The Google Web Toolkit (GWT): Widget Event Handling
(GWT 2.5 Version)

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Topics in This Section

• **Main approaches to event handling**
  – Separate event handler classes
  – Main class implementing event handler interface
  – Named inner classes
  – Anonymous inner classes

• **Basic widgets and their associated events**
  – Pushbuttons and related widgets
  – Checkboxes and related widgets
  – Listboxes and related widgets
  – Textfields and related widgets

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General Approach

- **Make a control**
  - TextBox textfield = new TextBox();

- **Attach an event handler (4 alternative ways)**
  - textfield.addKeyUpHandler(new MyKeyUpHandler());
    - MyKeyUpHandler is class that implements KeyUpHandler
  - textfield.addKeyUpHandler(this);
    - Current class (this) implements KeyUpHandler
  - textfield.addKeyUpHandler(new MyKeyUpHandler());
    - MyKeyUpHandler is inner class that implements KeyUpHandler
  - textfield.addKeyUpHandler(new KeyUpHandler () { ... });

- **Note**
  - This is *exactly* same approach as with Swing, AWT, SWT, Android
    - You write event handlers using the same strategies as in desktop Java GUI programming, even though code gets compiled to JavaScript and HTML at runtime
      - Client-side code will not support Java 8 for foreseeable future, so you cannot use lambdas for event handling. Too bad!

Option 1: Separate Handler Classes
Idea

• Monitor a textfield
  – Echo contents of textfield to table cell
  – If textfield contents match “gwt”, give special message

• Approach
  – Use an external class that implements KeyUpHandler

• Advantages
  – Separate classes generally promote loose coupling
    • Event handler can be changed independently from rest of app
  – Works even if you have multiple textfields to which you attach different handlers
  – You can pass arguments to the constructor to customize behavior

• Disadvantages
  – If you want to call code in main class, you need reference
  – Even then, code in main class must be public

Main Class (Initial Attempt)

```java
public class GwtEvents1 implements EntryPoint {
    private TextBox textfield;
    public HTML resultArea;

    public void onModuleLoad() {
        textfield = new TextBox();
        textfield.addKeyUpHandler(new WowHandler(this));
        resultArea = new HTML("<i>Result will go here</i>"));
        RootPanel.get().addClassName("tan");
        RootPanel.get("textfieldID").add(textfield);
        RootPanel.get("resultID").add(resultArea);
    }

    public void backgroundRed() {
        RootPanel.get().addClassName("red");
    }

    public void backgroundNormal() {
        RootPanel.get().removeClassName("red");
    }
}
```
**Handler Class (Initial Attempt)**

```java
public class WowHandler implements KeyUpHandler {
    private GwtEvents1 app;

    public WowHandler(GwtEvents1 app) {
        this.app = app;
    }

    public void onKeyUp(KeyUpEvent event) {
        TextBox textfield = (TextBox)event.getSource();
        String text = textfield.getText();
        if (text.equalsIgnoreCase("gwt")) {
            app.resultArea.setHTML("<span class='wow'>Wow!</span>\n"));
            app.backgroundRed();
        } else {
            app.resultArea.setHTML(text);
            app.backgroundNormal();
        }
    }
}
```

You need to call main application, so you need to store and use a reference to it. Data in main app must be public.

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**Main Class (Improved)**

```java
public class GwtEvents1 implements EntryPoint, RespondsToWow{ 
    private TextBox textfield;
    private HTML resultArea;

    public void onModuleLoad() {
        ...
    }
    @Override
    public void makeBackgroundRed() {
        RootPanel.get().addStyleName("red");
    }
    @Override
    public void makeBackgroundNormal() {
        RootPanel.get().removeStyleName("red");
    }
    @Override
    public void setResults(String html) {
        resultArea.setHTML(html);
    }
}
package coreservlets.client;

import com.google.gwt.user.client.ui.HTML;

public interface RespondsToWow {
  void setResults(String html);
  void makeBackgroundRed();
  void makeBackgroundNormal();
}

public class WowHandler implements KeyUpHandler {
  private RespondsToWow app;

  public WowHandler(RespondsToWow app) {
    this.app = app;
  }

  public void onKeyUp(KeyUpEvent event) {
    TextBox textfield = (TextBox) event.getSource();
    String text = textfield.getText();
    if (text.equalsIgnoreCase("gwt")) {
      app.setResults("<span class='wow'>Wow!</span>");
      app.makeBackgroundRed();
    } else {
      app.setResults(text);
      app.makeBackgroundNormal();
    }
  }
}
<link rel="stylesheet" href="./css/styles.css" type="text/css"/>
<script type="text/javascript" language="javascript" src="gwtevents1/gwtevents1.nocache.js"></script>

<body>
...
<table border="1">
<tr><th>Input</th><th>Result</th></tr>
<tr><td id="textfieldID"></td><td id="resultID"></td></tr>
...
To run in development mode, R-click project, Run As → Web Application (or click green arrow at top). If previous app is still running, first stop Jetty server by going to Development Mode tab and clicking red box on top right.

Option 2: Main Class
Implementing Handler Interface
Idea

- **Monitor a textfield**
  - Echo contents of textfield to table cell
  - If textfield contents match “gwt”, give special message

- **Approach**
  - Have main class implement KeyUpHandler

- **Advantages**
  - No need to pass main class reference to handler
  - Handler can easily access data in the main class
  - Methods or variables in main class can be private

- **Disadvantages**
  - Extra work if you have multiple textfields to which you attach different behaviors
    - You need if/then/else in the event handler to determine which textfield you are dealing with

Main Class

```java
public class GwtEvents2 implements EntryPoint, KeyUpHandler {
    private TextBox textfield;
    private HTML resultArea;

    public void onModuleLoad() {
        textfield = new TextBox();
        textfield.addKeyUpHandler(this);
        resultArea = new HTML(<i>Result will go here</i>);
        RootPanel.get().addStyleName("tan");
        RootPanel.get("textfieldID").add(textfield);
        RootPanel.get("resultID").add(resultArea);
    }

    private void makeBackgroundRed() {
        RootPanel.get().addStyleName("red");
    }

    private void makeBackgroundNormal() {
        RootPanel.get().removeStyleName("red");
    }
}
```
public void onKeyUp(KeyUpEvent event) {
    String text =textfield.getText();
    if(text.equalsIgnoreCase("gwt")) {
        resultArea.setHTML("<span class='wow'>Wow!</span>");
        makeBackgroundRed();
    } else {
        resultArea.setHTML(text);
        makeBackgroundNormal();
    }
}

Can easily call methods in main class (even private ones), since onKeyUp is part of main class.

HTML
(Same As Before Except for JavaScript File Name)

...<link rel="stylesheet"
    href="./css/styles.css"
    type="text/css"/>
<script type="text/javascript" language="javascript"
    src="gwtevents2/gwtevents2.nocache.js"></script>
</head>
<body>
...
<table border="1">
    <tr><th>Input</th>
        <th>Result</th></tr>
    <tr><td id="textfieldID"></td>
        <td id="resultID"></td></tr>
</table><br/>
...

Left in from auto-generated code

ids match values passed to RootPanel.get in main Java class
Option 3: Named Inner Classes
Idea

• **Monitor a textfield**
  – Echo contents of textfield to table cell
  – If textfield contents match “gwt”, give special message

• **Approach**
  – Use inner class that extends KeyUpHandler

• **Advantages**
  – Same advantages as interface (access to main class data)
  – Plus, would work for abstract adapter classes
  – Scales well if you have multiple textfields with different behaviors

• **Disadvantages**
  – Little advantage (vs. implementing interface) if handler interface has only one method and you have only one textfield
    • Most GWT handlers have only one method
  – Slightly more complex than interface approach

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Main Class

```java
public class GwtEvents3 implements EntryPoint {
    private TextBox textfield;
    private HTML resultArea;

    public void onModuleLoad() {
        textfield = new TextBox();
        textfield.addKeyUpHandler(new WowHandler());
        resultArea = new HTML("<i>Result will go here</i>");
        RootPanel.get().addStyleName("tan");
        RootPanel.get("textfieldID").add(textfield);
        RootPanel.get("resultID").add(resultArea);
    }

    private void makeBackgroundRed() {
        RootPanel.get().addStyleName("red");
    }

    private void makeBackgroundNormal() {
        RootPanel.get().removeStyleName("red");
    }
}
```
private class WowHandler implements KeyUpHandler {
    public void onKeyUp(KeyUpEvent event) {
        String text = textfield.getText();
        if (text.equalsIgnoreCase("gwt")) {
            resultArea.setHTML("<span class='wow'>Wow!</span>");
            makeBackgroundColorRed();
        } else {
            resultArea.setHTML(text);
            makeBackgroundColorNormal();
        }
    }
}

<html>
<head>
    <link rel="stylesheet"
          href="./css/styles.css"
          type="text/css"/>
    <script language='javascript'
            src='coreservlets.GwtEventsApp3.nocache.js'>
    </script>
</head>
<body>
    ...
    <table border="1">
        <tr><th>Input</th><th>Result</th></tr>
        <tr><td id="textfieldID"></td><td id="resultID"></td>
    </table>
    ...
</body>
</html>
Option 4: Anonymous Inner Classes
Idea

- **Monitor a textfield**
  - Echo contents of textfield to table cell
  - If textfield contents match “gwt”, give special message

- **Approach**
  - Use anonymous inner class that extends KeyUpHandler

- **Advantages**
  - Same advantages as inner classes
  - Shorter

- **Disadvantages**
  - Handler cannot be reused for multiple controls
  - May have small performance penalties in resultant JavaScript if there are many anonymous inner classes

Main Class

```java
public class GwtEvents4 implements EntryPoint {
  private TextBox textfield;
  private HTML resultArea;

  private void makeBackgroundRed() {
    RootPanel.get().addStyleName("red");
  }

  private void makeBackgroundNormal() {
    RootPanel.get().removeStyleName("red");
  }
}
public void onModuleLoad() {
    textfield = new TextBox();
textfield.addKeyUpHandler(new KeyUpHandler() {
        public void onKeyUp(KeyUpEvent event) {
            String text = textfield.getText();
            if (text.equalsIgnoreCase("gwt")) {
                resultArea.setHTML("<span class='wow'>Wow!</span>"无可
makeBackgroundRed();
            } else {
                resultArea.setHTML(text);
                makeBackgroundNormal();
            }
        }
    });
    resultArea = new HTML("<i>Result will go here</i>"无可
RootPanel.get("textfieldID").add(textfield);
RootPanel.get("resultID").add(resultArea);
})
}

Inner-class code refers only to instance variables and new local
variables. If you refer to local variables of the outside code, those
variables must be declared final. This is not particular to GWT, but is
a general requirement in Java for anonymous inner classes.

This is also a perfect place for Java 8 lambdas, but sadly, the client-
side GWT code will not support Java 8 for foreseeable future.

Left in from auto-generated code
ids match values passed to RootPanel.get in main Java class
Basic Widgets and Their Handlers
Compatibility Note

• Early GWT versions
  – Used BlahListener (with Widget as argument)
    • ClickListener, FocusListener, etc.
  – Had a single keyboard listener
    • KeyboardListener

• Recent GWT versions (GWT 1.5+)
  – Use BlahHandler (with BlahEvent as argument)
    • ClickHandler, FocusHandler, etc.
  – Have multiple keyboard listeners
    • KeyUpHandler, KeyDownHandler, KeyPressHandler

• GXT (from extjs.com)
  – Called BlahListener, but more closely follows the GWT 1.5 approach

Button and PushButton

• Purpose
  – To initiate an action
    • Button is normal HTML button
    • PushButton is custom image button

• Main handler
  – ClickHandler
    • onClick(ClickEvent event)

• Auxiliary handlers
  – FocusHandler
    • onFocus(Widget sender)
  – KeyDownHandler, KeyUpHandler, KeyPressHandler
    • onKeyDown, onKeyUp, onKeyPress (see TextBox)
**CheckBox, ToggleButton, and RadioButton**

- **Purpose**
  - To choose between two options  
    - CheckBox, ToggleButton
  - To choose among several options  
    - RadioButton

- **Main handler**
  - ClickHandler
    - onClick(ClickEvent event)

- **Auxiliary handlers**
  - FocusHandler
    - onFocus(FocusEvent event)
  - KeyDownHandler, KeyUpHandler, KeyPressHandler
    - onKeyDown, onKeyUp, onKeyPress (see TextBox)

**ListBox**

- **Purpose**
  - To choose one of options from list  
    - new ListBox(false)
  - To choose several of options from list  
    - new ListBox(true)

- **Main handler**
  - ChangeHandler
    - onChange(ChangeEvent event)

- **Auxiliary handlers**
  - ClickHandler
  - FocusHandler
  - KeyDownHandler, KeyUpHandler, KeyPressHandler
TextBox, PasswordTextBox, TextArea, SuggestBox

• **Purpose**
  – To collect text

• **Main handlers**
  – KeyDownHandler, KeyUpHandler, KeyPressHandler
    • onKeyDown(KeyDownEvent event)
    • onKeyUp(KeyUpEvent event)
    • onKeyPress(KeyPressEvent event)

• **Auxiliary handlers**
  – ChangeHandler
  – ClickHandler
  – FocusHandler

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**Wrap-Up**
Summary

• **Separate handler classes**
  – Pro: more modular (use interfaces to decouple)
  – Cons: hard to call code in main app
  – Least common approach

• **Main class implementing handler interface**
  – Pro: easy to call code in main app
  – Cons: harder if multiple methods in interface or multiple controls
  – Easiest when interface has one method and I am handling only one control with that event type

• **Named inner classes**
  – Pro: good if you have multiple textfields with different behaviors
  – Cons: slightly more complex
  – My favorite when interface has multiple methods or when handling multiple controls with the same event types. My overall favorite.

• **Anonymous inner classes**
  – Pro: short and succinct
  – Cons: more complex, small performance penalty in some cases
  – Favorite approach of many Swing, SWT, and Android developers

Questions?

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