

Providing Protractor to Java / .Net

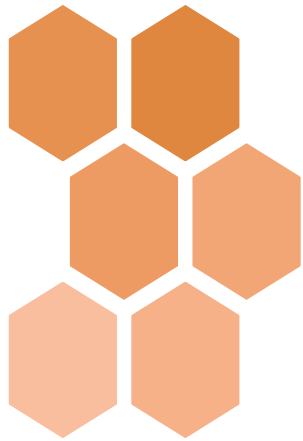
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Adding Key Client-side Protractor Methods to Java or .Net



Java



Node.js



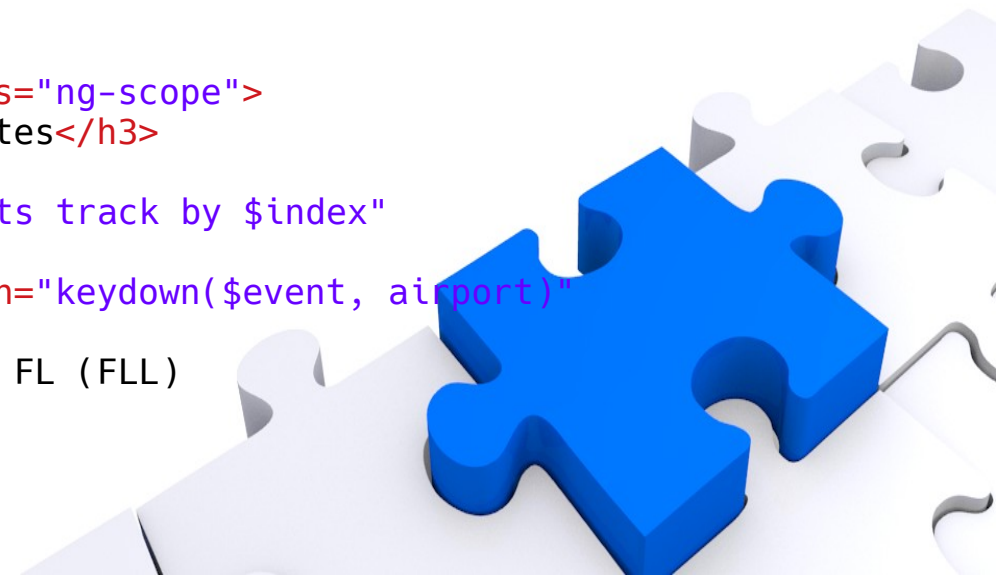
jProractor,
Protractor-
net



Framework-generated code

```
<div id="mega-topbar"
  class=
    "Pos(r) H(22px) mini-header_Mt(-19px) Reader-open_Mt(-19px)
    Bxsh($topbarShadow) Z(7) Bg($topbarBg)"
  data-ylk="rspns:nav;t1:a1;t2:hd;t3:tb;sec:hd;itc:0;elm:itm;elmt:pty;">
  <ul class="Pos(r) Miw(1000px) Pstart(9px) Lh(1.7) Reader-open_0p(0)
  mini-header_0p(0)" role="navigation">
    <li class="D(ib) Mstart(22px) Mend(8px)">
      <a class="C(#fff)" href="#" data-rapid_p="16">
        Make Yahoo Your Homepage<span>&nbsp;  ></span>
      </a>
    </li>
  </ul>
</div>

<ul ng-repeat="country in region.countries" class="ng-scope">
  <li> <h3 class="country ng-binding">United States</h3>
    <ul class="country-list">
      <li ng-repeat="airport in country.airports track by $index"
        class="popupLinks city jetblue">
        <a href="javascript:void(0)" ng-keydown="keydown($event, airport)"
          ng-click="select(airport)"
          class="ng-binding">Fort Lauderdale, FL (FLL)
        </a>
```



Bare-bones Angular page

```
<html ng-app="myApp">
<head>
<script src="angular.js"></script>
<script type="text/javascript">
var app = angular.module('myApp', []);
app.controller('myCtrl',
  function($scope){
    $scope.myChoice = 1;
    $scope.options = [
      {name: 'one', value: 1},
      {name: 'two', value: 2},
    ]
  });
</script>
</head>
```

```
<body ng-controller="myCtrl">
  <select ng-model="myChoice">
    <option ng-repeat="option in
options" value="{{option.value}}"
ng-selected=
  "option.value == myChoice"
>{{option.name}}</option>
  </select>
  <div>Value = {{myChoice}}</div>
</body>
</html>
```

Protractor 'client side' Javascript snippets injected in the browser enable test operate same language as page developer by offering element finder methods "by" binding, model, repeater etc. It also provides Angular agnostic methods like buttonText, cssContainingText

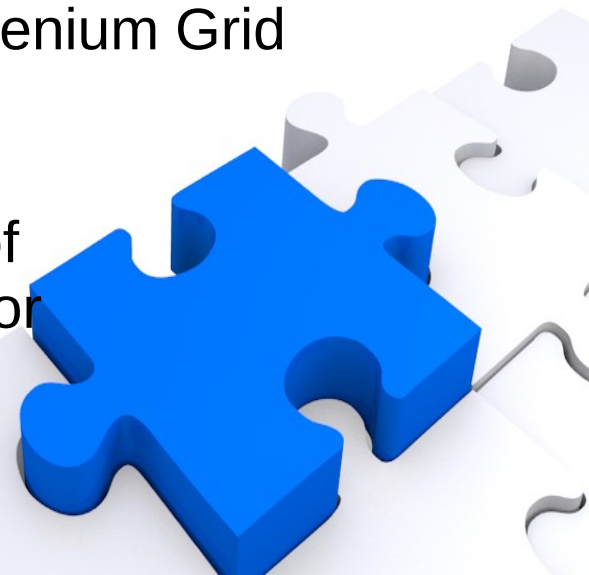


Angular Protractor in Javascript

Many of technologies considered part of Protractor Angular application "end to end" integration testing framework have same or better counterparts in Java and .Net stack outside of Selenium:

- mocha
- jasmine
- webdriverJs
- cucumber
- Junit / testNg
- Mockito
- Selenium / selenium Grid
- cucumber

From Selenium perspective, two outstanding features of Protractor are Angular semantics integration with locator and delegating the wait during element detection to Angular runtime.



Projects Timeline

- [angular/protractor](#) Jan 2013, 247 contributors
- [bbaia/protractor-net](#) Oct 2013, 10 contributors
- [paul-hammant/ngWebDriver](#) Sep 2013, 6 contributors
- [greengerong/maven-ng-protractor](#) Mar 2014, 1 contributor
- [caarlos0/jProtractor](#) Jul 2014, 2 contributors
- [kpodl/pytractor](#) Aug 2014, 2 contributors
- [GRITAG/Protractor-jvm](#) Jun 2015, 2 contributors
- [henrrich/jpagefactory](#) May 2016, 2 contributors



WebDriver Wire Protocol

Command	Method	URI Template
Find Element	POST	/session/{ <i>session id</i> }/element
Find Element from Another	POST	/session/{ <i>session id</i> }/element/{ <i>element id</i> }/element
Get Element Attribute	GET	/session/{ <i>session id</i> }/element/{ <i>element id</i> }/attribute/{ <i>name</i> }
Get Element Property	GET	/session/{ <i>session id</i> }/element/{ <i>element id</i> }/property/{ <i>name</i> }
Get Element CSS Value	GET	/session/{ <i>session id</i> }/element/{ <i>element id</i> }/css/{ <i>property name</i> }
Get Element Text	GET	/session/{ <i>session id</i> }/element/{ <i>element id</i> }/text
Get Element Tag Name	GET	/session/{ <i>session id</i> }/element/{ <i>element id</i> }/name
Get Element Rectangle position	GET	/session/{ <i>session id</i> }/element/{ <i>element id</i> }/rect
Execute Script	POST	/session/{ <i>session id</i> }/execute/sync
Execute Async script	POST	/session/{ <i>session id</i> }/execute/async

<https://w3c.github.io/webdriver/webdriver-spec.html#dfn-command>

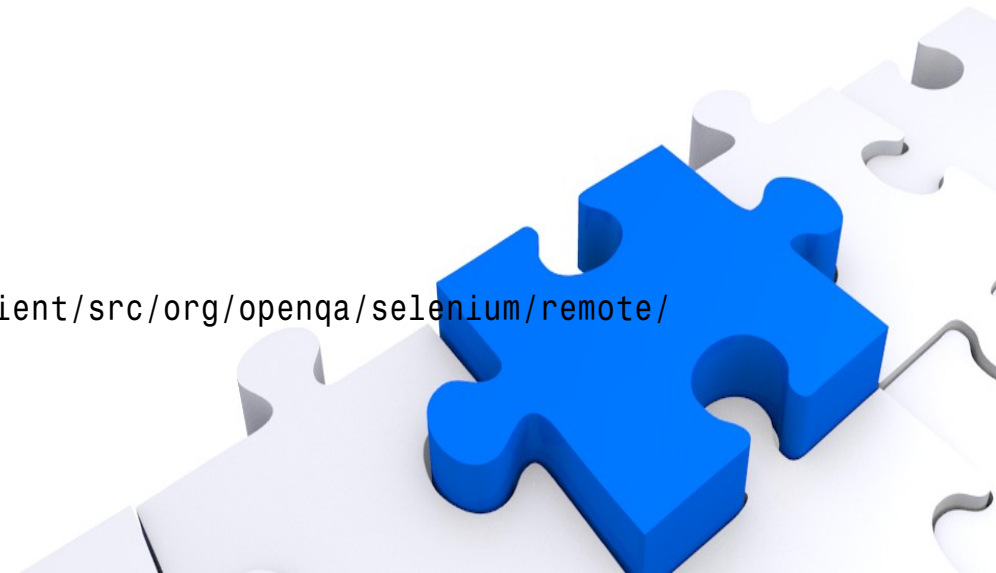
WebDriver Implementation

```
public class FirefoxDriver extends RemoteWebDriver {  
  
}
```

<https://github.com/SeleniumHQ/selenium/blob/master/java/client/src/org/openqa/selenium/firefox/FirefoxDriver.java>

```
public class RemoteWebDriver implements  
    WebDriver, JavascriptExecutor,  
    FindsById, FindsByClassName,  
    FindsByLinkText, FindsByName,  
    FindsByCssSelector, FindsByTagName,  
    FindsByXPath, HasInputDevices,  
    HasCapabilities, Interactive,  
    TakesScreenshot {  
  
}
```

<https://github.com/SeleniumHQ/selenium/blob/master/java/client/src/org/openqa/selenium/remote/RemoteWebDriver.java>

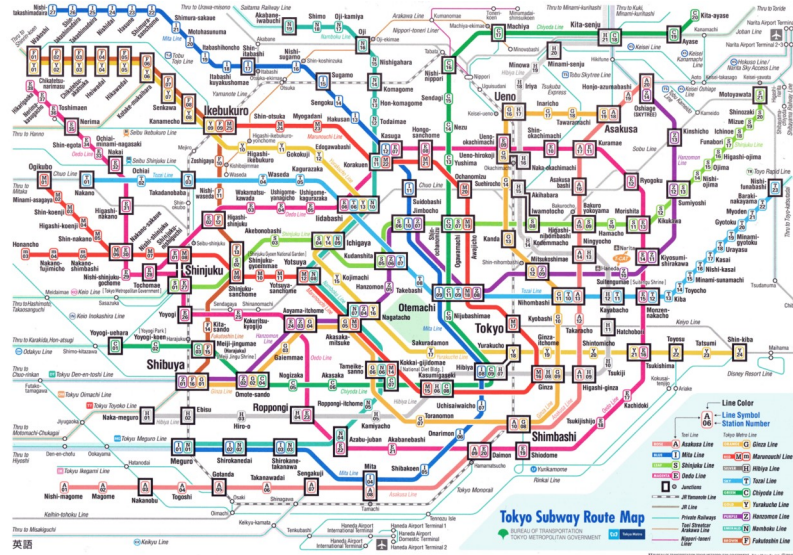


Russian Nesting Doll Architecture

Java program launches Selenium to be the carrier of Javascript snippet from Protractor library that commands Angular to find and process Page Elements



Internal Design



Swisswatch complexity vs. Tokyo Subway map complexity



Protractor methods

Method
model
binding
options
selectedOption, selectedRepeaterOption
repeater
repeaterRow, repeaterColumn, repeaterElement
buttonText, partialButtonText
cssContainingText
testForAngular, waitForAngular
evaluate

WebDriver extended with Protractor

- ByClassName, ByCssSelector, ById, ByLinkText, ByName, ByPartialLinkText, ByTagName, ByXPath (nested classes of By)
- NgBy (JavaScriptBy): binding, buttonText, cssContainingText, model, options, repeater, repeaterRows, repeaterElement, selectedOption, selectedRepeaterOption
- ExpectedConditions
- WebElement.findElements
- WebElement.evaluate
- Wait
- WebDriver.waitForAngular
- SendKeys
- Actions



Selenium JavascriptExecutor usage

Core Selenim 'By' classes support *a generic* DOM node therefore need annotated:

```
// finding selected customer
WebElement element = driver.findElement(By.xpath(
    "/div[13]/ul/li[4]/select"));

WebElement element = driver.findElement(By.cssSelector(
    "div#outer div.inner"));
```

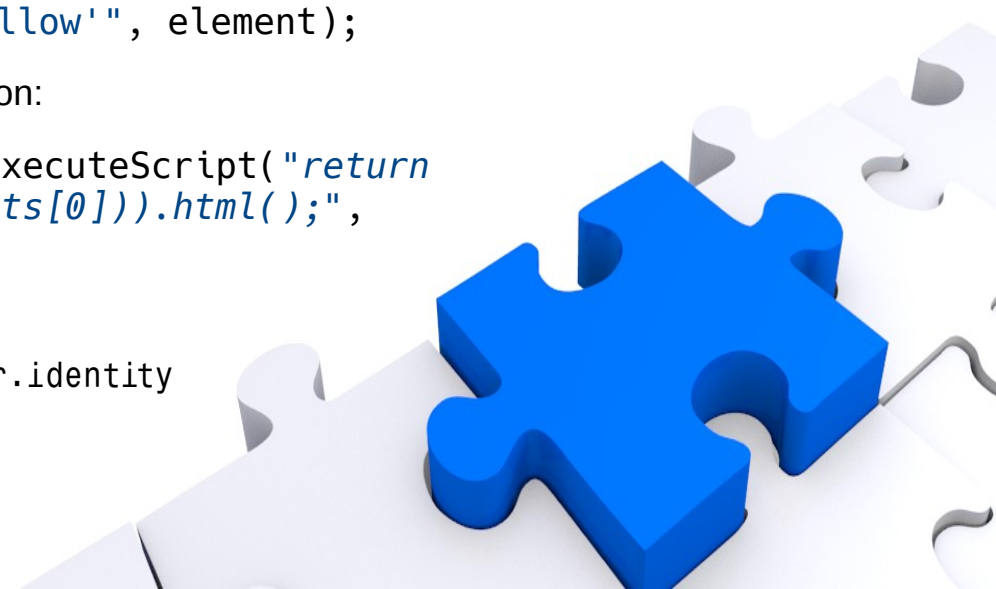
Javascript frequently used for visual cue:

```
// highlight
(JavascriptExecutor) driver.executeScript(
    "arguments[0].style.border='3px solid yellow'", element);
```

And can be equally used as well to return element information:

```
Object result = (JavascriptExecutor)driver.executeScript("return
    angular.identity(angular.element(arguments[0])).html();",
    element);
```

<https://docs.angularjs.org/api/ng/function/angular.identity>



Selenium Wait ExpectedConditions

- alertIsPresent :
- attributeContains
- attributeToBe :
- attributeToBeNotEmpty :
- elementSelectionModeToBe :
- elementToBeClickable :
- elementToBeSelected :
- frameToBeAvailableAndSwitchToIt :
- invisibilityOf :
- invisibilityOfAllElements :
- javaScriptThrowsNoExceptions :
- jsReturnsValue :
- and :
- or :
- not :
- numberOfElementsToBe :
- numberOfElementsToBeLessThan :
- numberOfElementsToBeMoreThan :
- numberOfWindowsToBe :
- presenceOfAllElementsLocatedBy :
- presenceOfElementLocated :
- presenceOfNestedElementLocatedBy :
- presenceOfNestedElementsLocatedBy :
- refreshed :
- stalenessOf :
- textMatches :
- textToBe :
- textToBePresentInElement :
- textToBePresentInElementLocated :
- textToBePresentInElementValue :
- titleContains :
- titles :
- urlContains :
- urlMatches :
- urlToBe :
- visibilityOf :
- visibilityOfAllElements :
- visibilityOfAllElementsLocatedBy :
- visibilityOfElementLocated :
- visibilityOfNestedElementsLocatedBy :

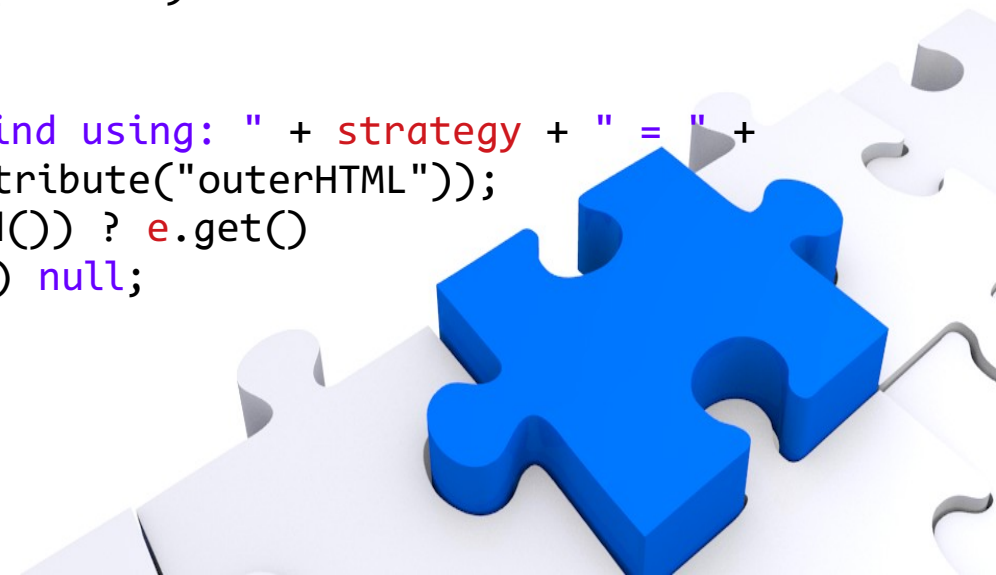
<https://seleniumhq.github.io/selenium/docs/api/java/>



Finding elements with explicit wait

```
switch (strategy) {  
    case "css":  
        locator = By.cssSelector(selectorValue);  
        break;  
};
```

```
element = (new WebDriverWait(driver, timeout)).until(new  
ExpectedCondition<WebElement>() {  
    @Override  
    public WebElement apply(WebDriver d) {  
        Optional<WebElement> e = d.findElements(locator)  
            .stream()  
            .findFirst();  
        if (e.isPresent()) { System.err.println("find using: " + strategy + " = " +  
            selectorValue + " => " + e.get().getAttribute("outerHTML"));  
        return (e.isPresent() && e.get().isDisplayed()) ? e.get()  
            : (WebElement) null;  
    }  
});
```



Protractor Wait

```
var el = document.querySelector(arguments[0]);  
var callback = arguments[1];  
angular.element(el).injector().get('$browser').notifyWhenNoOutstandingRequests(callback);
```

** in current version of Protractor – approx 100 lines*

```
public bool Displayed {  
    get {  
        this.ngDriver.WaitForAngular();  
        return this.element.Displayed;  
    }  
}
```

<https://github.com/angular/protractor/blob/master/lib/clientsidescripts.js>



Convenience of Protractor Locators

Choosing the same language the page and the Test makes test more readable: locators reflect the context

```
NgWebElement cell = ngDriver.findElement(  
    NgBy.repeaterElement("row in rows", rowNum, "cellName"));
```

```
ngDriver.findElement(ByAngular.repeater("car in Cars")  
    .row(2)  
    .column("item.isSelected")).click();
```

```
List<WebElement> customers = ngDriver.findElements(NgBy.repeater("cust in  
Customers"));
```

```
NgWebElement selectedCustomer =  
ngDriver.findElement(NgBy.model("selectedCustomer"));
```

```
WebElement customerName =  
selectedCustomer.findElement(NgBy.binding("Name"));
```

```
Object customerCountry = selectedCustomer.evaluate("customer.Country");
```

```
ArrayList<Long> accounts = (ArrayList<Long>)  
    new NgWebElement(ngDriver, selectedCustomer).evaluate(  
"customer.accountNo");
```



Sample Scenario

// Given I am at the Home Page And I proceed to customer login

```
ngDriver.findElement( NgBy.buttonText( "Customer Login" ))  
.click();
```

// I choose myself among existing customers

```
WebElement custId = ngDriver.findElement(NgBy.input( "custId" ));  
custId.click();
```

```
WebElement customer = custId.findElements(  
NgBy.repeater( "cust in Customers" )).stream().filter( cust ->  
cust.getText()  
.containsString( "Hermoine Granger" ))  
.findFirst().get();
```

```
customer.sendKeys( Keys.SPACE ); customer.click();  
ngDriver.waitForAngular();
```



Sample Scenario, contd.

```
// And I log in
login = ngDriver.findElement( NgBy.buttonText("Login"));
assertTrue(login.isEnabled());
highlight(login);
login.click();

// Then I am greeted by my name
assertThat("greeting", ngDriver.findElement( NgBy.binding("user")).getText(),
containsString("Hermoine Granger"));

// And I see balance on one of my accounts

NgWebElement accountNo = ngDriver.findElement(NgBy.binding("accountNo"));

assertThat("account number", accountNo.getText(),
anyOf(is("1001"), is("1002"), is("1003")));
highlight(accountNo);
```



Sample Scenario, contd.

// And I open account

```
ngDriver.findElements(NgBy.options("account for account in Accounts"))  
.stream().filter(account -> account.getText().matches("1001"))  
.collect(Collectors.toList()).get(0).click();
```

// And I click "Transactions" button

```
NgWebElement transactionsButton = ngDriver  
.findElement(NgBy.partialButtonText("Transactions"));  
highlight(transactionsButton);  
transactionsButton.click();
```

// And I inspect transactions

```
wait.until(ExpectedConditions.visibilityOf(  
ngDriver.findElement(  
NgBy.repeater("tx in transactions")).getWrappedElement()));
```



Sample Scenario, contd.

```
// Then for every transaction
```

```
for (WebElement tx : ngDriver.findElements(  
    NgBy.repeater("tx in transactions"))) {
```

```
    NgWebElement ngTx = new NgWebElement(ngDriver, tx);
```

```
    // it would be either Debit or Credit type
```

```
    assertThat("transaction type", ngTx.evaluate("tx.type").toString(),  
        anyOf(containsString("Debit"), containsString("Credit")));
```

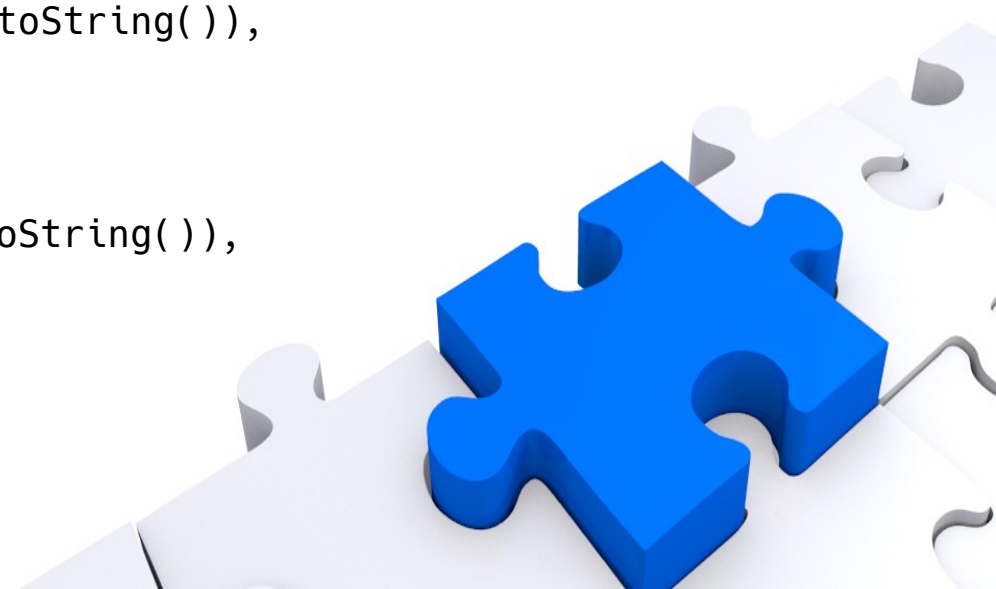
```
    // it will have non zero amount
```

```
    assertThat("it will have non zero amount",  
        Integer.parseInt(ngTx.evaluate("tx.amount").toString()),  
        greaterThan(0));
```

```
    // it date should be the past
```

```
    assertThat("transaction date",  
        dateFormat.parse(ngTx.evaluate("tx.date").toString()),  
        sameOrBefore(new Date()));
```

```
}
```



Sample Scenario, contd.

```
// perform some Credit transaction-specific
checksngDriver.findElement(NgBy.repeaterColumn("tx in transactions",
"tx.type"))
.stream()
.filter(txType -> txType.getText().equalsIgnoreCase("Credit"))
.forEach(txType -> highlight(txType));

// perform some set check over all accounts of certain customer
List<Long> accounts = (List<Long>) new NgWebElement(ngDriver,
ngDriver.findElement(
    NgBy.repeaterColumn("cust in Customers", "cust.fName"))
).evaluate("cust.accountNo");

System.err.println(accounts == null ? "No accounts"
: "Accounts: " + Arrays.toString(accounts.toArray()));
```



Sample Scenario, contd.

```
▶ <tr id="anchor1" ng-repeat="tx in transactions |
  orderBy:sortType:sortReverse | sDate:startDate:end" class="ng-scope"/>
◀ <tr id="anchor2" ng-repeat="tx in transactions |
  orderBy:sortType:sortReverse | sDate:startDate:end"
  class="ng-scope">
  <td class="ng-binding">Jan 1, 2015 12:00:00 AM</td>
  <td class="ng-binding">4</td>
  <td class="ng-binding">Debit</td>
</tr>
<table>
  <tbody>
    <tr id="anchor{{$index}}" ng-repeat="tx in transactions |
      orderBy:sortType:sortReverse | sDate:startDate:end">
      <td>{{ tx.date | date:'medium'}}</td>
      <td>{{ tx.amount }}</td>
      <td>{{ tx.type }}</td>
    </tr>
  </tbody>
</table>
```

view-source:<http://www.way2automation.com/angularjs-protractor/banking/listTx.html>



Protractor and Cucumber

@test **Scenario Outline:** Existing Customer Login

Given I am at the Home Page

When I continue as "Customer Login"

And I am choose my "<FirstName>", "<LastName>" among existing customers

And I log in

Then I am greeted by "<FirstName>", "<LastName>"

And I can switch to any of my accounts "<AccountNumbers>"

And I see balance

And I can not see any other accounts...

Examples:

AccountNumbers	FirstName	LastName
1001,1002,1003	Harry	Potter



Protractor and Cucumber cont.

```
// for scenario: Existing Customer Login
@When("^I am choose my \"([^\"]*)\", \"([^\"]*)\"$ among existing customers$")
public void loginWithFirstAndLastName(String fName, String lName) {
    WebElement customer = custId.findElements(
        NgBy.repeater("cust in Customers"))
        .stream()
        .filter(cust -> cust.getText()
            .containsString(String.format("%s %s", fName, lName)))
        .findFirst().get();

    customer.sendKeys(Keys.SPACE);
    customer.click();
    ngDriver.waitForAngular();
}
```



Protractor Annotations

```
NgWebElement firstoperand = ngDriver.findElement(NgBy.model("first"));
```

```
NgWebElement element = ngDriver.findElement(NgBy.options(  
"value for (key, value) in operators"));
```

```
@FindBy(how = How.MODEL, using = "first")
```

```
private WebElement element;
```

```
@FindBy(how = How.OPTIONS, using = "value for (key, value) in  
operators")
```



Clientsidescripts.js

18 methods

3 to > 100 lines of JavaScript / method

```
var element = arguments[0];  
var expression = arguments[1];  
return angular.element(element).scope().$eval(expression);
```

<https://github.com/angular/protractor/blob/master/lib/clientsidescripts.js#L623>



Clientsidescripts.js

```
var findBindings = function(binding, exactMatch, using, rootSelector) {
  var root = document.querySelector(rootSelector || 'body');
  using = using || document;
  var bindings = using.getElementsByClassName('ng-binding');
  var matches = [];
  for (var i = 0; i < bindings.length; ++i) {
    var dataBinding = angular.element(bindings[i]).data('$binding');
    var bindingName = dataBinding.exp || dataBinding[0].exp || dataBinding;
    var matcher = new RegExp('{{|\\s|^|\\|}}' +
      binding.replace(/[-\[\\]\|/g, '\\\\') + '\\(\\)\\*\\+\\?\\.\\\\\\\\^\\$\\|\\|/g,
    '\\\\$&') +
      '({|\\s|\\$|\\|}})');
    if (matcher.test(bindingName)) {
      matches.push(bindings[i]);
    }
  }
  return matches; /* Return the array for webdriver.findElement. */
};

var using = arguments[0] || document;
var binding = arguments[1];
var rootSelector = arguments[2];
return findBindings(binding, using, rootSelector);
```



Questions, Demos



Resources

- <https://github.com/angular/protractor>
- <https://giithub.com/sergueik/jProtractor>
- <https://github.com/henrrich/jpagefactory>
- <https://github.com/paul-hammant/ngWebDriver>
- <https://github.com/bbaia/protractor-net>



Resources

- <http://www.java2s.com/Tutorials/AngularJS/>
- <http://juliemr.github.io/protractor-demo/>
- <http://qualityshepherd.com/angular/friends/>
- <http://www.way2automation.com/angularjs-protractor/banking>
- <https://htmlpreview.github.io/?https://github.com/angular-ui/>
- <http://amitava82.github.io/angular-multiselect/>
- <http://www.codeproject.com/Articles/1066968/Developing-Protractor-tests-in-Csharp-or-Java>

