Intro to GUIs (Graphical User Interfaces)

Section 2.5 Intro. to GUIs: a GUI Greeter

Section 3.7 Graphical/Internet Java: Einstein's Equation

Alan Kay
Alto

- 1980
- The first *GUI* interface
- Developed at Xerox PARC by a group which included Kay.
- The key ideas are based on child psychology

from www.parc.xerox.com

"Only people born before a technology is invented think of it as a technology"

Steven Jobs (1955-)
MacOS

- 1984
- The first commercially successful GUI OS
- Developed at Apple by a group that included Jobs.
- Based on the Xerox PARC Alto

from www.apple.com

Example: Building a Temperature-Conversion GUI

(similar to Einstein Calculator in §3.7)

Problem Scenario:

Write a program to read a temperature in Celsius, compute and display the equivalent Fahrenheit temperature. However, instead of the text-based solution from before, use a graphical user interface.

Similar to GUI Lab #1

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Models of Programming

Data-Driven

- Limited interaction with the user
- Activity is initiated by the program:
  1. input data
  2. process the data
  3. output the results
- Single thread of execution.

Event-Driven

- Continuous interaction with the user
- Activity is initiated by user events:
  1. user initiates events
  2. system responds
- Can have multiple threads of execution doing different things simultaneously. One thread can process events, others can generate events, others can do computations.

Kinds of User Interfaces

Textual

- Uses text and keyboard
- Driven by:
  - text input prompts
  - command-line interfaces
- Relatively easy to program

Graphical

- Uses pictures and mouse (in addition to text & keyboard)
- Driven by user-initiated graphical events, e.g.,
  - pressing mouse button
  - releasing mouse button
  - dragging the mouse
  - pressing a keyboard key
- Requires more programming (mostly using libraries)

Behavior of our Temperature-Converter GUI

The program will have a graphical user interface that will:

- Open a window containing:
  - a prompt for a Celsius temperature
  - a box to enter the temperature
  - OK and Cancel buttons
- Let the user enter a Celsius temperature and then click OK (or press Enter key)
- Compute the equivalent Fahrenheit temperature
- Open a second window that displays:
  - the Fahrenheit temperature
  - a button for terminating the program

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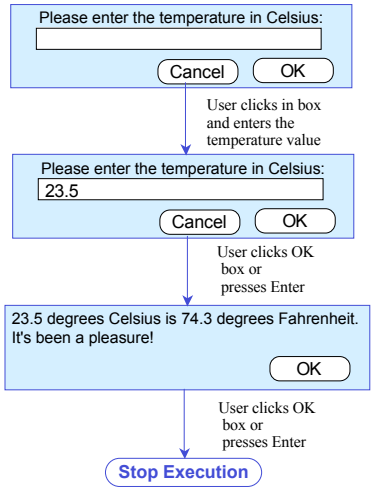
Transition Diagrams:

Graphical behavior is frequently modeled with state transition diagrams that show the various states of execution and what causes transitions from one state to another.



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Objects (Widgets):

In addition to the temperature variables and constants from our earlier text-based version, we obviously need new graphical objects, usually called widgets, to build the GUI — windows, buttons, menus, etc.

Abstract Windowing Toolkit AWT

- Java's first GUI-building library; still used directly and indirectly
- A package `java.awt` of classes — e.g., **`Component`** and **`Applet`** — for building widgets.

Java Foundation Classes JFC

- Extension to Java in 1997; now a standard part of Java 2 (JDK1.3), which still supports AWT, but . . .
- JFC has a collection of Swing components for enhanced GUIS that should be used whenever possible:
  - more powerful
  - easier to use
  - large collection, but most useful are those in `javax.swing` package
  - Names all begin with **'J'**

Some of the more commonly-used Swing classes:

• `JFrame`	To create a main frame (window) for a GUI
• `JApplet`	Like **`JFrame`**, but for applets
• `JOptionPane`	To implement pop-up input or output dialog boxes
• `JLabel`	To hold a short one-line message or an image
• `JTextArea`	To hold multi-line messages
• `JPanel`	To create panes (or panels) to put on a frame
• `JButton`	To create buttons
• `JMenu`	To create menus
• `JFileChooser`	A simple way for a user to choose a file

See the "How to Make Dialogs" section of Java's Swing Tutorial:
http://java.sun.com/docs/books/tutorial/uiswing/TOC.html#components

SwingSet

Building our GUI Temperature Converter

```
/** GUITemperature.java converts Celsius temperatures to
 * Fahrenheit.  It uses a graphical user interface to
 * interact with the user.
 * Author: L. Nyhoff
 * Date:   Nov. 29, 2002
 */

import javax.swing.*;

class GUITemperature extends Object  {

  public static void main(String [] args)   {

   //--- Get Celsius temperature

    double fahrenheit = ((9.0/5.0)*celsius) + 32;

   //--- Output Fahrenheit temperature

  }
}
```

Since we need a widget for creating pop-up input and output windows, we will use **`JOptionPane`**. Some of its most useful methods are the following; all are class (static) methods:

- **`showInputDialog()`** Prompt for input
- **`showMessageDialog()`** Display message to user
- **`showConfirmDialog()`** Ask user to confirm something, usually with Yes, No, or Cancel
- **`showOptionDialog()`** "a grand unification of the above three" (from Java's API doc.)

`http://java.sun.com/j2se/1.4.1/docs/api/`

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Input Dialogs:

- Used to get text input from user
- Simple form
  `showInputDialog(`*`prompt`*`)`
- Returns a **`String`**
- The ***`prompt`*** can be a **`String`**, a graphic image, or another Java **`Object`**.

So we can implement the first state in our program:

`http://java.sun.com/j2se/1.4.1/docs/api/`

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```
/** GUITemperature.java
      . . .
 */

import javax.swing.*;

class GUITemperature extends Object  {

  public static void main(String [] args)   {

    //--- Get Celsius temperature
    String celsiusString = JOptionPane.showInputDialog(
                "Please enter the temperature in Celsius: ")
    double celsius = Double.parseDouble(celsiusString);

    double fahrenheit = ((9.0/5.0)*celsius) + 32;

   //--- Output Fahrenheit temperature

  }
}
```

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Message Dialogs:

- Used to display information to the user
- Simple form
  `showMessageDialog(null, `*`message`*`)`
- A void method
- The ***`message`*** is a **`String`** or other Java **`Object`**
- The first parameter refers to the frame in which the message is to be displayed; **`null`** causes a default frame to be used.

So we can implement the last state in our program:

`http://java.sun.com/j2se/1.4.1/docs/api/`

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```
/** GUITemperature.java
      . . .
 */
import javax.swing.*;
class GUITemperature extends Object  {
  public static void main(String [] args)   {
    //--- Get Celsius temperature
    String celsiusString = JOptionPane.showInputDialog(
                "Please enter the temperature in Celsius: ");
    double celsius = Double.parseDouble(celsiusString);
    double fahrenheit = ((9.0/5.0)*celsius) + 32;
    //--- Output Fahrenheit temperature
    JOptionPane.showMessageDialog(null,
            celsius + " degrees Celsius is " + fahrenheit
          + " degrees Fahrenheit.\nIt's been a pleasure!\n");
    System.exit(1);
  }
}
```

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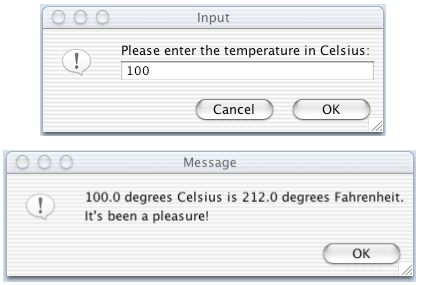
We added the line

```
System.exit(1);
```

to ensure that the application stops running when the OK button is clicked.

Execution:



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Some Improvements:

- Give each dialog box a meaningful title and appropriate symbol for type of dialog:

```
String TITLE = "Celsius-to-Fahrenheit Conversion";

String celsiusString = JOptionPane.showInputDialog(
            null,
            "Please enter the temperature in Celsius: ",
            TITLE,
            JOptionPane.QUESTION_MESSAGE);

JOptionPane.showMessageDialog(null,
       celsius + " degrees Celsius is " + fahrenheit
     + " degrees Fahrenheit.\nIt's been a pleasure!\n",
       TITLE,
       JOptionPane.PLAIN_MESSAGE);
```

http://java.sun.com/j2se/1.4.1/docs/api/

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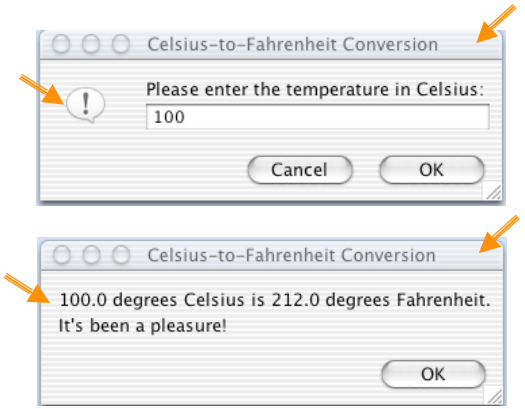

http://java.sun.com/j2se/1.4.1/docs/api/

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- Allow repeated conversions:

```
do {
  String celsiusString = JOptionPane.showInputDialog(
         null,
         "Please enter the temperature in Celsius: ",
         TITLE,
         JOptionPane.QUESTION_MESSAGE);

     double celsius = Double.parseDouble(celsiusString);

     double fahrenheit = ((9.0/5.0)*celsius) + 32;

     JOptionPane.showMessageDialog(null,
          celsius + " degrees Celsius is " +  fahrenheit
        + " degrees Fahrenheit.\nIt's been a pleasure!\n",
          TITLE,
            JOptionPane.PLAIN_MESSAGE);
}
while (JOptionPane.showConfirmDialog(null,
                                "More values to convert? ")
            == JOptionPane.YES_OPTION);
```

http://java.sun.com/j2se/1.4.1/docs/api/

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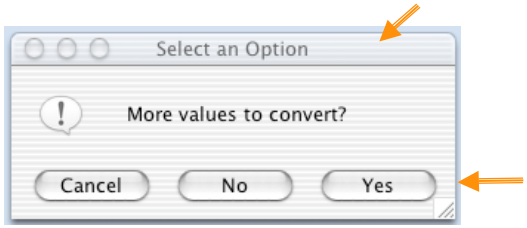

http://java.sun.com/j2se/1.4.1/docs/api/

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