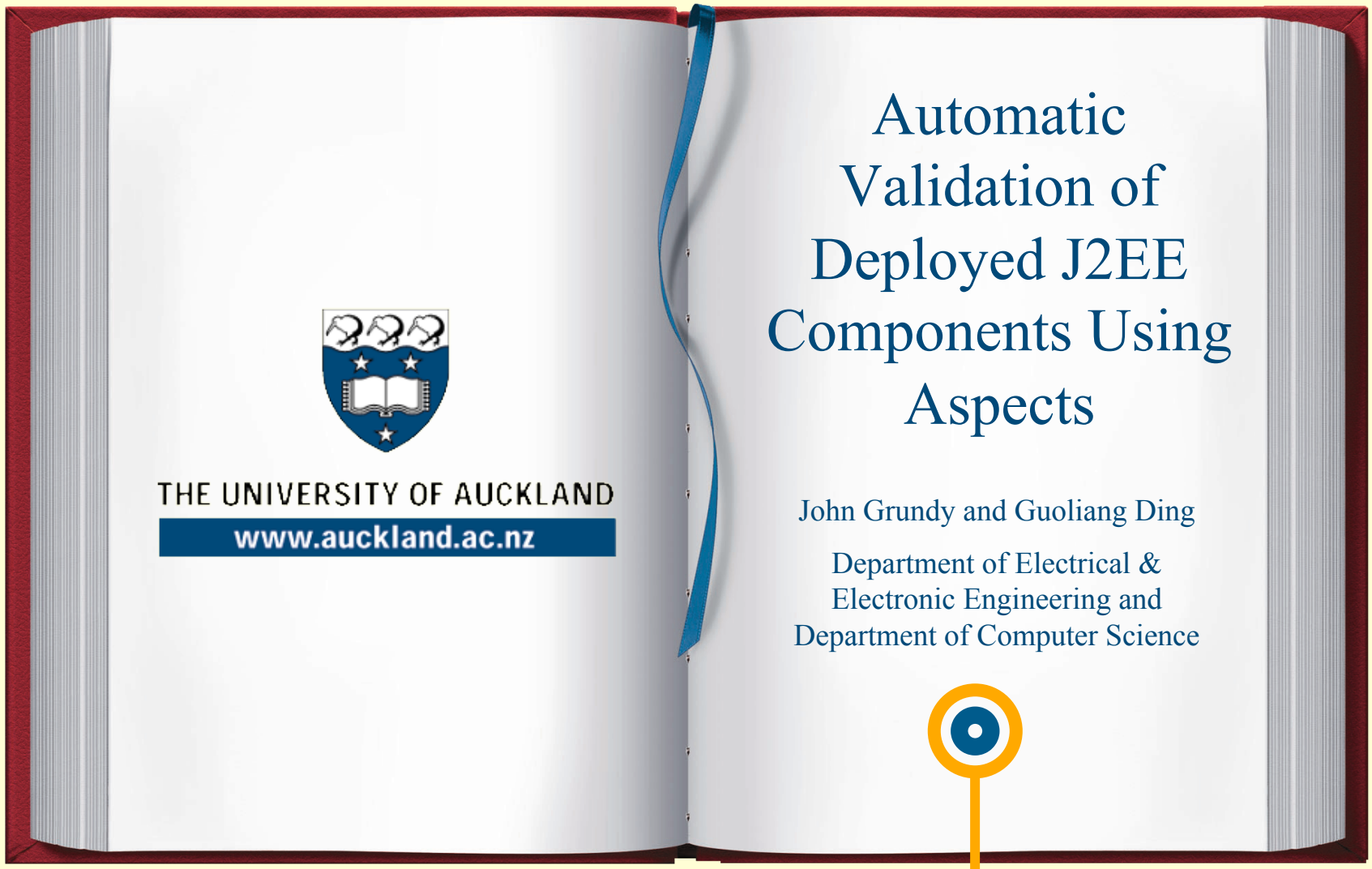

Automatic Validation of Deployed J2EE Components Using Aspects

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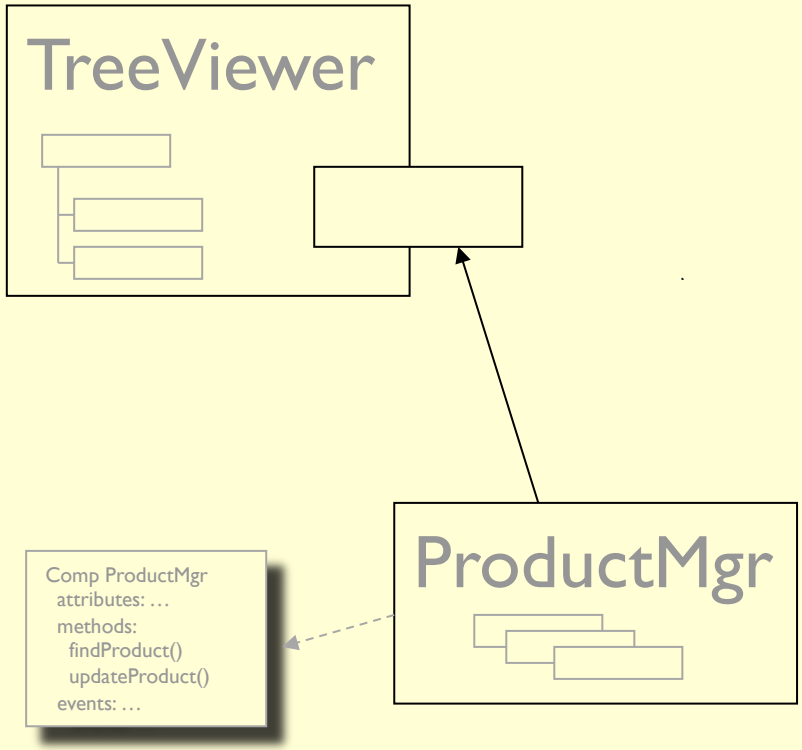
Outline

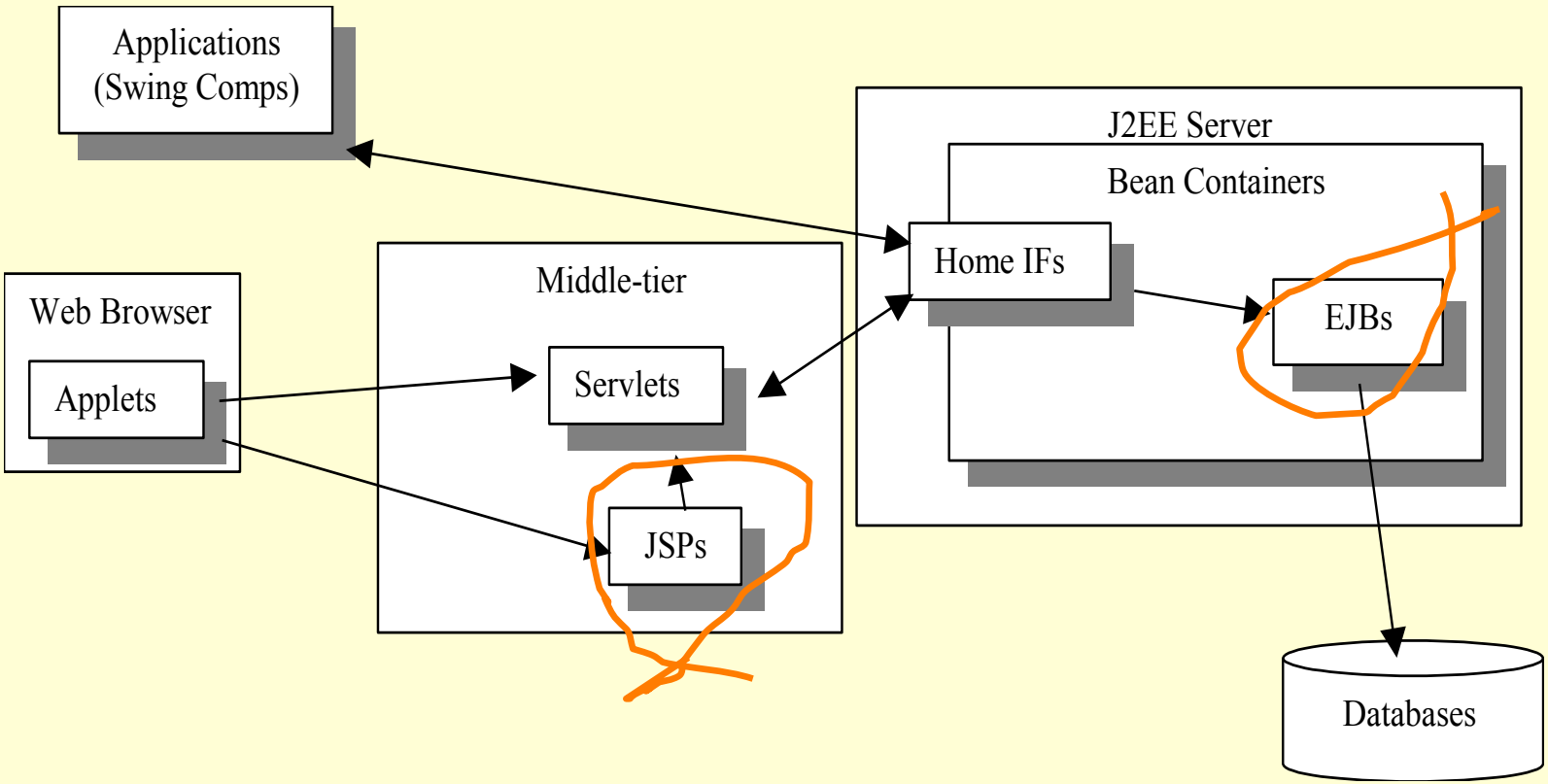
- Motivation
- Our Approach
- Example System
- Characterising software components
- Deploying and validating components
- Summary & Future Work

What are Software Components?



- Data/behaviour
- Interfaces
- Self-describing
- Plug-and-play
- Various constraints…
- e.g. J2EE, COM, .NET, CORBA, web services

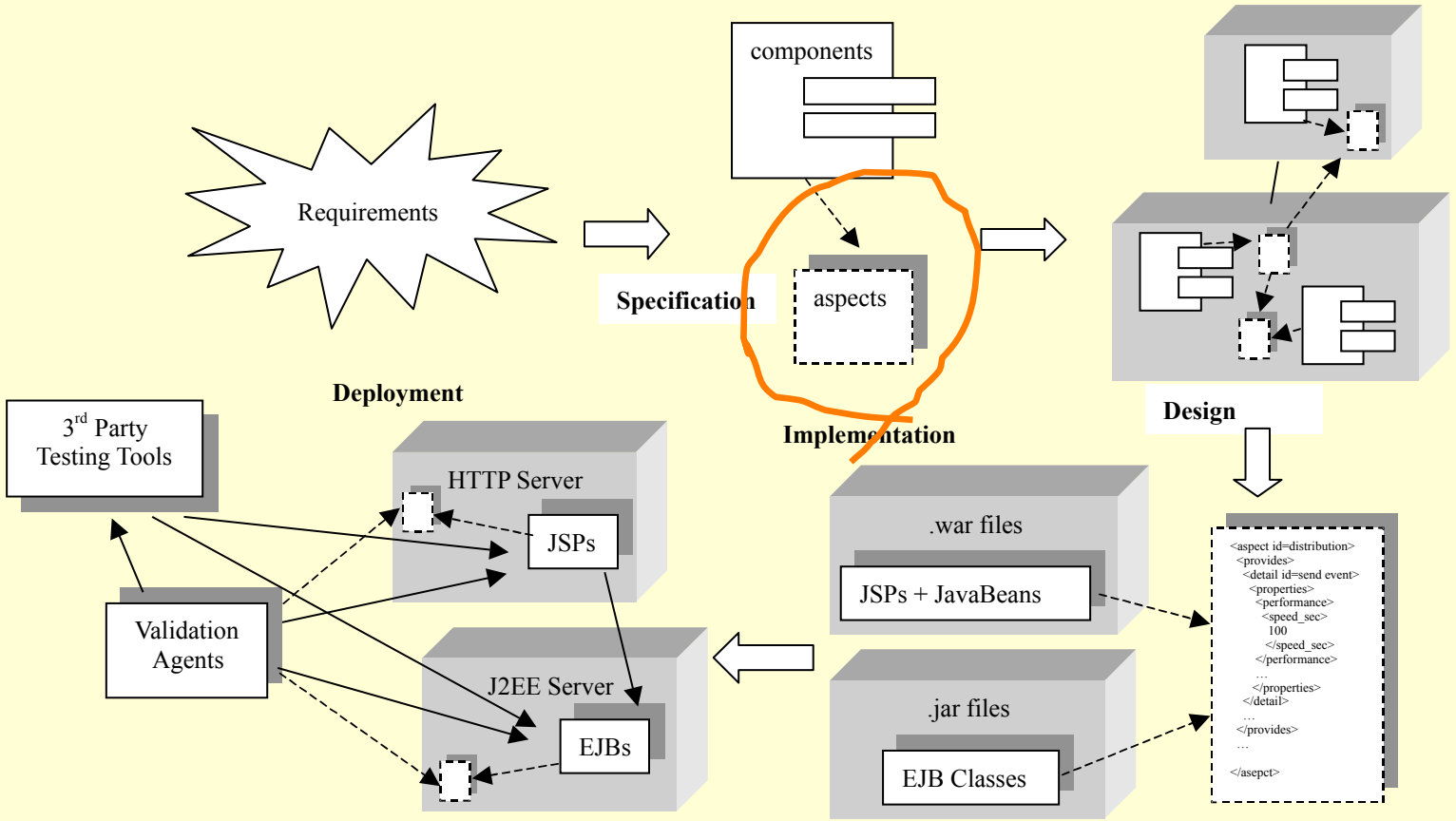
Java 2 Enterprise Edition Components



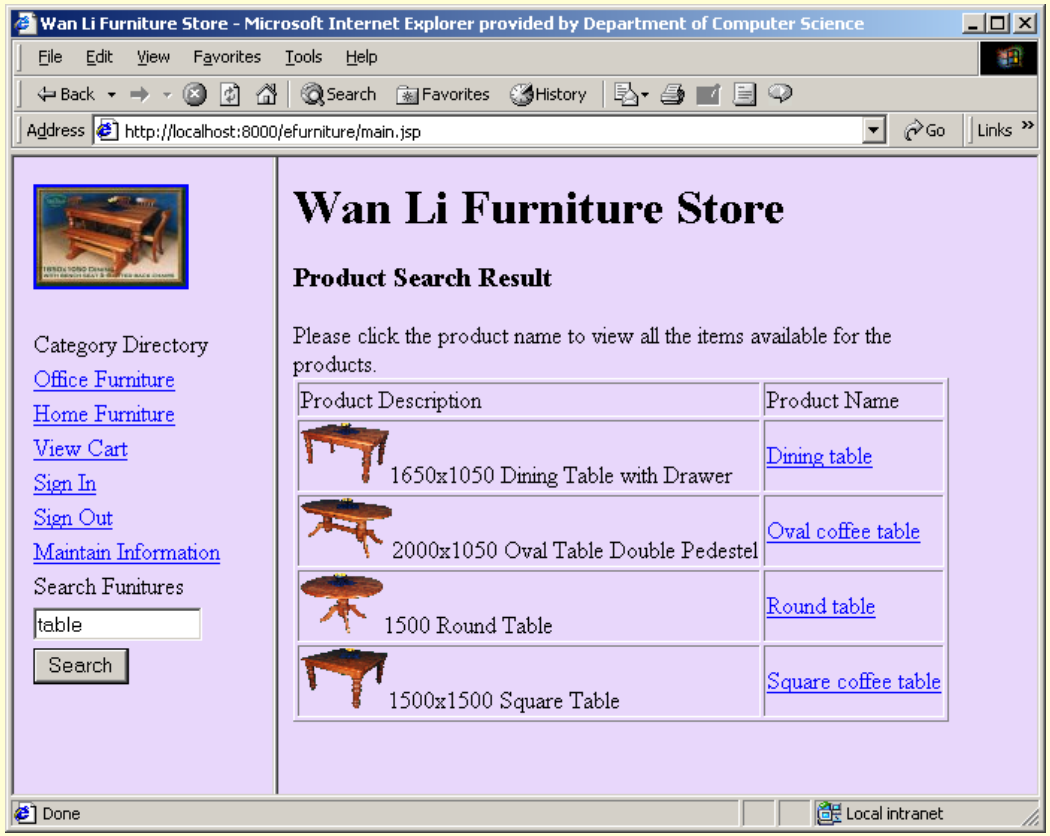
Ensuring Deployed Components Meet Specifications

- Component requirements/constraints:
  - Functional behaviour – data & processing they embody
  - Transaction processing, data integrity, security , resource usage
  - Performance, # users, reliability, trustability, …
  - Composite components – combine these constraints…
- Issues:
  - Static checking of constraints limited in usefulness…
  - Deployment scenario effects how component behaves
  - Depends on hardware, networking, applications, loading etc etc
- So how do we ensure deployed components meet their specifications???

Our Approach



An Example…



- Catalogue of products
- Searching
- Product info
- Orders
- Payment
- Messaging

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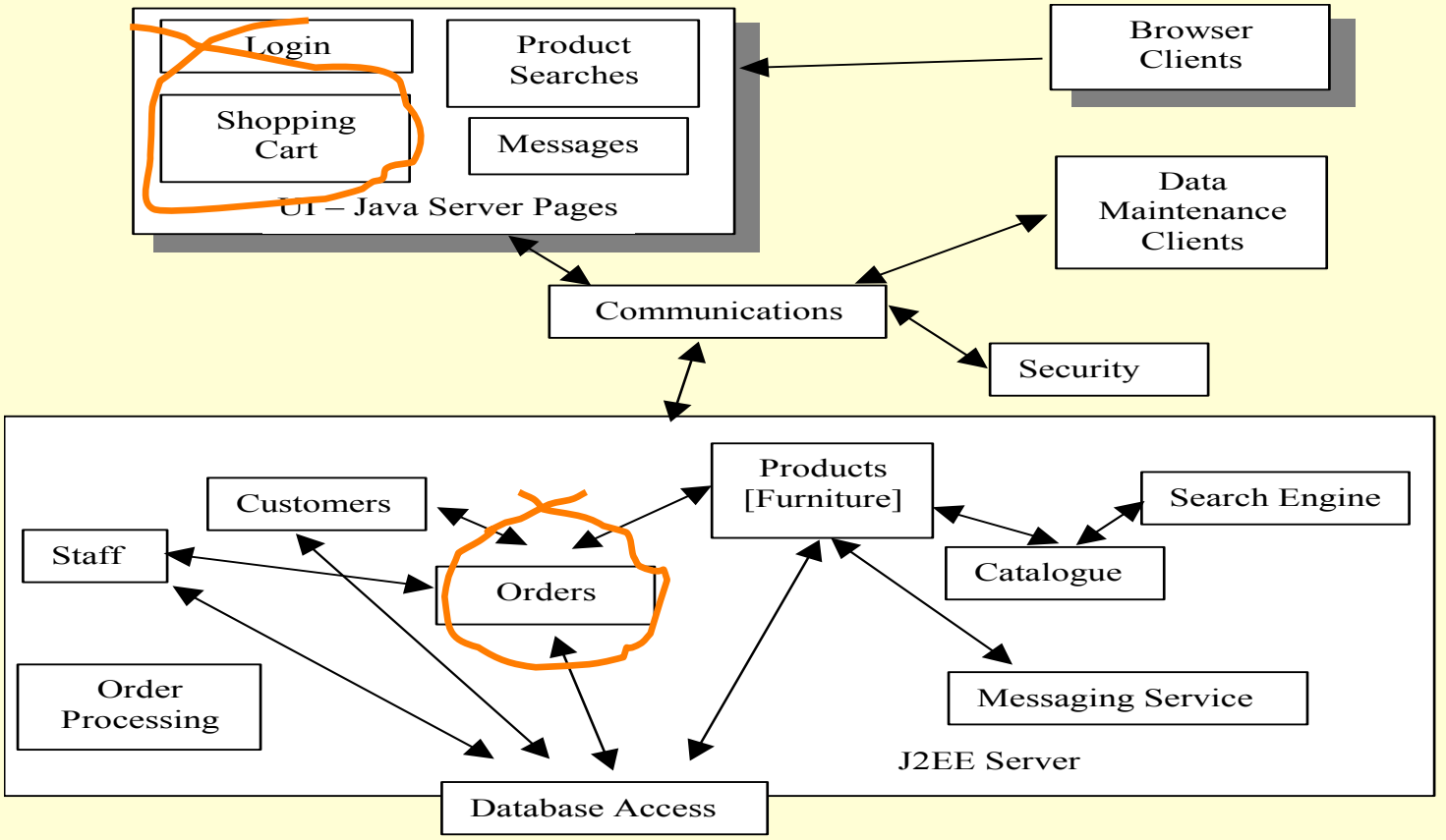
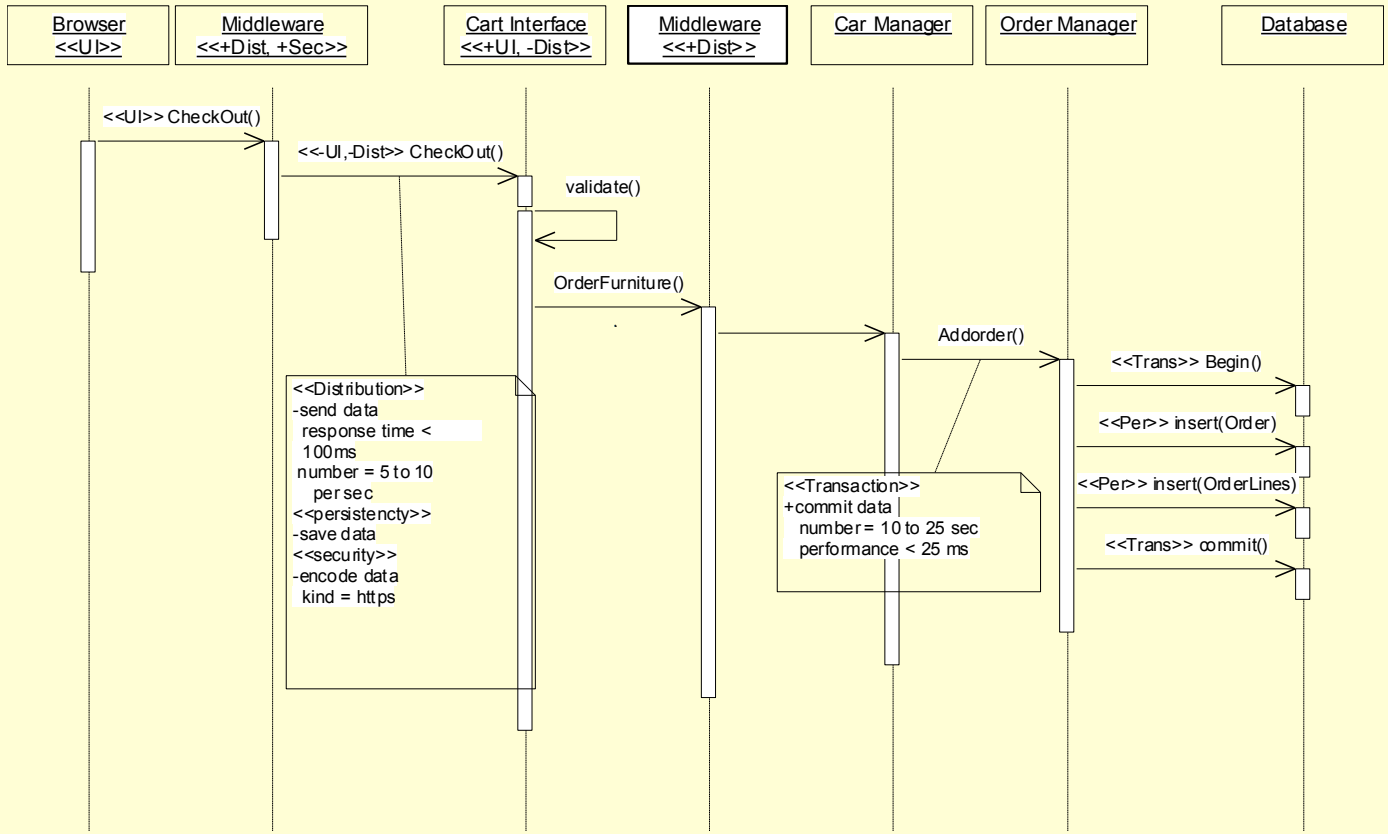
Some components



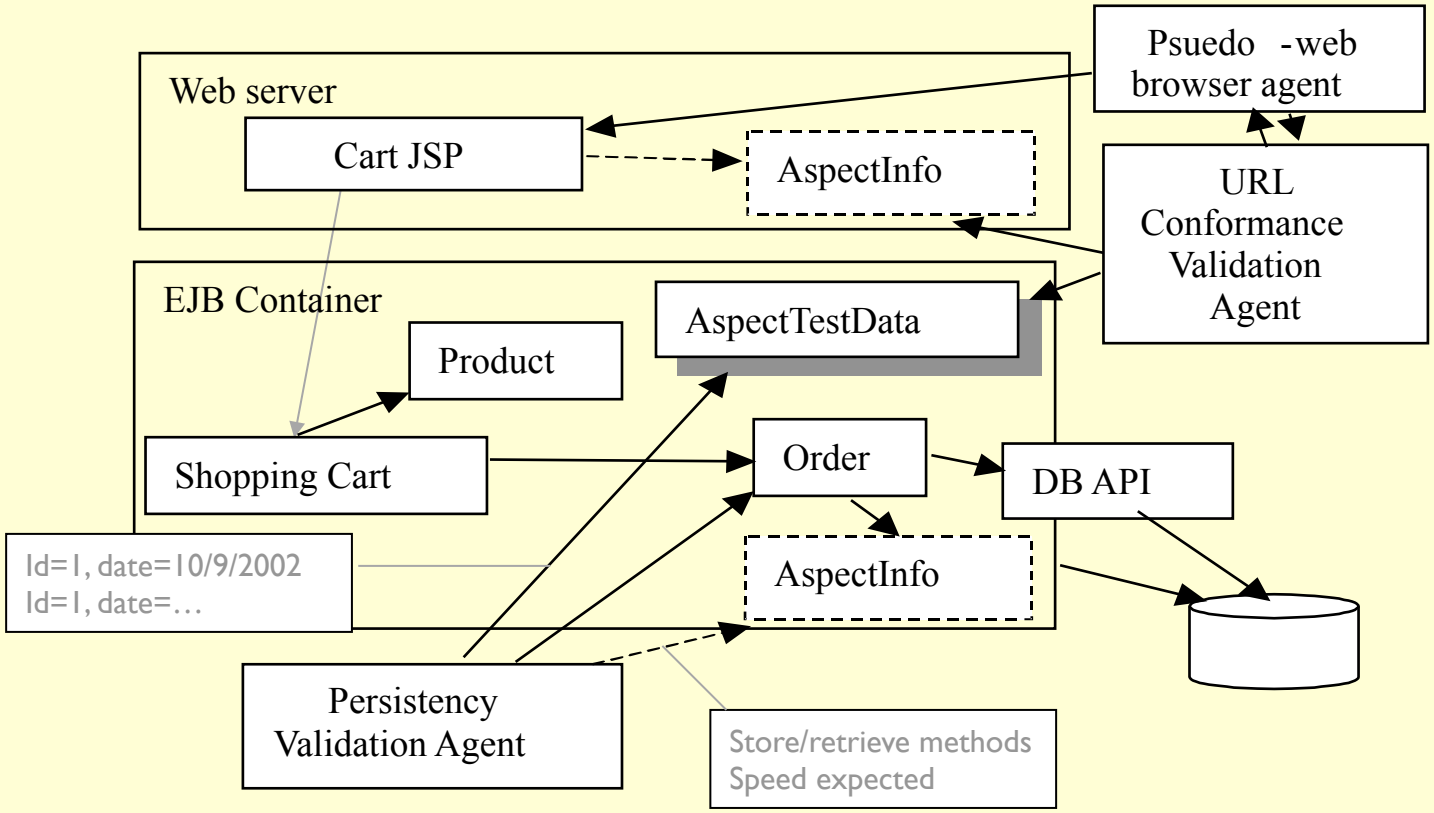
Characterisations of Components – via “Aspects”



XML Encoding of Aspects

```
<?xml version="1.0" encoding="UTF-8"?>
<!ELEMENT (Component|ComponentGroup)+>
<!ELEMENT Component (CompName, MappingName, CompProperties,
CompMethods, CompEvents, CompAspects)>
...
<!ELEMENT Aspects (Aspect)+>
<!ELEMENT Aspect (AspectName,Details)>
<!ELEMENT Details (Detail)+>
<!ELEMENT Detail (DetailName, DetailType, Provided, DetailProperties,
ImpactedMethods, DetailInfo)>
...
<!ELEMENT DetailProperty (DetailPropName, DetailPropType,
DetailPropConstraint, DetailTestMethods, DetailPropInfo)>
...
<!ELEMENT DetailPropConstraint Expr>
...
<!ELEMENT DetailTestMethod (MethodCall|URLCall)>
<!ELEMENT MethodCall (MethodName, MethodArgumentData)>
<!ELEMENT URLCall (URLName, URLArgumentData)>
```

Deploy Components/Validation Agents – an Example



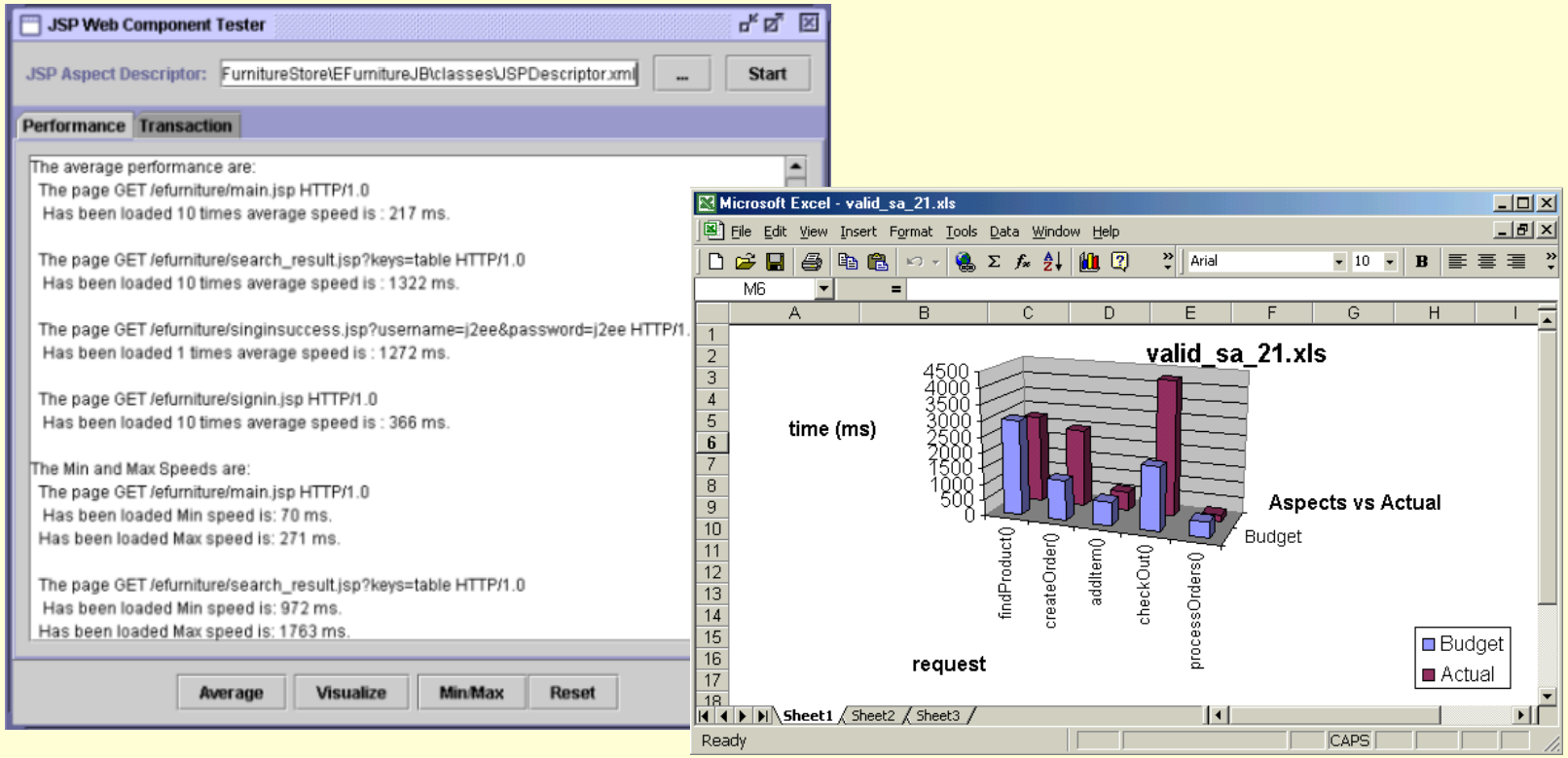
Example Aspects Extracted

```
<Component CompName="OrderEJB">
 <Aspects>
   <Aspect AspectName="Persistency">
    <Detail DetailName="Store" DetailType="StoreData" Provided='true'>
     < ImpactedMethod Name='ejbCreate' /><ImpactedMethod Name='ejbStore' />
    <DetailProperties>
     <DetailProperty DetailPropName="StoreSpeed" DetailType="ResponseTime">
      <DetailPropType>Milliseconds</DetailPropType>
      <DetailPropConstraint><Expr><LessThan>50</LessThan>...
      <DetailTestMethods>
        <DetailTestMethod MethodName="ejbStore"
            MethodArgumentData=' java:comp/env/ejb/staff_testdata'>
...

<Component CompName="ShoppingCart.jsp">
...  <Aspect AspectName="UserInterface" ...>
   ... <Detail DetailName="PostData" DetailType="DataOutput" Provided='true' ...>
     ... <DetailProperty DetailPropName="PostData" ...>
       .... <DetailTestMethod><URLCall URLName="ShoppingCart.jsp"
            URLArgumentData= java:comp/env/ejb/ShoppingCart_testdata'
              URLResultData = ... />
```

- XML gives full component spec – data, functions, non-functional constraints…
- Xpath expressions used by agents to obtain ones they want…

Results Visualisation



Evaluation

- Advantages:
  - Deployment-time assessment of components
  - Can deploy validation agents in different situations for reuse
  - Preliminary results compare well to manual testing efforts
- Disadvantages:
  - Extra effort of specifying aspect information (need tools)
  - Composite component aspects – if run-time composition? If dynamic architecture??
  - Aspect "ontologies" – what if compose comps with diff aspects?

Summary

- Validating deployed software components – checking that they meet their functional/non-functional constraints – is HARD!
- Static analysis not sufficient; manual testing too hard/error-prone; JUnit-style test drivers require much coding
- Aspect characterisations of components capture rich information about their functions/constraints
- Validation agents using component aspects promising approach
- We have developed J2EE-based validation agents; a number of different validation agents prototyped; have tried on some relatively simple J2EE applications/components…

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