Asian Institute of Technology
School of Engineering and Technology
AT70.19: Software Development and Quality Improvement

"AIR QUALITY (PM2.5) MONITORING SYSTEM" (IOT-BASED PLATFORM)

System Documentation

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1. Spring Boot Overview

It is a framework that gives us needed resources to build up an application.

1.1 Application of Spring Boot

Spring Boot can be applied and used in different ways like; If we need security, we can use security model available, logging integration, connecting to database (mongo dB, MySQL, etc.), is easy to learn, production ready, can build microservices, dependency injection, configuration, Great community and many more.

Link for beginner to start using Spring Boot:

https://spring.io/quickstart

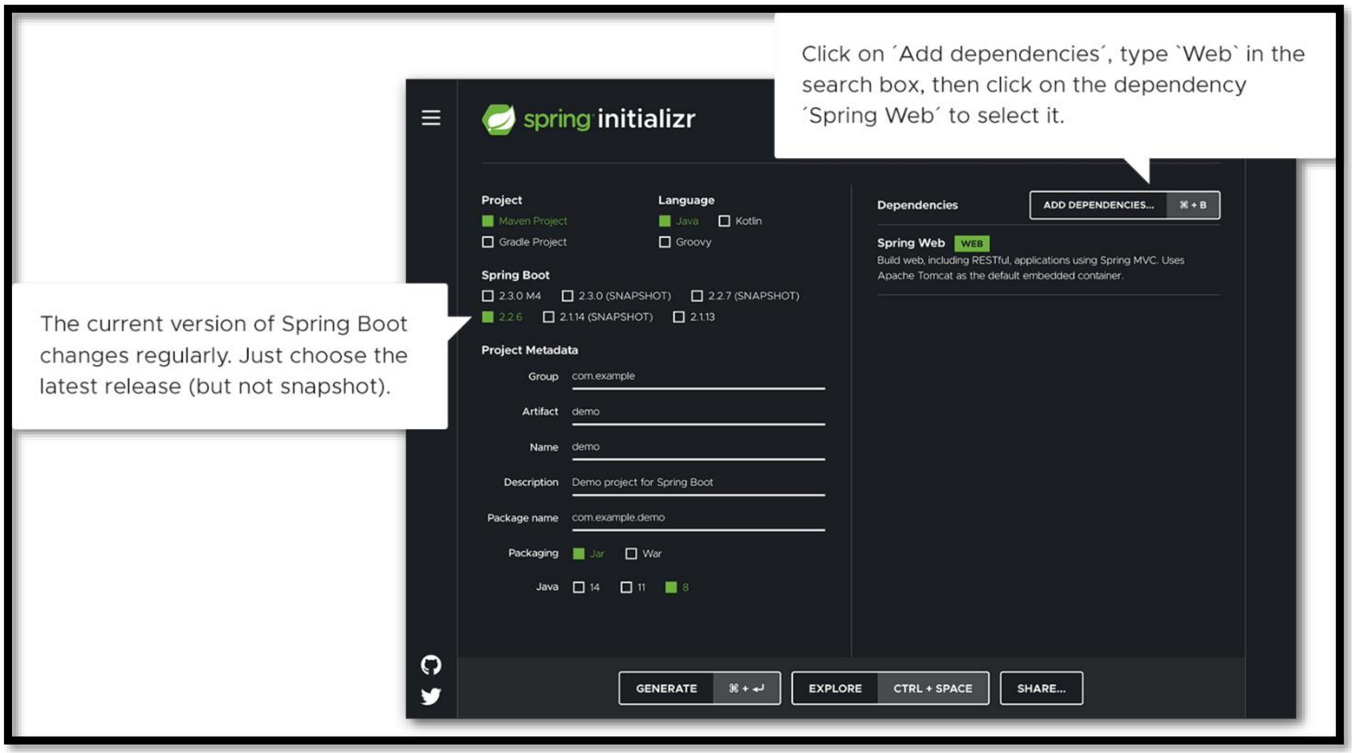
Steps to follow:

1. Choose one Integrated Developer Environment (IDE) and Install it
2. We need JDK (Java Development Kit), Install the correct version.

After the above steps, we are ready to start new Spring Boot project.

Use start.spring.io to create a "web" project.

In the "Dependencies" dialog search for and add the dependencies that are needed such as shown in the screenshot. Hit the "Generate" button, download the zip, and unpack it into a folder on your computer.



Click on ´Add dependencies´, type `Web` in the search box, then click on the dependency ´Spring Web´ to select it.

The current version of Spring Boot changes regularly. Just choose the latest release (but not snapshot).

spring initializr

Project
🟩 Maven Project
☐ Gradle Project

Language
🟩 Java ☐ Kotlin
☐ Groovy

Spring Boot
☐ 2.3.0 M4 ☐ 2.3.0 (SNAPSHOT) ☐ 2.2.7 (SNAPSHOT)
🟩 2.2.6 ☐ 2.1.14 (SNAPSHOT) ☐ 2.1.13

Project Metadata

Group	com.example
Artifact	demo
Name	demo
Description	Demo project for Spring Boot
Package name	com.example.demo
Packaging	🟩 Jar ☐ War
Java	☐ 14 ☐ 11 🟩 8

Dependencies

Spring Web WEB
Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

After this, open this folder from your IDE and add your code or you can copy and paste the code from the mention website. Then we can run the program from IDE terminal giving the following command:

1. MacOS/Linux

```
./mvnw spring-boot:run
```

2. Windows

```
mvnw spring-boot:run
```

If you have followed the steps from mention website, then you will be able to see Hello World! When you open your browser and typed the http://localhost:8080/hello.

You can check: http://localhost:8080/hello?name=SDQI%20Project

Output:

```
Hello SDQI Project!
```

2. Apache Kylin

Analytical Data Warehouse for Big Data

2.1 Installation Guide

2.1.1 Software Requirements

- ✓ Hadoop: 2.7+, 3.1+ (since v2.5)
- ✓ Hive: 0.13 - 1.2.1+
- ✓ HBase: 1.1+, 2.0 (since v2.5)
- ✓ Spark (optional) 2.3.0+
- ✓ Kafka (optional) 1.0.0+ (since v2.5)
- ✓ JDK: 1.8+ (since v2.5)
- ✓ OS: Linux only, CentOS 6.5+ or Ubuntu 16.0.4+

2.1.2 Hardware Requirements

The minimum configuration of a server running Kylin is 4 core CPU, 16 GB RAM and 100 GB disk. For high-load scenarios, a 24-core CPU, 64 GB RAM or higher is recommended.

2.2 Hadoop Environment

Kylin relies on Hadoop clusters to handle large data sets. We need to prepare a Hadoop cluster with HDFS, YARN, MapReduce, Hive, HBase, Zookeeper and other services for Kylin to run.

Kylin can be launched on any node in a Hadoop cluster. For convenience, we can run Kylin on the master node.

Linux accounts running Kylin must have access to the Hadoop cluster, including the permission to create/write HDFS folders, Hive tables, HBase tables, and submit MapReduce tasks.

2.3 Kylin Installation

1. Download a binary package for your Hadoop version from the Apache Kylin Download Site (https://kylin.apache.org/download/).
2. Unzip the tarball and configure the environment variable $KYLIN_HOME to the Kylin folder.

2.3.1 Kylin tarball structure

- **bin**: shell scripts to start/stop Kylin service, backup/restore metadata, as well as some utility scripts.
- **conf**: XML configuration files. The function of these xml files can be found in configuration page
- **lib**: Kylin jar files for external use, like the Hadoop job jar, JDBC driver, HBase coprocessor jar, etc.
- **meta_backups**: default backup folder when run “bin/metastore.sh backup”;
- **sample_cube**: files to create the sample cube and its tables.
- **spark**: the default spark binary that built with Kylin.
- **tomcat** the tomcat web server that run Kylin application.
- **tool**: the jar file for running utility CLI.

2.4 Start Kylin

Run the script, `$KYLIN_HOME/bin/kylin.sh start`, to start Kylin. The interface output is as follows:

```
Retrieving hadoop conf dir...
KYLIN_HOME is set to /usr/local/apache-kylin-2.5.0-bin-hbase1x
......
A new Kylin instance is started by root. To stop it, run 'kylin.sh stop'
Check the log at /usr/local/apache-kylin-2.5.0-bin-hbase1x/logs/kylin.log
Web UI is at http://<hostname>:7070/kylin
```

2.5 Using Kylin

Once Kylin is launched, we can access it via the browser http://<hostname>:7070/kylin with specifying <hostname> with IP address or domain name, and the default port is 7070.

The initial username and password are ADMIN/KYLIN.

After the server is started, we can view the runtime log, $KYLIN_HOME/logs/kylin.log.

2.6 Stop Kylin

Run the $KYLIN_HOME/bin/kylin.sh stop script to stop Kylin. The console output is as follows:

```
Retrieving hadoop conf dir...
KYLIN_HOME is set to /usr/local/apache-kylin-2.5.0-bin-hbase1x
Stopping Kylin: 25964
Stopping in progress. Will check after 2 secs again...
Kylin with pid 25964 has been stopped.
```

3. Run Kylin with Docker

To allow users to easily try Kylin, and to facilitate developers to verify and debug after modifying the source code. Kylin provide Kylin's docker image. In this image, each service that Kylin relies on is properly installed and deployed, including:

- ✓ JDK 1.8
- ✓ Hadoop 2.7.0
- ✓ Hive 1.2.1
- ✓ Hbase 1.1.2 (with Zookeeper)
- ✓ Spark 2.3.1
- ✓ Kafka 1.1.1
- ✓ MySQL 5.1.73

3.1 Quickly try Kylin

Kylin have pushed the Kylin image for the user to the docker hub. Users do not need to build the image locally, just execute the following command to pull the image from the docker hub:

```
docker pull apachekylin/apache-kylin-standalone:3.1.0
```

After the pull is successful, execute the following command to start the container:

```
docker run -d \
-m 8G \
-p 7070:7070 \
-p 8088:8088 \
-p 50070:50070 \
-p 8032:8032 \
-p 8042:8042 \
-p 16010:16010 \
apachekylin/apache-kylin-standalone:3.1.0
```

The following services are automatically started when the container starts:

- NameNode, DataNode
- ResourceManager, NodeManager
- HBase
- Kafka
- Kylin

and run automatically $KYLIN_HOME/bin/sample.sh , create a "kylin_streaming_topic" topic in Kafka and continue to send data to this topic. This is to let the users start the container and then experience the batch and streaming way to build the cube and query.

After the container is started, we can enter the container through the docker exec -it <container_id> bash command. Of course, since we have mapped the specified port in the container to the local port, we can open the pages of each service directly in the native browser, such as:

- Kylin Web UI: http://127.0.0.1:7070/kylin/login
- Hdfs NameNode Web UI: http://127.0.0.1:50070
- Yarn ResourceManager Web UI: http://127.0.0.1:8088
- HBase Web UI: http://127.0.0.1:16010

3.2 Container resource recommendation

To allow Kylin to build the cube smoothly, the memory resource we configured for Yarn Node Manager is 6G, plus the memory occupied by each service, please ensure that the memory of the container is not less than 8G, so as to avoid errors due to insufficient memory.

For more information follow the link: http://kylin.apache.org/docs/

4. Connecting Tableau Desktop and Tableau Server with Apache Kylin

Connect Tableau to Apache Kylin OLAP server, particularly in live mode to use both reporting and analytics features of Tableau together with Apache Kylin's fast query processing engine. The configuration is platform independent - it works for both Windows and Linux installations of Tableau Server.

For the time of writing this guide we tested that it works with ***Kylin 3.1.0 and Tableau Server 2020.4***.

4.1 Prerequisites

4.1.1 Apache Kylin JDBC Driver

First, we need to get Apache Kylin JDBC Driver - kylin-jdbc-X.Y.Z.jar file. You can either get it from the compiled package available on the download page http://kylin.apache.org/download/ from lib folder.

4.1.2 Compiling Apache Kylin JDBC Driver

```
git clone https://github.com/apache/kylin.git
cd kylin
mvn clean package -DskipTests -am -pl jdbc
```

4.1.3 Tableau Server on Linux

If you have installed Tableau Server in a Linux box, copy the driver's jar file to the following location: /opt/tableau/tableau_driver/jdbc/ and restart Tableau Server.

The server is now ready to create and refresh data from Apache Kylin.

4.1.4 Tableau Server and Tableau Desktop on Windows

For either Tableau Server or Tableau Desktop that is installed on a Windows machine, copy the driver's jar file to the following location C:\Program Files\Tableau\Drivers and restart Tableau Server or reopen Tableau Desktop.

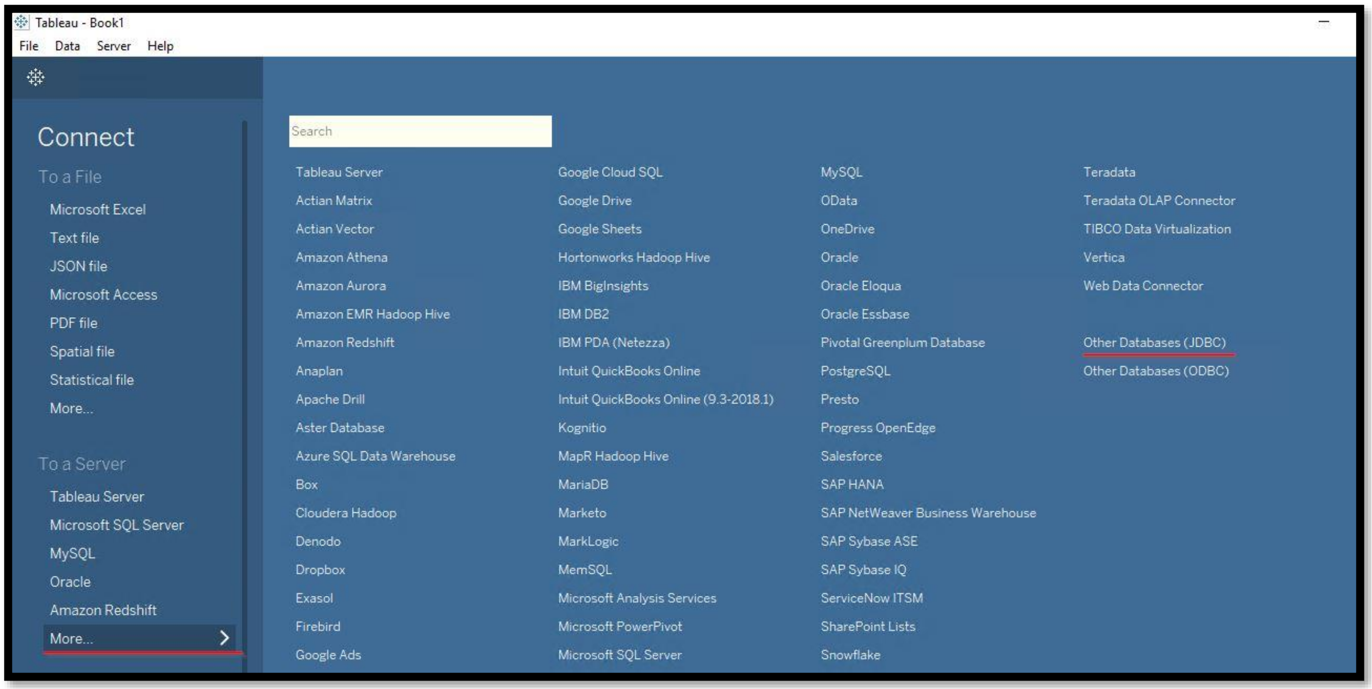
Some more details regarding jdbc connection from Tableau are well described in Tableau's documentation:

https://onlinehelp.tableau.com/current/pro/desktop/en-us/examples_otherdatabases_jdbc.htm

4.2 Creating report in Tableau Desktop - connecting to Apache Kylin

To create report, follow the following steps:

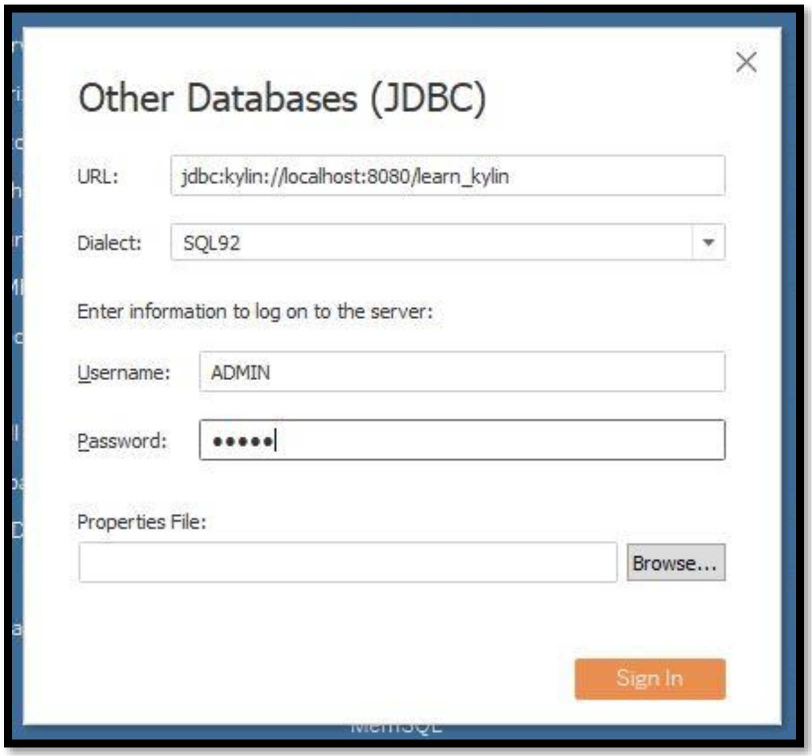
1. Open Tableau Desktop
2. Use "Other Databases (JDBC)" to create connection for the data source



3. Configure the connection in the following way:

   URL: jdbc:kylin://<kylin-server-name>:<kylin-port>/<project>

   Dialect: SQL92



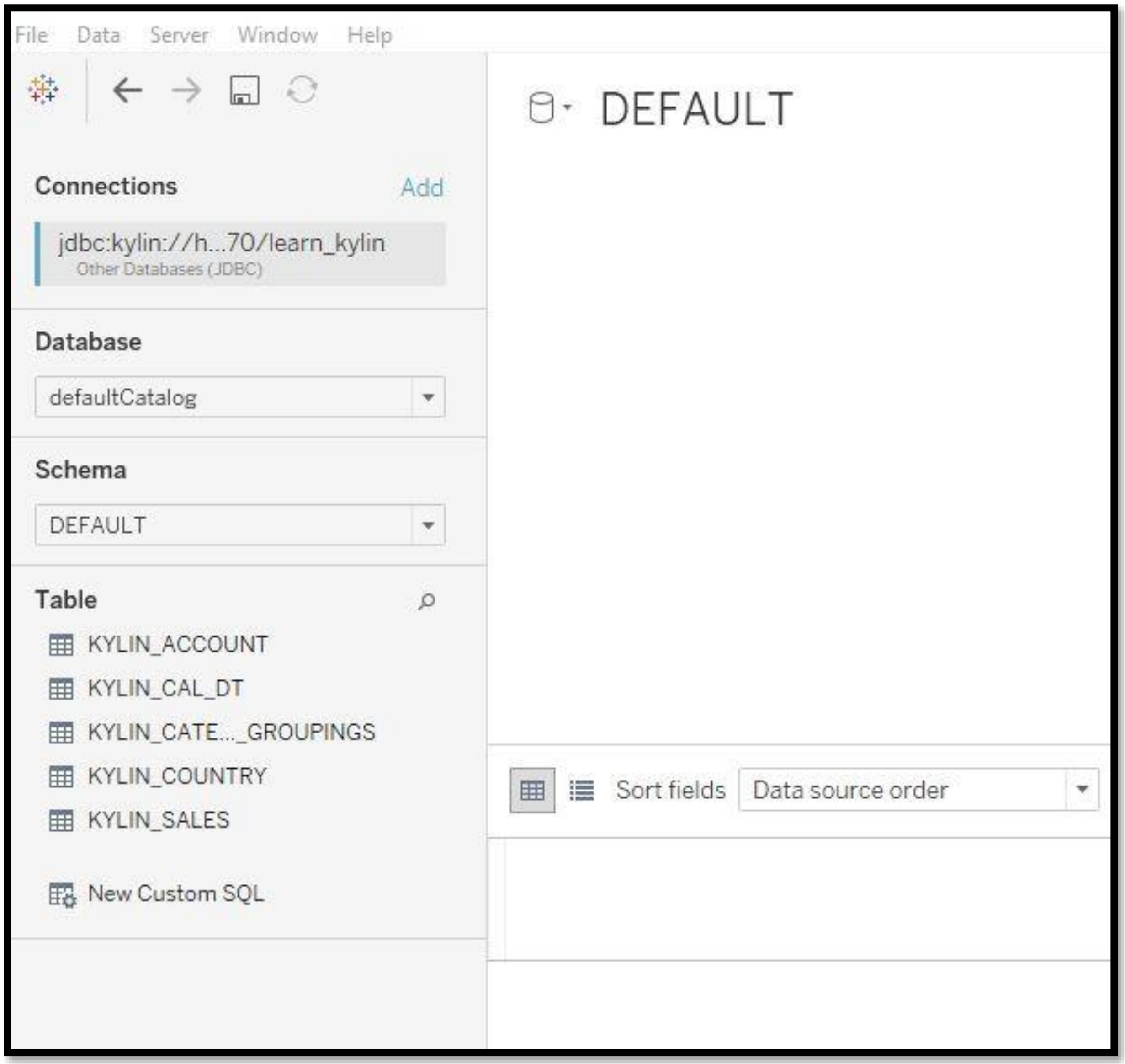
URL: jdbc:kylin://localhost:8080/learn_kylin

Dialect: SQL92

Username: ADMIN

Password: •••••

4. Configure data source as follows:
   - Database: *defaultCatalog*
   - Schema: *DEFAULT*
   We should be able to see the tables/cubes in the Apache Kylin's project



Connection: jdbc:kylin://h...70/learn_kylin
Other Databases (JDBC)

Database: defaultCatalog

Schema: DEFAULT

Table:
- KYLIN_ACCOUNT
- KYLIN_CAL_DT
- KYLIN_CATE..._GROUPINGS
- KYLIN_COUNTRY
- KYLIN_SALES

Note: Decide if we want the data source be in live or extract mode. Some of the functions might not work in live mode as for the other data sources - it is just how Tableau works. Recommendation is to start with live mode to utilize performance of Apache Kylin. If we are forced to switch to extract mode - consider creating a custom query against Apache Kylin's cubes to retrieve as small amount of data as possible as it will help the report to perform well.

5. Finish designing our data source and then switch to worksheets, dashboards

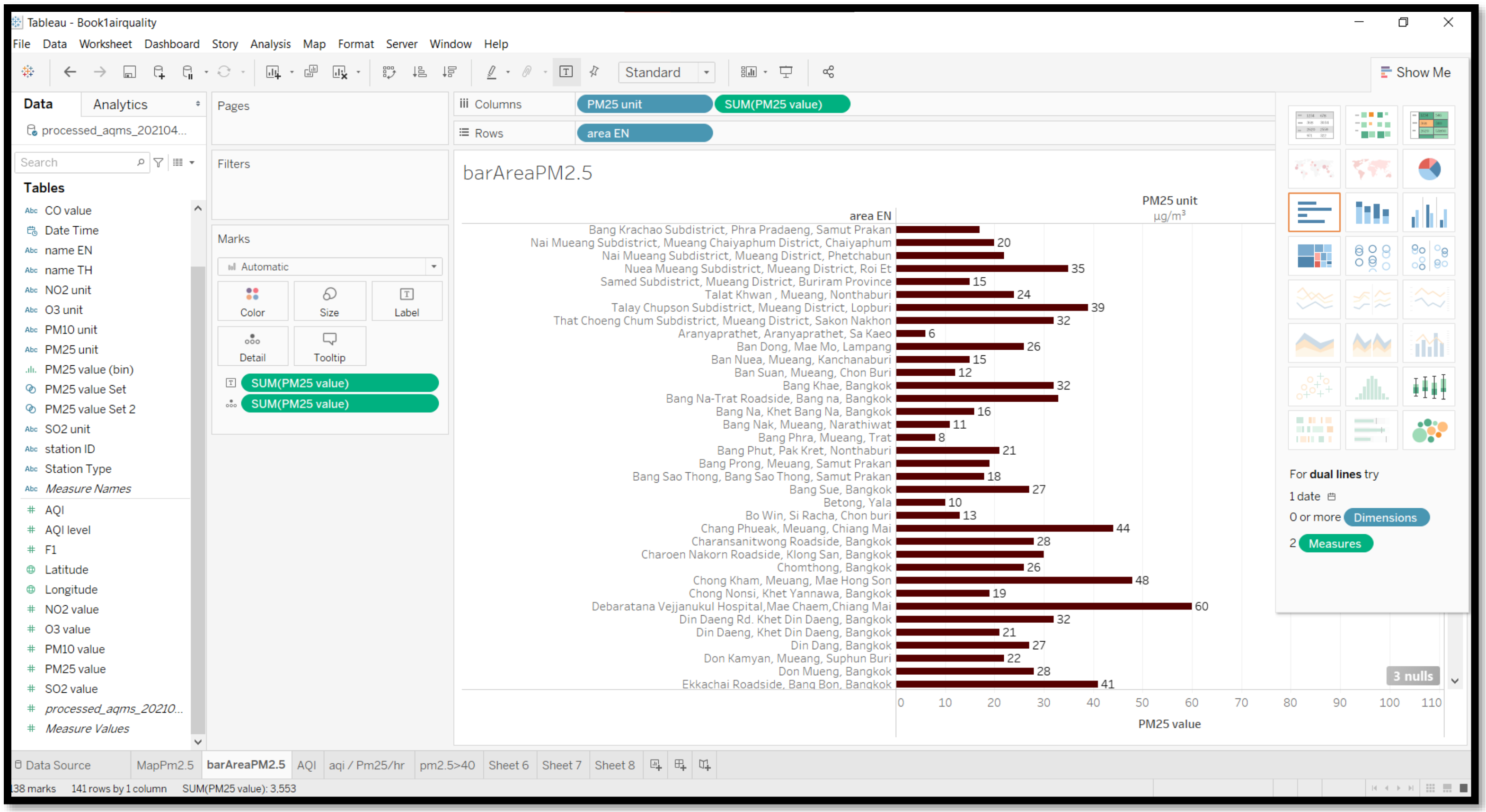


Tableau - Book1airquality
File Data Worksheet Dashboard Story Analysis Map Format Server Window Help
Standard
Show Me
Data
Analytics
processed_aqms_202104...
Tables
CO value
Date Time
name EN
name TH
NO2 unit
O3 unit
PM10 unit
PM25 unit
PM25 value (bin)
PM25 value Set
PM25 value Set 2
SO2 unit
station ID
Station Type
Measure Names
AQI
AQI level
F1
Latitude
Longitude
NO2 value
O3 value
PM10 value
PM25 value
SO2 value
processed_aqms_20210...
Measure Values
Pages
Filters
Marks
Automatic
Color
Size
Label
Detail
Tooltip
SUM(PM25 value)
SUM(PM25 value)
Columns
PM25 unit
SUM(PM25 value)
Rows
area EN
barAreaPM2.5
area EN
PM25 unit
µg/m³
Bang Krachao Subdistrict, Phra Pradaeng, Samut Prakan
Nai Mueang Subdistrict, Mueang Chaiyaphum District, Chaiyaphum 20
Nai Mueang Subdistrict, Mueang District, Phetchabun
Nuea Mueang Subdistrict, Mueang District, Roi Et 35
Samed Subdistrict, Mueang District, Buriram Province 15
Talat Khwan , Mueang, Nonthaburi 24
Talay Chupson Subdistrict, Mueang District, Lopburi 39
That Choeng Chum Subdistrict, Mueang District, Sakon Nakhon 32
Aranyaprathet, Aranyaprathet, Sa Kaeo 6
Ban Dong, Mae Mo, Lampang 26
Ban Nuea, Mueang, Kanchanaburi 15
Ban Suan, Mueang, Chon Buri 12
Bang Khae, Bangkok 32
Bang Na-Trat Roadside, Bang na, Bangkok
Bang Na, Khet Bang Na, Bangkok 16
Bang Nak, Mueang, Narathiwat 11
Bang Phra, Mueang, Trat 8
Bang Phut, Pak Kret, Nonthaburi 21
Bang Prong, Meuang, Samut Prakan
Bang Sao Thong, Bang Sao Thong, Samut Prakan 18
Bang Sue, Bangkok 27
Betong, Yala 10
Bo Win, Si Racha, Chon buri 13
Chang Phueak, Meuang, Chiang Mai 44
Charansanitwong Roadside, Bangkok 28
Charoen Nakorn Roadside, Klong San, Bangkok
Chomthong, Bangkok 26
Chong Kham, Meuang, Mae Hong Son 48
Chong Nonsi, Khet Yannawa, Bangkok 19
Debaratana Vejjanukul Hospital,Mae Chaem,Chiang Mai 60
Din Daeng Rd. Khet Din Daeng, Bangkok 32
Din Daeng, Khet Din Daeng, Bangkok 21
Din Dang, Bangkok 27
Don Kamyan, Mueang, Suphun Buri 22
Don Mueng, Bangkok 28
Ekkachai Roadside, Bang Bon, Bangkok 41
0 10 20 30 40 50 60 70 80 90 100 110
PM25 value
3 nulls
For dual lines try
1 date
0 or more Dimensions
2 Measures
Data Source
MapPm2.5
barAreaPM2.5
AQI
aqi / Pm25/hr
pm2.5>40
Sheet 6
Sheet 7
Sheet 8
38 marks 141 rows by 1 column SUM(PM25 value): 3,553

4.3 Publishing reports from Tableau Desktop to Tableau Server

To publish the data source and the report follow the following steps:

1. In Tableau Desktop from top menu select Server and then Publish
2. Choose the settings for publishing like Project, select sheets
3. Note: For data source Authentication set Embedded - this is very important for data refresh to work, however keep in mind that the credentials will be embeded in the report
4. Publish the report
5. Pop up should be displayed with the preview of the report rendered by the server
6. Verify if the report is displaying properly and can connect to Apache Kylin correctly by opening it directly in Tableau Server web application.

5. Testing tool

Robot Framework is a test automation framework that is Python-based. This framework supports writing an object-page model in keyword driven methodology. Robot Framework allows users to write their own test-cases without programming knowledge. In addition to this, it has very descriptive logs including complete debugging capabilities through readable logs.

To use Robot Framework, we must make sure our system has following prerequisites:

1. JDK 1.8-1
2. Python
3. Robot Framework Library
4. Robot Framework Selenium Library
5. Chrome Driver

5.1 Setup Robot Framework

5.1.1 JDK 1.8-1

The Java Development Kit (JDK) allows you to code and run Java programs.

Following are the steps to be followed for downloading and installing jdk in our system:

1. Goto https://www.oracle.com/in/java/technologies/javase-downloads.html click on *Download* JDK for latest version.
2. Next, Accept the license Agreement.
3. Click on download latest Java JDK depending on version of our PC.
4. Once Download is completed, then run the .exe for installation of JDK. Then click Next.
5. Select Proper PATH for Java installation and click next.
6. Once installation is complete then click close.

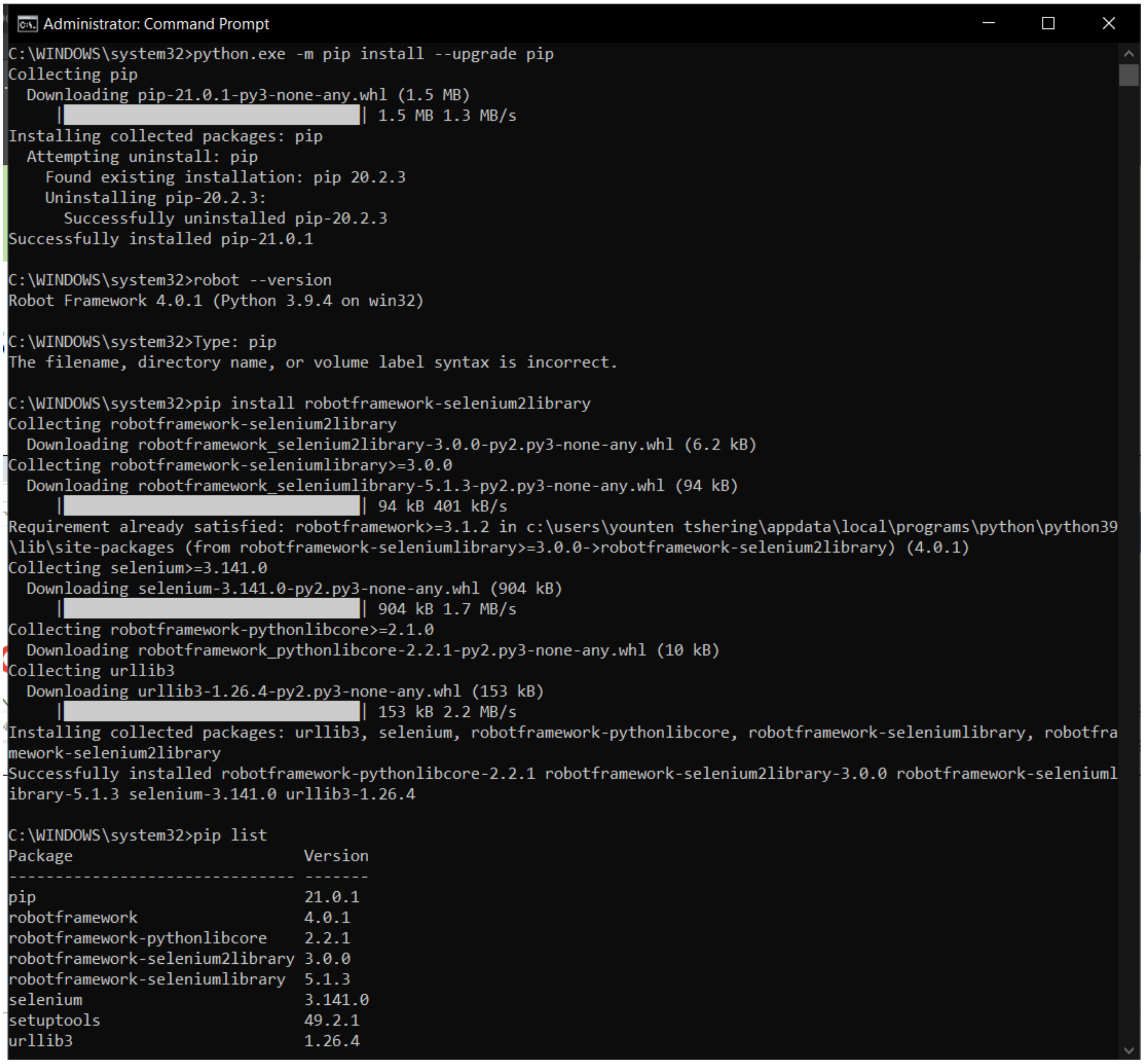
5.1.2 Python

Before downloading python, see what version is to be installed, the follow the steps:

1. Open web browser: https://www.python.org/downloads/release/python-2717/. Search for desired version and select a link download either Windows x86-64 executable installer or Windows x86 executable installer.
2. Run the executable Installer. Make sure you select the Install launcher for all users and Add Python to PATH checkbox. Then select Install Now.
3. Verify Python was installed or not by typing python -V in command Prompt.

Before downloading, make sure your system has PIP installed.

You can follow this link https://phoenixnap.com/kb/install-pip-windows for pip.



Administrator: Command Prompt

```
C:\WINDOWS\system32>python.exe -m pip install --upgrade pip
Collecting pip
  Downloading pip-21.0.1-py3-none-any.whl (1.5 MB)
     |████████████████████████████████| 1.5 MB 1.3 MB/s
Installing collected packages: pip
  Attempting uninstall: pip
    Found existing installation: pip 20.2.3
    Uninstalling pip-20.2.3:
      Successfully uninstalled pip-20.2.3
Successfully installed pip-21.0.1

C:\WINDOWS\system32>robot --version
Robot Framework 4.0.1 (Python 3.9.4 on win32)

C:\WINDOWS\system32>Type: pip
The filename, directory name, or volume label syntax is incorrect.

C:\WINDOWS\system32>pip install robotframework-selenium2library
Collecting robotframework-selenium2library
  Downloading robotframework_selenium2library-3.0.0-py2.py3-none-any.whl (6.2 kB)
Collecting robotframework-seleniumlibrary>=3.0.0
  Downloading robotframework_seleniumlibrary-5.1.3-py2.py3-none-any.whl (94 kB)
     |████████████████████████████████| 94 kB 401 kB/s
Requirement already satisfied: robotframework>=3.1.2 in c:\users\younten tshering\appdata\local\programs\python\python39
\lib\site-packages (from robotframework-seleniumlibrary>=3.0.0->robotframework-selenium2library) (4.0.1)
Collecting selenium>=3.141.0
  Downloading selenium-3.141.0-py2.py3-none-any.whl (904 kB)
     |████████████████████████████████| 904 kB 1.7 MB/s
Collecting robotframework-pythonlibcore>=2.1.0
  Downloading robotframework_pythonlibcore-2.2.1-py2.py3-none-any.whl (10 kB)
Collecting urllib3
  Downloading urllib3-1.26.4-py2.py3-none-any.whl (153 kB)
     |████████████████████████████████| 153 kB 2.2 MB/s
Installing collected packages: urllib3, selenium, robotframework-pythonlibcore, robotframework-seleniumlibrary, robotfra
mework-selenium2library
Successfully installed robotframework-pythonlibcore-2.2.1 robotframework-selenium2library-3.0.0 robotframework-seleniuml
ibrary-5.1.3 selenium-3.141.0 urllib3-1.26.4

C:\WINDOWS\system32>pip list
Package                         Version
------------------------------- -------
pip                             21.0.1
robotframework                  4.0.1
robotframework-pythonlibcore    2.2.1
robotframework-selenium2library 3.0.0
robotframework-seleniumlibrary  5.1.3
selenium                        3.141.0
setuptools                      49.2.1
urllib3                         1.26.4
```

5.1.3 Robot Framework Library

- Once python is installed, you have to access to the pip installer.
- Open command prompt and type

pip install robotframework

5.1.4 Robot Framework Selenium Library

Use the following command in command prompt to install robot framework selenium library.

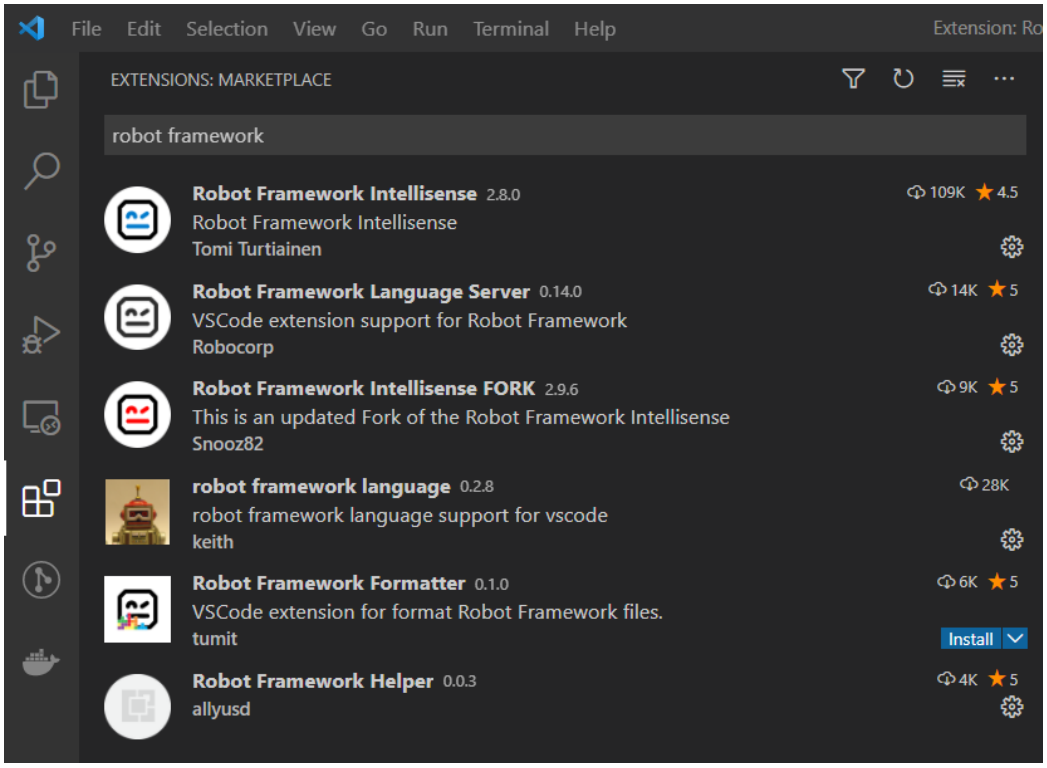
pip install robotframework-seleniumlibrary

5.1.5 Develop Test Script

Before having the script, we need to install VS Code for Develop Test Script.

Steps to install VS Code and configure:

1. Download Visual Studio Code
2. Run the execution file and make it run.
3. We must add some few extension as shown in below diagram:



robot framework

Robot Framework Intellisense 2.8.0 — 109K ★4.5
Robot Framework Intellisense
Tomi Turtiainen

Robot Framework Language Server 0.14.0 — 14K ★5
VSCode extension support for Robot Framework
Robocorp

Robot Framework Intellisense FORK 2.9.6 — 9K ★5
This is an updated Fork of the Robot Framework Intellisense
Snooz82

robot framework language 0.2.8 — 28K
robot framework language support for vscode
keith

Robot Framework Formatter 0.1.0 — 6K ★5
VSCode extension for format Robot Framework files.
tumit

Robot Framework Helper 0.0.3 — 4K ★5
allyusd

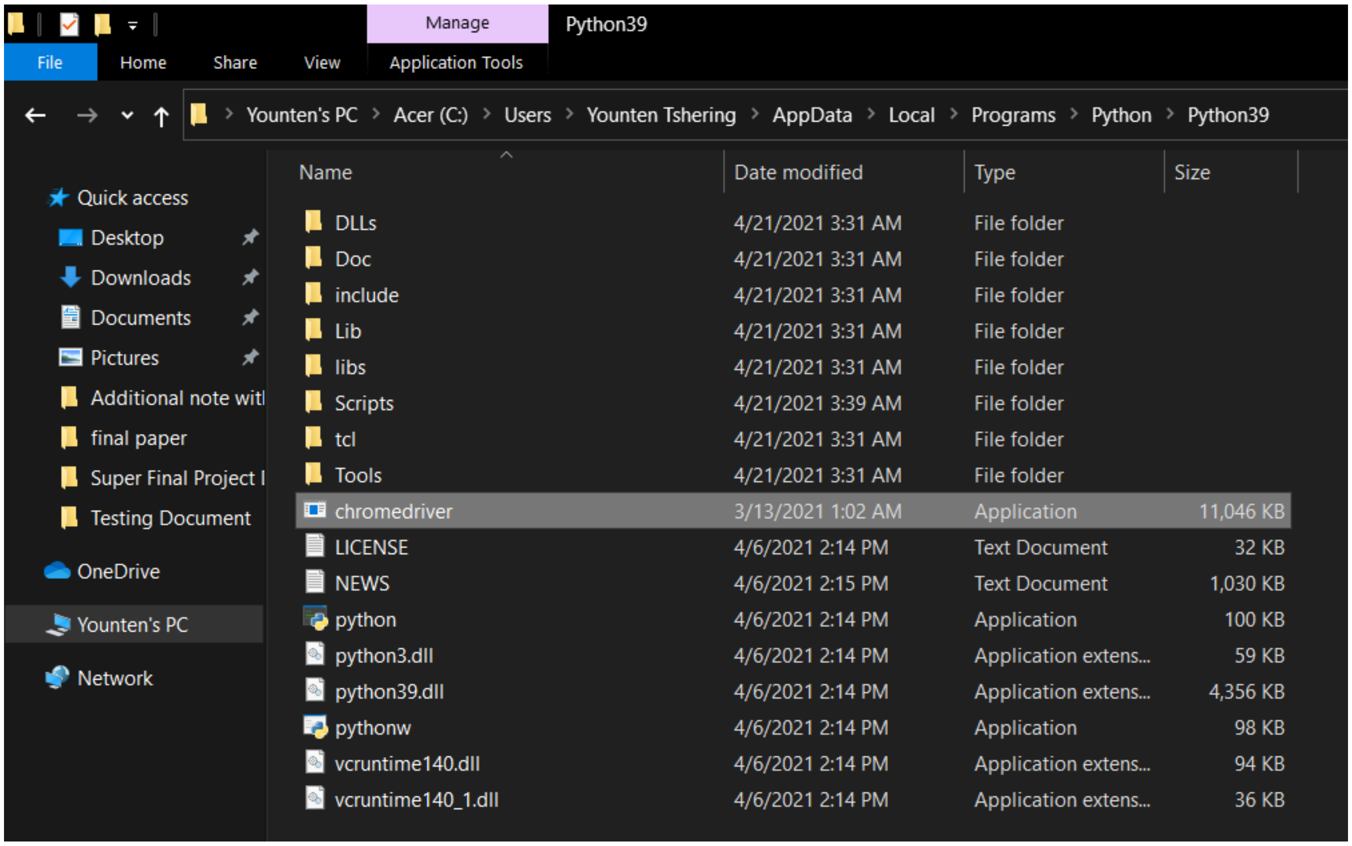
5.1.6 Chrome Driver

Steps for chrome driver installation:

1. Check Version of Google Chrome
2. Download Chrome Driver using this link :

   https://sites.google.com/a/chromium.org/chromedriver/

3. Click Latest release, then click on the driver zip file as per the version of your system to download chromedriver eg: chromedriver_win32.zip
4. Unzip/ extract zip file in python folder as shown below:



Younten's PC > Acer (C:) > Users > Younten Tshering > AppData > Local > Programs > Python > Python39

Name	Date modified	Type	Size
DLLs	4/21/2021 3:31 AM	File folder	
Doc	4/21/2021 3:31 AM	File folder	
include	4/21/2021 3:31 AM	File folder	
Lib	4/21/2021 3:31 AM	File folder	
libs	4/21/2021 3:31 AM	File folder	
Scripts	4/21/2021 3:39 AM	File folder	
tcl	4/21/2021 3:31 AM	File folder	
Tools	4/21/2021 3:31 AM	File folder	
chromedriver	3/13/2021 1:02 AM	Application	11,046 KB
LICENSE	4/6/2021 2:14 PM	Text Document	32 KB
NEWS	4/6/2021 2:15 PM	Text Document	1,030 KB
python	4/6/2021 2:14 PM	Application	100 KB
python3.dll	4/6/2021 2:14 PM	Application extens...	59 KB
python39.dll	4/6/2021 2:14 PM	Application extens...	4,356 KB
pythonw	4/6/2021 2:14 PM	Application	98 KB
vcruntime140.dll	4/6/2021 2:14 PM	Application extens...	94 KB
vcruntime140_1.dll	4/6/2021 2:14 PM	Application extens...	36 KB

5. Run executable exe file.
6. Make sure that system environments variables are properly configured.

For more details or complete guide, follow the link: https://www.youtube.com/watch?v=gleaQkECggo.

5.1.7 Try to write test script and run test script.

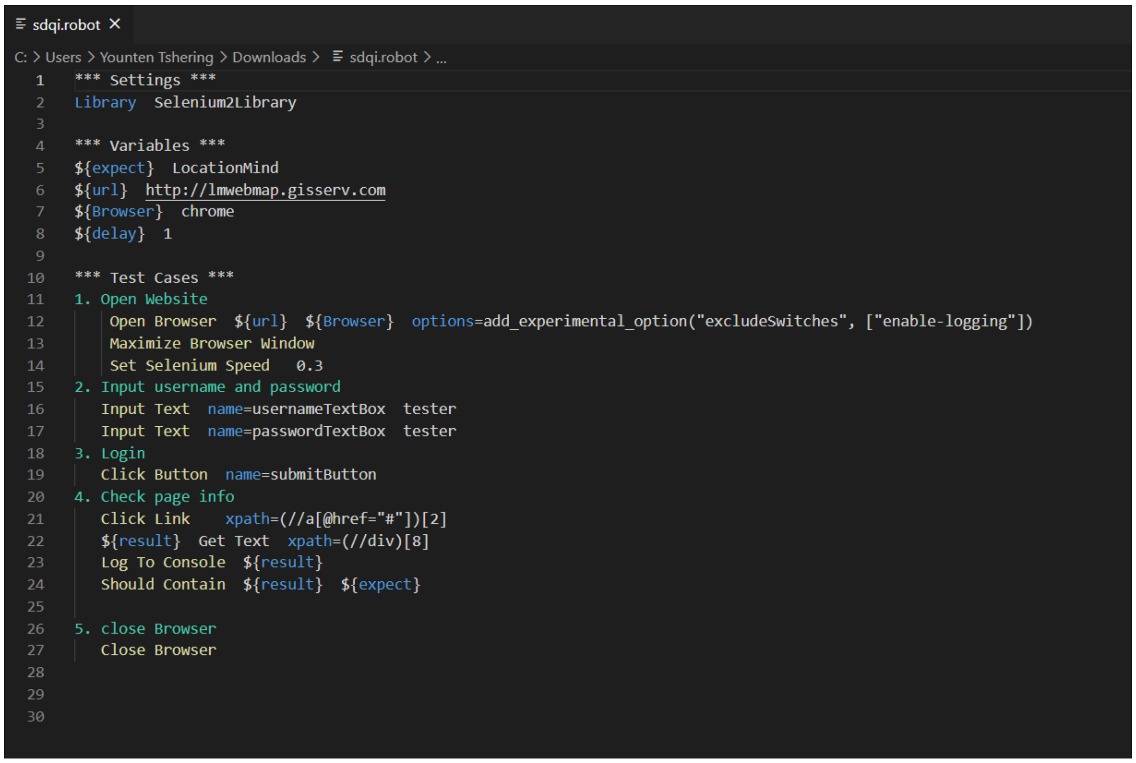
Before runing the script, we need to complete the install of chrome driver and then:

1. Create sample Robot Script for testing
2. Create variables
3. Create functions
4. Testing Step: Test cases

For more information follow the link: https://medium.com/edureka/robot-framework-tutorial-f8a75ab23cfd.

Test Robot with simple website access:

Write the script in VS Code with robot file extension and run. The example shown is the file uploaded by professor in basecamp, but project testing is included in the project documentation.



sdqi.robot ×

C: > Users > Younten Tshering > Downloads > sdqi.robot > ...

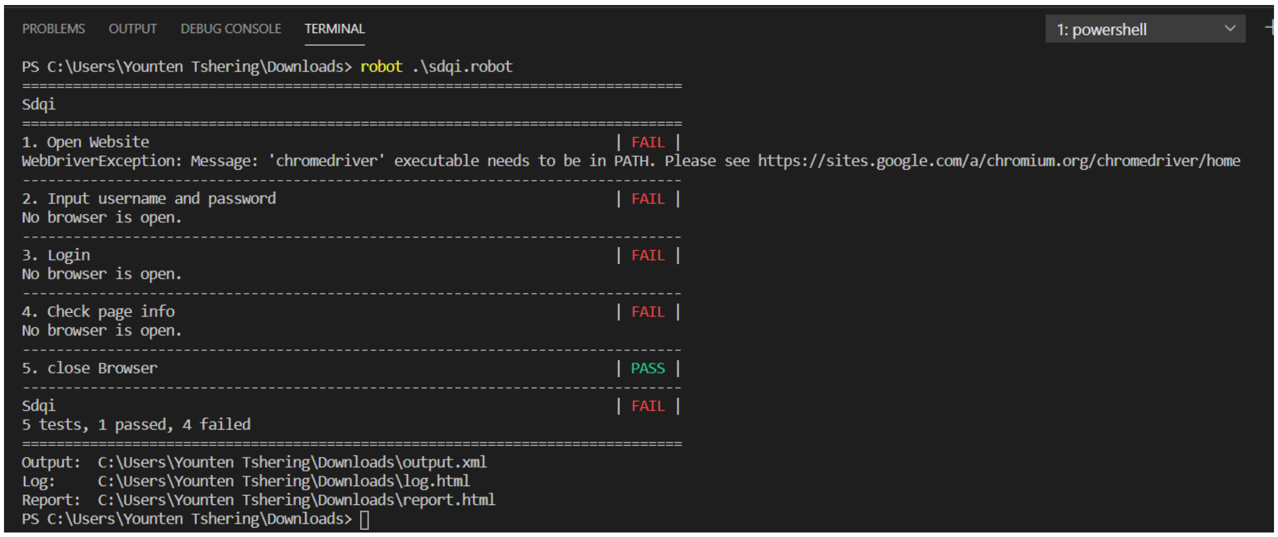
```
*** Settings ***
Library  Selenium2Library

*** Variables ***
${expect}  LocationMind
${url}  http://lmwebmap.gisserv.com
${Browser}  chrome
${delay}  1

*** Test Cases ***
1. Open Website
    Open Browser  ${url}  ${Browser}  options=add_experimental_option("excludeSwitches", ["enable-logging"])
    Maximize Browser Window
    Set Selenium Speed   0.3
2. Input username and password
   Input Text  name=usernameTextBox  tester
   Input Text  name=passwordTextBox  tester
3. Login
   Click Button  name=submitButton
4. Check page info
   Click Link    xpath=(//a[@href="#"])[2]
   ${result}  Get Text  xpath=(//div)[8]
   Log To Console  ${result}
   Should Contain  ${result}  ${expect}

5. close Browser
   Close Browser
```

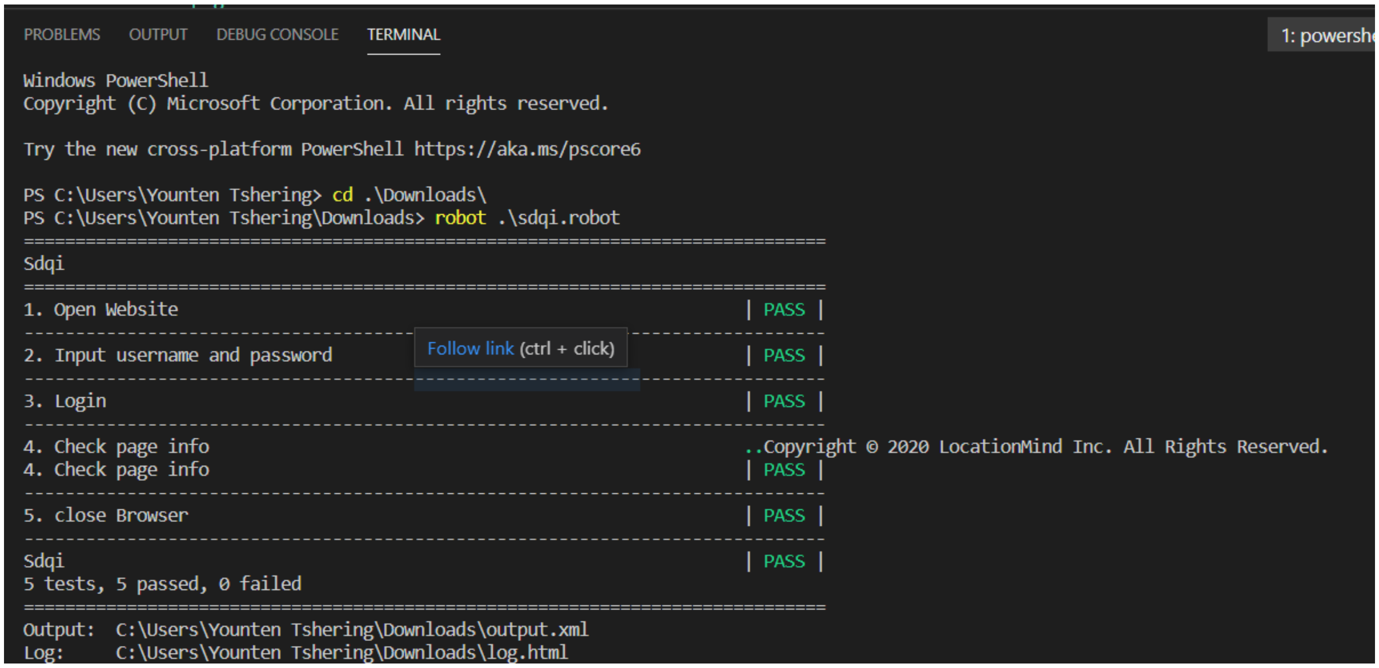
Output if the chrome driver is not installed:



PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: powershell

```
PS C:\Users\Younten Tshering\Downloads> robot .\sdqi.robot
==============================================================================
Sdqi
==============================================================================
1. Open Website                                                       | FAIL |
WebDriverException: Message: 'chromedriver' executable needs to be in PATH. Please see https://sites.google.com/a/chromium.org/chromedriver/home
------------------------------------------------------------------------------
2. Input username and password                                        | FAIL |
No browser is open.
------------------------------------------------------------------------------
3. Login                                                              | FAIL |
No browser is open.
------------------------------------------------------------------------------
4. Check page info                                                    | FAIL |
No browser is open.
------------------------------------------------------------------------------
5. close Browser                                                      | PASS |
------------------------------------------------------------------------------
Sdqi                                                                  | FAIL |
5 tests, 1 passed, 4 failed
==============================================================================
Output:  C:\Users\Younten Tshering\Downloads\output.xml
Log:     C:\Users\Younten Tshering\Downloads\log.html
Report:  C:\Users\Younten Tshering\Downloads\report.html
PS C:\Users\Younten Tshering\Downloads> 
```

Final output of automation testing if everything works fine and we can see the test case being passed or failed.



```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\Younten Tshering> cd .\Downloads\
PS C:\Users\Younten Tshering\Downloads> robot .\sdqi.robot
==============================================================================
Sdqi
==============================================================================
1. Open Website                                                       | PASS |
------------------------------------------------------------------------------
2. Input username and password                                        | PASS |
------------------------------------------------------------------------------
3. Login                                                              | PASS |
------------------------------------------------------------------------------
4. Check page info                                                    ..Copyright © 2020 LocationMind Inc. All Rights Reserved.
4. Check page info                                                    | PASS |
------------------------------------------------------------------------------
5. close Browser                                                      | PASS |
------------------------------------------------------------------------------
Sdqi                                                                  | PASS |
5 tests, 5 passed, 0 failed
==============================================================================
Output:  C:\Users\Younten Tshering\Downloads\output.xml
Log:     C:\Users\Younten Tshering\Downloads\log.html
```

5.2 Setup JMeter

JMeter for the purpose of load testing is considered as the one of the best tools. Apache JMeter is a Java open-source GUI-based software that is used as a performance testing tool for analyzing and measuring the performance of our application.

Performance testing can be widely categorized as

1. **load testing** - focuses on testing whether the system can handle *concurrent* user accesses without breaking.
2. **stress testing** focuses on how our system copes with high load and limited resources under constrained conditions.

JMeter is extensible, meaning that we can write custom script, using the pre-built interface of JMeter, making it even more powerful. Of course, it already has many powerful features such as

a) creating reusable test plans (in XML format) so we can reuse these similar test plans across all our products,

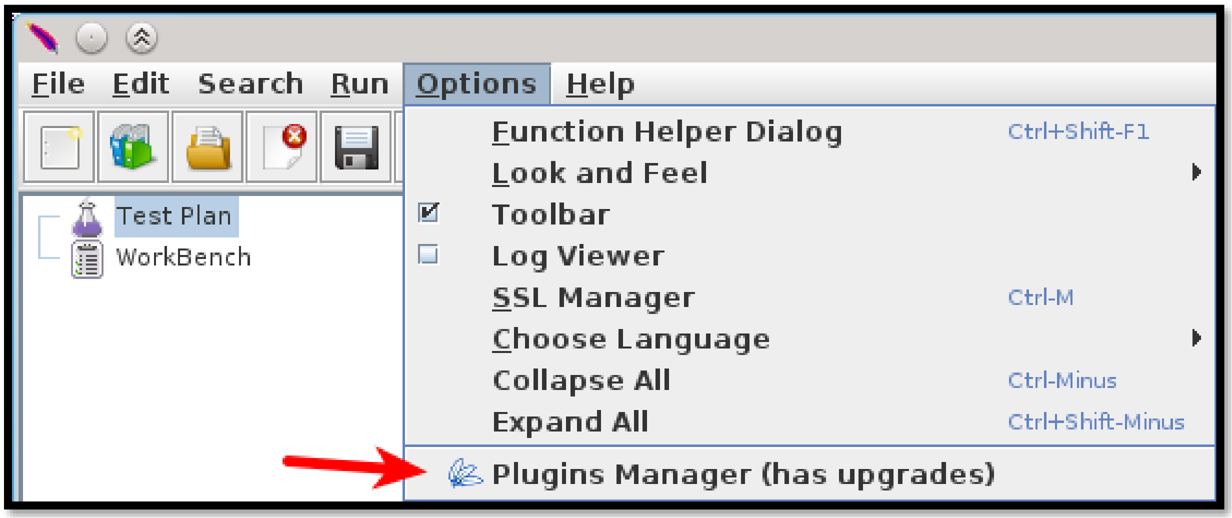
b) supporting various protocols such as HTTP, JDBC, SOAP, JMS, and FTP,

c) supporting various testing such as stress testing, distributed testing, web service testing, allowing user to record HTTP and HTTPS to create test plan,

d) having loads of plugins which we can installed via Option > Plugin Manager and support dashboard report generation.

5.2.1 Requirements

- Make sure you got java installed (Requires Java 8+)
- Install JMeter via http://jmeter.apache.org
- Download the Plugins Manager JAR file and put it into JMeter's lib/ext directory. Then start JMeter and go to "Options" menu to access the Plugins Manager.



5.2.2 JMeter - overview of how to use

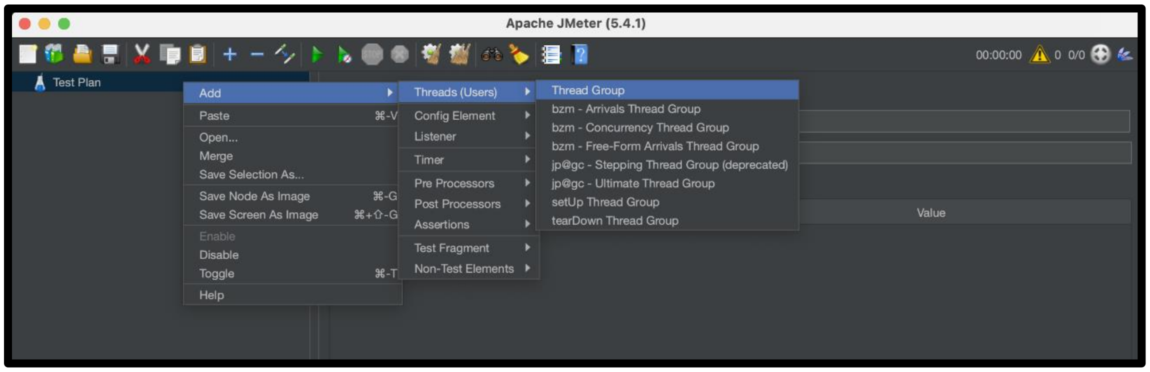
JMeter is conceptualized around a concept called “Test Plan”. To create a test plan which is the central execution unit of a test, we first need to understand the four important elements of a test plan:

1. Thread Group
2. Samplers
3. Listeners
4. Configuration

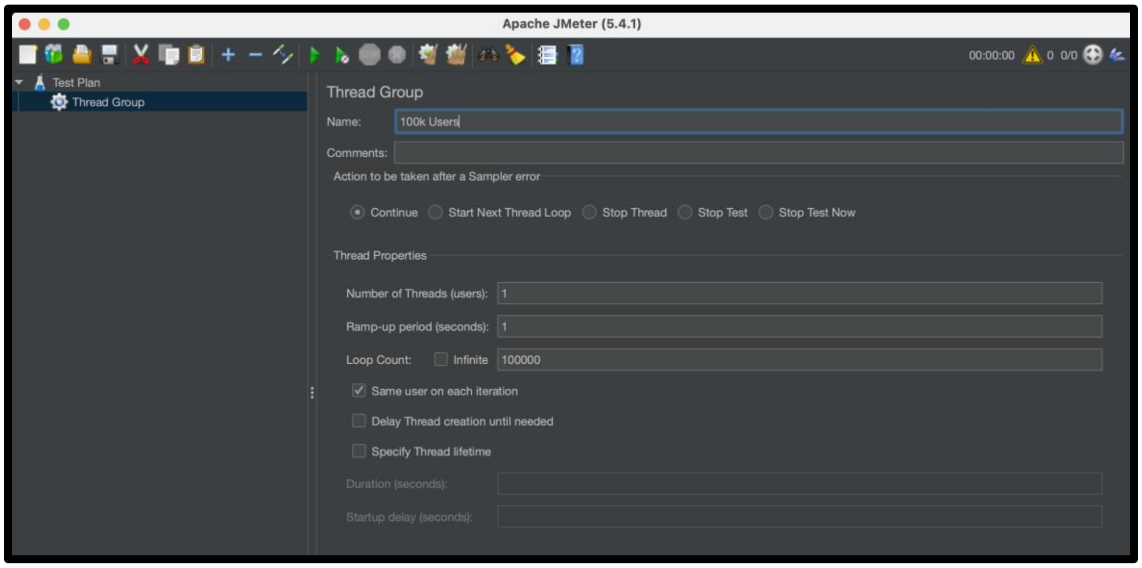
Thread group

- Represents a collection of threads. Each thread represents one user. Basically, in a test plan, we must specify how many users you want. If you set 100 threads, it simply means you have 100 users.

- Note that by default, these threads are not concurrent. If you would like to use concurrent threads, go to Option > Plugin Managers, and install Custom Thread Group which allows for testing concurrent threads.
- In the JMeter interface, under Test Plan, the first thing you want to do is create a thread group by right clicking like the following:



- Under the threads group, we can specify 100k users in the Name and Loop Count (100000) fields like this:



Thread Group

Name: 100k Users

Comments:

Action to be taken after a Sampler error

(● Continue) ○ Start Next Thread Loop ○ Stop Thread ○ Stop Test ○ Stop Test Now

Thread Properties

Number of Threads (users): 1

Ramp-up period (seconds): 1

Loop Count: ☐ Infinite 100000

☑ Same user on each iteration

☐ Delay Thread creation until needed

☐ Specify Thread lifetime

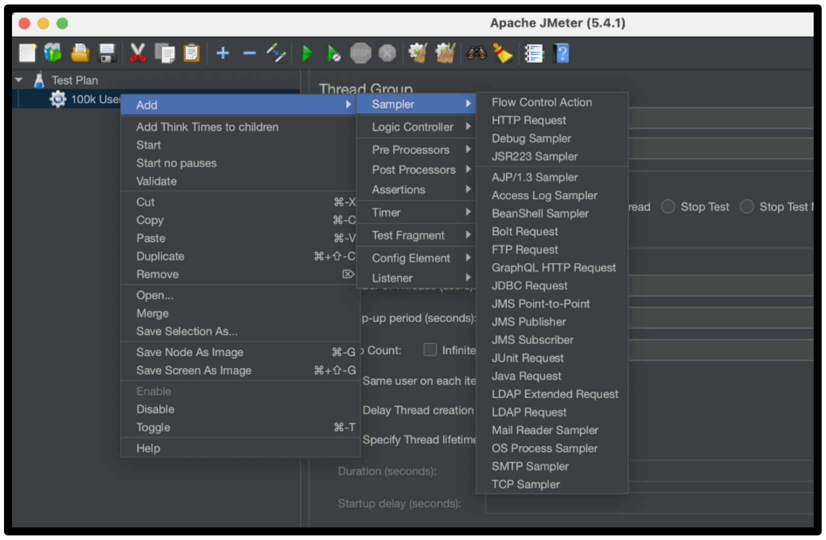
Duration (seconds):

Startup delay (seconds):

Samplers

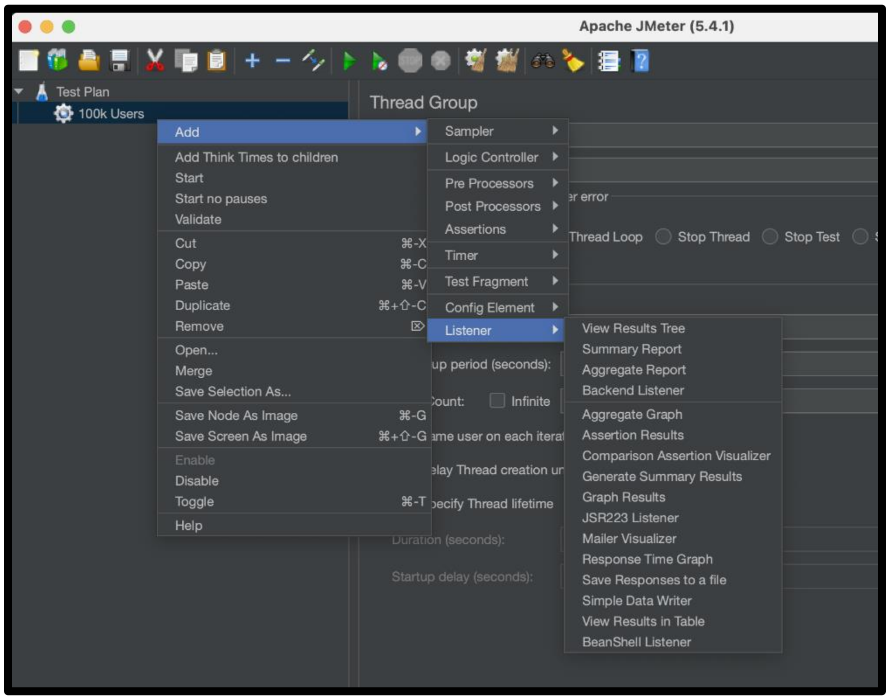
- As we have mentioned already, JMeter supports testing several protocols such as HTTP, FTP, JDBC, and many more. For example, if we want to send a download request to a server, then we can use FTP requests for our thread groups; if we want to check how a certain query will run in our database, use JDBC request for our thread groups (before we can use, we need to set the connection configuration - see Configuration); if we want to check how our web service works, use HTTP request. If we want to check how our email will work, use SMTP Sampler.

- Under the Thread Group we have just created, we can right click, select Sampler, and we will see many possible protocols we can test.
- We shall look at specifically HTTP requests and JDBC requests later in our short demo section.



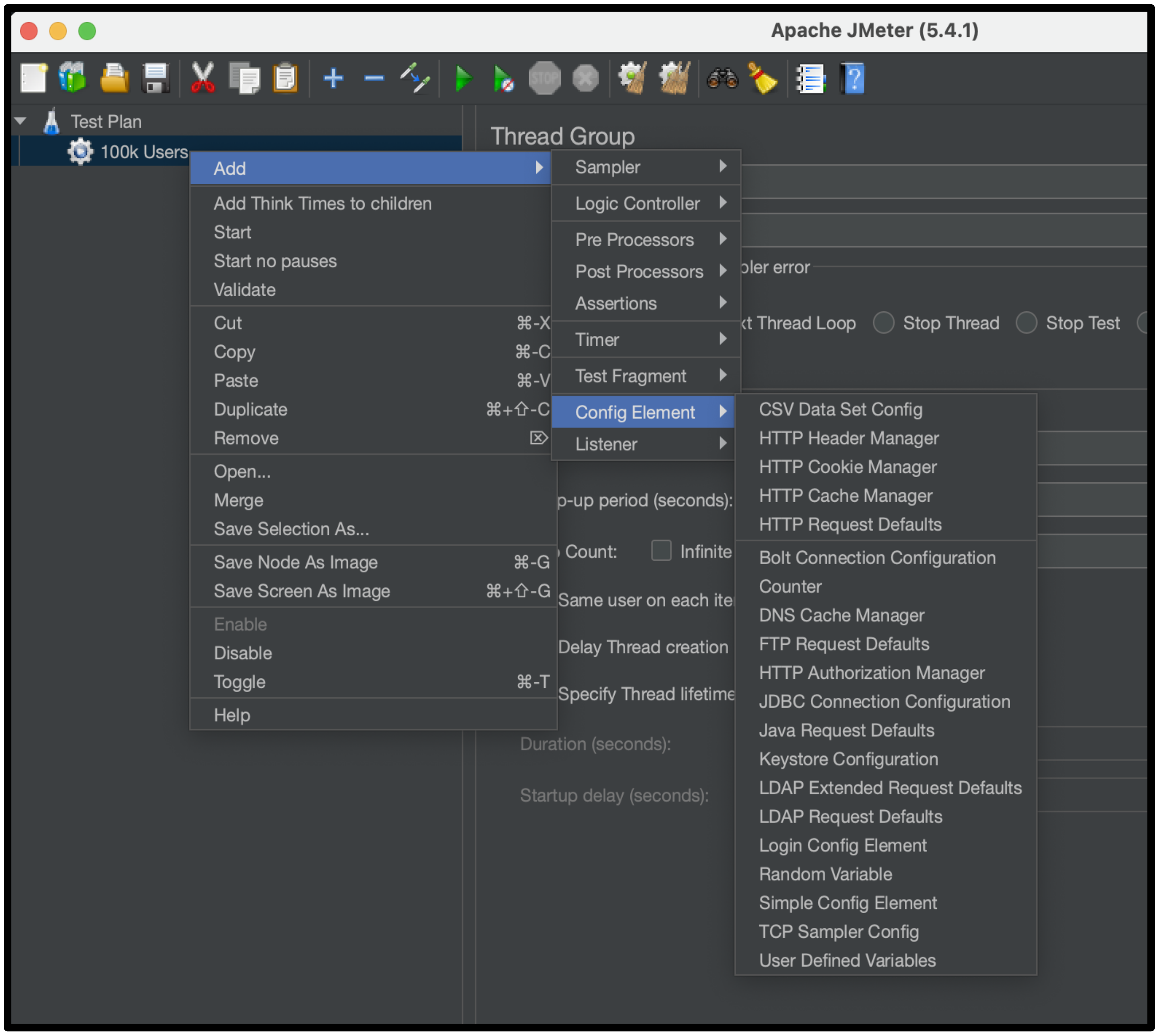
Listeners

- Once we set the Thread Group and the associated Samplers, we want to see the results and that's the Listeners.
- JMeter supports many nice visualizations in (1) graph, (2) table, (3) tree, and (4) text format.



Configuration

The last element to set for Thread Group is Configuration, which is about setting up some variables such as database connection. For example, for CSV Data set Config, we can put in any variable we want in a CSV format which will be automatically parsed and can be used when we script. HTTP Cookie will store all cookies of a particular website for future requests. HTTP Request Defaults set some default variables such as domain; so instead of typing http://google.com as our target 100 times, we can just config one time here. Login Config Element allows us to set up the username and password in a user request.

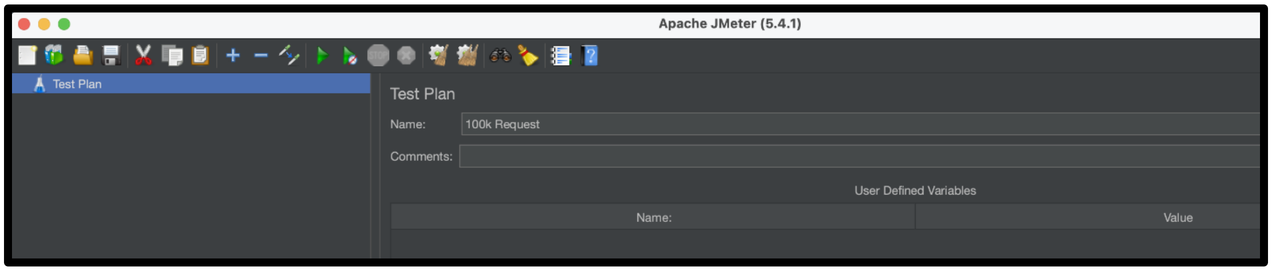


5.2.3 Testing Demo

Demo 1: Simple HTTP Request

Very basic HTTP Request load testing

1. First let's name the Test Plan as 100k Request



Apache JMeter (5.4.1)

Test Plan

Test Plan

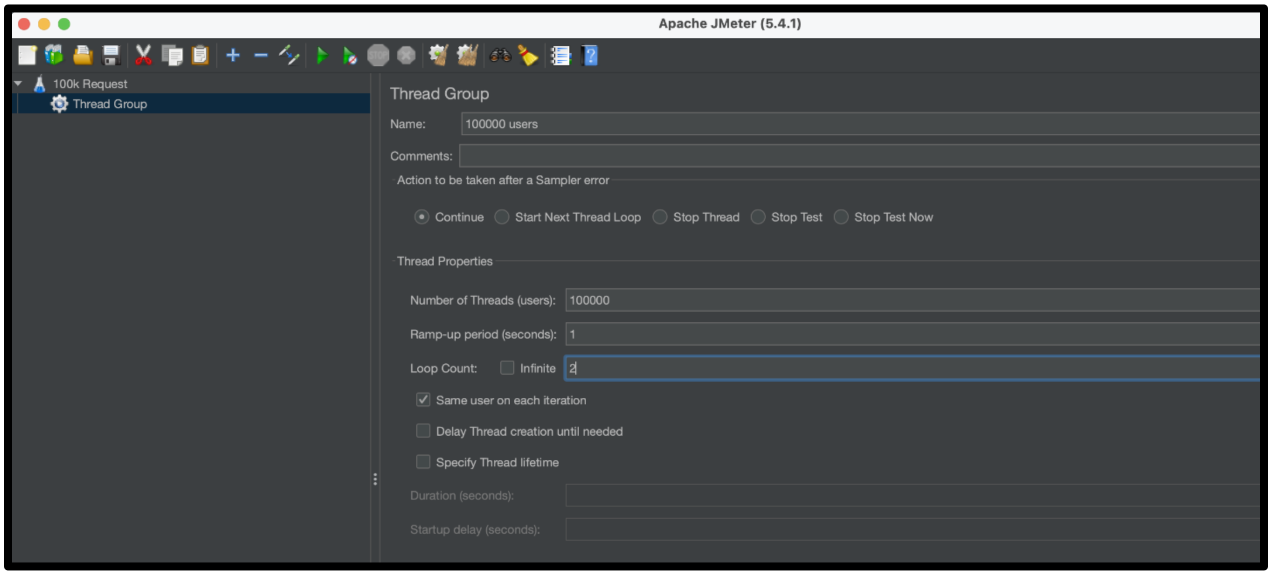
Name: 100k Request

Comments:

User Defined Variables

Name: Value

2. Right click the Test Plan and add Thread Group. In the Thread Group, put any Name, and specify the Number of threads and Loops.



Apache JMeter (5.4.1)

100k Request
Thread Group

Thread Group

Name: 100000 users

Comments:

Action to be taken after a Sampler error

[✓ Continue] Start Next Thread Loop Stop Thread Stop Test Stop Test Now

Thread Properties

Number of Threads (users): 100000

Ramp-up period (seconds): 1

Loop Count: Infinite 2

[✓] Same user on each iteration

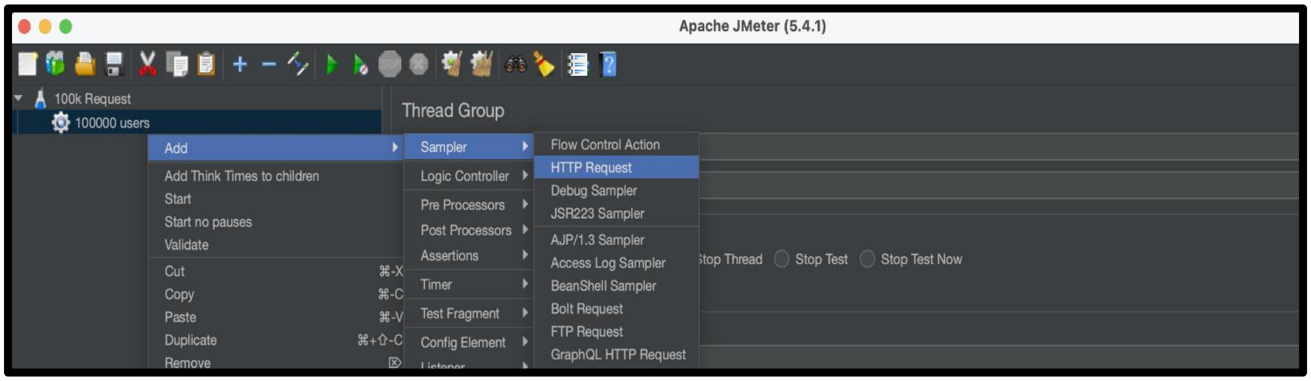
Delay Thread creation until needed

Specify Thread lifetime

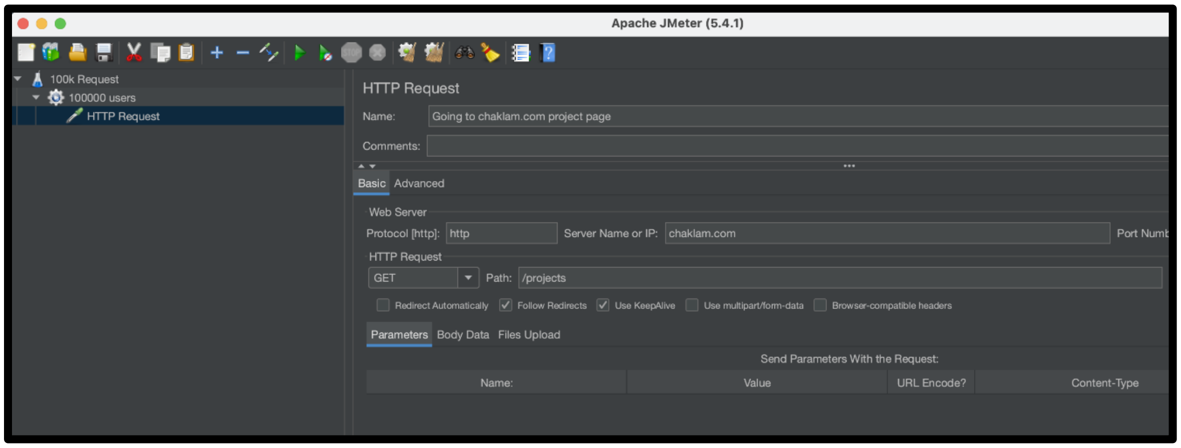
Duration (seconds):

Startup delay (seconds):

3. Once we have the Thread Group, we specify what are the testing protocols we will be using. Right click on the Thread Group and add Sampler > HTTP Request.

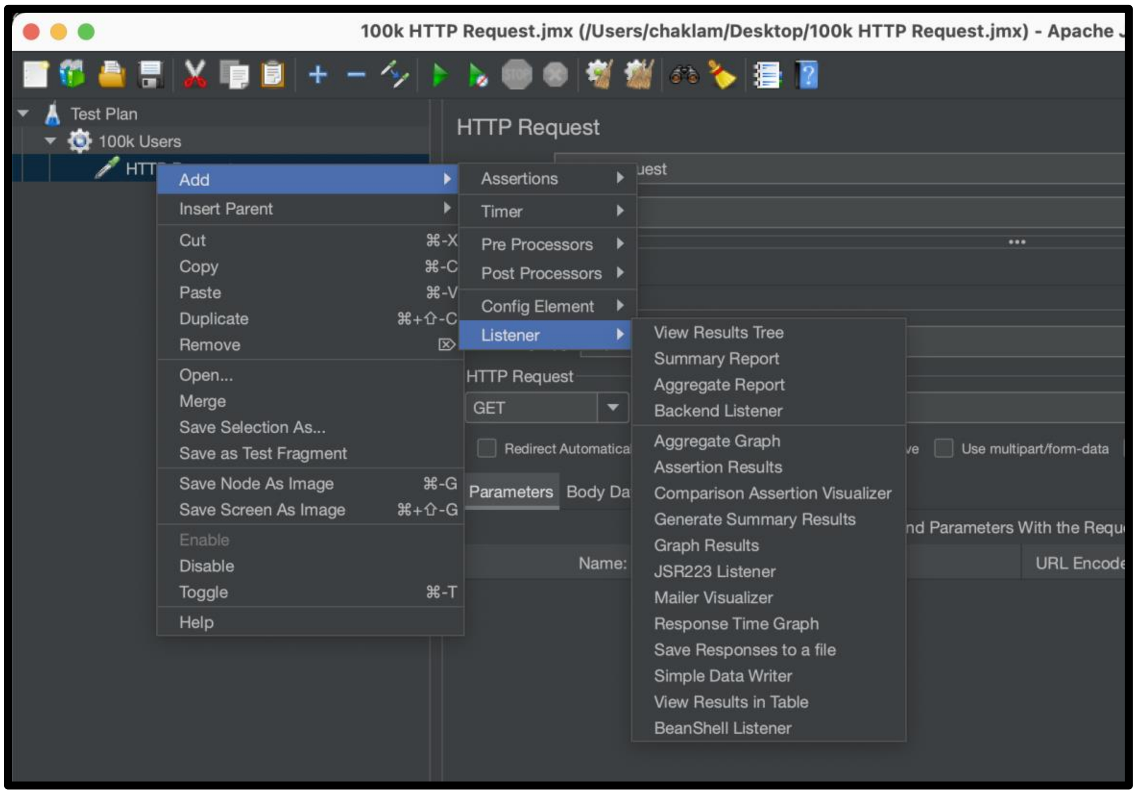


4. Specify the HTTP Request parameters as
    a. Protocol: HTTP
    b. Server name: chaklam.com
    c. Path: /projects

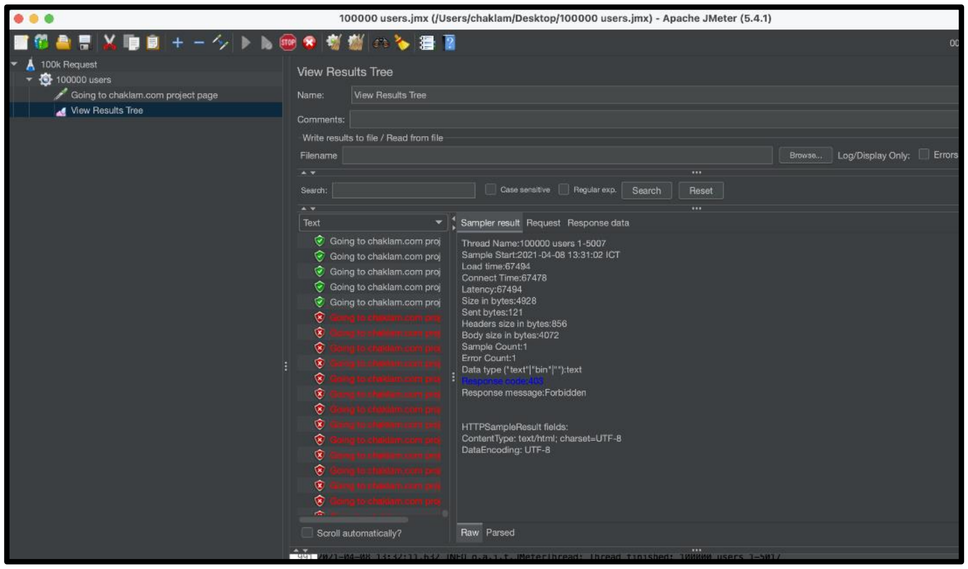


HTTP Request
Name: Going to chaklam.com project page
Comments:
Protocol [http]: http
Server Name or IP: chaklam.com
HTTP Request
GET
Path: /projects
☐ Redirect Automatically ✓ Follow Redirects ✓ Use KeepAlive ☐ Use multipart/form-data ☐ Browser-compatible headers

5. Next, before we actually run the test, let's add some visualization so we can better understand our result. Right click on the Thread Group and add Listener > View Result Tree



6. Before you click the Play (Green Triangle) button, the system will ask us to save. Save it so that we can reuse this whole Test Plan for our other project. Here is the result of my test result. As we can see, website can hardly handle 100k users as there are way too many reds.



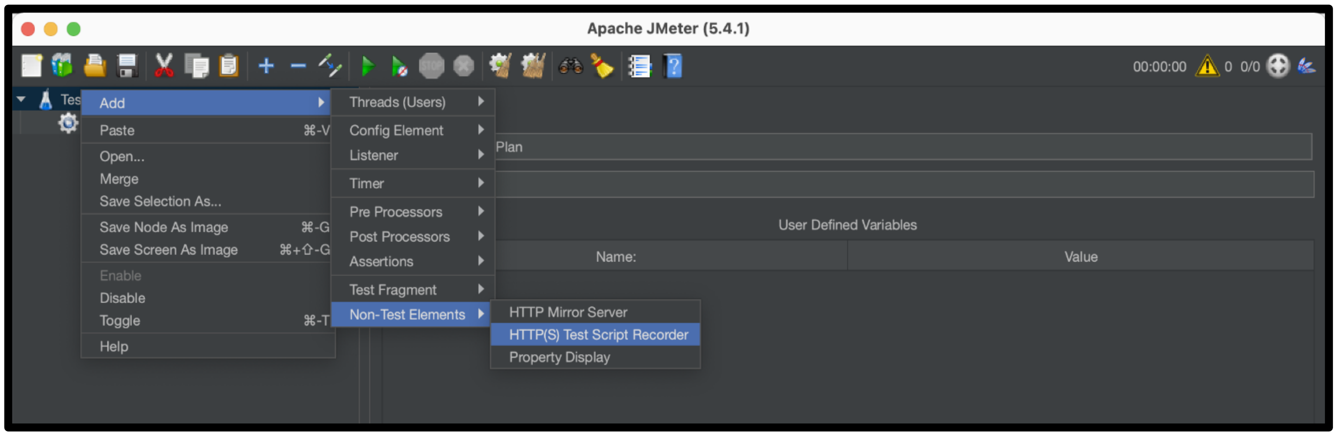
```
Thread Name:100000 users 1-5007
Sample Start:2021-04-08 13:31:02 ICT
Load time:67494
Connect Time:67478
Latency:67494
Size in bytes:4928
Sent bytes:121
Headers size in bytes:856
Body size in bytes:4072
Sample Count:1
Error Count:1
Data type ("text"|"bin"|""):text
Response code:403
Response message:Forbidden


HTTPSampleResult fields:
ContentType: text/html; charset=UTF-8
DataEncoding: UTF-8
```

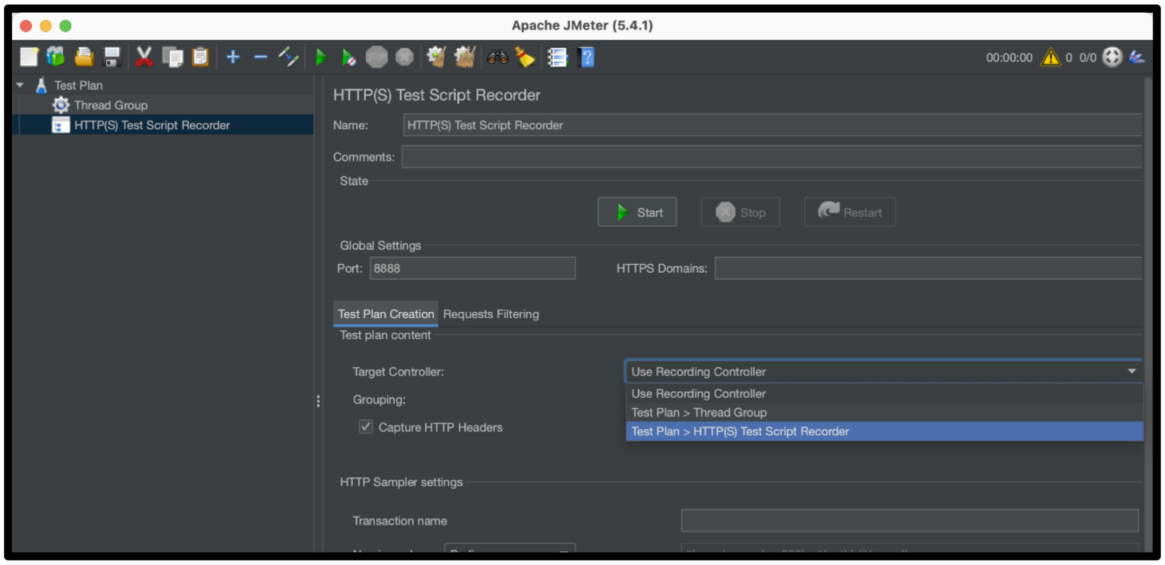
Demo 2: Recording

Sometimes we are lazy to configure the HTTP Request, we can use the Record feature to record all our actions so we can replay all our action as a test procedure.

1. First, create a Thread Group. Then, under the Test Plan, add Non-Test Elements > HTTP(s) Test Script Recorder



2. Set the Port to whatever we want. I will leave the default 8888. For the Target Controller, we select the last option. You can actually choose Use Recording Controller which will give you more options, but we will keep it simple for demonstration.



HTTP(S) Test Script Recorder

Name: HTTP(S) Test Script Recorder

Comments:

Port: 8888

HTTPS Domains:

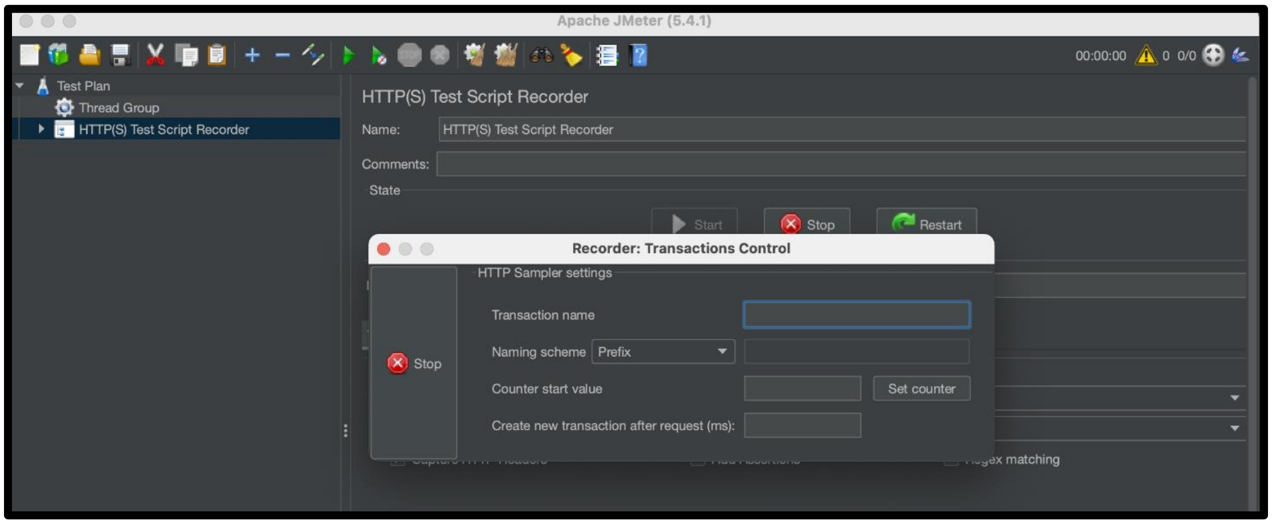
Target Controller: Use Recording Controller

Grouping:

☑ Capture HTTP Headers

Transaction name

3. If we are Window users, you have to install JMeter certificate in our browser, refer to this manual → [Apache JMeter - User's Manual: Component Reference]() (Search *Installing the certificate in Chrome or Internet Explorer*)
4. Now, we can press Start. You will see that the Recorder is now recording any activities running at port 8888



HTTP(S) Test Script Recorder

Name: HTTP(S) Test Script Recorder

Comments:

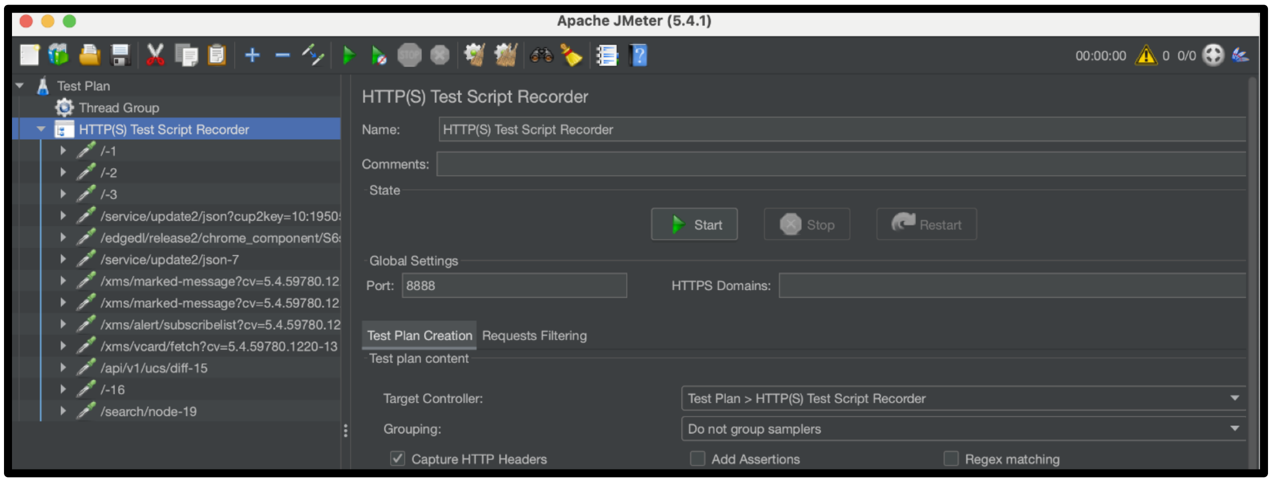
Transaction name

Naming scheme Prefix

Counter start value

Create new transaction after request (ms):

5. What we can do is visit some website and search for some keywords, and then press Stop. If everything is right, you will see there are many samplers recorded as the picture below shown.

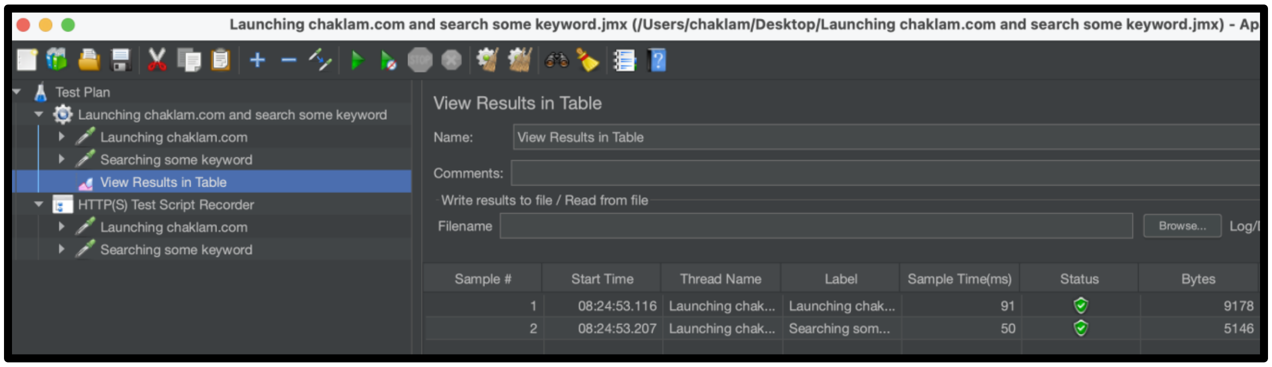


Test Plan
Thread Group
HTTP(S) Test Script Recorder
/-1
/-2
/-3
/service/update2/json?cup2key=10:1950
/edgedl/release2/chrome_component/S6
/service/update2/json-7
/xms/marked-message?cv=5.4.59780.12
/xms/marked-message?cv=5.4.59780.12
/xms/alert/subscribelist?cv=5.4.59780.12
/xms/vcard/fetch?cv=5.4.59780.1220-13
/api/v1/ucs/diff-15
/-16
/search/node-19

HTTP(S) Test Script Recorder

Name: HTTP(S) Test Script Recorder
Comments:
State
Global Settings
Port: 8888 HTTPS Domains:
Test plan content
Target Controller: Test Plan > HTTP(S) Test Script Recorder
Grouping: Do not group samplers
✓ Capture HTTP Headers ☐ Add Assertions ☐ Regex matching

6. Add some Listeners and we are good to go!



Launching chaklam.com and search some keyword.jmx (/Users/chaklam/Desktop/Launching chaklam.com and search some keyword.jmx) - Ap

Test Plan
Launching chaklam.com and search some keyword
Launching chaklam.com
Searching some keyword
View Results in Table
HTTP(S) Test Script Recorder
Launching chaklam.com
Searching some keyword

View Results in Table

Name: View Results in Table
Comments:
Write results to file / Read from file
Filename

Sample #	Start Time	Thread Name	Label	Sample Time(ms)	Status	Bytes
1	08:24:53.116	Launching chak...	Launching chak...	91	✓	9178
2	08:24:53.207	Launching chak...	Searching som...	50	✓	5146

6. Continuous integration

Continuous integration (CI) is the practice of automating the integration of code changes from multiple contributors into a single software project. It is a primary software development (Dev) and IT operations (Ops) best practice, allowing developers to frequently merge code changes into a central repository where builds and tests then run.

6.1 Setup Jenkins:

1. Download software from link given https://www.jenkins.io/download/thank-you-downloading-windows-installer-stable/ for Windows
2. Install Jenkins (we can follow the process from class note)

6.2 Overview of Jenkins

6.2.1 Software Requirements for full cycle for CI:

Define Repository

- SVN : TortoiseSVN
- Git : GitHub

Define Build Software

- MS Build : version VS 2017 or later
- DOT NET CORE SDK 2.2
- Java: version
- IONIC

Deploy

- IIS
- Tomcat
- Android

Testing Software

- Robot framework
- Selenium
- Selenium 2 library
- Chrome driver
- POSTMAN
- JMeter (https://www.jenkins.io/doc/book/using/using-jmeter-with-jenkins/)

Notification

- Microsoft Team
- Slack

6.2.2 Jenkin prerequisites

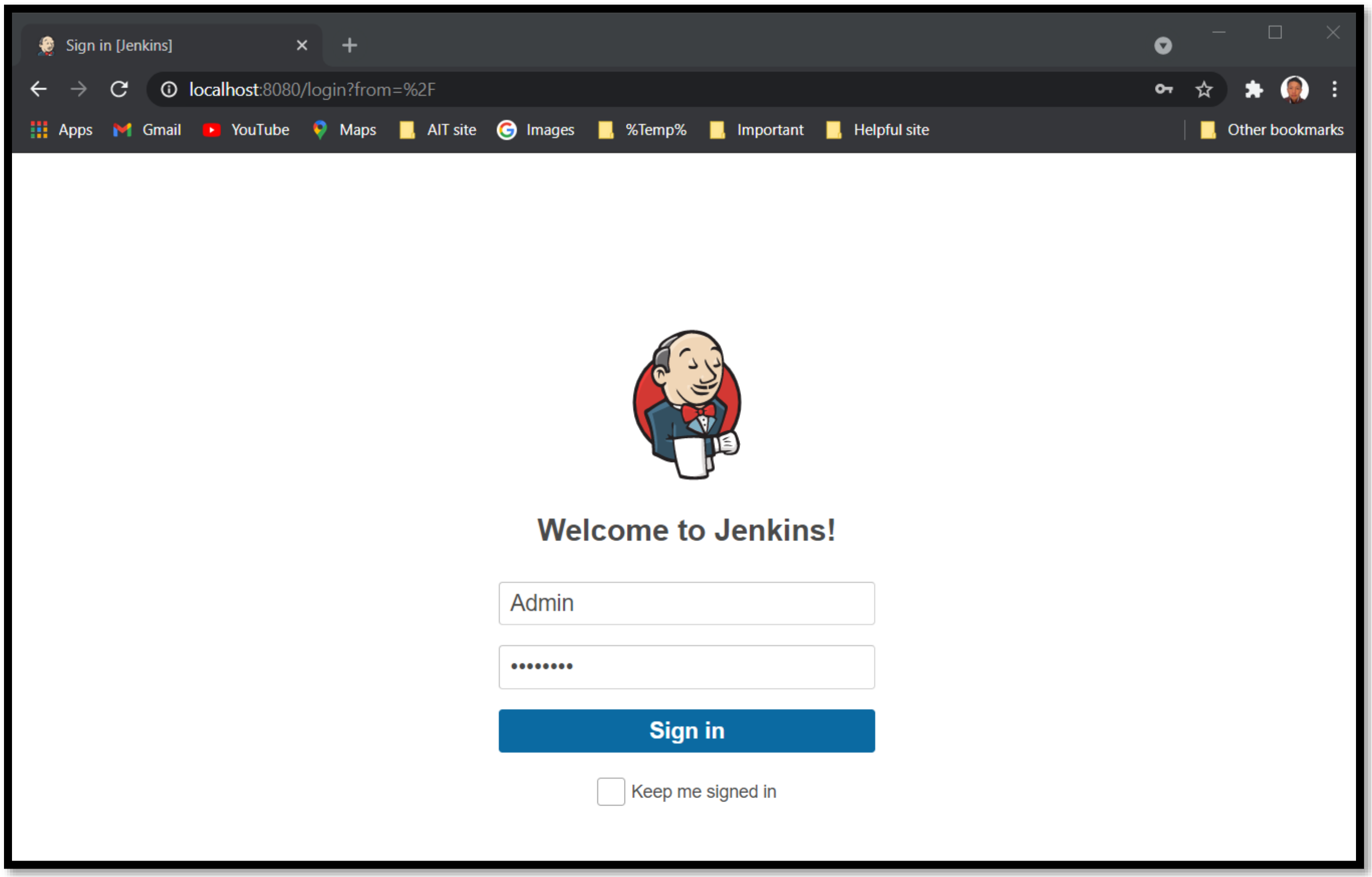
For this tour, you will require:

- A machine with:
    - ✓ 256 MB of RAM, although more than 2 GB is recommended.
    - ✓ 10 GB of drive space

- The following software installed:
    - Java 8 or 11 (either a JRE or Java Development Kit (JDK) is fine)

6.2.3 Run Jenkins

1. Run java -jar jenkins.war --httpPort=8080.
2. Browse to http://localhost:8080.
3. Follow the setup instructions to complete the installation.

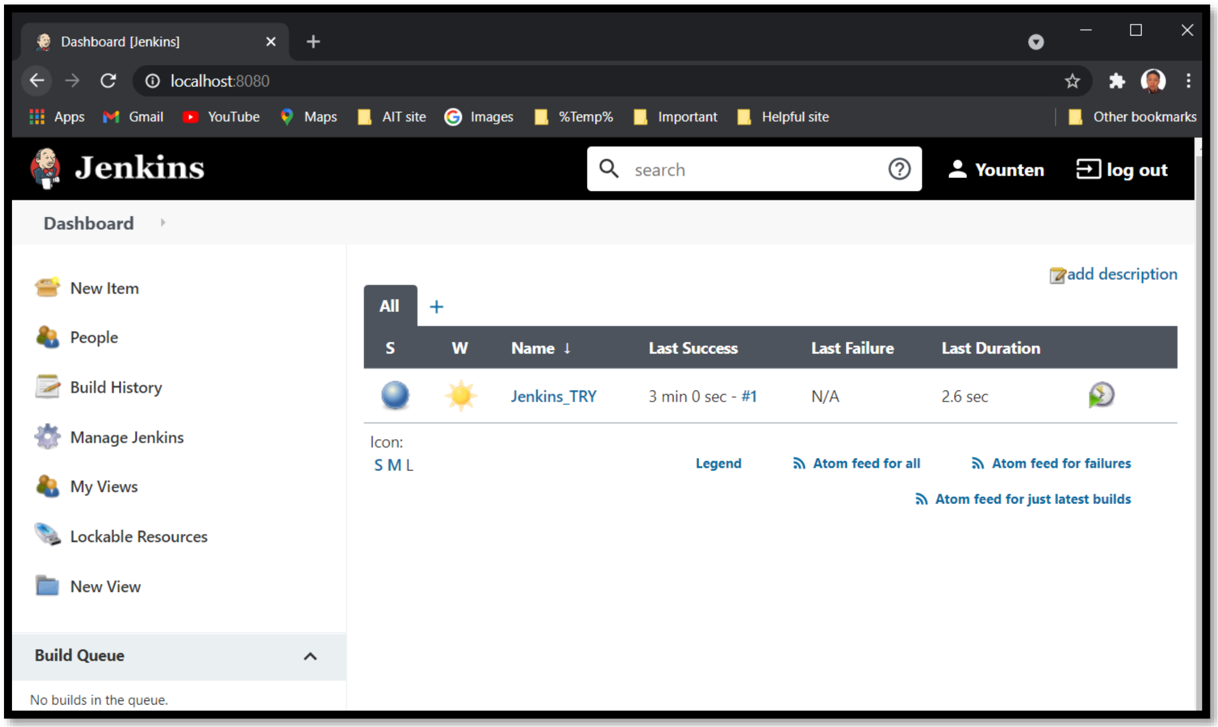


6.2.4 Creating Pipeline

Jenkins Pipeline (or simply "Pipeline") is a suite of plugins which supports implementing and integrating continuous delivery pipelines into Jenkins.

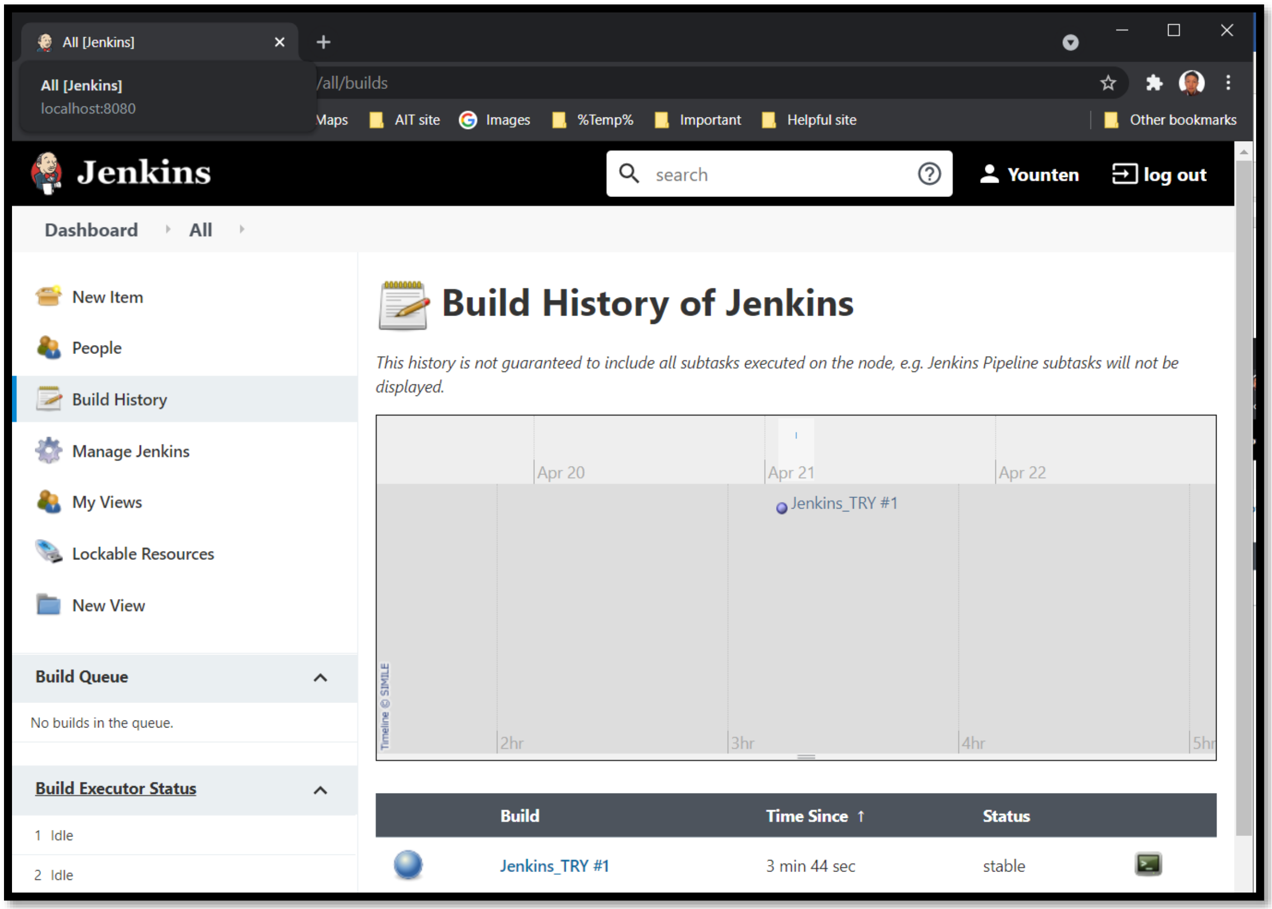
A continuous delivery pipeline is an automated expression of our process for getting software from version control right through to our users and customers.

Jenkins Pipeline provides an extensible set of tools for modeling simple-to-complex delivery pipelines "as code". The definition of a Jenkins Pipeline is typically written into a text file (called a Jenkinsfile) which in turn is checked into a project’s source control repository.



No builds in the queue.

S	W	Name ↓	Last Success	Last Failure	Last Duration
●	☀	Jenkins_TRY	3 min 0 sec - #1	N/A	2.6 sec



Build History of Jenkins

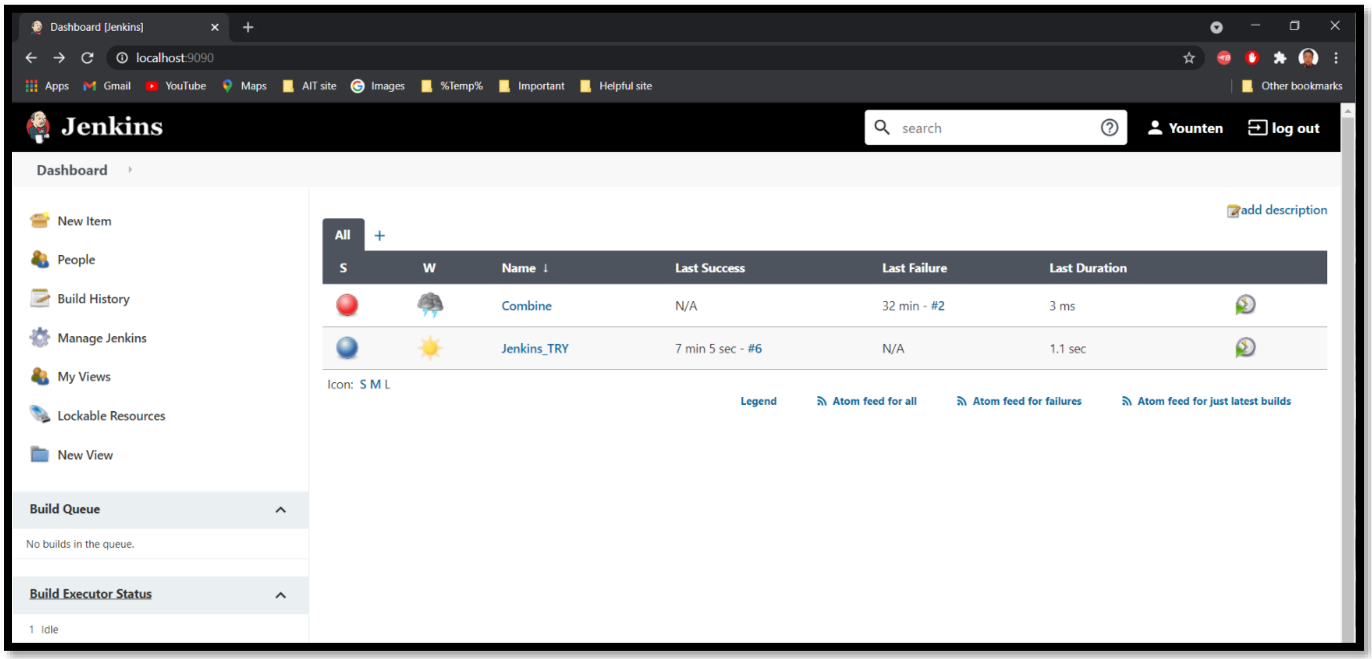
This history is not guaranteed to include all subtasks executed on the node, e.g. Jenkins Pipeline subtasks will not be displayed.

No builds in the queue.

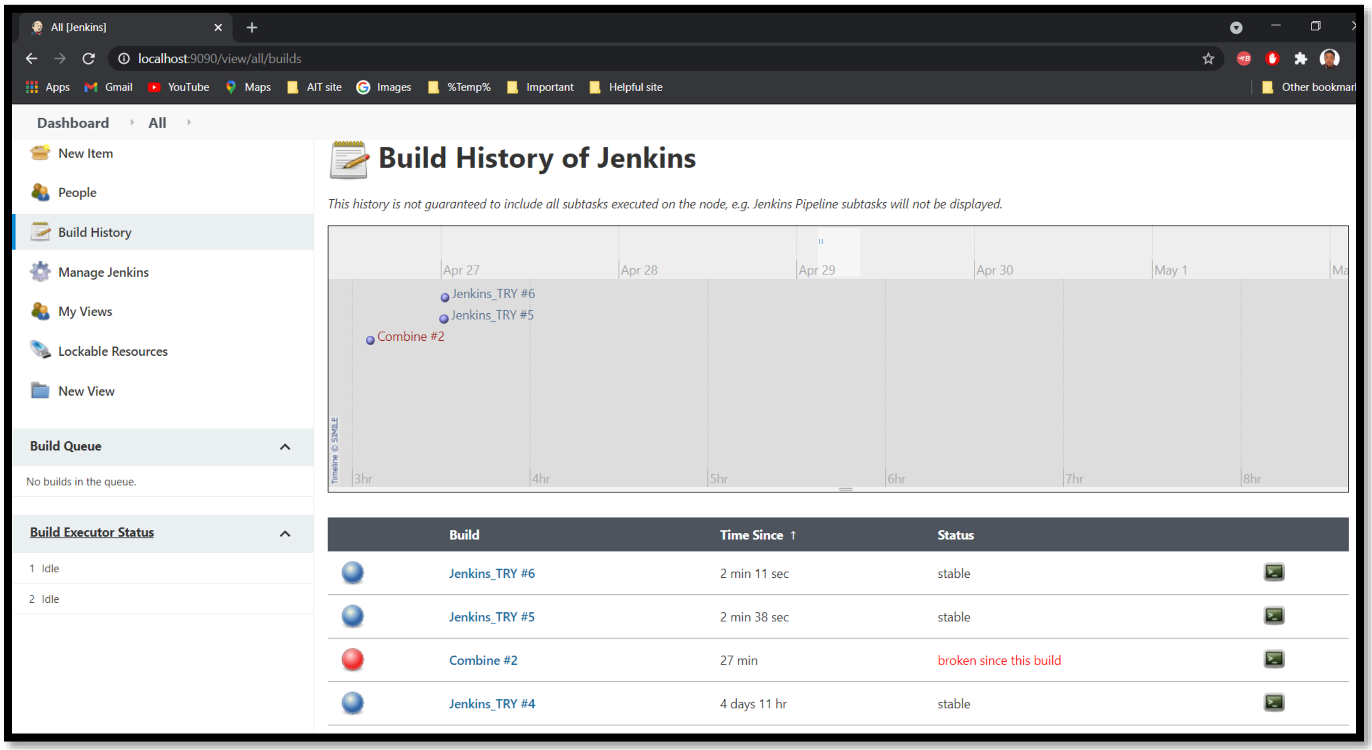
1 Idle

2 Idle

	Build	Time Since ↑	Status
●	Jenkins_TRY #1	3 min 44 sec	stable



S	W	Name ↓	Last Success	Last Failure	Last Duration
🔴		Combine	N/A	32 min - #2	3 ms
🔵		Jenkins_TRY	7 min 5 sec - #6	N/A	1.1 sec



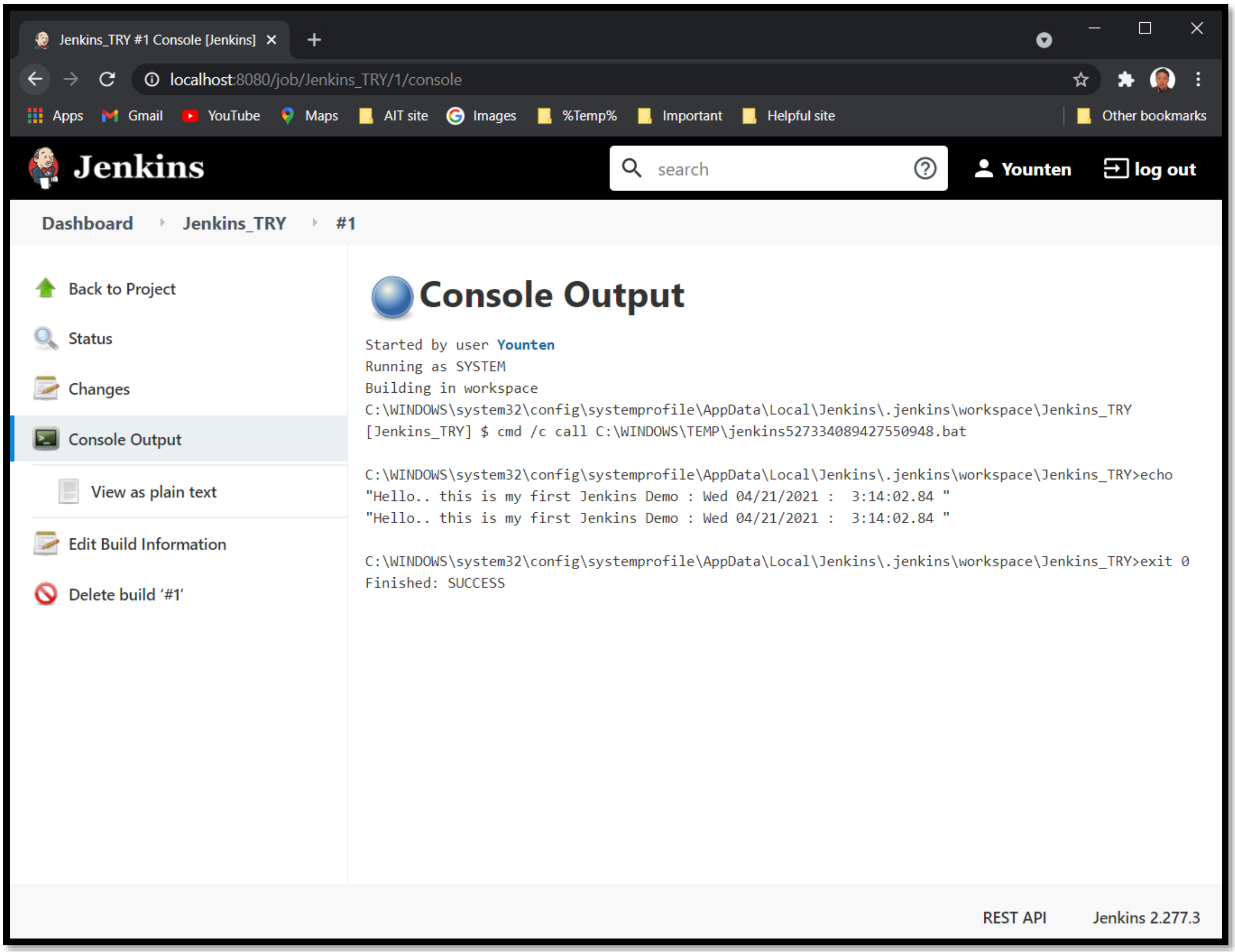
Build History of Jenkins

This history is not guaranteed to include all subtasks executed on the node, e.g. Jenkins Pipeline subtasks will not be displayed.

	Build	Time Since ↑	Status
🔵	Jenkins_TRY #6	2 min 11 sec	stable
🔵	Jenkins_TRY #5	2 min 38 sec	stable
🔴	Combine #2	27 min	broken since this build
🔵	Jenkins_TRY #4	4 days 11 hr	stable

After adding item and build:

We can see the output for the jobs that we have added or created and check the build history.



Console Output

```
Started by user Younten
Running as SYSTEM
Building in workspace
C:\WINDOWS\system32\config\systemprofile\AppData\Local\Jenkins\.jenkins\workspace\Jenkins_TRY
[Jenkins_TRY] $ cmd /c call C:\WINDOWS\TEMP\jenkins5273340894275509 48.bat

C:\WINDOWS\system32\config\systemprofile\AppData\Local\Jenkins\.jenkins\workspace\Jenkins_TRY>echo
"Hello.. this is my first Jenkins Demo : Wed 04/21/2021 :  3:14:02.84 "
"Hello.. this is my first Jenkins Demo : Wed 04/21/2021 :  3:14:02.84 "

C:\WINDOWS\system32\config\systemprofile\AppData\Local\Jenkins\.jenkins\workspace\Jenkins_TRY>exit 0
Finished: SUCCESS
```