Media Computation

Lecture 15.2, December 3, 2008

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Today -- new Stuff !

- Two kinds of methods:
  - object
  - class
- Creating Classes
  - identifying objects and classes
  - constructors
  - adding a method, accessors and modifiers, creating a main method
  - comments, javadocs

A note about colors

- Exercises are colored “cantaloupe”.
  - please try some of these before Lab on Friday.
  - be sure to ask questions on Friday for anything you don’t understand
- Breaks between sections are blue.

Two kinds of methods

- Object methods
- Class methods

Object Methods

- So far we have created object methods
- Object methods must be invoked on an object
  - And they work on the object
    - Which is implicitly passed to an object method
      - And can be referenced using the 'this' keyword
- Examples
  - `pictureObj.show();`
  - `soundObj.play();`
  - `turtleObj.forward();`

Class (Static) Methods

- Can be invoked using the class name
  - Or invoked on an object
- Are used for general methods
  - Like Math.abs(num);
- Also used to create objects of the class
  - `Sound s = Sound.createSineWave();`
- Can only work with class (static) fields
  - Not object fields
- Are declared with the keyword static
  - Usually after the visibility

Create Sine Wave Class Method

```
public static Sound createSineWave(int freq, int
  maxAmplitude)
{
 String file =
  FileChooser.getMediaPath("sec1silence.wav");
 Sound s = new Sound(file);
 double samplingRate = s.getSamplingRate();
 double rawValue = 0;
 int value = 0;
 double interval = 1.0 / freq; // length of cycle in
  seconds
 double samplesPerCycle = interval * samplingRate;
 double maxValue = 2 * Math.PI;
```

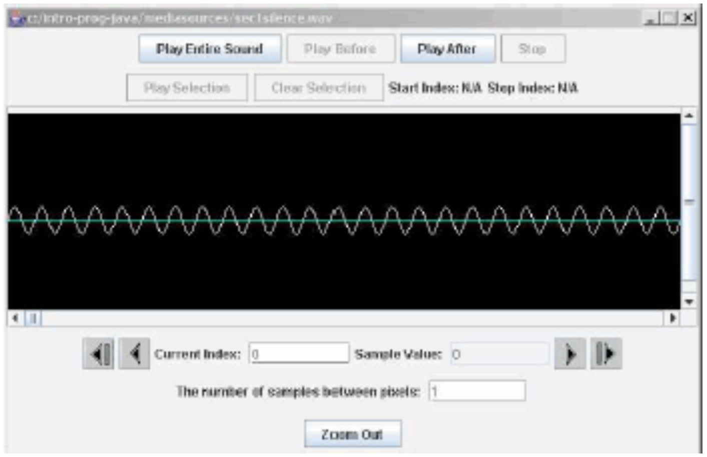
Create Sine Wave Class Method - Cont

```
 // loop through the length of the sound
 for (int i = 0; i < s.getLength(); i++)
 {
   // calculate the value between -1 and 1
   rawValue = Math.sin((i / samplesPerCycle) * maxValue);

   // multiply by the desired max amplitude
   value = (int) (maxAmplitude * rawValue);

   // set the value at this index
   s.setSampleValueAt(i,value);
 }
 return s;
}
```

Testing Create a Sine Wave

- To create a sound with 880 Hz and a maximum amplitude of 4000:

```
Sound s = Sound.createSineWave(880,4000);
s.explore();
```



Start Index: N/A Stop Index: N/A

Current Index: 0 Sample Value: 0

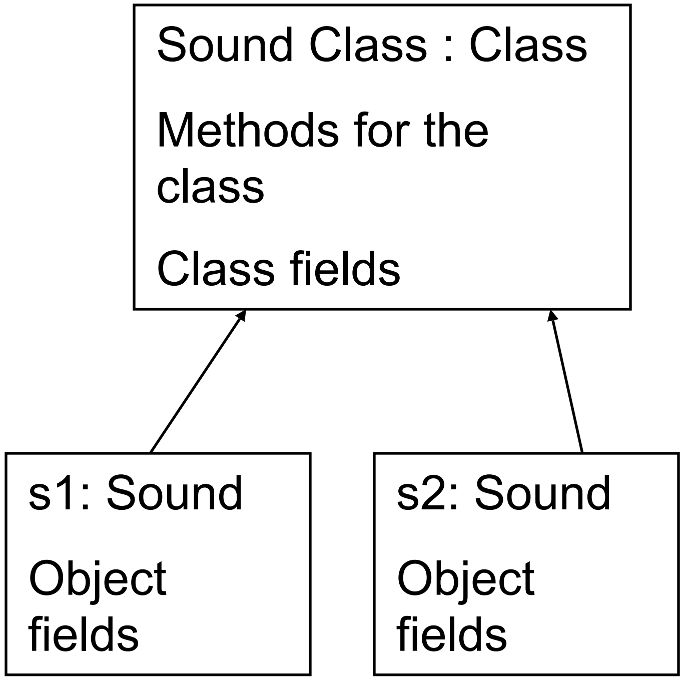
The number of samples between pixels: 1

Invoking a Class Method Exercise

- Use the class method
  - `createSineWave(freq,maxAmplitude)`
- To create 4 sounds and save each to a file
  - Try freq = 440 and maxAmplitude = 8000
  - Try freq = 440 and maxAmplitude = 10000
  - Try freq = 880 and maxAmplitude = 8000
  - Try freq = 880 and maxAmplitude = 10000
- Try invoking the method on a sound object
  - Does this work?

Class Methods

- All methods are compiled and the code for the methods is stored in the object that defines the class
  - An object of the class called class
- Object methods must be called on an object
  - And the object is implicitly passed to the method
- Class methods can be called using the class name or on an object of the class
  - Objects always have a reference to their class



Creating Square Waves

- To create a square shaped wave we can use positive and negative values
  - and switch between them at the halfway point in the cycle
- Pass in the desired frequency and maximum amplitude
- Calculate the interval (1 / freq)
- Calculate the samples per cycle
  - Interval * sampling rate
- Calculate half of the samples per cycle
- Loop through the whole sound
  - Init a sampleCounter to 0
  - If the sampleCounter < the halfSamplesPerCycle
    - Use maxAmplitude
  - Else
    - Use -1 * maxAmplitude
  - If the sampleCounter is >= samplesPerCycle reset it to 0

Create Square Wave Exercise

- Write a class (static) method
  - createSquareWave(int freq, int maxAmplitude);
- It should generate and return a sound
  - With a length of 1 second
  - That is comprised of square waves
- Use it to generate
  - Try freq = 440 and maxAmplitude = 8000
  - Try freq = 440 and maxAmplitude = 10000
  - Try freq = 880 and maxAmplitude = 8000
  - Try freq = 880 and maxAmplitude = 10000
- Compare the square waves and sine waves

MidiPlayer Class

- Create an object of this class
  - MidiPlayer player = new MidiPlayer();
- Use it to play a note (with a duration)
  - player.playNote(62,250);
    - The 62 is the key on the piano (d in fourth octave)
    - The 250 is the length of time to play it
      - out of 1000 milliseconds so if a measure is played in 1 second this is a quarter note
    - See http://www.harmony-central.com/MIDI/Doc/table2.htm for note numbers
- Specify rests with
  - player.rest(int duration) in milliseconds

Method to Play Jingle Bells (4 measures)

```
public void playJingleBells4()
{
 // measure 1
 playNote(52,250); // e eighth note
 playNote(60,250); // c eighth note
 playNote(58,250); // b flat eighth
   note
 playNote(56,250); // a flat eighth
   note

 // measure 2
 playNote(52,500); // e quarter note
 rest(250);        // rest
 playNote(52,125); // e sixteenth
   note
 playNote(52,125); // e sixteenth
   note

 // measure 3
 playNote(52,500); // e eighth note
 playNote(60,250); // c eighth note
 playNote(58,250); // b flat eighth
   note
 playNote(56,250); // a flat eighth
   note

 // measure 4
 playNote(53,1000); // f half note
}
```

Setting the Instrument

- Use
  - setInstrument(int number)
  - To set the instrument to make the sounds with
- Testing playJingleBells4

```
MidiPlayer player = new MidiPlayer();
player.setInstrument(MidiPlayer.FLUTE);
player.playJingleBells4();
```

Constants

- The instrument numbers are represented with class constants
  - in the MidiPlayer class
- A constant is something that doesn’t change
  - Declared with the keyword final
  - If you try to change it after the constructor is called you will get a compile error
- Class constants are variables that have space in the object that defines the class
  - Declared with the keywords static and final
  - Can be used by *Class*.Constant
- Java naming convention is to use all uppercase letters for constants
  - With _ between words

Some Instrument Constants

- MidiPlayer.PIANO
- MidiPlayer.MUSIC_BOX
- MidiPlayer.GUITAR
- MidiPlayer.HARP
- MidiPlayer.TROMBONE
- MidiPlayer.TRUMPET
- MidiPlayer.ALTO_SAX
- MidiPlayer.TENOR_SAX

Play a Song Exercise

- Write a method to play at least 4 measures of a song
- For public domain sheet music of classical piano see
  - http://www.sheetmusic1.com/NEW.GREAT.MUSIC.HTML
- For public domain American popular music see
  - http://levysheetmusic.mse.jhu.edu

Breaking up Long Methods

- Music often has verses and a refrain
  - You play a verse and then the refrain
  - And then play the next verse and then the refrain
- You could put all of this in one big method
  - Put it would be more work and harder to change
- A better approach is to break the playing of a song into several methods
  - And create one method that calls the others

Playing Jingle Bells Method

```
public void playJingleBells()
 {
  // play verse 1
  playJingleBellsV1();

  // play refrain
  playJingleBellsRefrain();

  // play verse 2
  playJingleBellsV2();

  // play refrain
  playJingleBellsRefrain();
 }
```

Private Methods

- If you want code in another class to be able to invoke a method in your class
  - Make the visibility public
- If you don't want code in another class to be able to invoke a method in your class
  - Make the visibility private
- Private methods can only be invoked by code in the same class
  - So they can be changed without worrying about affecting another class

Summary

- Class fields
  - Are allocated space in the object that defines the class (an object of the class Class)
  - Each object has a reference to the object that defines a class and can access Class fields
  - Are declared using the static keyword
- Constants
  - Don’t change
  - Are declared using the final keyword
- Private Methods
  - Can only be invoked by code in the same class

Today -- new Stuff !

- Two kinds of methods:
  - object
  - class
- Creating Classes
  - identifying objects and classes
  - constructors
  - adding a method, accessors and modifiers, creating a main method
  - comments, javadocs

Identifying Objects and Classes

- Object-oriented programs
  - Consist of interacting objects
    - Which are defined by and created by classes
- To identify the objects in a task
  - What are the things that are doing the work or being acted upon?
  - How do you classify them?
  - What data (fields) do they need to know to do the task?
  - What procedures (methods) do they need?

Identifying the Objects and Classes

- Say that we want to write a program to do a slide show
  - A series of pictures shown one after the other with some time waiting between the pictures
- One way to start is to underline the nouns
  - Slide show, picture, wait time
- A slide show has pictures and a time to wait between pictures

Class Definition

- Each class is defined in a file
  - With the same name as the class: SlideShow.java
- Class names
  - Are singular (SlideShow not SlideShows)
  - Start with an Uppercase letter
  - The rest of the word is lowercase
  - upperCase the first letter of each additional word
- The syntax for a class definition is:
  - *visibility* class *Name* {}
- Inside the class definition goes:
  - Fields, constructors, and methods

Class Declaration

- To declare a SlideShow class
  - Click on the New button in DrJava
- Type in:

```
public class SlideShow
{
}
```

- Save it in SlideShow.java
  - Click on File then Save
- Click the Compile All button to compile it

SlideShow Fields

- A SlideShow has pictures and a wait time
  - What type should we use for each of these?
    - For the pictures we can use a 1-D array
    - For wait time we can use integer to hold the number of milliseconds to wait
    - Use `Thread.sleep(waitTime)` to wait for waitTime number of milliseconds
    - This can cause an *exception* so write the method to throw Exception by adding `throw Exception` to the method definition line

Declaring Fields

- Syntax
  - visiblity type name;
  - visibility type name = expression;
- Usually use private for the visibility
  - So that other classes can’t access it directly
- The type is any of the primitive types, a class name , or an interface name
- Arrays are declared with [] after the type or after the name
  - type[] name; or type name[];
- Names start with a lowercase letter
  - The first letter of each additional word is upperCased

Default Field Values

- If you don’t specify an initial value for a field
  - It will get one anyway when it is created
    - Numbers = 0
    - Objects = null (not referring to any object yet)
    - boolean = false

```
public class SlideShow
{
 /////////////////
   fields ////////////////////////////////////////////
 private Picture[] pictureArray;
 private int waitTime = 2000;
}
```

Initial value will be null

Testing the SlideShow Class

- Add the fields to the class definition and compile it
- Try the following in the interactions pane

```
SlideShow slideShowObj = new SlideShow();
System.out.println(slideShowObj);
```

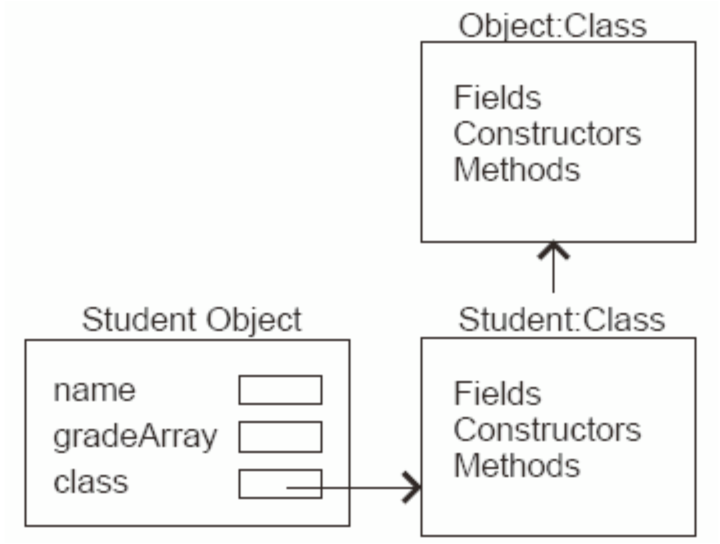
- What happens?
  - SlideShow@2bd3a <<< you may not get the exact same thing

What Happened? (Inherited Methods)

- When you executed
  - System.out.println(slideShowObj);
- The class SlideShow was checked for a toString method
  - Since it didn't have one the parent class was checked for a toString method
    - The one in Object was executed
      - Which prints the hash code for the object
- The SlideShow class *inherited* the toString method from the Object class

How Inheritance Works

- When a method is invoked on an object
- We first check for that method in the object that defines the object's class
- If it isn't there we look in the parent of that class



based on slides by Barb Ericson, Georgia Institute of Technology

All Classes Inherit from Object

- If you don't specify the parent class when you declare a class
  - The class with inherit from java.lang.Object
- You can specify the parent class
  - Add extends *Parent* to the class declaration

```
public class SlideShow extends Object
```

- A declaration of

```
public class SlideShow
```

- Is the same as

```
public class SlideShow extends Object
```

Getting the Class

- An object keeps a reference to the class that created it
  - You can get this class with
    - Class currClass = obj.getClass();
- Each class keeps a reference to its parent class
  - You can get this class with
    - Class parentClass = currClass.getSuperclass();
- Try the following:

```
SlideShow showObj = new SlideShow();
Class showClass = showObj.getClass();
System.out.println(showClass);
Class parentClass = showClass.getSuperclass();
System.out.println(parentClass);
```

Overriding an Inherited Method

- If a class defines a method with the same name, parameter list, and return type as an inherited method
  - This method will be called instead of the parent method
- To override Object’s toString add this one to SlideShow:

```
public String toString()
{
  return "A slide show with " +
   this.pictureArray.length + " pictures and " +
   "a wait time of " + this.waitTime;
}
```

Testing toString

- Compile SlideShow.java
- Type the following in the interactions pane

```
SlideShow showObj = new SlideShow();
System.out.println(showObj);
```

- What do you get this time?
  - And why?
- Can you fix this?

Summary

- Object-oriented programs
  - Have interacting objects
- To decide what classes to create
  - Identify the objects doing the action or being acted upon
    - And classify them (what type of thing are they?)
- To declare a class
  - public class SlideShow{}
- To declare a field
  - private type fieldName;
- All classes inherit from Object
  - Inherit the toString() method
- Add a toString() method to your own classes
  - To override the inherited method

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Constructors

- Are used to initialize the fields of an object
  - To other than the default values or assigned values
- You can have more than one constructor
  - As long as the parameter lists are different
  - This is called overloading constructors
- Syntax
  - visibility ClassName(paramList) {}
- Example

```
public SlideShow(Picture[] pictArray)
{
   this.pictureArray = pictArray;
}
```

Creating 1D Arrays

- You can declare an array using
  - `Type[] arrayName;`
- You can create an array using
  - `new Type[size];`
- You can declare an array and create it at the same time
  - `Type[] arrayName = new Type[size];`
- Array indices start at 0 and end at length – 1
- You can get the length of an array using
  - `arrayName.length`
- You can add an element to an array using
  - `name[index] = Object;`

Add a Constructor

- Add the following after the field declarations to SlideShow.java:

```
public SlideShow(Picture[] pictArray)
{
   this.pictureArray = pictArray;
}
```

- Compile and test

```
SlideShow showObj = new SlideShow();
```

Why did you get an Error?

- We hadn't declared any constructors before we added this one
  - But a constructor is called each time a new object is created
  - We didn't provide one so the compiler added a no-argument constructor
    - One that takes no parameters and leaves the fields with their default or assigned values
- But once you add a constructor
  - The compiler will not add any for you
    - So now you get an error when you try to use a no-argument constructor

Adding a No-Argument Constructor

- Add the following constructor to the Student class

```
public SlideShow() { }
```

- Now test it again with:

```
SlideShow showObj = new SlideShow();
System.out.println(showObj);
```

- Also try:

```
Picture[] pictArray = new Picture[5];
pictArray[0] = new Picture(FileChooser.getMediaPath("beach.jpg"));
pictArray[1] = new
    Picture(FileChooser.getMediaPath("blueShrub.jpg"));
pictArray[2] = new
    Picture(FileChooser.getMediaPath("church.jpg"));
pictArray[3] = new Picture(FileChooser.getMediaPath("eiffel.jpg"));
pictArray[4] = new Picture(FileChooser.getMediaPath("greece.jpg"));
SlideShow vacShow = new SlideShow(pictArray);
System.out.println(vacShow);
```

Tracing Execution

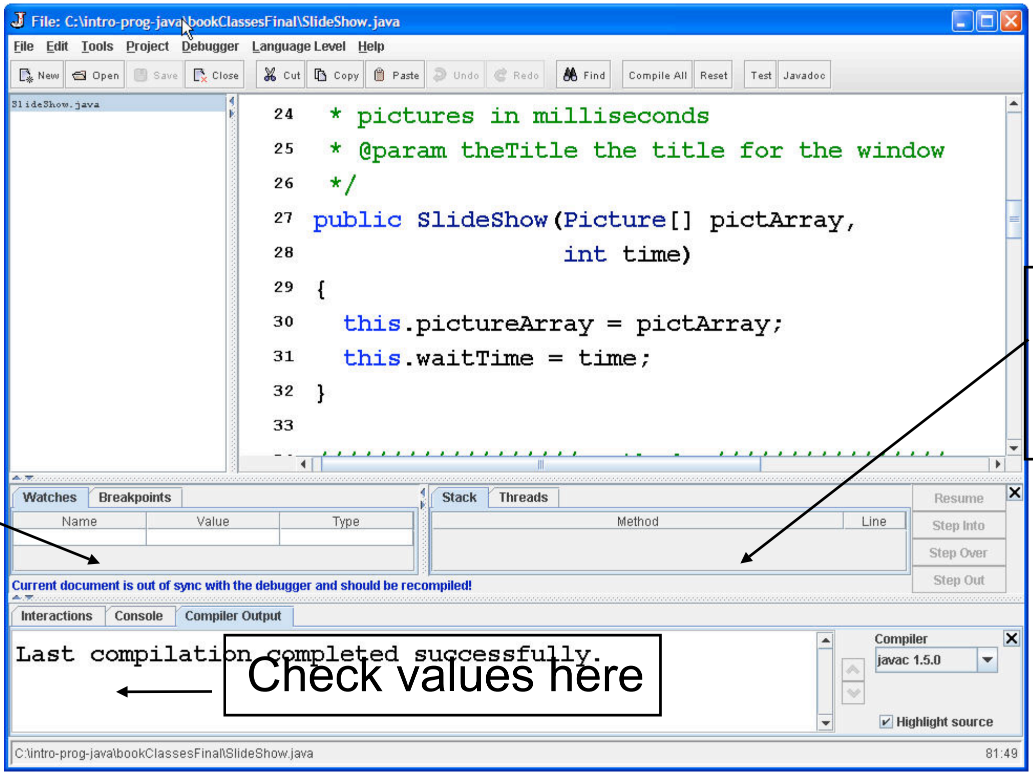
- One way to trace what is happening in your program is
  - To add System.out.println() statements
- Add these to print out the value of the picture array both before and after it is set
  - System.out.println(this.pictureArray);
  - this.pictureArray = pictArray;
  - System.out.println(this.pictureArray);

Debuggers

- You can use a debugger to find the cause of bugs (errors in your program)
  - A moth caused one bug
  - http://www.jamesshuggins.com/h/tek1/first_computer_bug.htm
- And to trace execution to see what is happening
  - Which constructor is executed or what method is executed
  - What values are in the fields

DrJava's Debugger

- Click on Debugger in the menu
  - Then check the Debug Mode checkbox


File: C:\intro-prog-java\bookClassesFinal\SlideShow.java
File Edit Tools Project Debugger Language Level Help
New Open Save Close Cut Copy Paste Undo Redo Find Compile All Reset Test Javadoc
SlideShow.java
Watches Breakpoints
Name Value Type
Stack Threads
Method Line
Resume
Step Into
Step Over
Step Out
Interactions Console Compiler Output
Compiler
javac 1.5.0
Highlight source
81:49

```
   * pictures in milliseconds
   * @param theTitle the title for the window
   */
  public SlideShow(Picture[] pictArray,
                   int time)
  {
    this.pictureArray = pictArray;
    this.waitTime = time;
  }
```

Current document is out of sync with the debugger and should be recompiled!

```
Last compilation completed successfully.
```

C:\intro-prog-java\bookClassesFinal\SlideShow.java

Watches and Breakpoints Area

Stack and Threads Area

Check values here

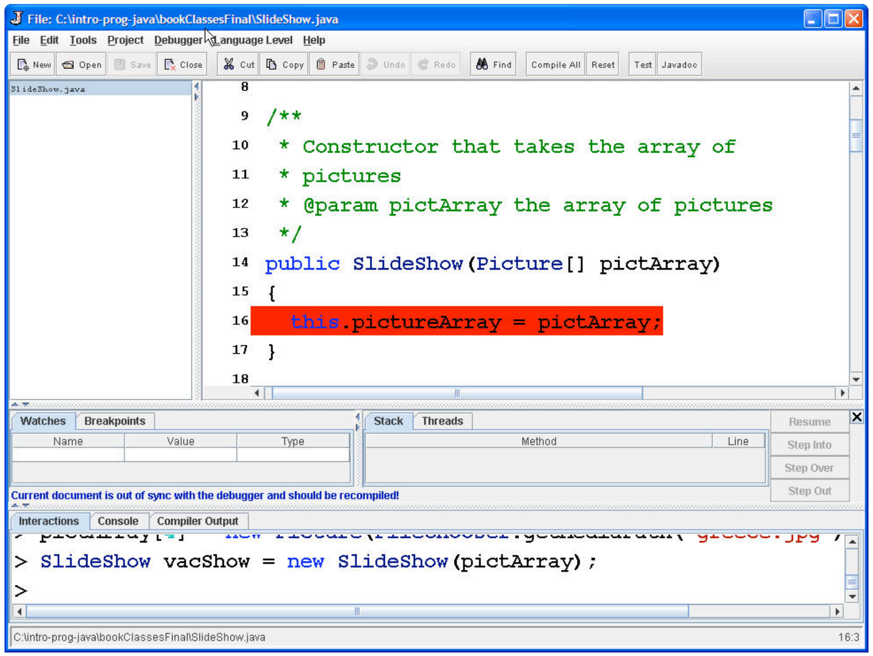
based on slides by Barb Ericson,
Georgia Institute of Technology

Setting a Breakpoint

- When you use a debugger you often want to set places to stop execution
  - Each place to stop at is a breakpoint
- Once execution has stopped there
  - You can check the value of parameters and fields
- To set a breakpoint
  - Right click on a line of code
  - Pick “Toggle Breakpoint”
  - It will be highlighted in red

Showing a Breakpoint

- Lines with breakpoints are highlighted in red in DrJava
- Set a breakpoint at the line that sets the picture array


File Edit Tools Project Debugger Language Level Help
New Open Save Close Cut Copy Paste Undo Redo Find Compile All Reset Test Javadoc
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Interactions Console Compiler Output

File: C:\intro-prog-java\bookClassesFinal\SlideShow.java

```
/**
 * Constructor that takes the array of
 * pictures
 * @param pictArray the array of pictures
 */
public SlideShow(Picture[] pictArray)
{
  this.pictureArray = pictArray;
}
```

Current document is out of sync with the debugger and should be recompiled!

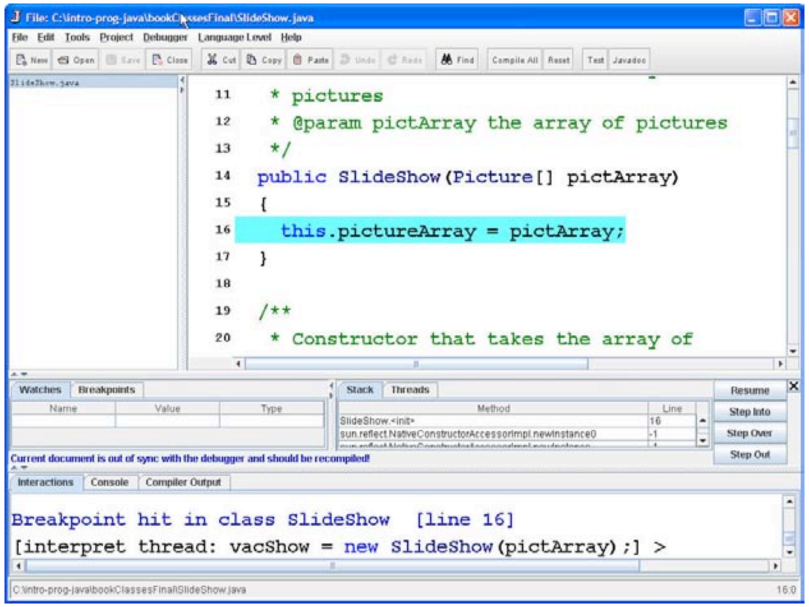
```
> SlideShow vacShow = new SlideShow(pictArray);
>
```

C:\intro-prog-java\bookClassesFinal\SlideShow.java 16:3

based on slides by Barb Ericson,
Georgia Institute of Technology

Testing a Breakpoint

- Try the constructor again that takes an array of pictures
- Execution should stop at the breakpoint
  - And the color will change to blue



File: C:\intro-prog-java\bookClassesFinal\SlideShow.java

```
11    * pictures
12    * @param pictArray the array of pictures
13    */
14   public SlideShow(Picture[] pictArray)
15   {
16     this.pictureArray = pictArray;
17   }
18
19   /**
20    * Constructor that takes the array of
```

Method	Line
SlideShow.<init>	16
sun.reflect.NativeConstructorAccessorImpl.newInstance0	-1

Current document is out of sync with the debugger and should be recompiled!

```
Breakpoint hit in class SlideShow  [line 16]
[interpret thread: vacShow = new SlideShow(pictArray);] >
```

C:\intro-prog-java\bookClassesFinal\SlideShow.java 16:0

File Edit Tools Project Debugger Language Level Help
New Open Save Close Cut Copy Paste Undo Redo Find Compile All Reset Test Javadoc
SlideShow.java
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Checking Values

- Execution stops before the breakpoint line is executed
  - So the array hasn't been set yet
  - Check this by printing out the value of it in the interactions pane
    - this.pictureArray
  - Then click on the Step Over button
    - To let the current line of code be executed
  - And check the values again

Debugging Options

- Step Over
  - Execute the current line of code and then stop again before you execute the next line of code
- Step Into
  - If the line of code that we are stopped at has a method call in it stop at the first line in the called method
- Resume
  - Continue execution at the current point
    - Until the next breakpoint
    - Or the program ends
- Step Out
  - Execute the rest of the current method and stop at the first line after the call to this method
- You can quit debugging by clicking on the X

Adding a Constructor Exercise

- Create another constructor in the SlideShow class
  - That takes both the array of pictures and the time to wait between pictures

```
public SlideShow(Picture[] pictArray,
                 int time)
```

  - Use the debugger to check what happens during execution of this constructor

Summary

- Constructors initialize the fields in an object
- To declare a constructor
  - public *ClassName*(*paramList*) {}
    - No return type
    - Same name as the class
- You can overload constructors
  - The parameter lists must be different
- Use a debugger
  - To watch what happens during execution

Today -- new Stuff !

- Two kinds of methods:
  - object
  - class
- Creating Classes
  - identifying objects and classes
  - constructors
  - adding a method, accessors and modifiers, creating a main method
  - comments, javadocs

Showing the Slide Show

- Now that a slide show has an array of slides we would like to
  - Show the pictures in the array
    - We can loop through the elements of the array
      - And show the current picture
      - And wait for the wait time
      - Then hide the current picture
    - We need to be careful of
      - A null pictureArray

Create a Method Exercise

- Create a method `show` that will first check that the picture array isn't null
  - And if it isn't will loop through the pictures in the array
    - Showing the current picture
    - Waiting till the wait time has passed
    - Hiding the current picture

Accessing Fields from Other Classes

- Fields are usually declared to be private
  - So that code in other classes can't directly access and change the data
- Try this in the interactions pane
  - System.out.println(showObj.pictureArray);
- You will get an exception
  - Short for exceptional event – error
- Outside classes can not use object.field to access the field value
  - Unless it is declared with public visibility

Accessors and Modifiers

- Accessors
  - Are public methods that return data
    - In such a way as to protect the data for this object
    - Syntax

      ```
      public fieldType getFieldName()
      ```
    - Example

      ```
      public String getName() { return this.name;}
      ```
- Modifiers
  - Are public methods that modify data
    - In such a way as to protect the data for this object
    - Syntax

      ```
      public returnType setFieldName(type name);
      ```
    - Example

      ```
      public void setName(String theName)
      {this.name = theName; }
      ```

Naming Conventions

- Accessors – also called Getters
  - Use getFieldName for non boolean fields
  - Use isFieldName for boolean fields
- Modifiers – also called Setters and Mutators
  - Use setFieldName
  - Sometimes return a boolean value to indicate if the value was set successfully
- Examples
  - getName and setName

Creating SlideShow Accessors

- Add a method to get the wait time

  `public int getWaitTime()`

- What about a method to get the array of pictures?
  - If someone gets the array s/he can directly change the pictures in the array
  - It is safer to return the picture at an index
    - Then other classes can't directly change the array of pictures

Exercise

- Create a method that returns the wait time
- Create a method that returns the picture at a given index in the array
  - If the array is null return null
  - If the index isn't valid return null

Creating Slide Show Modifiers

- We need public methods
  - That let other classes set the time to wait between pictures
  - Our class is responsible for making sure this only happens in such a way
    - as to keep the data valid and not cause errors
- Setting the wait time
  - The wait time must be > 0
- Setting an array of pictures
  - We can decide if this can be changed or not when it isn't null

Set Picture Array Modifier

- Setting the array of pictures only if it is currently null

```
public boolean setPictureArray(Picture[] theArray)
  {
   boolean result = false;
   if (this.pictureArray == null)
   {
    this.pictureArray = theArray;
    result = true;
   }
   return result;
  }
```

Wait Time Modifier

```
public void setWaitTime(int time)
  {
    // check that it is a valid wait time
    if (time >= 0)
     this.waitTime = time;
  }
```

Add a Field Exercise

- Add a title field to the SlideShow class
- Add an accessor to get the value of this field
- Add a modifier to set the value of this field
- Modify the show method to first create a blank picture with the title on it and show that as the first picture in the slide show

Adding a Main Method

- We have been typing stuff in the interactions pane in DrJava
  - To try out Java code and to try methods
- Most development environments make you write a main method to start execution
  - DrJava allows this too
- Each class can have a main method declared as follows:
  - `public static void main(String[] args)`
    - It is public so that it can be called by other classes
    - It is static because no object of the class exists when it is executed
    - It doesn’t return anything so the return type is void
    - You can pass several arguments to the main method and these are put in an array of strings

Main Method

- Add a main method to SlideShow
  - Put the statements that you have been doing in the interactions pane in the main method

```
public static void main(String[] args) throws Exception
  {
   Picture[] pictArray = new Picture[5];
   pictArray[0] = new
    Picture(FileChooser.getMediaPath("beach.jpg"));
   pictArray[1] = new
    Picture(FileChooser.getMediaPath("blueShrub.jpg"));
   pictArray[2] = new
    Picture(FileChooser.getMediaPath("church.jpg"));
   pictArray[3] = new
    Picture(FileChooser.getMediaPath("eiffel.jpg"));
   pictArray[4] = new
    Picture(FileChooser.getMediaPath("greece.jpg"));
   SlideShow vacShow = new SlideShow(pictArray);
   vacShow.show();
  }
```

Execute the Main Method

- In DrJava you can run the main method in the class that is displayed in the definitions pane
  - By clicking on Tools then Run Document's Main Method (or press key F2)
- It will do
  - java SlideShow
  - In the interactions pane
  - Which executes the main in the SlideShow class

Summary

- Classes have fields, constructors, and methods
- Constructors are used to initialize fields in the object
- Fields are usually declared to be private
  - To protect the data from misuse by other classes
  - So you need to provide public accessor (getter) and modifier (setter) methods
    - That still protect the data
- Use a main method to begin execution
  - public static void main(String[] args) {}

Today -- new Stuff !

- Two kinds of methods:
  - object
  - class
- Creating Classes
  - identifying objects and classes
  - constructors
  - adding a method, accessors and modifiers, creating a main method
  - comments, javadocs

Comments

- You should add comments to your code
  - To make it easier to read and change
- Comments are ignored by the complier
  - Not added to the byte codes
- Java has 3 kinds of comments
  - // comment ends at the end of this line
  - /* comment ends with next */
  - /** Javadoc comment that ends with */
    - can be used by the javadoc utility to create HTML documentation

Javadoc Comments

- Add a comment before the class definition
  - That explains the purpose of this class
  - And says who wrote it
    - @author Barb Ericson

```
/**
 * Class that represents a slide show.  A slide show has
 *  an array of pictures, a time to wait between pictures,
 *  and a title that is shown at the beginning of the show.
 *
 * @author Barb Ericson
 */
public class SlideShow
```

Method Comments

- Add a comment before each method
- What the parameters are
  - @param name info
- What is returned
  - @return info

```
/**
  * Method to change the time to wait
  * between pictures
  * @param time the new time to use
  * in milliseconds
  */
 public void setWaitTime(int time)
 {
    if (time >= 0)
       this.waitTime = time;
 }
```

Previewing Javadoc HTML

- Click on Tools
- Click on Preview Javadoc for Current Document
  - This will generate the HTML from the javadoc comments and display it
- The HTML document will display

Generating all HTML for Directory

- In DrJava click on the Javadoc button
  - to create the HTML documentation
  - based on the Javadoc comments
- This will generate HTML for all files in the same directory as all open files
- Generates an index.html as a starting point

Javadoc Exercise

- Add a class javadoc comment and method javadoc comments to the SlideShow class
- Execute Javadoc and check out the created documentation

Summary

- Comments are added to make a program
  - Easier to read and understand
  - Comments are ignored by the compiler
- There are three types of comments in Java
  - // end of line
  - /* multi line */
  - /** java doc */
- Javadoc is a utility that comes with the jdk
  - Produces HTML documentation from Javadoc comments