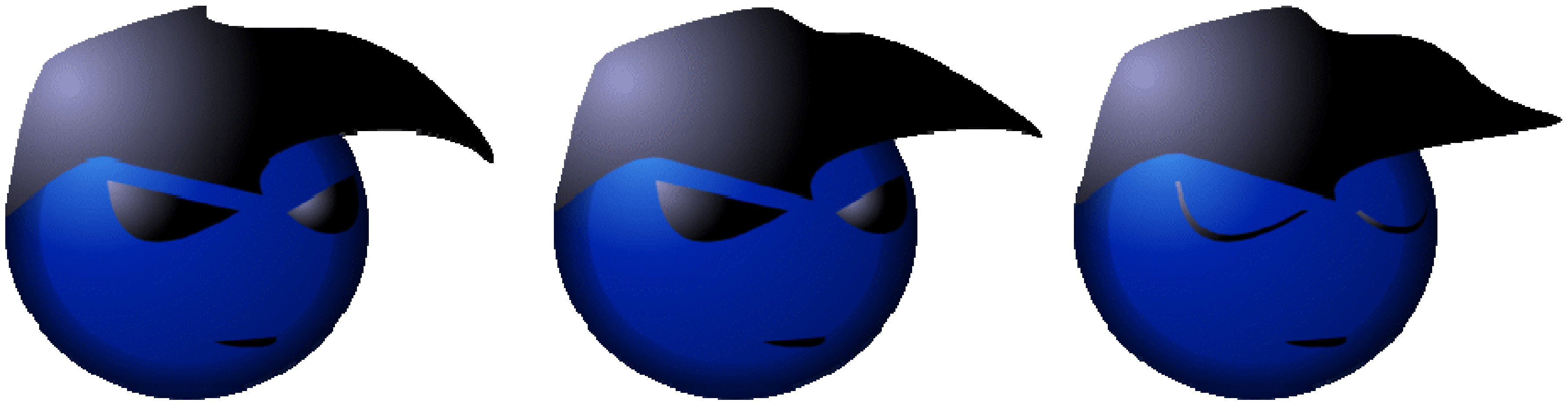
The `MediaTracker` class is a utility class to track the status of a number of media objects. Media objects could include audio clips as well as images, though currently only images are supported.

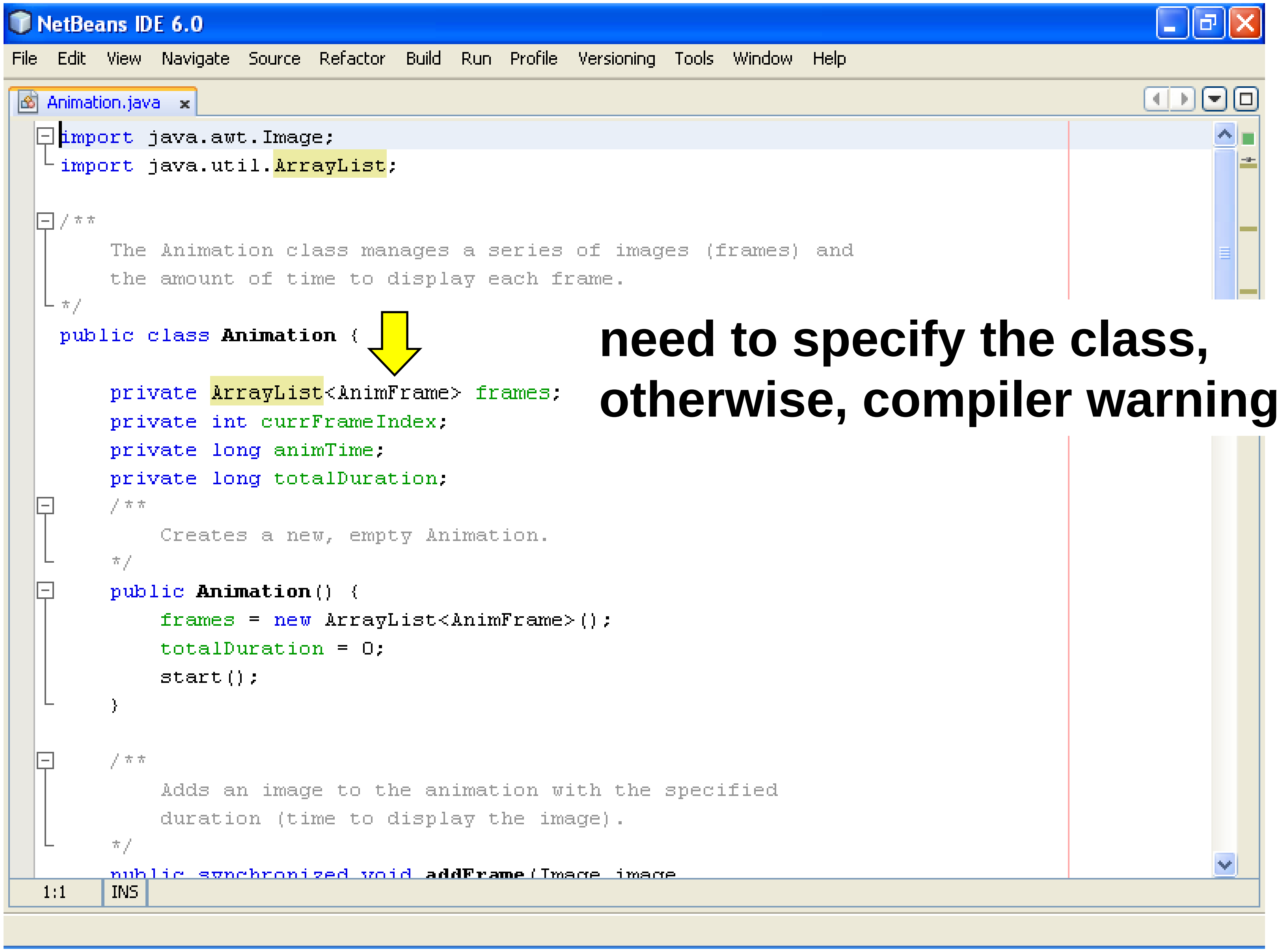
To use a media tracker, create an instance of `MediaTracker` and call its `addImage` method for each image to be tracked. In addition, each image can be assigned a unique identifier. This identifier controls the priority order in which the images are

## Animation

## Animation

- Change frames with small differences quickly.
- The time in each frame may be different.

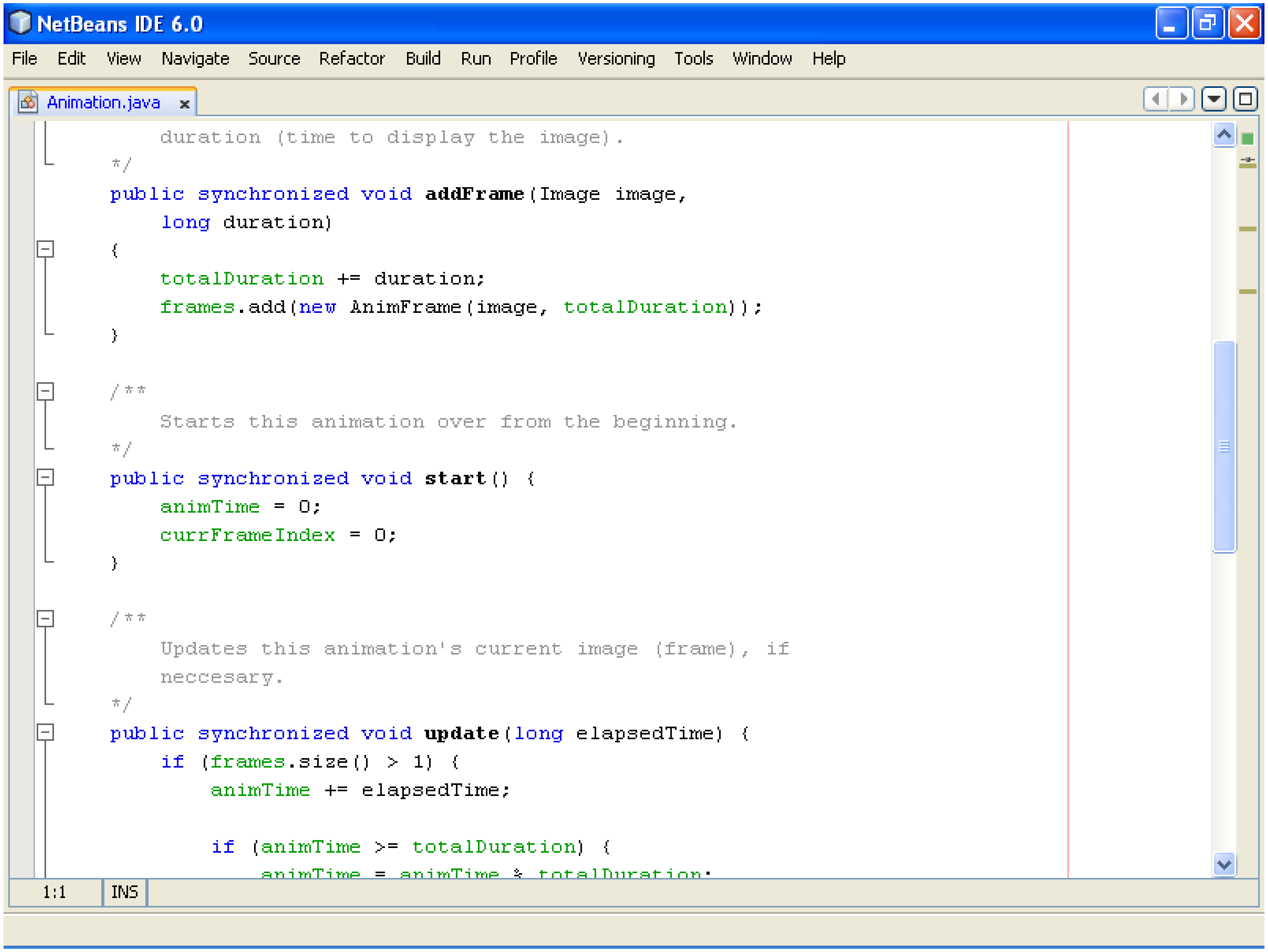



NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
Animation.java
1:1 INS

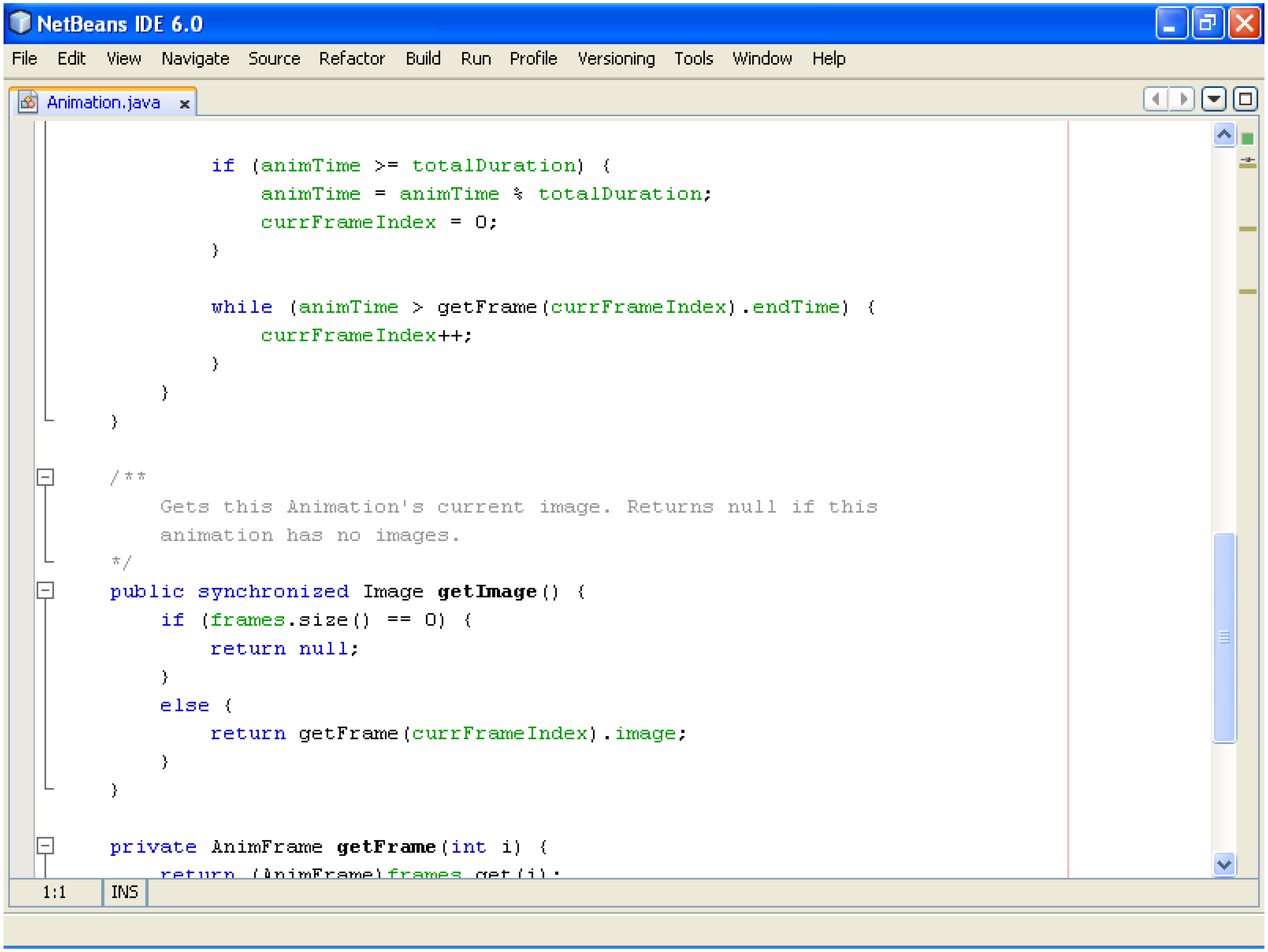
```
import java.awt.Image;
import java.util.ArrayList;

/**
    The Animation class manages a series of images (frames) and
    the amount of time to display each frame.
*/
public class Animation {

    private ArrayList<AnimFrame> frames;
    private int currFrameIndex;
    private long animTime;
    private long totalDuration;
    /**
        Creates a new, empty Animation.
    */
    public Animation() {
        frames = new ArrayList<AnimFrame>();
        totalDuration = 0;
        start();
    }

    /**
        Adds an image to the animation with the specified
        duration (time to display the image).
    */
    public synchronized void addFrame(Image image,
```

**need to specify the class, otherwise, compiler warning**

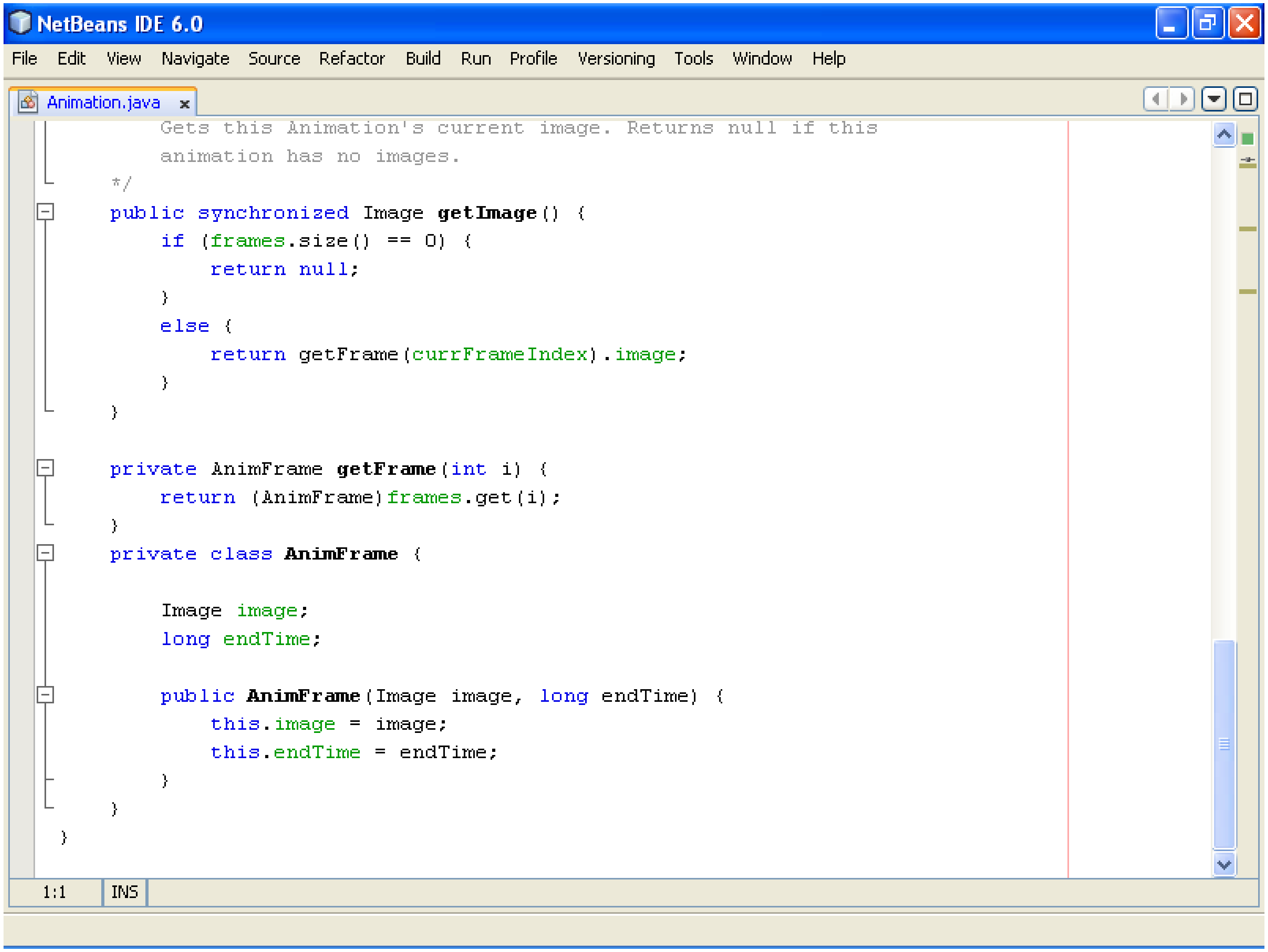
```
> javac -Xlint:unchecked Animation.java
Animation.java:34: warning: [unchecked] unchecked
call to add(E) as a member of the raw type
java.util.ArrayList
        frames.add(new AnimFrame(image,
totalDuration));
```


NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
Animation.java
1:1
INS

```
        duration (time to display the image).
    */
    public synchronized void addFrame(Image image,
        long duration)
    {
        totalDuration += duration;
        frames.add(new AnimFrame(image, totalDuration));
    }

    /**
        Starts this animation over from the beginning.
    */
    public synchronized void start() {
        animTime = 0;
        currFrameIndex = 0;
    }

    /**
        Updates this animation's current image (frame), if
        neccesary.
    */
    public synchronized void update(long elapsedTime) {
        if (frames.size() > 1) {
            animTime += elapsedTime;

            if (animTime >= totalDuration) {
                animTime = animTime % totalDuration;
```


NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
Animation.java
1:1
INS

```
            if (animTime >= totalDuration) {
                animTime = animTime % totalDuration;
                currFrameIndex = 0;
            }

            while (animTime > getFrame(currFrameIndex).endTime) {
                currFrameIndex++;
            }
        }
    }

    /**
        Gets this Animation's current image. Returns null if this
        animation has no images.
    */
    public synchronized Image getImage() {
        if (frames.size() == 0) {
            return null;
        }
        else {
            return getFrame(currFrameIndex).image;
        }
    }

    private AnimFrame getFrame(int i) {
        return (AnimFrame)frames.get(i);
```


NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
Animation.java
1:1
INS

```
        Gets this Animation's current image. Returns null if this
        animation has no images.
    */
    public synchronized Image getImage() {
        if (frames.size() == 0) {
            return null;
        }
        else {
            return getFrame(currFrameIndex).image;
        }
    }

    private AnimFrame getFrame(int i) {
        return (AnimFrame)frames.get(i);
    }
    private class AnimFrame {

        Image image;
        long endTime;

        public AnimFrame(Image image, long endTime) {
            this.image = image;
            this.endTime = endTime;
        }
    }
}
```

| frame | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| duration (ms) | 150 | 250 | 300 | 150 | 200 |
| endTime | 150 | 400 | 700 | 850 | 1050 |

- animTime = 600 ⇒
  - animTime > 150? Yes, index ++ ⇒ index = 1
  - animTime > 400? Yes, index ++ ⇒ index = 2
  - animTime > 700? No, index = 2
- animTime = 2900 ⇒ 2 iterations = 2100
  - animTime = 2900 % 1050 = 800, index = 0
  - animTime > 150? Yes, index ++ ⇒ index = 1
  - animTime > 400? Yes, index ++ ⇒ index = 2
  - animTime > 700? Yes, index ++ ⇒ index = 3
  - animTime > 850? No, index = 3

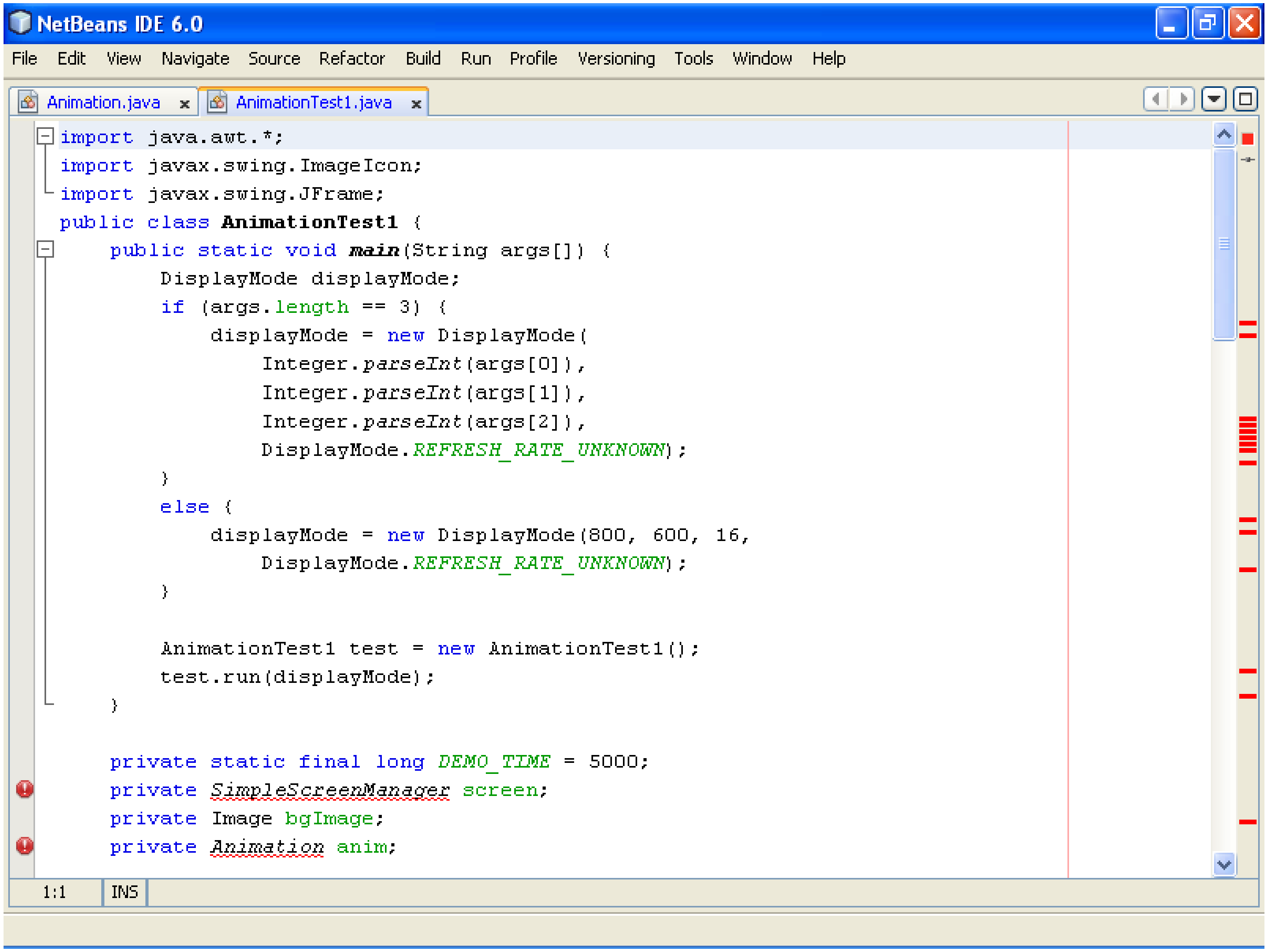
# Synchronized Methods

- At any moment, only one of each object's synchronized methods can execute.

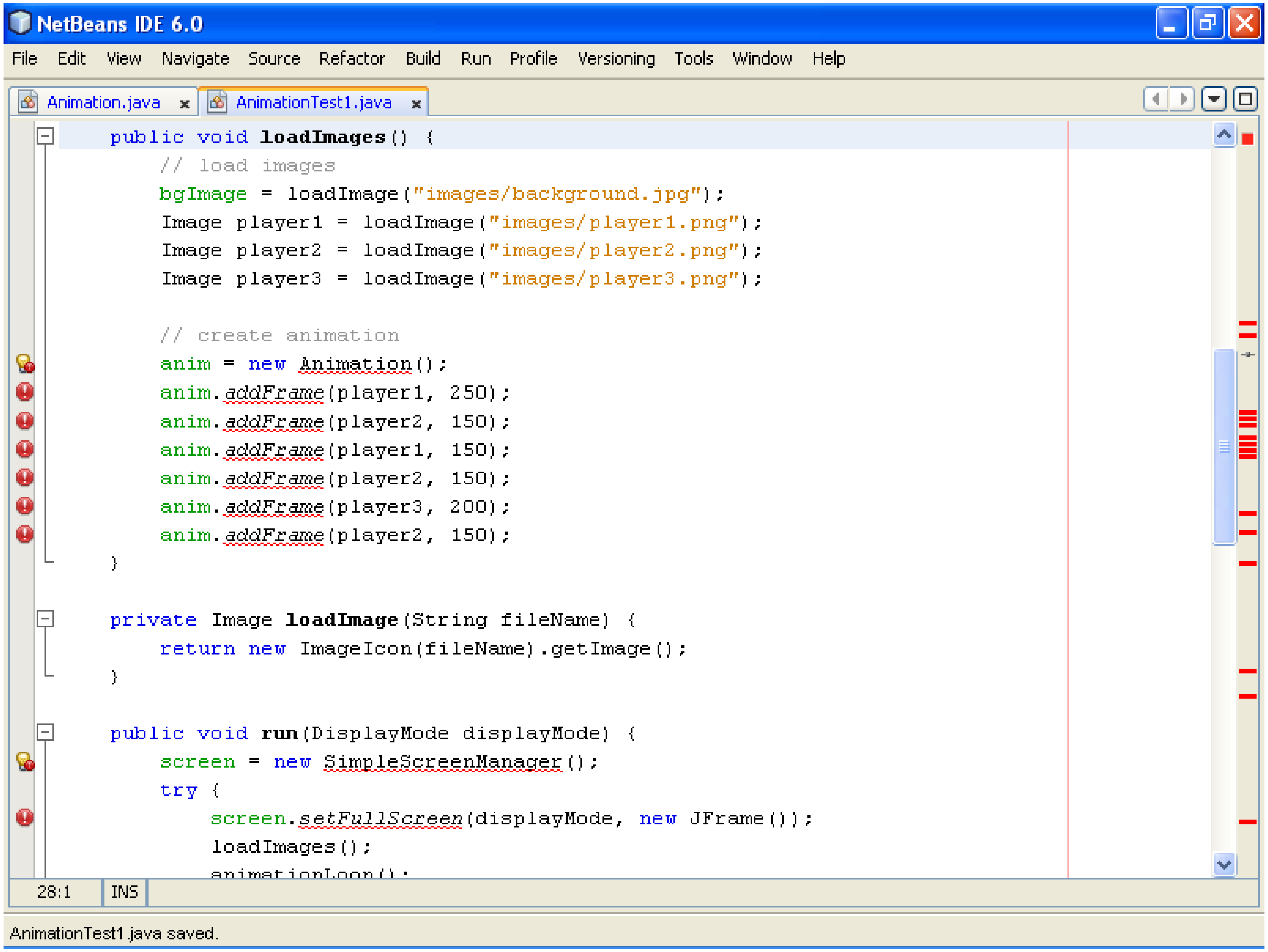
```
Animation anim = new Amination();
anim.addFrame(...);
anim.addFrame(...);
...
anim.update(...);
```

$\Big\}$ **the execution time of synchronized methods cannot overlap**

- Since the program is not multi-**thread**, it is unnecessary to make methods synchronized.


NetBeans IDE 6.0
File Edit View Navigate Source Refactor Build Run Profile Versioning Tools Window Help
Animation.java
AnimationTest1.java
1:1
INS

```java
import java.awt.*;
import javax.swing.ImageIcon;
import javax.swing.JFrame;
public class AnimationTest1 {
    public static void main(String args[]) {
        DisplayMode displayMode;
        if (args.length == 3) {
            displayMode = new DisplayMode(
                Integer.parseInt(args[0]),
                Integer.parseInt(args[1]),
                Integer.parseInt(args[2]),
                DisplayMode.REFRESH_RATE_UNKNOWN);
        }
        else {
            displayMode = new DisplayMode(800, 600, 16,
                DisplayMode.REFRESH_RATE_UNKNOWN);
        }

        AnimationTest1 test = new AnimationTest1();
        test.run(displayMode);
    }

    private static final long DEMO_TIME = 5000;
    private SimpleScreenManager screen;
    private Image bgImage;
    private Animation anim;
```


NetBeans IDE 6.0
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Animation.java
AnimationTest1.java
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INS

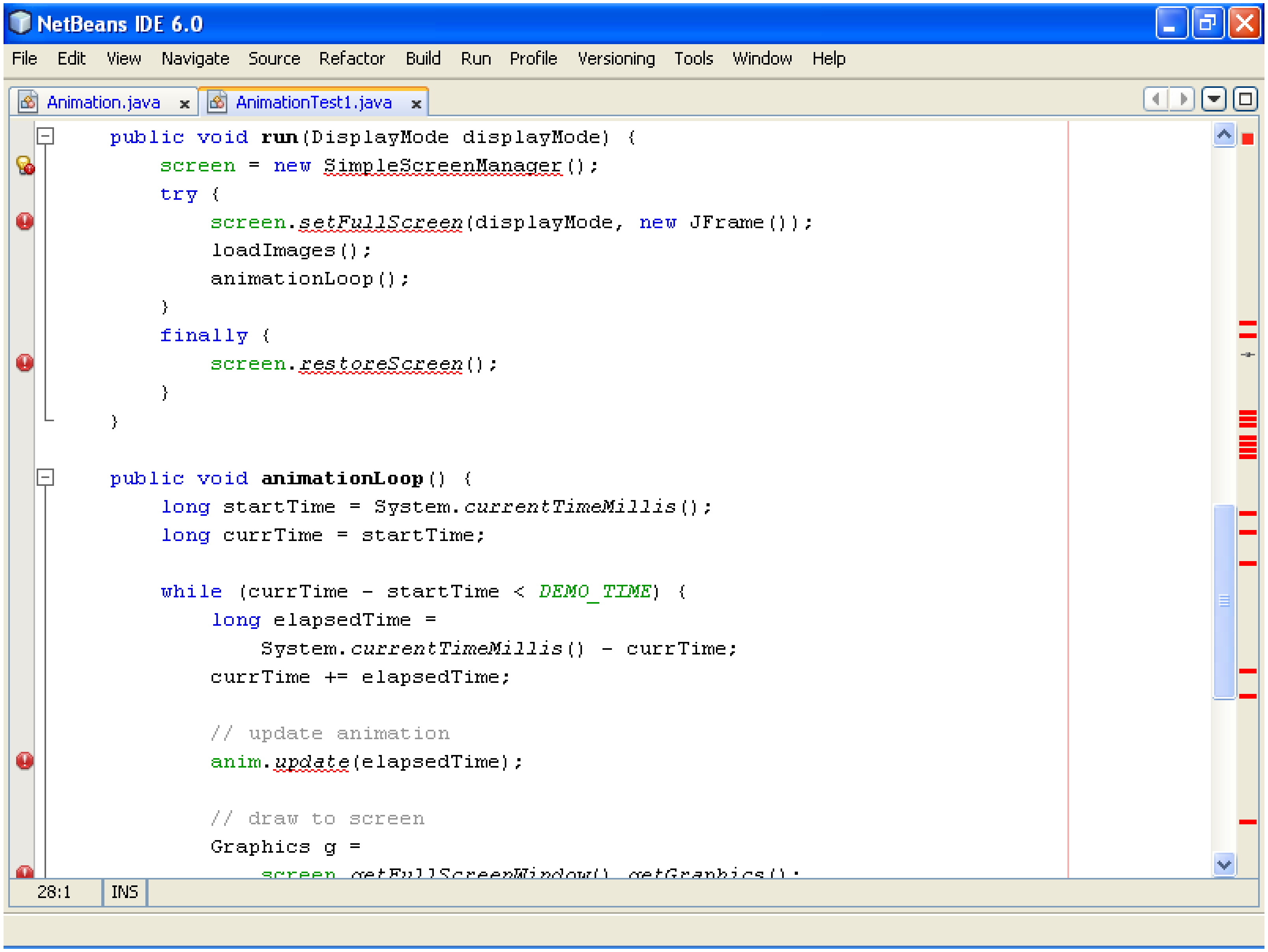
```
    public void loadImages() {
        // load images
        bgImage = loadImage("images/background.jpg");
        Image player1 = loadImage("images/player1.png");
        Image player2 = loadImage("images/player2.png");
        Image player3 = loadImage("images/player3.png");

        // create animation
        anim = new Animation();
        anim.addFrame(player1, 250);
        anim.addFrame(player2, 150);
        anim.addFrame(player1, 150);
        anim.addFrame(player2, 150);
        anim.addFrame(player3, 200);
        anim.addFrame(player2, 150);
    }

    private Image loadImage(String fileName) {
        return new ImageIcon(fileName).getImage();
    }

    public void run(DisplayMode displayMode) {
        screen = new SimpleScreenManager();
        try {
            screen.setFullScreen(displayMode, new JFrame());
            loadImages();
            animationLoop();
```

AnimationTest1.java saved.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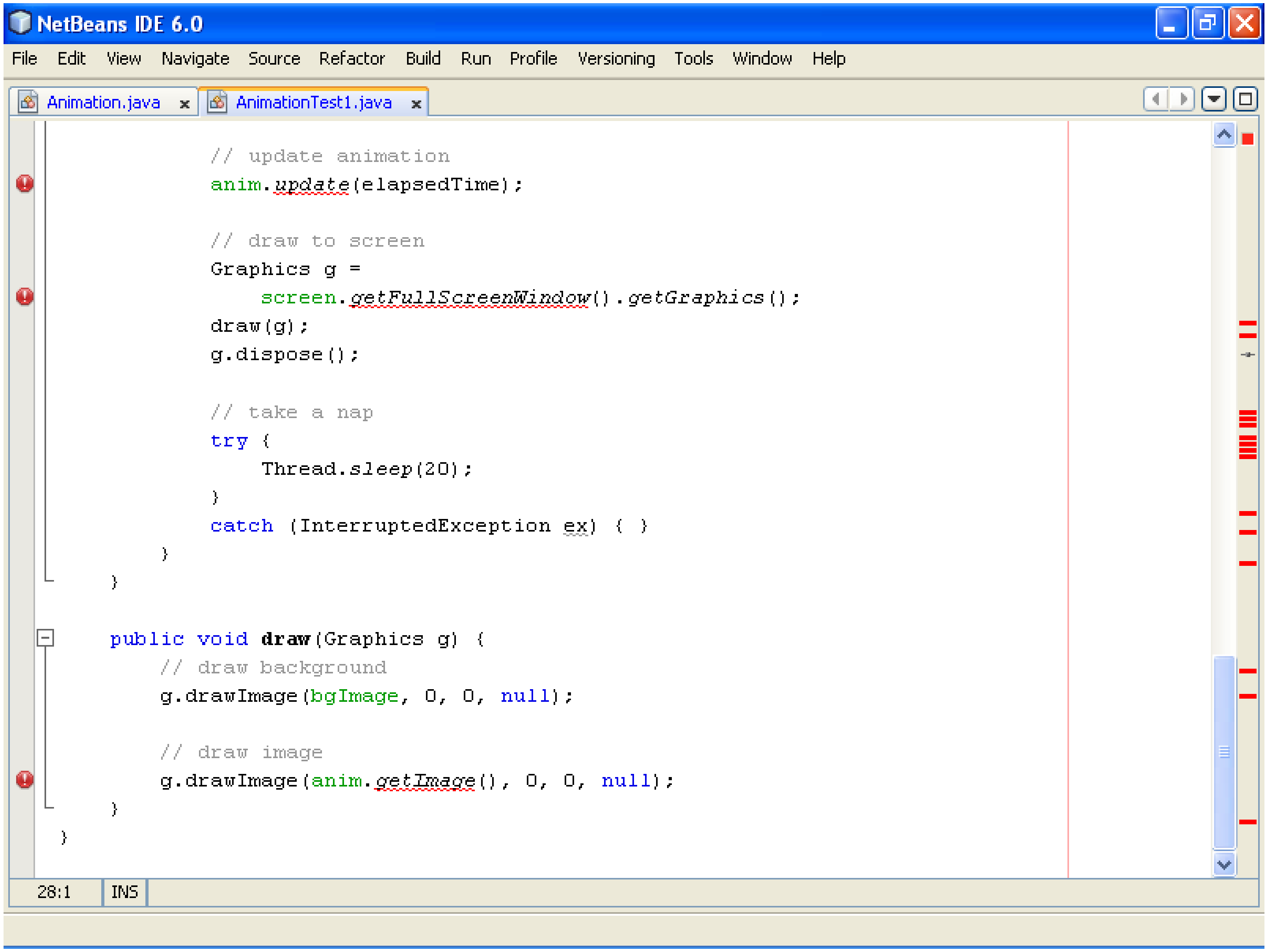
```
    public void run(DisplayMode displayMode) {
        screen = new SimpleScreenManager();
        try {
            screen.setFullScreen(displayMode, new JFrame());
            loadImages();
            animationLoop();
        }
        finally {
            screen.restoreScreen();
        }
    }

    public void animationLoop() {
        long startTime = System.currentTimeMillis();
        long currTime = startTime;

        while (currTime - startTime < DEMO_TIME) {
            long elapsedTime =
                System.currentTimeMillis() - currTime;
            currTime += elapsedTime;

            // update animation
            anim.update(elapsedTime);

            // draw to screen
            Graphics g =
                screen.getFullScreenWindow().getGraphics();
```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```
                // update animation
                anim.update(elapsedTime);

                // draw to screen
                Graphics g =
                    screen.getFullScreenWindow().getGraphics();
                draw(g);
                g.dispose();

                // take a nap
                try {
                    Thread.sleep(20);
                }
                catch (InterruptedException ex) { }
            }
        }

        public void draw(Graphics g) {
            // draw background
            g.drawImage(bgImage, 0, 0, null);

            // draw image
            g.drawImage(anim.getImage(), 0, 0, null);
        }
    }
```