



# DOM-Based Test Adequacy Criteria for Web Applications

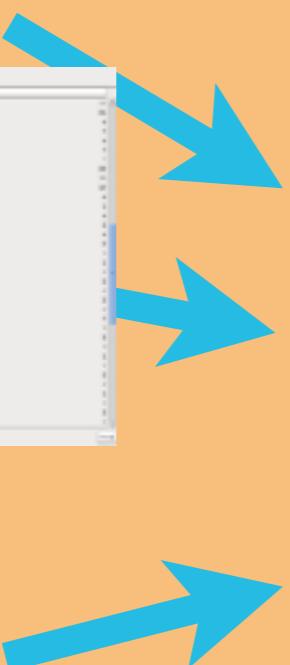
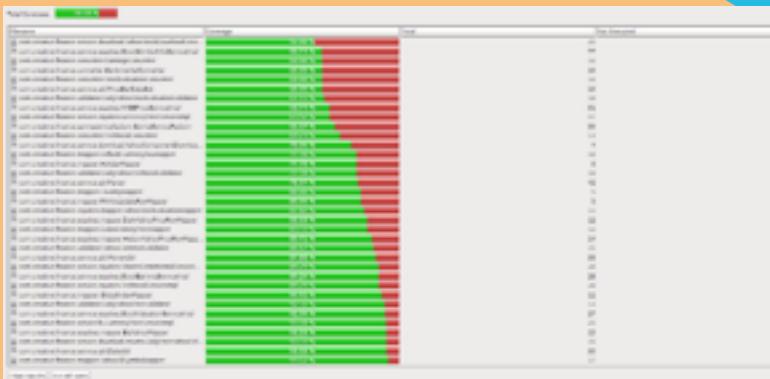


Mehdi Mirzaaghaei



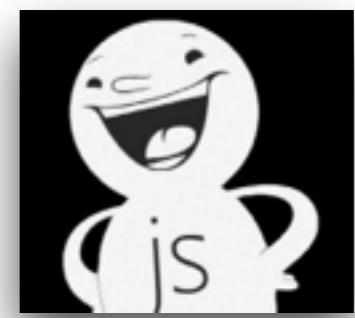
Ali Mesbah

**HTML**

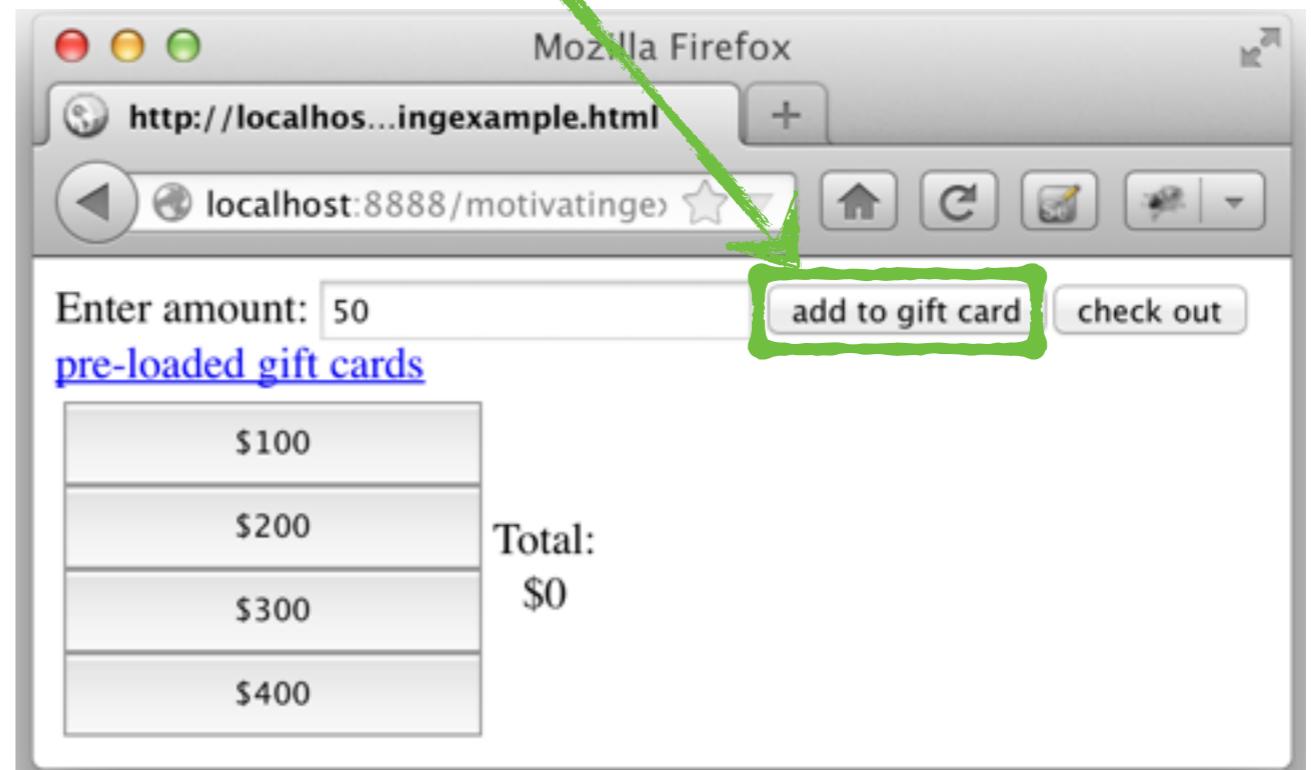


**CSS**

**ServerSide Code**



```
@Test  
public void testShoppingCard() {  
    driver = new FirefoxDriver();  
    driver.get(url);  
    driver.findElement(By.id("add2cart")).click();  
    assertEquals("$50.0", driver.  
        findElement(By.linktext("p")).text());  
}
```



CSS

```
<style>  
div{  
font-size: 12pt;  
}  
</style>
```

JavaScript

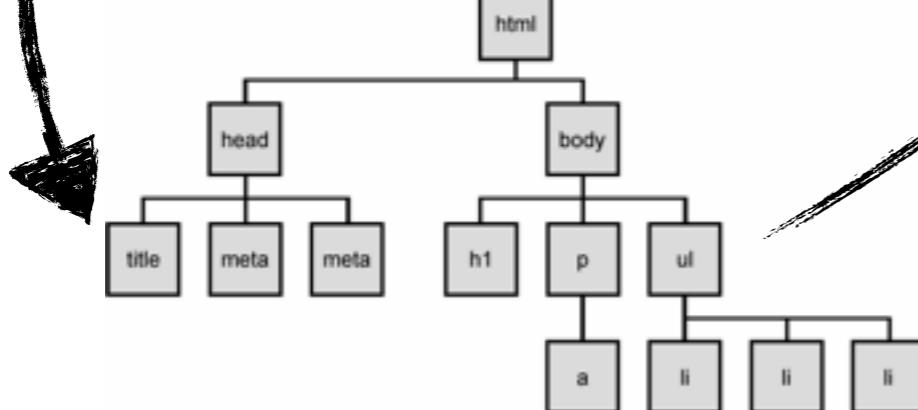
```
function addTotal(x){  
document.getElementById("p1").innerHTML="$"+x;  
}
```

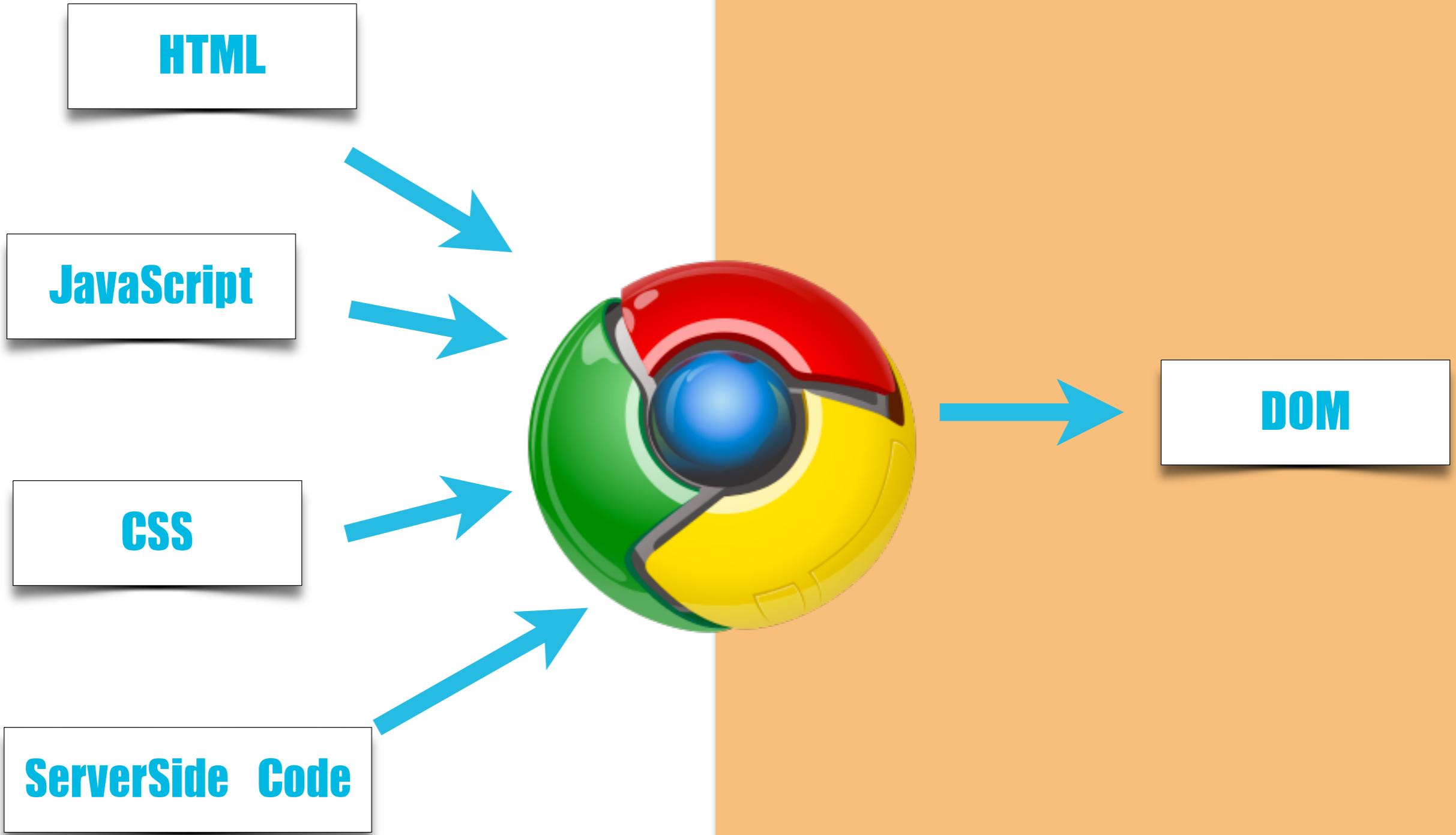
HTML

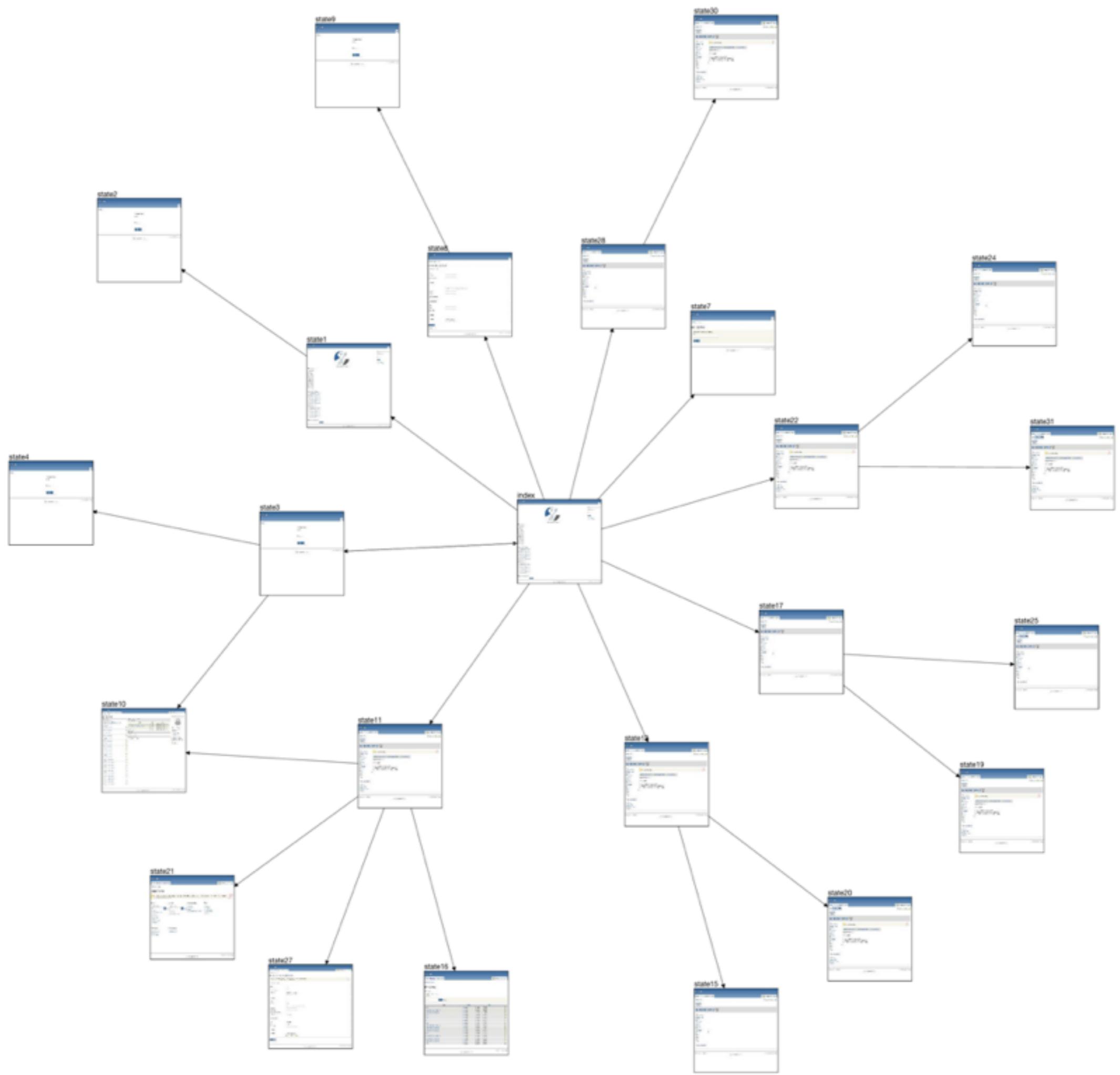
```
Enter amount: <input id="amount" type="text" value="0" />  
<input id="add2cart" value="add" type="button" onclick="addTotal(amount.value)" />  
<input onclick="addTotal(150); " value="\$100" />  
<input onclick="addTotal(250); " value="\$200" />  
<input onclick="addTotal(350); " value="\$300" />  
<input onclick="addTotal(400); " value="\$400" />  
Total:<div coverage="true" id="payable"></div>
```

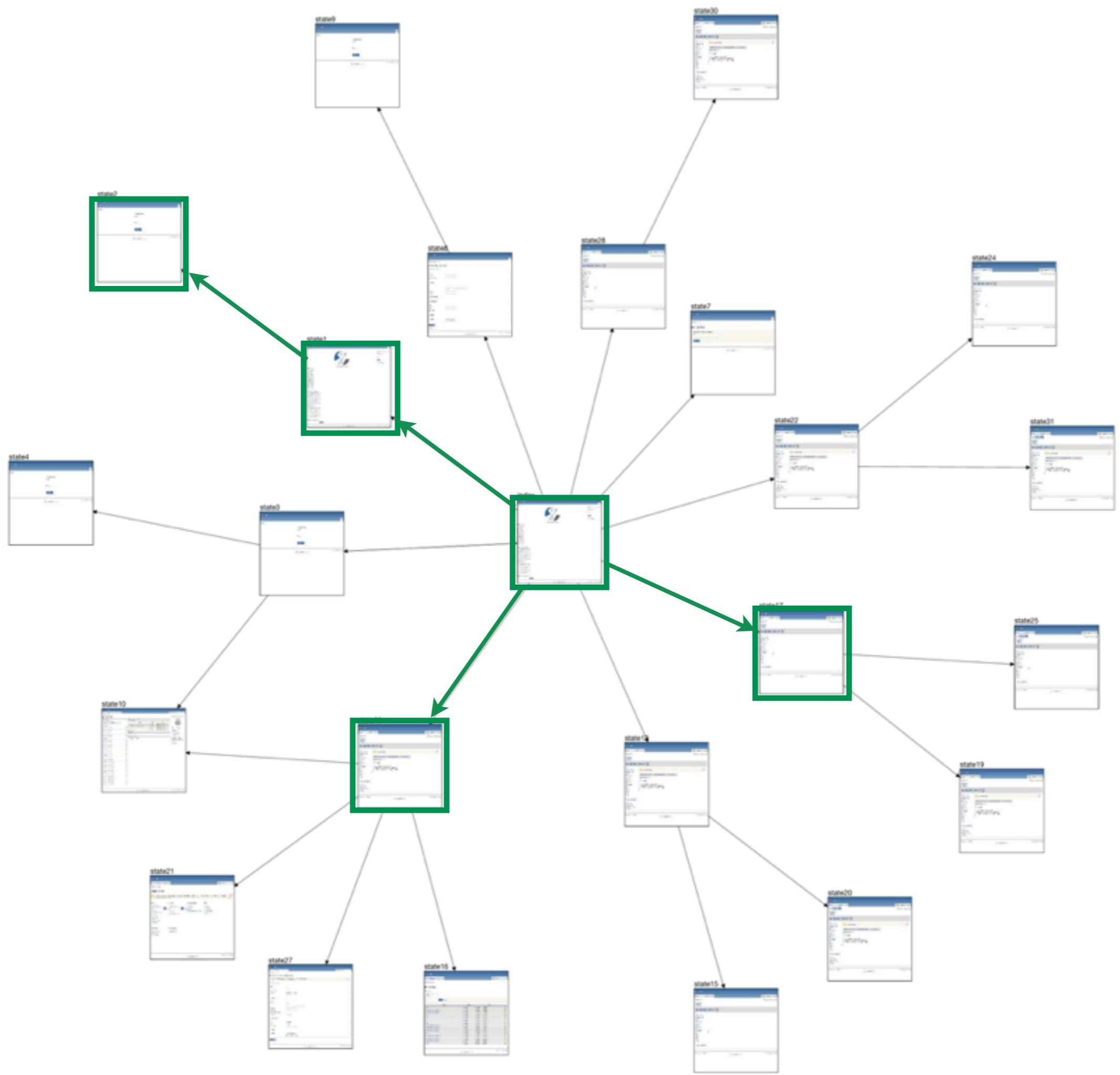
@Test

```
public void testShoppingCard() {  
driver = new FirefoxDriver();  
driver.get(url);  
driver.findElement(By.id("add2cart")).click();  
assertEquals("$50.0", driver.  
findElement(By.linktext("p")).text());  
}
```









The screenshot shows the Claroline administration interface. At the top, there are two smaller windows showing different parts of the system: one with a file tree and another with a list of users.

The main window has a blue header bar with the Claroline logo, a search bar containing "localhost:8888/claroline-1.11.7/", and a menu bar with "Claroline", "My desktop", "My messages", "Platform administration", "mm nainy", "Manage my account", and "Logout".

The main content area has a breadcrumb navigation: "Claroline > Administration".

## ADMINISTRATION

**Users**

Search for a user  Go Advanced

- User list
- Send a message to all users
- Create user
- Add a user list
- Manage classes
- Right profile list
- Manage user desktop
- Merge user accounts

**Courses**

Search for a course  Go Advanced

- Course list
- Create course
- Manage course categories

**Platform configuration**

- Configuration
- Edit text zones
- Modules
- Manage administrator email notifications

**Tools**

System Info  
Files statistics  
Platform statistics  
Scan technical fault  
Upgrade

**Claroline.net**

- Register my campus
- Support forum
- Claroline.net news

**Communication**

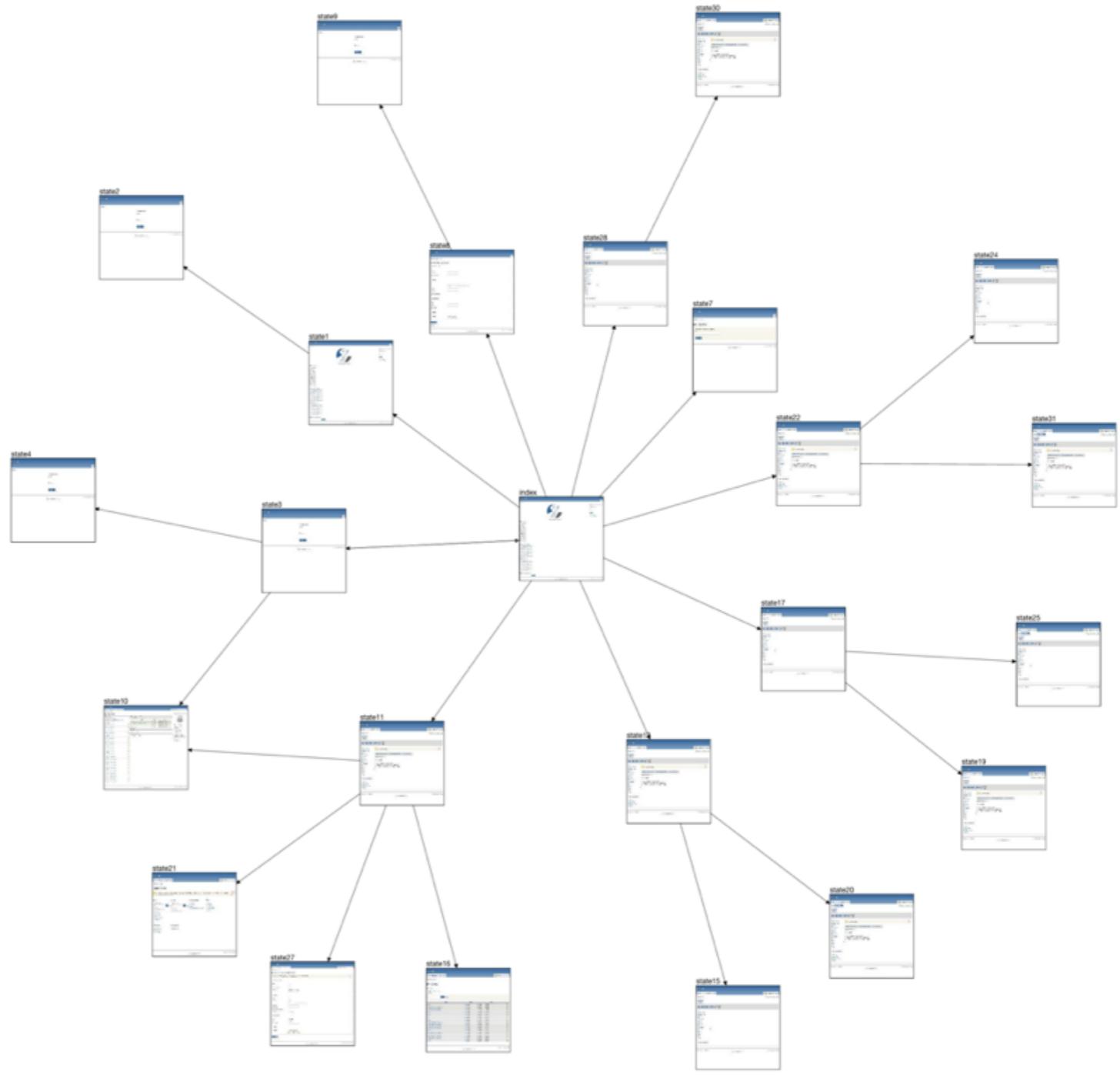
- Internal messaging

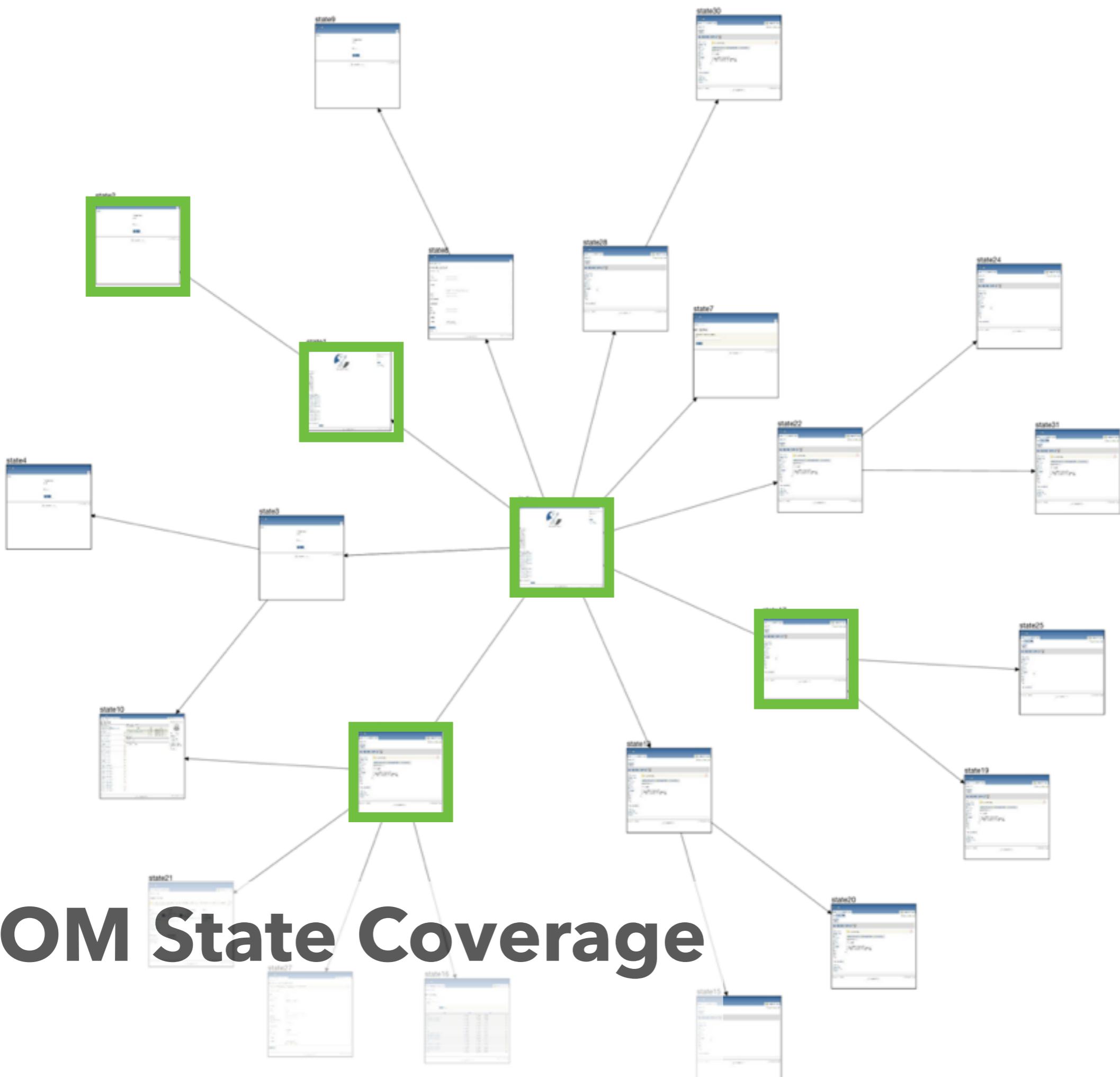
Powered by Claroline © 2001 - 2013

Administrator for Claroline : Nainy Nainy

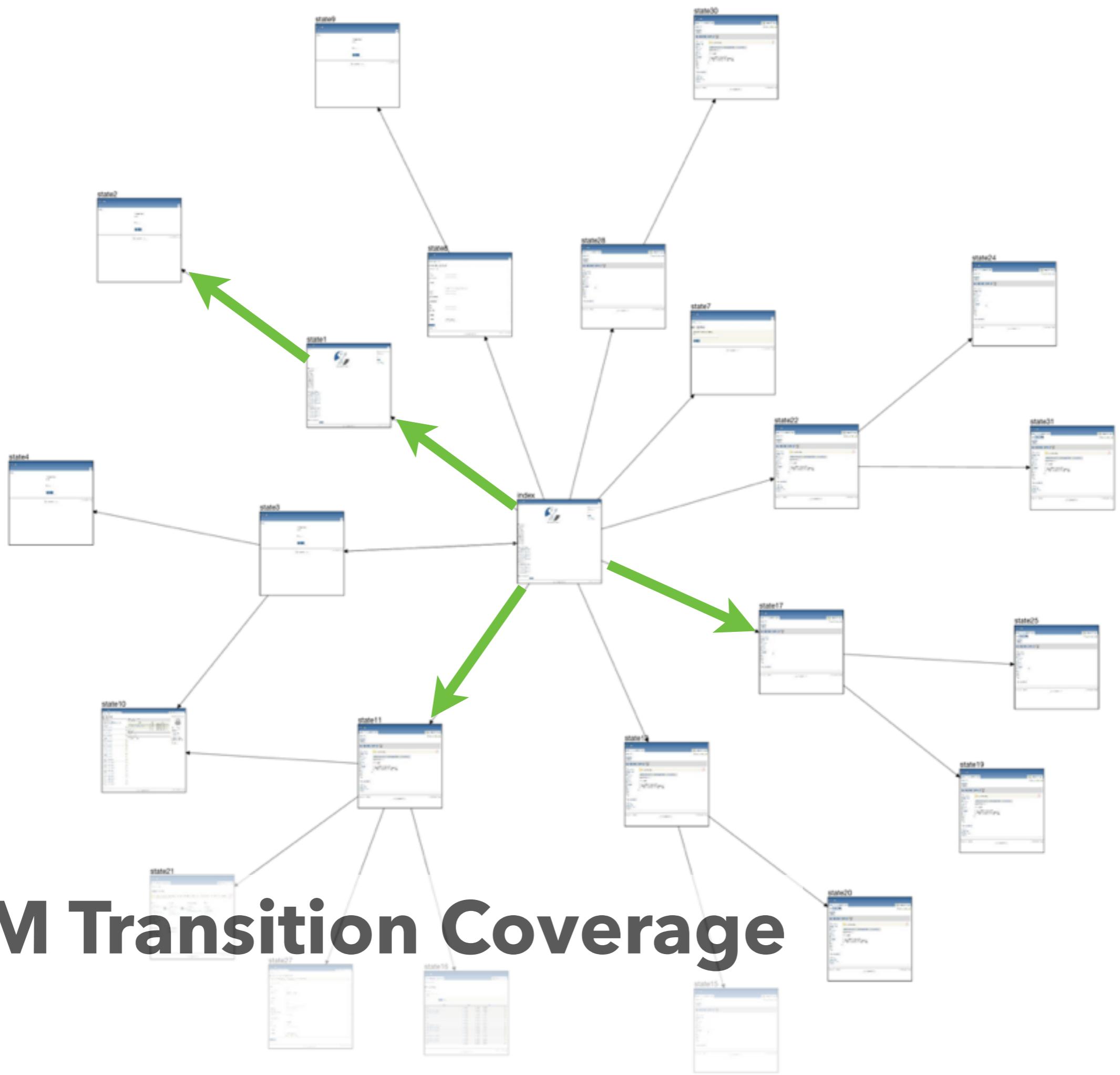
# Inter-State Coverage Criteria

- DOM State
- DOM Transition





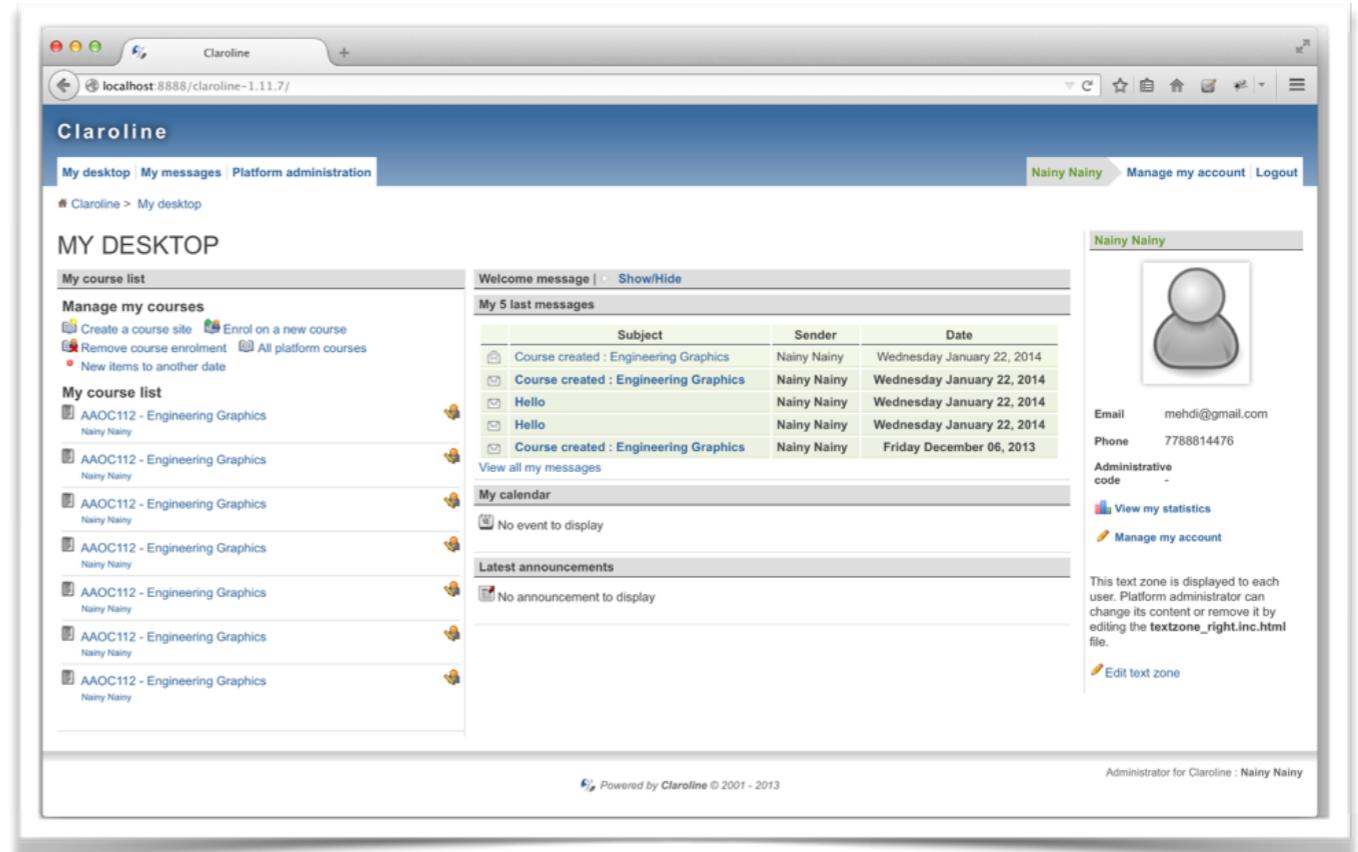
# DOM State Coverage



# DOM Transition Coverage

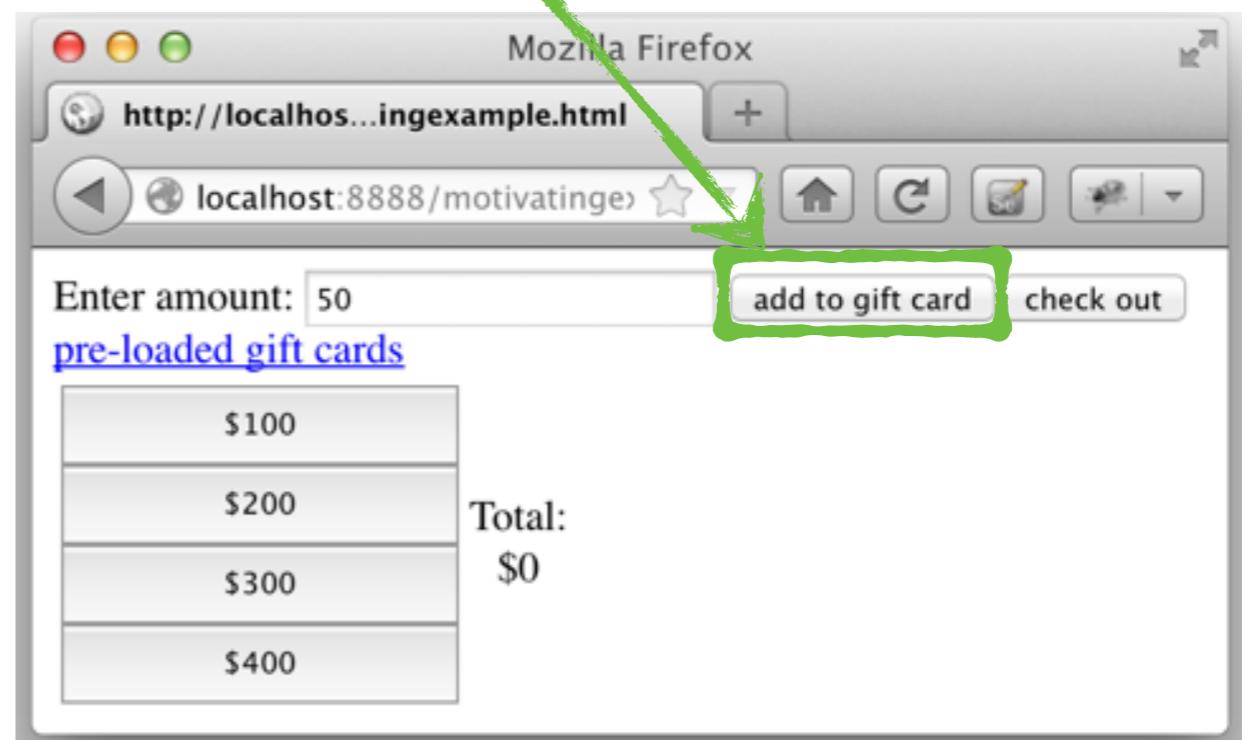
# Intra-State Coverage Criteria

Explicit Element  
Actionable Element  
Implicit Element  
Checked Element

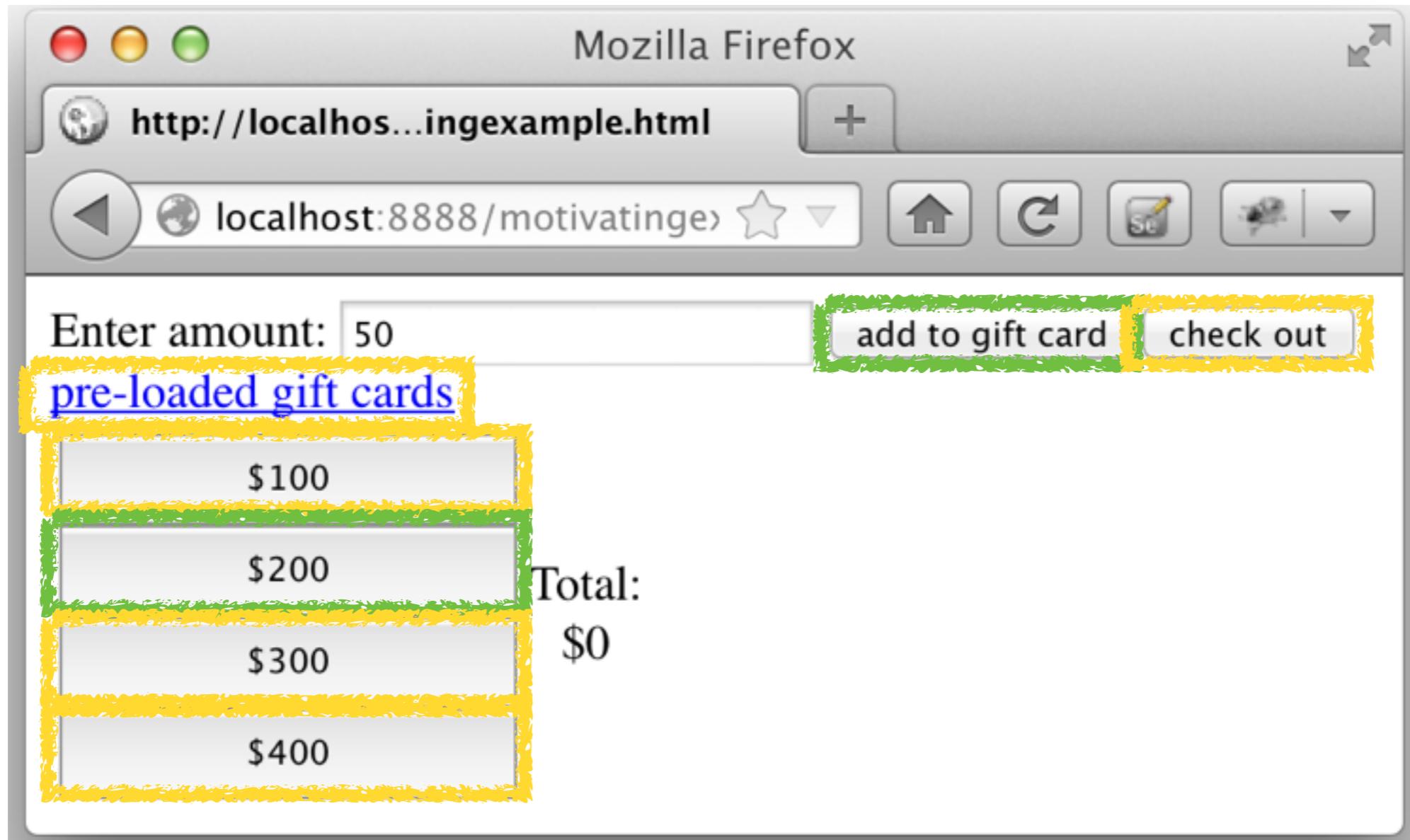


# Explicit Element Coverage

```
@Test  
public void testShoppingCard() {  
    driver = new FirefoxDriver();  
    driver.get(url);  
    driver.findElement(By.id("add2cart")).click();  
    assertEquals("$50.0", driver.  
        findElement(By.linktext("p")).text());  
}
```



# Actionable Element Coverage

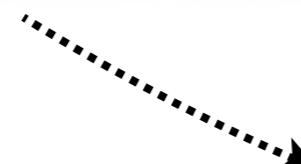


# Implicit Element Coverage

```
@Test  
public void testShoppingCard() {  
    driver = new FirefoxDriver();  
    driver.get(url);  
    driver.findElement(By.id("add2cart")).click();  
    assertEquals("$0", driver.  
        findElement(By.linktext("p1")).text());  
}
```



```
<input id="add2cart" value="add"  
      onclick="addTotal(amount.value)">
```

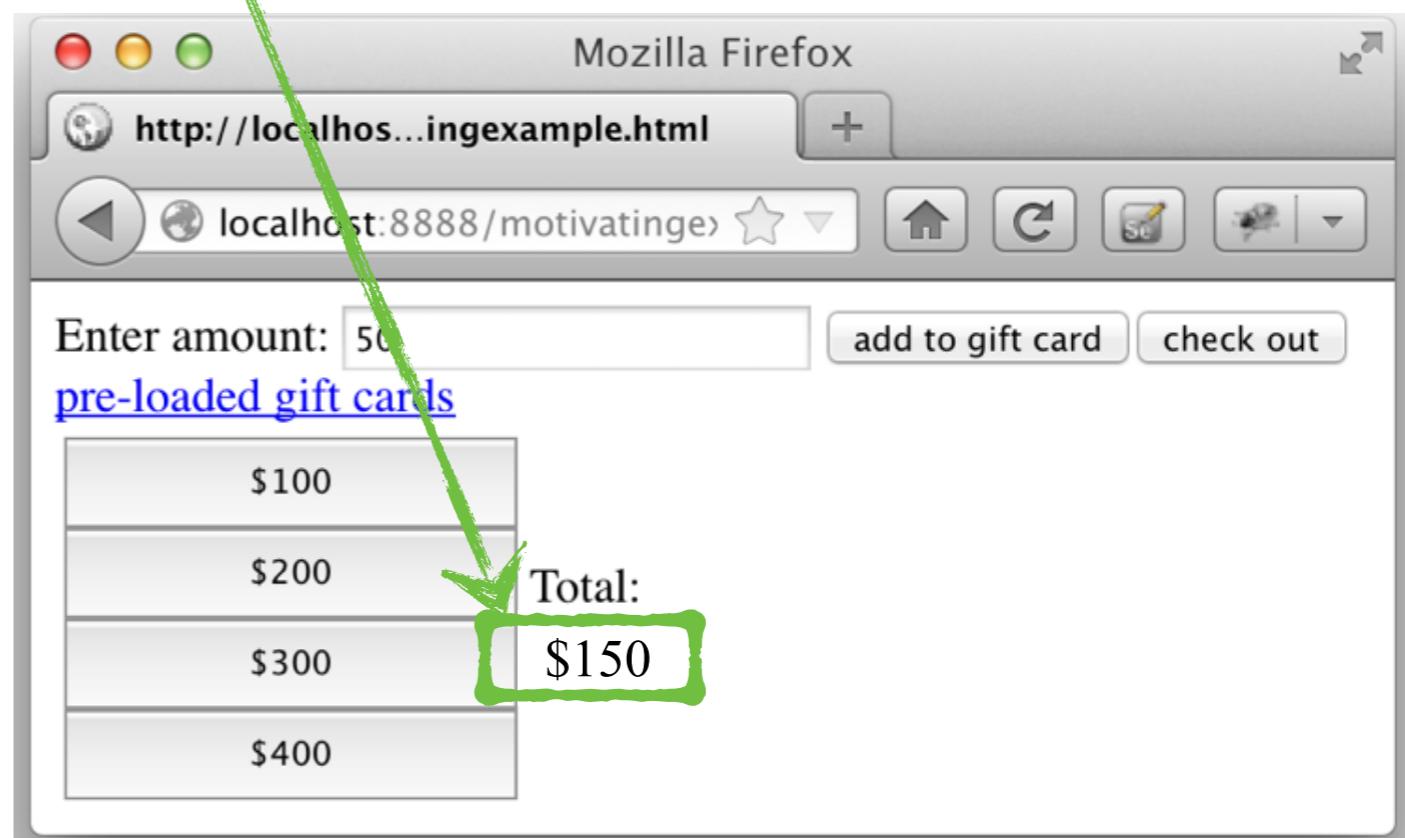


```
function addTotal(x){  
    document.getElementById("p1").innerHTML="$"+x;  
}
```



# Checked Element Coverage

```
@Test  
public void testShoppingCard() {  
    driver = new FirefoxDriver();  
    driver.get(url);  
    driver.findElement(By.id("add2cart")).click();  
    assertEquals("$150", driver.  
        findElement(By.linktext("p1")).text());  
}
```





# DOMCoverage

## **Instrument Test suite**

**Execute the Test Suite and Collect Data**



# DOM State Abstraction

**Test Suite**

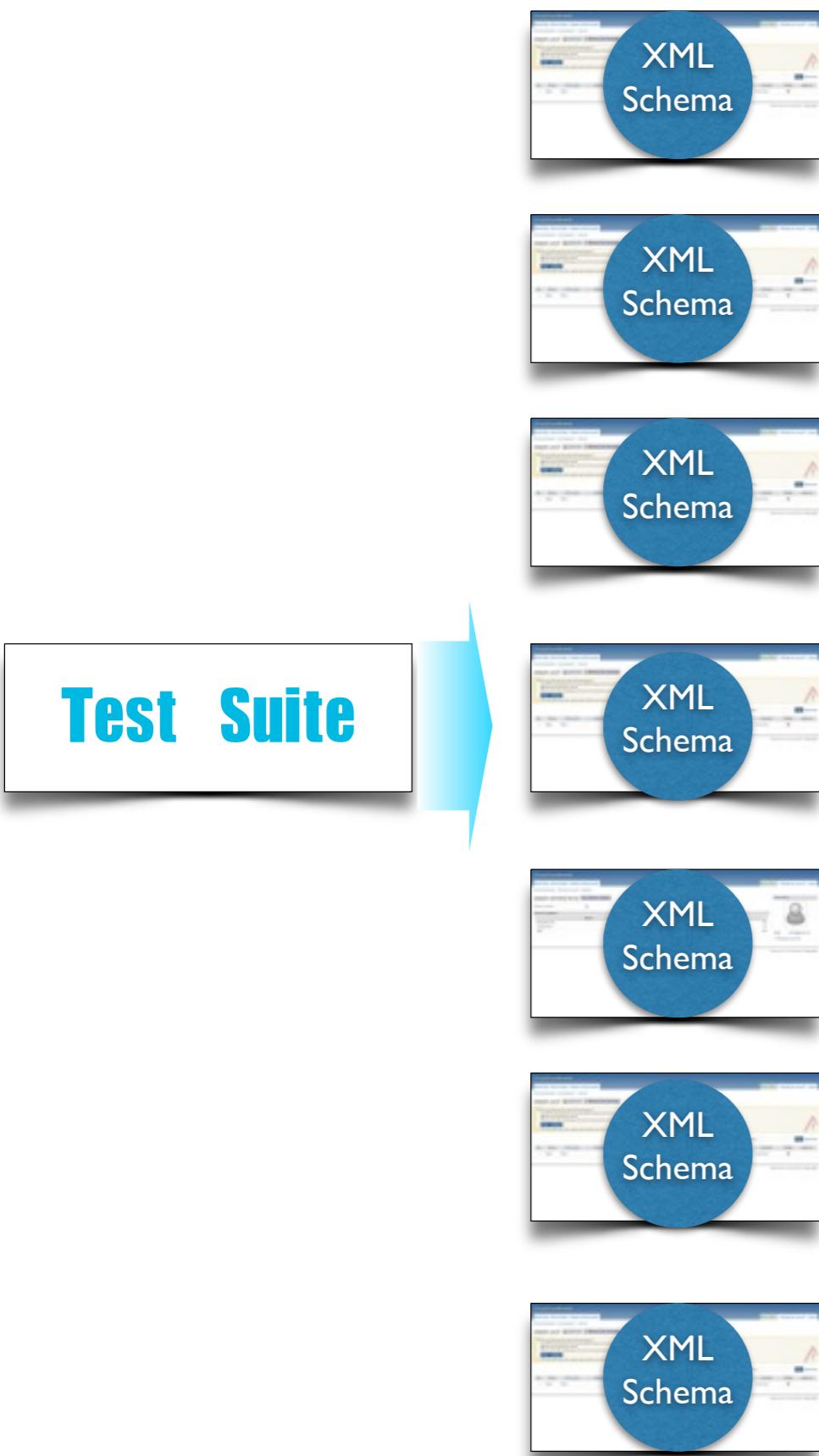
# DOM State Abstraction



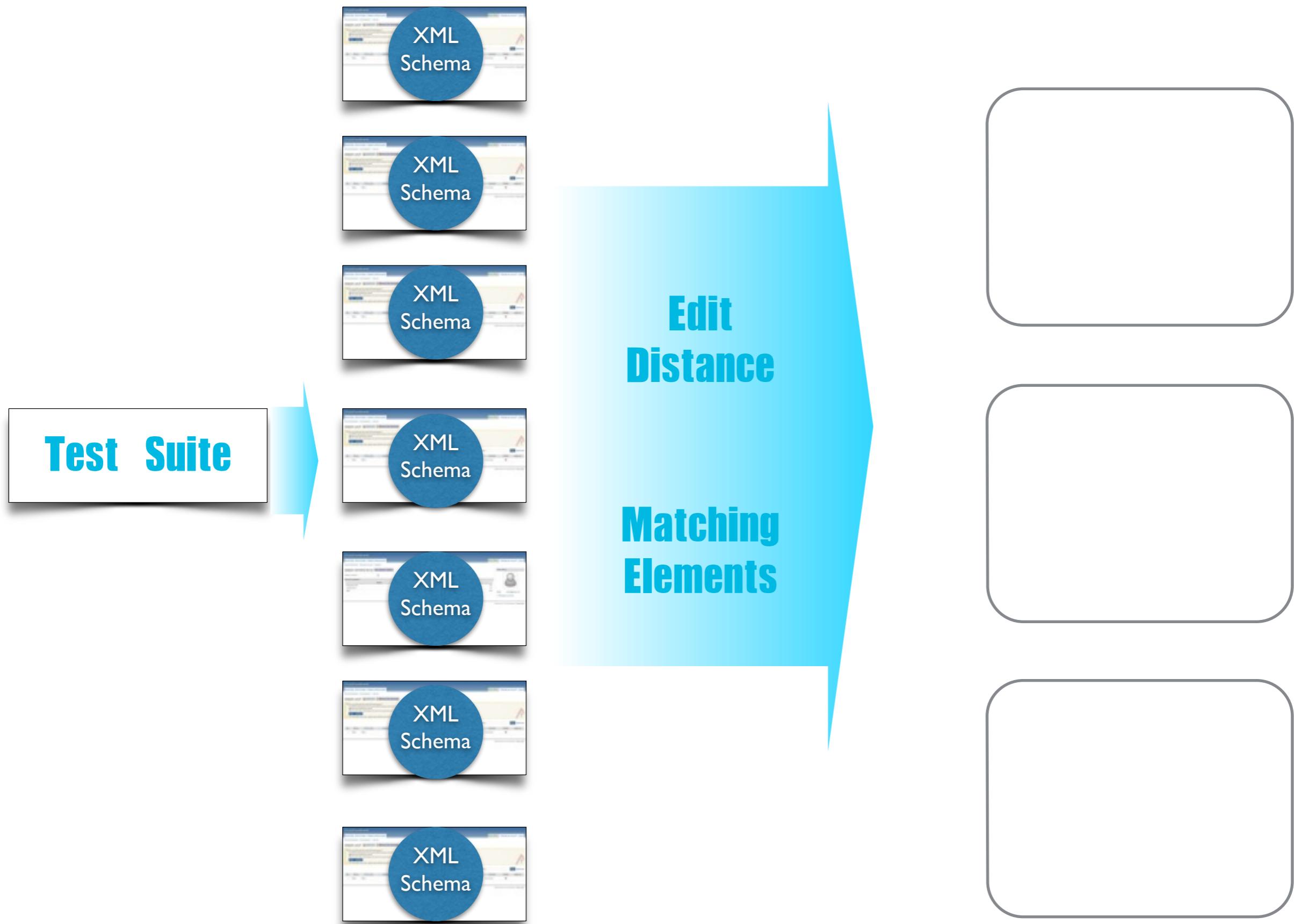
Test Suite



# DOM State Abstraction



# DOM State Clustering



# DOM State Clustering

Test Suite

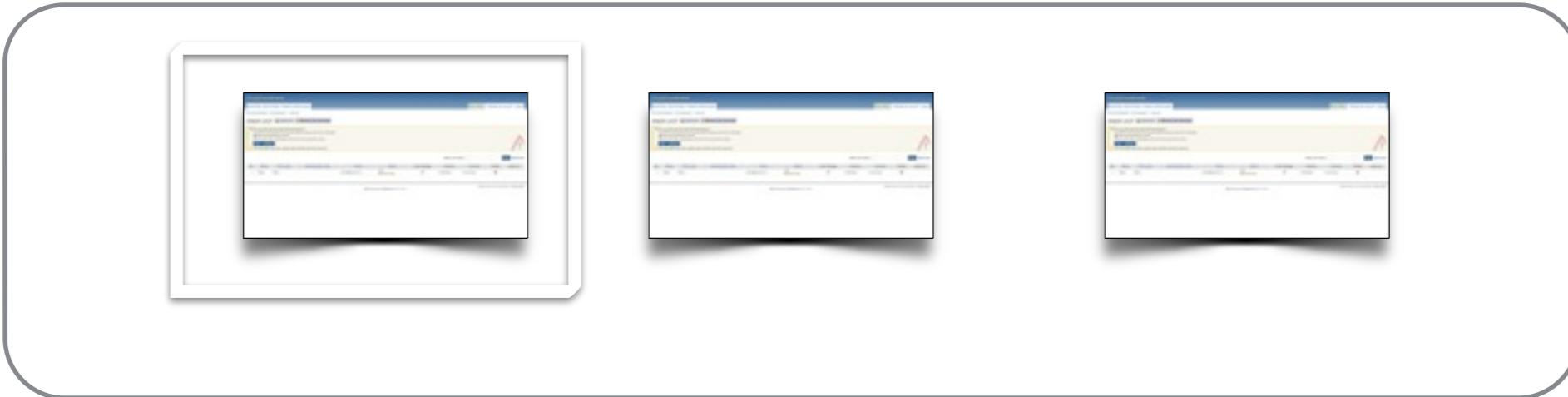


Edit  
Distance

Matching  
Elements

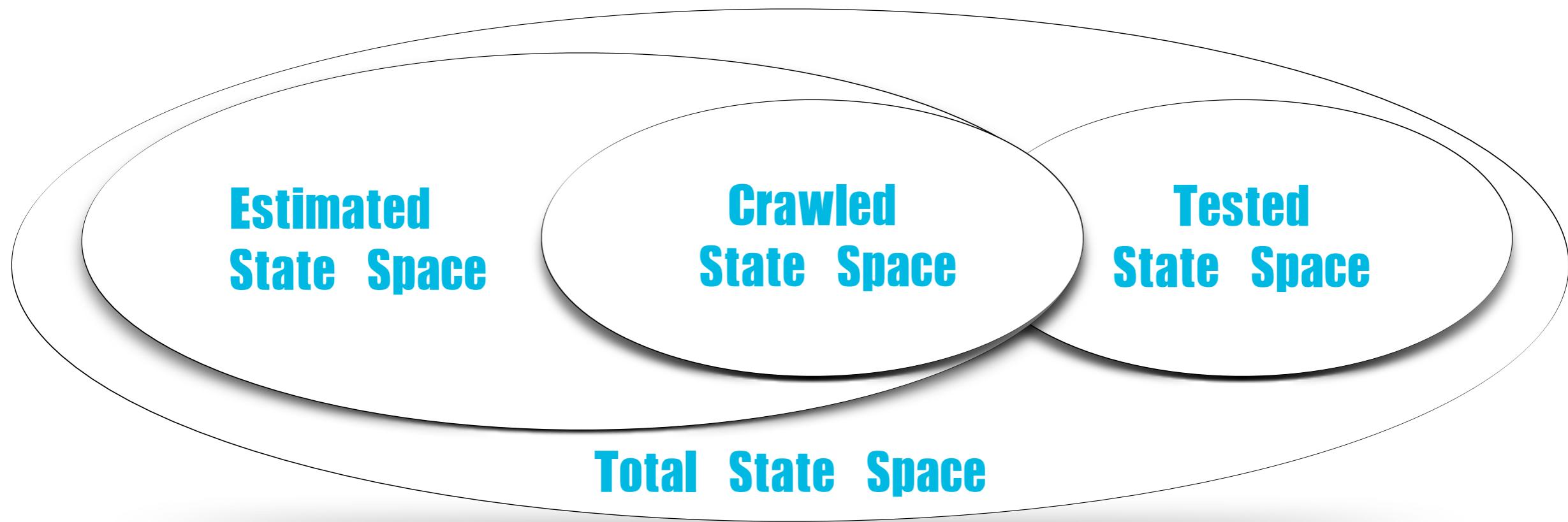


# Merging States in Clusters



- Find biggest DOM State in Cluster
- Merge Covered Elements

# Extracting Inter-state Coverage



# State Space Estimation



# Implementation



[github.com/saltlab/DomCovery](https://github.com/saltlab/DomCovery)



# Implementation



Selenium  
TestSuite  
(Java)



DOM  
Coverage  
Report



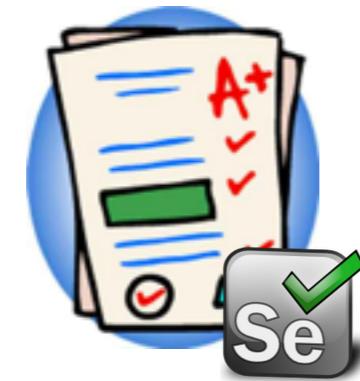
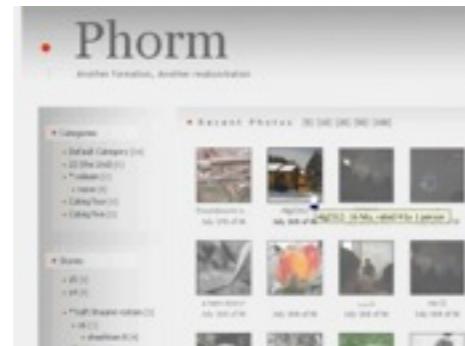
# Evaluation

**Is DOM coverage correlated  
with the Code coverage?**

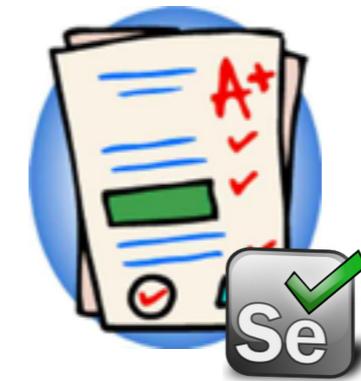
**How effective  
is DOMCoverage?**



6 KLOC



300 KLOC



# Correlation



**Code-Based Coverage**

	State	Transition	Explicit	Implicit	Checked	Actionable
Function						
Statement						
Branch						

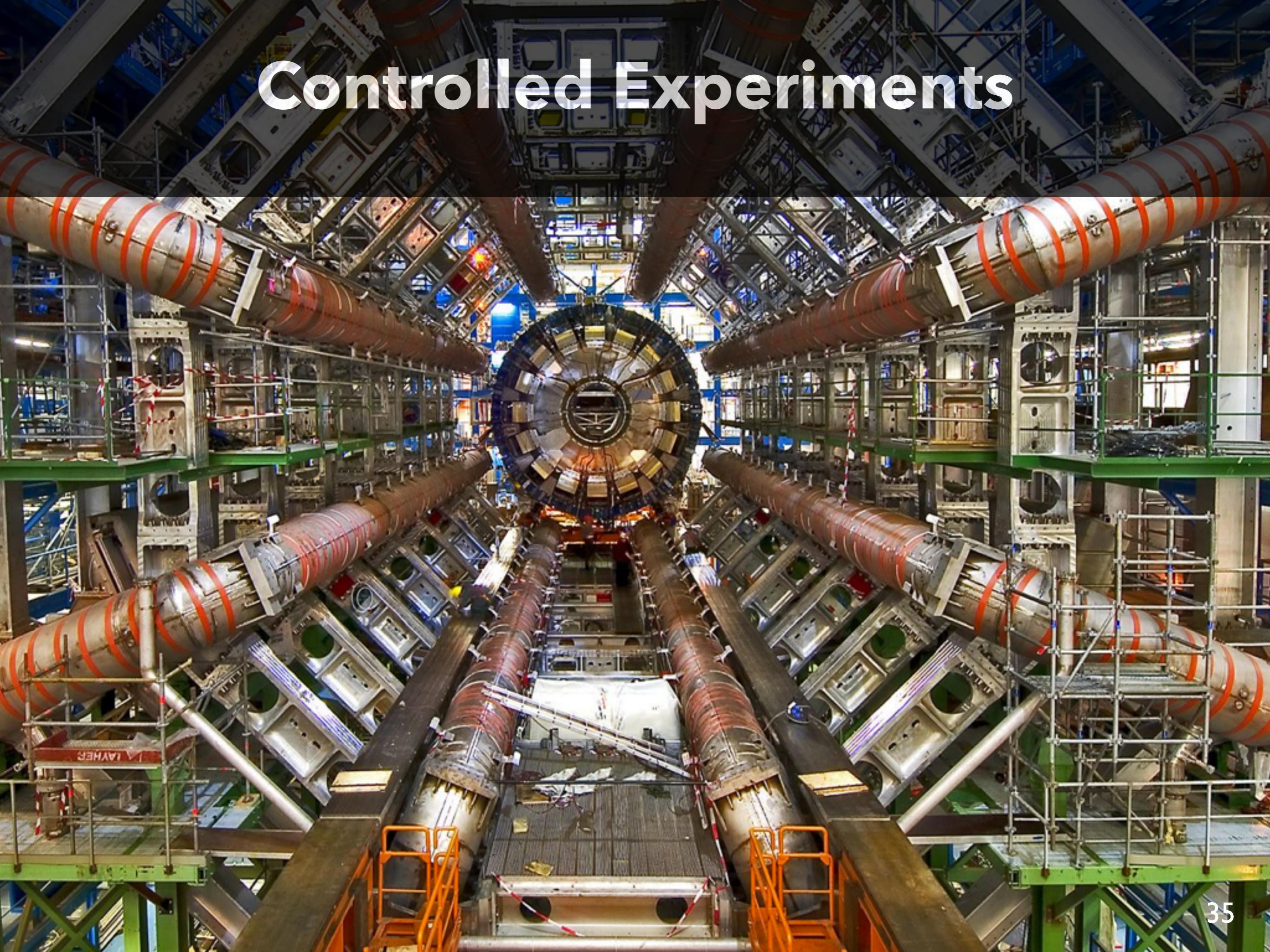
# Kandall Correlation Coefficient

Code-Based Coverage	Dom-Based Coverage					
	State	Transition	Explicit	Implicit	Checked	Actionable
Function	0.18					
Statement		0.19				
Branch			0.06			

# Kandall Correlation Coefficients

Code-Based Coverage	Dom-Based Coverage					
	State	Transition	Explicit	Implicit	Checked	Actionable
Function	0.18	0.17	-0.07	0.43	-0.16	0
Statement	0.19	0.19	-0.15	0.47	-0.26	-0.09
Branch	0.06	0.03	-0.06	0.43	-0.15	-0.05

# Controlled Experiments



# Experiment Design



Experimental Object

Experimental Subjects

Experimental Group  
Domcovery

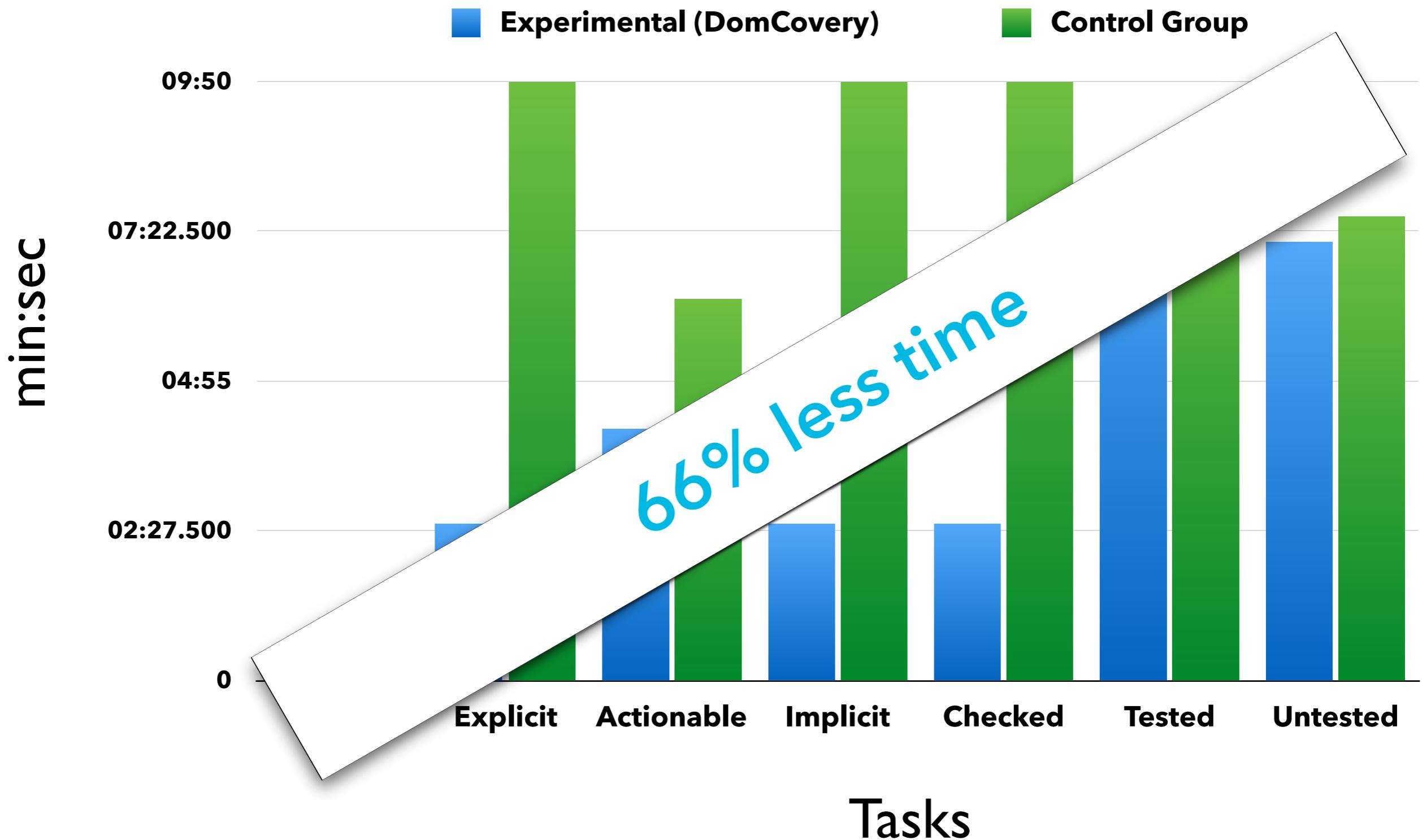
Controlled Group  
JSCover, FireBug, ...

# Tasks

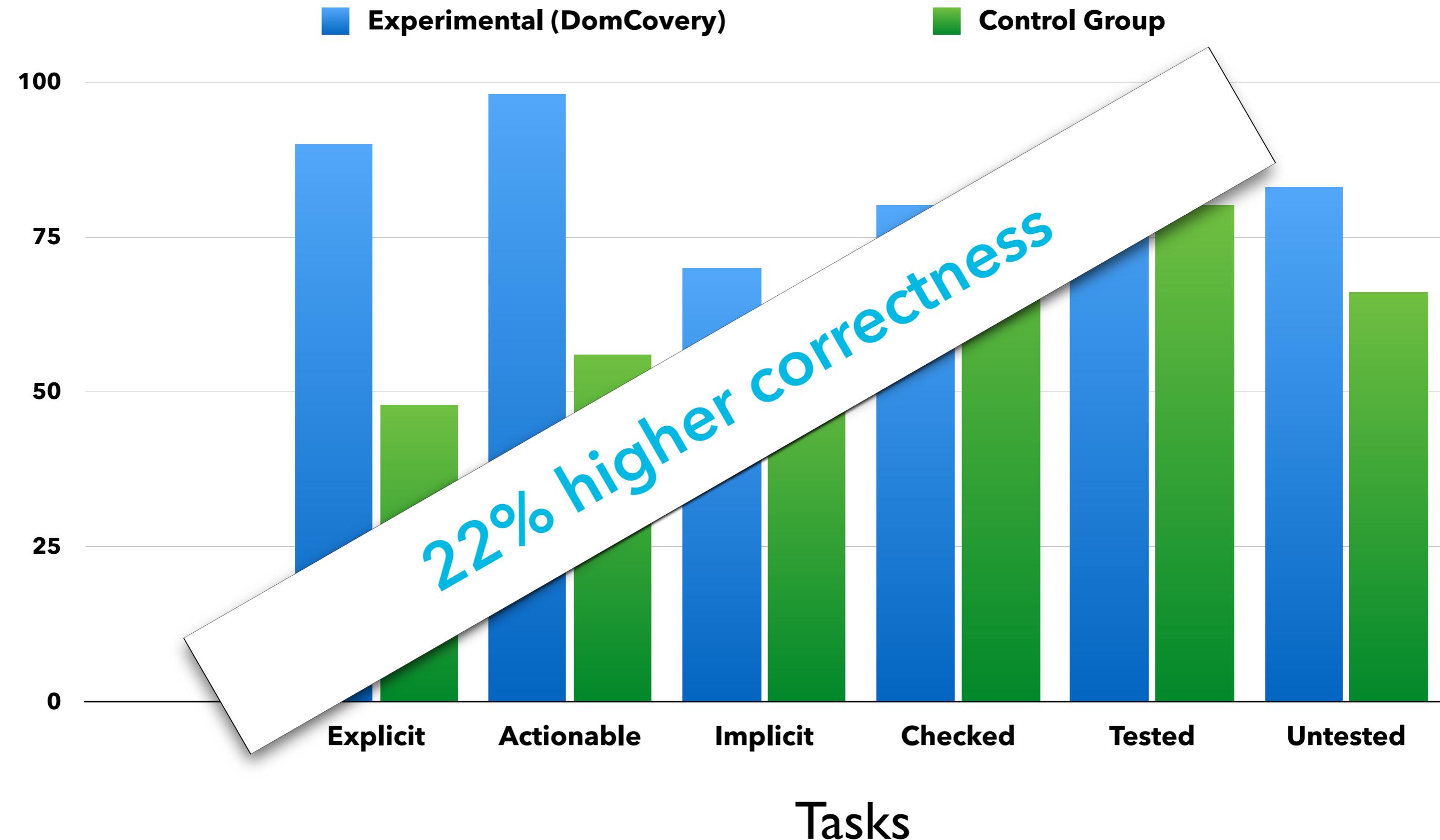
- T1: Locating the **explicit** elements covered by a test suite
- T2: Locating the **actionable** elements accessed via a test suite
- T3: Locating the **implicit** elements asserted in a test suite
- T4: Locating the **checked** elements covered by a test suite
  
- T5: Identifying the **features under tests** given a test suite
- T6: Identifying the **untested features** given a test suite



# Completion Time



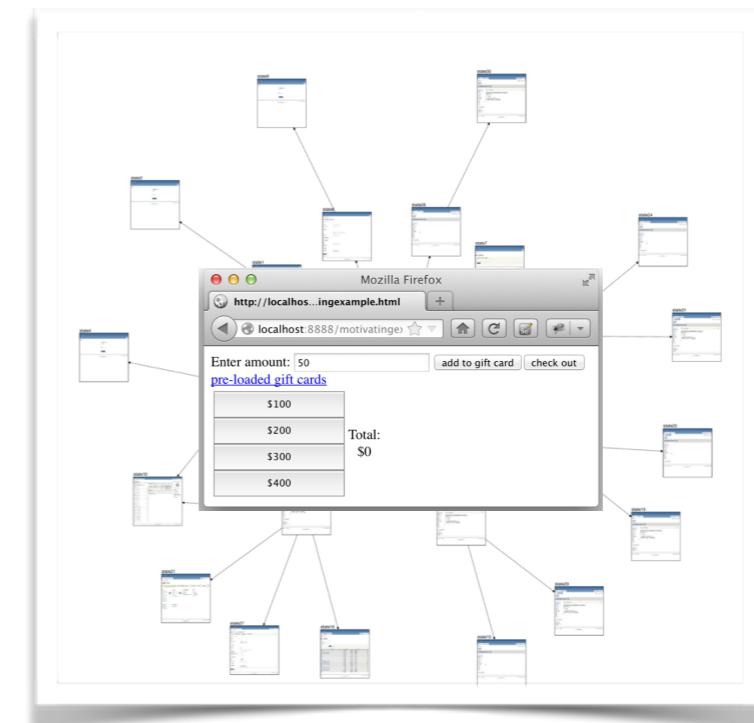
# Correctness



# Summary



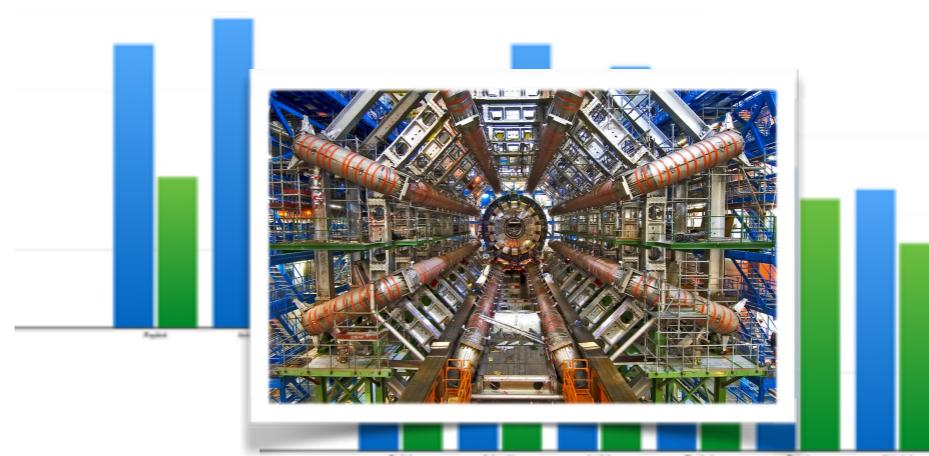
**DOM-based coverage criteria**



**2 inter-state and 4 intra-state  
adequacy criteria**



**Domcovery**

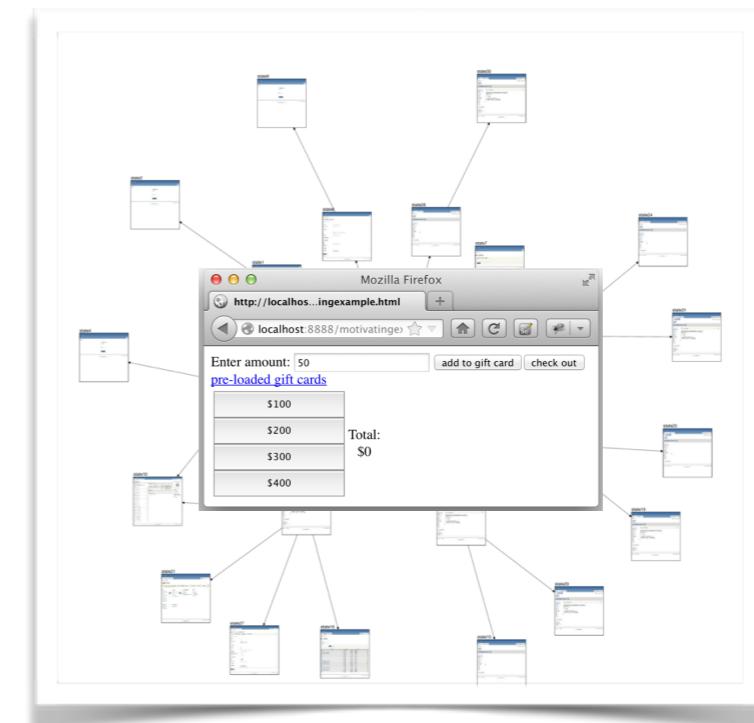


**Correlation/  
Controlled experiment**

# Summary



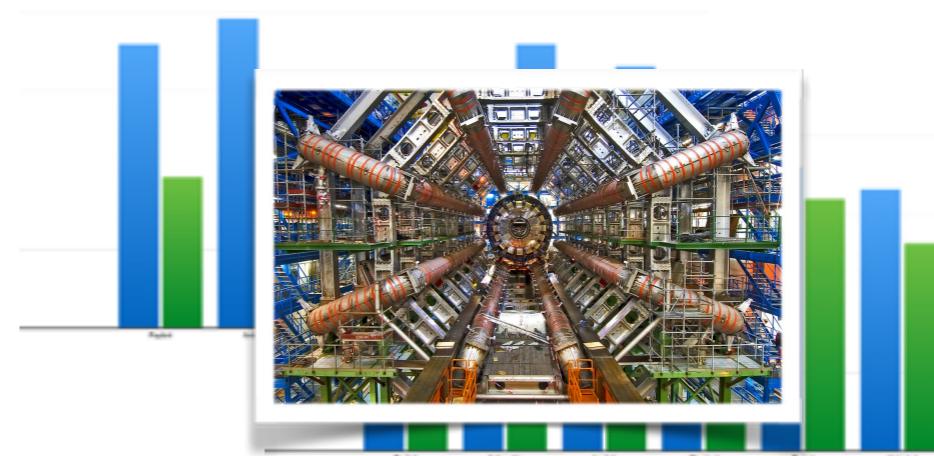
**DOM-based coverage criteria**



**2 inter-state and 4 intra-state adequacy criteria**



**Domcovery**



**Correlation/  
Controlled experiment**

back up

# Matching element