Test Automation & Advanced Selenium

Lesson 8 : Selenium Frameworks

Lesson Objectives

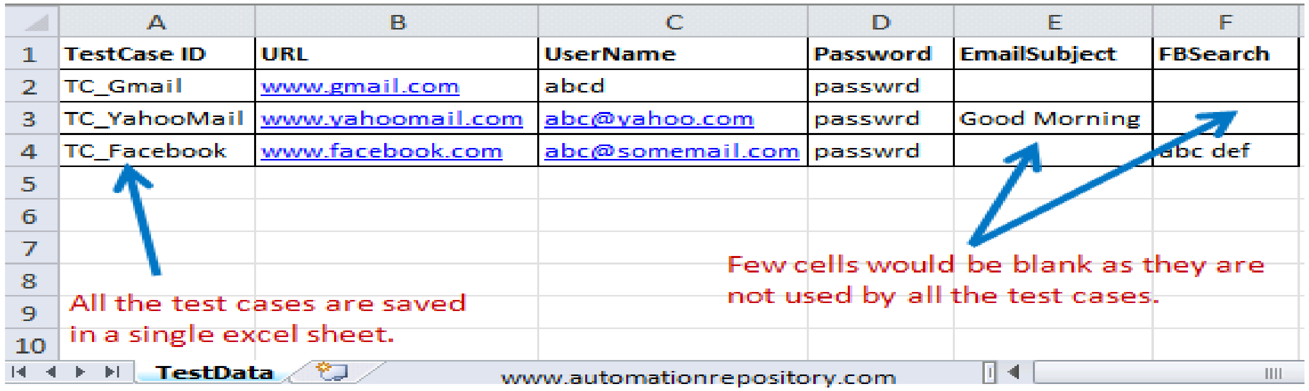
- Framework Overview
- Data Driven (Excel, Databases)
- Keyword Driven
- Component based (Sprintest®/CBF)
- Reports (Excel, PDF)
- TDD (Junit, TestNG)
- BDD (Cucumber, SpecFlow)
- ATDD (Fitnesse)
- CI Tools (Jenkins etc)

Framework Overview

- Automation testing requires a well-defined approach, based on a comprehensive framework, in order to reap maximum benefits.
- A framework is a hierarchical directory that encapsulates shared resources, such as a dynamic shared library, image files, localized strings, header files, and reference documentation, in a single package. There are various frameworks available for automation, such as:
  - Data-Driven Automation Framework.
  - Keyword-Driven Automation Framework.
  - Hybrid Automation Framework.
- Component based framework(CBF) is an hybrid Automation framework.

Data Driven

- Data driven is the design of possible inputs what may given by the end user. This would cover maximum probabilities of an input data.
- It can be Spread sheet or sql. We have to connect and pass the values to the respective field or element.
- In this type of framework Data is not hardcoded with script ,but data is provided from external source.
- When some test needs to repeat for different data set , Data driven framework gets used. In this framework, Parameters in the test case gets linked to database, excel, csv, text files from there test case run for all defined parameter in the file.
- Below figure shows example of the data driven, test case stored in excel



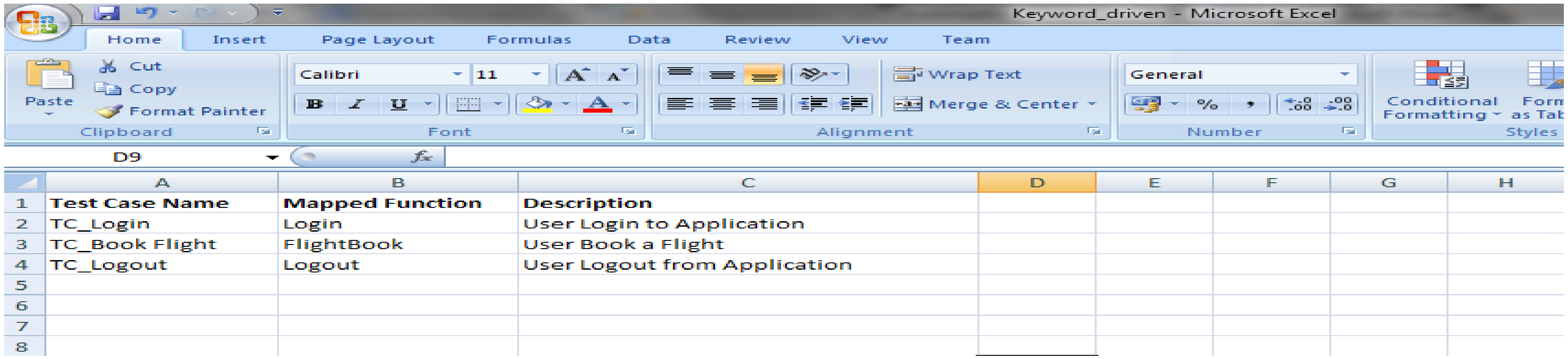
	A	B	C	D	E	F
1	TestCase ID	URL	UserName	Password	EmailSubject	FBSearch
2	TC_Gmail	www.gmail.com	abcd	passwrd		
3	TC_YahooMail	www.yahoomail.com	abc@yahoo.com	passwrd	Good Morning	
4	TC_Facebook	www.facebook.com	abc@somemail.com	passwrd		abc def
5						
6						
7						
8						
9						
10						

All the test cases are saved in a single excel sheet.

Few cells would be blank as they are not used by all the test cases.

Keyword-Driven

- As Name suggest, Keyword nothing but a code which represent some action, say “login”. in this framework, we map the set of code which perform certain action with a keyword and then we use that keyword across the framework.
- The Keyword-Driven or Table-Driven framework requires the development of data tables and keywords, independent of the test automation tool used to execute them. Keyword-driven tests look very similar to manual test cases.
- The driver code "drives" the application-under-test, keyword driven test and the data. In a keyword-driven test, the functionality of the application-under-test is documented in a table like structure for e.g. Excel Sheet
- Below figure shows example of the keyword-driven, test case stored in excel



Test Case Name	Mapped Function	Description
TC_Login	Login	User Login to Application
TC_Book Flight	FlightBook	User Book a Flight
TC_Logout	Logout	User Logout from Application

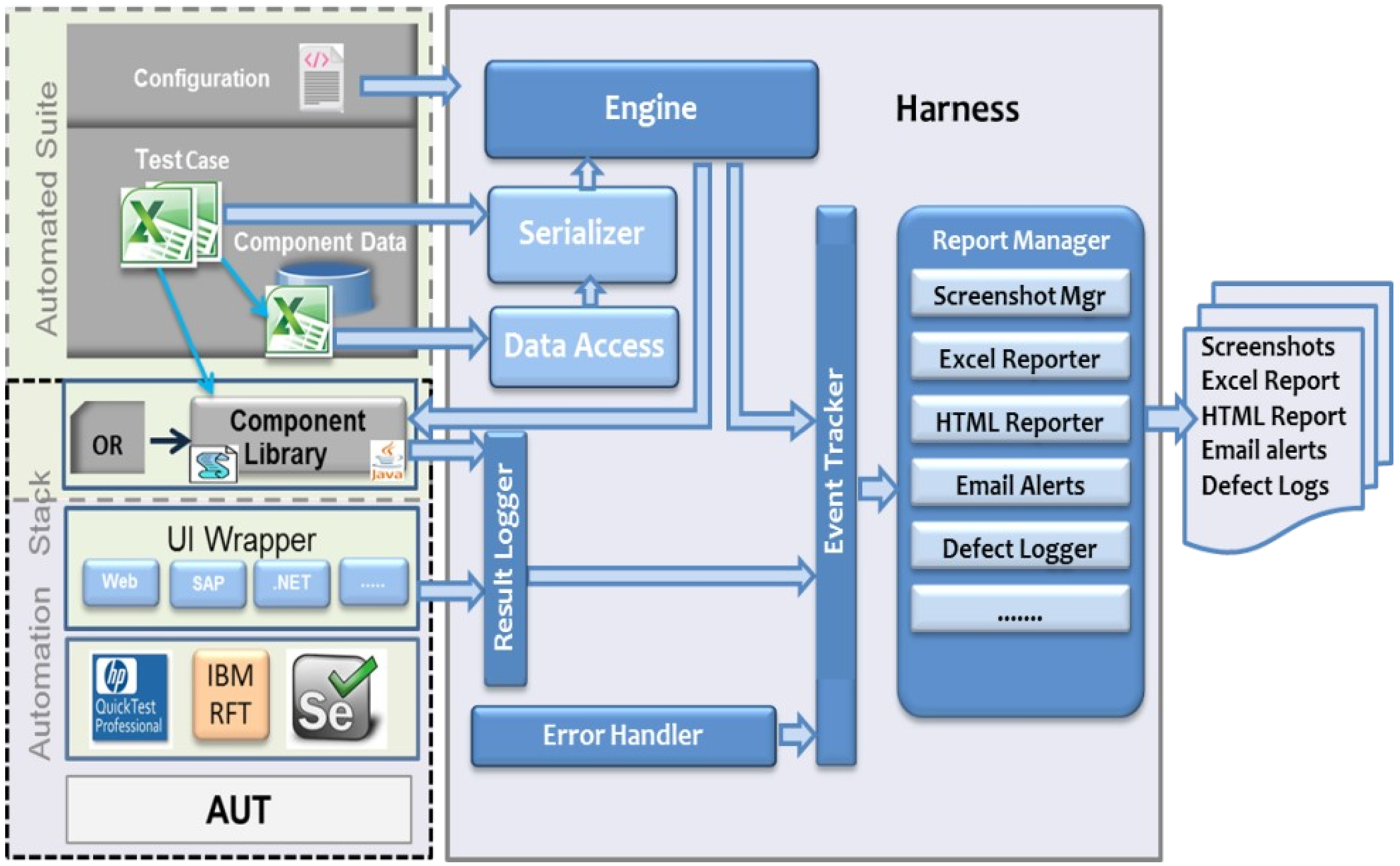
Component Based (Sprintest®/CBF)

- Component Based is an automatic test which is made up of components.
- It allows you to create automatic tests.
- IGATE’s Test Automation Framework (CBF) is IGATE’s Component Based Test Automation solution, aimed at optimizing test automation for business critical applications.
- CBF is designed to help test analysts and engineers build and automate tests using such abstraction, thus fine-tuning the test engineering process to the application under test (AUT) and minimizing the tedium of detailing each test step in each test one by one.

Framework Architecture

In consideration to the richness and diversity of UI of the applications and nature of test cases in scope, we are using a Modular Based Hybrid Automation Framework for the Automation project.

Sprintest®/CBF Architecture



Sprintest®/CBF Architecture (Cont.)

- Harness: Execution gets triggered from here. Initializes the result logs, reports and initiates execution.
- Engine: General purpose runner for executing component based test cases. It supports a robust event model for reporting. Also Encapsulates runtime exception handling, test failures and recovery.
- Serializer: Deserializes the Auto_TC.xls file, resolves the references with the help of Data Access and creates a testcase object for execution.
- Data Access: Reads data from centrally maintained data files at the module level, thus helps in resolving data refs.
- Error Handler: Logs errors in a csv file, thus helps in tracking error.

Sprintest®/CBF Architecture (Cont.)

- Result Logger: Exposes set of methods like Passed, Failed, Error, Done etc, which will be used to log results in the component libraries on verification. The logged results are made available in the selected reports.
- Report Manager: Manages different report types on user selection like ScreenshotMgr, Excel reporter, HTML Reporter, Email Alerts etc..
- Component Libraries:Collection of automation driver scripts for each action. Provision to organize functions into a small number of module driver files for maintainability. Simplifies test layer to a series of calls to this layer.
- OR:Used to store the Object Repository map file.
- Configuration: Refers to either hardware or software, or the combination of both

Sprintest®/CBF Architecture (Cont.)

- Configuration: Refers to either hardware or software, or the combination of both
- Component Data: Data maintained for components in the module excel workbooks.
- TestCase: Assembly of different combinations of components.
- Application Under Test: Application considered for automation.
- Automated testing tools: Execute tests, report outcomes and compare results with earlier test runs.
- UI Wrapper: Generic methods like SetValue(), Click(), GetCtrlProperty() etc.. which will be used in scripting the components.

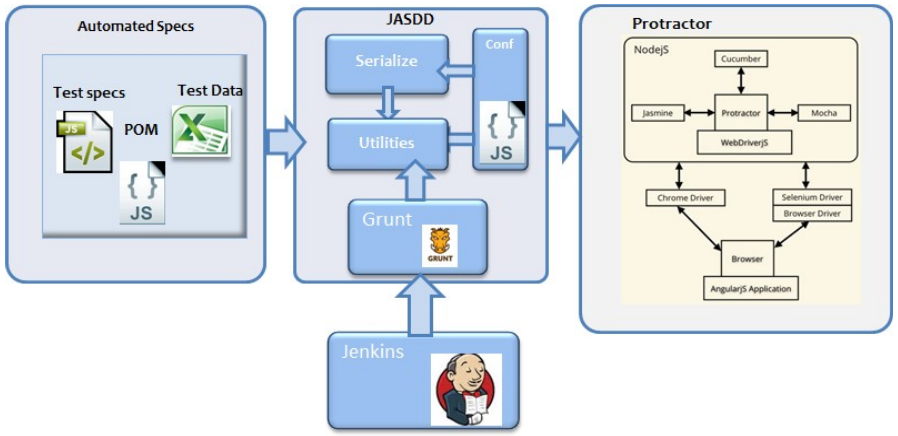
Sprintest®/Quadrant

- A Solution built over Protractor with options for Excel based test data and HTML & Excel based reports primarily for test automation of AngularJS based applications.

Highlights

- Uses Grunt for easy integration with CI tools and Command Line invocation as well
- Provides Test Data in Excel
- Provides facility to select Browser and Test Suite to executed
- Provides HTML report with Screenshots of failed steps

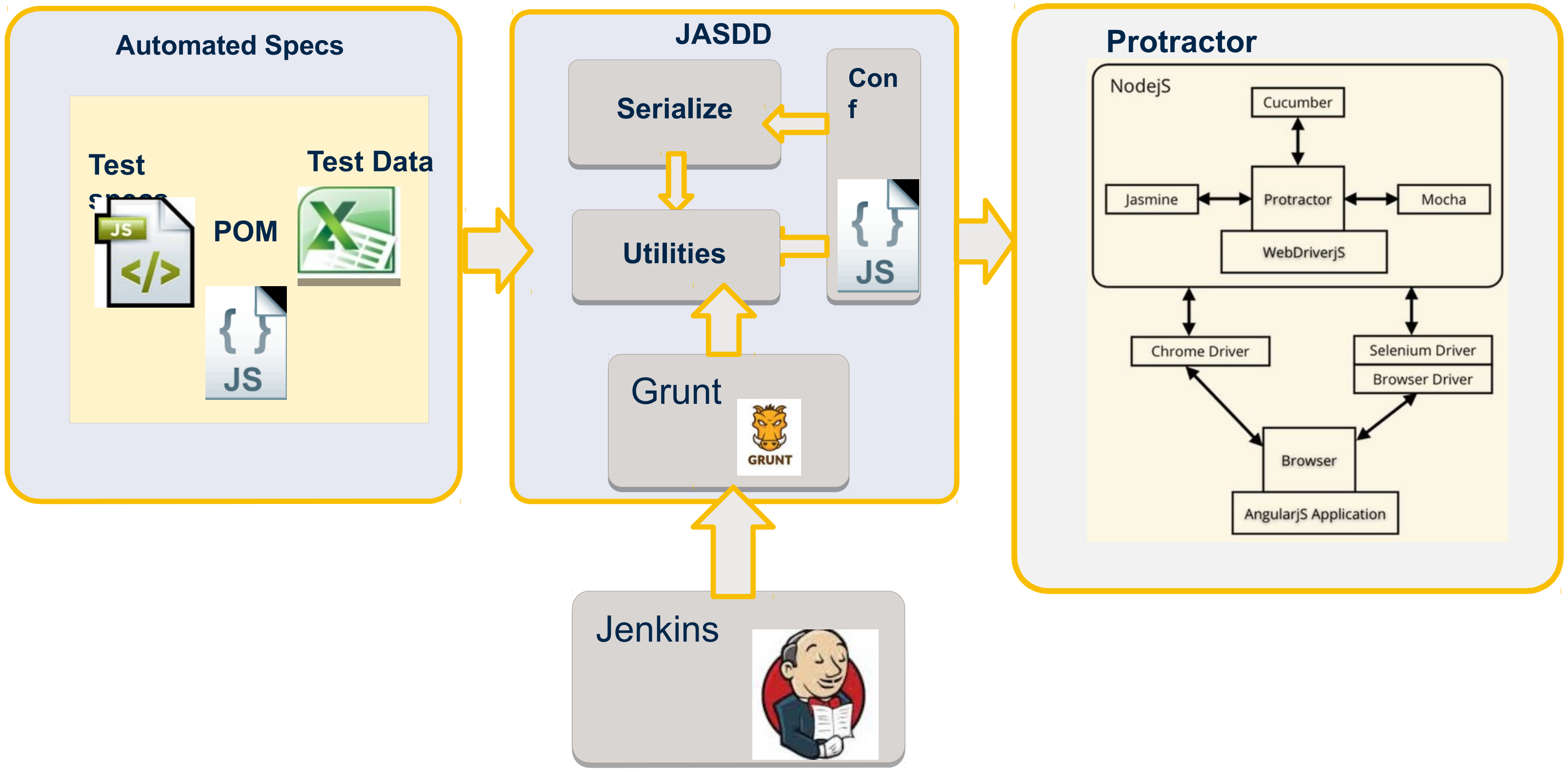
Architecture



Benefits

- Easy management of executions and results from a Jenkins central console
- Easily integrates with Jenkins .
- Provides to create Data Driven Test cases

Sprintest®/Quadrant Architecture

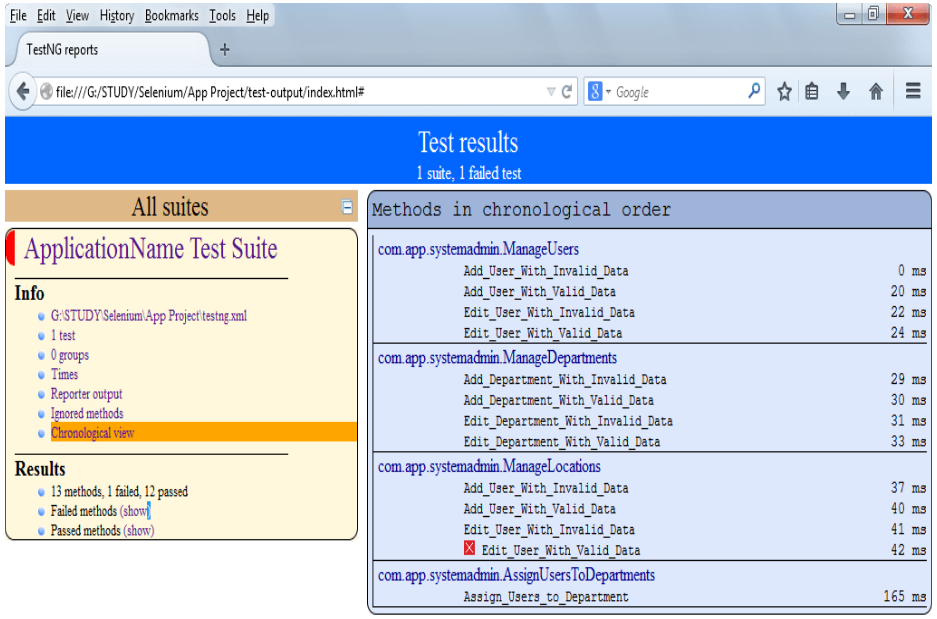


Reports

- Different applications have different reporting needs. Some require combined results for a test batch and some require individual level test report for each test case in test batch. Thus, framework should be flexible enough to generate required reports.
- Reports output in many formats such as Html/Excel/PDF Format.
- We can also capture and store all the screen shots for failed and passed scenarios
- It also store the executed data sheets with Pass/Fail status.
- It provides two types of reports
  - summary report and
  - detailed report
- The summary report provides details of execution duration, test start time and end time
- The detailed reports describe exceptional cases handled, steps passed, and steps failed.

Reports (Cont.)

- The below(fig:a) is the sample html format summary report generated by TestNG.
- The below(fig:b) is the example report to see failed test cases report in detail


File Edit View History Bookmarks Tools Help
TestNG reports
file:///G:/STUDY/Selenium/App Project/test-output/index.html#
Google

Test results
1 suite, 1 failed test

All suites

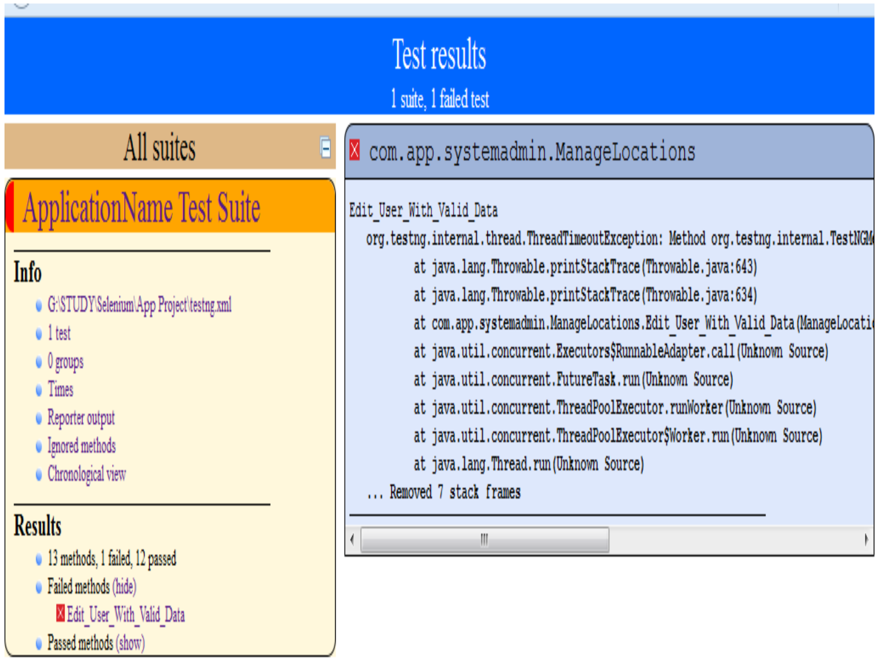
ApplicationName Test Suite

Info
- G:\STUDY\Selenium\App Project\testng.xml
- 1 test
- 0 groups
- Times
- Reporter output
- Ignored methods
- Chronological view

Results
- 13 methods, 1 failed, 12 passed
- Failed methods (show)
- Passed methods (show)

```
Methods in chronological order

com.app.systemadmin.ManageUsers
            Add_User_With_Invalid_Data                      0 ms
            Add_User_With_Valid_Data                       20 ms
            Edit_User_With_Invalid_Data                    22 ms
            Edit_User_With_Valid_Data                      24 ms
com.app.systemadmin.ManageDepartments
            Add_Department_With_Invalid_Data               29 ms
            Add_Department_With_Valid_Data                 30 ms
            Edit_Department_With_Invalid_Data              31 ms
            Edit_Department_With_Valid_Data                33 ms
com.app.systemadmin.ManageLocations
            Add_User_With_Invalid_Data                     37 ms
            Add_User_With_Valid_Data                       40 ms
            Edit_User_With_Invalid_Data                    41 ms
          ☒ Edit_User_With_Valid_Data                      42 ms
com.app.systemadmin.AssignUsersToDepartments
            Assign_Users_to_Department                    165 ms
```



Test results
1 suite, 1 failed test

All suites

ApplicationName Test Suite

Info
- G:\STUDY\Selenium\App Project\testng.xml
- 1 test
- 0 groups
- Times
- Reporter output
- Ignored methods
- Chronological view

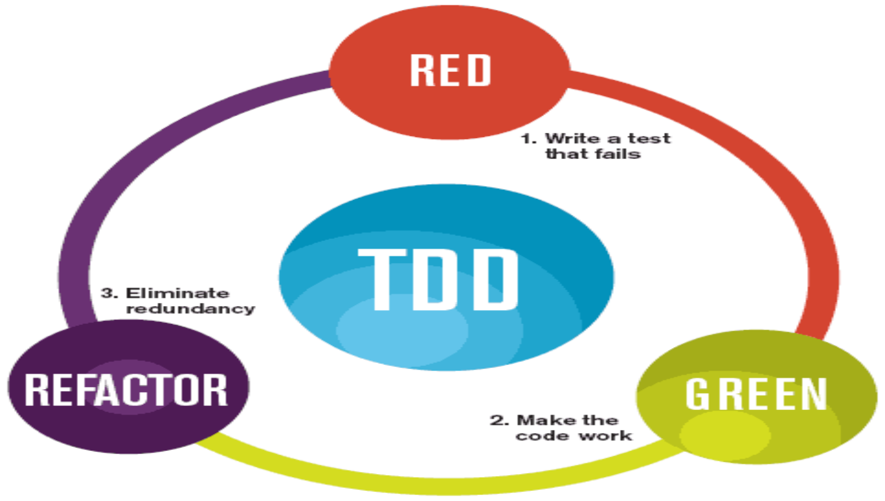
Results
- 13 methods, 1 failed, 12 passed
- Failed methods (hide)
  - ☒ Edit_User_With_Valid_Data
- Passed methods (show)

```
☒ com.app.systemadmin.ManageLocations

Edit_User_With_Valid_Data
  org.testng.internal.thread.ThreadTimeoutException: Method org.testng.internal.TestNGM
        at java.lang.Throwable.printStackTrace(Throwable.java:643)
        at java.lang.Throwable.printStackTrace(Throwable.java:634)
        at com.app.systemadmin.ManageLocations.Edit_User_With_Valid_Data(ManageLocati
        at java.util.concurrent.Executors$RunnableAdapter.call(Unknown Source)
        at java.util.concurrent.FutureTask.run(Unknown Source)
        at java.util.concurrent.ThreadPoolExecutor.runWorker(Unknown Source)
        at java.util.concurrent.ThreadPoolExecutor$Worker.run(Unknown Source)
        at java.lang.Thread.run(Unknown Source)
  ... Removed 7 stack frames
```

TDD

- Test-driven development (TDD) is a software development process that relies on the repetition of a very short development cycle: first the developer writes an (initially failing) automated test case that defines a desired improvement or new function, then produces the minimum amount of code to pass that test, and finally refactors the new code to acceptable standards.



The mantra of Test-Driven Development (TDD) is "red, green, refactor."

RED – The developer writes a failing test essentially capturing the requirements in a test.
GREEN – The developer implements the business functionality, writing just enough code to pass the test
REFACTOR – The developer refines and improves the code without adding new functionality.

Acceptance TDD

- There are two levels of TDD:
  - Acceptance TDD (ATDD):It is a development methodology based on communication between the business customers, the developers, and the testers .
  - With ATDD you write a single acceptance test, or behavioral specification depending on your preferred terminology, and then just enough production functionality/code to fulfill that test.
  - The goal of ATDD is to specify detailed, executable requirements for your solution on a just in time (JIT) basis. Since, ATDD encompasses many of the same practices it is also called Behavior Driven Development (BDD)

  - Behavior Driven(BDD) :Behavior-driven development combines practices from TDD and from ATDD.
  - It includes the practice of writing tests first, but focuses on tests which describe behavior, rather than tests which test a unit of implementation. Tools such as Mspec and Specflow provide a syntax which allow non-programmers to define the behaviors which developers can then translate into automated tests.

ATDD Framework

- FitNesse
  - FitNesse is one of the Acceptance TDD framework.
  - It is a web server, a wiki and an automated testing tool for software.
  - It allows users of a developed system to enter specially formatted input (its format is accessible to non-programmers).
  - The input is interpreted and tests are created automatically. These tests are then executed by the system and output is returned to the user.
  - The advantage of this approach is very fast feedback from users. The developer of the system to be tested needs to provide some support
  - It is written in Java. The program first supported only Java, but versions for several other languages have been added over time likeC++, Python, Ruby, Delphi, C#, etc.
  - Different Principles of fitNesse is described in the next page.

ATDD Framework (Cont.)

- **FitNesse as a testing method**

  It was originally designed as a highly usable interface around the Fit framework. As such its intention is to support an agile style of black-box testing acceptance and regression testing. In this style of testing the functional testers in a software development project collaborate with the software developers to develop a testing suite.

- **FitNesse as a testing tool**

  Tests are described in Fitnesse as some sort of coupling of inputs and expected output. These couplings are expressed as some sort of variation of a decision table. The FitNesse tool supports several of these variations, ranging from literal decision tables to tables that execute queries to tables that express testing scripts (i.e. a literal ordering of steps that must be followed to reach a result).

- **FitNesse as a software tool**

  It is a tool developed in Java and shipped as a single, executable jar file. The executable includes a wiki engine, an embedded web server, a testing engine and all the resources (images, stylesheets and so on) required to create a web site in FitNesse's own style.

Behavior TDD

- In software engineering, behavior-driven development is a software development process that emerged from test-driven development (TDD).
- Behavior-driven development combines the general techniques and principles of TDD with ideas from domain-driven design and object-oriented analysis and design to provide software development and management teams with shared tools and a shared process to collaborate on software development.
- Although BDD is principally an idea about how software development should be managed by both business interests and technical insight, the practice of BDD does assume the use of specialized software tools to support the development process.
- BDD is an agile software development technique that encourages collaboration between developers, QA, and non-technical or business participants in a software project. It's more about business specifications than about tests. You write a specification for a story and verify whether the specs work as expected.
- Some of BTDD Frameworks are:
  - Cucumber
  - Spec Flow

BTDD Frameworks

Cucumber

- Cucumber is a software tool that computer programmers use for testing other software. It runs automated acceptance tests written in a behavior-driven development (BDD) style.
- Cucumber is written in the Ruby programming language.
- Cucumber allows the execution of feature documentation written in business-facing text.
  - Example:
    - A feature definition, with a single scenario:
- Feature:
  - Division In order to avoid silly mistakes Cashiers must be able to calculate a fraction
- Scenario:
  - Regular numbers * I have entered 3 into the calculator * I press divide * I have entered 2 into the calculator * I press equal * The result should be 1.5 on the screen.

BTDD Frameworks (Cont.)

The execution of the test implicit in the feature definition above requires the definition, using the Ruby language, of a few "steps"

```
Before do @calc = Calculator.new
end
After do
End
 Given /I have entered (\d+) into the calculator/ do |n|
@calc.push n.to_i
end
When /I press (\w+)/ do |op|
@result = @calc.send op
end
Then /the result should be (.*) on the screen/ do |result|
 @result.should == result.to_f
end
```

BTDD Frameworks (Cont.)

Specflow

- SpecFlow is a BDD library/framework for .NET that adds capabilities that are similar to Cucumber. It allows to write specification in human readable Gherkin format
- Gherkin is the language that Cucumber understands. It is a Business Readable, Domain Specific Language that lets you describe software behavior without detailing with how that behavior is implemented. It's simply a DSL for describing the required functionality for a given system. This functionality is broken down by feature, and each feature has a number of scenarios.
- It is open source and provided under a BSD license . As a part of the Cucumber family, it uses the official Gherkin parser and provides integration to the .NET framework, Silverlight, Windows Phone and Mono.
- It bridges the communication gap between domain experts and developers by binding business readable behavior specifications and examples to the underlying source code.
- It also supports the concepts of Acceptance Test Driven Development (ATDD) and Behavior Driven Development (BDD).

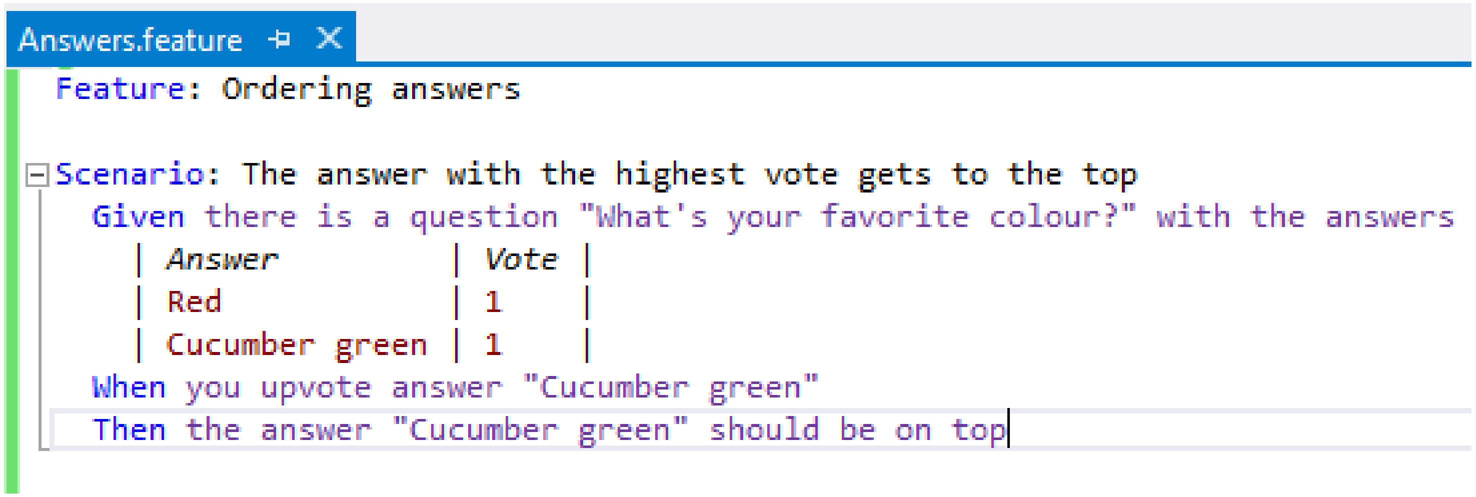
BTDD Frameworks (Cont.)

Example:

- THE ESSENCE IN two EASY STEPS

Specify!

Describe behavior and evolve a business readable testing and specification DSL.



Answers.feature

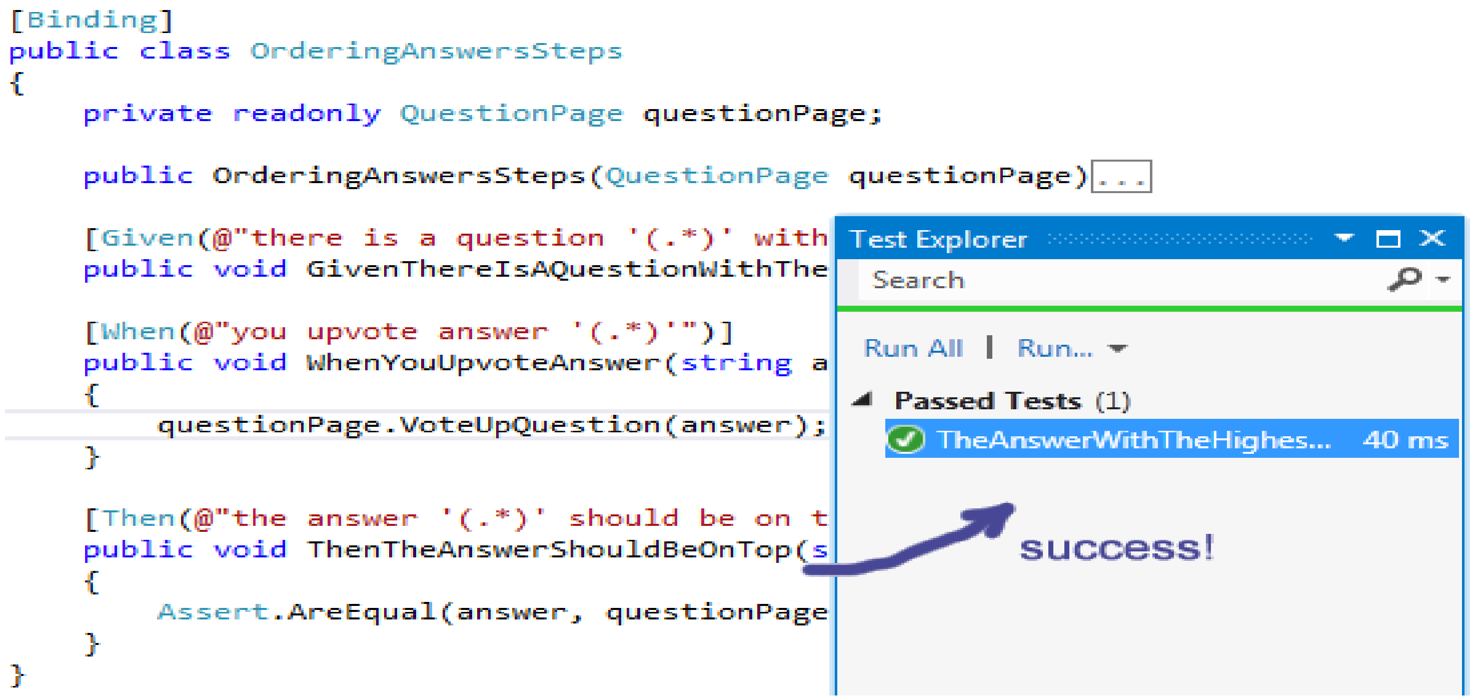
```
Feature: Ordering answers

Scenario: The answer with the highest vote gets to the top
  Given there is a question "What's your favorite colour?" with the answers
    | Answer          | Vote |
    | Red             | 1    |
    | Cucumber green  | 1    |
  When you upvote answer "Cucumber green"
  Then the answer "Cucumber green" should be on top
```

BTDD Frameworks (Cont.)

Automate!

- Automate scenarios to establish a continuously validated living documentation.



```
[Binding]
public class OrderingAnswersSteps
{
    private readonly QuestionPage questionPage;

    public OrderingAnswersSteps(QuestionPage questionPage)...

    [Given(@"there is a question '(.*)' with
    public void GivenThereIsAQuestionWithThe

    [When(@"you upvote answer '(.*)'")]
    public void WhenYouUpvoteAnswer(string a
    {
        questionPage.VoteUpQuestion(answer);
    }

    [Then(@"the answer '(.*)' should be on t
    public void ThenTheAnswerShouldBeOnTop(s
    {
        Assert.AreEqual(answer, questionPage
    }
}
```

Test Explorer

Passed Tests (1)

TheAnswerWithTheHighes... 40 ms

success!

Continuous Integration

- Continuous integration (CI) is the practice, in software engineering, of merging all developer working copies to a shared mainline several times a day.
- The main aim of CI is to prevent integration problems, referred to as "integration hell" in early descriptions of XP. CI isn't universally accepted as an improvement over frequent integration, so it is important to distinguish between the two as there is disagreement about the virtues of each.
- In addition to automated unit tests, organizations using CI typically use a build server to implement continuous processes of applying quality control in general — small pieces of effort, applied frequently.
- Continuous integration involves integrating early and often, so as to avoid the pitfalls of "integration hell". The practice aims to reduce rework and thus reduce cost and time.
- A complementary practice to CI is that before submitting work, each programmer must do a complete build and run (and pass) all unit tests. Integration tests are usually run automatically on a CI server when it detects a new commit.

CI Tools

Jenkins

- Jenkins provides continuous integration services for software development. It is a server-based system running in a servlet container such as Apache Tomcat .
- Plugins have been released for Jenkins that extend its use to projects written in languages other than Java. Plugins are available for integrating Jenkins with most version control systems and big databases. Many build tools are supported via their respective plugins. Plugins can also change the way Jenkins looks or add new functionality.
- Builds can generate test reports in various formats supported by plugins (JUnit support is currently bundled) and Jenkins can display the reports and generate trends and render them in the GUI.

Summary

- In this lesson, you have learnt
  - In this lesson, you have understood the different ways in the data is driven from the framework.
  - In the Data Driven Automation Framework, the Input Data/Input Parameters are not hard-coded in the test scripts. Instead, these are stored and passed from external files/resources such as Microsoft Excel Spreadsheets, Microsoft Access Tables, SQL Tables and XML files etc.
  - In the Keyword Driven Automation Framework, we can create multiple keywords that allow testers to associate a unique action or function for each of these keywords
  - After execution of the test script, it is necessary to get the results of the execution. The reports are customized in the framework such that the summary report and the detailed report are stored in html format.
  - Test-driven development does not perform sufficient testing in situations where full functional tests are required to determine success or failure, due to extensive use of unit tests.

Review Question

- Question 1:
  - CBF is
  - Data Driven Framework
  - Key word Driven Framework
  - Hybrid Framework
  - None of the above

- Question 2: True/False
  - The summary report provides details of execution duration, test start time and end time

- Question 3: Fill in the Blanks
  - Cucumber is written in the ________________language.