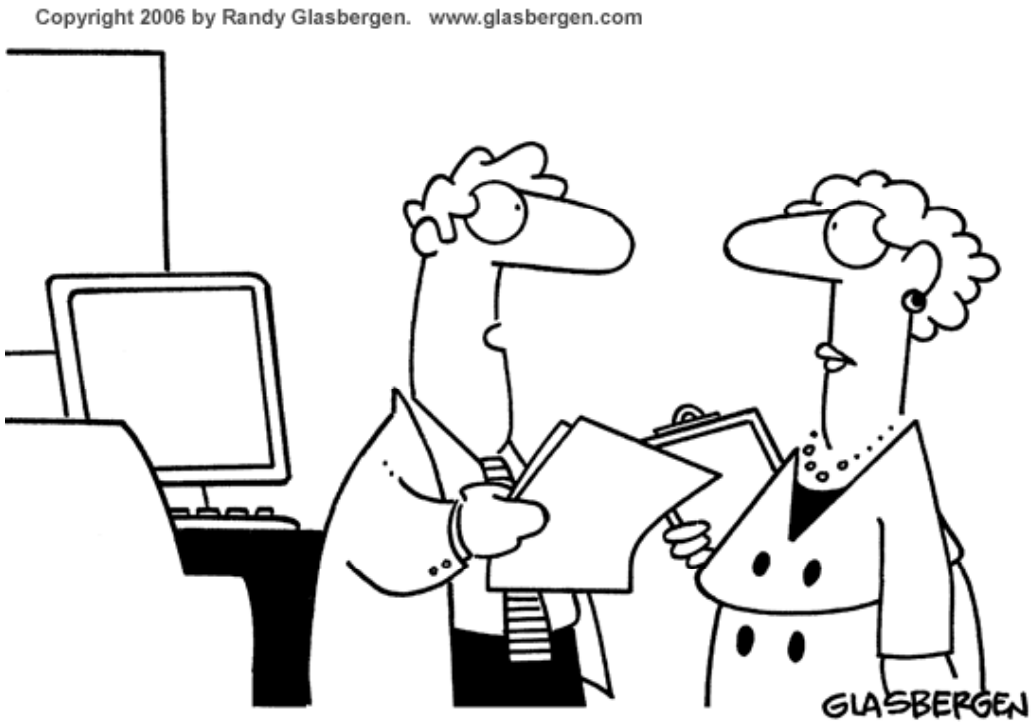
# Web Applications

and

# Struts 2

# Problem area



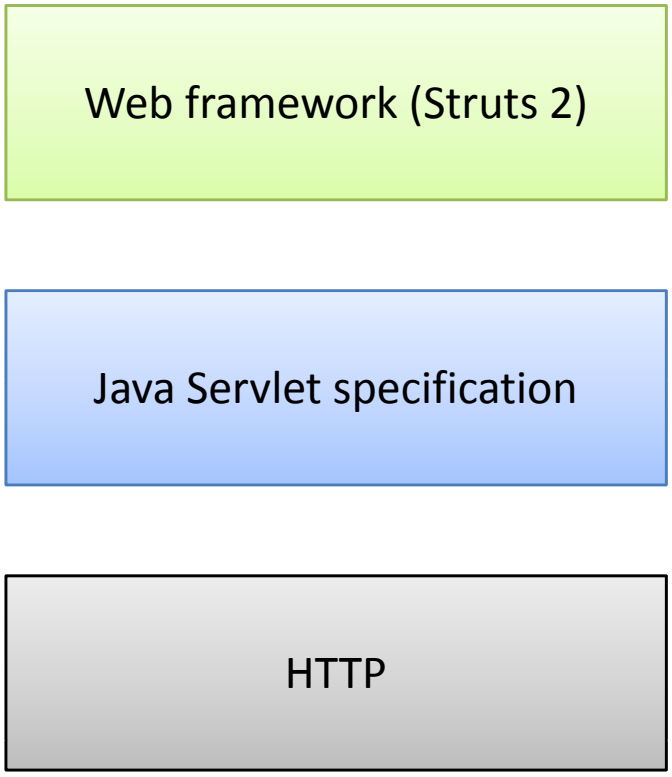

**"My team has created a very innovative solution, but we're still looking for a problem to go with it."**

# Problem area

- Separation of application logic and markup
  - Easier to change and maintain
  - Easier to re-use
  - Less error prone
- Access to functionality to solve routine needs
  - Data transfer between client (HTTP) and server (Java)
  - Validation
  - Internationalization
  - User interface components (tags)

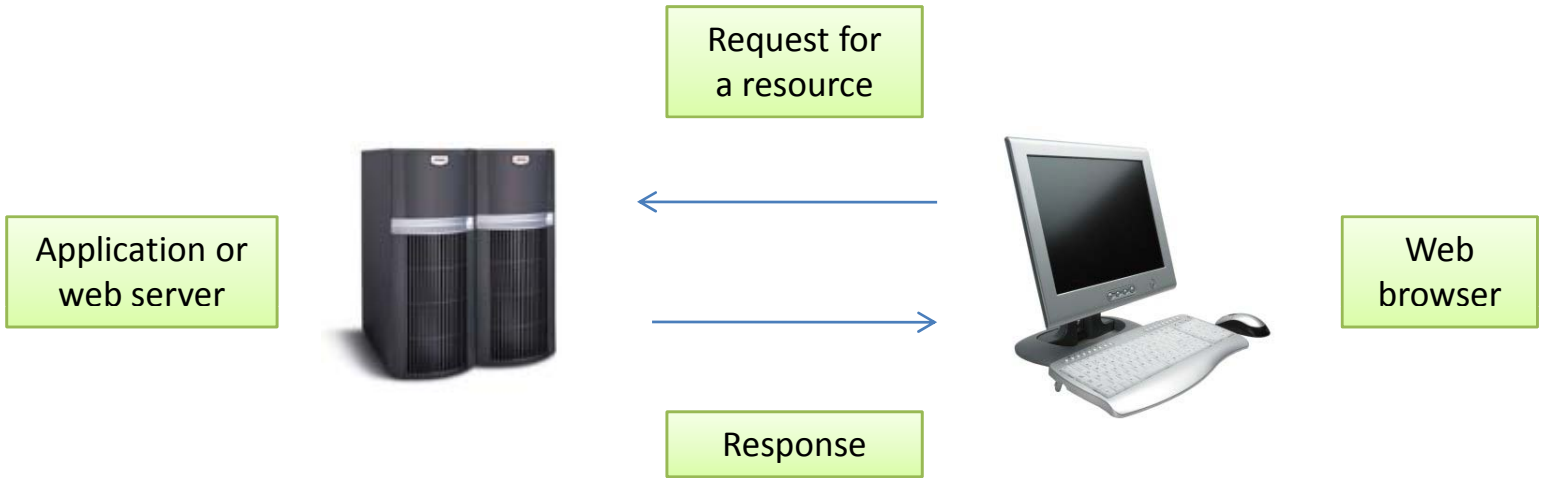
# Web applications

- Struts 2 sits on top of two important technologies



# Hypertext Transfer Protocol (HTTP)

- Series of client-server message exchanges
- Designed for static HTML rather than dynamic
  - Stateless (how to do things like authentication?)
  - Text  based (how to map to and from Java types?)



# Java Servlet specification


- Provides intuitive object-oriented abstraction of HTTP:
- Servlet (HttpServlet)
  - Small Java program
  - Receive and respond to requests from Web clients
- Request (HttpRequest)
  - Object representing a client request
  - Access to parameters, request URL, input stream…
- Response (HttpResponse)
  - Object representing a server response
  - Access to content type, header, writer…

# Java Servlet specification


- Session
  - Provides a session between multiple requests
  - Usually corresponds to a user
  - Allows Servlets to bind objects and manipulate information

- Filter
  - Performs filtering on request sand/or responses
  - Configured in web.xml
  - Useful for authentication, logging…

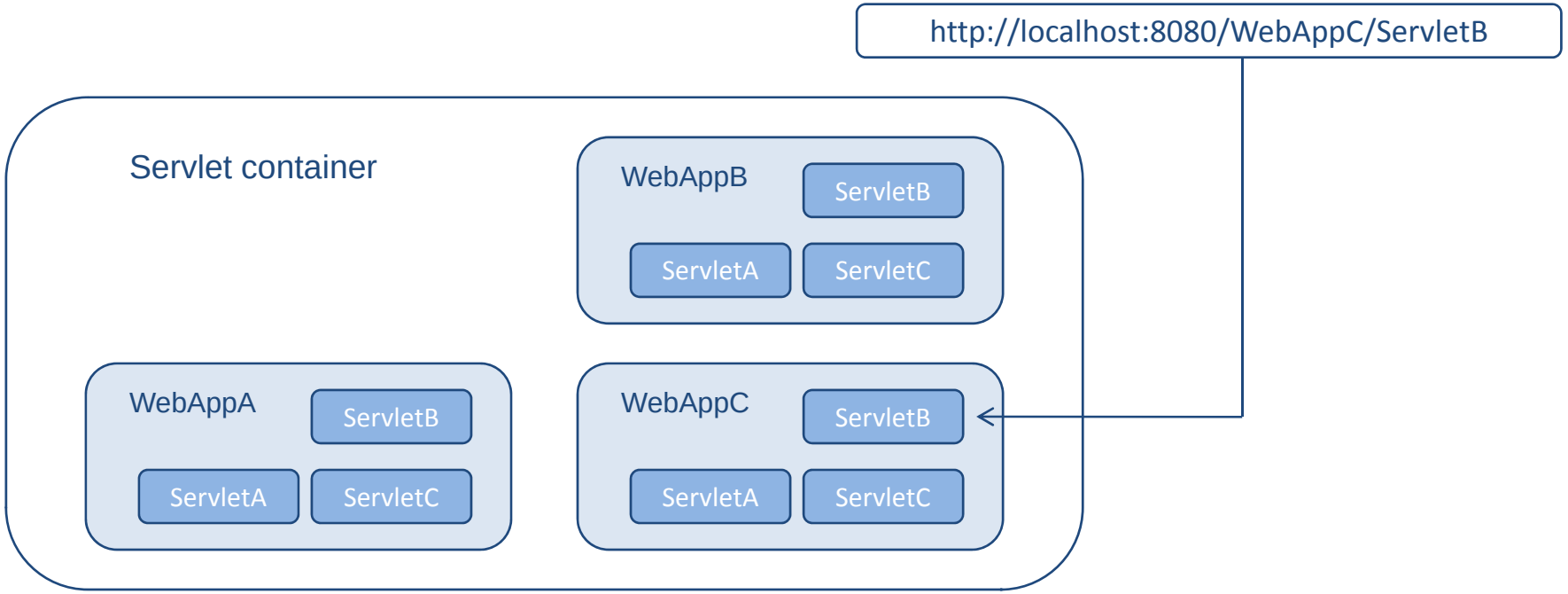
# Web application archive


- Servlets are packaged into web applications as *WAR-files*
  - Zip file with a specific structure
- Contains:
  - Servlets
  - Java classes
  - Web resources (HTML, CSS, templates, images)
  - Dependent libraries (JARs)

| | |
|---|---|
| / | Web resources (HTML, CSS, templates, images) |
| /WEB-INF | Private files (not returned by Web server) |
| /WEB-INF/web.xml | Deployment descriptor / configuration file |
| /WEB-INF/classes | Java classes |
| /WEB-INF/lib | Depdendent libraries / JARs |

# Servlet container


- Web applications are deployed in *Servlet containers*
  - Implementation of the Servlet specification
  - Web server able to run and manage the life-cycle of servlets
  - Popular open-source versions are *Tomcat* and *Jetty*



# Purpose of Web frameworks

- Solving application level concerns / routine work!
  - Binding request parameters to Java types
  - Validating data
  - Providing internationalization
  - Rendering presentation layer (HTML etc)
  - Making calls to business layer

# Action classes

- Purposes
  - Encapsulates the work to be done for a request
  - Serve as data carrier in transfer from request to view
  - Determine which result should render the view

```
public class InvertStringAction implements Action
{
    private String word;
    // set-method

    private String invertedWord;
    // get-method

    public String execute()
    {
        if ( word == null || word.trim().length() == 0 )
        {
            return INPUT;
        }

        invertedWord = getInvertedWord(); // implemented another place

        return SUCCESS;
    }
}
```

# Action classes

- ActionSupport: Abstract  convenience class providing:
  - Validation
  - Internationalization
- Works together with interceptors in the default stack

- ActionContext: Container holding relevant data for a request:
  - ValueStack
  - Request parameters
  - Session variables
  - Application attributes

# ModelDriven Actions

- Transfers data directly onto model objects
  - Avoids tedious object creation code
- Provided by interface *ModelDriven<T>*
  - Exposes method *T getModel()*

# ModelDriven Actions

Class extending ActionSupport and implementing ModelDriven

Student instance created

getModel implemented

Student object populated with data and ready to use

Don’t change object reference!

Data will be availabe in view

```
public class SaveStudent
   extends ActionSupport implements ModelDriven<Student>
{
   private Student student = new Student();

   public Student getModel()
   {
      return student;
   }

   private StudentService studentService = // retrieved somehow

   public String execute()
   {
      studentService.saveStudent( student );

      return SUCCESS;
   }
}
```

# Validation

- Basic validation accessible from ActionContext
- The *DefaultWorkFlowInterceptor* works behind the scenes
- Separates validation logic from business logic

# Validation

Class extending ActionSupport

Java bean properties

Validate method containing logic for checking validity of data

Storing errors via methods provided by ActionSupport

Validation workflow separated from execution

Execute method containing logic

```
public class CalculateAction extends ActionSupport
{
    private Integer numerator;
    private Integer denominator;
    // set-methods

    private Double result;
    // get-method

    public void validate()
    {
        if ( denominator == null )
        {
            addFieldError( ”denominator”, ”Please enter a numerator” );
        }
        elseif ( denominator == 0 )
        {
            addFieldError( ”denominator”, ”Divison by zero not allowed” );
        }
    }

    public String execute()
    {
        result = // calculate somehow
    }
}
```

# Validation

Input result is used when validation errors exist

```
<action name=”calcuate” class=”no.uio.inf5750.example.action.CalculateAction”>
    <result name=”success” type=”velocity”>calculate.vm</result>
    <result name=”input” type=”velocity”>calculate.vm</result>
</action>
```

Validation error messages printed for appropriate UI tag in view

```
<html>
<body>

#sform( "action=calculate" )
    #stextfield( "label=Numerator" "name=numerator" )
    #stextfield( "label=Denominator" "name=denominator" )
    #ssubmit( "value=Calculate" )
  #end

</body>
</html>
```

# Internationalization

- Separation layer between source code and messages
- Built upon Java resource bundles, which will be found in:
  - Same package and with same name as Action class
  - Classpath after setting *struts.custom.i18n.resources* config property
- Messages accessible in Java code through *getText(..)*
- Locale accessible in Java code through *getLocale()*
- Messages accessible in template through *key* and *name* properties of UI tags

# Internationalization

struts.xml configuration

```
<constant name="struts.custom.i18n.resources" value="i18n.i18n" />
```

i18n.properties in i18n folder on classpath

```
salute=Bonjour!
```

Action class using getText(..) and getLocale()

```
Public class SaluteAction extends ActionSupport
{
   public String execute()
   {
      String salute = getText( ”salute” );
      Locale locale = getLocale();
      return SUCCESS;
   }
}
```

Velocity template using text tag

```
<h3>#stext( "name=salute" )</h3>
```

# UI component tags

- High level tag API implemented in:
  - JSP
  - Velocity (used in this lecture)
  - Freemarker

- Data tags
  - Moves data between the ValueStack and the view
- Control tags
  - Alters the rendering flow of the view
- UI tags
  - Provides advanced HTML form controls

# Spring integration

- Useful to apply *dependency injection* to a Struts 2 application
  - *Struts 2 Spring plugin* is required (struts2-spring-plugin)
  - Spring must be started in web.xml with *ContextLoaderListener*
- Approach 1: Define dependencies and action classes in Spring
  - *Class* attribute in Struts 2 config will point at Spring bean identifiers
- Approach 2: Use auto-wiring by name
  - Struts 2 will instantiate Actions but let Spring inject beans afterwards
  - Bean identifiers are matched to set-methods in Actions

# Auto-wiring dependencies by name

Only the StudentService bean is defined in the configuration

```
<bean id="studentService" class="no.uio.inf5750.model.DefaultStudentService"/>
```

Action class provides StudentService property and set-method

Name of set-method is matched with Spring bean identifiers

```
public class SaveStudentAction extends ActionSupport
{
    private StudentService studentService;

    public voic setStudentService( StudentService studentService )
    {
        this.studentService = studentService;
    }

    // Student properties and setters

    public String execute()
    {
        studentService.saveStudent( student );
    }
}
```

# Summary

- Struts 2 is built upon the Java Servlet specification which is built upon HTTP
- Struts 2 solves application level routine work not provided by the Servlet specifiction
  - Binding request params to Java types
  - Validating data
  - Providing internationalization
  - Rendering presentation layer
  - Making calls to business layer

# Resources

- Brown, Davis, Stanlick: *Struts 2 in Action*
- Velocity user guide:
  - http://velocity.apache.org/engine/devel/user-guide.html
- Struts home page:
  - http://struts.apache.org
- Example code on course homepage