DB Programming - Cont

Database Systems

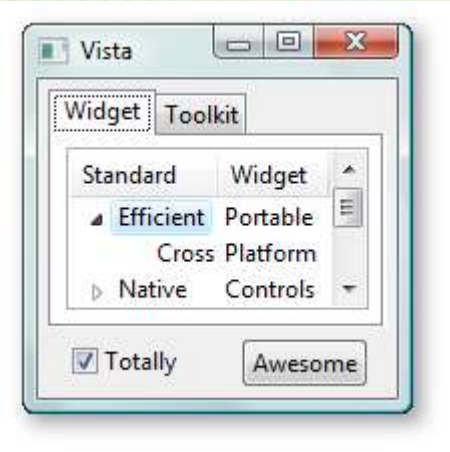
Agenda

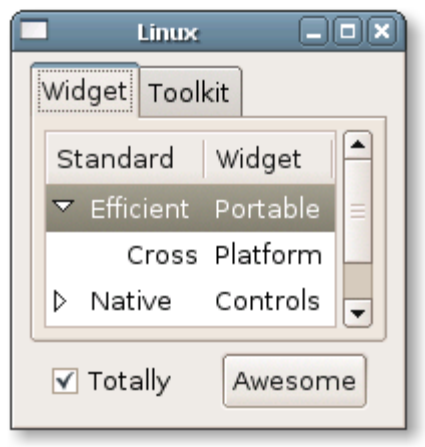
- SWT
- Updating the UI (Why do we need Threads?)

SWT (Standard Widget Toolkit)

- Developed by IBM, maintained today by Eclipse
- Easy implementation
- Not portable – requires implementation for each platform. BUT, all major platforms has one ☺
  → "LCD" fixed ☺
- Had performance issues, but today they are fixed ☺

SWT - Takes the look of the OS





Using the SWT package

- Same as always:
  - Add the right swt.jar (Windows/Linux/OS X)
    (http://www.eclipse.org/swt/)
  - `import org.eclipse.swt.widgets…`
- (same as “installing” JDBC)

Widgets

- Widget is the “UI element” (window, button, icon…)
- When creating a Widget, we need to supply its parent
- Every Widget needs to be disposed when done. →Luckily, disposing the parents disposes of its Children

Hello World


```
import org.eclipse.swt.widgets.*;

public class HelloWorldAlone {

        public static void main(String[] args) {
                Display display = new Display();
                Shell shell = new Shell(display);
                shell.setText("Hello World");
                shell.setSize(300, 100);

                shell.open();

                while (!shell.isDisposed()) {
                        if (!display.readAndDispatch()) {
                                display.sleep();
                        }
                }

                display.dispose();
        }

}
```

Hello World – A few more words

- Shell is the main window. As any widget, it must have a parent:
  → Display (connection to the OS)

- If you do not keep the shell open (listening to events) the program immediately terminates

- We can extract the event loop to a utility class

SWTUtill

```
import org.eclipse.swt.widgets.*;

public class SWTUtil {
	private static Display display = new Display();

	public static Shell getShell(){
		Shell shell = new Shell(display);
		return shell;
	}

	public static void openShell(Shell shell) {
		shell.open();
		while (!shell.isDisposed()) {
			if (!display.readAndDispatch()) {
				display.sleep();
			}
		}
		display.dispose();
	}

}
```

Hello World (with SWTUtill)

```
import org.eclipse.swt.widgets.*;

public class HelloWorld {

	public static void main(String[] args) {
		Shell shell = SWTUtil.getShell();
		shell.setText("Hello World");
		shell.setSize(300, 100);

		SWTUtil.openShell(shell);
	}
}
```

More on Widgets

- Widgets are created by:
  → Specifying parent
  → Specifying style

- A parent is the container inside which the widget is created (e.g. Shell)

- Styles can be specified by constants from the SWT class (`SWT.BORDER, SWT.LEFT, SWT.NONE ...`)

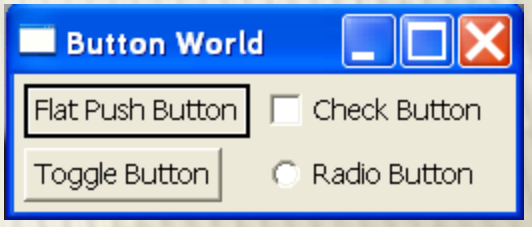
- Multiple styles can be joined with "|"
  `SWT.V_SCROLL|SWT.H_SCROLL| SWT.BORDER`

Label

(javadocs)


```
Shell shell = SWTUtil.getShell();
shell.setText("Label World");
shell.setLayout(new GridLayout()); // layouts are explained later

// Create labels
new Label(shell, SWT.NONE).setText("Regular label");
new Label(shell, SWT.SEPARATOR);
new Label(shell, SWT.SEPARATOR|SWT.HORIZONTAL);

// pack and show
shell.pack();
SWTUtil.openShell(shell);
```

Button

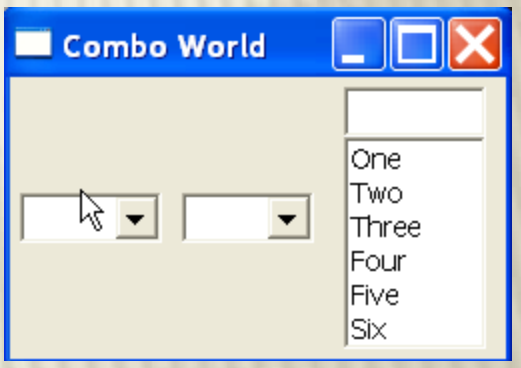


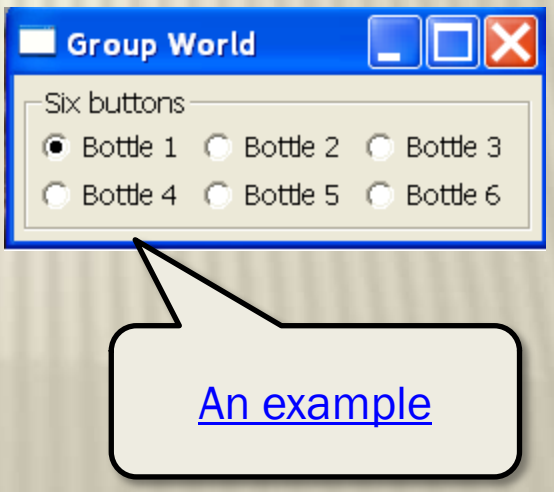
(javadocs)

```
shell.setText("Button World");
shell.setLayout(new GridLayout(2, true)); // layouts are
explained later

new Button(shell, SWT.PUSH | SWT.FLAT).setText("Flat Push
Button");
new Button(shell, SWT.CHECK).setText("Check Button");
new Button(shell, SWT.TOGGLE).setText("Toggle Button");
new Button(shell, SWT.RADIO).setText("Radio Button");
```

Some more Widgets

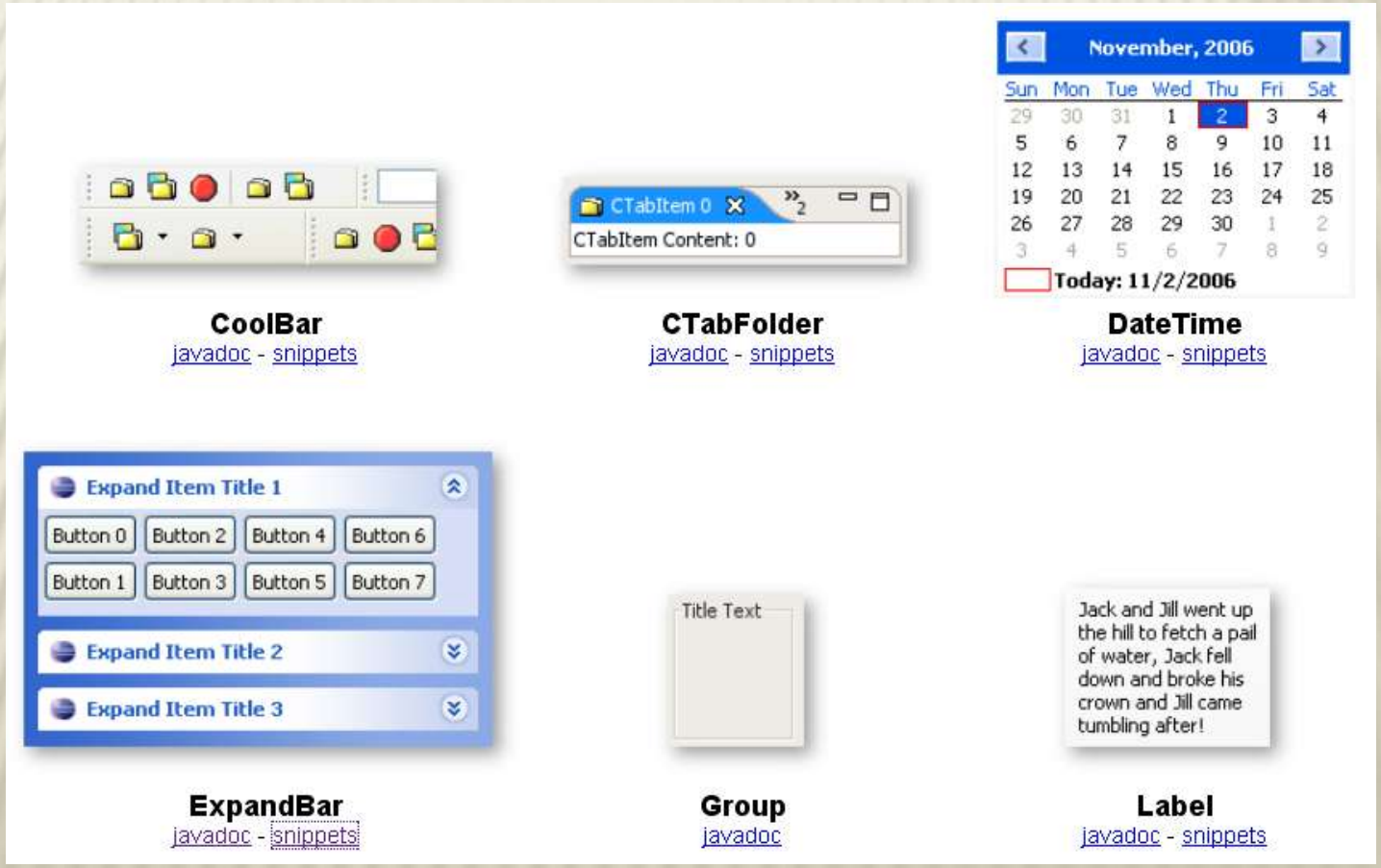
- Take a look at the SWT Tutorial PPT (on the course slides page)





Some more Widgets (2)

- http://www.eclipse.org/swt/widgets/



CoolBar
javadoc - snippets

CTabFolder
javadoc - snippets

DateTime
javadoc - snippets

ExpandBar
javadoc - snippets

Group
javadoc

Label
javadoc - snippets

Some more Widgets (3)

- http://www.eclipse.org/swt/widgets/

Layouts

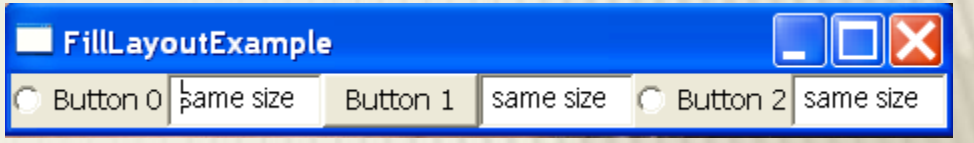
- First introduced in AWT
- Ease burden of laying out components
- SWT offers 5 layouts:
  - FillLayout
  - RowLayout
  - GridLayout
  - FormLayout
  - (*) Stack Layout

- http://www.eclipse.org/articles/article.php?file=Article-Understanding-Layouts/index.html

FillLayout

- Places all widgets in either a single column or row (SWT.VERTICAL,SWT.HORIZONTAL)
- Makes all widgets the same size

FillLayout

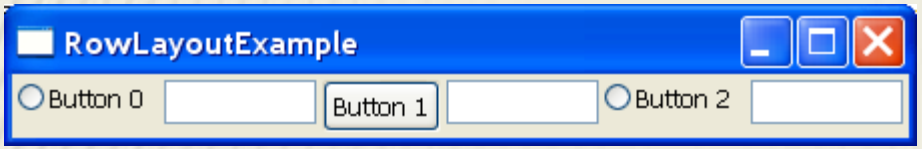


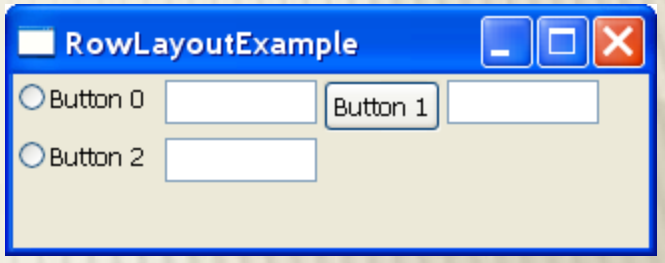

```
shell.setLayout(new FillLayout(SWT.HORIZONTAL));

for(int i = 0; i < 3; i ++) {
   new Button(shell,
        (i % 2 == 0) ? SWT.RADIO : SWT.PUSH).setText("Button " + i);
   new Text(shell, SWT.BORDER).setText("same size");
}
```

RowLayout

- Places all widgets in either a single column or row (SWT.VERTICAL,SWT.HORIZONTAL)
- Doesn't force all widgets to be the same size
- Can wrap to a new row or column if it runs out of space
- Can use **RowData** objects to determine initial heights/widths for controls

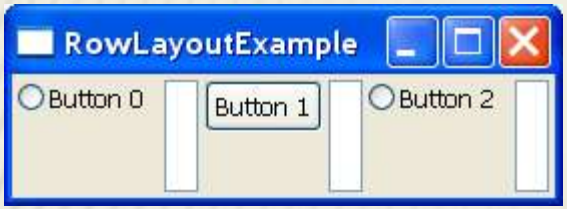
RowLayout

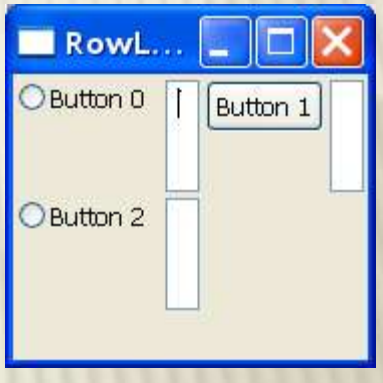





```
shell.setLayout(new RowLayout(SWT.HORIZONTAL));

for(int i = 0; i < 3; i ++) {
   new Button(shell,
        (i % 2 == 0) ? SWT.RADIO : SWT.PUSH).setText("Button " + i);
   new Text(shell, SWT.BORDER);
}
```

RowLayout

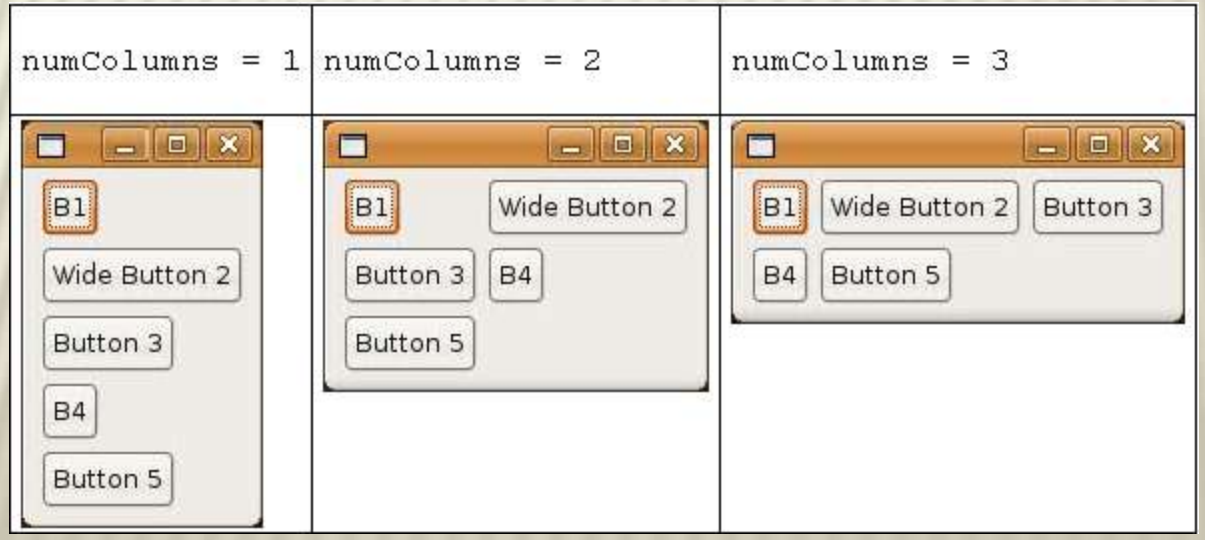





```
shell.setLayout(new RowLayout(SWT.HORIZONTAL));

for(int i = 0; i < 3; i ++) {
   new Button(shell,
        (i % 2 == 0) ? SWT.RADIO : SWT.PUSH).setText("Button " + i);
   new Text(shell, SWT.BORDER).setLayoutData(new RowData(5, 50));
}
```

GridLayout

- Lays out controls in a grid
- Added from left to right, new row is created when numColumns + 1 Widgets are added



GridLayout – Main Properties

- `int horizontalSpacing` – horizontal space in pixels between adjacent cells
- `int verticalSpacing` – vertical space in pixels between adjacent cells
- `boolean makeColumnsEqualWidth` – forces all columns to be same width
- `int marginWidth` – margin in pixels along right and left edges
- `int marginHeight` – margin in pixels along top and bottom edges
- `int numColumns` – number of columns for the layout

GridData

- Provides better control..
  `widget.setLayoutData(GridData)`
- Lots of options…check the API
- Warning for Swing programmers – DO NOT TRY TO REUSE GridData objects
  (simply create new for each widget)

GridData - Example

`horizontalAlignment = GridData.BEGINNING` (default)	
`horizontalAlignment = GridData.CENTER`	
`horizontalAlignment = GridData.END`	
`horizontalAlignment = GridData.FILL`	

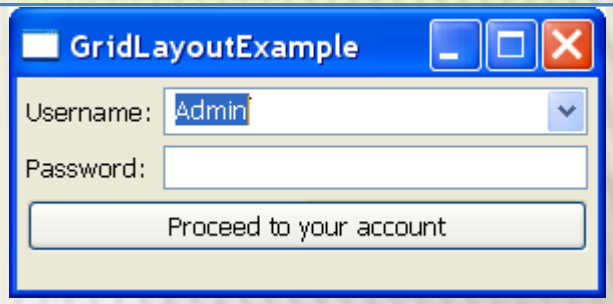
Another Example

```
GridData gridData = new GridData();
gridData.horizontalAlignment = GridData.FILL;
gridData.horizontalSpan = 2;
button5.setLayoutData(gridData);
```


```
GridData gridData = new GridData();
gridData.horizontalAlignment = GridData.FILL;
gridData.horizontalSpan = 2;
button2.setLayoutData(gridData);
```

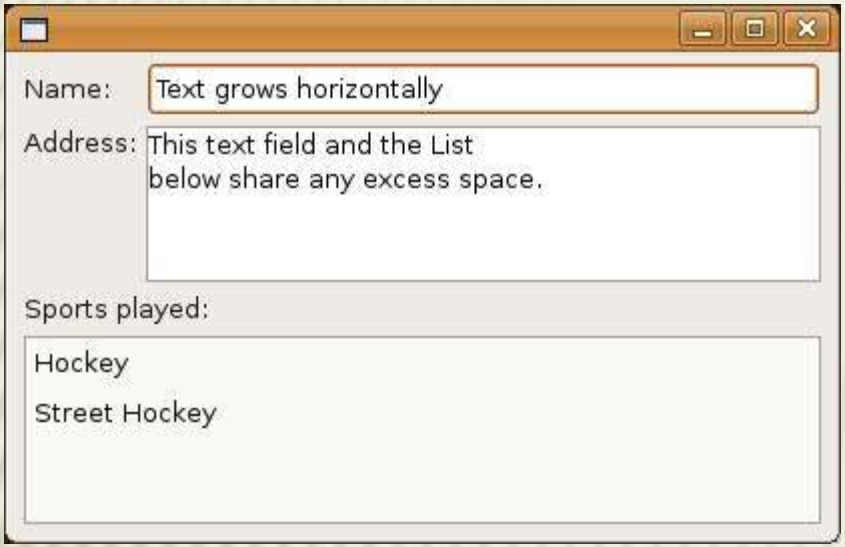

```
GridData gridData = new GridData();
gridData.verticalAlignment = GridData.FILL;
gridData.verticalSpan = 2;
button3.setLayoutData(gridData);
```

Another Example




```
shell.setLayout(new GridLayout(2, false));


new Label(shell, SWT.NONE).setText("Username:");
Combo cmbUsername = new Combo(shell, SWT.DROP_DOWN);
cmbUsername.setLayoutData(new GridData(GridData.FILL_HORIZONTAL));
cmbUsername.setItems(new String[]{"Howard", "Admin", "Kalman"});
cmbUsername.setText("Admin");

new Label(shell, SWT.NONE).setText("Password:");
new Text(shell, SWT.BORDER | SWT.PASSWORD).setLayoutData(new
      GridData(GridData.FILL_HORIZONTAL));

Button loginButton = new Button(shell, SWT.PUSH | SWT.FLAT);
loginButton.setText("Proceed to your account");
GridData data = new GridData(GridData.FILL_HORIZONTAL);
data.horizontalSpan = 2; // span 2 columns
loginButton.setLayoutData(data);
```

Google for other examples



- http://www.eclipse.org/articles/article.php?file=Article-Understanding-Layouts/index.html

Event Handling

- **Listener** is basically an interface that defines when certain behaviors happen
- **Listeners** are attached to widgets
- **Adapters** implements the interfaces

Popular Listeners / Adapters

- *FocusListener/FocusAdapter* – listens for focus gained and focus lost events
- *KeyListener/KeyAdapter* – listens for key presses and releases
- *ModifyListener*(only has 1 method) – listens for text modifications
- *VerifyListener* – listens for (and potentially intercepts) text modifications
- *MouseListener/MouseAdapter* – listens for mouse button presses
- *SelectionListener/SelectionAdapter* – listens for selection events, for example button presses (similar to ActionListener in Swing)

Simple Example

```
Button loginButton = new Button(shell, SWT.PUSH |
   SWT.FLAT);
loginButton.setText("Click me!");
loginButton.addSelectionListener(new SelectionAdapter() {
   public void widgetSelected(SelectionEvent e) {
        System.out.println("Clicked!");
   }
});
```

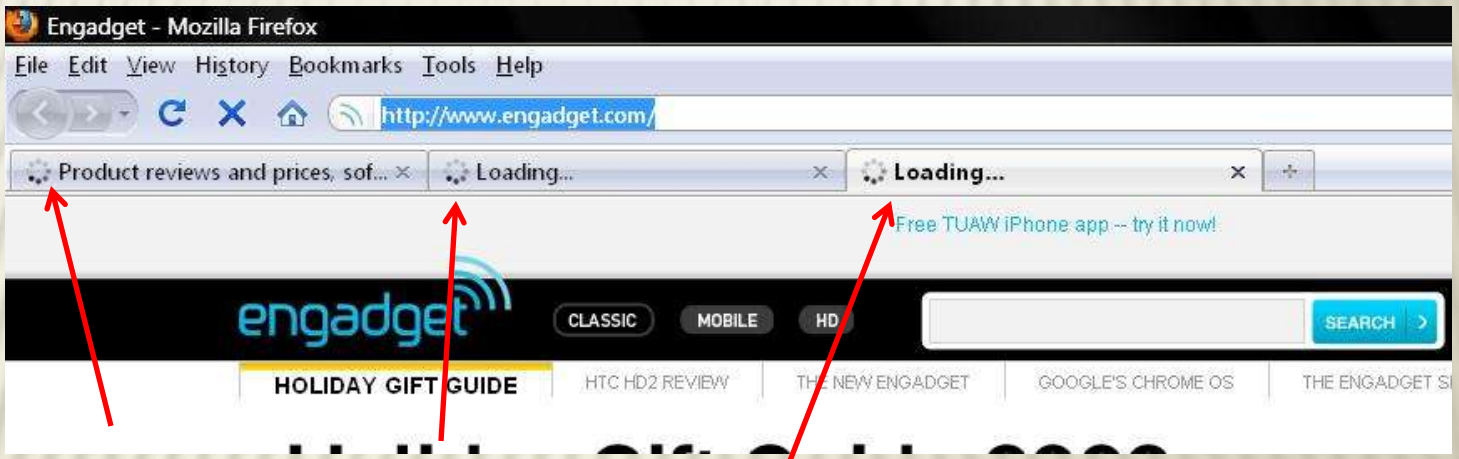
Agenda

- SWT
- Updating the UI (Why do we need Threads?)

Why do we need threads??

We need threads to support:

- Multitask applications



- Long task applications (with GUI)

Threads

- Context Switch / Interrupt
- Threads vs. Cores (CPUs)
- Threads vs. Processes
  (Memory space, “Locking”, Lightweight)

Implementing Threads in Java

2 Options:

- Implement the Runnable interface: myImpl
  → "create a 'thread class' and pass myImpl"

- Extend the Thread class: myClass
  → "create your myClass and start() it

Locks??

- Why do we need them??
- No “Mutex”..
- Define a function as synchronized
  → only one thread at a time can “enter it”
  → per object or per class

More on Java & Threads

Read the links:

- http://www.javabeginner.com/learn-java/java-threads-tutorial

- http://docs.oracle.com/javase/tutorial/essential/concurrency/index.html

Threads in SWT: Lets start from the end...

- In SWT the UI (widgets)
  can only be updated from the UI thread
  = the one thread that executes the event loop,
  usually this is the main thread.

- For any other thread, use:
  - syncExec(Runnable)
  - asyncExec(Runnable)

Going Back, Example for updating UI

```
final Text text = new Text(shell, SWT.BORDER);
text.setLayoutData(new
      GridData(GridData.FILL_HORIZONTAL));

Button button = new Button(shell, SWT.PUSH | SWT.FLAT);
button.setText("Click Me");

button.addSelectionListener(new SelectionAdapter() {
      public void widgetSelected(SelectionEvent e) {
          text.setText(getName());
      }
});
```

Blocking function

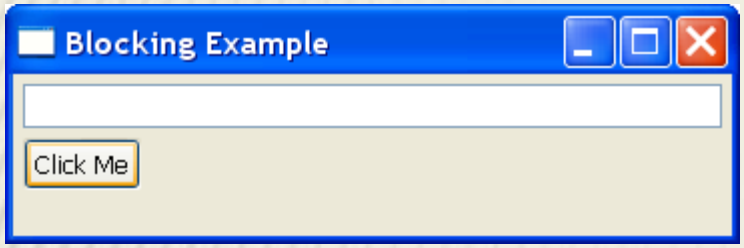
- “A function that takes a long time to return..”

- Example:
  - While (i<100000000){...}
  - DB calls
  - Network communications

Blocking Function + UI

- The UI is repeatedly “drawn” by the UI thread
- The triggered events (e.g. button click) are executed by the drawing thread
- If the thread is **blocked** for a while, then it can’t draw the UI and the program is “stuck”

Blocking Function + UI



Solution – Threads

- Use a different thread to calculate `getName()`

```
public void widgetSelected(SelectionEvent e) {
      text.setText(getName());
      // create a thread to calculate getName()
}
```

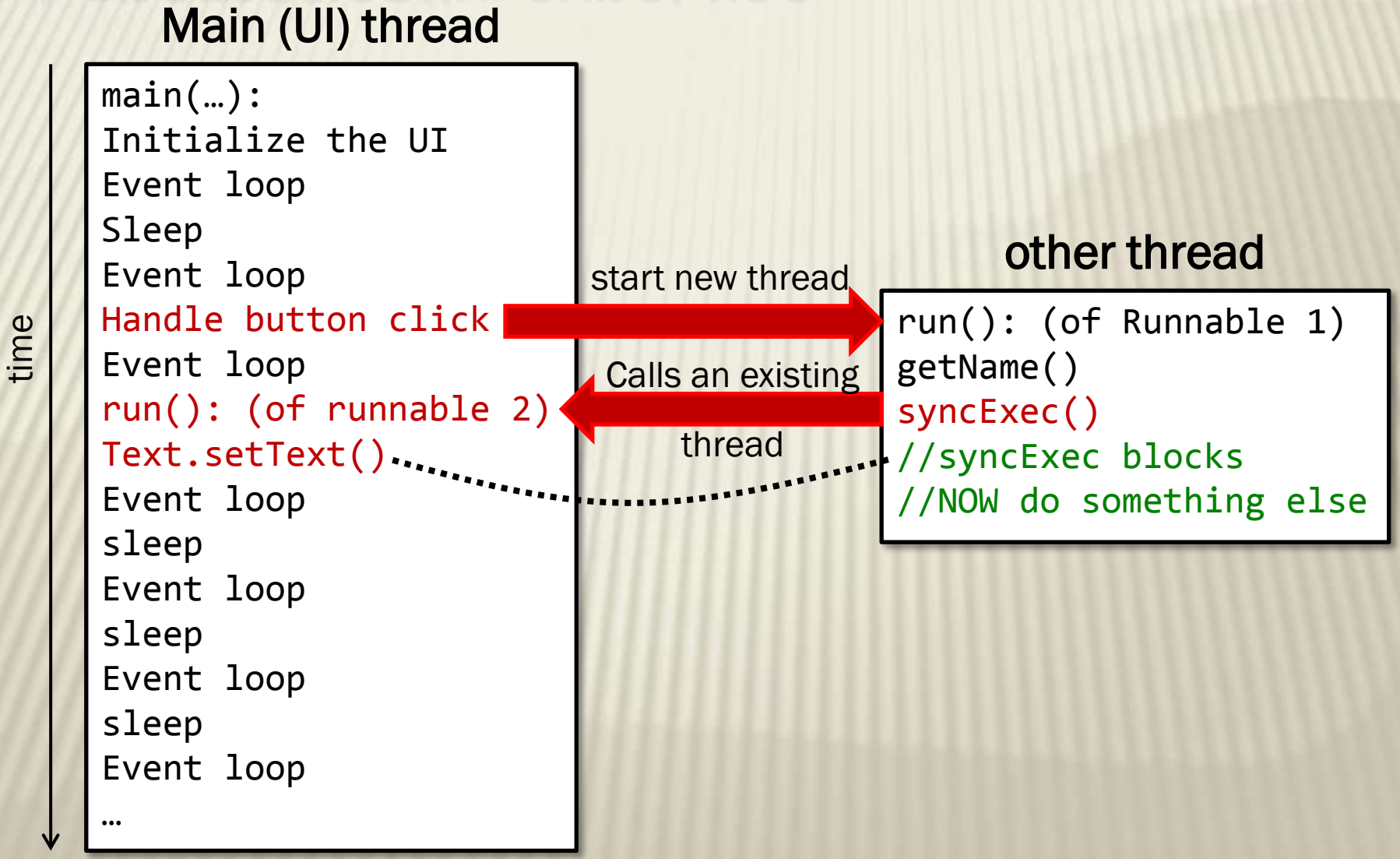
- But who will call `text.setText(...)`?

Setting the UI from a different Thread

- You CANNOT call `text.setText(...)` from the new thread – it is not the UI thread! (Exception…)
- Use:
  - `syncExec(Runnable)`
  - `asyncExec(Runnable)`
- The implementation of the `run()` method in `Runnable` will call `text.setText(...)`.
- The `sync` blocks until the UI thread updates the UI

Schematically: asyncExec

Schematically: syncExec



Setting the UI from a different Thread

```
display.asyncExec(new Runnable() {
      public void run() {
            text.setText(...);
      }
});
```

Example of Non-Blocking Functions (1)

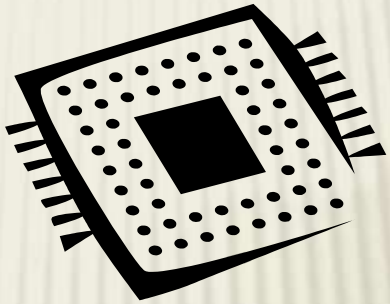
(there are many ways, this is just one)

- Implement a pool of Threads
- Implement a queue of “requests”
- The results of the function will be returned by the pooled thread

Example of Non-Blocking Functions (2)

getLongOperation1()

The function returns immediately with a request id



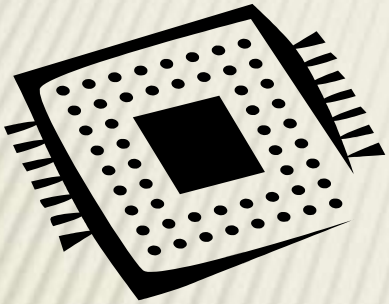
int getLongOperation1()

requestID = “Generate unique ID”
addRequestToQueue(“LongOperation1”, requestID)
return requestID

addRequestToQueue(operation, requestID)

queue.add(operation)
wakeUpThreads

Example of Non-Blocking Functions (3)



returnLongOperation1Results()

AfterThreadIsAwake()

"Get top request from the queue"

"Process the request"

"return the results to the GUI" →:

gui.returnOperationResults(operation, requestID)

Example of Non-Blocking Functions (4)

- You can use Java's thread pool / executor
  http://docs.oracle.com/javase/tutorial/essential/concurrency/executors.html

  (The Fork/Join is NOT for you..)

- Many implementation details are left for you to resolve
  - How to return the answer
    (How to notify the GUI)
  - How to represents tasks (Constants / Objects)

Bad examples

- The following next slides are examples for what NOT-TO-DO when you write an application (your project, in particular!).
- Based on last years submissions.

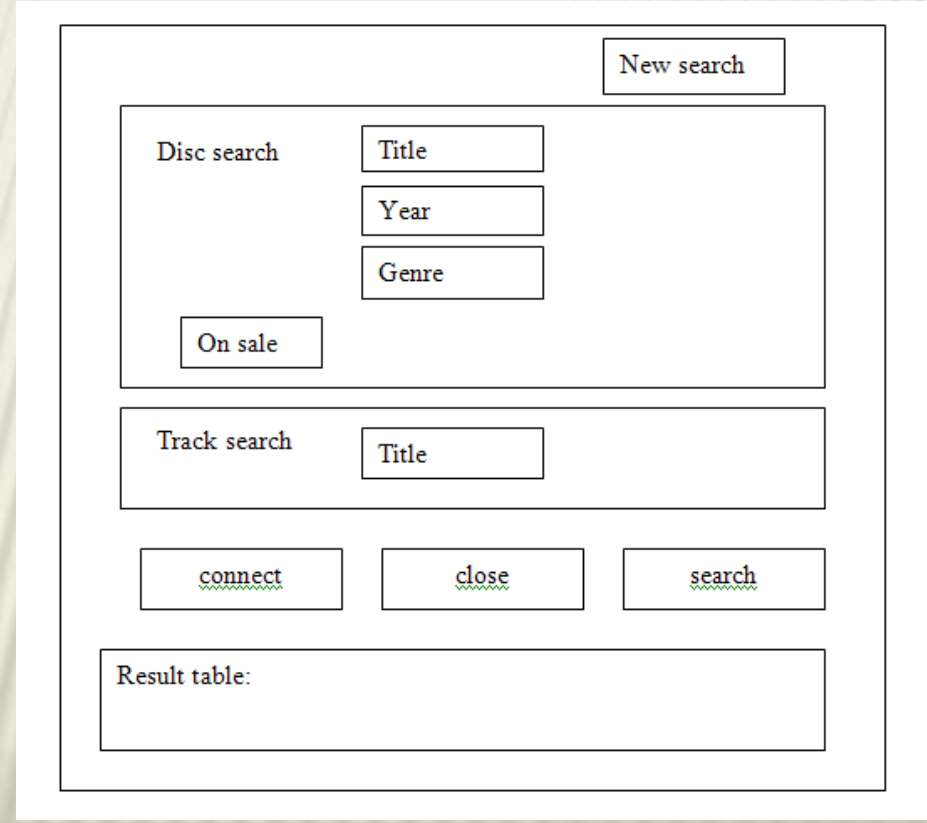
Bad examples: Usability

- “non-refreshed” windows
- “Hanging” windows

- Instead:“Please wait, your query may take a couple of minutes…”, progress bar, etc.

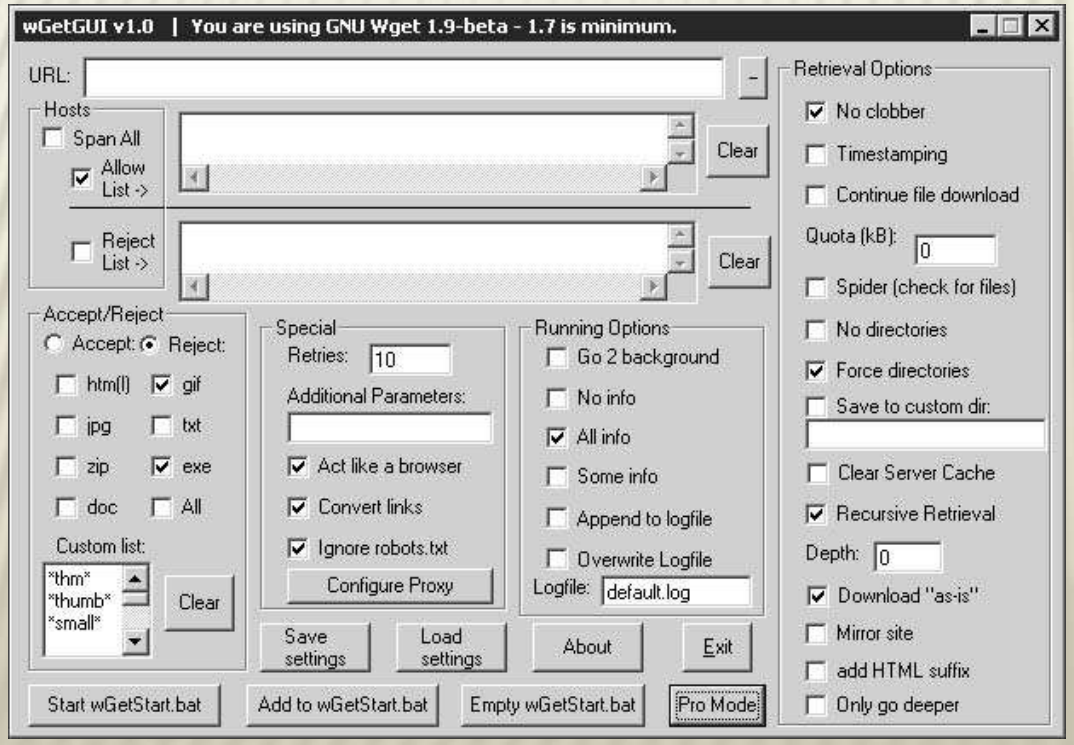
Bad examples: Usability

- Window layout should be clear and intuitive



Bad examples: Usability

- Window layout should not be overloaded
  - Use tabs, pop-up dialogs, drop down menus…



http://www.ssw.com.au/ssw/Standards/Rules/RulesToBetterinterfaces.aspx