NULLCON

INTERNATIONAL SECURITY CONFERENCE

SecQAtion

Security Tests Automation using Robot Framework

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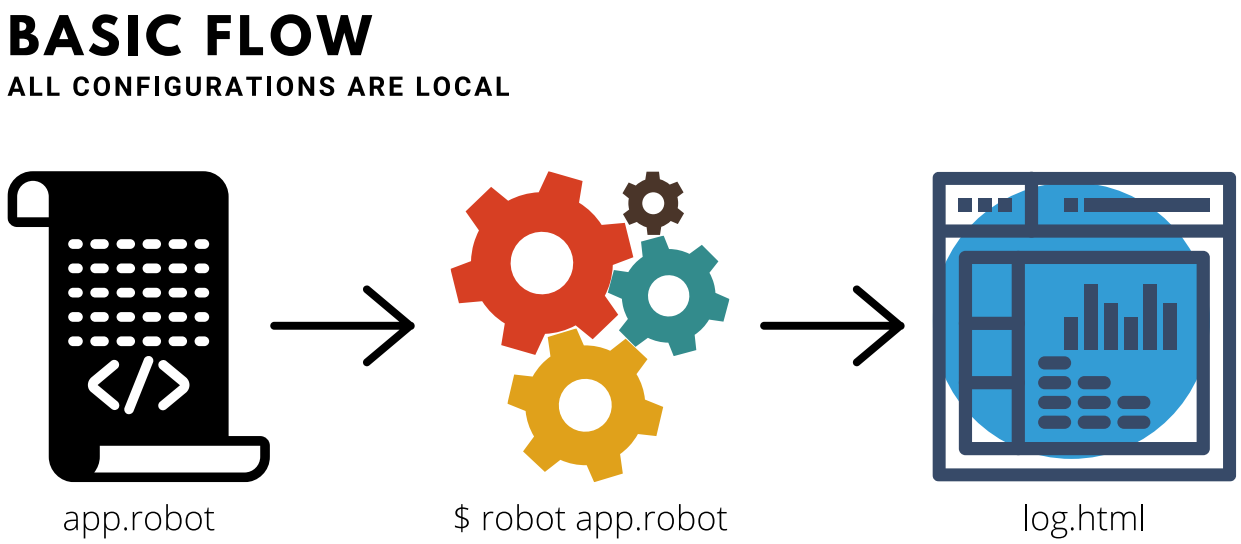
1. SecQAtion - Security Tests Automation using Robot Framework

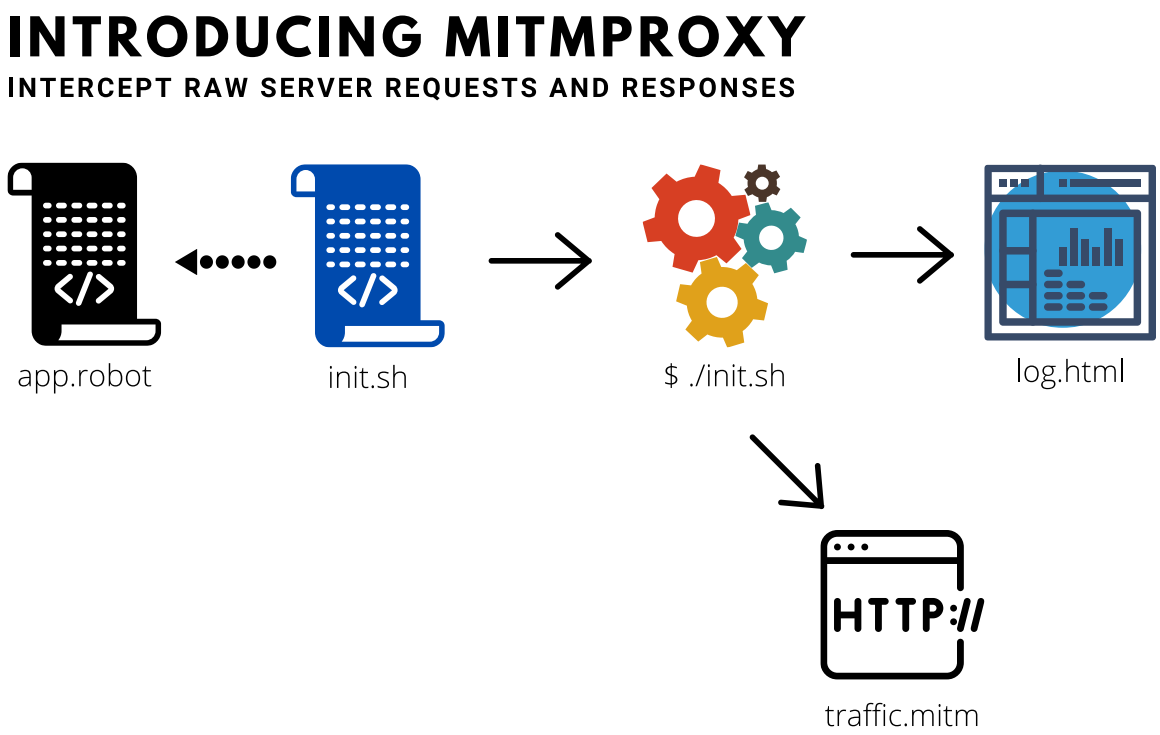
1.1 What are we solving?

While doing a security assessment: * Get rid of boring manual tasks * Make your job fun and productive * Ensure consistency and repeatability * Generate business friendly test reports * Let developers incorporate your tests into their build pipeline * Adapt and evolve, quickly and easily

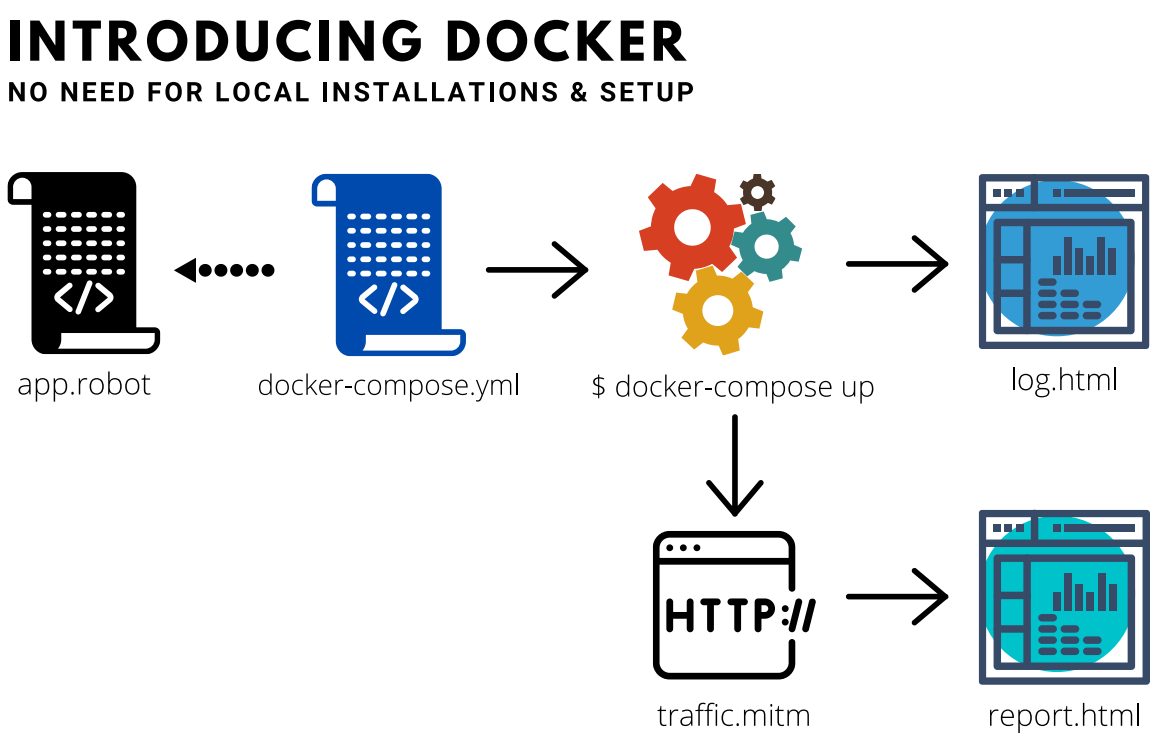
1.2 Scenario 1:



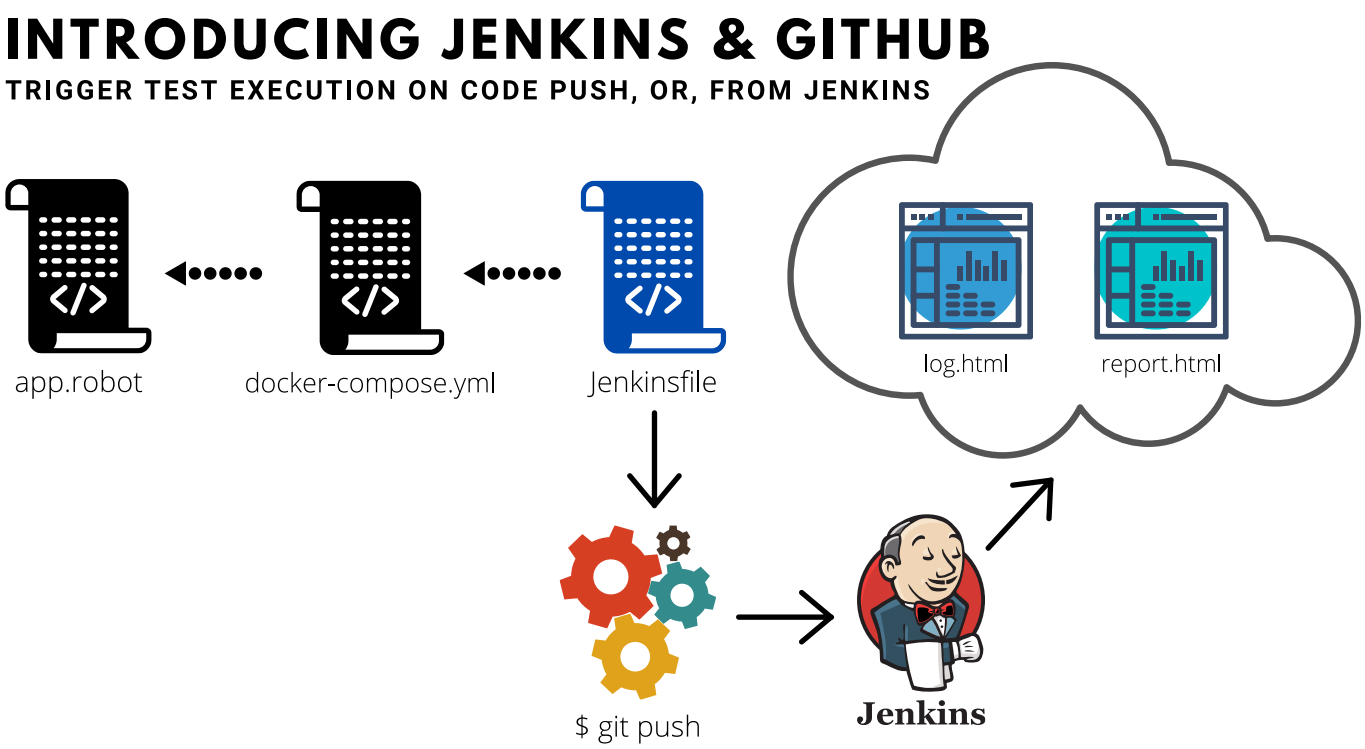
1.3 Scenario 2:



1.4 Scenario 3:



1.5 Scenario 4:



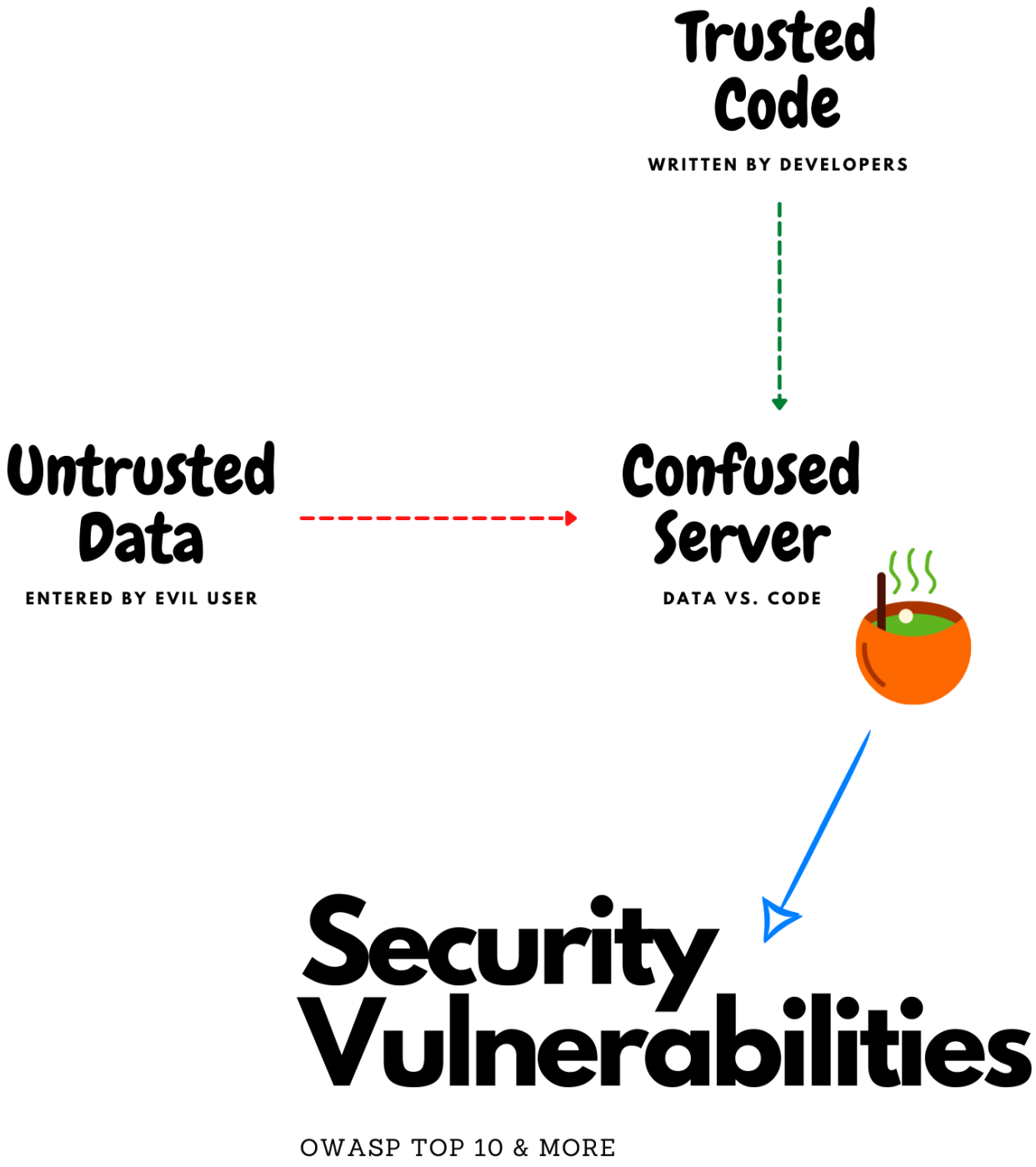
1.6 Table of Contents

1.7 Trainer

Security Analyst Consultant @Arogya.ai

2. Standard Security Testing Approach

1. Browse
2. Analyze
3. Prepare
4. Attack
5. Confirm
6. Report



2.1 1. Browse

Browse the target application in its entirety, using valid data, so that no feature is left untouched.

But, why?

Let's call this process "reconnaisance".

What information are we collecting?

Everything we possibly can. Most importantly, the raw server requests and responses.

- API endpoints
- Request headers
- Response headers
- Request body
- Response body

2.2 2. Analyze

Identify all entry and exit points.

What are they?

An entry point could be any place that accepts user input. An exit point could be any place in the application that either reflects user input directly, or returns a processed result based upon user-supplied input.

How does it help?

Probably one of these entrypoints is not secure enough. Probably, user can enter arbitrary data that allows confusion at the server. What if due to lack of sufficient user input validation on the server-side, the server confuses user entered data for code that needs to be executed.

The situation could worsen if system manages to dump the unprocessed server responses insecurely in a webpage.

What information are we collecting?

Identify target operating system and version, supported programming language, supported server-side technologies, running software versions, etc.

2.3 3. Prepare

Identify the metacharacter, or, a set of characters that can successfully elicit a "useful" (error) response from the server.

What are metacharacters?

According to Wikipedia,

> A **metacharacter** is a character that has a special meaning to a computer program, such as a shell interpreter or a regular expression (regex) engine.
>
> In POSIX extended regular expressions, there are 14 metacharacters that must be *escaped* (preceded by a backslash (`\`)) in order to drop their special meaning and be treated literally inside an expression: opening and closing square brackets (`[` and `]`); backslash (`\`); caret (`^`); dollar sign (`$`); period/full stop/dot (`.`); vertical bar/pipe symbol (`|`); question mark (`?`); asterisk (`*`); plus and minus signs (`+` and `-`); opening and closing curly brackets/braces (`{` and `}`); and opening and closing parentheses (`(` and `)`).
>
> For example, to match the arithmetic expression `(1+1)*3=6` with a regex, the correct regex is `\(1\+1\)\*3=6` ; otherwise, the parentheses, plus sign, and asterisk will have special meanings.

What are we looking for?

We are looking for an error response from the server. A server error would indicate a possibility to control the code running on the server via malicious inputs controlled by a low privileged user.

What shall we prepare?

Prepare a set of payloads to launch targeted attacks on the server.

2.4 4. Attack

With entry points identified, vulnerability confirmed via server error response, and payloads prepared, we are ready to lunch an attack on the server.

Take help of cheatsheets to possibly bypass any filters or firewall protection mechanisms.

Research, refine and relaunch the attack until you are satisfied with your findings.

2.5 5. Confirm

If you think your attack was successful, repeat the steps and confirm its reproducibility.

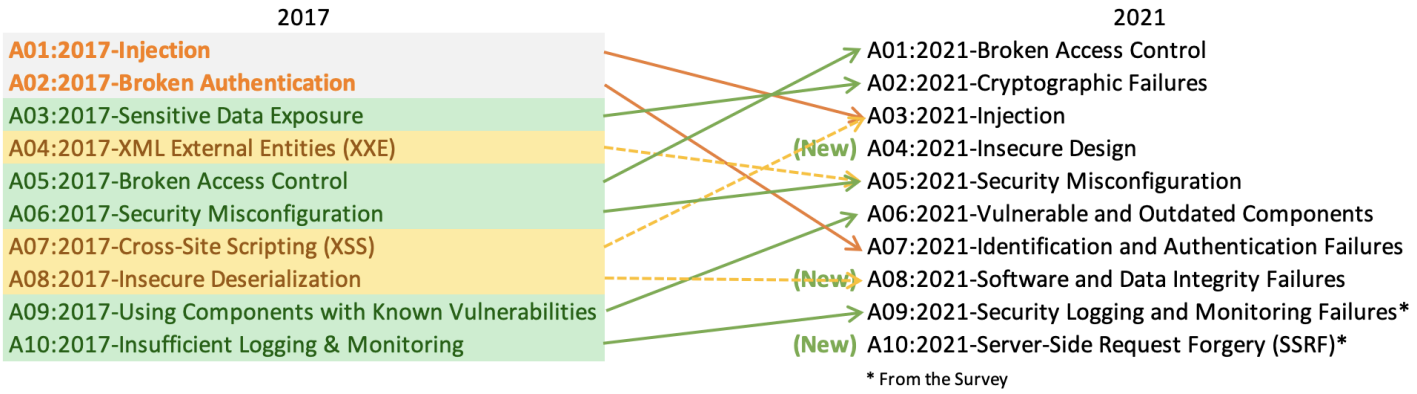
2.6 6. Report

Once confirmed, document your findings and share the security report with the concerned team.

3. Exercise

1. Go to defendtheweb.net
2. Follow the approach explained above (Alloted time: **5 minutes**)
3. Share your findings with us. Explain your approach, any interesting observation, difficulties you faced, issues you found, etc.

4. OWASP Top 10 2021



1. A01:2021-Broken Access Control
2. A02:2021-Cryptographic Failures
3. A03:2021-Injection
4. A04:2021-Insecure Design
5. A05:2021-Security Misconfiguration
6. A06:2021-Vulnerable and Outdated Components
7. A07:2021-Identification and Authentication Failures
8. A08:2021-Software and Data Integrity Failures
9. A09:2021-Security Logging and Monitoring Failures
10. A10:2021-Server-Side Request Forgery

4.1 Let Me Explain

1. **A01:2021-Broken Access Control**: Parameter tampering, URL tampering, CORS misconfiguration

    1. Broken Authentication and Authorization Scenarios
    2. Example: Generate valid JWT token by modifying the vulnerable "email" input parameter
    3. JWT Toolkit: Attacking JWT Tokens

2. **A02:2021-Cryptographic Failures**: This includes security failures when data is in transit or at rest, such as the implementation of weak cryptographic algorithms, poor or lax key generation, a failure to implement encryption or to verify certificates, and the transmission of data in cleartext.

    1. Example: Decrypting RSA
    2. Example: Hashes do NOT ensure safety on their own!

3. **A03:2021-Injection**:

    1. Various types of Injection attacks
    2. Cross-Site Scripting

4. **A04:2021-Insecure Design**: Not following secure design patterns and principles

    1. Follow best practices and secure design principles, wherever possible
    2. Build things with security-centric mindset
    3. Conduct code reviews to avoid any bad code going into the production
    4. Conduct regular code audits and pentests

5. **A05:2021-Security Misconfiguration**: The simplest example would be misconfigurations in the cloud service called IAM (Identity and Access Management). If the permissions assigned to an entity is more than it needs to do it's job effectively, this could open room for exploitation, if the credentials for that entity got compromised or misused by trusted parties.

    1. Security Misconfigurations
    2. Example: Amazon Cognito misconfiguration
    3. Example: Cognito misconfiguration detection and exploitation technique
    4. Exploiting XML External Entity

6. **A06:2021-Vulnerable and Outdated Components**: Example: Zero-day in Sign in with Apple

    1. Maintain an inventory of components you are using and ensure that they are kept up-to-date
    2. Remove unused dependencies and components
    3. Install the components via trusted channels and make sure to validate their integrity. Also, it's better to use signed packages (if available)
    4. Be on the lookout for any security patches for the components you are relying on. If the packages you use are not maintained, then either make sure you apply patches yourself or use some alternate component that is well maintained.

7. **A07:2021-Identification and Authentication Failures**: Password bruteforcing, credential stuffing, flawed password reset functionality, mishandled/weak session identifiers

    1. Example: Improper API rate limiting
    2. Examplle: Security Shepherd — Broken Auth and Session Management Challenge 5

8. **A08:2021-Software and Data Integrity Failures**: How sure are you about the integrity of the apps or data that you are consuming? Ensure that a software supply chain security tool, such as **OWASP Dependency Check** or **OWASP CycloneDX**, is used to verify that components do not contain known vulnerabilities.

    1. Example: Supply chain attack trojanized SolarWinds Orion business software updates in order to distribute malware

9. **A09:2021-Security Logging and Monitoring Failures**: When a security-critical event occurs, the software either does not record the event or omits important details about the event when logging it. When security-critical events are not logged properly, such as a failed login attempt, this can make malicious behavior more difficult to detect and may hinder forensic analysis after an attack succeeds. If security critical information is not recorded, there will be no trail for forensic analysis and discovering the cause of problems or the source of attacks may become more difficult or impossible.
10. **A10:2021-Server-Side Request Forgery**:
    1. Journey of a security bug — From a naive-looking PDF Download to SSRF via HTML Injection in AWS
    2. A10:2021 – Server-Side Request Forgery (SSRF)

4.2 Getting Serious?

Pre-requisites: Create a free account on portswigger.net

Try out these labs:

1. SQL Injection
2. XSS
3. CSRF
4. Clickjacking
5. XXE
6. Many More

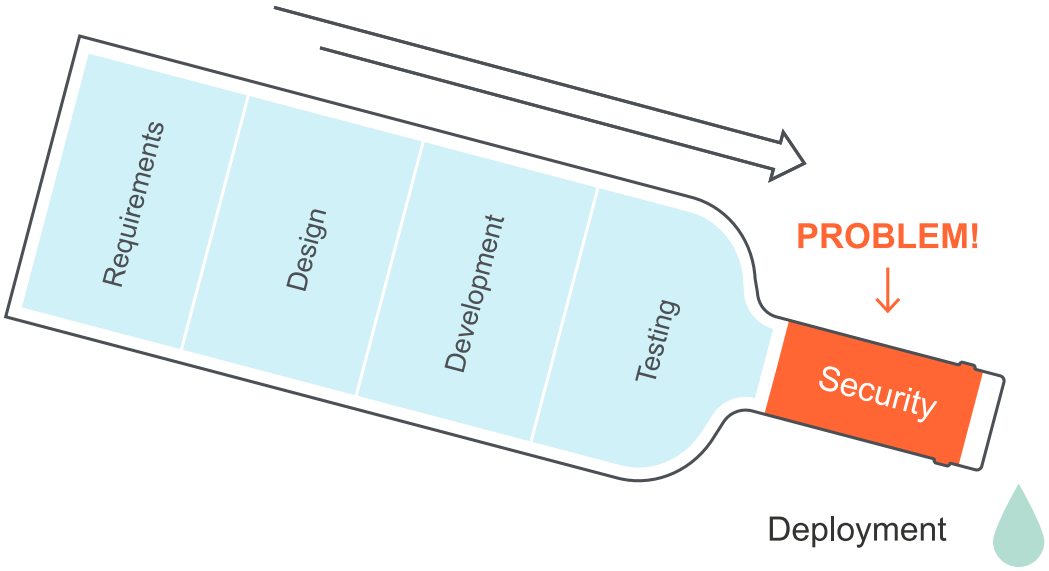
4.3 Further Reading

- https://owasp.org/Top10/
- https://owasp.org/Top10/A01_2021-Broken_Access_Control/
- https://portswigger.net/daily-swig/owasp-shakes-up-web-app-threat-categories-with-release-of-draft-top-10
- https://owasp.org/Top10/A02_2021-Cryptographic_Failures/
- https://medium.com/@shivam_bathla/a05-2021-security-misconfiguration-fe6d321d71d7
- https://medium.com/@shivam_bathla/a06-2021-vulnerable-and-outdated-components-a5d96017049c
- https://medium.com/@shivam_bathla/a07-2021-identification-and-authentication-failures-b585c856eb24
- https://www.sans.org/brochure/course/log-management-in-depth/6
- https://owasp-top-10-proactive-controls-2018.readthedocs.io/en/latest/c9-implement-security-logging-monitoring.html
- https://cwe.mitre.org/data/definitions/778.html
- https://docs.microsoft.com/en-us/azure/architecture/best-practices/monitoring

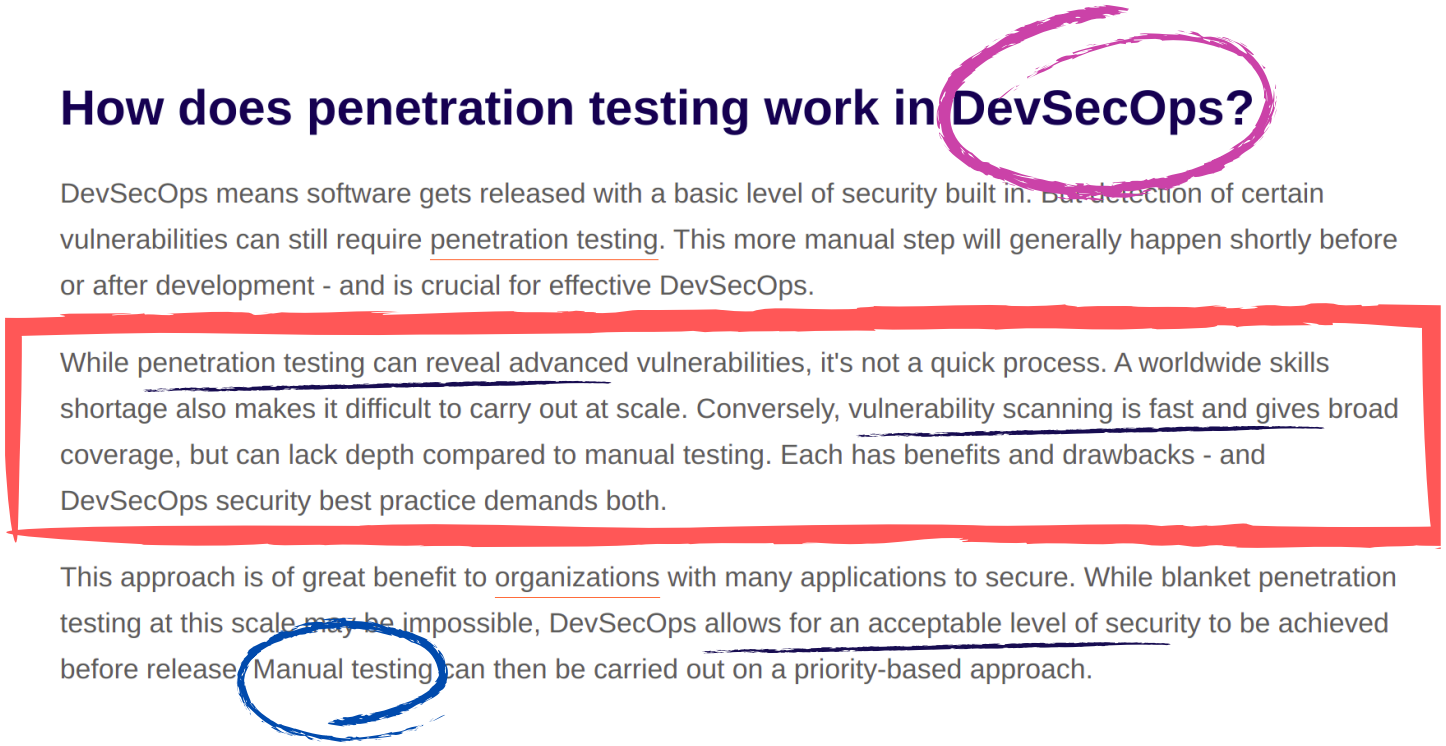
5. Inconveniences/Gaps

5.1 Developer's Perspective

In traditional software development, security is a bottleneck



5.2 DevSecOps: Is there a scope for improvement?



- Do we really have to choose between manual testing and vulnerability scanning?
- Manual pentesting is slow and tedious, but highly effective
- Vulnerability scans are fast and effortless, but less reliable
- Is there a way to achive much more than a plain vulnerability scan? Is there a way to make manual testing less tedious?

5.3 Test Automation: Is it too tedious for pentesters?

Not really.

5.4 References:

- `https://portswigger.net/solutions/devsecops/guide-to-devsecops`

6. Introduction to Robot Framework

6.1 Overview

Robot Framework is a generic open source automation framework. It can be used for **test automation** and **robotic process automation** (RPA). **SeleniumLibrary** is one of the many test libraries that can be used with Robot Framework.

6.2 Advantage

- Easy syntax
- Human-readable keywords
- Operating system and application independent
- Supports both Python 2.7 and Python 3.5+
- Has a rich ecosystem consisting of pre-existing libraries and tools
- Capabilities can be extended by libraries implemented with Python or Java

6.3 Installation

```
pip install robotframework pip install --upgrade robotframework-seleniumlibrary sudo pip install webdrivermanager sudo webdrivermanager firefox chrome --li
```

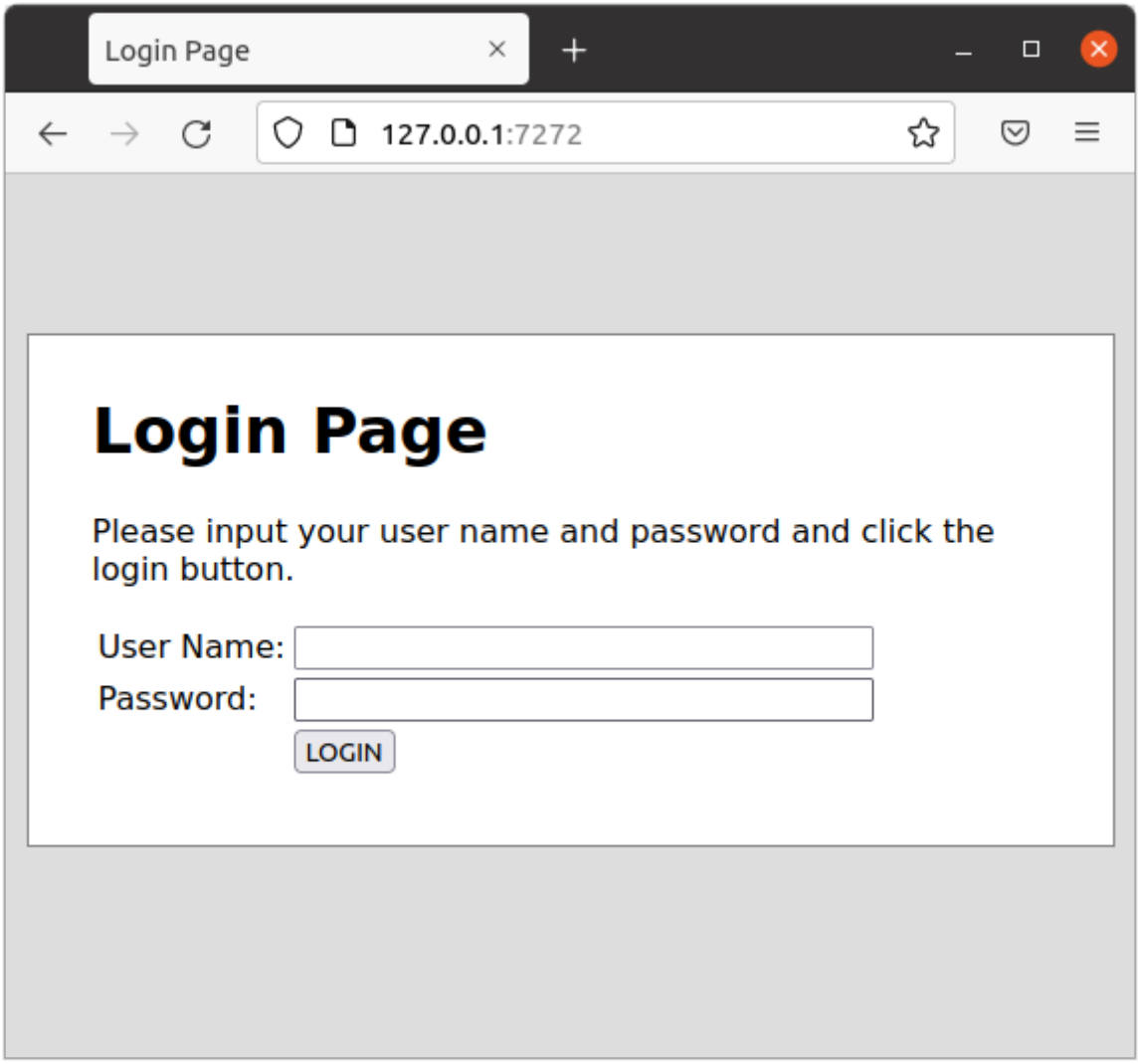
More details here and here.

6.4 Demo: Standard Usage

1. Clone following GitHub repository `git clone https://github.com/robotframework/WebDemo.git`
2. Start the demo application `cd WebDemo/ python demoapp/server.py`

```
secqation@mirage:~/Desktop/WebDemo$ ls -1
BUILD.rst
demoapp
demoapp.png
docs
login_tests
README.rst
requirements.txt
tasks.py
secqation@mirage:~/Desktop/WebDemo$ python demoapp/server.py
Demo server starting on port 7272.
127.0.0.1 - - [08/Aug/2021 21:51:19] "GET / HTTP/1.1" 200 -
127.0.0.1 - - [08/Aug/2021 21:51:19] "GET /demo.css HTTP/1.1" 200 -
127.0.0.1 - - [08/Aug/2021 21:51:19] code 404, message File not found
127.0.0.1 - - [08/Aug/2021 21:51:19] "GET /favicon.ico HTTP/1.1" 404 -
```

3. Access the demo application by navigating to `127.0.0.1:7272`



4. Trigger automated test execution

```
robot login_tests/
```

```
Login Tests.Invalid Login :: A test suite containing tests related to inval...
==============================================================================
Invalid Username                                                      | PASS |
------------------------------------------------------------------------------
Invalid Password                                                      | PASS |
------------------------------------------------------------------------------
Invalid Username And Password                                         | PASS |
------------------------------------------------------------------------------
Empty Username                                                        | PASS |
------------------------------------------------------------------------------
Empty Password                                                        | PASS |
------------------------------------------------------------------------------
Empty Username And Password                                           | PASS |
------------------------------------------------------------------------------
Login Tests.Invalid Login :: A test suite containing tests related... | PASS |
6 tests, 6 passed, 0 failed
==============================================================================
Login Tests.Valid Login :: A test suite with a single test for valid login.
==============================================================================
Valid Login                                                           | PASS |
------------------------------------------------------------------------------
Login Tests.Valid Login :: A test suite with a single test for val... | PASS |
1 test, 1 passed, 0 failed
==============================================================================
Login Tests                                                           | PASS |
8 tests, 8 passed, 0 failed
==============================================================================
Output:  /home/secqation/Desktop/WebDemo/output.xml
Log:     /home/secqation/Desktop/WebDemo/log.html
Report:  /home/secqation/Desktop/WebDemo/report.html
```

5. Access test execution report

```
firefox log.html
```

Statistics by Suite	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
Login Tests	8	8	0	0	00:00:25	
Login Tests . Gherkin Login	1	1	0	0	00:00:08	
Login Tests . Invalid Login	6	6	0	0	00:00:10	
Login Tests . Valid Login	1	1	0	0	00:00:07	

Test Execution Log

SUITE **Login Tests**

Full Name: Login Tests
Source: /home/secqation/Desktop/WebDemo/login_tests
Start / End / Elapsed: 20210808 22:07:28.920 / 20210808 22:07:53.464 / 00:00:24.544
Status: 8 tests total, 8 passed, 0 failed, 0 skipped

SUITE **Gherkin Login**

Full Name: Login Tests.Gherkin Login
Documentation: A test suite with a single Gherkin style test.
This test is functionally identical to the example in valid_login.robot file.
Source: /home/secqation/Desktop/WebDemo/login_tests/gherkin_login.robot
Start / End / Elapsed: 20210808 22:07:28.952 / 20210808 22:07:36.574 / 00:00:07.622
Status: 1 test total, 1 passed, 0 failed, 0 skipped

TEST **Valid Login**

Full Name: Login Tests.Gherkin Login.Valid Login
Start / End / Elapsed: 20210808 22:07:29.216 / 20210808 22:07:36.572 / 00:00:07.356
Status: PASS

KEYWORD **Given browser is opened to login page**
KEYWORD **When user "demo" logs in with password "mode"**
KEYWORD resource . **Then welcome page should be open**
TEARDOWN SeleniumLibrary . **Close Browser**

SUITE **Invalid Login**

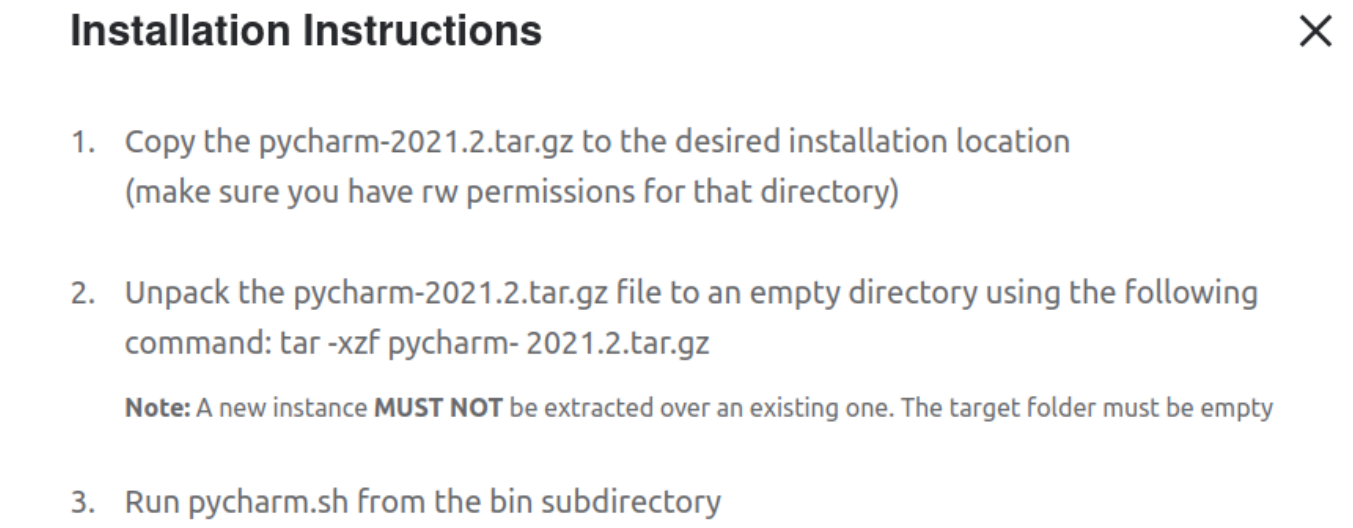
SUITE **Valid Login**

6.5 References

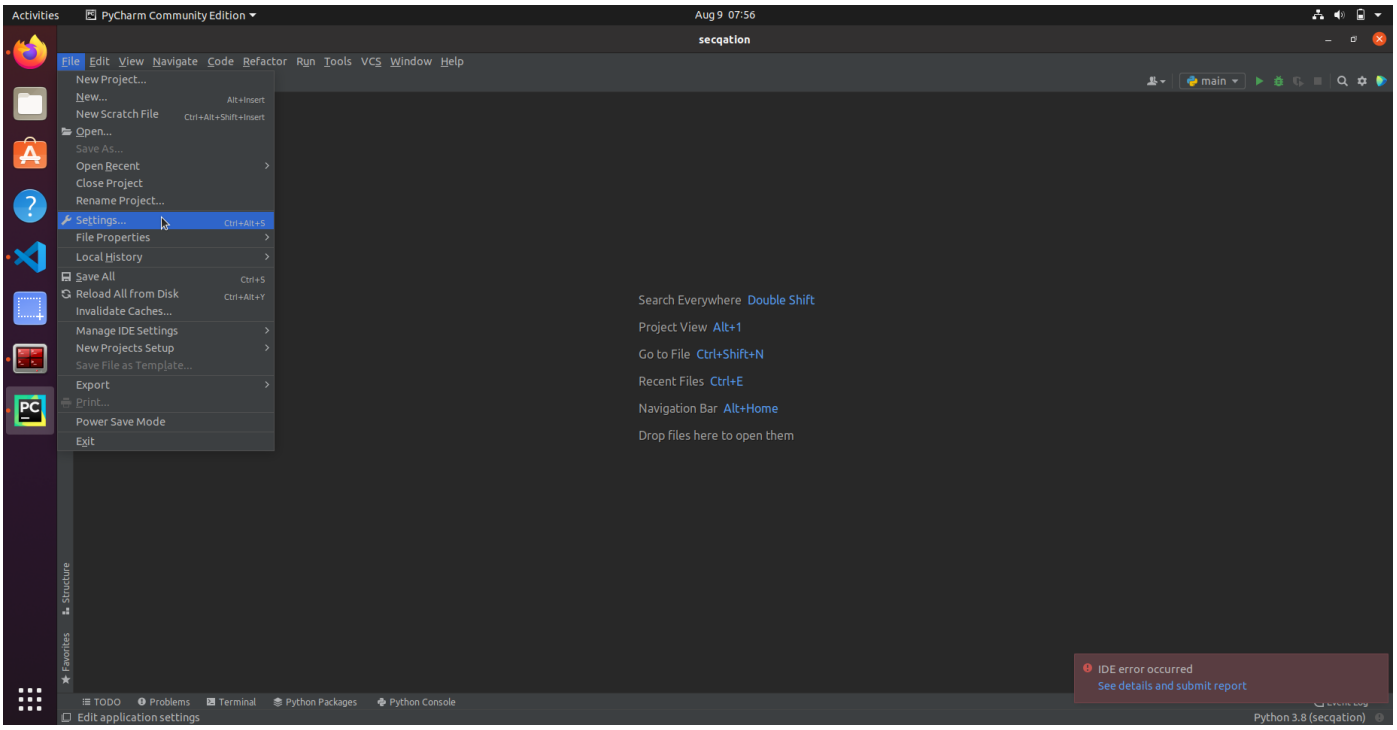
- Installation instructions
- SeleniumLibrary
- Web testing with Robot Framework and SeleniumLibrary
- Running Demo

7. Configuring PyCharm

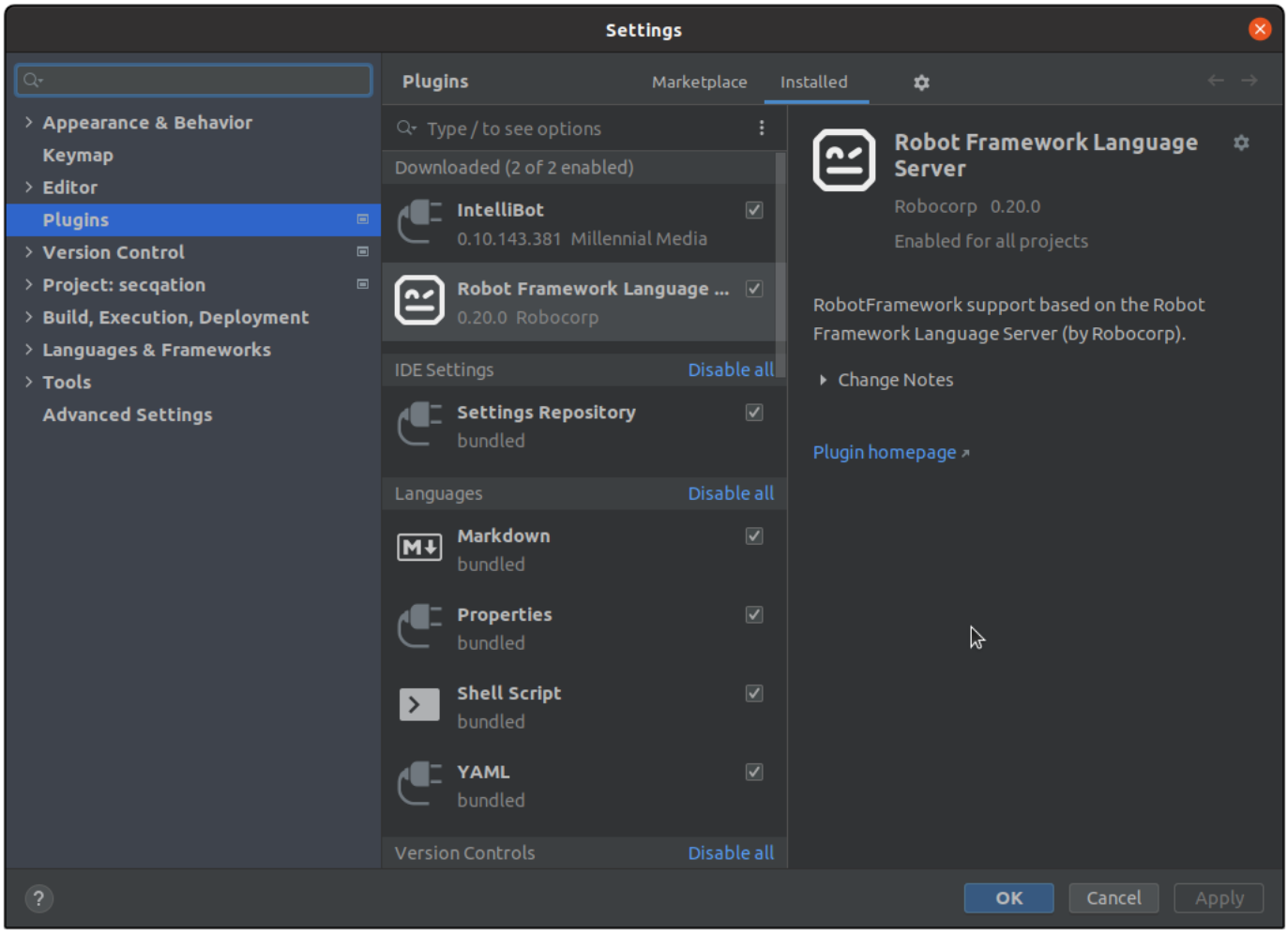
1. Download PyCharm
2. Install and run PyCharm



3. Go to "File" > "Settings"

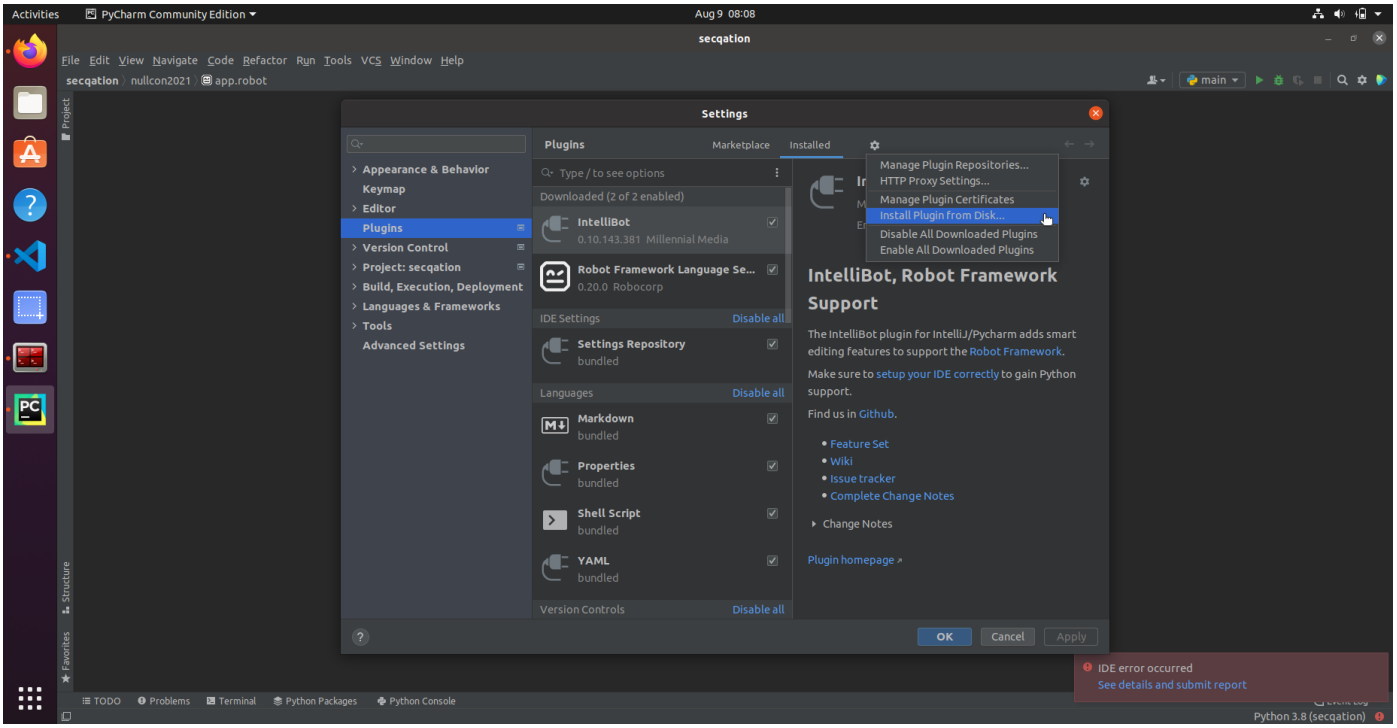


4. Install the "Robot Framework Language Server" plugin



5. Download intellibot.jar

6. Install `intellibot.jar` plugin to your IDE by using the 'Install plugin from disk...' option



7. Re-start PyCharm

7.1 References

- Download and install PyCharm
- IntelliJ/PyCharm Plugin for Robot Automation Framework
- intellibot.jar

8. Recommended Folder Structure

8.1 Short on time? Create single robot file.

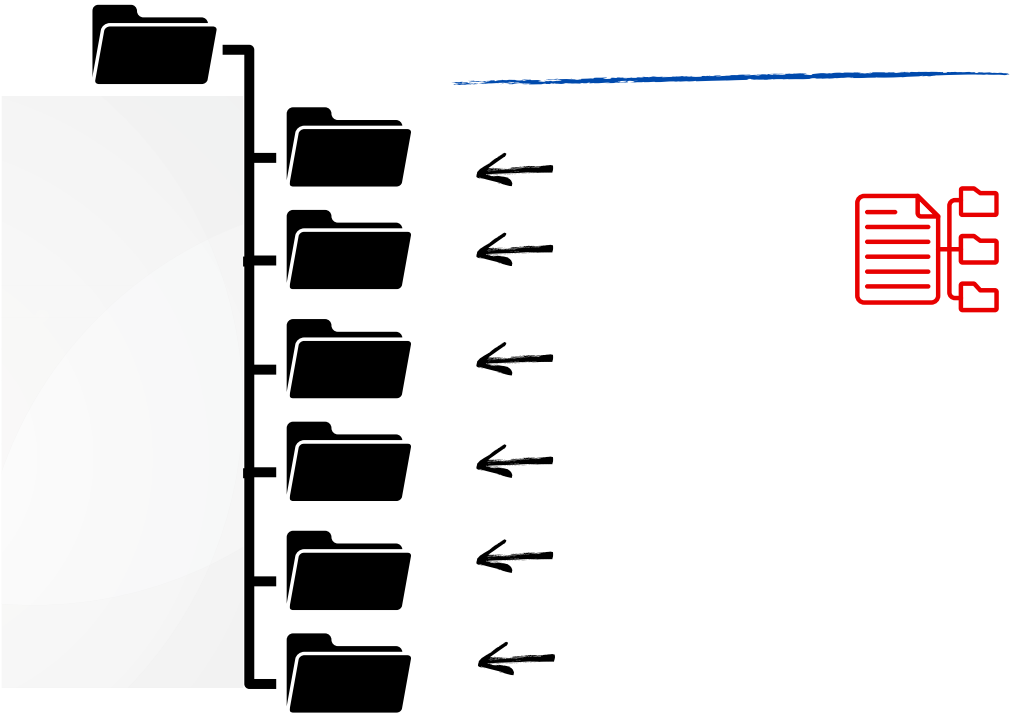
```
*** Settings ***
Library     SeleniumLibrary

*** Variables ***
${BASE_URL} =  https://www.winja.site

*** Keywords ***
Custom keyword
    Log    This is a custom keyword

*** Test Cases ***
Test Case 1
    Set Selenium Speed    0
    Open Browser  ${BASE_URL}
    Custom keyword
    Close All Browsers

```

8.2 For something more serious, get organized?

1. Be in control of your assets
2. Know where to find what
3. Avoid unmanageable pile of files, as your project grows bigger
4. Scale easily
5. Easy maintenance
6. etc.

In short, don't waste your time cleaning the garbage off your desk, when you could very well use that time for doing something more productive. Get organized now, to save time and effort later.

8.3 What kind of structure are we talking about?



8.4 Practice Exercise

1. Open PyCharm IDE
2. Create a new project
3. Create a folder structure as described below:
    - Create 6 folders: **Tests**, **Resources**, **Data**, **Results**, **CustomLibraries**, **BashScripts**
    - Create `App.robot` file inside **Tests** folder
    - Inside **Resources** folder
        - Create **PageObjects** sub-folder
        - Create `Common.robot` and `App.robot` files

9. Basic Elements of Robot Framework

1. Keyword
2. Library
3. Template
4. Test Case
5. Report and Log

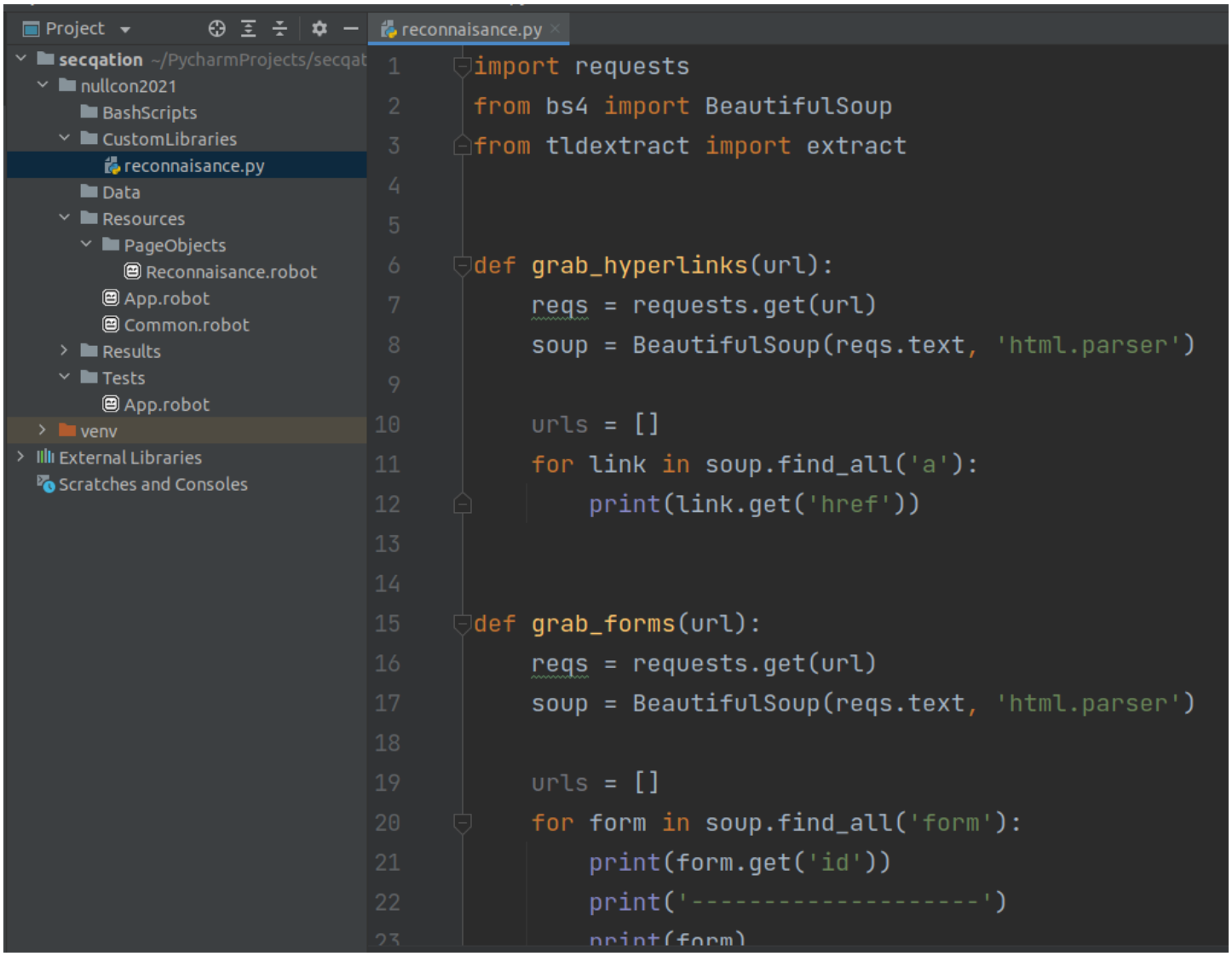
9.1 Keyword

Robot Framework has easy syntax, utilizing human-readable keywords.

```
*** Keywords ***
Open Browser To Login Page
    Open Browser    ${LOGIN URL}    ${BROWSER}
    Maximize Browser Window
    Set Selenium Speed    ${DELAY}
    Login Page Should Be Open

Login Page Should Be Open
    Title Should Be    Login Page

Go To Login Page
    Go To    ${LOGIN URL}
    Login Page Should Be Open

Input Username
    [Arguments]    ${username}
    Input Text    username_field    ${username}

Input Password
    [Arguments]    ${password}
    Input Text    password_field    ${password}

Submit Credentials
    Click Button    login_button

Welcome Page Should Be Open
    Location Should Be    ${WELCOME URL}
    Title Should Be    Welcome Page
```

9.2 Library

Custom keywords can be created by defining methods in a Python file. Capabilities can be extended by libraries implemented with Python or Java.



9.3 Template

For scenarios where test data varies, but test steps remain the same, use templates.

```
*** Settings ***
Test Template       Calculate
Library             CalculatorLibrary

*** Test Cases ***      Expression      Expected
Additions               12 + 2 + 2      16
                        2 + -3          -1

Substractions           12 - 2 - 2      8
                        2 - -3          5

Multiplication          12 * 2 * 2      48
                        2 * -3          -6

Division                12 / 2 / 2      3
                        2 / -3          -1

Calculation error       [Template]      Calculation should fail
                        kekkonen        Invalid button 'k'.
                        ${EMPTY}        Invalid expression.
                        1 / 0           Division by zero.

*** Keywords ***
Calculate
    [Arguments]     ${expression}     ${expected}
    Push buttons     C${expression}=
    Result should be     ${expected}

Calculation should fail
    [Arguments]     ${expression}     ${expected}
    ${error} =     Should fail     C${expression}=
    Should be equal     ${expected}     ${error}
```

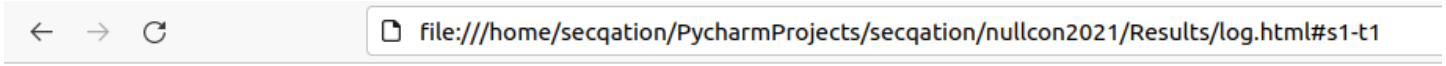
9.4 Test Case

It's an abstraction layer, under which a series of automated test steps and output validations take place.

```
*** Settings ***
Documentation     A test suite with a single test
...
...               This test has a workflow that is
...               the imported resource file.
Resource          resource.txt

*** Test Cases ***
Valid Login
    Open Browser To Login Page
    Input Username    demo
    Input Password    mode
    Submit Credentials
    Welcome Page Should Be Open
    [Teardown]    Close Browser
```

9.5 Report and Log

One-stop place to view the test outputs and to analyze the overall application health.



App Log

Generated
20210811 00:55:16 UTC+05:30
2 days 10 hours ago

Test Statistics

Total Statistics	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
All Tests	1	1	0	0	00:01:08	

Statistics by Tag	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
No Tags						

Statistics by Suite	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
App	1	1	0	0	00:01:22	

Test Execution Log

SUITE **App**
Full Name: App
Source: /home/secqation/PycharmProjects/secqation/nullcon2021/Tests/App.robot
Start / End / Elapsed: 20210811 00:53:54.525 / 20210811 00:55:16.498 / 00:01:21.973
Status: 1 test total, 1 passed, 0 failed, 0 skipped

SETUP Common.**Begin Web Assessment**

TEARDOWN Common.**End Web Assessment**

TEST **Information Gathering**
Full Name: App.Information Gathering
Start / End / Elapsed: 20210811 00:54:06.935 / 20210811 00:55:14.971 / 00:01:08.036
Status: PASS

KEYWORD App.**Crawl** https://defendtheweb.net/
Start / End / Elapsed: 20210811 00:54:06.938 / 20210811 00:54:56.433 / 00:00:49.495

KEYWORD SeleniumLibrary.**Go To** ${Target_URL}

KEYWORD Reconnaisance.**Read Source Code** ${Target_URL}

KEYWORD reconnaisance.**Grab Hyperlinks** ${Target_URL}

KEYWORD reconnaisance.**Grab Forms** ${Target_URL}

KEYWORD ${domain} = reconnaisance.**Extract Domain** ${Target_URL}

KEYWORD Reconnaisance.**Google search** ${domain}

KEYWORD Reconnaisance.**Check Wayback Machine** ${domain}

KEYWORD App.**Crawl** http://demo.testfire.net/

10. Exercise: Structured Reconnaisance in <10 min

Target Application: https://defendtheweb.net/

10.1 Task #1

Allotted Time: 10 minutes

1. Open a browser.
2. Navigate to https://defendtheweb.net.
3. Explore the target application and share what you've discovererd.

Questions:

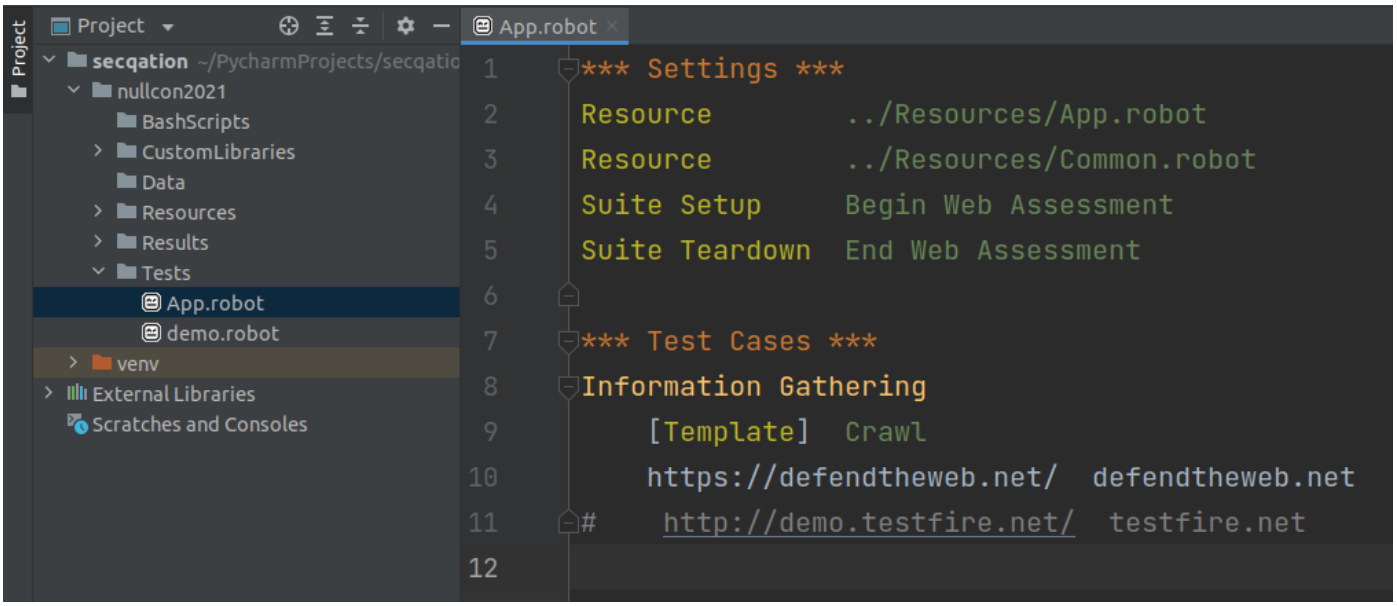
- How much reconnaisance were you able to perform manually?
- Is it enough, or do you feel you need to spend more time to explore the target application?

10.2 Task #2

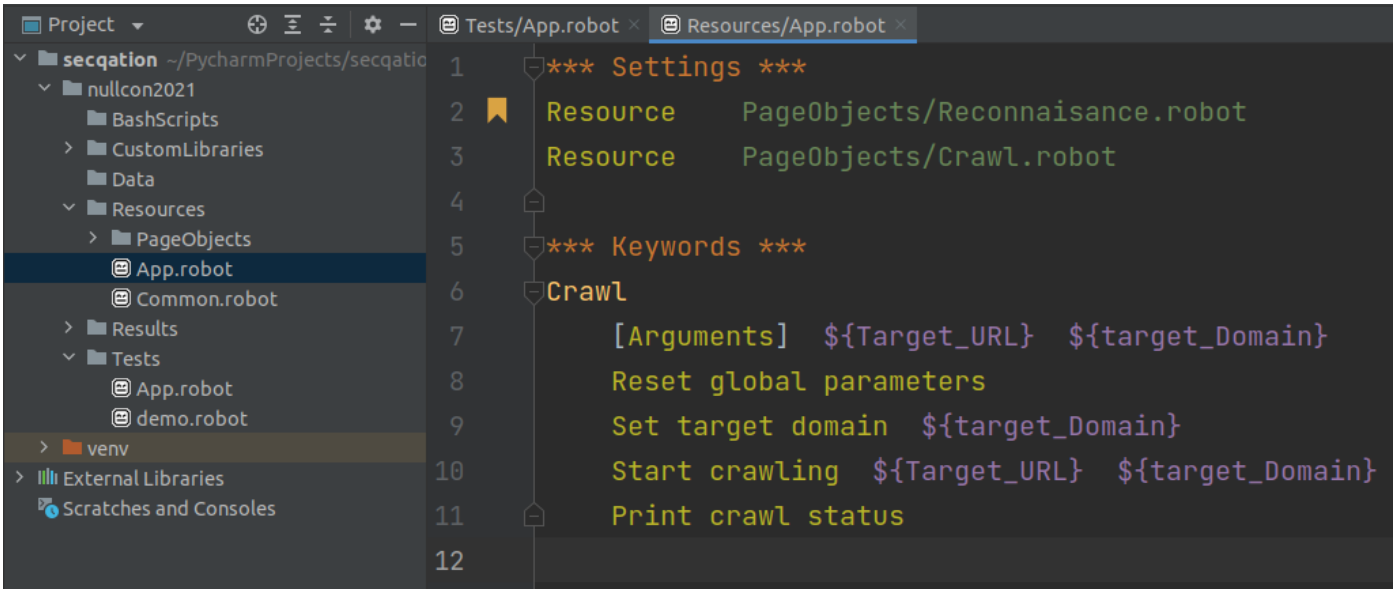
Allotted Time: 10 minutes

Resource Folder Location: `/home/secqation/Desktop/NullconTraining2021/2-example/`

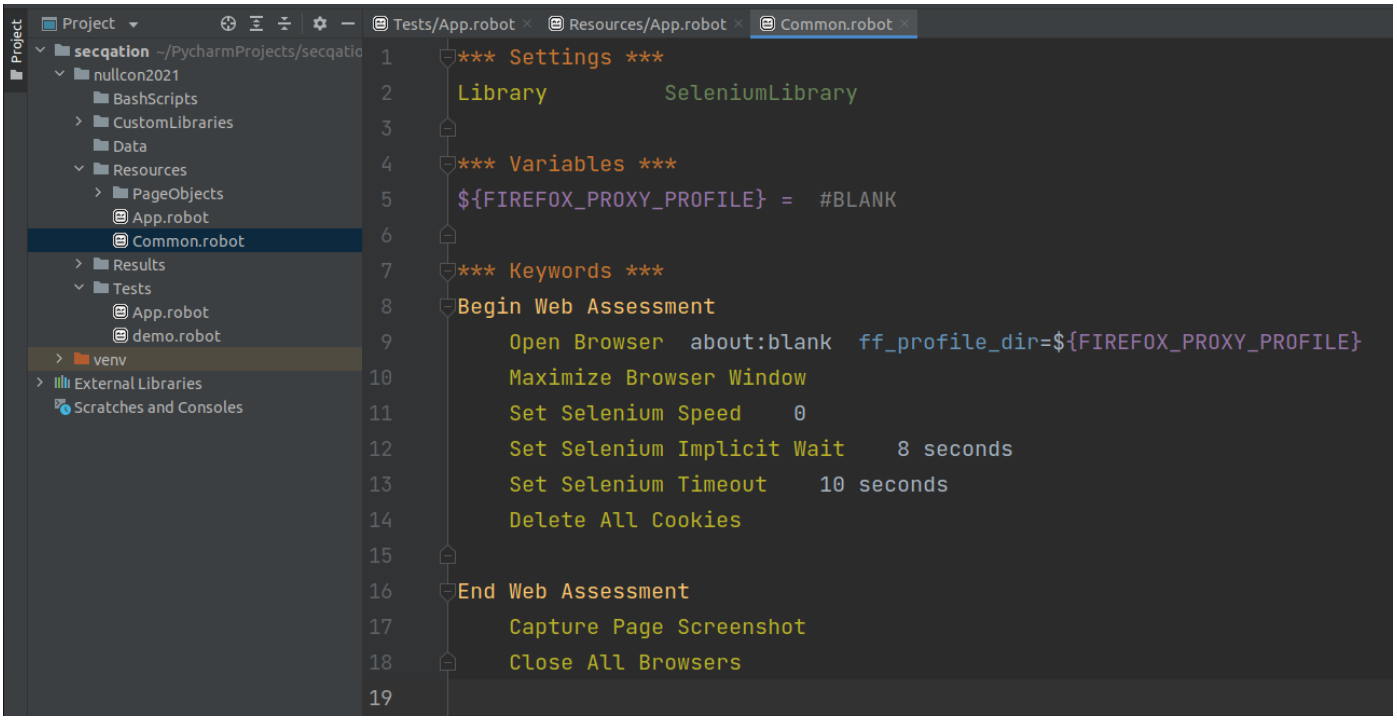
1. Create a new project in PyCharm
2. Copy `App.robot` file from `2-example/Tests/App.robot` into **Tests** folder



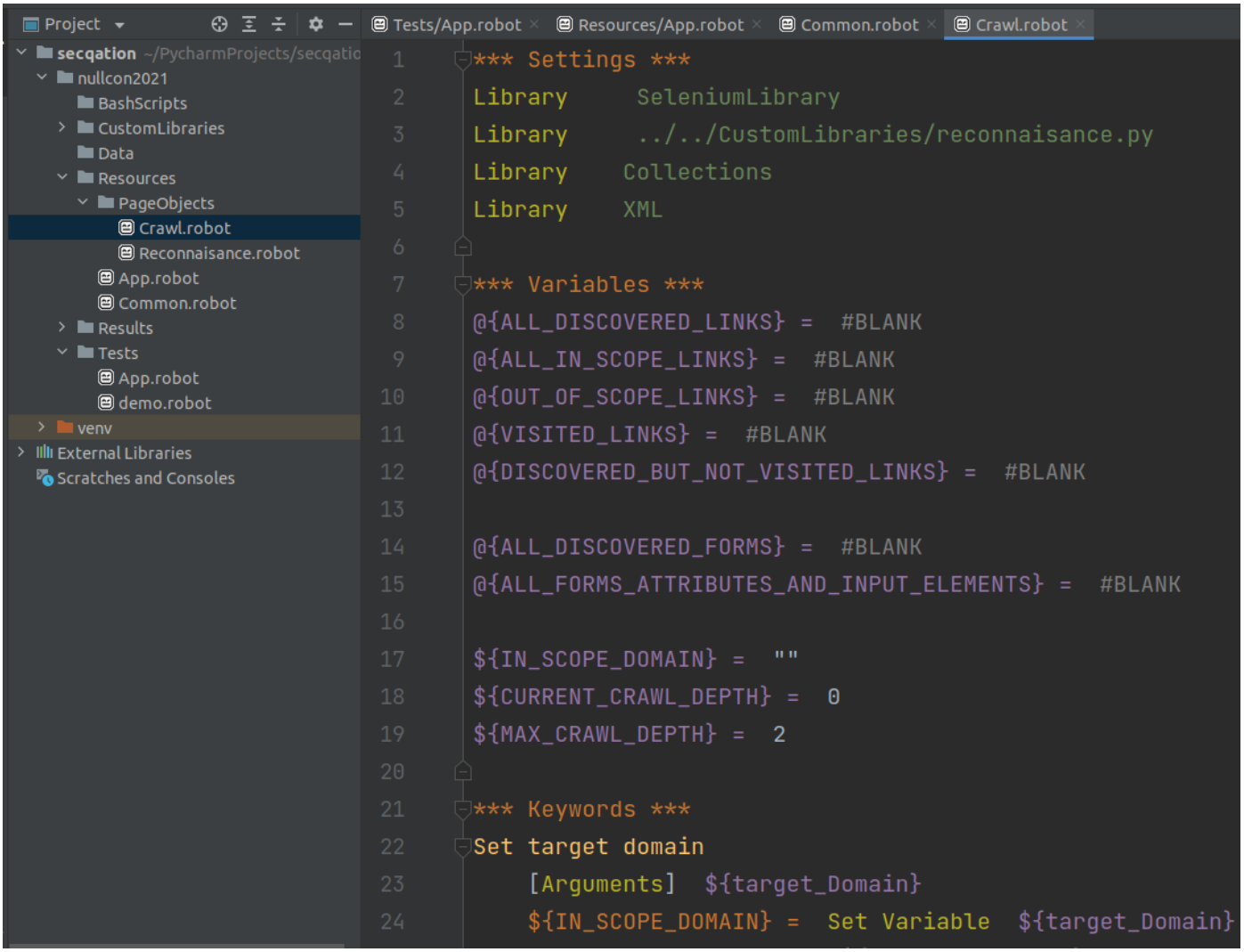
3. Copy `App.robot` file from `2-example/Resources/App.robot` into **Resources** folder



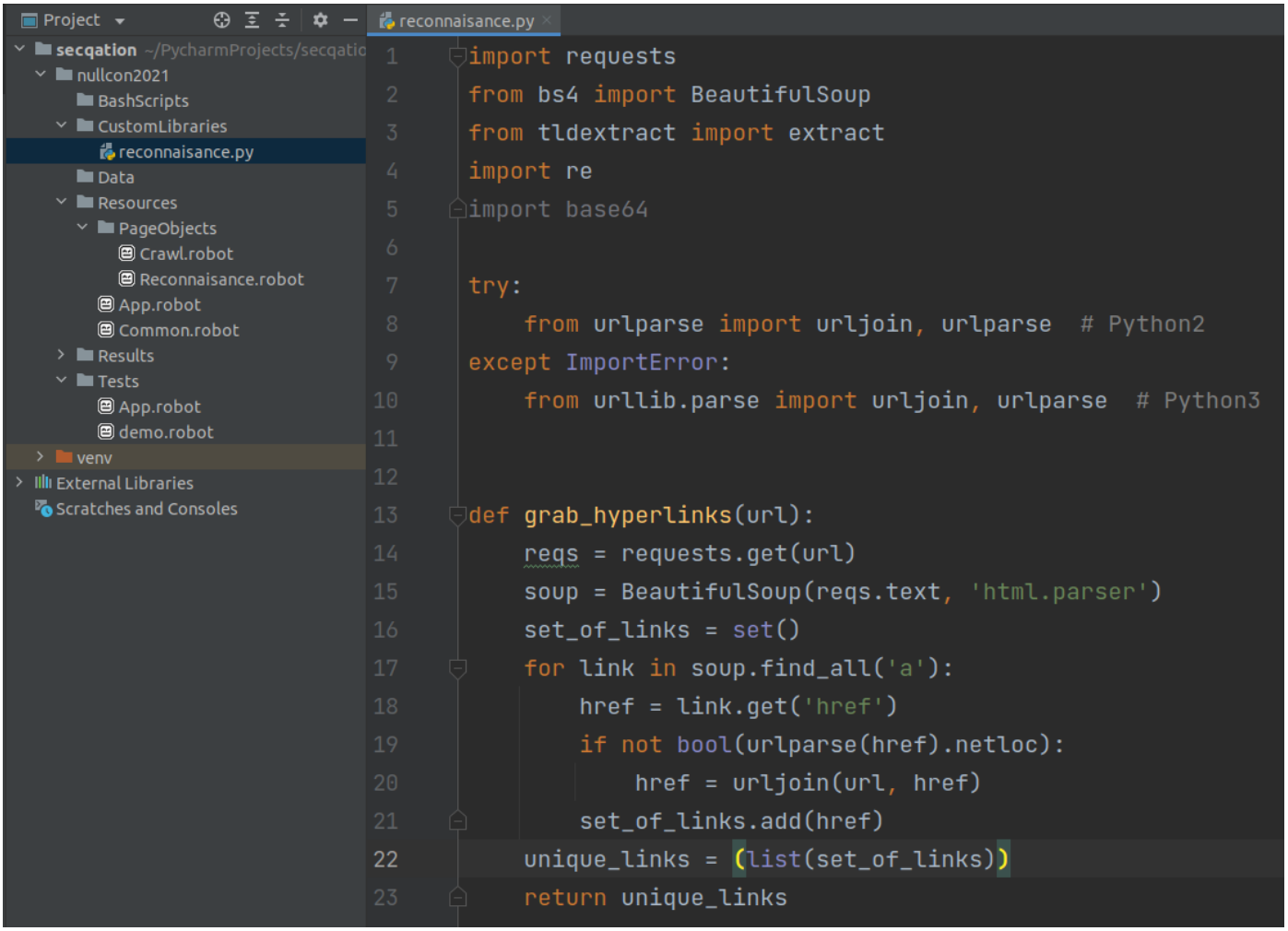
4. Copy `Common.robot` file from `2-example/Resources/Common.robot` into **Resources** folder



5. Copy `Crawl.robot` file from `2-example/Resources/PageObjects/Crawl.robot` into **Resources/PageObjects** folder



6. Copy `reconnaisance.py` file from `2-example/CustomLibraries/reconnaisance.py` into **CustomLibraries** folder



7. Trigger test execution:

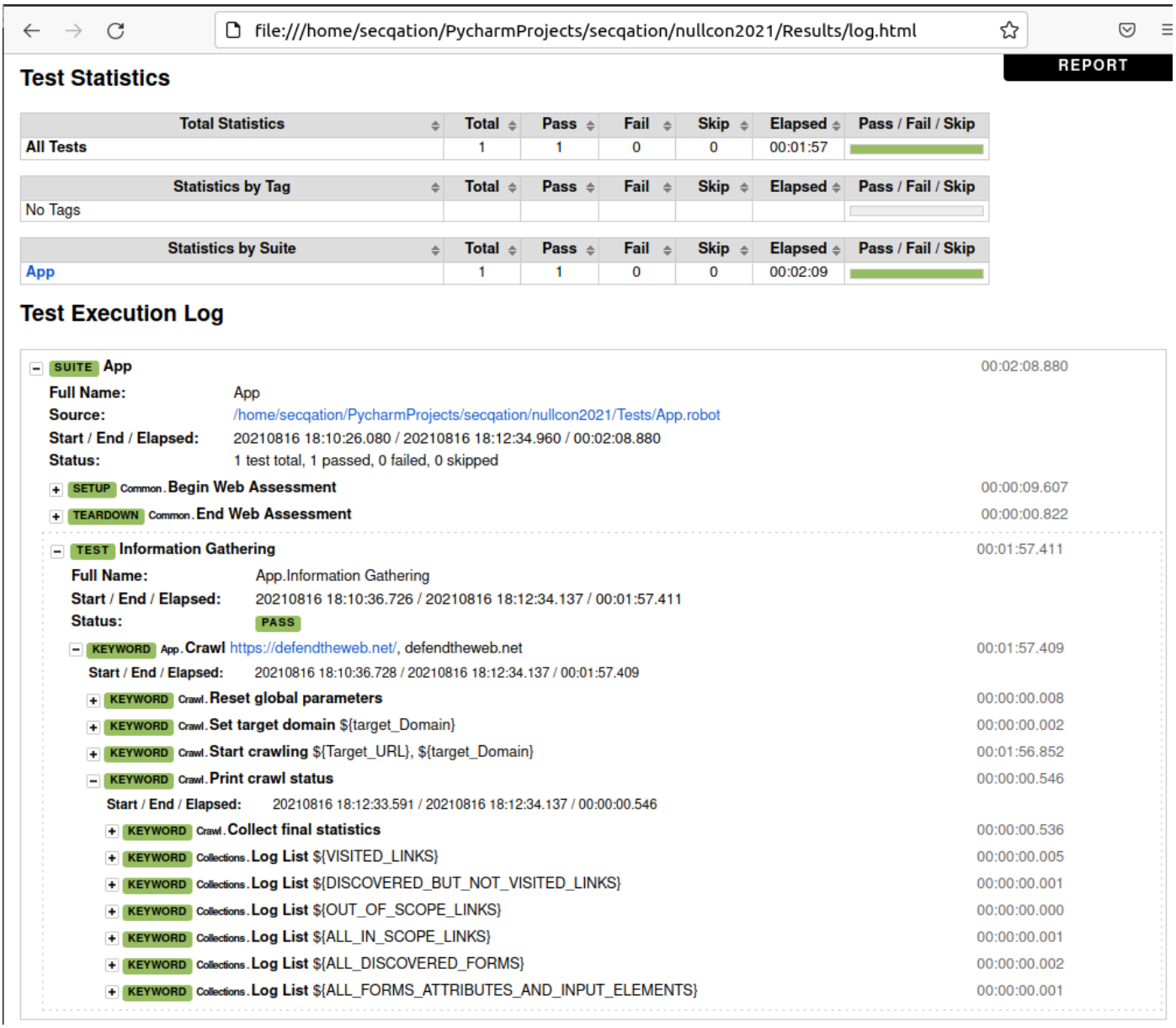
```
robot -d Results/ Tests/App.robot
```

```
secqation@mirage:~/PycharmProjects/secqation/nullcon2021$ ll
total 40
drwxr-xr-x 8 secqation seqation  4096 Aug  9 19:39 ./
drwxr-xr-x 5 secqation seqation  4096 Aug  4 21:03 ../
drwxr-xr-x 2 secqation seqation  4096 Aug  9 19:39 BashScripts/
drwxr-xr-x 3 secqation seqation  4096 Aug 16 18:03 CustomLibraries/
drwxr-xr-x 2 secqation seqation  4096 Aug  9 19:38 Data/
drwxr-xr-x 3 secqation seqation  4096 Aug 16 17:43 Resources/
drwxr-xr-x 2 secqation seqation 12288 Aug 15 23:20 Results/
secqation@mirage:~/PycharmProjects/secqation/nullcon2021$ robot -d Results/ Tests/App.robot
```

8. Take a break until test execution is done

```
secqation@mirage:~/PycharmProjects/secqation/nullcon2021$ robot -d Results/ Tests/App.robot
==============================================================================
App
==============================================================================
Information Gathering                                                 | PASS |
------------------------------------------------------------------------------
App                                                                   | PASS |
1 test, 1 passed, 0 failed
==============================================================================
Output:  /home/secqation/PycharmProjects/secqation/nullcon2021/Results/output.xml
Log:     /home/secqation/PycharmProjects/secqation/nullcon2021/Results/log.html
Report:  /home/secqation/PycharmProjects/secqation/nullcon2021/Results/report.html
secqation@mirage:~/PycharmProjects/secqation/nullcon2021$
```

9. Open `log.html` in your browser window, to view the test results 10. Expand "**Print crawl status**" keyword



11. Expand desired keywords to view captured details

KEYWORD Crawl . **Print crawl status** 00:

Start / End / Elapsed: 20210816 18:12:33.591 / 20210816 18:12:34.137 / 00:00:00.546

KEYWORD Crawl . **Collect final statistics** 00:

KEYWORD Collections . **Log List** ${VISITED_LINKS} 00:

Documentation: Logs the length and contents of the `list` using given `level`.

Start / End / Elapsed: 20210816 18:12:34.127 / 20210816 18:12:34.132 / 00:00:00.005

18:12:34.131 INFO List length is 26 and it contains following items:
0: https://defendtheweb.net/
1: https://defendtheweb.net/article/4-lesser-known-attack-types
2: https://defendtheweb.net/article/beyond-root-custom-firmware-for-embedded-mobile-chips
3: https://defendtheweb.net/article/buffer-overflow-to-run-root-shell-full-tutorial
4: https://defendtheweb.net/article/build-a-virtual-private-network-with-wireguard-and-fedora
5: https://defendtheweb.net/article/have-you-been-pwned
6: https://defendtheweb.net/articles
7: https://defendtheweb.net/articles/coding
8: https://defendtheweb.net/articles/hacking
9: https://defendtheweb.net/articles/privacy
10: https://defendtheweb.net/articles/talks-videos
11: https://defendtheweb.net/auth
12: https://defendtheweb.net/auth/signup
13: https://defendtheweb.net/dashboard
14: https://defendtheweb.net/discussions
15: https://defendtheweb.net/donations
16: https://defendtheweb.net/help
17: https://defendtheweb.net/help/conduct/code-of-conduct
18: https://defendtheweb.net/help/contact
19: https://defendtheweb.net/legal/privacy
20: https://defendtheweb.net/legal/terms
21: https://defendtheweb.net/playground
22: https://defendtheweb.net/profile/hackingguy
23: https://defendtheweb.net/profile/keeper
24: https://defendtheweb.net/shop
25: https://defendtheweb.net/statistics

KEYWORD Collections . **Log List** ${DISCOVERED_BUT_NOT_VISITED_LINKS} 00:

KEYWORD Collections . **Log List** ${DISCOVERED_BUT_NOT_VISITED_LINKS} 00:00:00

Documentation: Logs the length and contents of the `list` using given `level`.

Start / End / Elapsed: 20210816 18:12:34.132 / 20210816 18:12:34.133 / 00:00:00.001

18:12:34.132 INFO List length is 311 and it contains following items:
0: http://defendtheweb.net
1: https://defendtheweb.net/article/about-sql-injections-with-ms-sql-server
2: https://defendtheweb.net/article/all-your-devices-can-be-hacked
3: https://defendtheweb.net/article/blind-sql-injection
4: https://defendtheweb.net/article/buffer-overflows-and-ids-basics
5: https://defendtheweb.net/article/bypassing-msi-installer-checks
6: https://defendtheweb.net/article/c-basics
7: https://defendtheweb.net/article/common-php-attacks-directory-traversal
8: https://defendtheweb.net/article/common-php-attacks-poison-null-byte
9: https://defendtheweb.net/article/confessions-of-a-cyber-spy-hunter
10: https://defendtheweb.net/article/cookie-based-sql-injection
11: https://defendtheweb.net/article/cracking-zip-files-known-plaintext-attack
12: https://defendtheweb.net/article/cross-site-request-forgery
13: https://defendtheweb.net/article/cross-site-scripting-xss-by-example
14: https://defendtheweb.net/article/defcon-21-the-secret-life-of-sim-cards
15: https://defendtheweb.net/article/defcon-23-looping-surveillance-cameras
16: https://defendtheweb.net/article/heartbleed-the-door-to-secret-communications
17: https://defendtheweb.net/article/how-to-spoof-magnetic-stripes-credit-card-hacking
18: https://defendtheweb.net/article/how-to-use-gpg
19: https://defendtheweb.net/article/hybrid-multiple-layer-encryption
20: https://defendtheweb.net/article/introduction-to-java
21: https://defendtheweb.net/article/introduction-to-jquery-basic-jquery-animations
22: https://defendtheweb.net/article/password-generation-and-safe-offline-storage
23: https://defendtheweb.net/article/php-oop-part-1-abstract-classes-interfaces
24: https://defendtheweb.net/article/php-oop-part-2-serialization-of-objects-variable-variables
25: https://defendtheweb.net/article/php-oop-part-3-magic-methods
26: https://defendtheweb.net/article/php-oop-part-4-exception-handling-namespaces-overview
27: https://defendtheweb.net/article/php-oop-part-5-property-hiding-type-hintinting
28: https://defendtheweb.net/article/php-oop-part-6-object-types-validation-documenting
29: https://defendtheweb.net/article/practical-applications-of-cross-site-scripting-xss
30: https://defendtheweb.net/article/practical-applications-of-directory-traversals
31: https://defendtheweb.net/article/second-order-sql-injections
32: https://defendtheweb.net/article/security-of-virtual-hosts-traffic-cessation
33: https://defendtheweb.net/article/serious-vulnerability-in-excel-sheets-vba-bruteforce
34: https://defendtheweb.net/article/shell-via-lfi-and-proc-self-environ
35: https://defendtheweb.net/article/sqlmap-tutorial-to-your-first-sql-injection-tool
36: https://defendtheweb.net/article/ted-cracking-stuxnet-a-21st-century-cyber-weapon
37: https://defendtheweb.net/article/ted-gps-spoofing
38: https://defendtheweb.net/article/ted-hackers-the-internet-s-immune-system
39: https://defendtheweb.net/article/ted-how-the-nsa-betrayed-the-world-s-trust
40: https://defendtheweb.net/article/ted-nsa-is-spying-on-us-but-there-are-others
41: https://defendtheweb.net/article/understanding-source-code
42: https://defendtheweb.net/article/warriors-of-the-net
43: https://defendtheweb.net/article/what-is-cross-site-scripting-xss
44: https://defendtheweb.net/article/xslt-inclusion-vulnerabilities
45: https://defendtheweb.net/articles/encryption-steganography
46: https://defendtheweb.net/articles/lock-picking
47: https://defendtheweb.net/articles/misc
48: https://defendtheweb.net/articles/network-security
49: https://defendtheweb.net/articles/phreaking
50: https://defendtheweb.net/articles/submit
51: https://defendtheweb.net/auth/facebook
52: https://defendtheweb.net/auth/forgot
53: https://defendtheweb.net/auth/github
54: https://defendtheweb.net/auth/google
55: https://defendtheweb.net/auth/twitter
56: https://defendtheweb.net/discussion/119-level-4

KEYWORD Collections . **Log List** ${OUT_OF_SCOPE_LINKS} 00:00:00.000

Documentation: Logs the length and contents of the `list` using given `level`.

Start / End / Elapsed: 20210816 18:12:34.133 / 20210816 18:12:34.133 / 00:00:00.000

18:12:34.133 INFO List length is 69 and it contains following items:
0: http://creativecommons.org/licenses/by/3.0/
1: http://creativecommons.org/terms
2: http://r00t.org/
3: http://www.noiseprotocol.org/
4: http://www.sha1-online.com/
5: http://www.thespanner.co.uk/2014/03/21/rpo/
6: https://amzn.to/2GAQAqG
7: https://amzn.to/2LMySF2
8: https://amzn.to/2Ysdsmt
9: https://api.pwnedpasswords.com/range/8cb22.
10: https://creativecommons.org/licenses/by-sa/4.0/
11: https://developers.google.com/web/tools/lighthouse/audits/noopener
12: https://en.wikipedia.org/wiki/Address_space_layout_randomization
13: https://en.wikipedia.org/wiki/Buffer_overflow#History
14: https://en.wikipedia.org/wiki/K-anonymity
15: https://example.com
16: https://fedoramagazine.org/build-a-virtual-private-network-with-wireguard/
17: https://fedoramagazine.org/howto-use-sudo/
18: https://gist.github.com/masasron/1beca41f42599db1c6d48a89e135f653
19: https://github.com/Iskuri
20: https://hal.inria.fr/hal-02100345
21: https://haveibeenpwned.com/
22: https://haveibeenpwned.com/API/v2#PwnedPasswords.
23: https://httpd.apache.org/docs/2.4/logs.html#accesslog
24: https://keepers.space
25: https://krebsonsecurity.com
26: https://krebsonsecurity.com/2021/08/microsoft-patch-tuesday-august-2021-edition/
27: https://krebsonsecurity.com/2021/08/new-anti-anti-money-laundering-services-for-crooks/
28: https://krebsonsecurity.com/2021/08/phishing-sites-targeting-scammers-and-thieves/
29: https://krebsonsecurity.com/2021/08/ransomware-gangs-and-the-name-game-distraction/
30: https://phrack.org/issues/49/14.html
31: https://portswigger.net/research/detecting-and-exploiting-path-relative-stylesheet-import-prssi-vulnerabilities
32: https://root-me.org
33: https://stackoverflow.com/questions/10446819/do-apache-access-logs-ever-miss-requests
34: https://threatpost.com
35: https://threatpost.com/adload-malware-apple-xprotect/168634/
36: https://threatpost.com/aggah-wordpress-spearphishing/168657/
37: https://threatpost.com/amazons-track-worker-keystrokes/168687/
38: https://threatpost.com/black-hat-novel-dns-hack/168636/
39: https://threatpost.com/cyberattackers-captchas-phishing-malware/168684/
40: https://threatpost.com/exchange-servers-attack-proxyshell/168661/
41: https://threatpost.com/qr-code-scammers-bitcoin-atms/168621/
42: https://threatpost.com/ransomware-payments-quadruple-extortion/168622/
43: https://threatpost.com/rogue-marketplace-alphabay-reboots/168648/
44: https://threatpost.com/solarwinds-financial-crisis-podcast/168677/
45: https://unsplash.com/@blackzheng?utm_source=unsplash&utm_medium=referral&utm_content=creditCopyText
46: https://unsplash.com/@shanerounce?utm_source=unsplash&utm_medium=referral&utm_content=creditCopyText
47: https://www.danielmills.org/downloads/buffer_overflow/escalate.cpp
48: https://www.danielmills.org/downloads/buffer_overflow/shellcode.txt
49: https://www.darkreading.com
50: https://www.darkreading.com/application-security/http-2-implementation-errors-exposing-websites-to-serious-risks/d/d-id/1341593?_mc=rss_x_drr_edt_aud_dr_x_x-rss-simple
51: https://www.darkreading.com/application-security/researchers-find-significant-vulnerabilities-in-macos-privacy-protections/d/d-id/1341590?_mc=rss_x_drr_edt_aud_dr_x_x-rss-simple
52: https://www.darkreading.com/careers-and-people/organizations-still-struggle-to-hire-and-retain-infosec-employees-report/d/d-id/1341587?_mc=rss_x_drr_edt_aud_dr_x_x-rss-simple
53: https://www.darkreading.com/cloud/new-normal-demands-new-security-leadership-structure/d/d-

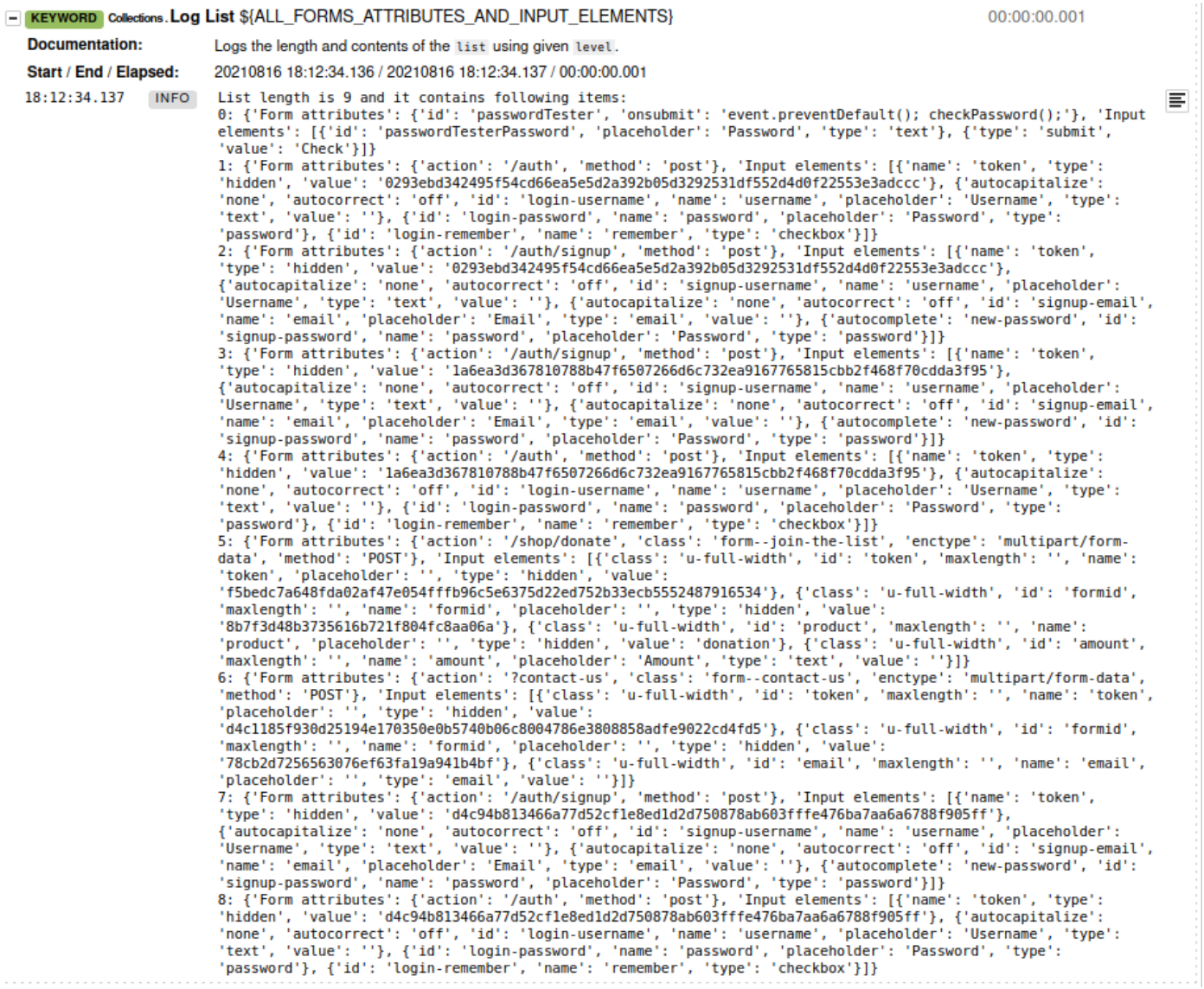
KEYWORD Collections . **Log List** ${ALL_DISCOVERED_FORMS} 00:0 REPORT

Documentation: Logs the length and contents of the `list` using given `level`.

Start / End / Elapsed: 20210816 18:12:34.134 / 20210816 18:12:34.136 / 00:00:00.002

18:12:34.136 INFO

```
List length is 9 and it contains following items:
0: <form id="passwordTester" onsubmit="event.preventDefault(); checkPassword();">
<input id="passwordTesterPassword" placeholder="Password" type="text"/>
<input type="submit" value="Check"/>
</form>
1: <form action="/auth" method="post">
<input name="token" type="hidden" value="0293ebd342495f54cd66ea5e5d2a392b05d3292531df552d4d0f22553e3adccc"/>
<div class="input">
<label for="login-username">Username</label>
<input autocapitalize="none" autocorrect="off" id="login-username" name="username" placeholder="Username"
type="text" value=""/>
</div>
<div class="input">
<label for="login-password">Password</label>
<input id="login-password" name="password" placeholder="Password" type="password"/>
</div>
<div class="input input--checkbox">
<input id="login-remember" name="remember" type="checkbox"/>
<label for="login-remember">Remember me</label>
</div>
<div class="row">
<div class="six columns">
<a class="button button--wide" href="/auth/forgot">Forgotten password?</a>
</div>
<div class="six columns">
<button class="button button--main button--wide" type="submit">Log in</button>
</div>
</div>
</form>
2: <form action="/auth/signup" method="post">
<input name="token" type="hidden" value="0293ebd342495f54cd66ea5e5d2a392b05d3292531df552d4d0f22553e3adccc"/>
<div class="input">
<label for="signup-username">Username</label>
<input autocapitalize="none" autocorrect="off" id="signup-username" name="username" placeholder="Username"
type="text" value=""/>
</div>
<div class="input">
<label for="signup-email">Email</label>
<input autocapitalize="none" autocorrect="off" id="signup-email" name="email" placeholder="Email" type="email"
value=""/>
</div>
<div class="input">
<label for="signup-password">Password</label>
<input autocomplete="new-password" id="signup-password" name="password" placeholder="Password" type="password"/>
</div>
<p>By providing my information and clicking on the sign up button, I confirm that I have read and agree to this
website's <a href="/legal/terms" target="_blank">terms of use</a> and <a href="/legal/privacy"
target="_blank">privacy policy</a>.</p>
<p>All members must abide by the <a href="/help/conduct/code-of-conduct" target="_blank">Code of Conduct</a>.
Failing to do so will result in your account being terminated.</p>
<div class="row">
<div class="six columns">

                        </div>
<div class="six columns">
<button class="button button--main button--wide" type="submit">Sign up</button>
</div>
</div>
</form>
```



KEYWORD Collections . **Log List** ${ALL_FORMS_ATTRIBUTES_AND_INPUT_ELEMENTS} 00:00:00.001

Documentation: Logs the length and contents of the `list` using given `level`.

Start / End / Elapsed: 20210816 18:12:34.136 / 20210816 18:12:34.137 / 00:00:00.001

18:12:34.137 INFO

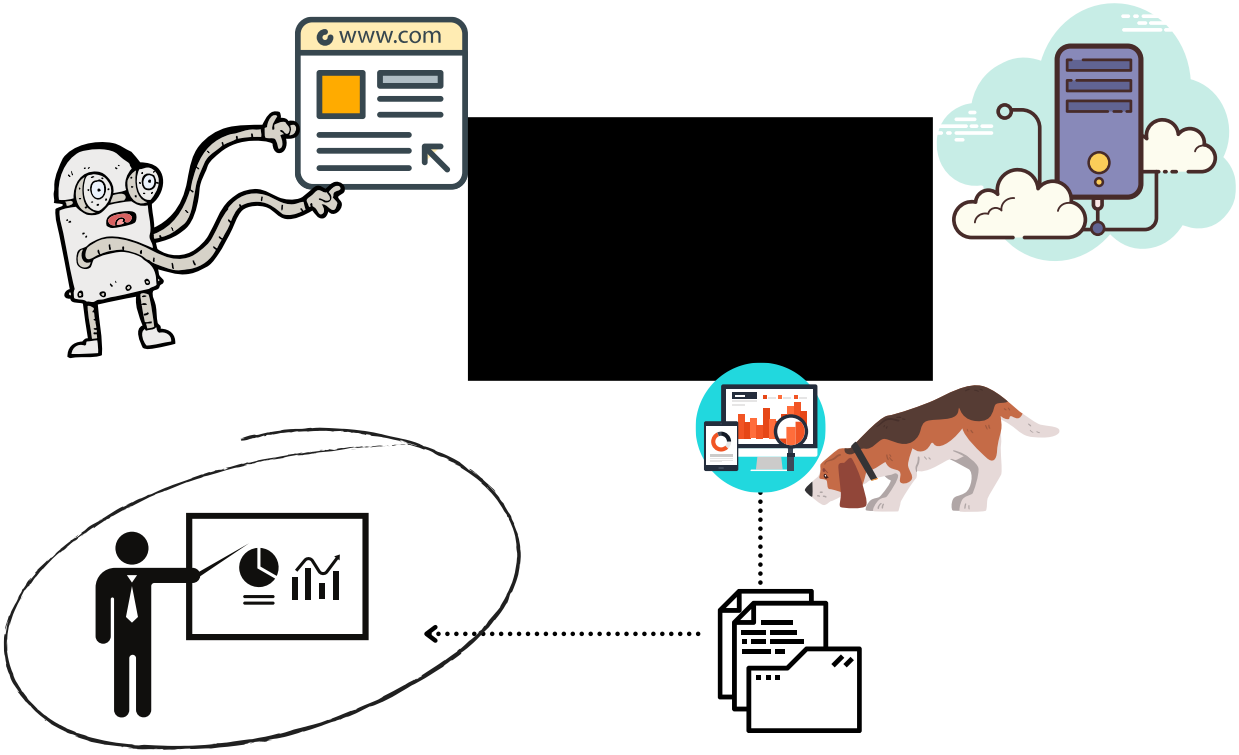
```
List length is 9 and it contains following items:
0: {'Form attributes': {'id': 'passwordTester', 'onsubmit': 'event.preventDefault(); checkPassword();'}, 'Input
elements': [{'id': 'passwordTesterPassword', 'placeholder': 'Password', 'type': 'text'}, {'type': 'submit',
'value': 'Check'}]}
1: {'Form attributes': {'action': '/auth', 'method': 'post'}, 'Input elements': [{'name': 'token', 'type':
'hidden', 'value': '0293ebd342495f54cd66ea5e5d2a392b05d3292531df552d4d0f22553e3adccc'}, {'autocapitalize':
'none', 'autocorrect': 'off', 'id': 'login-username', 'name': 'username', 'placeholder': 'Username', 'type':
'text', 'value': ''}, {'id': 'login-password', 'name': 'password', 'placeholder': 'Password', 'type':
'password'}, {'id': 'login-remember', 'name': 'remember', 'type': 'checkbox'}]}
2: {'Form attributes': {'action': '/auth/signup', 'method': 'post'}, 'Input elements': [{'name': 'token',
'type': 'hidden', 'value': '0293ebd342495f54cd66ea5e5d2a392b05d3292531df552d4d0f22553e3adccc'},
{'autocapitalize': 'none', 'autocorrect': 'off', 'id': 'signup-username', 'name': 'username', 'placeholder':
'Username', 'type': 'text', 'value': ''}, {'autocapitalize': 'none', 'autocorrect': 'off', 'id': 'signup-email',
'name': 'email', 'placeholder': 'Email', 'type': 'email', 'value': ''}, {'autocomplete': 'new-password', 'id':
'signup-password', 'name': 'password', 'placeholder': 'Password', 'type': 'password'}]}
3: {'Form attributes': {'action': '/auth/signup', 'method': 'post'}, 'Input elements': [{'name': 'token',
'type': 'hidden', 'value': '1a6ea3d367810788b47f6507266d6c732ea9167765815cbb2f468f70cdda3f95'},
{'autocapitalize': 'none', 'autocorrect': 'off', 'id': 'signup-username', 'name': 'username', 'placeholder':
'Username', 'type': 'text', 'value': ''}, {'autocapitalize': 'none', 'autocorrect': 'off', 'id': 'signup-email',
'name': 'email', 'placeholder': 'Email', 'type': 'email', 'value': ''}, {'autocomplete': 'new-password', 'id':
'signup-password', 'name': 'password', 'placeholder': 'Password', 'type': 'password'}]}
4: {'Form attributes': {'action': '/auth', 'method': 'post'}, 'Input elements': [{'name': 'token', 'type':
'hidden', 'value': '1a6ea3d367810788b47f6507266d6c732ea9167765815cbb2f468f70cdda3f95'}, {'autocapitalize':
'none', 'autocorrect': 'off', 'id': 'login-username', 'name': 'username', 'placeholder': 'Username', 'type':
'text', 'value': ''}, {'id': 'login-password', 'name': 'password', 'placeholder': 'Password', 'type':
'password'}, {'id': 'login-remember', 'name': 'remember', 'type': 'checkbox'}]}
5: {'Form attributes': {'action': '/shop/donate', 'class': 'form--join-the-list', 'enctype': 'multipart/form-
data', 'method': 'POST'}, 'Input elements': [{'class': 'u-full-width', 'id': 'token', 'maxlength': '', 'name':
'token', 'placeholder': '', 'type': 'hidden', 'value':
'f5bedc7a648fda02af47e054fffb96c5e6375d22ed752b33ecb5552487916534'}, {'class': 'u-full-width', 'id': 'formid',
'maxlength': '', 'name': 'formid', 'placeholder': '', 'type': 'hidden', 'value':
'8b7f3d48b3735616b721f804fc8aa06a'}, {'class': 'u-full-width', 'id': 'product', 'maxlength': '', 'name':
'product', 'placeholder': '', 'type': 'hidden', 'value': 'donation'}, {'class': 'u-full-width', 'id': 'amount',
'maxlength': '', 'name': 'amount', 'placeholder': 'Amount', 'type': 'text', 'value': ''}]}
6: {'Form attributes': {'action': '?contact-us', 'class': 'form--contact-us', 'enctype': 'multipart/form-data',
'method': 'POST'}, 'Input elements': [{'class': 'u-full-width', 'id': 'token', 'maxlength': '', 'name': 'token',
'placeholder': '', 'type': 'hidden', 'value':
'd4c1185f930d25194e170350e0b5740b06c8004786e3808858adfe9022cd4fd5'}, {'class': 'u-full-width', 'id': 'formid',
'maxlength': '', 'name': 'formid', 'placeholder': '', 'type': 'hidden', 'value':
'78cb2d7256563076ef63fa19a941b4bf'}, {'class': 'u-full-width', 'id': 'email', 'maxlength': '', 'name': 'email',
'placeholder': '', 'type': 'email', 'value': ''}]}
7: {'Form attributes': {'action': '/auth/signup', 'method': 'post'}, 'Input elements': [{'name': 'token',
'type': 'hidden', 'value': 'd4c94b813466a77d52cf1e8ed1d2d750878ab603fffe476ba7aa6a6788f905ff'},
{'autocapitalize': 'none', 'autocorrect': 'off', 'id': 'signup-username', 'name': 'username', 'placeholder':
'Username', 'type': 'text', 'value': ''}, {'autocapitalize': 'none', 'autocorrect': 'off', 'id': 'signup-email',
'name': 'email', 'placeholder': 'Email', 'type': 'email', 'value': ''}, {'autocomplete': 'new-password', 'id':
'signup-password', 'name': 'password', 'placeholder': 'Password', 'type': 'password'}]}
8: {'Form attributes': {'action': '/auth', 'method': 'post'}, 'Input elements': [{'name': 'token', 'type':
'hidden', 'value': 'd4c94b813466a77d52cf1e8ed1d2d750878ab603fffe476ba7aa6a6788f905ff'}, {'autocapitalize':
'none', 'autocorrect': 'off', 'id': 'login-username', 'name': 'username', 'placeholder': 'Username', 'type':
'text', 'value': ''}, {'id': 'login-password', 'name': 'password', 'placeholder': 'Password', 'type':
'password'}, {'id': 'login-remember', 'name': 'remember', 'type': 'checkbox'}]}
```

Questions:

- If you are asked to **repeat** the test steps, which method would you prefer? Would you prefer manual approach, or would you just re-trigger test execution while you comfortably sip a cup of coffee (or whatever it is you like).
- Do you see how the second approch could provide more information in less time, while also leaving you less exhausted, more refreshed and focused for the next step (which is to identify entry points)!

11. mitmproxy: Intercepting API Requests & Responses

11.1 Scenario



11.2 Install mitmproxy

1. Install mitmproxy tool
2. Set LANG environment variable

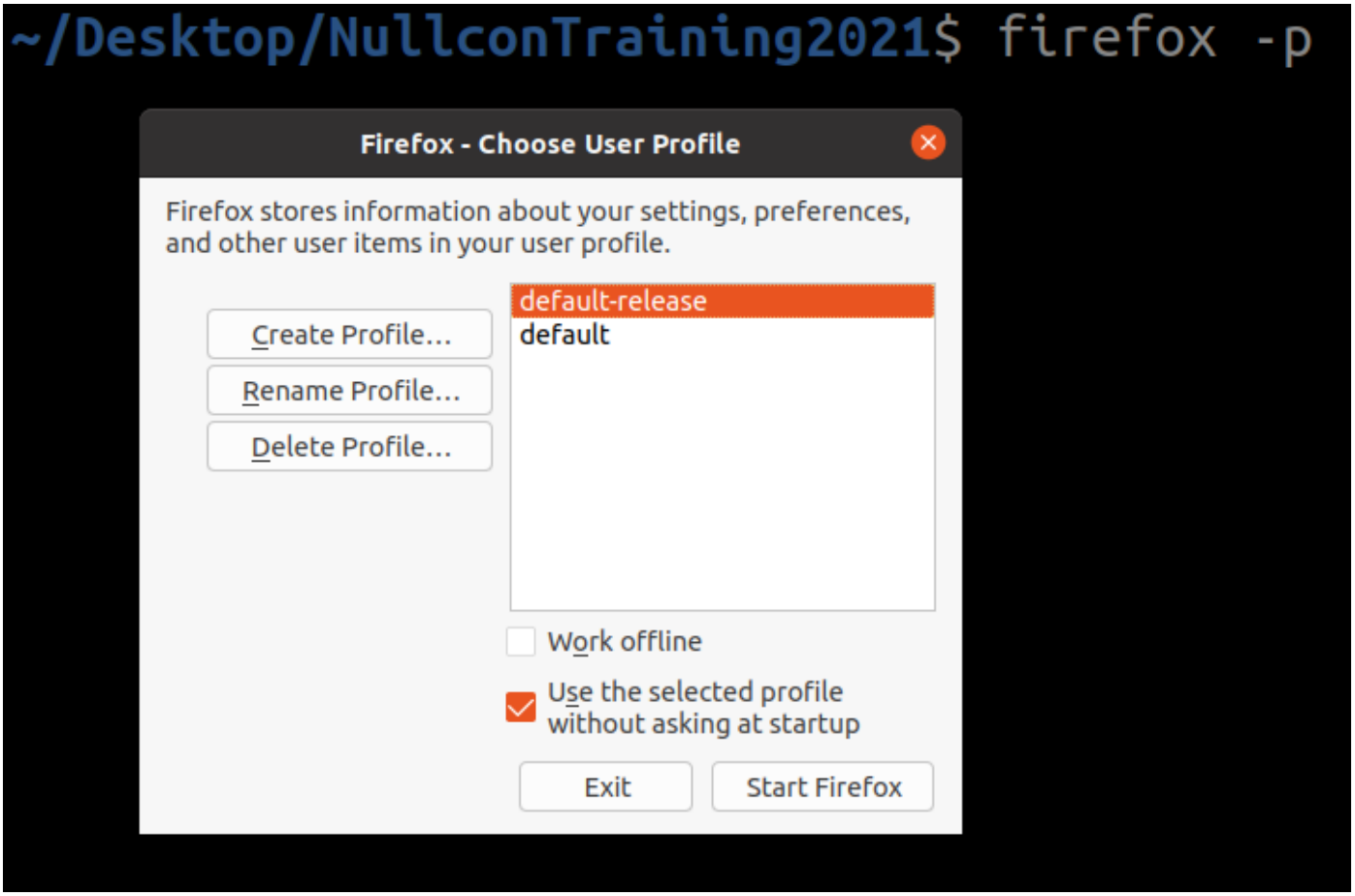
```
export LANG=en_US.UTF-8
```

```
secqation@mirage:/$ mitmproxy
Error: mitmproxy requires a UTF console environment.
Set your LANG environment variable to something like en_US.UTF-8
secqation@mirage:/$ export LANG=en_US.UTF-8
secqation@mirage:/$
secqation@mirage:/$
secqation@mirage:/$ mitmproxy
secqation@mirage:/$ mitmdump
Proxy server listening at http://*:8080
```

11.3 Create Browser Profile

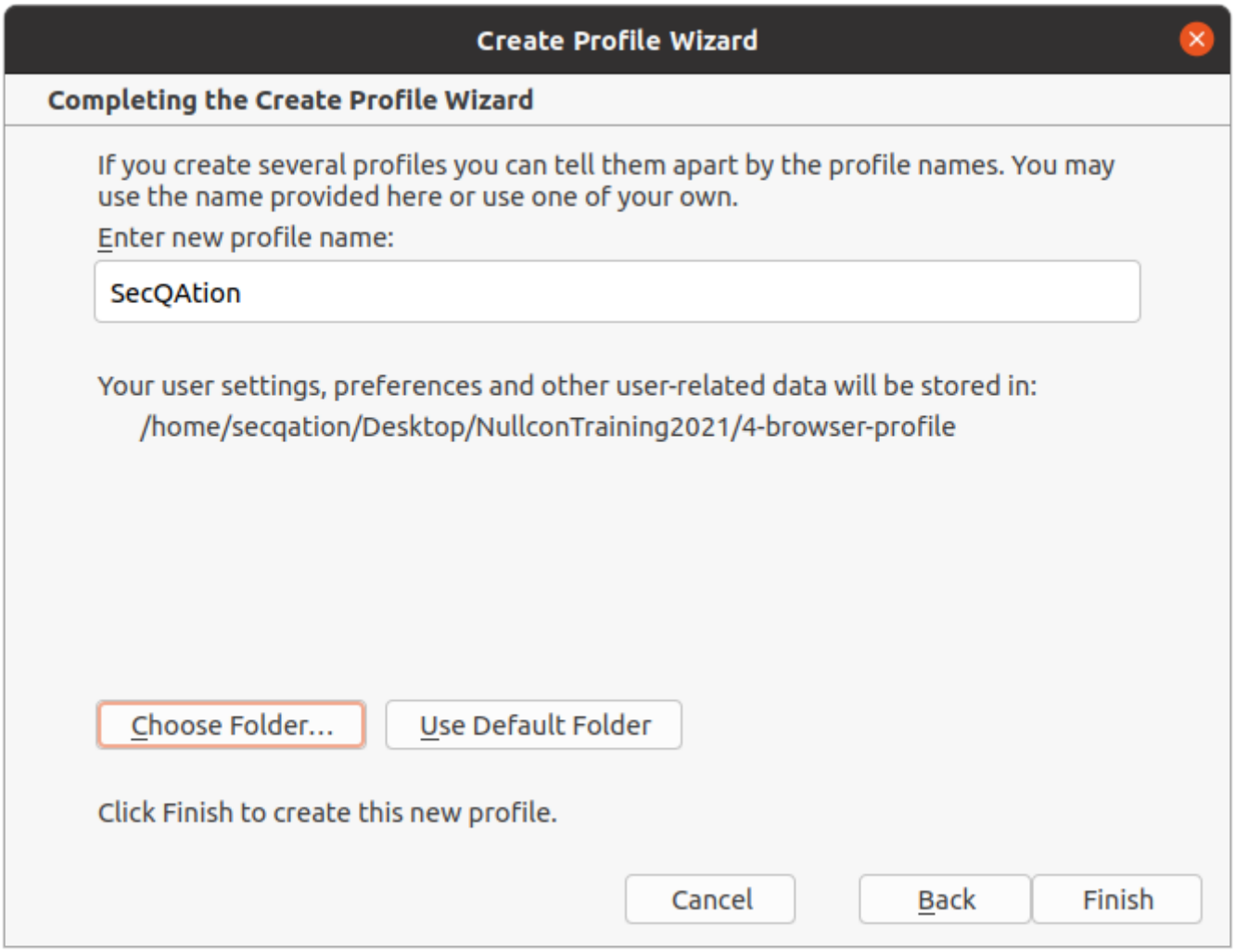
1. Ensure Firefox browser is installed
2. Run following command

```
firefox -p
```



3. Click on "Create Profile" > "Next"
4. Enter a profile name (e.g. `SecQAtion`)
5. Choose a folder path

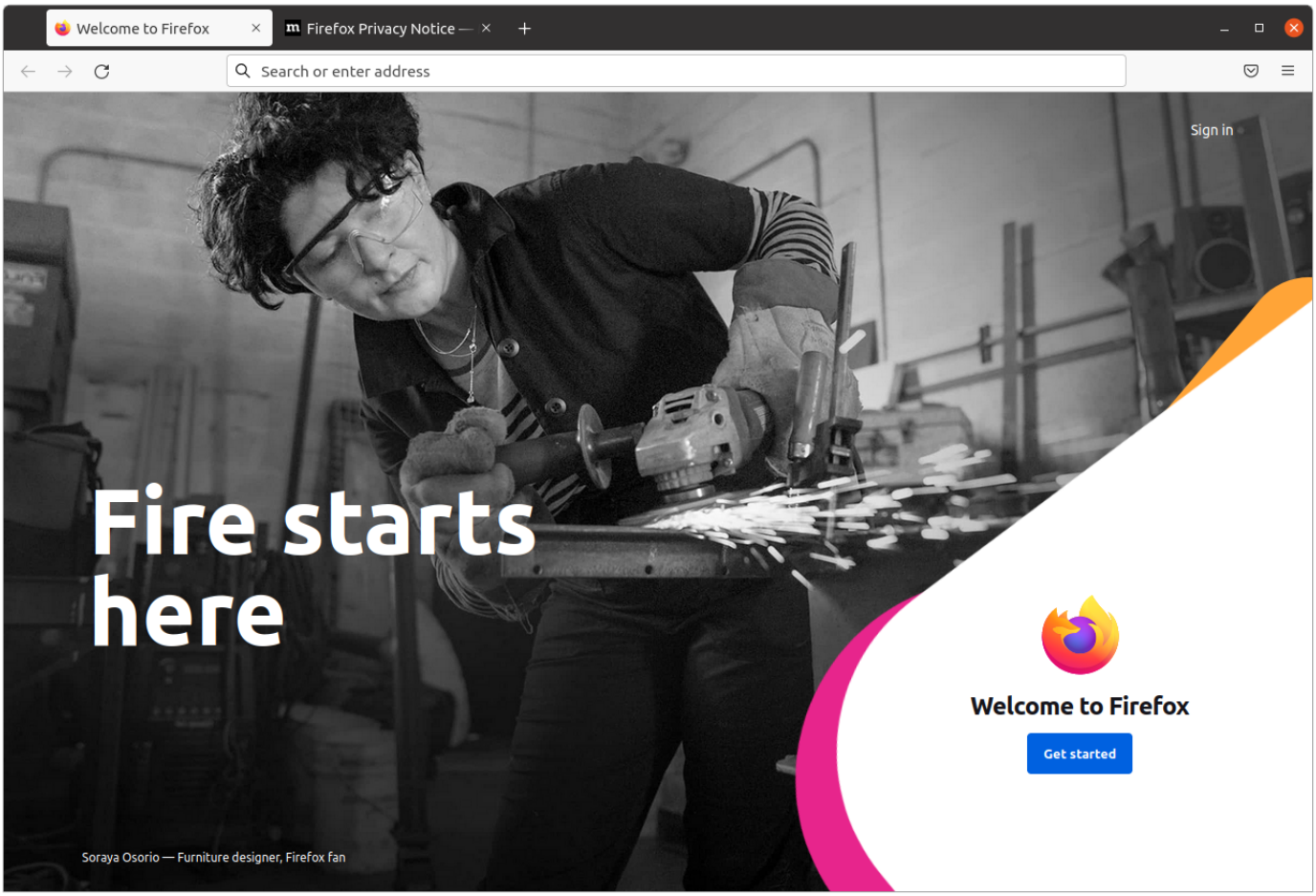
6. Click on "Finish"



7. Select newly created profile

8. Uncheck `Use the selected profile without asking at startup` checkbox

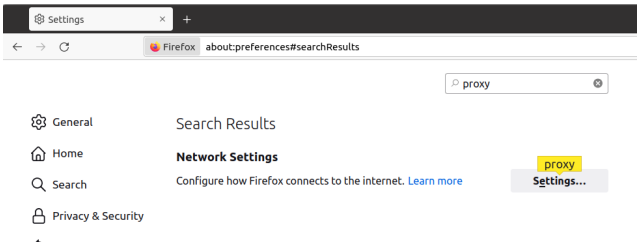
9. Click on "Start Firefox"



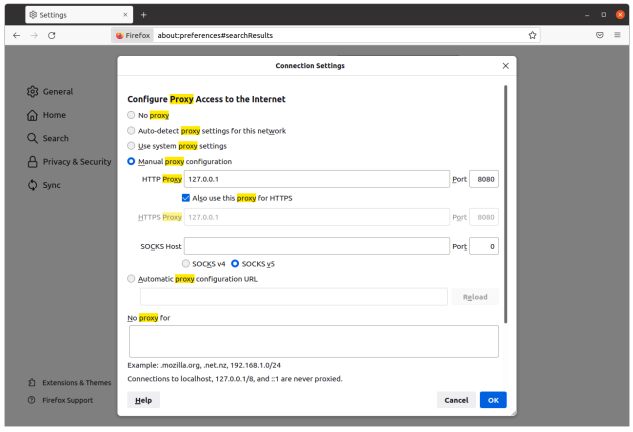
11.4 Configure Browser Profile

11.4.1 Enable Proxy

1. In the Firefox browser, go to "Settings" page
2. Search for "Network Settings"



3. Click on "Settings..." button
4. Select "Manual proxy configuration" radio button
5. Enter `127.0.0.1` as HTTP Proxy value
6. Enter `8080` as HTTP Port value
7. Check "Also use this proxy for HTTPS" checkbox



8. Click on "OK" button

11.4.2 Install mitmproxy CA Certificate

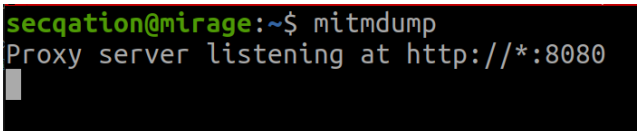
Mitmproxy can decrypt encrypted traffic on the fly, as long as the client trusts mitmproxy's built-in certificate authority. Usually this means that the mitmproxy CA certificate has to be installed on the client device.

Ref:

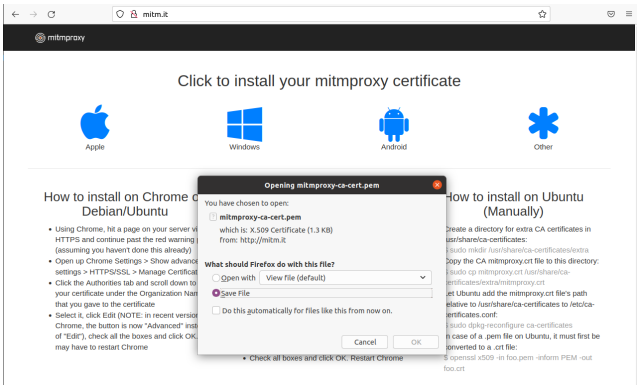
`https://docs.mitmproxy.org/stable/concepts-certificates/`

1. Open a command prompt and type:

`mitmdump`

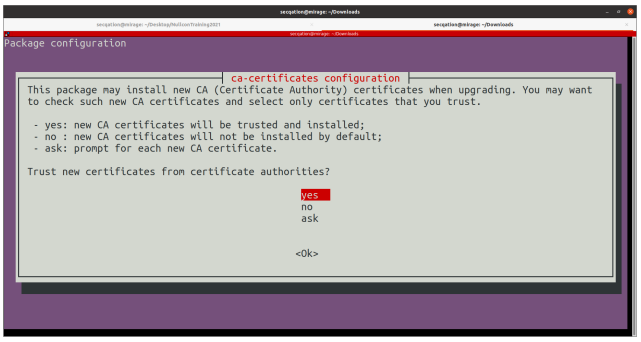


10. In the Firefox browser, navigate to mitm.it 11. Download relevant certificate

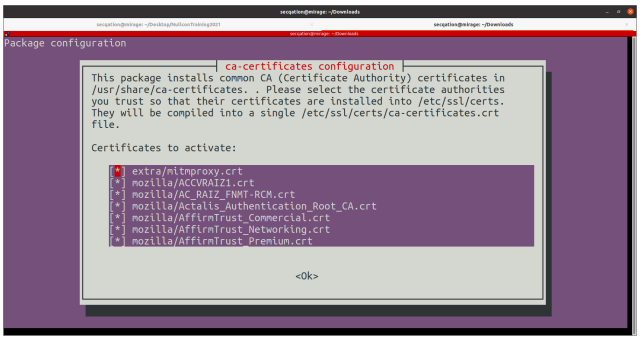


12. Follow certificate installation instructions

`$ cd ~/Downloads $ openssl x509 -in mitmproxy-ca-cert.pem -inform PEM -o`



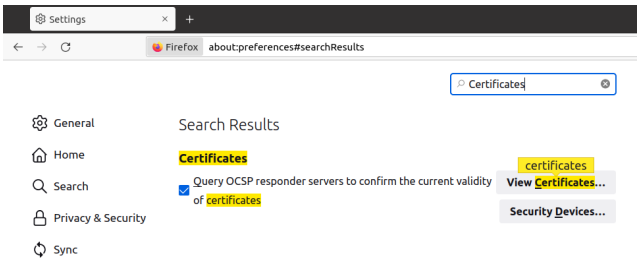
13. Select "yes" when asked to trust new certificates from certificate authorities 14. Select the newly added certificate by pressing **[TAB]** button,



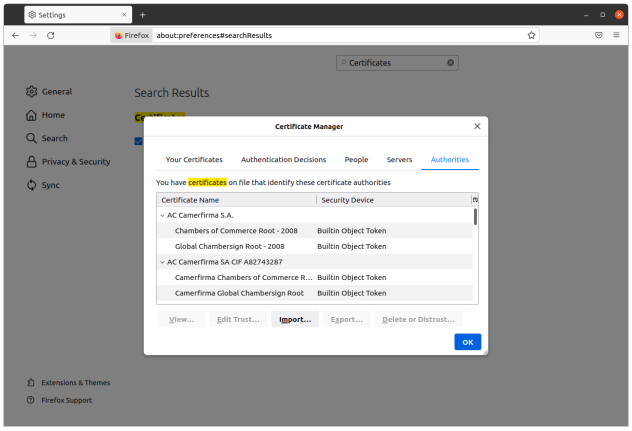
15. Press **[TAB]** and **[ENTER]** to select "Ok"

```
secqation@mirage:~/Downloads$ ls mitmproxy-ca-cert.pem
secqation@mirage:~/Downloads$ openssl x509 -in mitmproxy-ca-cert.pem -inform PEM -out mitmproxy-ca-cert.crt
secqation@mirage:~/Downloads$ ll mitm*
-rw-r--r-- 1 secqation seqation 1318 Aug 17 02:14 mitmproxy-ca-cert.crt
-rw-r--r-- 1 secqation seqation 1318 Aug 17 01:59 mitmproxy-ca-cert.pem
secqation@mirage:~/Downloads$ sudo mkdir /usr/share/ca-certificates/extra
[sudo] password for secqation:
secqation@mirage:~/Downloads$ sudo cp mitmproxy-ca-cert.crt /usr/share/ca-certificates/extra/mitmproxy.crt
secqation@mirage:~/Downloads$ sudo dpkg-reconfigure ca-certificates
Updating certificates in /etc/ssl/certs...
1 added, 0 removed; done.
Processing triggers for ca-certificates (20210119~20.04.1) ...
Updating certificates in /etc/ssl/certs...
0 added, 0 removed; done.
Running hooks in /etc/ca-certificates/update.d...
done.
secqation@mirage:~/Downloads$
```

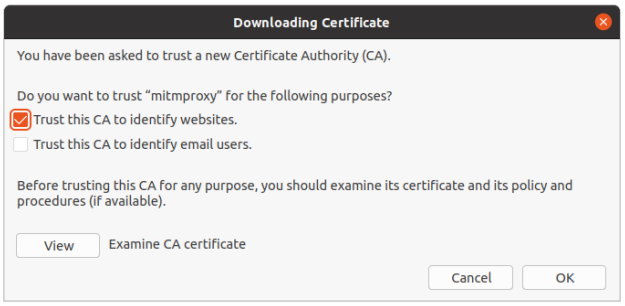
16. In Firefox browser, go to "Settings" page 17. Search for "Certificates"



18. Click on "View Certificates" 19. Click on "Import"



20. Choose the CA certificate "mitmproxy-ca-cert.crt" 21. Select the checkbox labeled as "Trust this CA to identify websites."



22. Click on "OK"

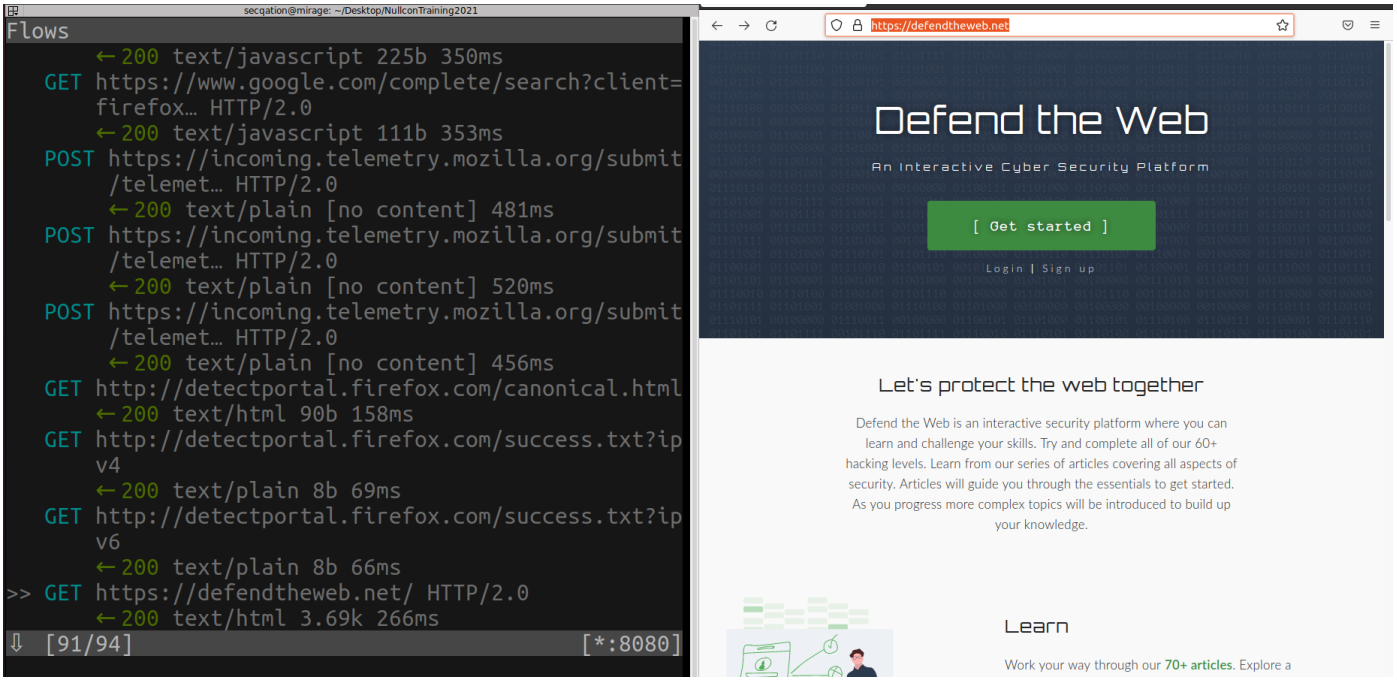
11.5 Verify Setup

1. Open a terminal window by pressing **[CTRL]+[ALT]+T**
2. Start mitmproxy by running following command:

```
mitmproxy
```

3. Open Firefox browser, and load the newly created browser profile (with proxy mode enabled)
4. Navigate to https://defendtheweb.net/
5. The secure website should load successfully

6. You should see the captured server requests and responses in mitmproxy screen



7. Your browser is configured and ready for use.

11.6 What Next?

1. mitmproxy should intercept all server requests and responses while automated test cases get executed by the robot framework
2. Irrelevant browser traffic should be ignored
3. All of the captured traffic should be saved to a file
4. It should be possible to open the saved output file and analyze the intercepted traffic

11.7 Prepare Bash Script

init.sh

```
mitmdump -p 8080 -w +traffic.mitm "! ~u firefox|ocsp|mozilla|googleapis" & robot -d ~/PycharmProjects/secqation/nullcon2021/Results ~/PycharmProjects/secqa
```

Note: You must update the **absolute path** to "Results" and "Tests" folder as per your own directory structure.

```
secqation@mirage:~/PycharmProjects/secqation/nullcon2021/BashScripts$ ll
total 12
drwxr-xr-x 2 secqation seqation 4096 Aug 17 10:39 ./
drwxr-xr-x 8 secqation seqation 4096 Aug  9 19:39 ../
-rw-r--r-- 1 secqation seqation  225 Aug 17 10:39 init.sh
secqation@mirage:~/PycharmProjects/secqation/nullcon2021/BashScripts$ cat init.sh
mitmdump -p 8080 -w +traffic.mitm "! ~u firefox|ocsp|mozilla|googleapis" &
robot -d ~/PycharmProjects/secqation/nullcon2021/Results ~/PycharmProjects/secqation/nullcon2021/Tests/App.
robot
pkill mitmdump
echo "Test Complete."
```

11.8 Run Bash Script

Run following two commands, and take a short break:

`chmod +x init.sh ./init.sh`

```
secqation@mirage:~/PycharmProjects/secqation/nullcon2021/BashScripts$ chmod +x init.sh
secqation@mirage:~/PycharmProjects/secqation/nullcon2021/BashScripts$ ./init.sh
==============================================================================
App
==============================================================================
Proxy server listening at http://*:8080
Information Gathering                                                 | PASS |
------------------------------------------------------------------------------
App                                                                   | PASS |
1 test, 1 passed, 0 failed
==============================================================================
Output:  /home/secqation/PycharmProjects/secqation/nullcon2021/Results/output.xml
Log:     /home/secqation/PycharmProjects/secqation/nullcon2021/Results/log.html
Report:  /home/secqation/PycharmProjects/secqation/nullcon2021/Results/report.html
Test Complete.
secqation@mirage:~/PycharmProjects/secqation/nullcon2021/BashScripts$ ll
total 12
drwxr-xr-x 2 secqation seqation 4096 Aug 17 10:45 ./
drwxr-xr-x 8 secqation seqation 4096 Aug  9 19:39 ../
-rwxr-xr-x 1 secqation seqation  225 Aug 17 10:39 init.sh*
-rw-r--r-- 1 secqation seqation    0 Aug 17 10:45 traffic.mitm
secqation@mirage:~/PycharmProjects/secqation/nullcon2021/BashScripts$
```

Observation:

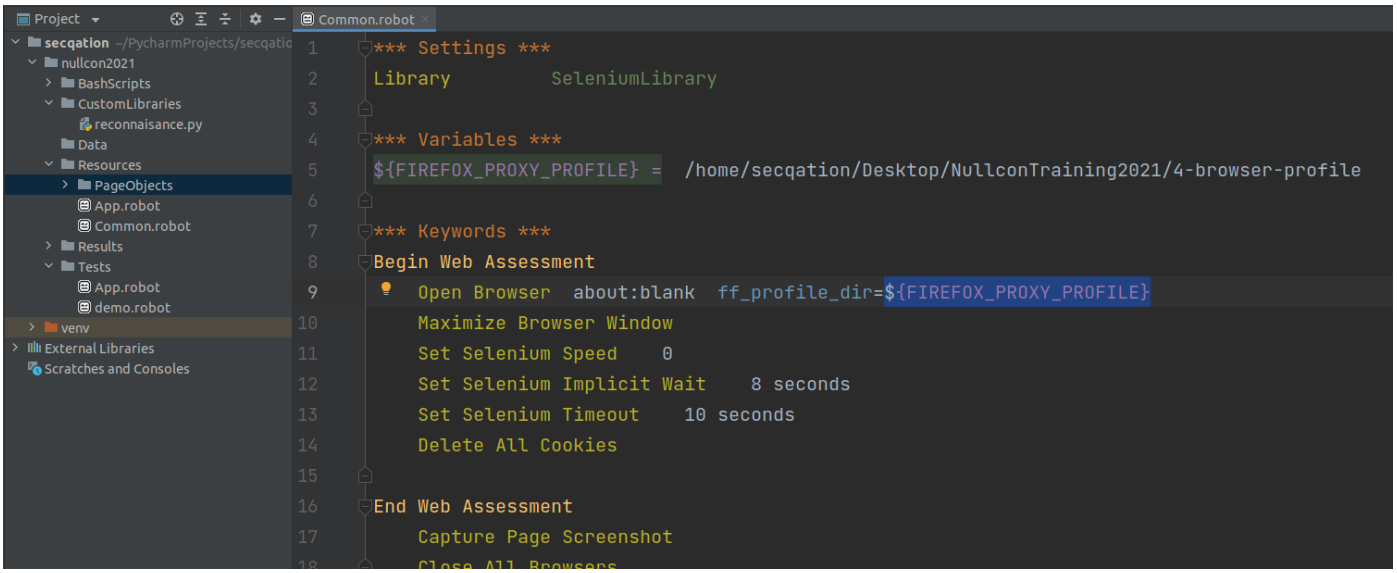
- "traffic.mitm" file was created
- File size is 0, indicating no traffic was captured
- What went wrong?

11.9 Update Browser Settings in Robot Framework

1. Locate the **folder** that stores data related to custom Firefox browser profile (that we created earlier), e.g.,

   `/home/secqation/Desktop/NullconTraining2021/4-browser-profile`

2. In PyCharm, open "**Common.robot**" file under "**Resources**" folder
3. Update the value of **global variable** `${FIREFOX_PROXY_PROFILE}`. Set it as absolute path to Firefox profile directory.



11.10 Re-run Bash Script

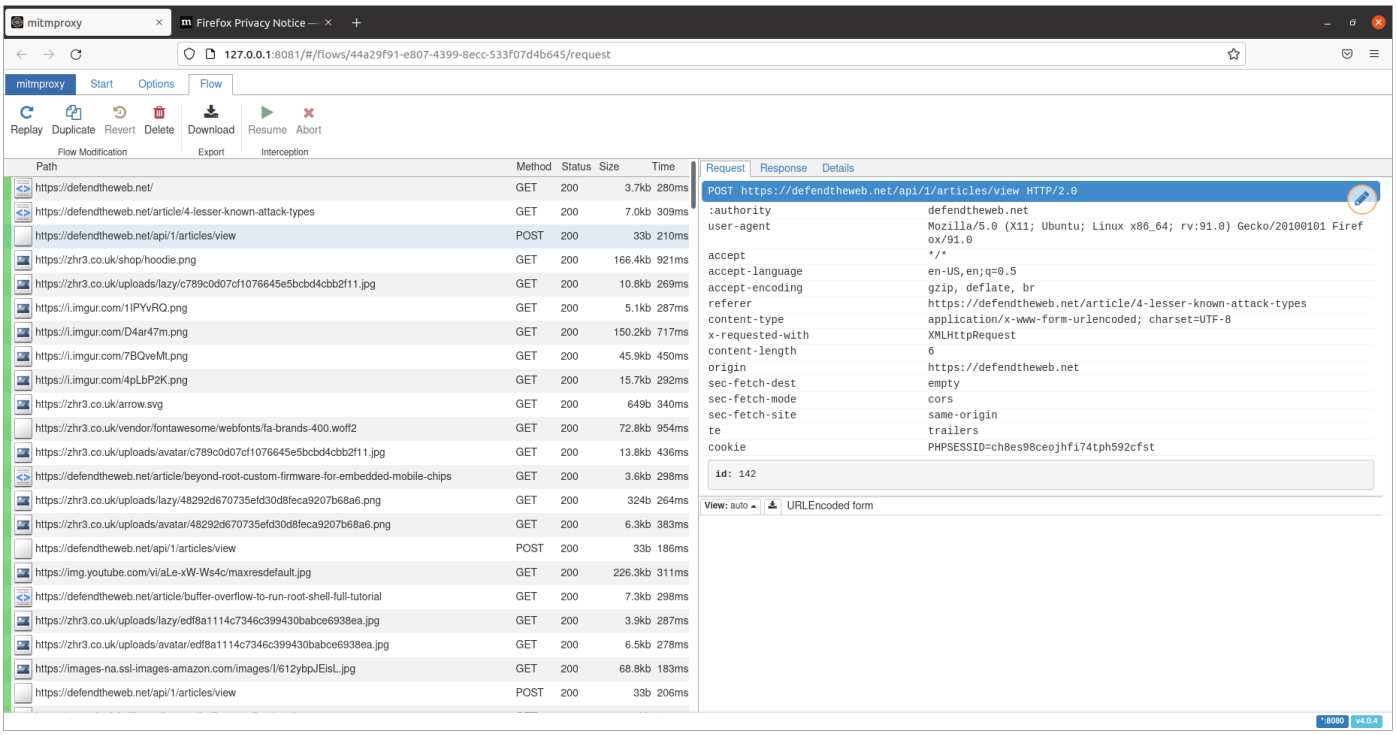
1. Re-run the bash script

```
./init.sh
```

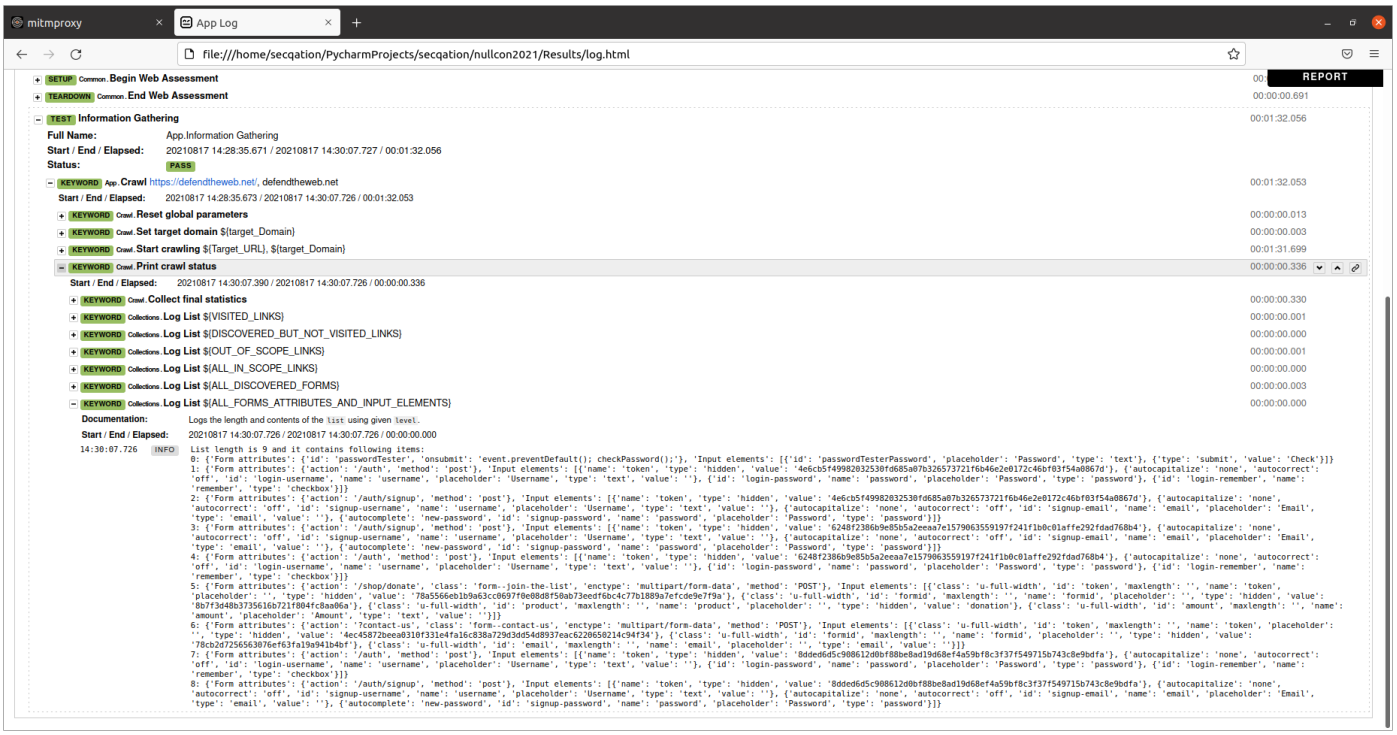
```
App                                                                   | PASS |
1 test, 1 passed, 0 failed
==============================================================================
Output:  /home/secqation/PycharmProjects/secqation/nullcon2021/Results/output.xml
Log:     /home/secqation/PycharmProjects/secqation/nullcon2021/Results/log.html
Report:  /home/secqation/PycharmProjects/secqation/nullcon2021/Results/report.html
Test Complete.
secqation@mirage:~/PycharmProjects/secqation/nullcon2021/BashScripts$ ll
total 5388
drwxr-xr-x 2 secqation seqation    4096 Aug 17 14:19 ./
drwxr-xr-x 8 secqation seqation    4096 Aug  9 19:39 ../
-rwxr-xr-x 1 secqation seqation     225 Aug 17 14:18 init.sh*
-rw-r--r-- 1 secqation seqation 5504528 Aug 17 14:30 traffic.mitm
secqation@mirage:~/PycharmProjects/secqation/nullcon2021/BashScripts$
```

2. Notice that server traffic has been captured and saved successfully in the file `traffic.mitm`
3. Run following command to analyze the saved traffic

```
mitmweb -r traffic.mitm
```



4. Also, access `log.html` file from Results folder, to view data scraped from the target website



11.11 Apply Human Intelligence Now

While the robots were at work, it was a break for you. With a refreshed mind, now is the time to look at all the gathered data and **identify potential attack vectors**.

The current data set can give you a good understanding about the target application.

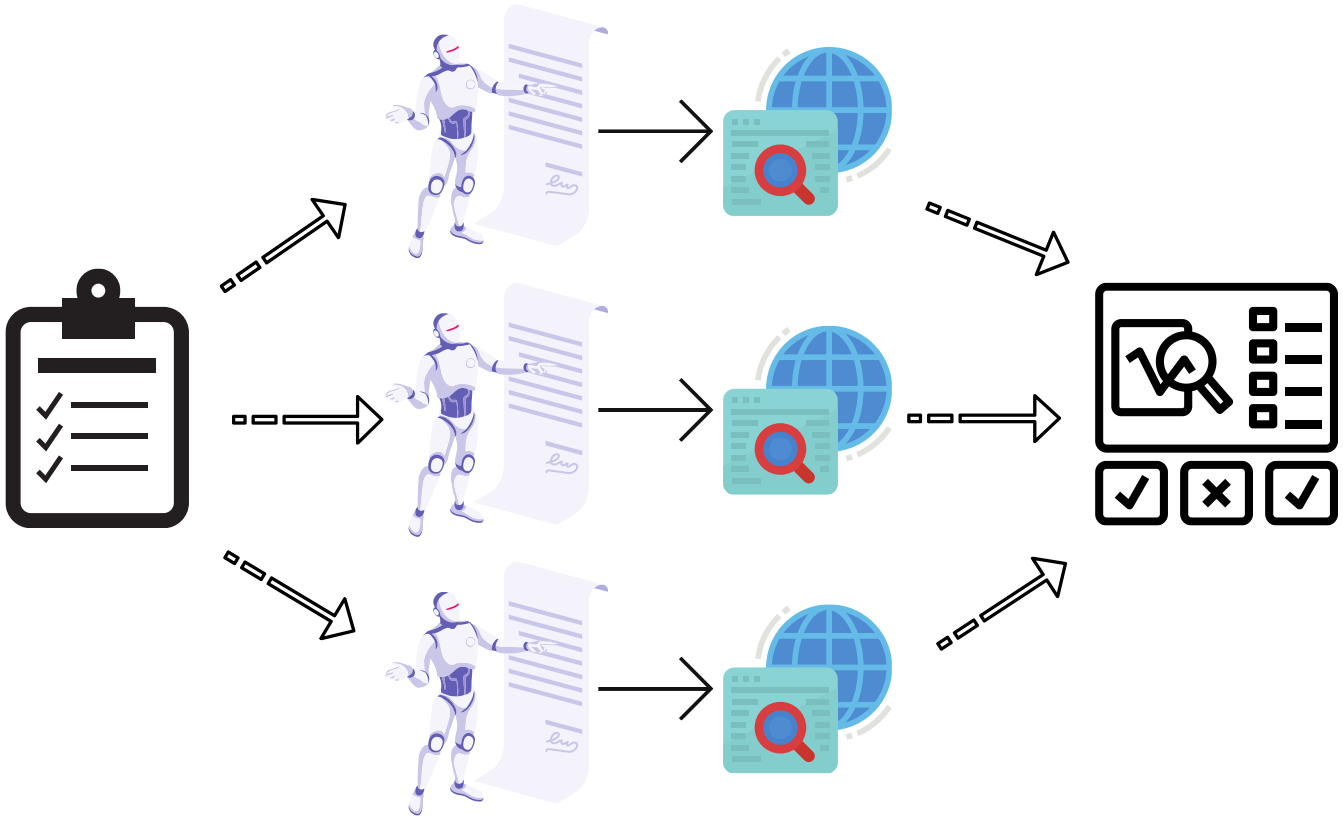
After having a first look at the target application, if there's a need, the robot test cases can be enhanced further to automate the form filling process, or any other manual task, including reading emails from your email account or running commands in your bash shell, etc.

If you have clarity in your mind regarding the exact steps that you wish to perform, writing robot test cases is really a trivial process.

12. Pabot: Parallel Processing

12.1 Pabot

It's a parallel executor for Robot Framework tests. Split one execution into multiple and save test execution time.



Scenario:

What if we wish to a set of operation across different pages of a website? Shall we scroll through the pages one-by-one, or is there a way to spin up multiple processes that perform same set of tasks but on different endpoints...

12.2 Installation

Run following command to install Pabot libraries:

```
pip install -U robotframework-pabot
```

12.3 Syntax

- By default, two parallel processes would run:

```
pabot --pabotlib -d ./OutputFolder/ ./TestSuite/
```

- Use `--processes` option to specify specific number of parallel processes that should be run:

```
pabot --pabotlib --processes 6 --testlevelsplit -d ./OutputFolder/ ./TestSuite/
```

12.4 New Keywords

1. Run Setup Only Once
2. Acquire Lock
3. Release Lock
4. Set Parallel Value For Key
5. Get Parallel Value For Key
6. etc.

12.5 Exercise

1. Add a test step to export all in-scope links, gathered during the crawling process
2. Consider this list of URLs as an input to another set of test cases
3. Start parallel processes such that each process would pick one unique URL from the input list
4. Use `Pabot` to analyze several URLs at the same time, performing same test steps but on different endpoints

12.6 Hint

Check the `DeepCrawl` test suite in `Tests` folder.

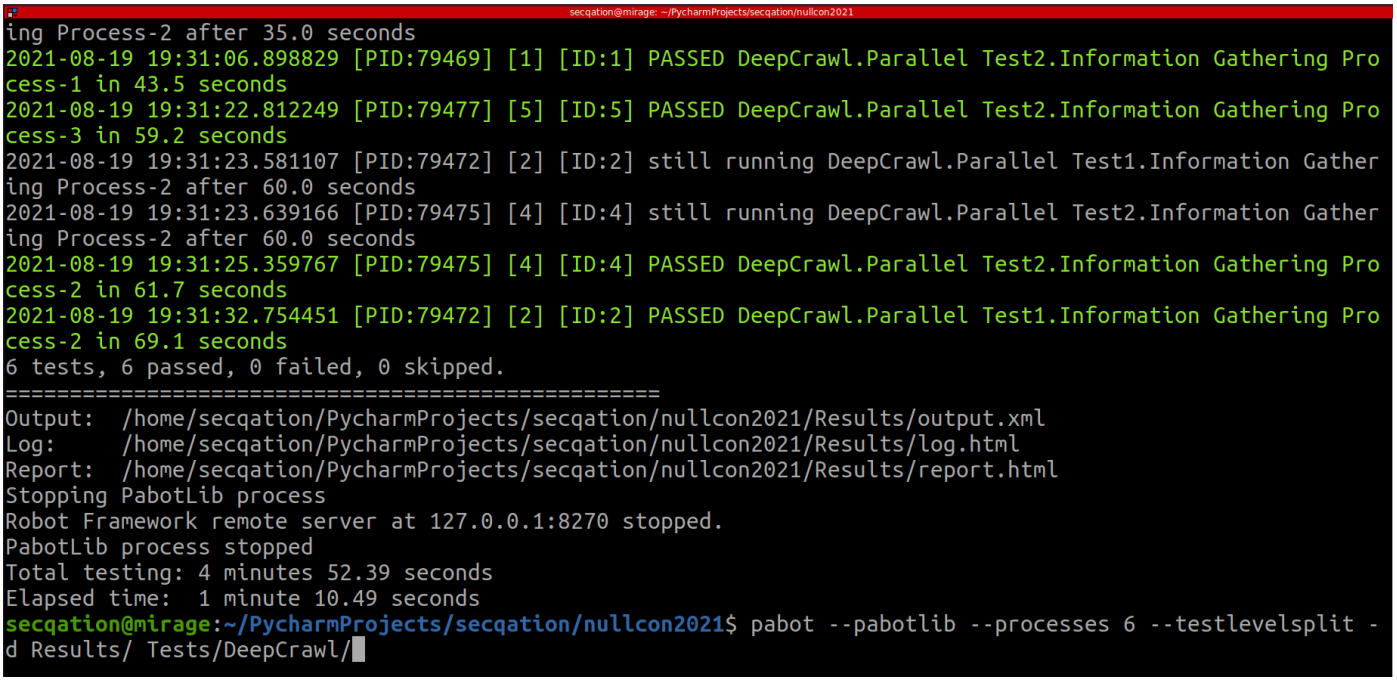
```
secqation@mirage:~/Desktop/NullconTraining2021/2-example$ ll
total 32
drwxr-xr-x 8 secqation seqation 4096 Aug 19 14:58 ./
drwxr-xr-x 7 secqation seqation 4096 Aug 19 12:04 ../
drwxr-xr-x 2 secqation seqation 4096 Aug 17 14:57 BashScripts/
drwxr-xr-x 3 secqation seqation 4096 Aug 18 16:21 CustomLibraries/
drwxr-xr-x 3 secqation seqation 4096 Aug 18 12:06 Data/
drwxr-xr-x 3 secqation seqation 4096 Aug 19 12:03 Resources/
drwxr-xr-x 3 secqation seqation 4096 Aug 19 12:03 Results/
drwxr-xr-x 3 secqation seqation 4096 Aug 19 14:56 Tests/
secqation@mirage:~/Desktop/NullconTraining2021/2-example$ tree Tests/
Tests/
├── App.robot
├── DeepCrawl
│   ├── DeepCrawl.robot
│   ├── __init__.robot
│   ├── parallel_test1.robot
│   ├── parallel_test2.robot
│   ├── parallel_test3.robot
│   ├── parallel_test4.robot
│   └── parallel_test5.robot
└── demo.robot

1 directory, 9 files
secqation@mirage:~/Desktop/NullconTraining2021/2-example$
```

1. Access the sample code

```
cd /home/secqation/Desktop/NullconTraining2021/2-example
```

2. Run following command to trigger parallel test execution

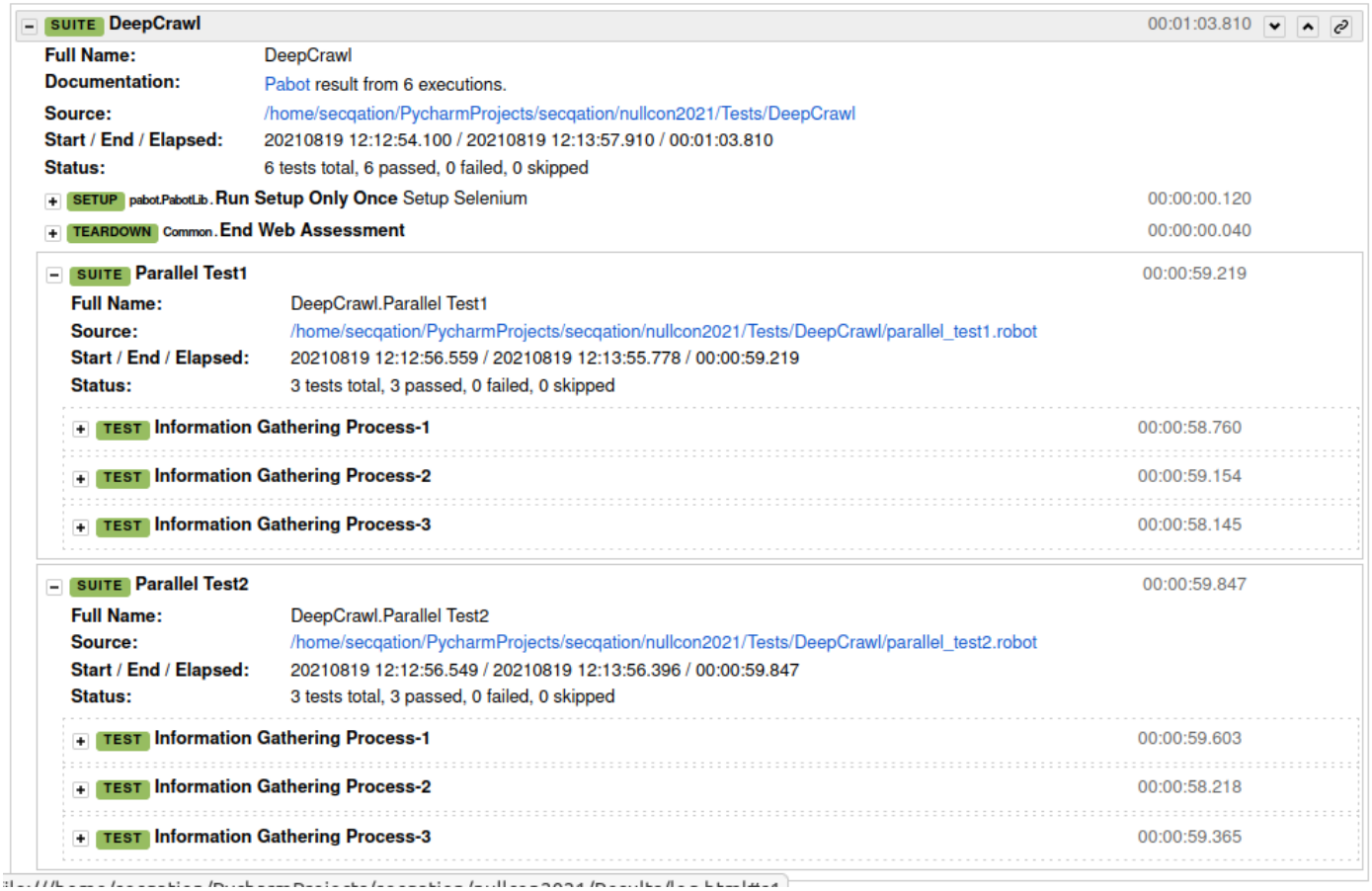
```
pabot --pabotlib --processes 6 --testlevelsplit -d Results/ Tests/DeepCrawl/
```



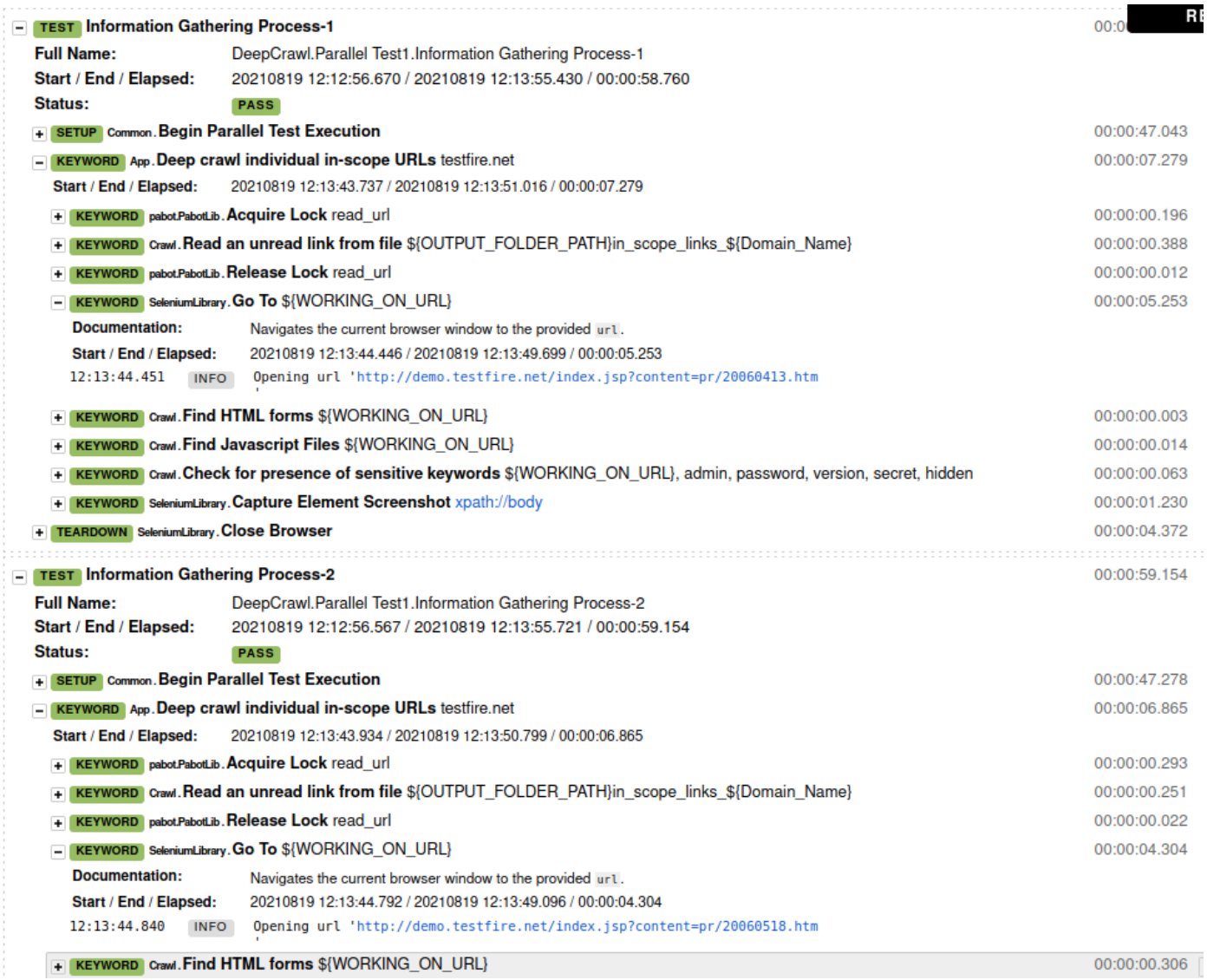
3. View the execution log by accessing **log.html** in your browser

```
file:///home/secqation/PycharmProjects/secqation/nullcon2021/Results/log.html
```

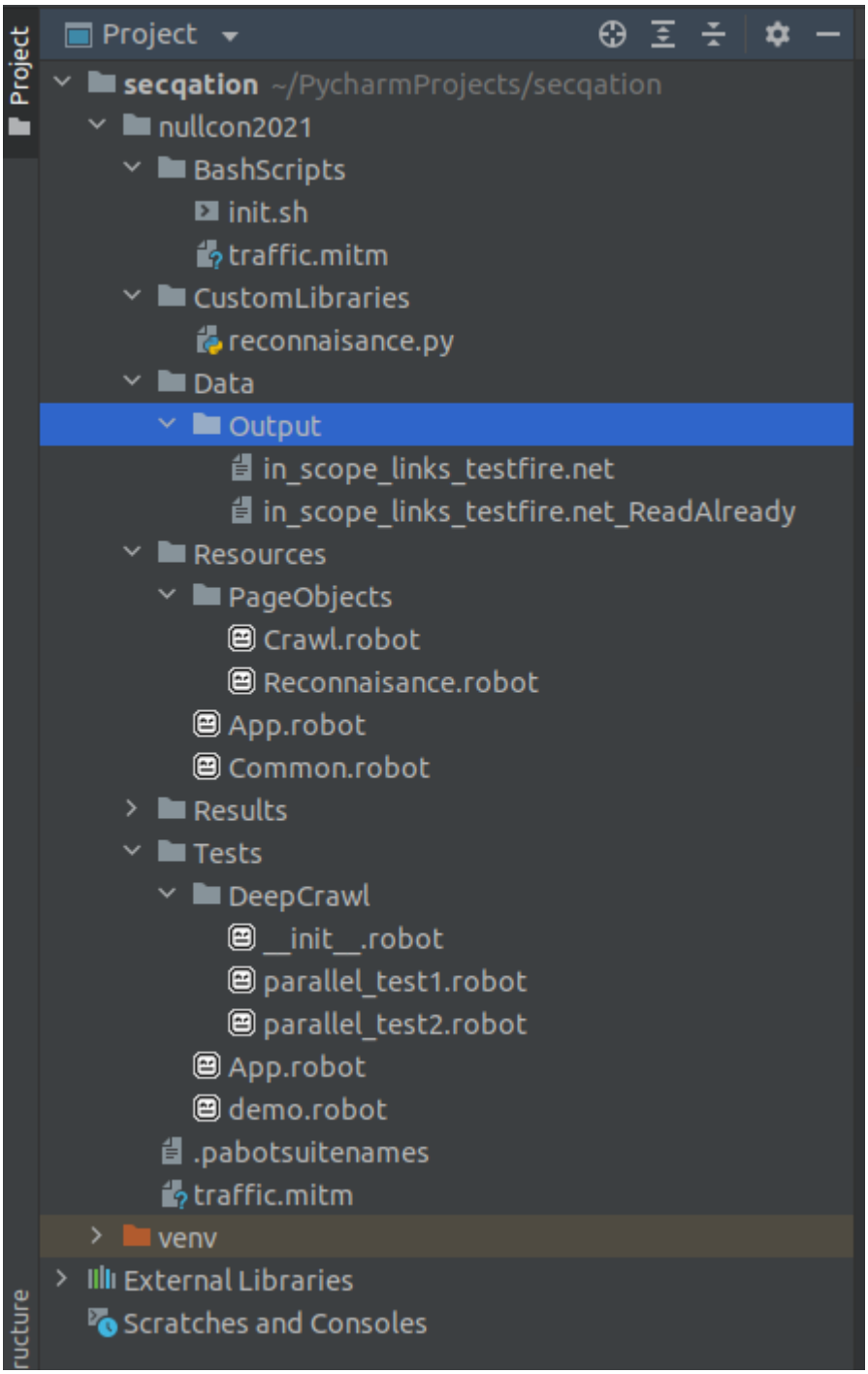
Test Execution Log



4. **Expand keywords** to the see captured data



5. Observe changes in the files stored in the Output folder, before and after test execution completes successfully. Explain your observations.



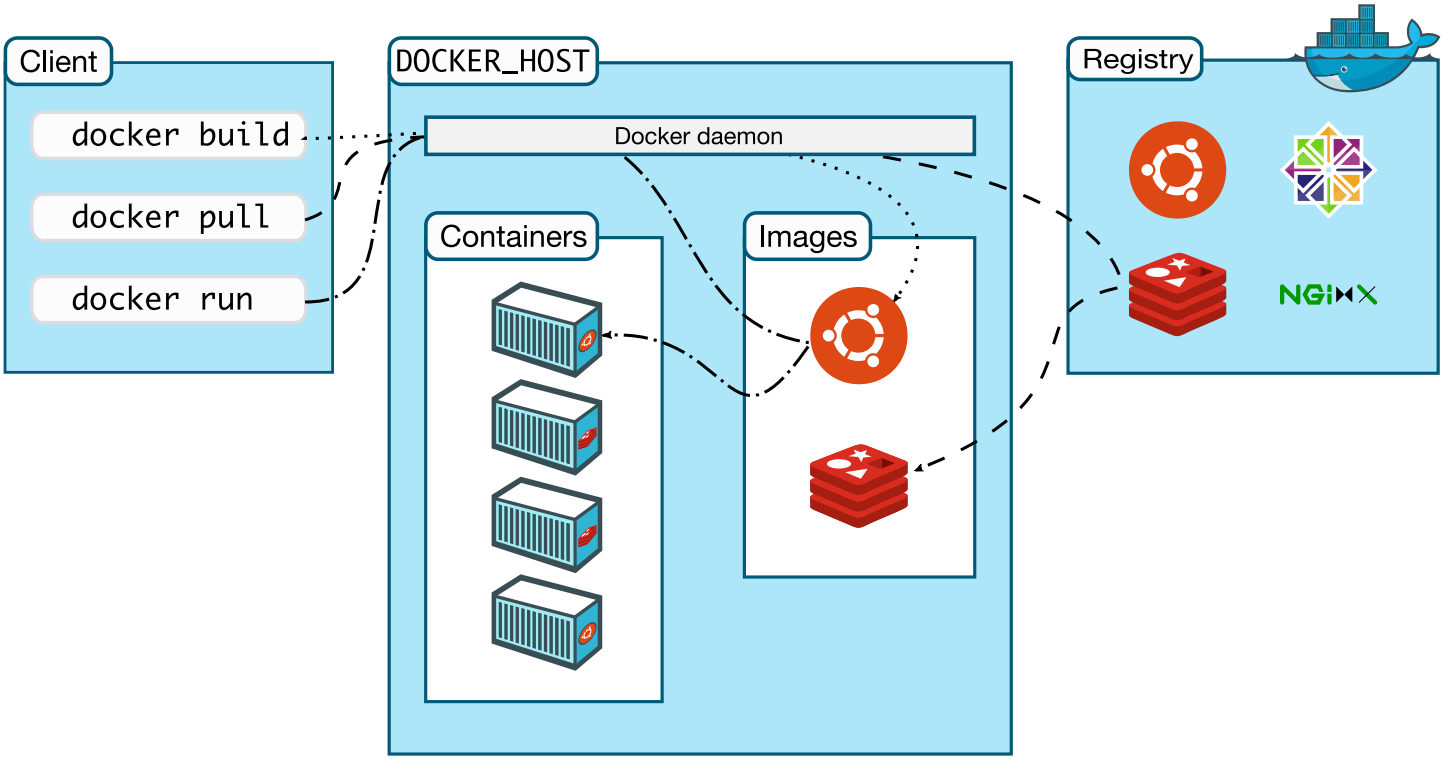
6. Also check a modified version of the code at following location:

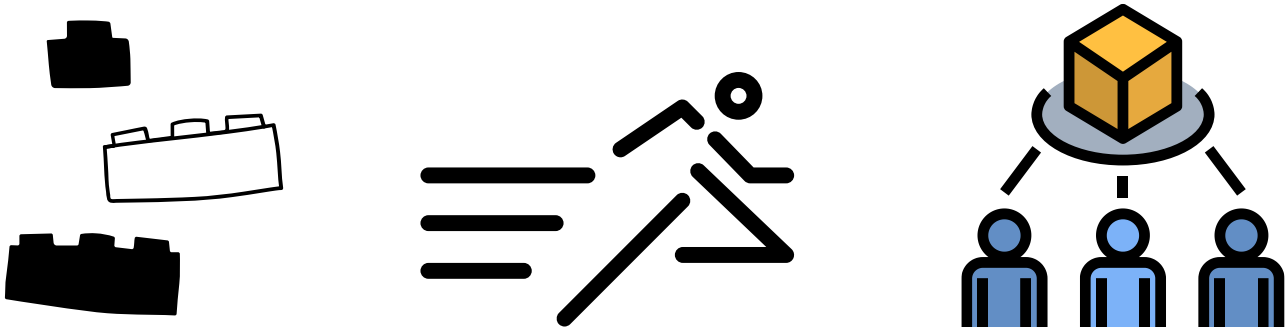
`/home/secqation/Desktop/NullconTraining2021/3-example-pabot/`

13. Understanding Docker and Docker Compose

Docker provides the ability to **package and run an application** in a loosely isolated environment called a container. The isolation and security allow you to run many containers simultaneously on a given host. Containers are lightweight and contain everything needed to run the application, so you do not need to rely on what is currently installed on the host. You can easily share containers while you work, and be sure that everyone you share with gets the same container that works in the same way. https://docs.docker.com/get-started/overview/

Compose is a tool for **defining and running multi-container Docker applications**. With Compose, you use a YAML file to configure your application's services. Then, with a single command, you create and start all the services from your configuration.





13.1 Pre-requisites:

- Install Docker

13.2 1. Create Dockerfile

1. Create a new file, called **Dockerfile**
2. Paste following contents

```
FROM python:3.9.5-alpine3.13 LABEL maintainer="Riddhi Shree" ENV PYTHONUNBUFFERED=1 RUN pip install robotframework RUN pip install selenium RUN pip in
```

3. Create **healthcheck.sh** file
4. Paste following contents

```
#!/usr/bin/env bash robot -d ./test_results ./robo-tests
```

5. Create a folder called **demo-test-suite**

```
$ mkdir demo-test-suite $ cd demo-test-suite
```

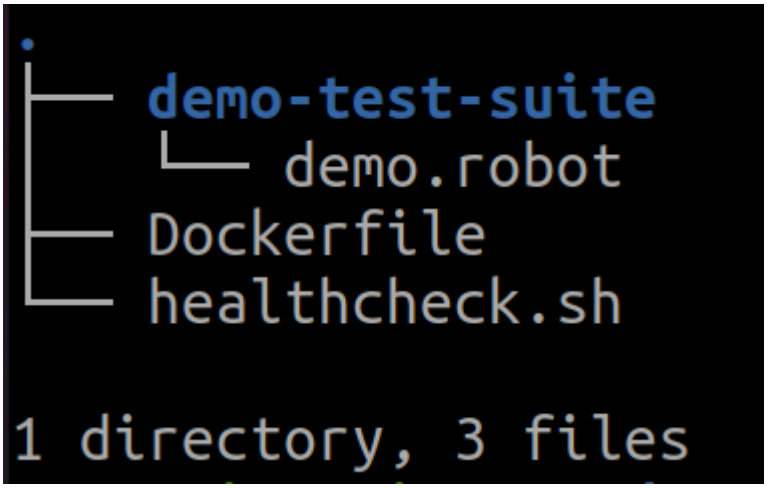
6. Inside **demo-test-suite** folder, create **demo.robot** file

```
$ touch demo.robot
```

7. Paste following code in **demo.robot** file

```
*** Settings *** Library SeleniumLibrary *** Variables *** ${BASE_URL} = https://www.winja.site *** Keywords *** Custom keyword Log This is a custom k
```

8. The final structure should look like this:



Note: To access readymade files, check following path:

```
/home/secqation/Desktop/NullconTraining2021/4-example-docker/1-Dockerfile/
```

13.3 2. Build Docker Image

1. Run following command to build a new Docker image from **Dockerfile**

```
$ docker build -t demo .
```

```
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker$ docker build -t demo .
Sending build context to Docker daemon  121.9kB
Step 1/13 : FROM python:3.9.5-alpine3.13
3.9.5-alpine3.13: Pulling from library/python
540db60ca938: Pull complete
d037ddac5dde: Pull complete
629719f9106a: Pull complete
f9ef3a05a91e: Pull complete
2407aae58672: Pull complete
Digest: sha256:cc416abe30153111c005e8c7d69a6817d5e1977512939336ec37d92e4bce1769
Status: Downloaded newer image for python:3.9.5-alpine3.13
 ---> 46a196bf50ae
Step 2/13 : LABEL maintainer="Riddhi Shree"
 ---> Running in cce5b6bb0ca0
Removing intermediate container cce5b6bb0ca0
 ---> 72f38b7916ae
Step 3/13 : ENV PYTHONUNBUFFERED=1
 ---> Running in efe78b2b8906
Removing intermediate container efe78b2b8906
 ---> bdf1f486e252
Step 4/13 : RUN pip install robotframework
 ---> Running in 395ffd4b03e0
Collecting robotframework
  Downloading robotframework-4.1-py2.py3-none-any.whl (657 kB)
```

2. Check if image was created successfully

```
$ docker images
```

```
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker$ docker images
REPOSITORY   TAG                 IMAGE ID       CREATED          SIZE
demo         latest              d9ffb8a44e18   2 minutes ago    59.6MB
python       3.9.5-alpine3.13    46a196bf50ae   7 weeks ago      45MB
```

13.4 3. Run Docker Container

1. Start a running container from the Docker image

```
$ docker run -itd demo $ docker ps -a
```

```
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker$ docker run -itd demo
53945980fc4a80031419e67633a759b6d3bb831294234f10bb30dedf669cf381
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker$ docker ps -a
CONTAINER ID   IMAGE     COMMAND                  CREATED         STATUS
S
53945980fc4a   demo      "/bin/sh -c 'sh ./he…"   7 seconds ago   Exited (1) 5 seconds ago
xed_hertz
```

2. Read the container **logs**

```
$ docker logs <CONTAINER_ID>
```

```
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker$ docker ps -a
CONTAINER ID   IMAGE     COMMAND                  CREATED         STATUS
S
53945980fc4a   demo      "/bin/sh -c 'sh ./he…"   7 seconds ago   Exited (1) 5 seconds ago
xed_hertz
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker$ docker logs 53
==============================================================================
Robo-Tests
==============================================================================
Robo-Tests.Demo
==============================================================================
Test Case 1                                                           | FAIL |
WebDriverException: Message: 'geckodriver' executable needs to be in PATH.
------------------------------------------------------------------------------
Robo-Tests.Demo                                                       | FAIL |
1 test, 0 passed, 1 failed
==============================================================================
Robo-Tests                                                            | FAIL |
1 test, 0 passed, 1 failed
==============================================================================
Output:  /robo-vault/test_results/output.xml
Log:     /robo-vault/test_results/log.html
Report:  /robo-vault/test_results/report.html
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker$
```

3. What did you observe?
4. The tests have failed. But, why? Can you fix this?

13.5 4. Create Docker Compose file

1. Download docker-compose-v3.yml

```
$ wget https://raw.githubusercontent.com/SeleniumHQ/docker-selenium/trunk/docker-compose-v3.yml
```

2. Modify the file as follows

```
version: "3" services: firefox_1: image: selenium/node-firefox:4.0.0-rc-1-prerelease-20210804 shm_size: 2gb depends_on: - selenium-hub environment: -
```

3. Modify the contents of **healthcheck.sh** file as follows

```
#!/usr/bin/env/bash echo "Checking if hub is ready - $HUB_HOSTNAME" while [[ "$(curl -s http://$HUB_HOSTNAME:4444/wd/hub/status | jq .value.ready)" !=
```

4. Add following two lines in **Dockerfile**

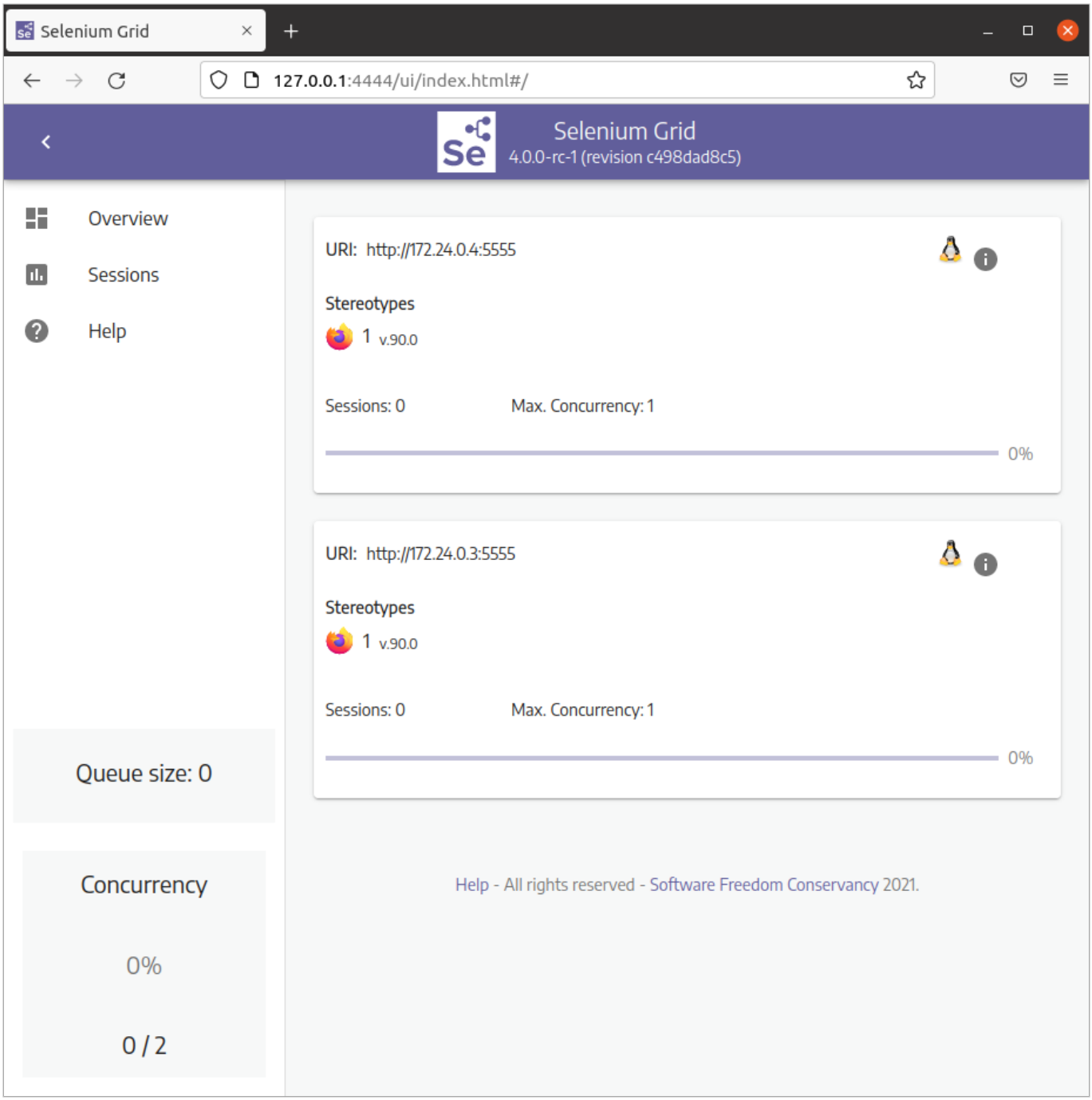
```
... RUN apk add curl RUN curl -OL https://github.com/stedolan/jq/releases/download/jq-1.6/jq-linux64 -o ./jq-linux64 && chmod a+x ./jq-linux64 && mv .
```

5. Run following command to start Selenium Hub and to execute robot test cases:

```
$ docker-compose build $ docker-compose up -d $ docker-compose ps
```

```
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker/2-docker-compose$ docker-compose -f docker-
compose-v3.yml up -d
Creating network "robo-network" with the default driver
Creating selenium-hub ... done
Creating 2-docker-compose_firefox_1_1 ... done
Creating 2-docker-compose_firefox_2_1 ... done
Creating 2-docker-compose_robotframework_1 ... done
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker/2-docker-compose$ docker-compose -f docker-
compose-v3.yml ps
             Name                           Command              State                Ports
-------------------------------------------------------------------------------------------------------
2-docker-compose_firefox_1_1       /opt/bin/entry_point.sh          Up      0.0.0.0:6902->5900/tcp,:::6902-
                                                                            >5900/tcp
2-docker-compose_firefox_2_1       /opt/bin/entry_point.sh          Up      5900/tcp
2-docker-                          /bin/sh -c sh ./healthcheck.sh   Up
compose_robotframework_1
selenium-hub                       /opt/bin/entry_point.sh          Up      0.0.0.0:4442->4442/tcp,:::4442-
                                                                            >4442/tcp, 0.0.0.0:4443->4443/t
                                                                            cp,:::4443->4443/tcp, 0.0.0.0:4
                                                                            444->4444/tcp,:::4444->4444/tcp
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker/2-docker-compose$
```

6. **Selenium Grid** dashboard can be accessed at http://127.0.0.1:4444



7. Check the logs to see if robot test cases got executed successfully, or not.

```
$ docker logs 2-docker-compose_robotframework_1
```

```
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker/2-docker-compose$ docker logs 2-docker-comp
ose_robotframework_1
Checking if hub is ready - selenium-hub
==============================================================================
Robo-Tests
==============================================================================
Robo-Tests.Demo
==============================================================================
Test Case 1                                                           | FAIL |
WebDriverException: Message: 'geckodriver' executable needs to be in PATH.
------------------------------------------------------------------------------
Robo-Tests.Demo                                                       | FAIL |
1 test, 0 passed, 1 failed
==============================================================================
Robo-Tests                                                            | FAIL |
1 test, 0 passed, 1 failed
==============================================================================
Output:  /robo-vault/test_results/output.xml
Log:     /robo-vault/test_results/log.html
Report:  /robo-vault/test_results/report.html
```

8. Something is still missing. Let's check what has gone wrong!

13.6 References

- https://docs.docker.com/get-started/overview/
- https://docs.docker.com/compose/
- https://docs.docker.com/compose/install/
- https://hub.docker.com/r/selenium/hub/tags?page=1&ordering=last_updated
- https://raw.githubusercontent.com/SeleniumHQ/docker-selenium/trunk/docker-compose-v3.yml
- https://robotframework.org/SeleniumLibrary/SeleniumLibrary.html

14. Dockerizing Selenium Test Execution Environment

14.1 The Problem

So far, we have seen that our **robot test cases are failing** even though we are trying to run them in a Dockerized environment.

```
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker/2-docker-compose$ docker logs 2-docker-comp
ose_robotframework_1
Checking if hub is ready - selenium-hub
==============================================================================
Robo-Tests
==============================================================================
Robo-Tests.Demo
==============================================================================
Test Case 1                                                           | FAIL |
WebDriverException: Message: 'geckodriver' executable needs to be in PATH.
------------------------------------------------------------------------------
Robo-Tests.Demo                                                       | FAIL |
1 test, 0 passed, 1 failed
==============================================================================
Robo-Tests                                                            | FAIL |
1 test, 0 passed, 1 failed
==============================================================================
Output:  /robo-vault/test_results/output.xml
Log:     /robo-vault/test_results/log.html
Report:  /robo-vault/test_results/report.html
```

On checking the documentation for SeleniumLibrary, we find that all **drivers must be explicitly installed**.

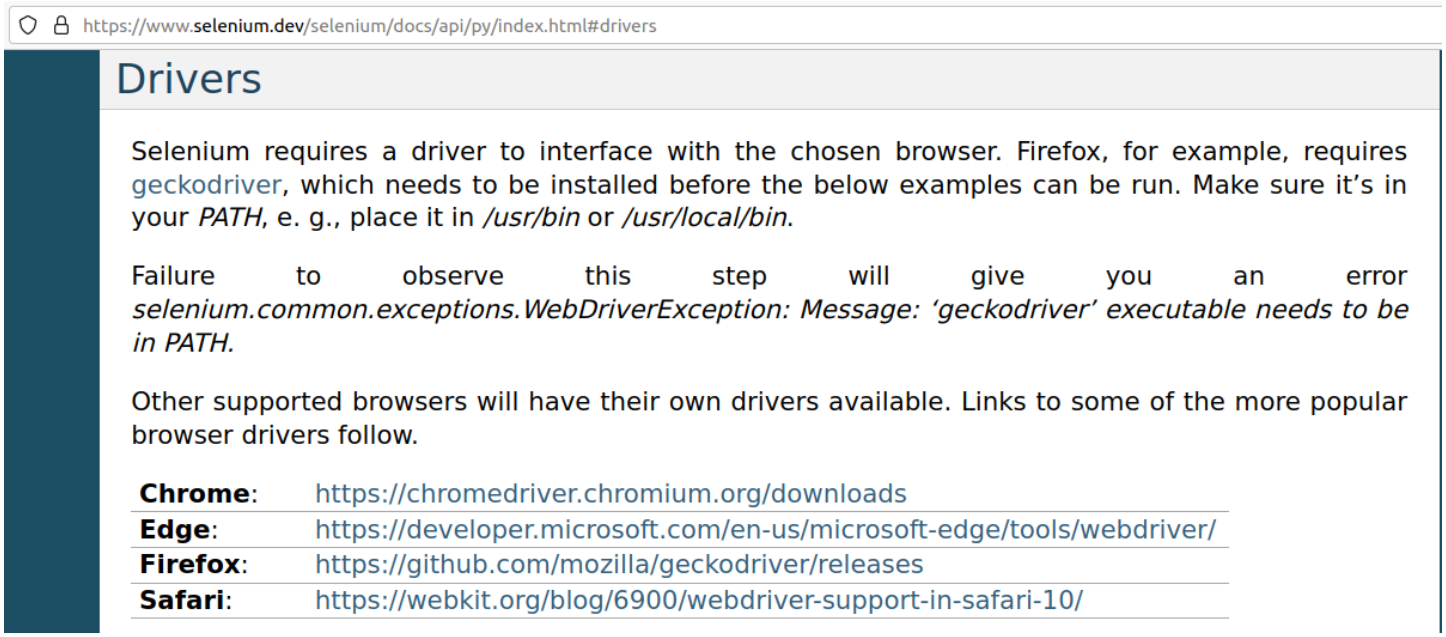
Browser drivers

After installing the library, you still need to install browser and operating system specific browser drivers for all those browsers you want to use in tests. These are the exact same drivers you need to use with Selenium also when not using SeleniumLibrary. More information about drivers can be found from Selenium documentation.

The general approach to install a browser driver is downloading a right driver, such as chromedriver for Chrome, and placing it into a directory that is in PATH. Drivers for different browsers can be found via Selenium documentation or by using your favorite search engine with a search term like selenium chrome browser driver. New browser driver versions are released to support features in new browsers, fix bug, or otherwise, and you need to keep an eye on them to know when to update drivers you use.

Furthermore, on checking the Selenium documentation, we find an explanation for the exact error that we saw earlier, i.e.,

`WebDriverException: Message: 'geckodriver' executable needs to be in PATH`



Browser drivers can be installed using **webdrivermanager**:

```
$ pip install webdrivermanager $ webdrivermanager firefox chrome --linkpath /usr/local/bin
```

Under normal circumstances, it would have been required for us to manually install drivers for any browser that our robot test cases are configured to use.

But, in current situation, as we are consuming the Selenium and Firefox **Docker services**, should we not have everything **preconfigured**?

15. Solution: Headless Browser

In our test case, we need to modify the `Open Browser ${BASE_URL}` test step to open a headless browser, instead.

Check SeleniumBrowser documentation for various **arguments** that can be passed to **Open Browser** keyword.

Open Browser

Arguments

`url`	=	`None`	<str>
`browser`	=	`firefox`	<str>
`alias`	=	`None`	<str>
`remote_url`	=	`False`	<bool> or <str>
`desired_capabilities`	=	`None`	<dict> or <None> or <str>
`ff_profile_dir`	=	`None`	<FirefoxProfile> or <str> or <None>
`options`	=	`None`	<Any>
`service_log_path`	=	`None`	<str>
`executable_path`	=	`None`	<str>

Documentation

Opens a new browser instance to the optional `url`.

The `browser` argument specifies which browser to use. The supported browsers are listed in the table below. The browser names are case-insensitive and some browsers have multiple supported names.

Browser	Name(s)
Firefox	firefox, ff
Google Chrome	googlechrome, chrome, gc
Headless Firefox	headlessfirefox
Headless Chrome	headlesschrome
Internet Explorer	internetexplorer, ie
Edge	edge

We can configure a **headless Firefox browser** as shown below:

```
... ${firefox_options}= Evaluate sys.modules['selenium.webdriver'].FirefoxOptions() sys, selenium.webdriver Call Method ${firefox_options} add_argument hea
```

After modification, our files should have following contents:

1. **demo-test-suite/demo.robot**

```
*** Settings *** Library SeleniumLibrary *** Variables *** ${BASE_URL} = https://www.winja.site ${SELENIUM_HUB} = http://%{HUB_HOSTNAME}:4444/wd/hub $
```

2. **Dockerfile**

```
FROM python:3.9.5-alpine3.13 LABEL maintainer="Riddhi Shree" ENV PYTHONUNBUFFERED=1 RUN pip install --upgrade pip RUN pip install robotframework RUN p
```

3. **docker-compose.yml**

```
version: "3.9" services: firefox_1: image: selenium/node-firefox:4.0.0-rc-1-prerelease-20210804 shm_size: 2gb container_name: firefox_1 depends_on: -
```

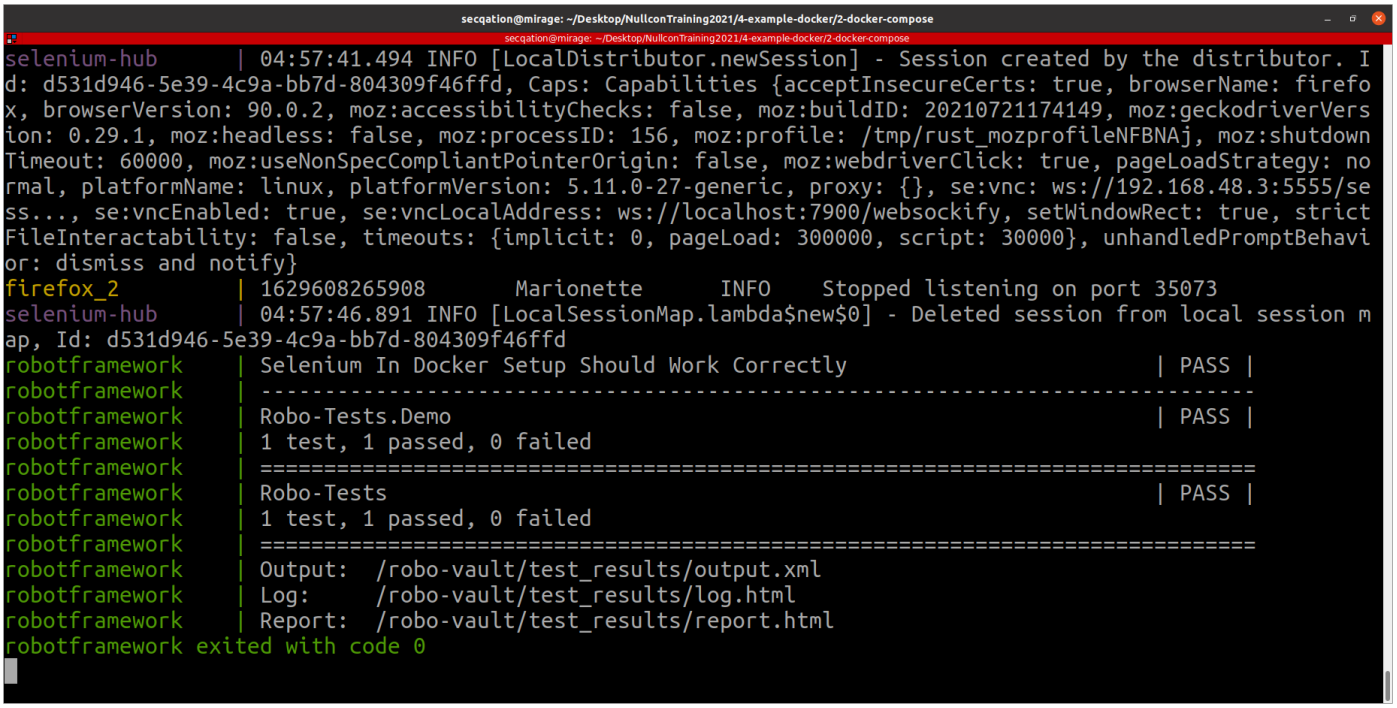
4. **healthcheck.sh**

```
#!/usr/bin/env/bash echo "Checking if hub is ready - $HUB_HOSTNAME" while [[ "$(curl -s http://$HUB_HOSTNAME:4444/wd/hub/status | jq .value.ready)" !=
```

15.1 Test Execution

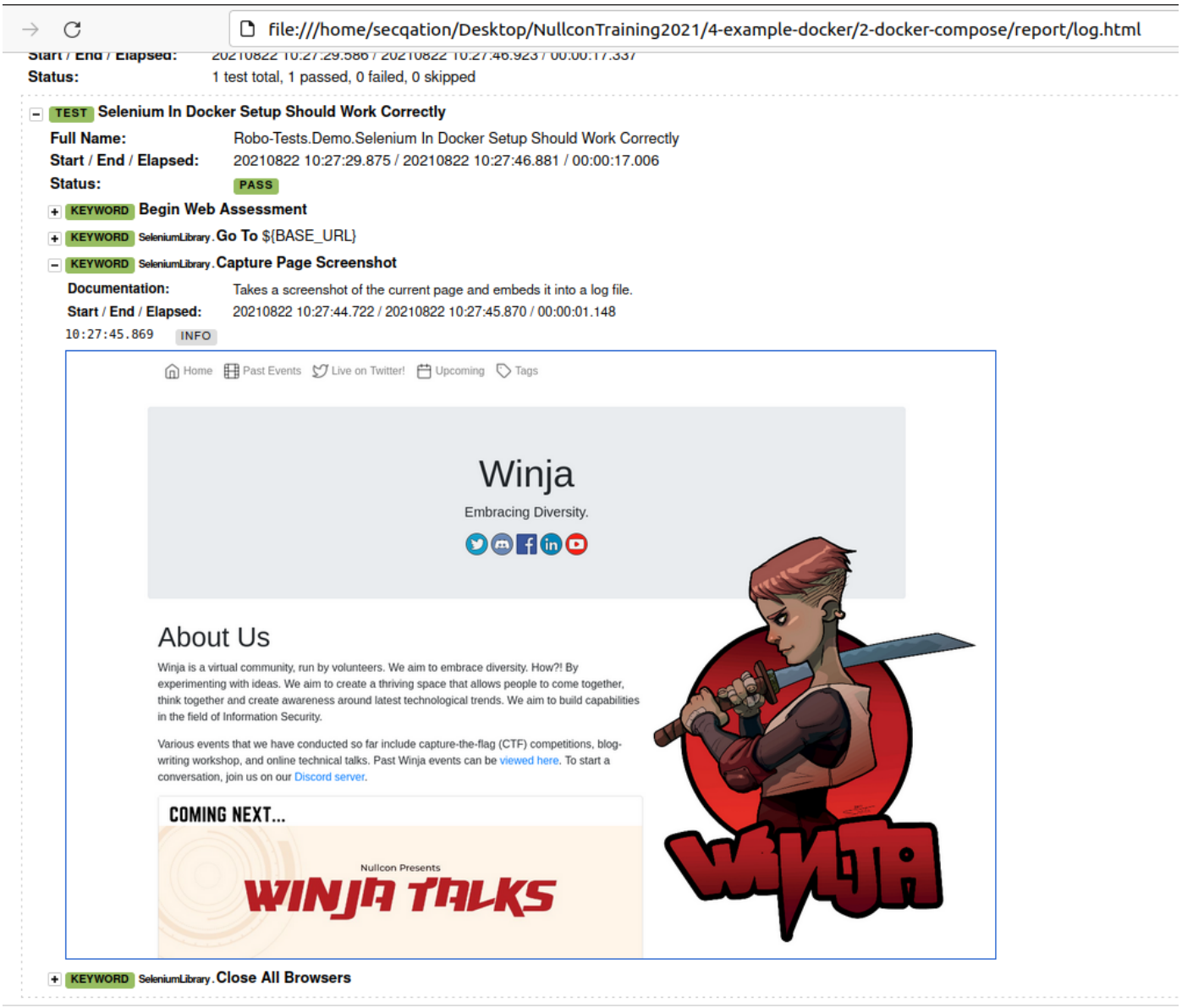
1. Run following commands to execute robot test cases in a headless Firefox browser, inside a Docker network:

```
$ docker-compose build $ docker-compose up
```



2. A new folder called **report** must have been created in the working directory. This folder contains the test report that was auto-generated by the robot framework.

3. Open **log.html** file in a browser to view the test logs



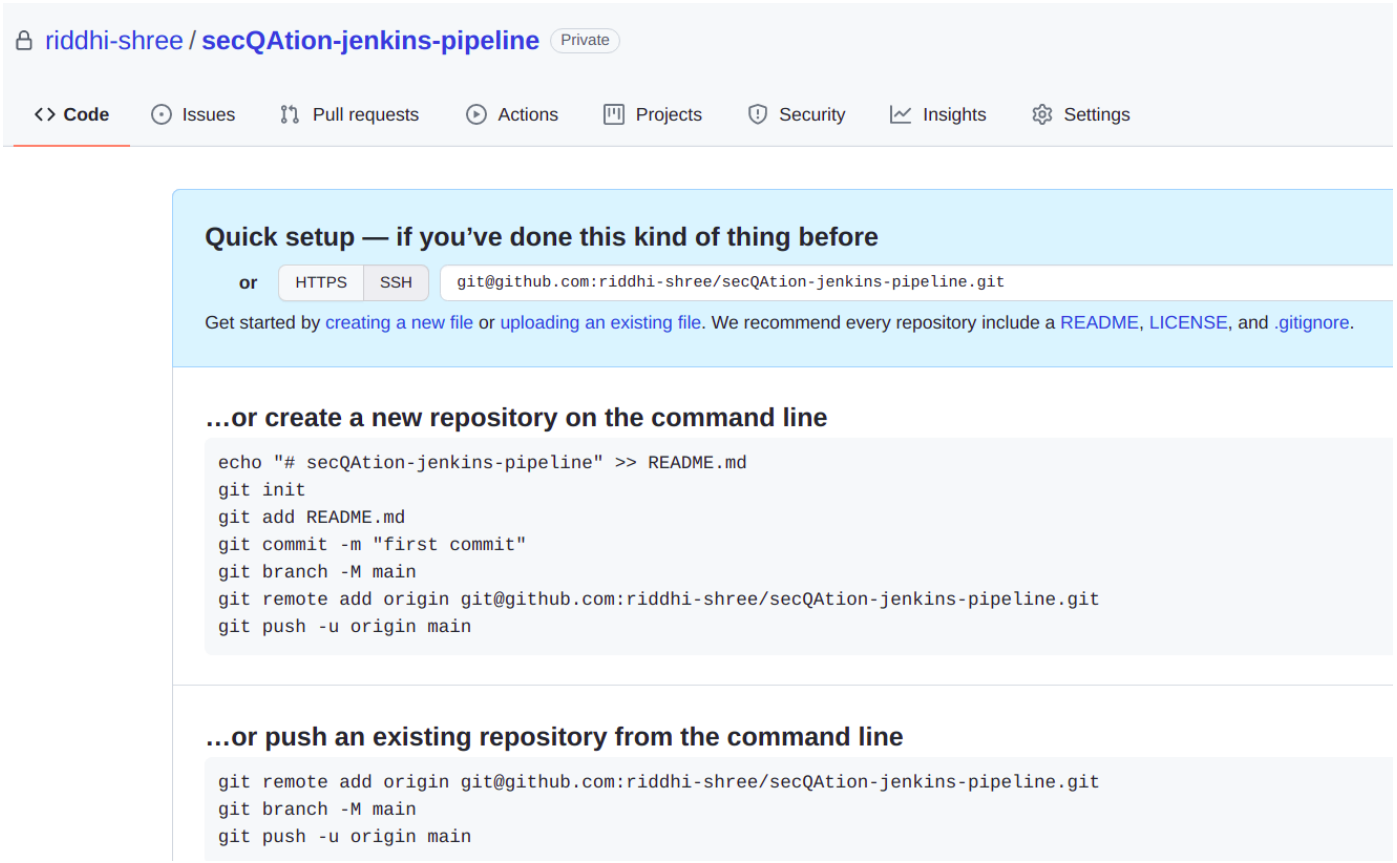
15.2 References

- https://robotframework.org/SeleniumLibrary/
- https://www.selenium.dev/selenium/docs/api/py/index.html#drivers
- https://github.com/rasjani/webdrivermanager
- https://robotframework.org/SeleniumLibrary/SeleniumLibrary.html

16. CI/CD Build Pipeline

16.1 Git

1. Create a new Git repository in github.com

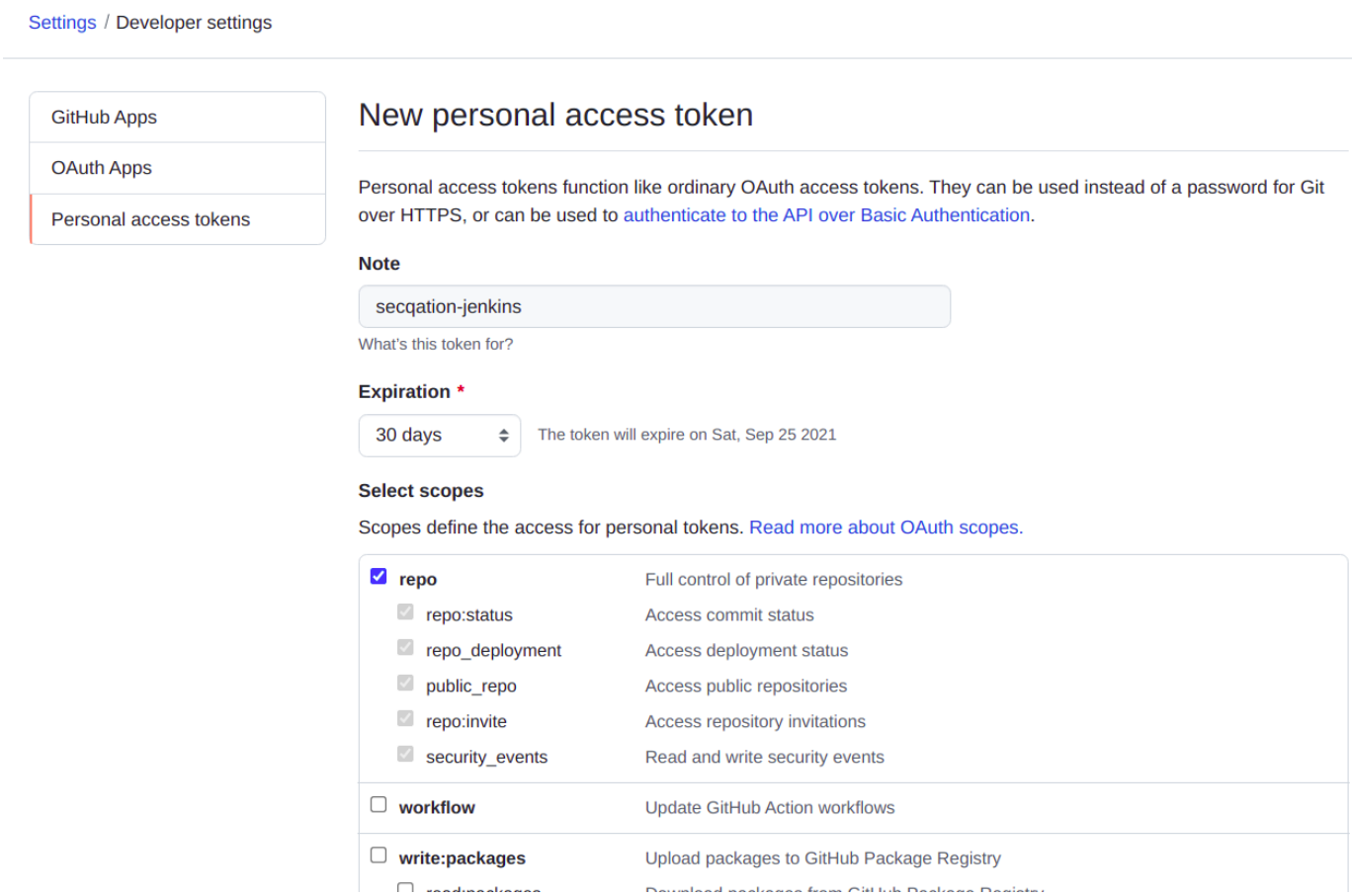


2. Create a new directory locally, and run the setup commands

```
$ git init $ git remote add origin git@github.com:riddhi-shree/secQAtion-jenkins-pipeline.git
```

16.2 Personal Access Token

1. Login to github.com
2. Go to **Settings > Developer settings > Personal access tokens**
3. Click on **Generate new token** button



4. Enter a descriptive text in **Note** input field, to uniquely identify the token
5. Select **repo** checkbox
6. Click on **Generate token** button
7. Copy the generated personal access token value, and use this secret to access GitHub repository from Jenkins

16.3 Jenkinsfile

1. Create a file called **Jenkinsfile**
2. Add following contents

```
pipeline { agent any stages { stage('Build') { steps { echo 'Building..' } } stage('Test') { steps { echo 'Testing..' } } stage('Deploy') { steps { ec
```

16.4 Jenkins Server

1. In a separate folder, create a **Dockerfile** with following contents

```
FROM jenkins/jenkins:lts USER root RUN mkdir -p /tmp/download && \ curl -L https://download.docker.com/linux/static/stable/x86_64/docker-18.03.1-ce.tg
```

2. Build Jenkins Docker image

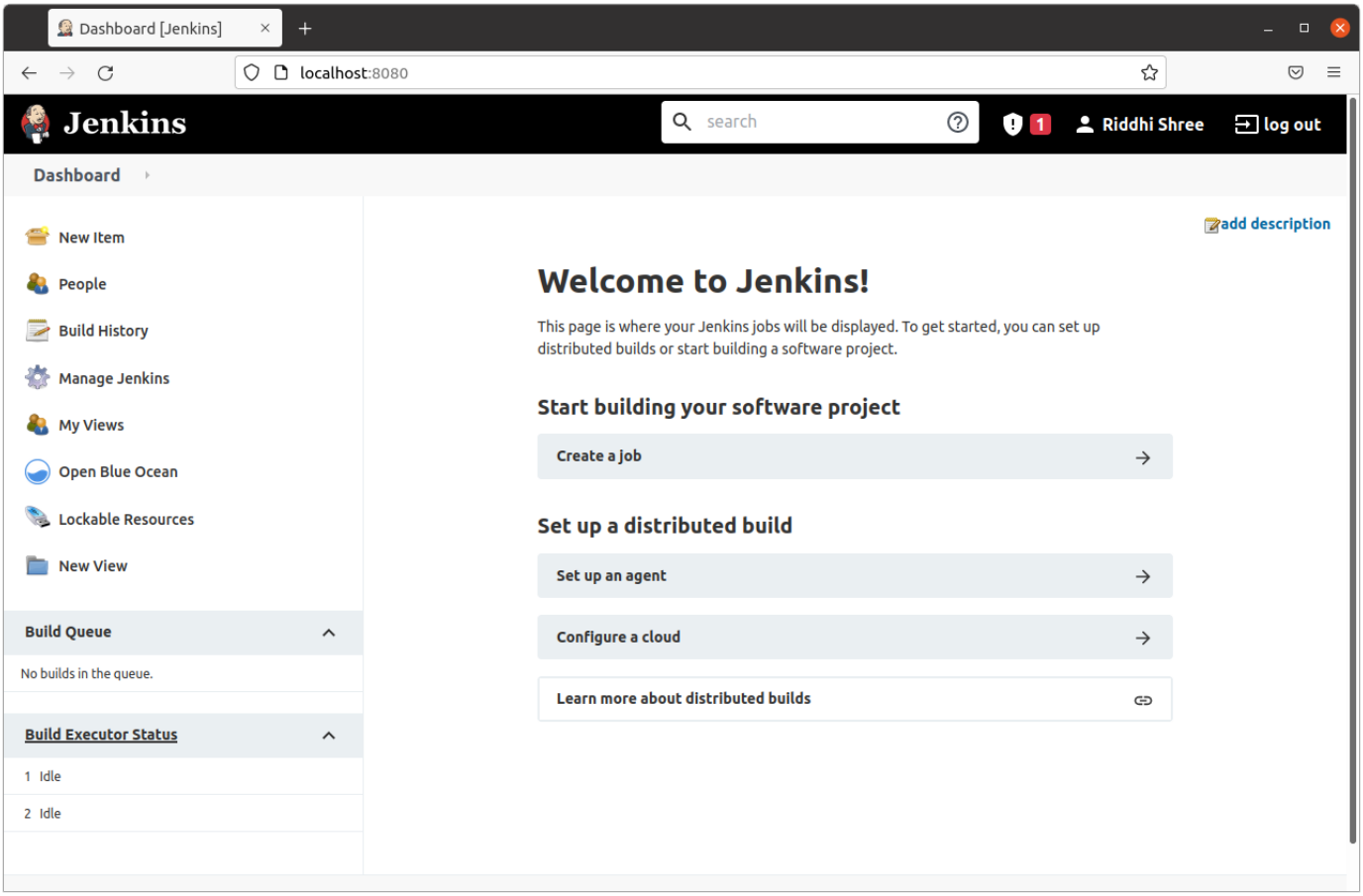
```
docker build -t jenkins-docker .
```

3. Run following commands to successfully start the Jenkins server

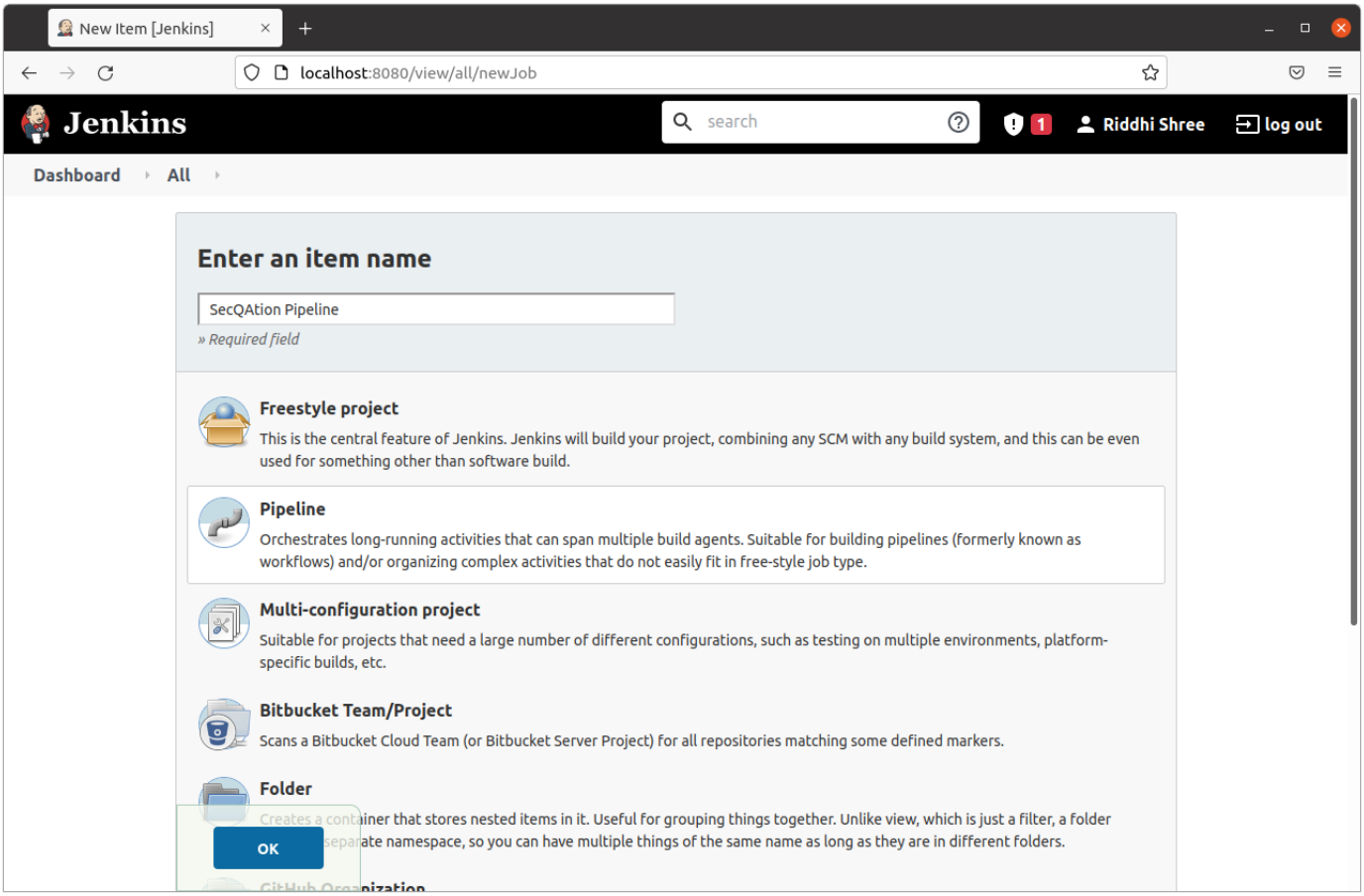
```
$ mkdir -p /var/jenkins_home $ chown -R 1000:1000 /var/jenkins_home/ $ docker run -p 8080:8080 -p 50000:50000 -v /var/jenkins_home:/var/jenkins_home -
```

```
secqation@mirage:~/Desktop/NullconTraining2021/4-example-docker/3-jenkins$ docker ps -a
CONTAINER ID   IMAGE            COMMAND                  CREATED       STATUS       PORTS
                                                                    NAMES
a67458de0da3   jenkins-docker   "/sbin/tini -- /usr/…"   3 hours ago   Up 3 hours   0.0.0.0:8080->8080/tcp,
 :::8080->8080/tcp, 0.0.0.0:50000->50000/tcp, :::50000->50000/tcp   jenkins
```

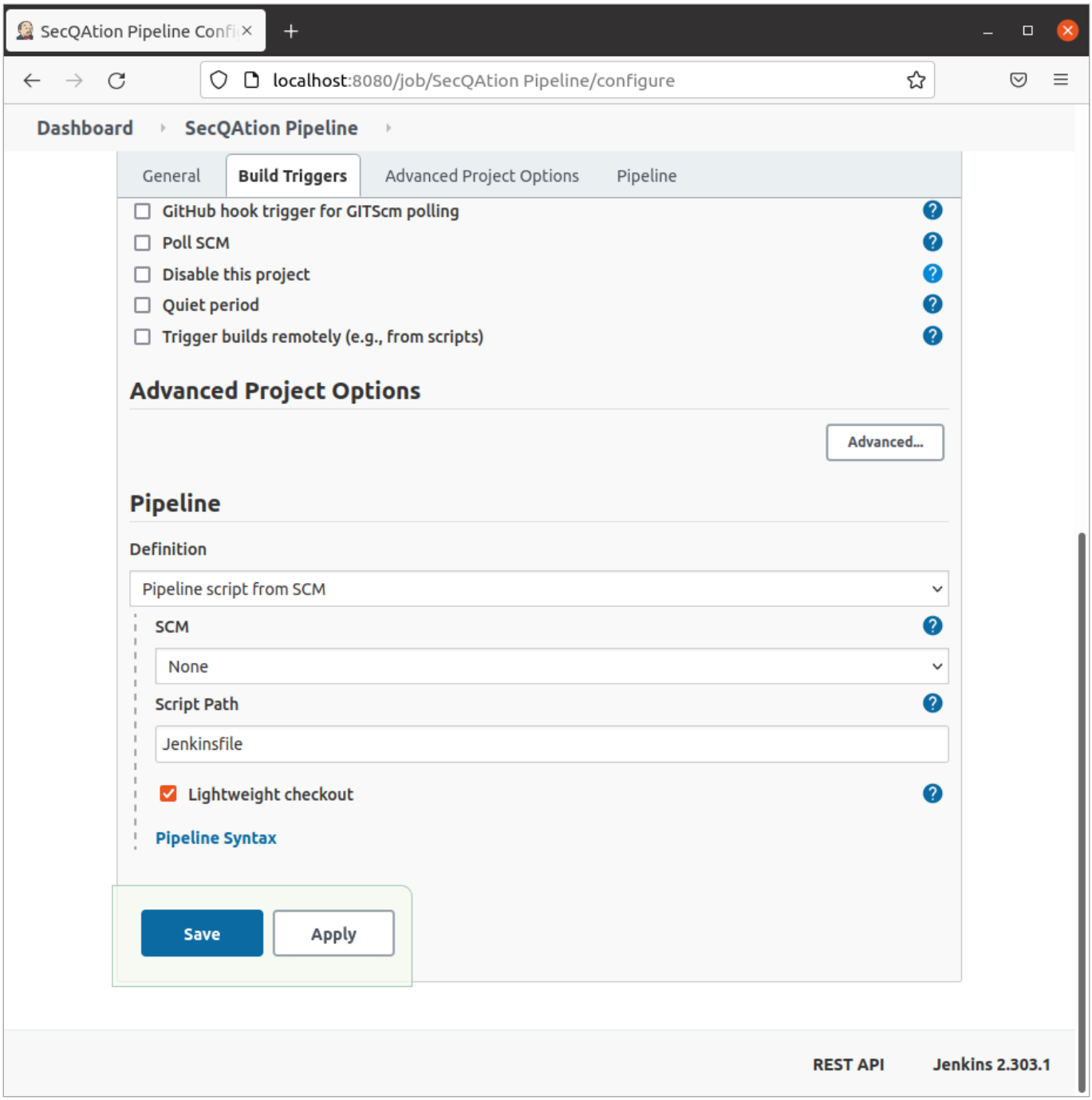
4. Navigate to http://localhost:8080/



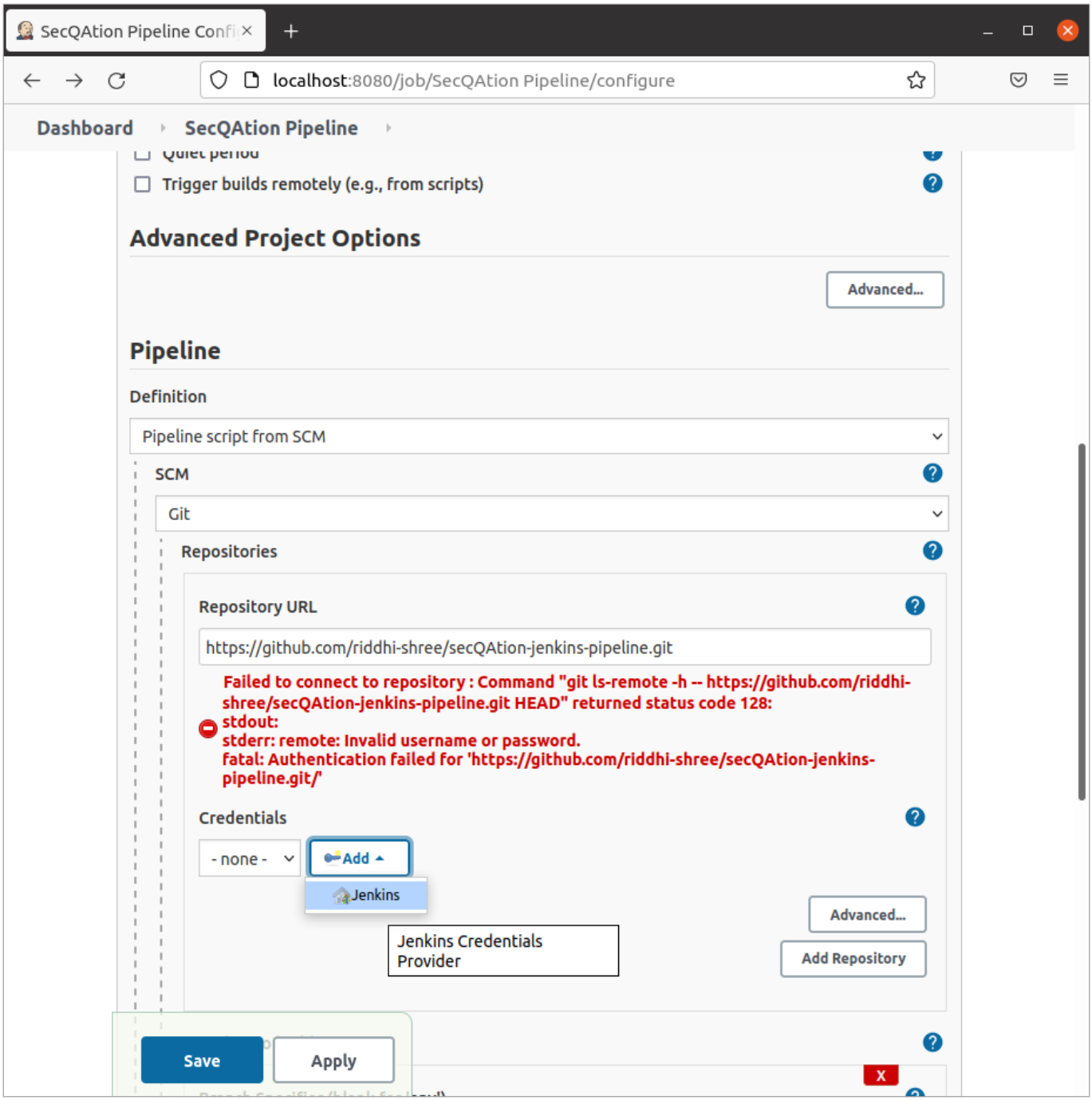
5. Click on **New Item** option in left navigation menu
6. Enter an item name, e.g., `SecQAtion`
7. Select **Pipeline** option, and click **OK**



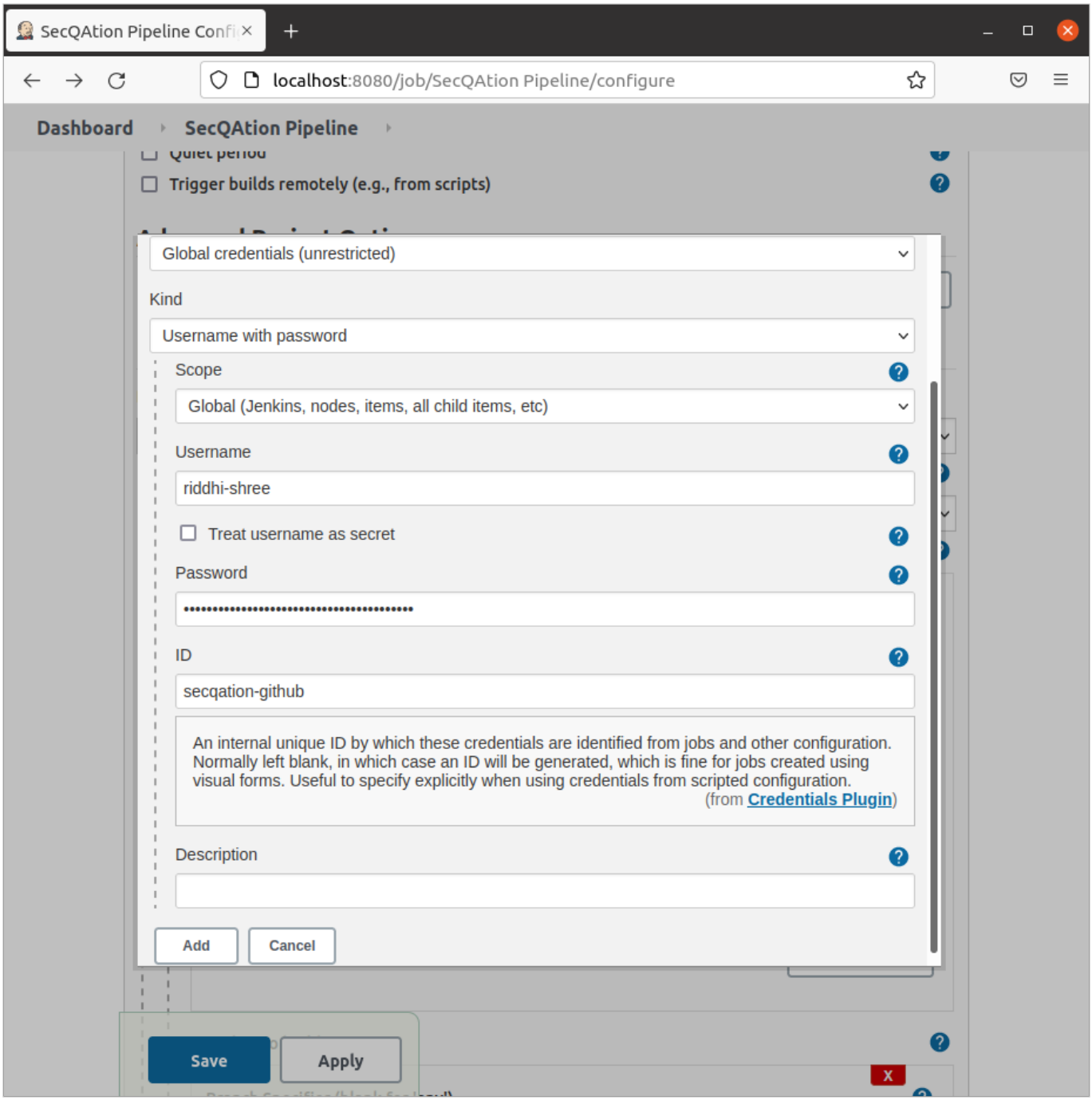
8. Scroll down to **Advanced Project Options** > **Pipeline** 9. Select `Pipeline script from SCM` option in **Definition** dropdown list



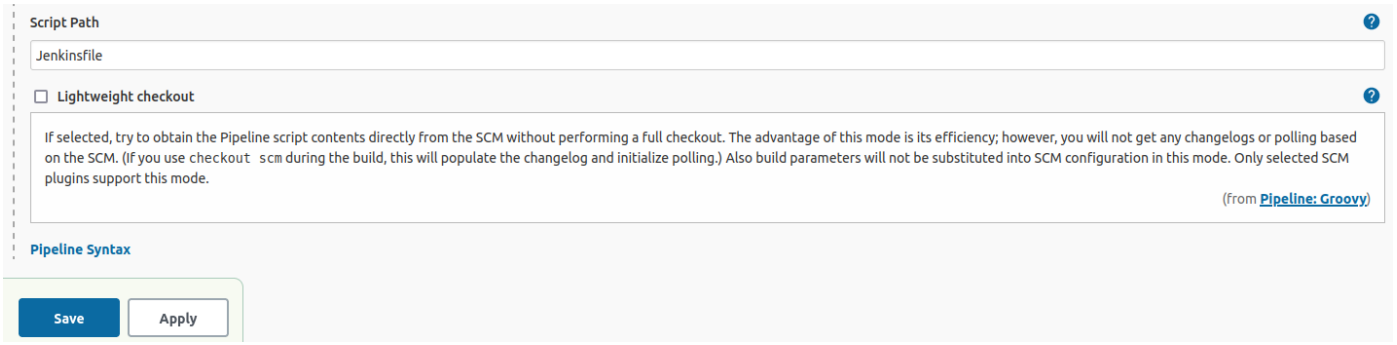
10. From **SCM** dropdown, select `Git` option 11. Enter your Git repository URL, e.g., `https://github.com/riddhi-shree/secQAtion-jenkins-pipeline.git`



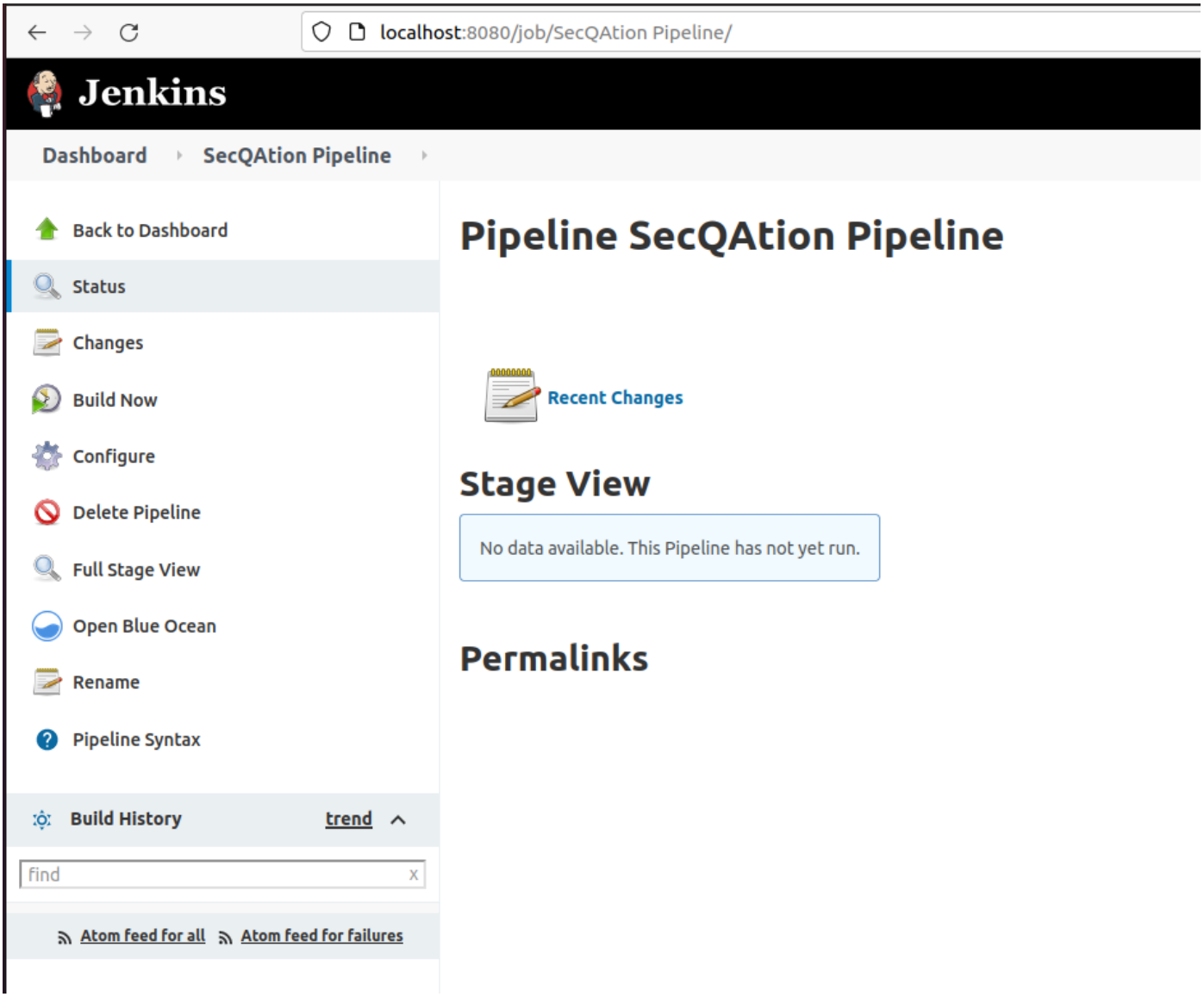
12. Select **Credentials** > **Add** > **Jenkins** 13. Enter GitHub username 14. Enter your GitHub **Personal Access Token** in **Password** field 15. Enter a unique name in **ID** field, e.g. `secqation-github`



8. Validate **Script Path** that specifies path to the **Jenkinsfile** in GitHub repository
9. Uncheck **Lightweight checkout** checkbox



10. Click on **Apply** button
11. Click on **Save** button



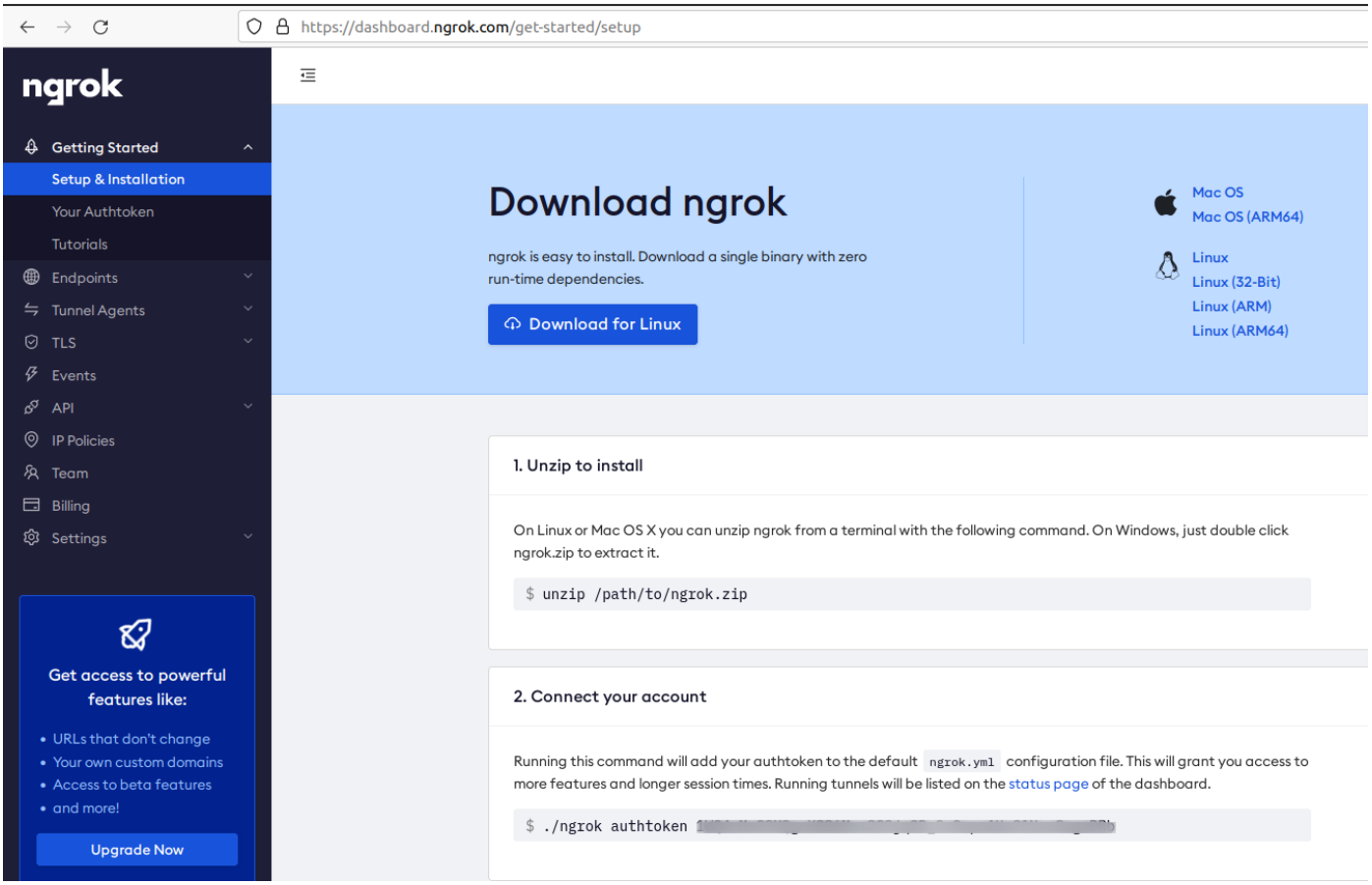
16.5 ngrok

1. Download ngrok

2. Unzip ngrok

```
unzip /path/to/ngrok.zip
```

3. Sign up and login to ngrok dashboard



4. Copy your authtoken
5. Connect your account

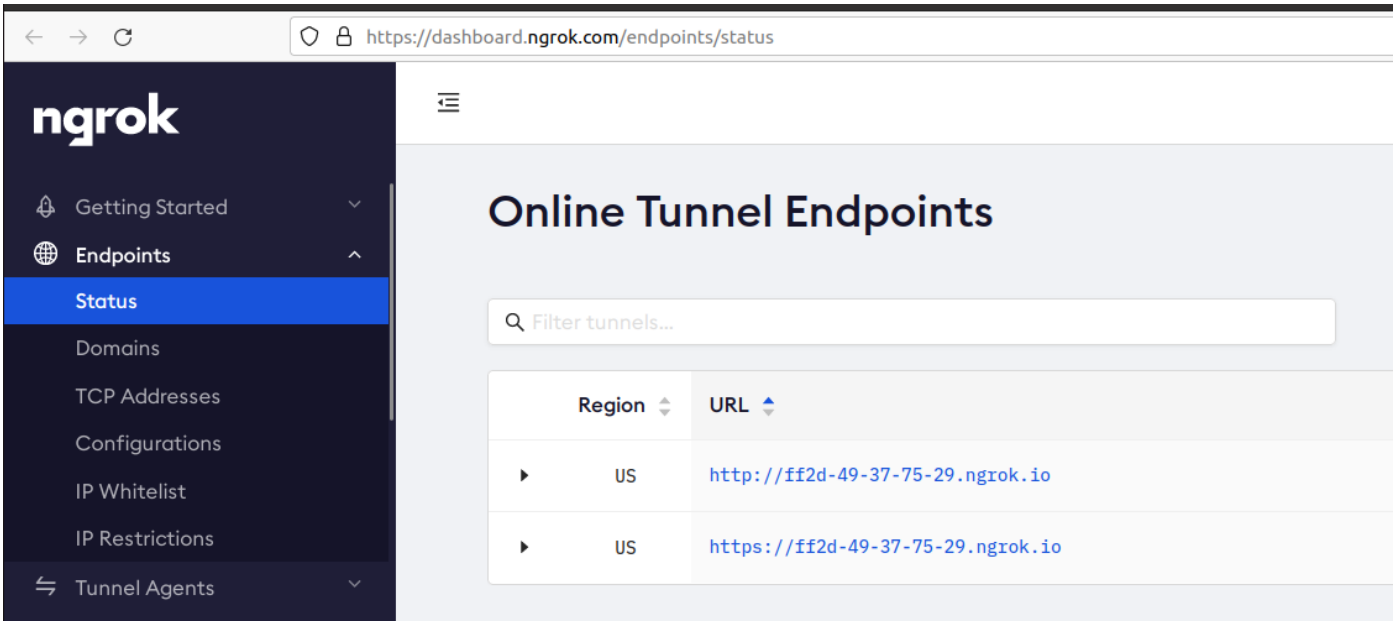
```
./ngrok authtoken <your_auth_token>
```

6. Start a HTTP tunnel forwarding to your local port 8080 (where Jenkins server is running)

```
./ngrok http 8080
```

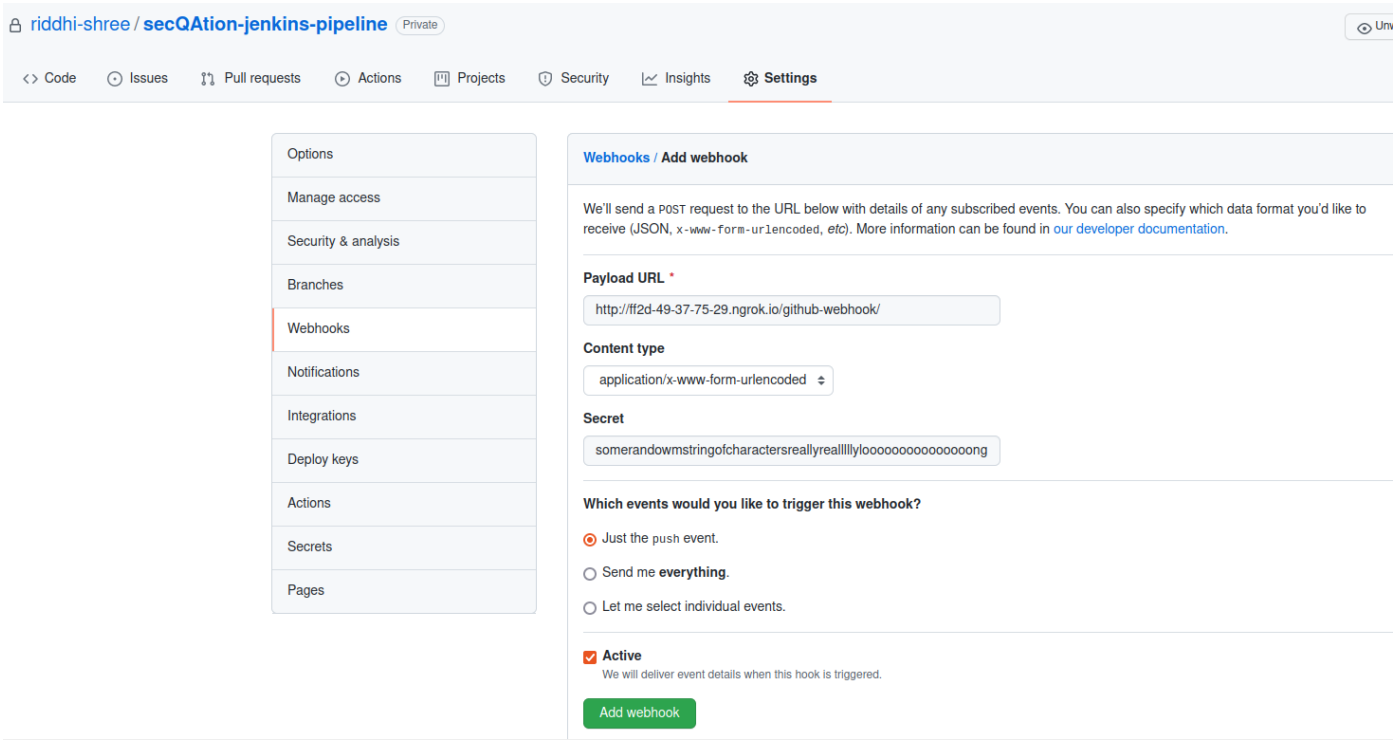
```
ngrok by @inconshreveable

Session Status                online
Account                       Riddhi Shree (Plan: Free)
Version                       2.3.40
Region                        United States (us)
Web Interface                 http://127.0.0.1:4040
Forwarding                    http://ff2d-49-37-75-29.ngrok.io -> http://localhost:8080
Forwarding                    https://ff2d-49-37-75-29.ngrok.io -> http://localhost:8080

Connections                   ttl     opn     rt1     rt5     p50     p90
                              12      0       0.00    0.00    7.38    10.58

HTTP Requests
-------------

POST /github-webhook/                                                  200 OK
POST /github-webhook/                                                  200 OK
GET  /static/89c5c2ca/images/rage.png                                  200 OK
GET  /static/89c5c2ca/favicon.ico                                      200 OK
GET  /static/89c5c2ca/images/material-icons/svg-sprite-action-symbol.svg 200 OK
GET  /static/89c5c2ca/images/jenkins-header-logo-v2.svg                200 OK
GET  /static/89c5c2ca/images/title.png                                 200 OK
GET  /adjuncts/89c5c2ca/lib/layout/breadcrumbs.js                      200 OK
```

7. Take a note of the **forwarding URL**, e.g., `http://ff2d-49-37-75-29.ngrok.io`

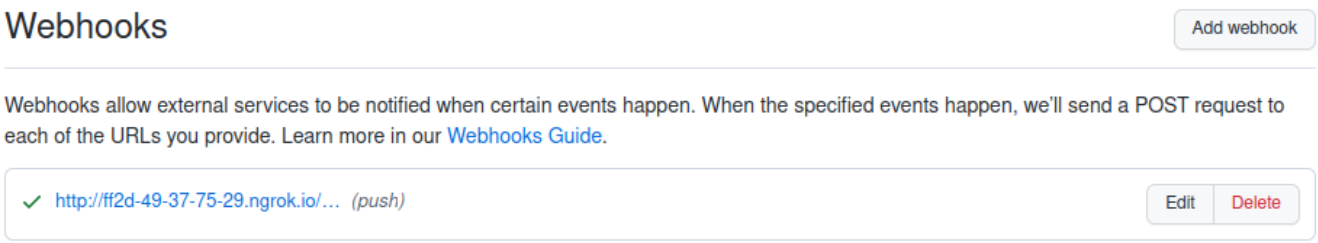


16.6 Webhook

1. Login to your GitHub account
2. Go to the project repository
3. Click on **Settings** > **Webhooks** > **Add webhook**
4. Enter payload URL, e.g. `http://ff2d-49-37-75-29.ngrok.io/github-webhook`

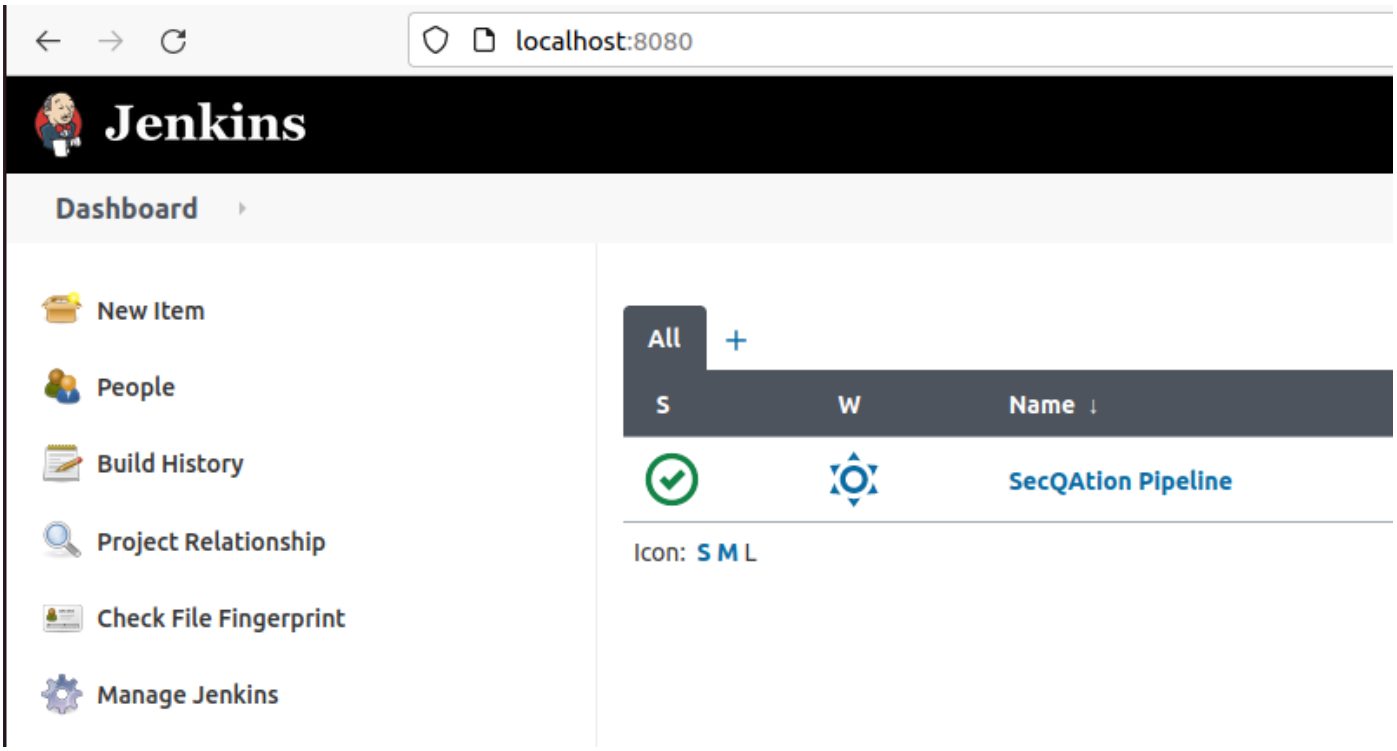


Note: Appending the URL path `/github-webhook` to ngrok forwarding URL (e.g., `http://ff2d-49-37-75-29.ngrok.io`) will give us the **Payload URL** for GitHub webhook 5. Optionally, enter a **Secret** 6. Select **Just the push event** option 7. Click on **Add webhook** button

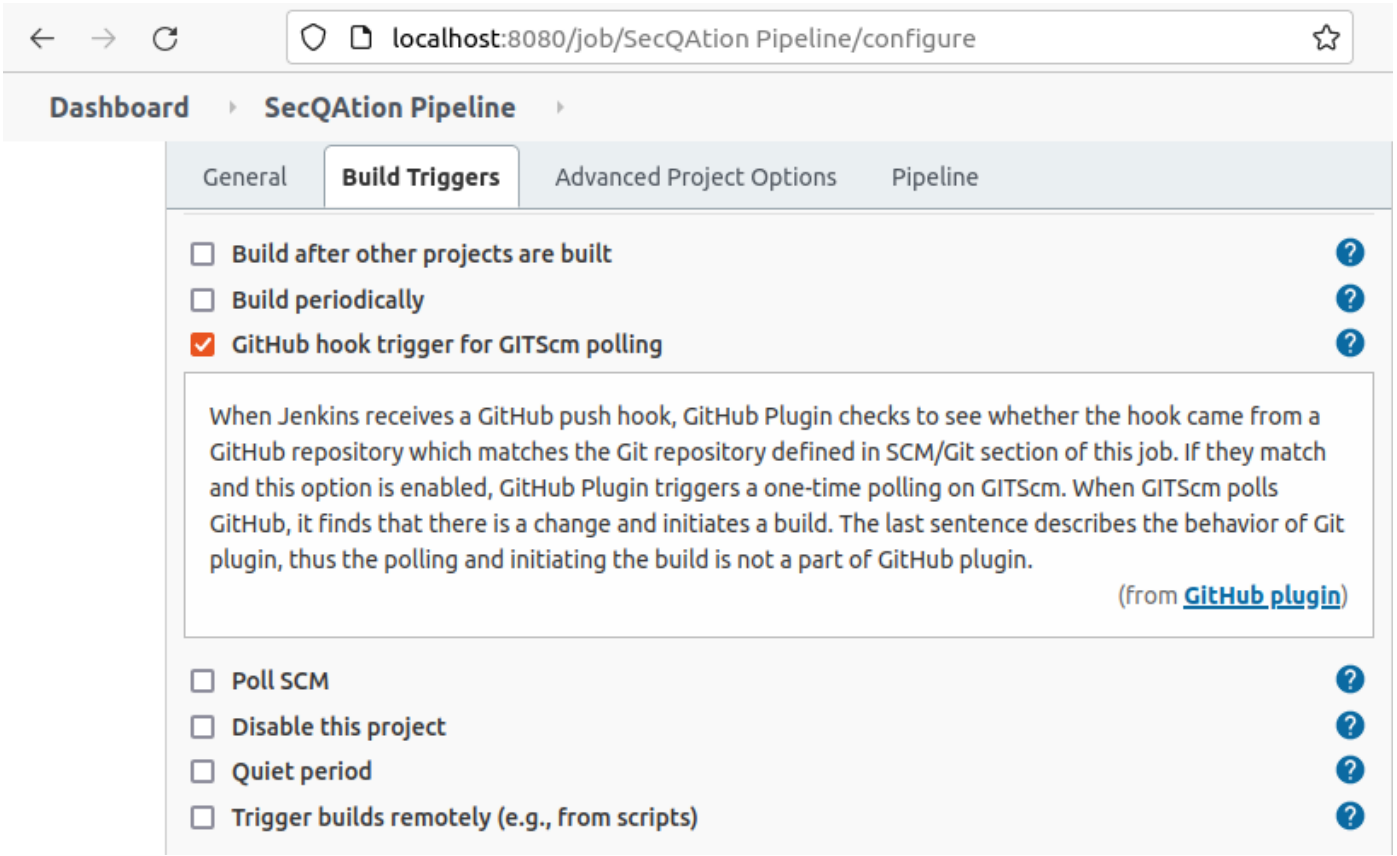


16.7 Configure Build Trigger

1. Login to Jenkins server
2. Select your pipeline from the Dashboard



3. Click on **Configure > Build Triggers**
4. Select the option **GitHub hook trigger for GITScm polling**



5. Click on **Save** button

16.8 Git Commit

1. Open a terminal and navigate to your local Git repository

```
cd /home/secqation/Desktop/NullconTraining2021/6-example-jenkins
```

2. Modify the **echo** command in **Jenkinsfile** (just for testing purpose)

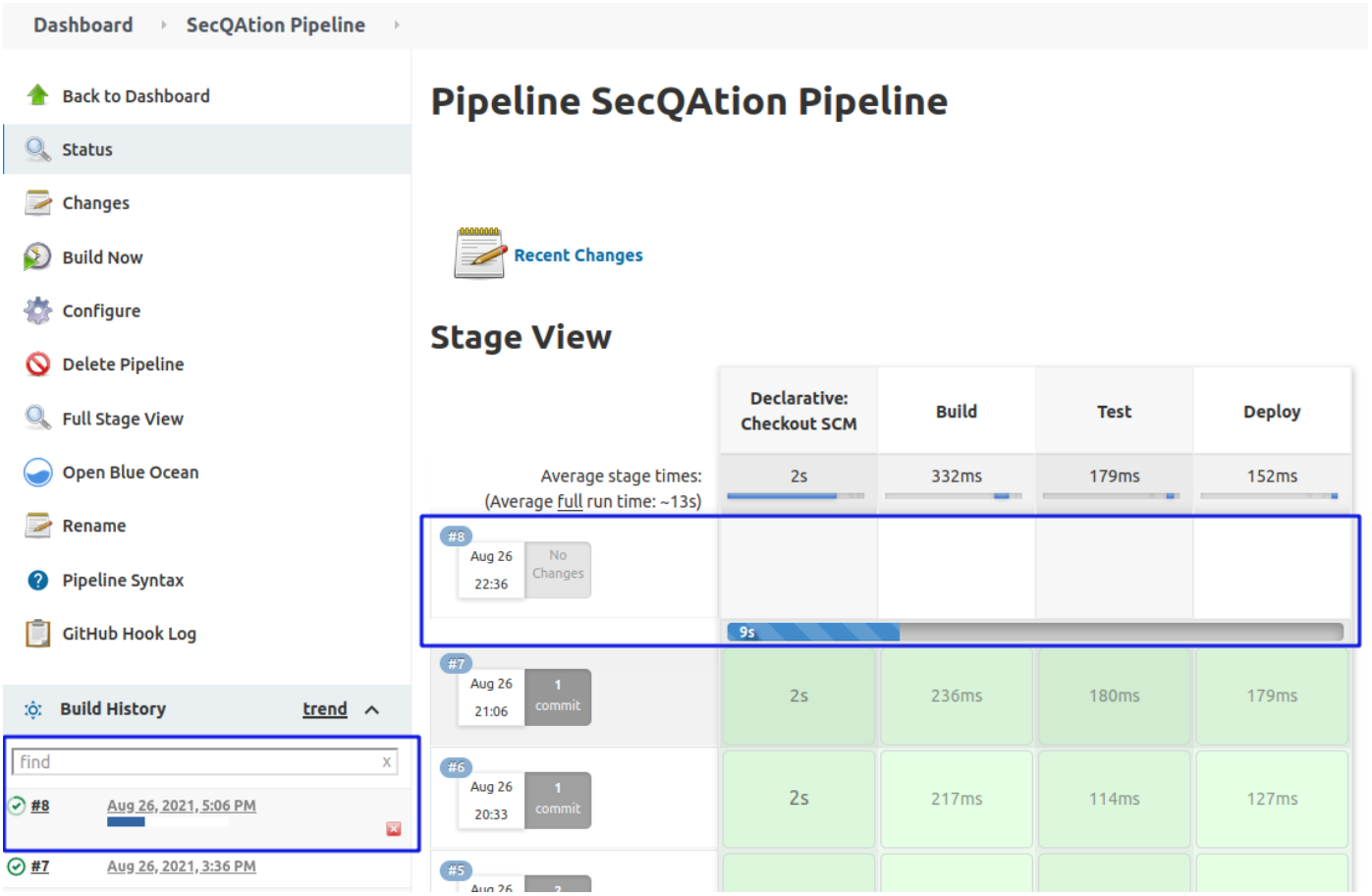
```
pipeline { agent any stages { stage('Build') { steps { echo 'Building..' echo 'Added webhook. Testing connection!!!' } } stage('Test') { steps { echo
```

3. Push the changes to remote GitHub repository

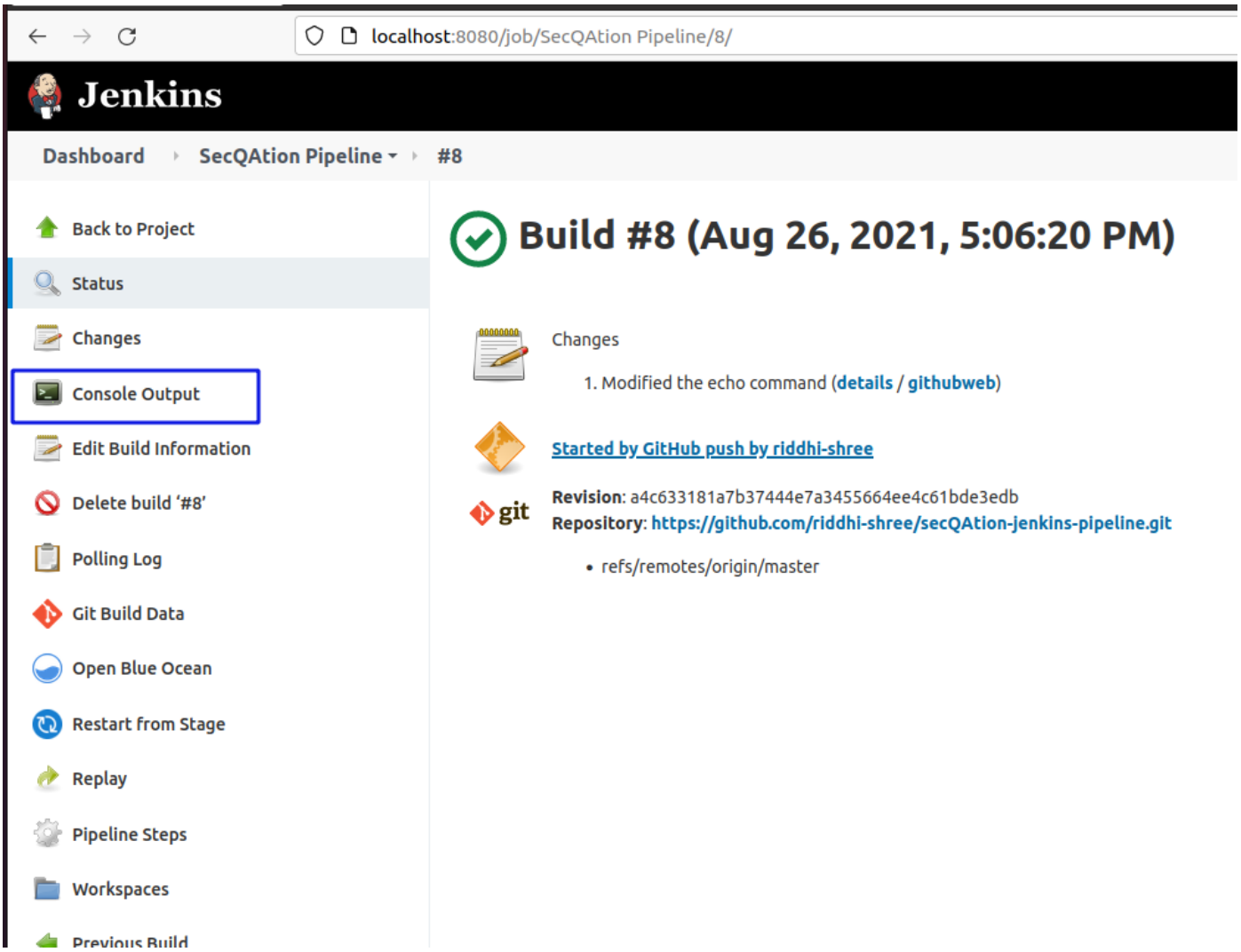
```
$ git add . $ git status $ git commit -m "Your comment" $ git push
```

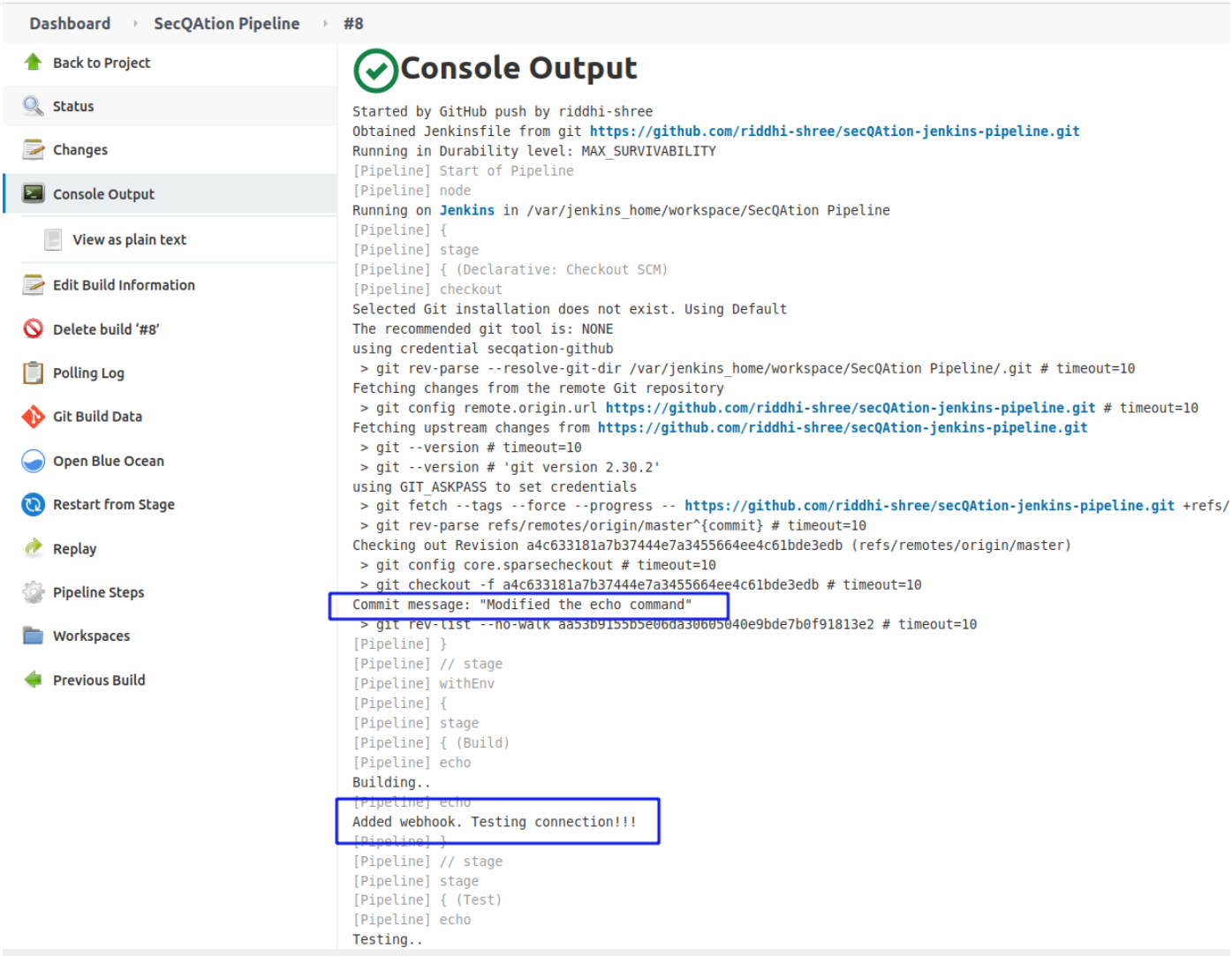
```
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   Jenkinsfile

no changes added to commit (use "git add" and/or "git commit -a")
secqation@mirage:~/Desktop/NullconTraining2021/6-example-jenkins$ tree
.
├── Jenkinsfile
└── README.md

0 directories, 2 files
secqation@mirage:~/Desktop/NullconTraining2021/6-example-jenkins$ git add .
secqation@mirage:~/Desktop/NullconTraining2021/6-example-jenkins$ git status
On branch master
Your branch is up to date with 'origin/master'.

Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        modified:   Jenkinsfile

secqation@mirage:~/Desktop/NullconTraining2021/6-example-jenkins$ git commit -m "Modified the echo command"
[master a4c6331] Modified the echo command
 1 file changed, 1 insertion(+), 1 deletion(-)
secqation@mirage:~/Desktop/NullconTraining2021/6-example-jenkins$ git push
```

4. Notice that a new build is triggered automatically



5. Click on the **build number**
6. Click on **Console Output**


localhost:8080/job/SecQAtion Pipeline/8/
Jenkins
Dashboard
SecQAtion Pipeline
#8
Back to Project
Status
Changes
Console Output
Edit Build Information
Delete build '#8'
Polling Log
Git Build Data
Open Blue Ocean
Restart from Stage
Replay
Pipeline Steps
Workspaces
Previous Build
Build #8 (Aug 26, 2021, 5:06:20 PM)
Changes
1. Modified the echo command (details / githubweb)
Started by GitHub push by riddhi-shree
git
Revision: a4c633181a7b37444e7a3455664ee4c61bde3edb
Repository: https://github.com/riddhi-shree/secQAtion-jenkins-pipeline.git
refs/remotes/origin/master



16.9 Triggering Robot Test Case Execution

We can now succesfully trigger a build in Jenkins for every `git push` event in GitHub. So, what's pending then? We are yet to execute the automated test cases and fetch test results.

The final **folder structure** of our Git repository might look similar to following:

```
secqation@mirage:~/Desktop/NullconTraining2021/6-example-jenkins$ tree
.
├── demo-test-suite
│   └── demo.robot
├── docker-compose.yml
├── Dockerfile
├── healthcheck.sh
├── init.sh
├── Jenkinsfile
└── README.md
```

Let's confirm the contents of each file at this point.

16.9.1 demo.robot

```
*** Settings *** Library SeleniumLibrary *** Variables *** ${BASE_URL} = http
```

16.9.2 docker-compose.yml

```
version: "3.9" services: firefox_1: image: selenium/node-firefox:4.0.0-rc-1-p
```

16.9.3 Dockerfile

```
FROM python:3.9.5-alpine3.13 LABEL maintainer="Riddhi Shree" ENV PYTHONUNBUFF
```

16.9.4 healthcheck.sh

```
#!/usr/bin/env bash echo "Checking if hub is ready - $HUB_HOSTNAME" while [[
```

16.9.5 init.sh

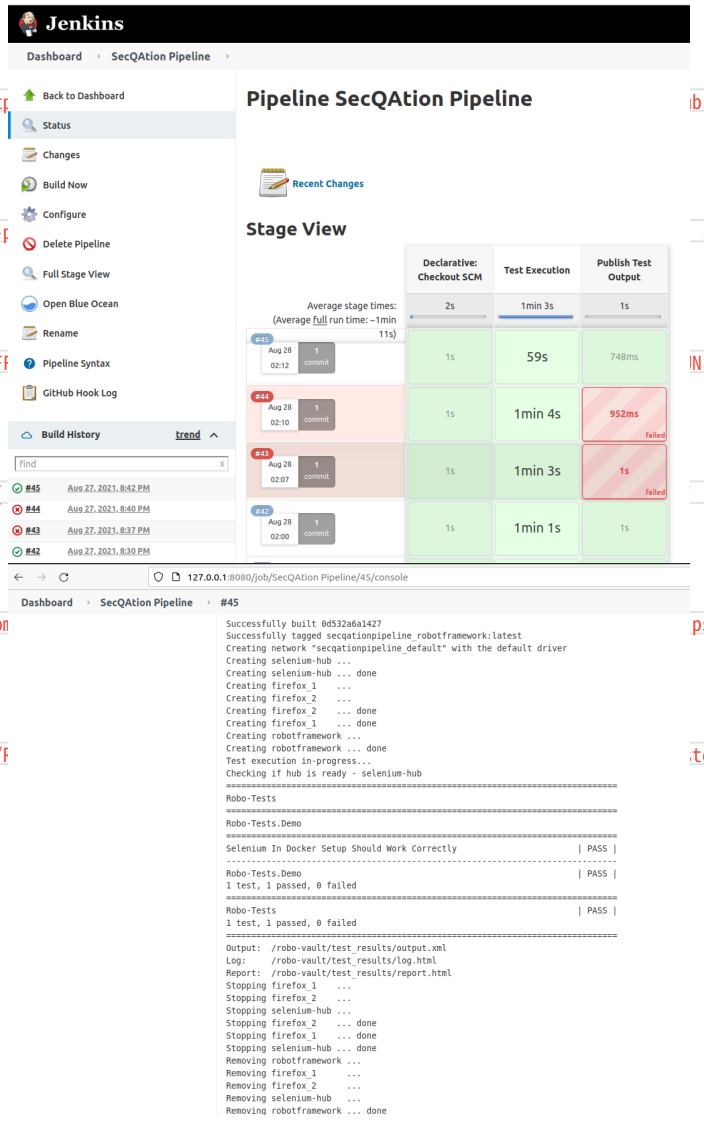
```
docker-compose down docker rm `docker ps -aq` docker-compose build docker-com
```

16.9.6 Jenkinsfile

```
pipeline { agent any stages { stage('Test Execution') { steps { sh 'rm -r ./F
```

16.9.7 View Build Output

Once a new commit is pushed to remote **GitHub** repository, a build is triggered in Jenkins server. Steps mentioned in **Jenkinsfile** get executed.



Note: To run this example yourself, look at the code available at location `/home/secqation/Desktop/NullconTraining2021/6-example-jenk`

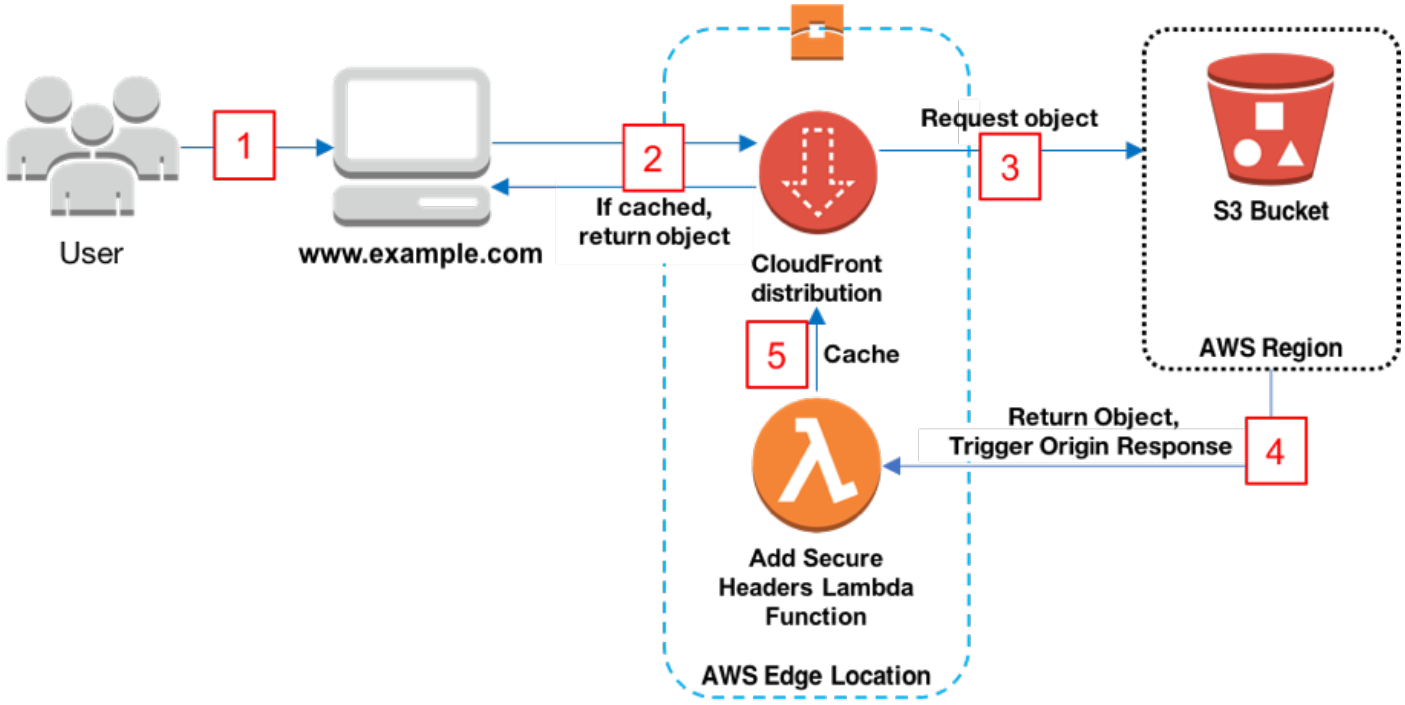
16.10 What's next?

How do we view the detailed test results...

16.11 References

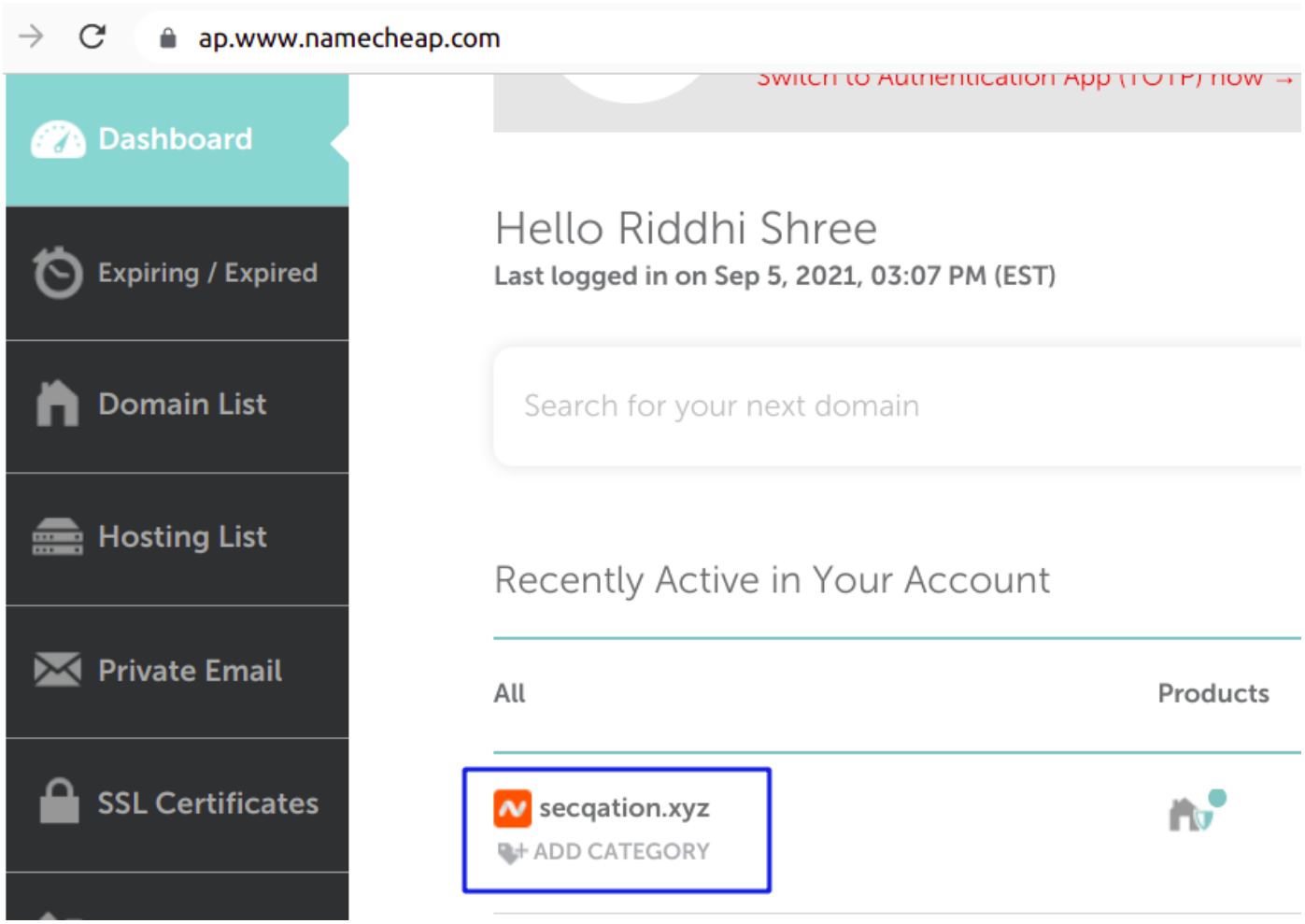
- `https://blog.knoldus.com/opsinit-adding-a-github-webhook-in-jenkins-pipeline/`
- `https://github.com/`
- `https://ngrok.com/download`
- `https://dashboard.ngrok.com/login`
- `https://dashboard.ngrok.com/get-started/setup`

17. Serving test report via S3 and CloudFront

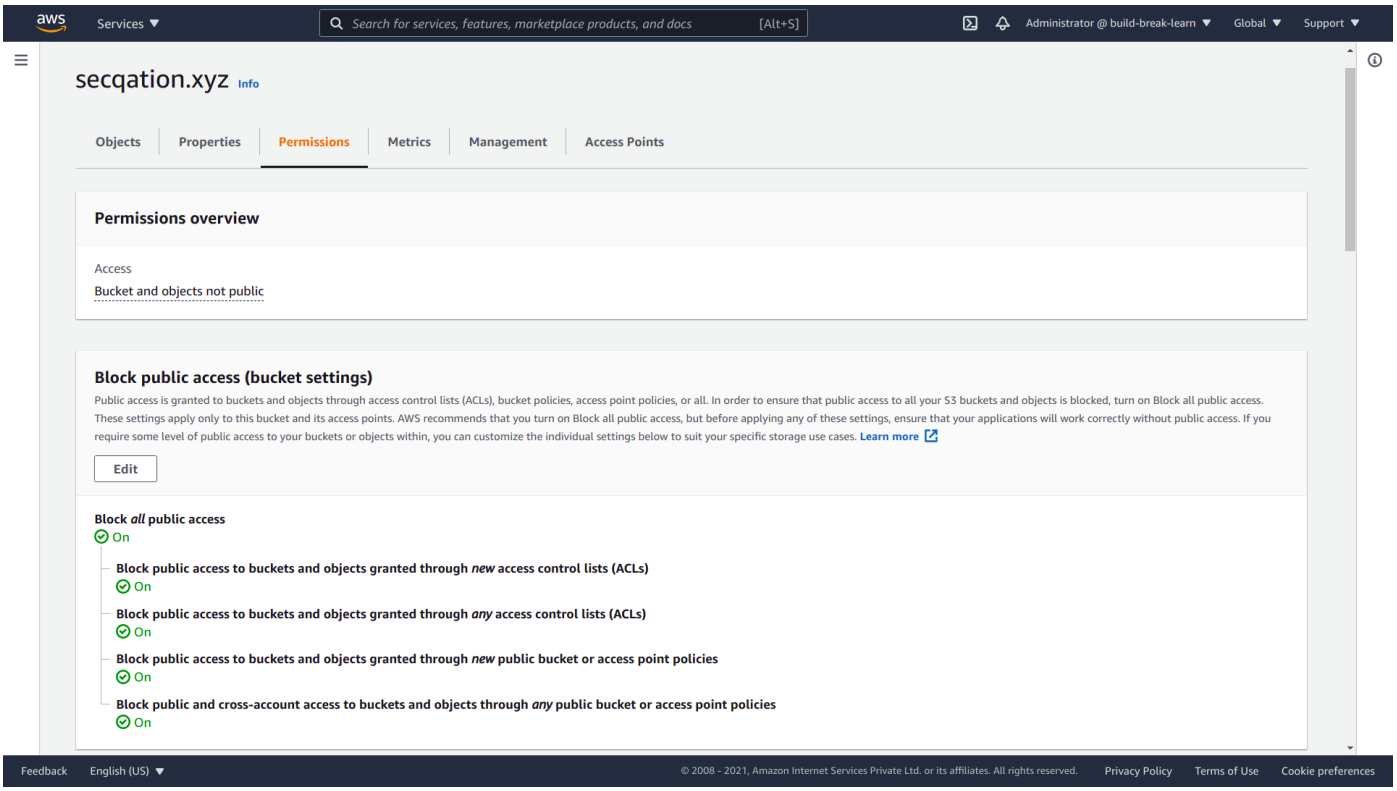


17.1 Steps

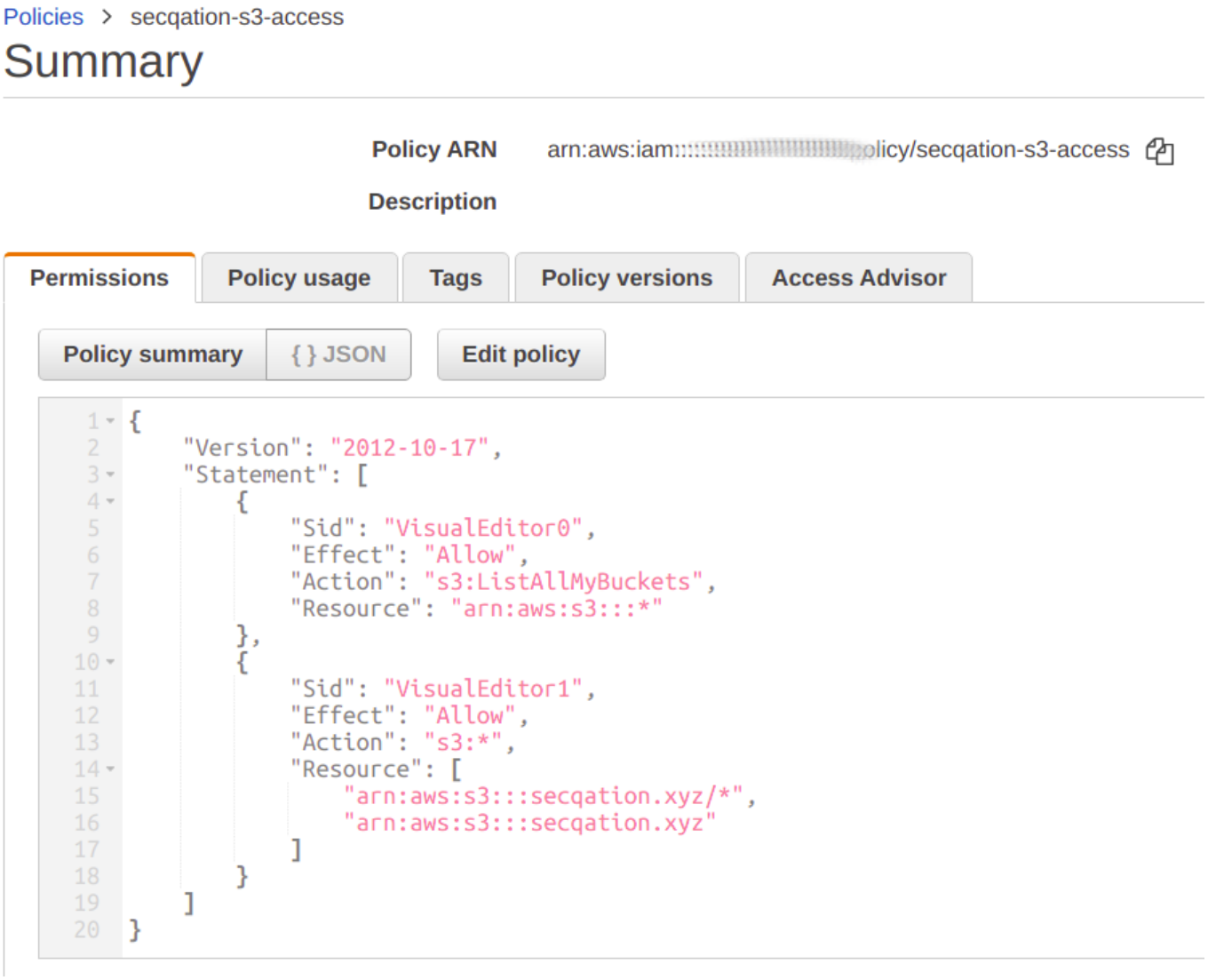
1. Purchase a **domain name** (e.g., `secqation.xyz`)



2. Create a private S3 bucket, having same name as the purchased domain name (i.e., `secqation.xyz`)



3. Create an **IAM user** having permission to upload files to S3 bucket

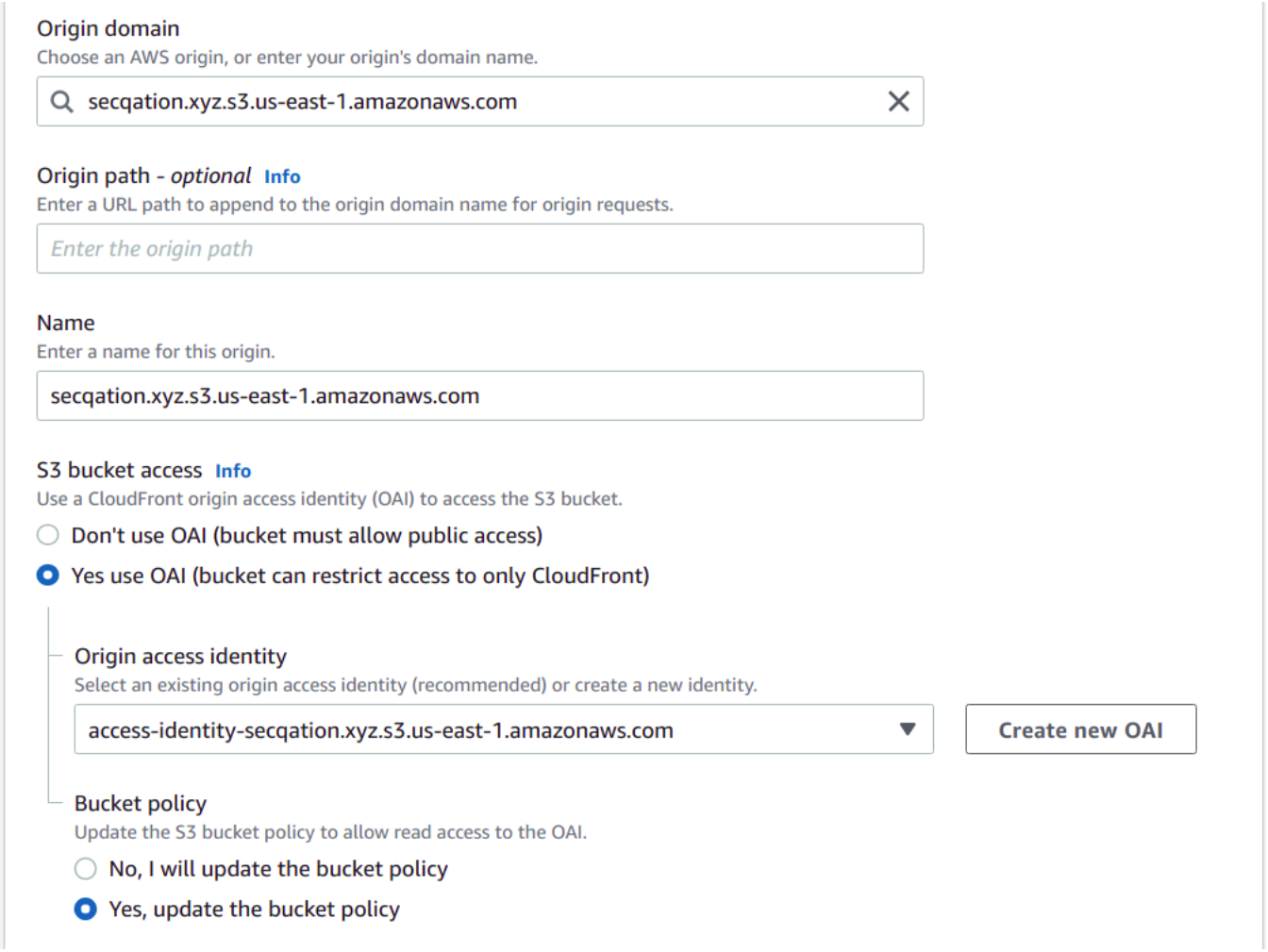


17.2 CloudFront

1. Login to AWS account
2. Got to CloudFront console
3. Click on **Create Distribution** button

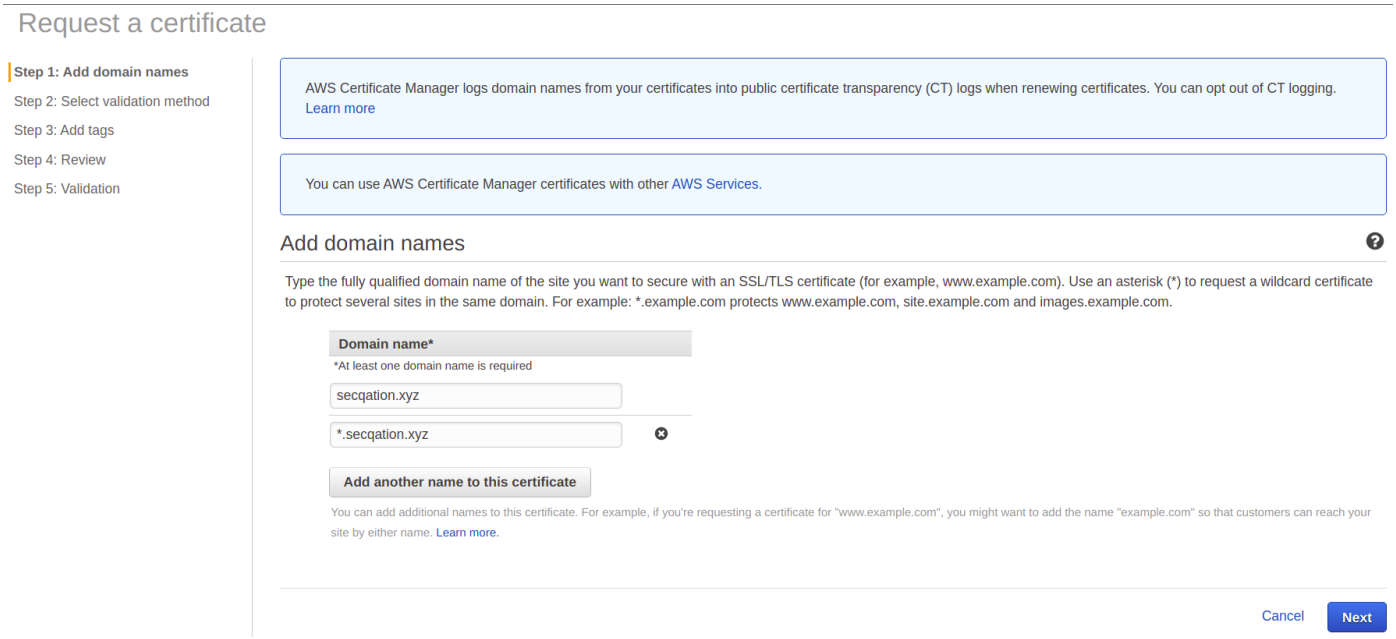
4. Fill the create distribution form:

    1. Origin Domain: Choose your **S3 bucket** from dropdown list
    2. S3 bucket access: Select **Yes use OAI (bucket can restrict access to only CloudFront)**
    3. Click on **Create new OAI > Create**
    4. Bucket policy: Select **Yes, update the bucket policy**

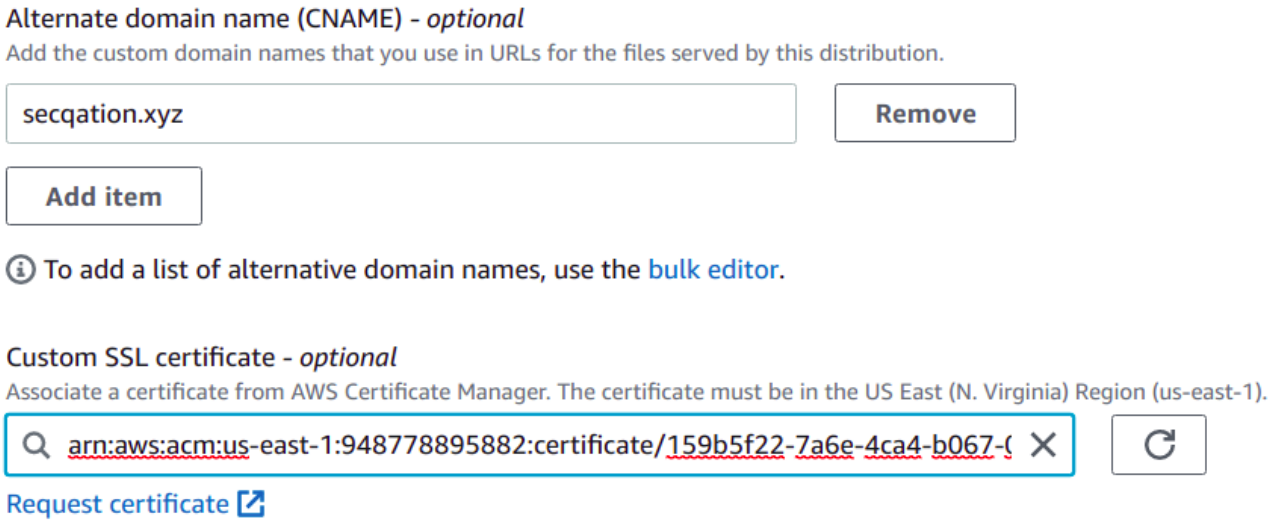


    5. Viewer protocol policy: Select **Redirect HTTP to HTTPS**
    6. Allowed HTTP methods: Select **GET, HEAD**

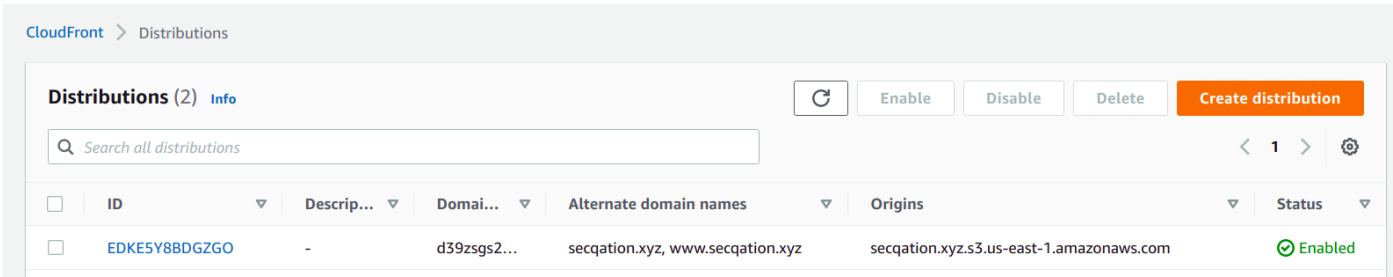
5. Scroll down to "Settings" and select an option (e.g., **Use North America, Europe, Asia, Middle East, and Africa**)
6. Select **Alternate domain name (CNAME) >> Add item**, and enter target domain name (e.g., `secqation.xyz`)
7. Select **Custom SSL certificate >> Request certificate**



8. Fill and submit the "Request a certificate" form
9. Return to "Create distribution" form
10. In the **Custom SSL certificate** dropdown field, select the cetificate that was just created.

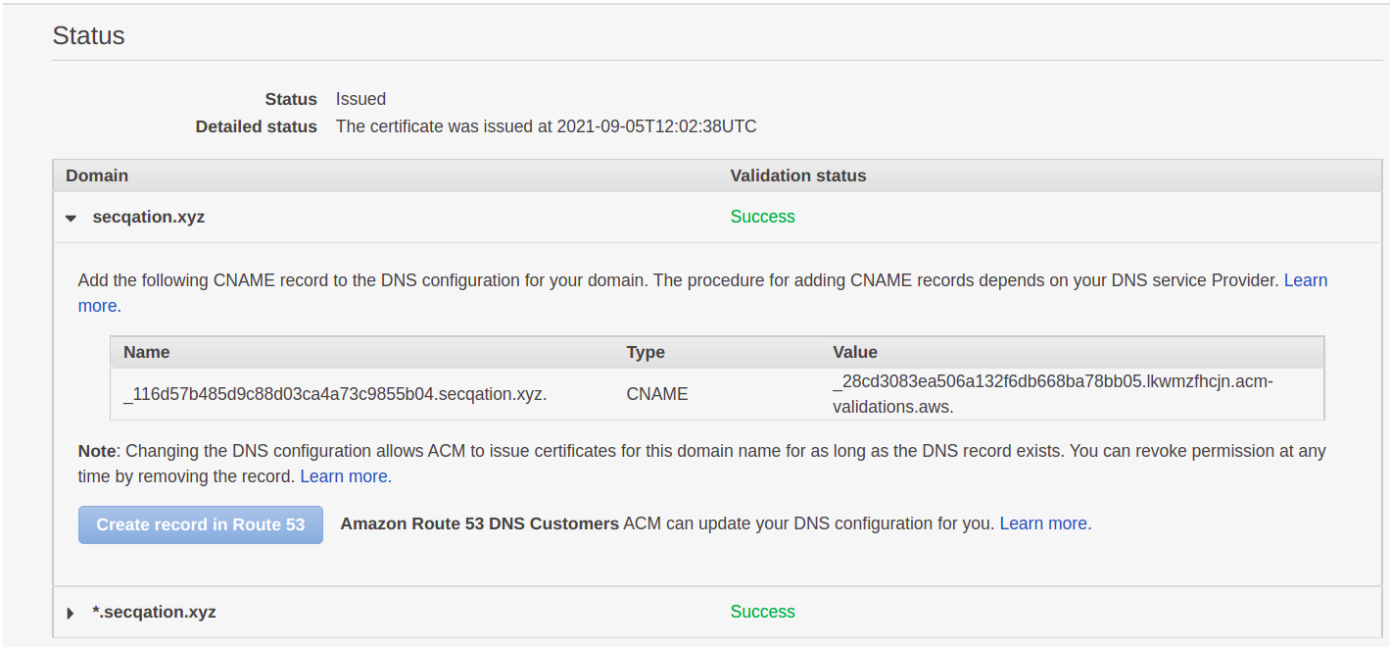


11. Click on **Create Distribution** button
12. Wait until the CloudFront distribution creation status becomes **Enabled**

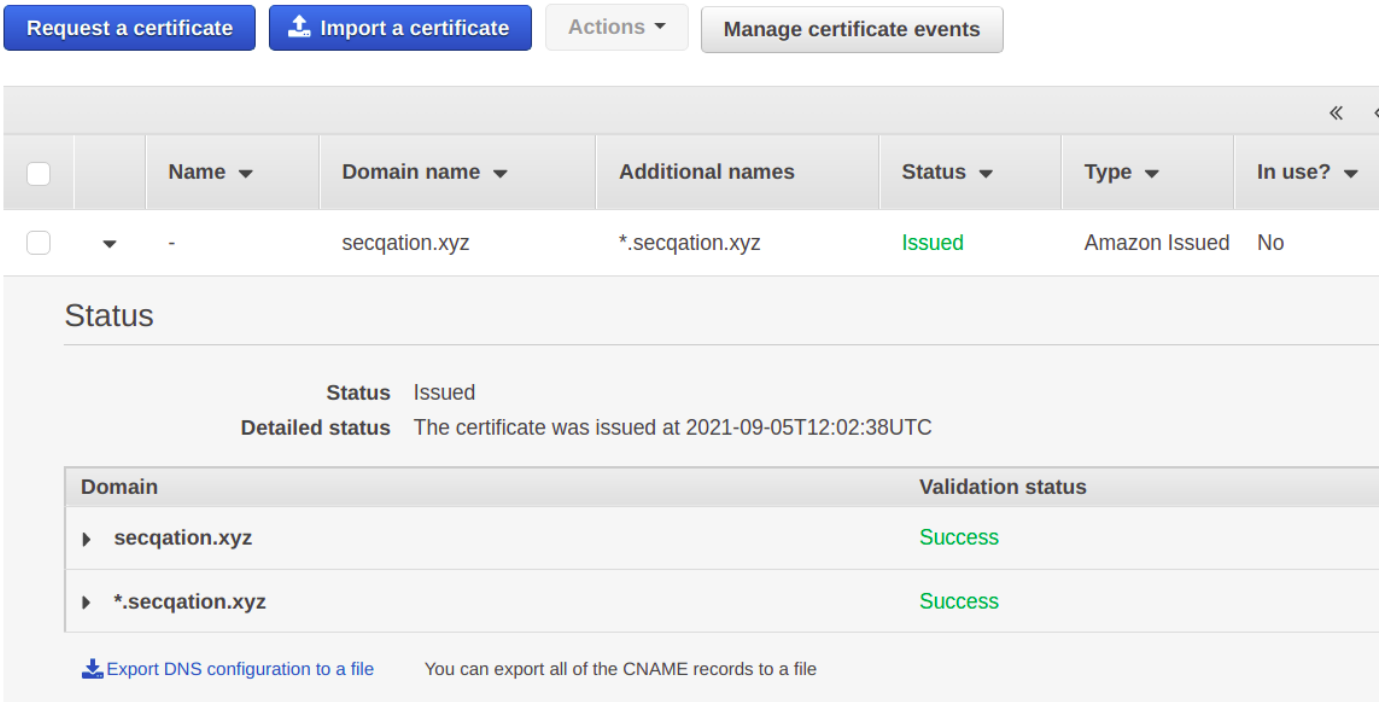


17.3 Hosted Zone

1. When a certificate is issued for a domain, user is required to add a CNAME record to their domain to prove the domain ownership.

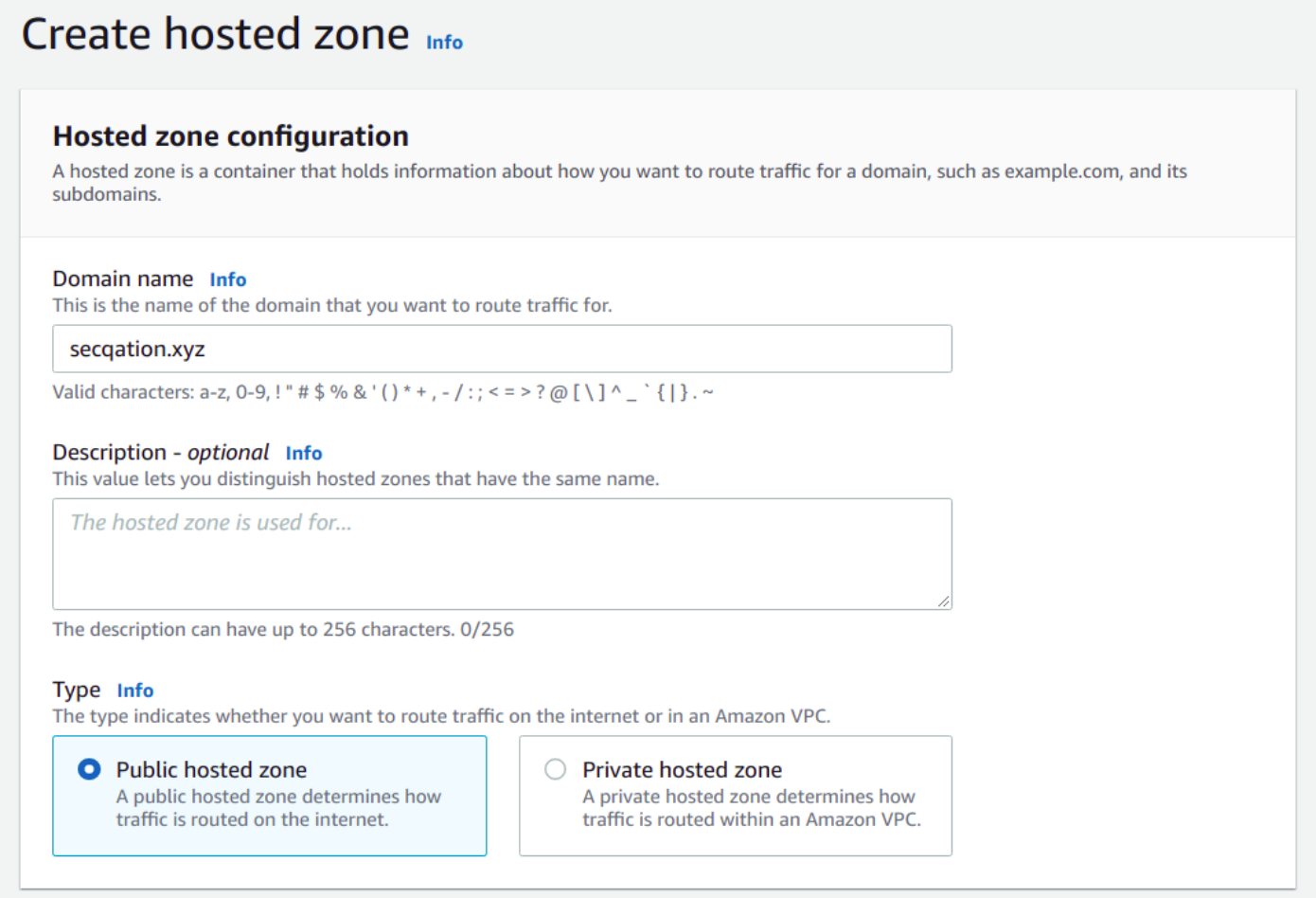


2. After the CNAME record is added successfully to the domain, it takes a while to update the DNS validation status in AWS. Wait until the "Validation status" shows as **Success**, and certificate status shows as **Issued**.

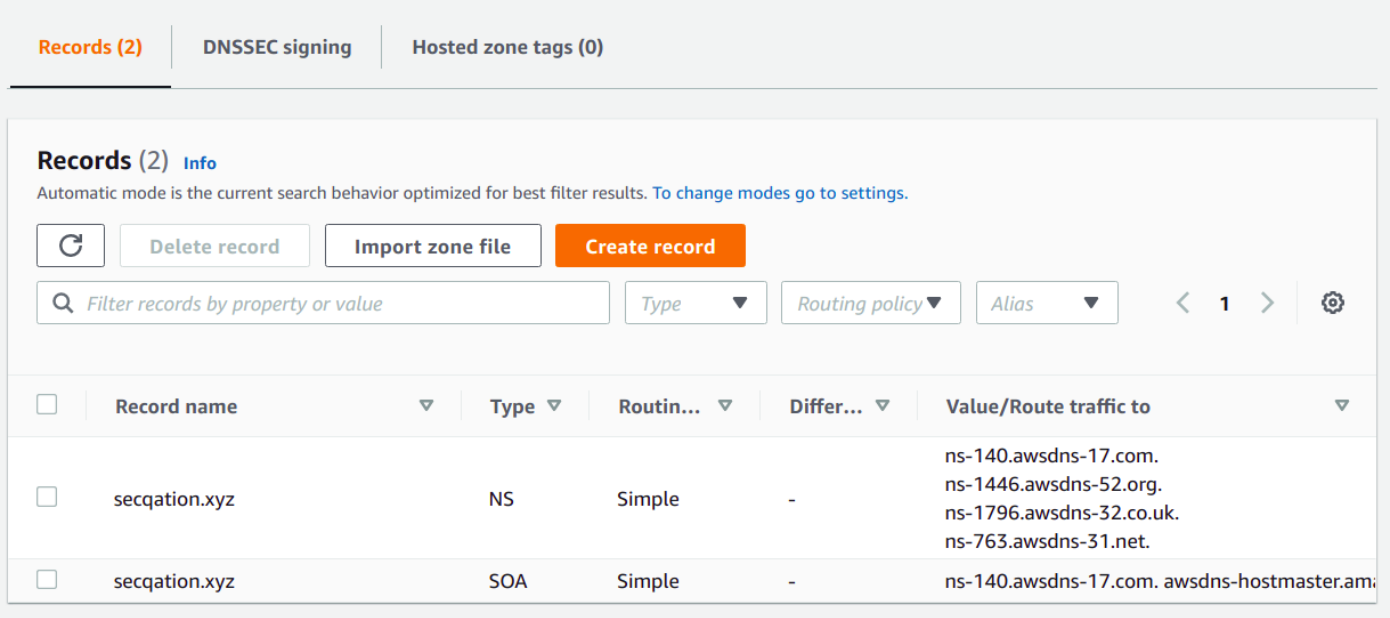


3. Go to Route 53 dashboard

4. Click on **Hosted zones > Create hosted zone**
5. Enter **Domain name**, e.g., `secqation.xyz`



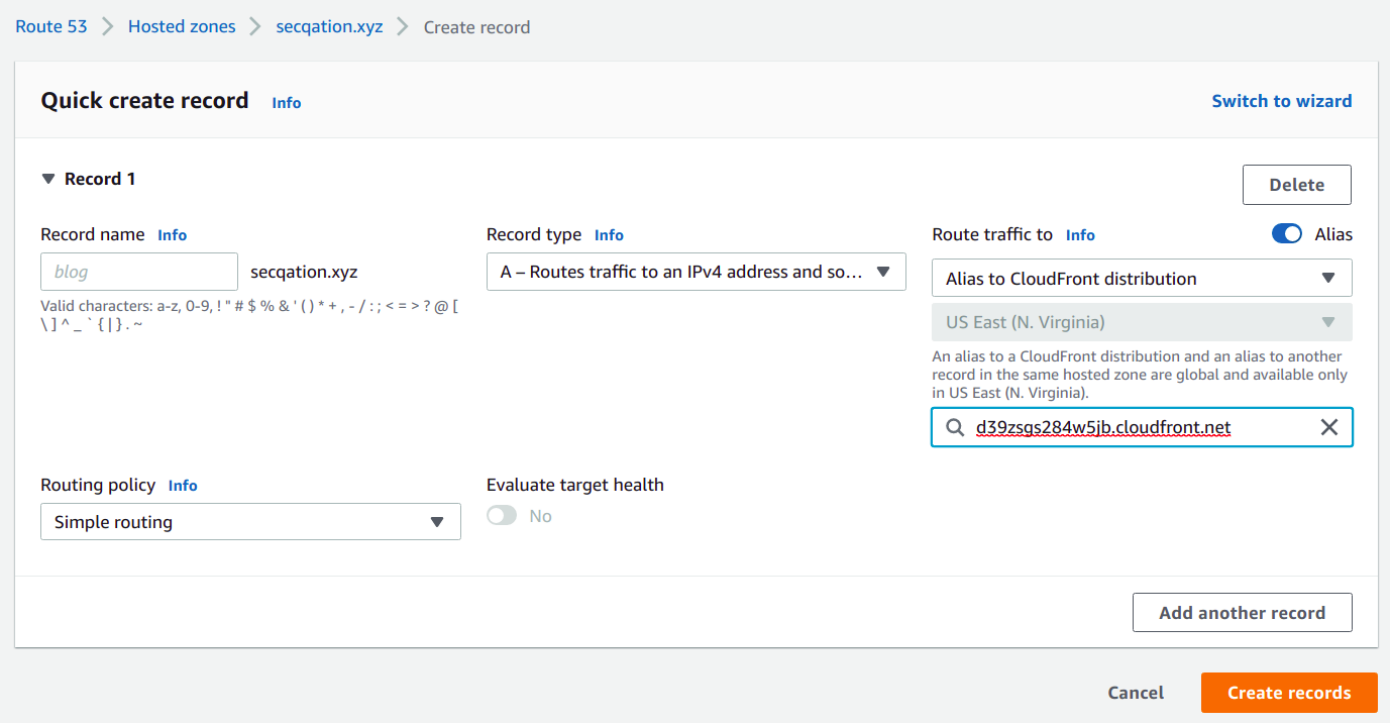
6. Click on **Create hosted zone** button
7. You will be displayed with a list of **AWS nameservers**.



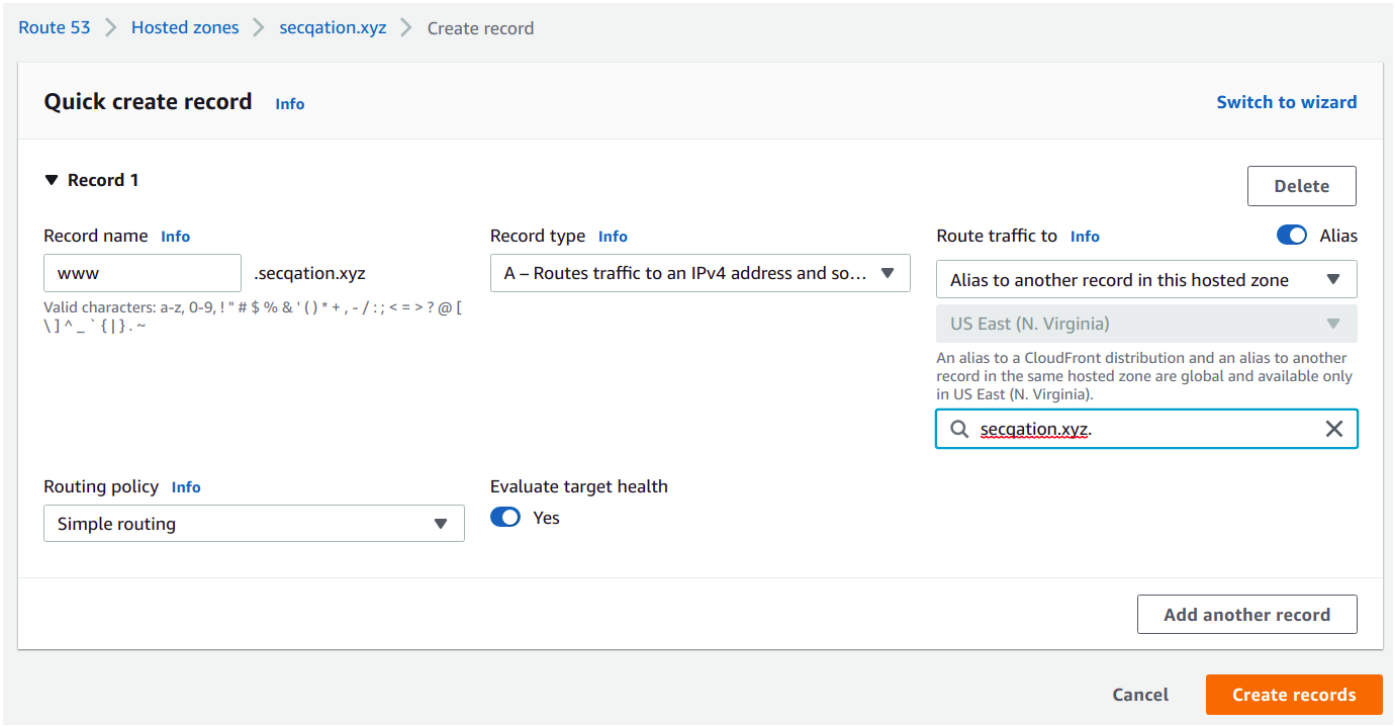
8. Change your domain's default nameserver to these **external nameservers**.
9. Wait until the nameservers are updated successfully for your domain. Check the status by running following command:

```
dig NS secqation.xyz
```

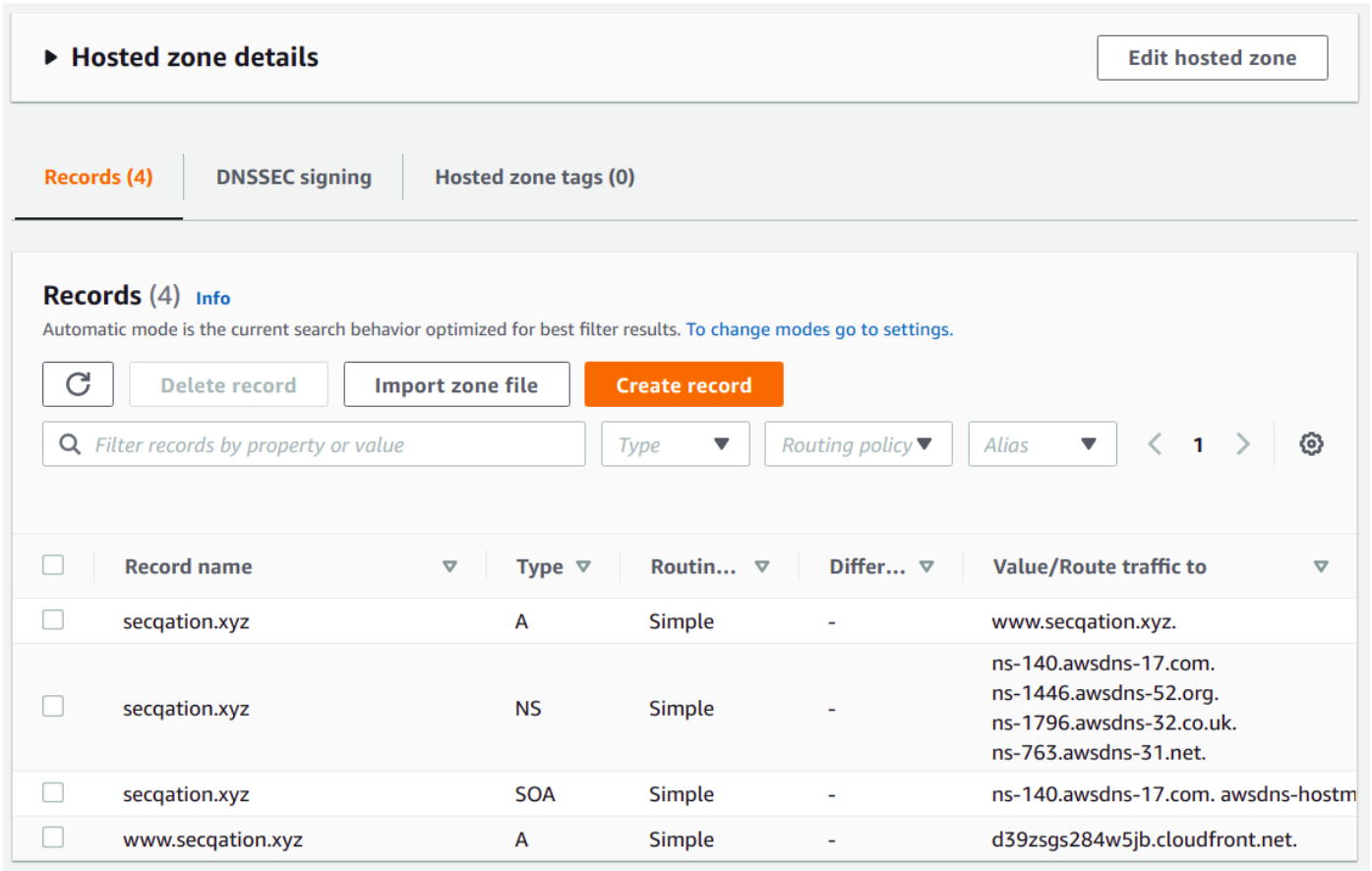
10. Add records in your hosted zone to redirect a user to the CloudFront endpoint, that would fetch website contents from an S3 bucket
11. Click on **Create record** button
12. Leave **Record name** as empty
13. Switch on the **Alias** option
14. In "Route traffic to" dropdown list, select **Alias to CloudFront distribution**



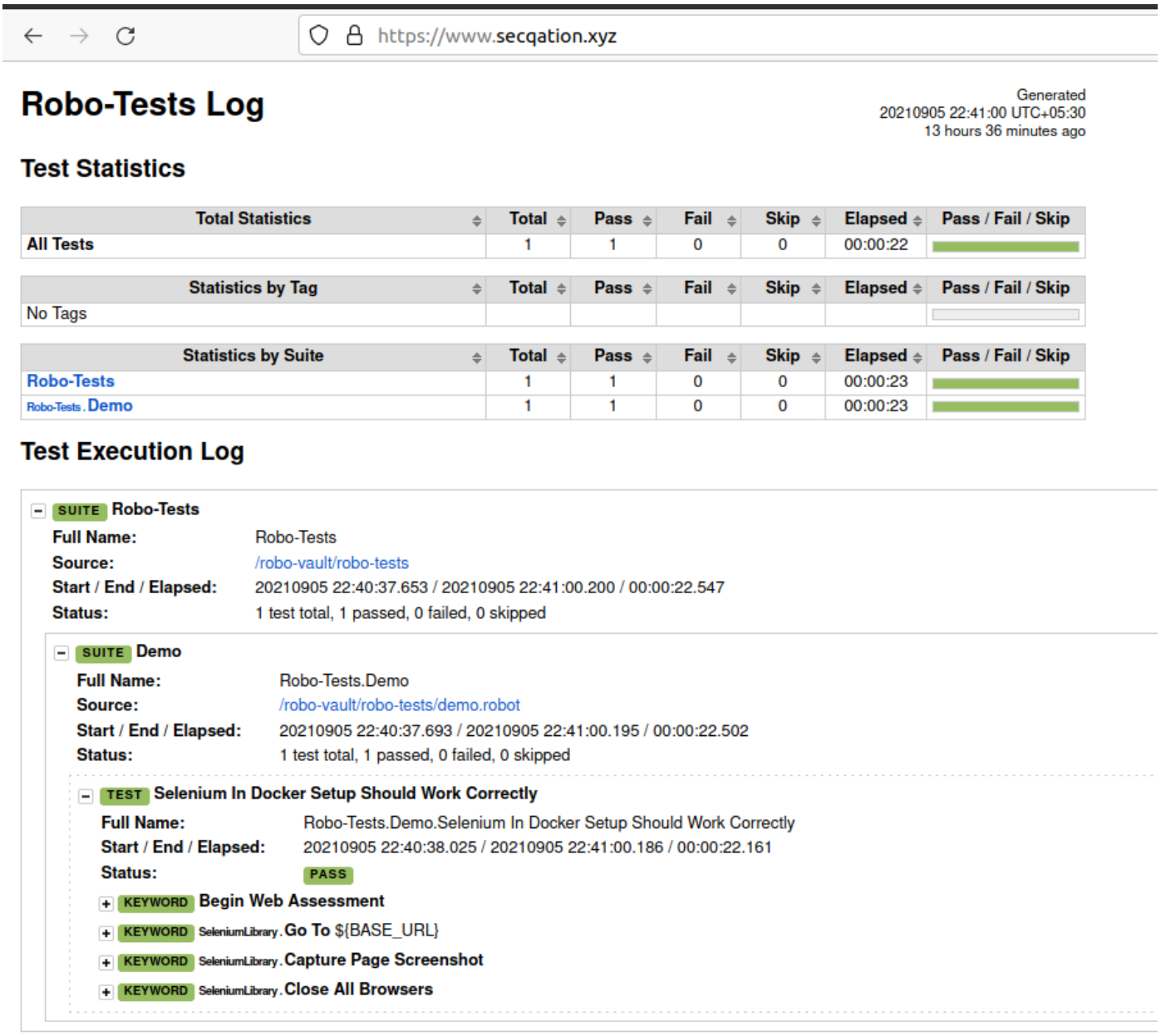
15. Select the appropriate CloudFront distribution endpoint
16. Click on **Add another record** button
17. In the **Record name** field, enter `www`
18. In "Route traffic to" dropdown list, select **Alias to another record in this hosted zone**
19. Select the record that was just created, i.e. `secation.xyz.`



20. Click on **Create records** button



21. Open a browser window and enter your domain name to access the static website hosted on S3 bucket



https://www.secqation.xyz

Robo-Tests Log

Generated
20210905 22:41:00 UTC+05:30
13 hours 36 minutes ago

Test Statistics

Total Statistics	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
All Tests	1	1	0	0	00:00:22	

Statistics by Tag	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
No Tags						

Statistics by Suite	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
Robo-Tests	1	1	0	0	00:00:23	
Robo-Tests . Demo	1	1	0	0	00:00:23	

Test Execution Log

SUITE **Robo-Tests**
Full Name: Robo-Tests
Source: /robo-vault/robo-tests
Start / End / Elapsed: 20210905 22:40:37.653 / 20210905 22:41:00.200 / 00:00:22.547
Status: 1 test total, 1 passed, 0 failed, 0 skipped

SUITE **Demo**
Full Name: Robo-Tests.Demo
Source: /robo-vault/robo-tests/demo.robot
Start / End / Elapsed: 20210905 22:40:37.693 / 20210905 22:41:00.195 / 00:00:22.502
Status: 1 test total, 1 passed, 0 failed, 0 skipped

TEST **Selenium In Docker Setup Should Work Correctly**
Full Name: Robo-Tests.Demo.Selenium In Docker Setup Should Work Correctly
Start / End / Elapsed: 20210905 22:40:38.025 / 20210905 22:41:00.186 / 00:00:22.161
Status: PASS

KEYWORD **Begin Web Assessment**
KEYWORD SeleniumLibrary . **Go To** ${BASE_URL}
KEYWORD SeleniumLibrary . **Capture Page Screenshot**
KEYWORD SeleniumLibrary . **Close All Browsers**

17.4 S3 Bucket: Content Update

17.4.1 AWS Vault

AWS Vault is a tool to securely store and access AWS credentials in a development environment. AWS Vault stores IAM credentials in your operating system's

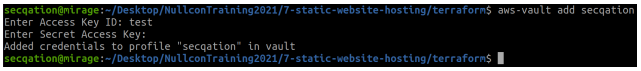
secure keystore and then generates **temporary credentials** from those to expose to your shell and applications.

1. Download **aws-vault** binary

```
$ wget https://github.com/99designs/aws-vault/releases/download/v6.3.1/aws-vault-linux-amd64 $ chmod +x aws-vault-linux-amd64 $ mv aws-vault-linux-amd
```

2. Create a new AWS **profile**, and save your IAM credentials securely

```
aws-vault add secqation
```



3. **Execute** a command (using temporary credentials)

```
aws-vault exec secqation -- aws s3 ls
```

4. **Authenticate** with your AWS IAM account

```
aws-vault exec --duration=12h secqation
```

Note: This should set your AWS credentials in your current Terminal session.

5. **View** the temporary AWS credentials

```
aws-vault exec secqation -- env | grep AWS
```

17.4.2 AWS CLI

- Single file upload

```
aws s3 cp ./index.html s3://amazon-cloudfront-secure-static-site-s3bucke
```

- Multiple files upload

aws s3 cp ./test-suite/ s3://amazon-cloudfront-secure-static-site-s3bucketroot-9z7rxapslwau/ --recursive

17.5 CloudFront: Caching Policy Update

If changes are not reflecting on your website, invalidate the cached files, and update the chaching policy.

1. Go to **CloudFront** console
2. Select your distribution
3. Select **Behaviors** tab
4. **Edit** behavior
5. In **Edit Behavior** screen, scroll down to **Cache key and origin requests** section
6. Choose **Legacy cache settings**
7. Under **Object caching** section, choose **Customize**
8. For **Minimum TTL**, enter `0`
9. For **Maximum TTL**, enter `1`
10. For **Default TTL**, enter `1`

Note: After this update, your website will instantaneously reflect any changes made to the files stored in S3 bucket.

17.6 Update Dockerfile for Jenkins server

1. Add steps to install 4 new packages, namely aws-vault, pass, GnuPG and AWS CLI on our Jenkins server. These packages would help us in uploading files to S3 bucket in a secure manner.

```
FROM jenkins/jenkins:lts USER root RUN mkdir -p /tmp/download && \ curl -L https://download.docker.com/linux/static/stable/x86_64/docker-18.03.1-ce.tg
```

   Note: Sample code is available in following path - `/home/secqation/Desktop/NullconTraining2021/4-example-docker/3-jenkins`
2. Stop and remove the running Jenkins container

```
$ docker stop jenkins $ docker rm jenkins $ docker ps -a
```

3. Re-build the Jenkins Docker image

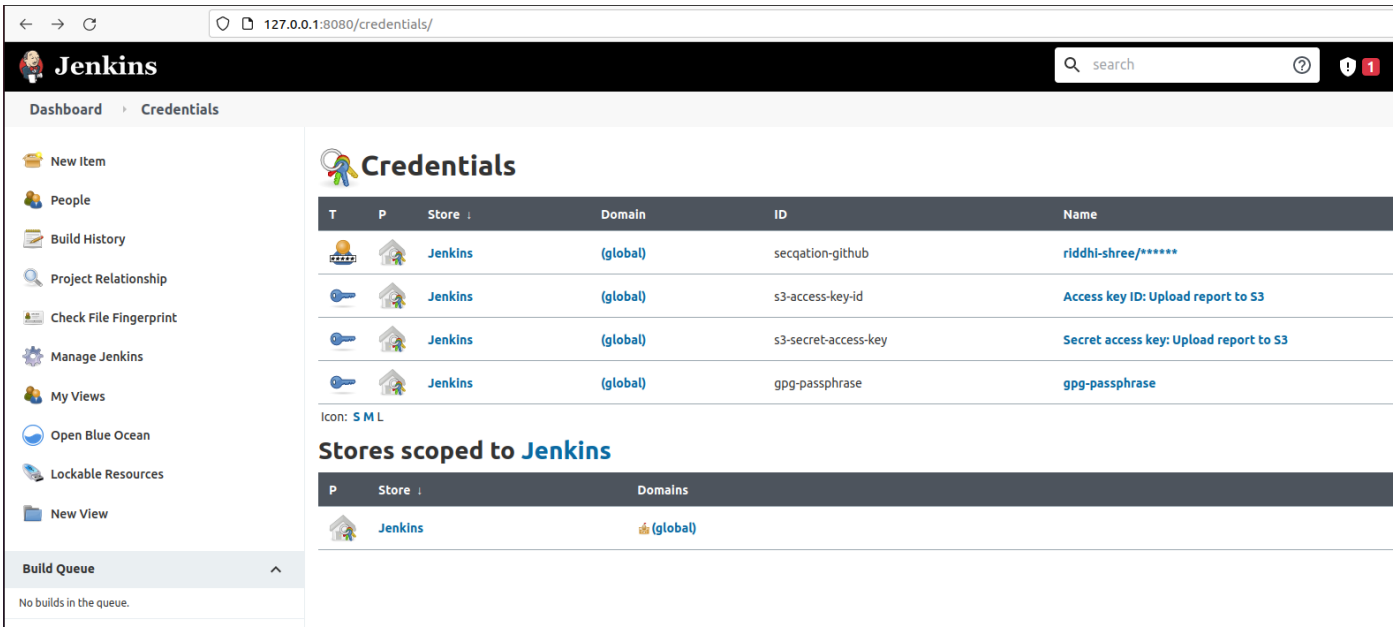
```
docker build -t jenkins-docker .
```

4. Start a new container for Jenkins server

```
docker run -p 8080:8080 -p 50000:50000 -v /var/jenkins_home:/var/jenkins_home -v /var/run/docker.sock:/var/run/docker.sock --name jenkins -d jenkins-d
```

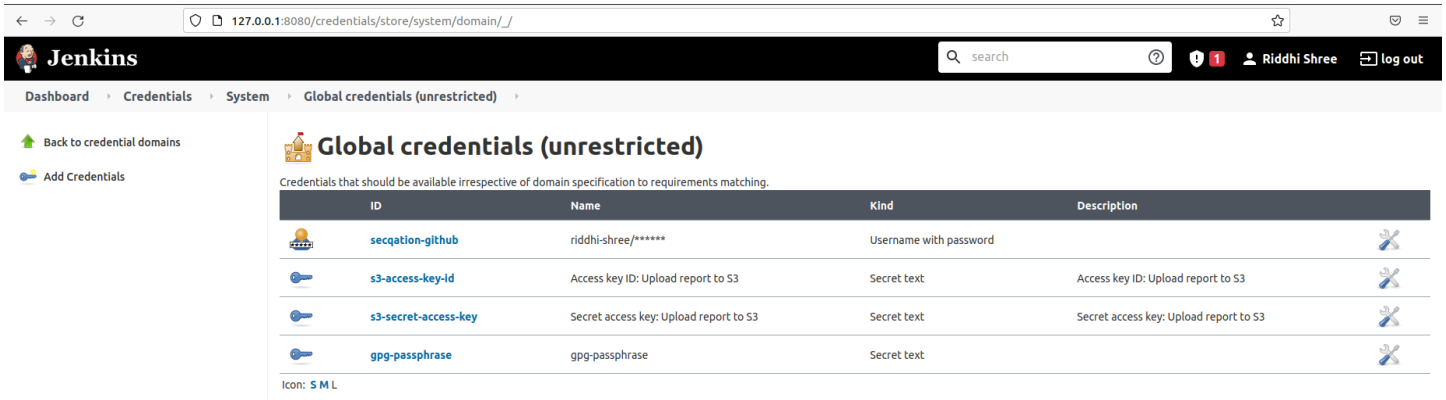
17.7 Add Secrets in Jenkins' Credentials Store

1. Go to http://127.0.0.1:8080/
2. Click on **Manage Jenkins > Manage Credentials**
3. Under **Domain** column, click on a link labeled as **(global)**



8. In the **Global credentials** page, click on **Add Credentials** link 9. From **Kind** dropdown list, select `Secret text` option 10. In the **Secret** input field, enter your secret value 11. In the **ID** input field, enter an identifying name 12. Click on **OK** button

Repeat above steps for storing AWS access key ID, AWS secret access key, and any other secrets.



17.8 Update Jenkinsfile

1. In the **Jenkinsfile**, add steps to upload the robot test execution results to S3 bucket.

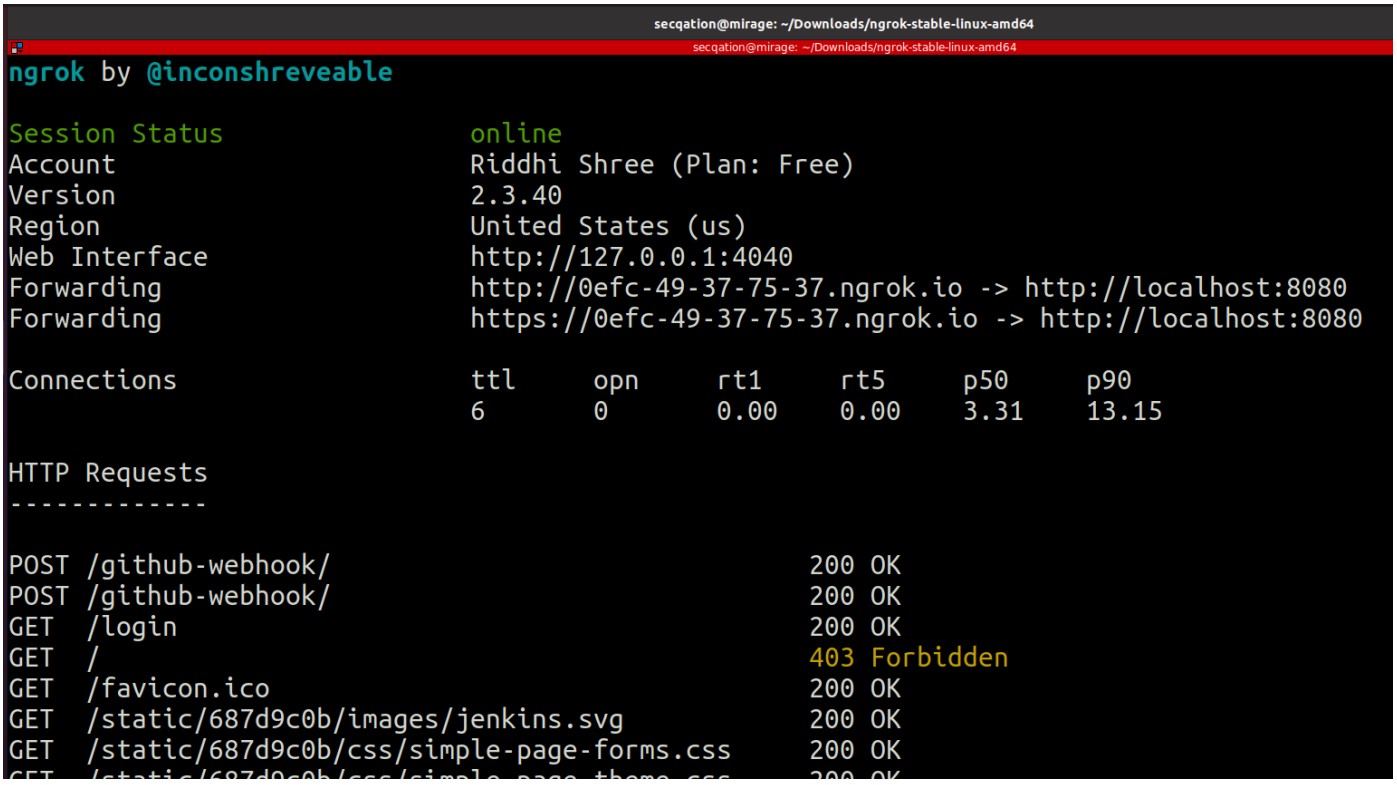
```
pipeline{ agent any stages{ stage('Cleanup'){ steps{ sh 'docker stop selenium-hub firefox_1 firefox_2 robotframework || true' sh 'docker rm selenium-h
```

Note: Sample code is available in following path - `/home/secqation/Desktop/NullconTraining2021/7-static-website-hosting`

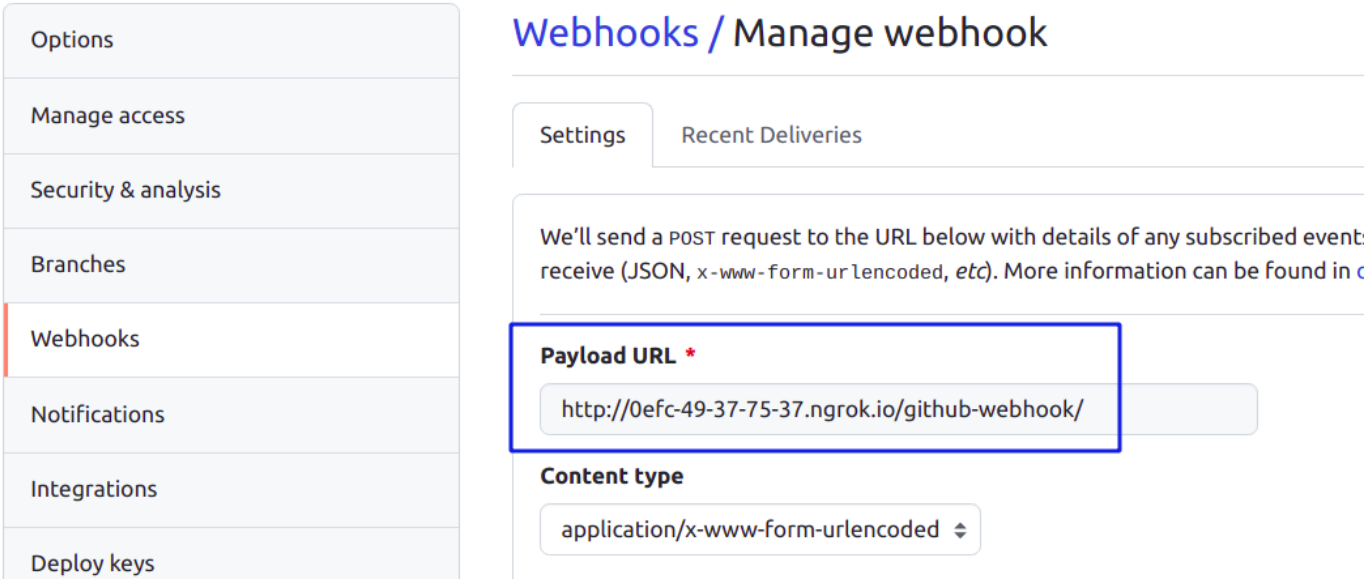
17.9 Push Changes to GitHub Repository

1. Start **ngrok**

```
./ngrok http 8080
```



2. Update the **Payload URL** for webhook in GitHub



3. Push local changes to remote GitHub repository

```
$ git add . $ git commit -m "Test S3 upload" $ git push
```

```
secqation@mirage:~/Desktop/NullconTraining2021/7-static-website-hosting$ git status
On branch master
Your branch is up to date with 'origin/master'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   Jenkinsfile

no changes added to commit (use "git add" and/or "git commit -a")
secqation@mirage:~/Desktop/NullconTraining2021/7-static-website-hosting$ git add .
secqation@mirage:~/Desktop/NullconTraining2021/7-static-website-hosting$ git commit -m "Test S3 upload"
[master c05ecaa] Test S3 upload
 1 file changed, 19 deletions(-)
secqation@mirage:~/Desktop/NullconTraining2021/7-static-website-hosting$ git push
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 2 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 292 bytes | 146.00 KiB/s, done.
Total 3 (delta 2), reused 0 (delta 0)
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To github.com:riddhi-shree/secQAtion-jenkins-pipeline.git
   9081421..c05ecaa  master -> master
secqation@mirage:~/Desktop/NullconTraining2021/7-static-website-hosting$
```

4. Wait for a while and visit your website at https://www.secqation.xyz to view the updated website contents.

17.10 Is there a problem?

Unauthenticated users can access our sensitive security report...

17.11 References

- https://github.com/aws-samples/amazon-cloudfront-secure-static-site#user-content-amazon-cloudfront-secure-static-website
- https://docs.aws.amazon.com/Route53/latest/DeveloperGuide/dns-configuring.html
- https://aws.amazon.com/premiumsupport/knowledge-center/prevent-cloudfront-from-caching-files/
- https://docs.aws.amazon.com/AmazonCloudFront/latest/DeveloperGuide/Invalidation.html#invalidation-specifying-objects-paths
- https://aws.amazon.com/blogs/networking-and-content-delivery/adding-http-security-headers-using-lambdaedge-and-amazon-cloudfront/
- https://infosec.mozilla.org/guidelines/web_security
- https://docs.aws.amazon.com/AmazonS3/latest/userguide/WebsiteAccessPermissionsReqd.html
- https://aws.amazon.com/premiumsupport/knowledge-center/cloudfront-serve-static-website/
- https://londonappdeveloper.com/2021/04/12/how-to-use-terraform-via-docker-compose-for-professional-developers/
- https://github.com/99designs/aws-vault
- https://docs.aws.amazon.com/cli/latest/userguide/install-cliv2-linux.html
- https://registry.terraform.io/providers/hashicorp/aws/latest/docs/resources/cloudfront_distribution
- https://www.jenkins.io/doc/book/pipeline/syntax/#declarative-sections
- https://medium.com/cuc4/aws-credential-hygiene-on-dev-machines-ed9e8793ea67
- https://blog.chapagain.com.np/gpg-remove-keys-from-your-public-keyring/
- https://www.passwordstore.org/
- https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/6/html/security_guide/sect-security_guide-encryption-gpg-creating_gpg_keys_usir
- https://stackoverflow.com/questions/49072403/suppress-the-passphrase-prompt-in-gpg-command
- https://docs.github.com/en/github/authenticating-to-github/managing-commit-signature-verification/generating-a-new-gpg-key
- https://stackoverflow.com/questions/39596446/how-to-get-gpg-public-key-in-bash
- https://www.passwordstore.org/

18. Implementing authentication via Lamda Edge

18.1 Private S3 Bucket

1. Login to AWS account
2. Go to `https://s3.console.aws.amazon.com/`
3. Click on "Create bucket" button
4. Enter a unique bucket name
5. Click on "Create bucket" button
6. A private S3 bucket should be created successfully.

18.2 File Upload

1. Create "index.html" file

   ```
   <html>My index file</html>
   ```

2. Go to `https://s3.console.aws.amazon.com/`
3. Select the newly created S3 bucket
4. Click on "Upload" button
5. Click on "Add files" button
6. Select your "index.html" file
7. Click on "Upload" >> "Close"

18.3 CloudFront

1. Go to `https://console.aws.amazon.com/cloudfront`
2. Click on "Create distribution" button
3. Under "Origin domain", select your newly created private S3 bucket
4. Under "S3 bucket access", select `Yes use OAI (bucket can restrict access to only CloudFront)`
5. Click on "Create new OAI"
   1. Accept default entry, or, enter a new name
   2. Click on "Create" button
6. Under "Bucket policy", select `Yes, update the bucket policy`
7. Under "Viewer protocol policy", select `HTTPS only`
8. Under "Allowed HTTP methods", select `GET, HEAD`
9. Under "Settings" > "Price class", select a suitable option
10. Under "Settings" > "Default root object", enter `index.html`

11. Click on "Create distribution" button
12. Note down the CloudFront distribution ID

18.4 Lambda@Edge

Lambda@Edge functions must be created in `us-east-1` region.

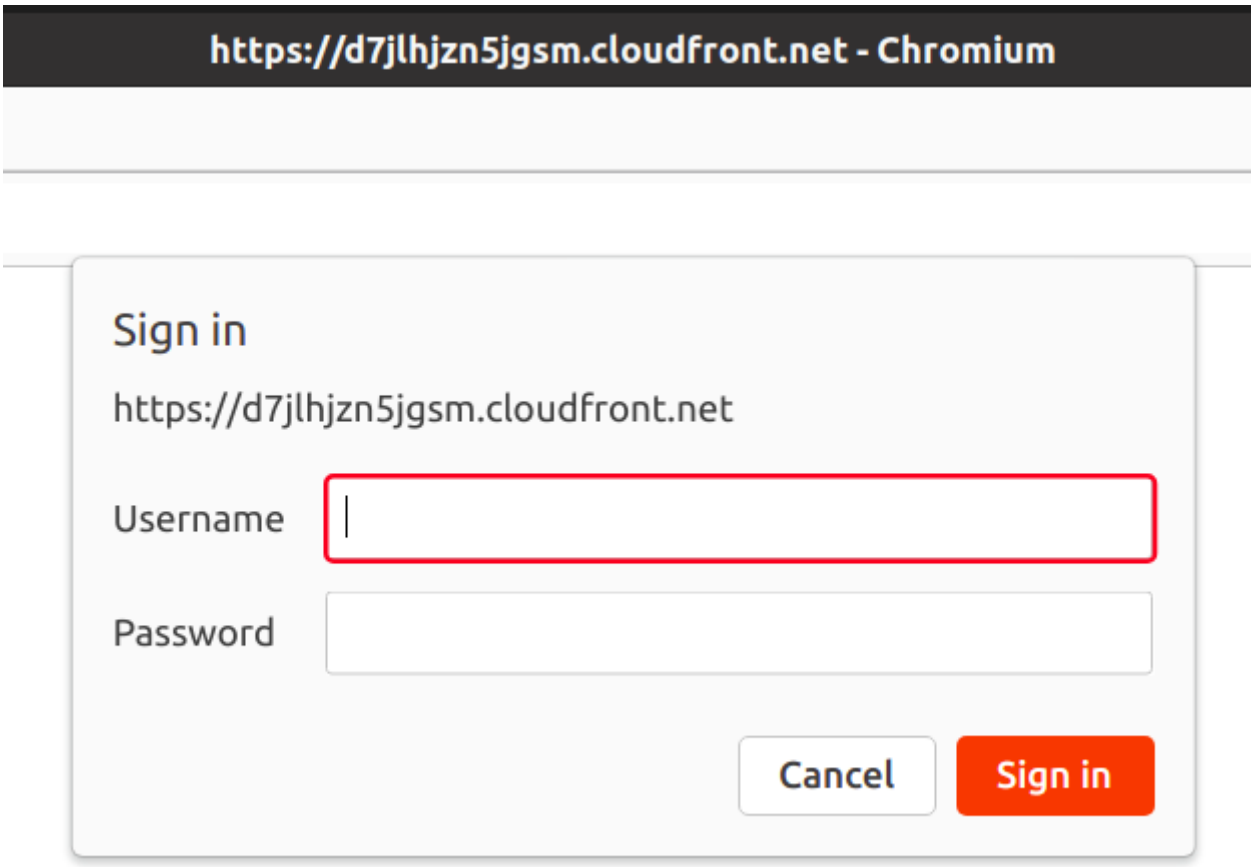
1. Go to `https://console.aws.amazon.com/lambda/home?region=us-east-1`
2. Click on "Create function" button
3. Select `Author from scratch` option
4. Enter a function name of your choice
5. Accept the default ruuntime, i.e. `Node.js 14.x`
6. Click on "Create function" button
7. Scroll down to "Code source" section
8. Replace the contents of "index.js" file with

```
exports.handler = (event, context, callback) => { // Get the request and its headers const request = event.Records[0].cf.request; const headers = requ
```

9. Click on "Deploy" button
10. Click on "Configuration" tab >> "Permissions"
11. Under "Execution role", click on the role name
12. On the IAM role page, click on "Trust relationships" >> "Edit trust relationship"
13. Replace the line `"Service": "lambda.amazonaws.com"` with

```
"Service": ["lambda.amazonaws.com","edgelambda.amazonaws.com"]
```

14. Click on "Update Trust Policy" button
15. Return to the Lambda@Edge function page
16. Click on "Actions" button
17. Click on `Publish new version` >> "Publish"
18. Click on "Add trigger"
19. Under "Trigger configuration", select `CloudFront`
20. Under "Configure CloudFront trigger" >> "Distribution", select the correct CloudFront distribution ID
21. Under "CloudFront event", select `Viewer request`
22. Select the `Confirm deploy to Lambda@Edge` checkbox
23. Click on "Add" button
24. Navigate to `https://console.aws.amazon.com/cloudfront`
25. Wait until the CloudFront distribution status changes from `Deploying...` to `Enabled`
26. This process might take a few minutes to complete
27. Once enabled, copy the **distribution domain name** and paste it in a browser window, e.g. `https://d7jlhjzn5jgsm.cloudfront.net`
28. You woud be prompted to enter a valid username and password



29. Only after correct credentials are provided, user would be allowed to access the `index.html` page

18.5 Cleanup

When not needed anymore, make sure the S3, CloudFront and Lambda@Edge AWS resources are deleted. This will prvent incurring unnecessary costs.

CloudFront

1. Select your CloudFront distribution
2. Click on "Disable" button
3. Once disabled completely, click on "Delete" button
4. Click "Delete" in the confirmation box

S3 Bucket

1. Select your S3 bucket
2. Click on "Empty" button
3. Enter `permanently delete`
4. Click on "Empty" >> "Exit"
5. Select your emptied S3 bucket
6. Click on "Delete" button
7. Enter name of your S3 bucket in the confirmation box
8. Click on "Delete bucket" button

Lambda@Edge

1. Wait for a few hours
2. Select your lambda@edge function
3. Click on "Actions" >> "Delete"
4. Refer this link

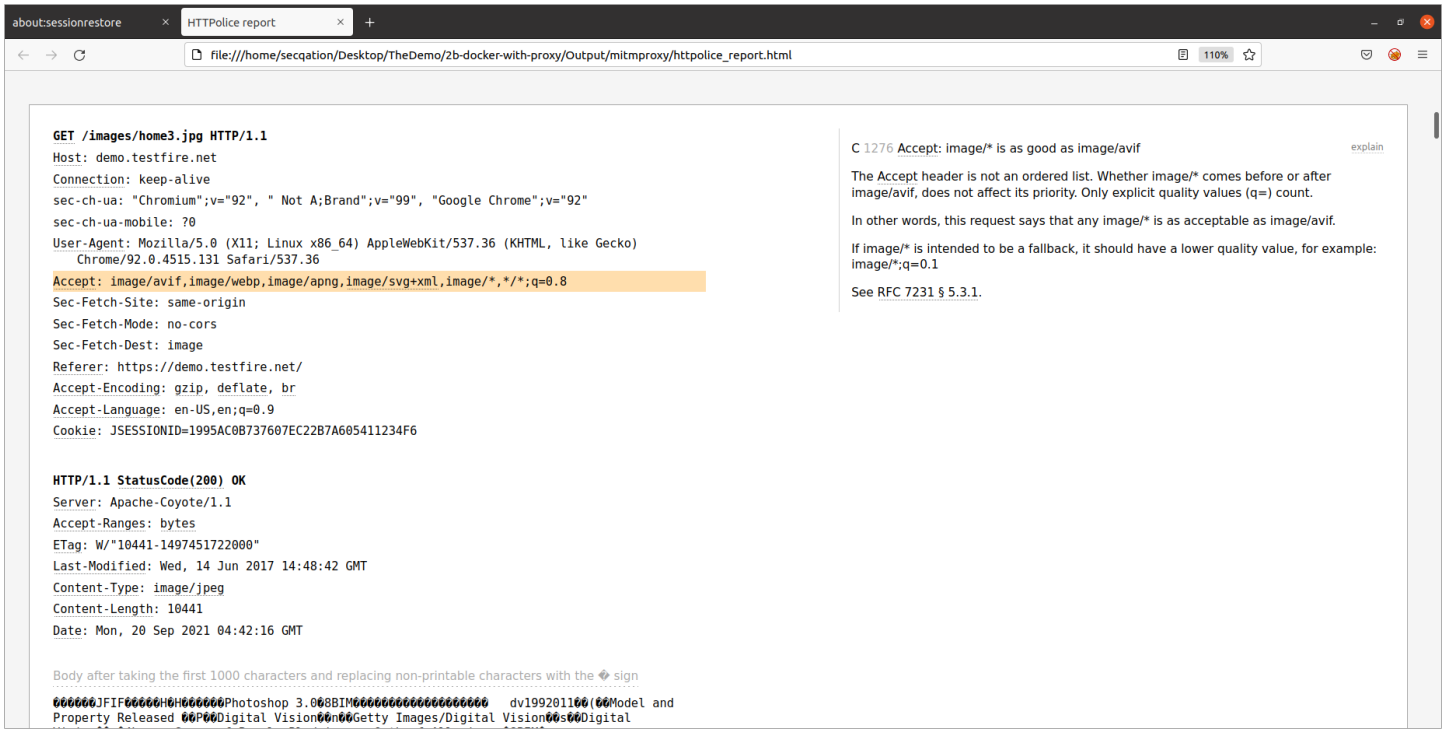
Note: Replicated functions cannot be deleted instantly

19. Leveraging HTTPolice

HTTPolice is a validator or “linter” for **HTTP requests and responses**. It can spot bad header syntax, inappropriate status codes, and other potential problems in your HTTP server or client.

19.1 Sample Report

The final report generated by HTTPolice looks like this:



19.2 Installation

```
pip3 install mitmproxy-HTTPolice
```

19.3 Integrating HTTPolice with mitmproxy

The network traffic sniffed by mitmproxy tool can be filtered and passed as an input to HTTPolice, which in turn can generate an HTML report containing full requests and responses. Analysing, storing and sharing of a well structured auto-generated HTML report is a lot easier than trying to organize the data manually.

1. Run following commands:

```
$ cd /home/secqation/Desktop/TheDemo/3b-jenkins-pipeline/ $ ./init.sh
```

2. Check the contents of **init.sh** file. What is it doing?

```
rm Input/mitmproxy/.mitmproxy/* rm Output/mitmproxy/* rm Output/robotframework/* docker-compose down docker-compose up -d --build mitmproxy docker-com
```

3. Check the contents of **docker-compose.yml** file. How did we configure proxy? Notice the use of environment variables **HTTP_PROXY** and **HTTPS_PROXY**

```
version: "3.9" services: firefox: image: selenium/node-firefox:4.0.0-rc-1-prerelease-20210804 shm_size: 2gb container_name: firefox depends_on: - sele
```

4. Also take a note of the volume mappings (especially for "mitmproxy" service)
5. Check the contents of **Dockerfile** for **mitmproxy** service.

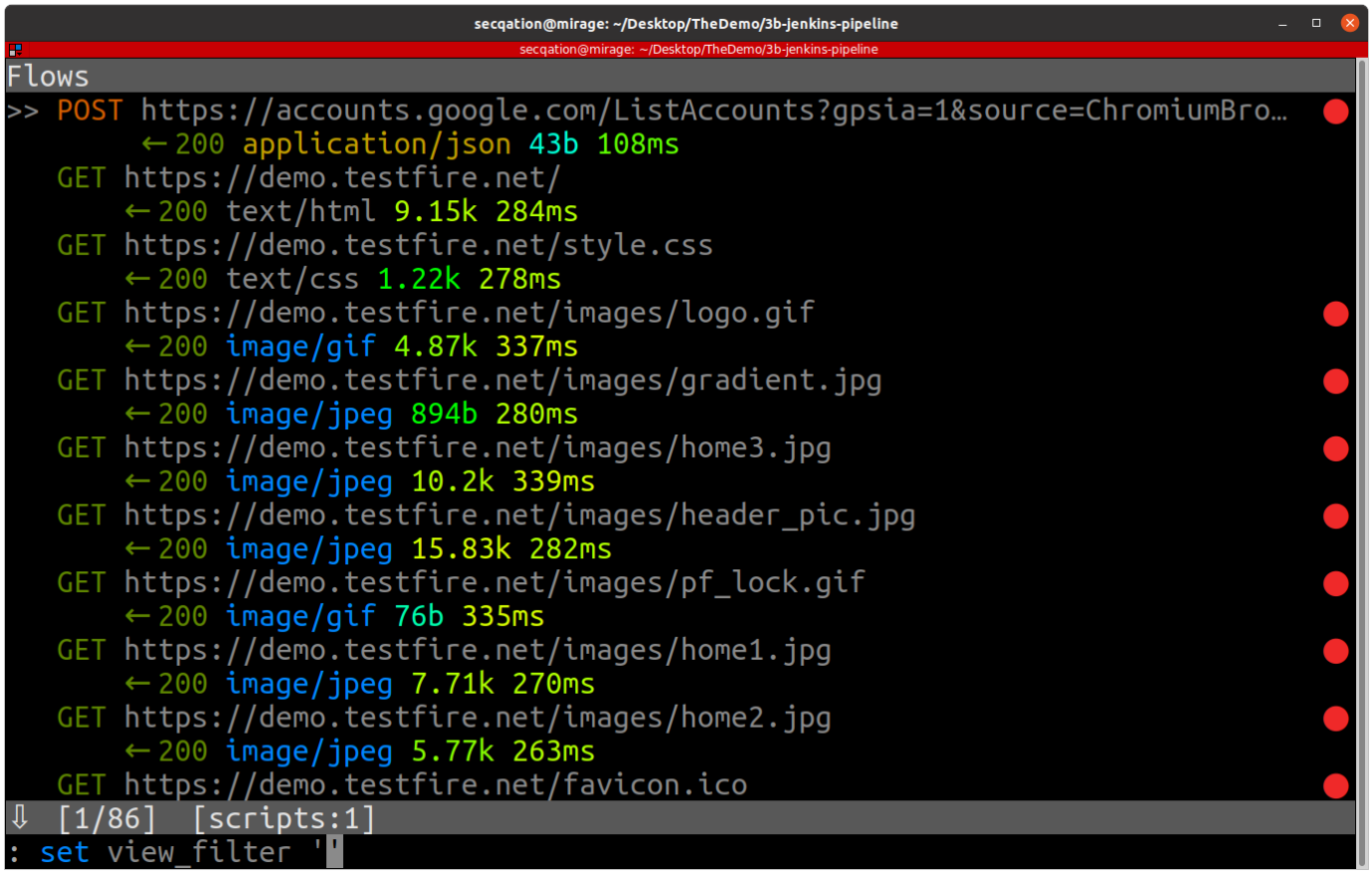
```
FROM mitmproxy/mitmproxy RUN apt-get update RUN apt-get install procps curl -y ENV LANG=en_US.UTF-8 VOLUME /home/mitmproxy/.mitmproxy CMD ["mitmdump",
```

   Notice that the intercepted traffic is being saved into a file called **traffic.mitm**. This file is saved in an **Output** folder that has a corresponding volume mapping in our host machine.
6. Once the **init.sh** script execution completes successfully, locate the **traffic.mitm** output file in path `/home/secqation/Desktop/TheDemo/3b-jenkins-pipeline/Output/mitmproxy`
7. Check the contents of **docker-compose-httpolice.yml** file

```
version: "3.9" services: HTTPolice: build: context: . dockerfile: ./Input/HTTPolice/Dockerfile image: httpolice:latest container_name: httpolice volum
```

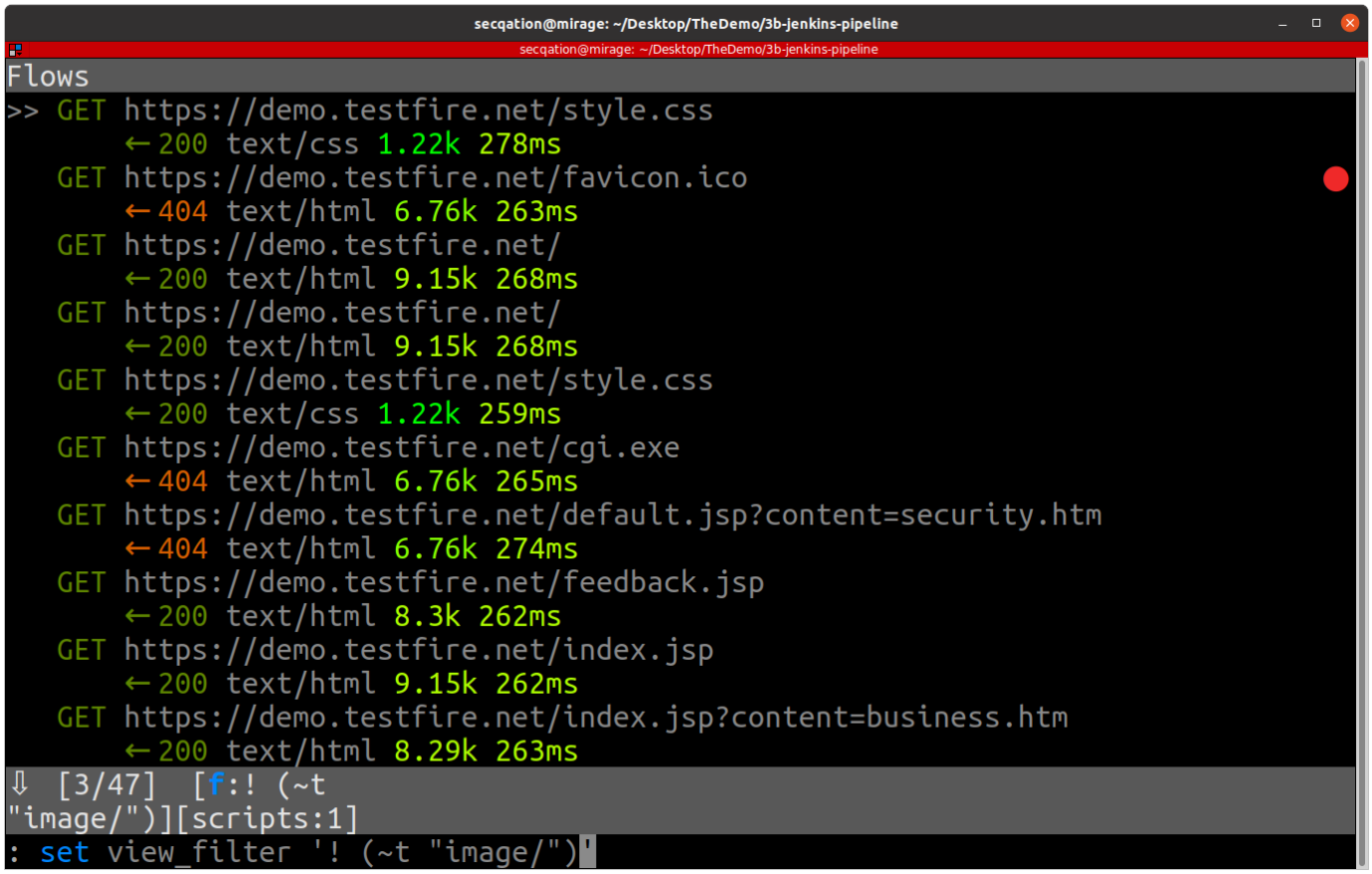
8. Run HTTPolice in **interactive mode** using Docker Compose **run** command

```
docker-compose -f docker-compose-httpolice.yml run HTTPolice
```



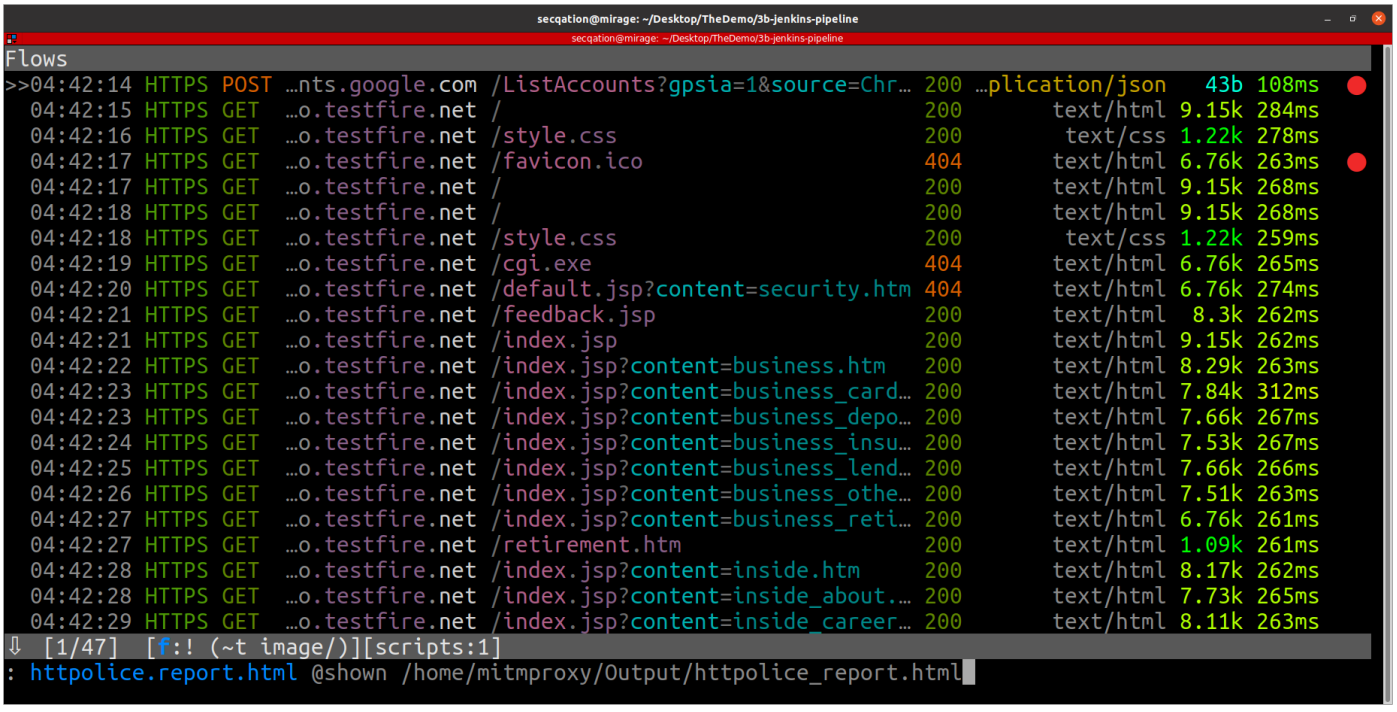
9. Filter out unwanted traffic. Press **[F]** key on keyboard and enter a filter expression

```
: set view_filter '! ~u firefox|mozilla' : set view_filter '! (~t "image/")' : set view_filter '(~t text/)'
```

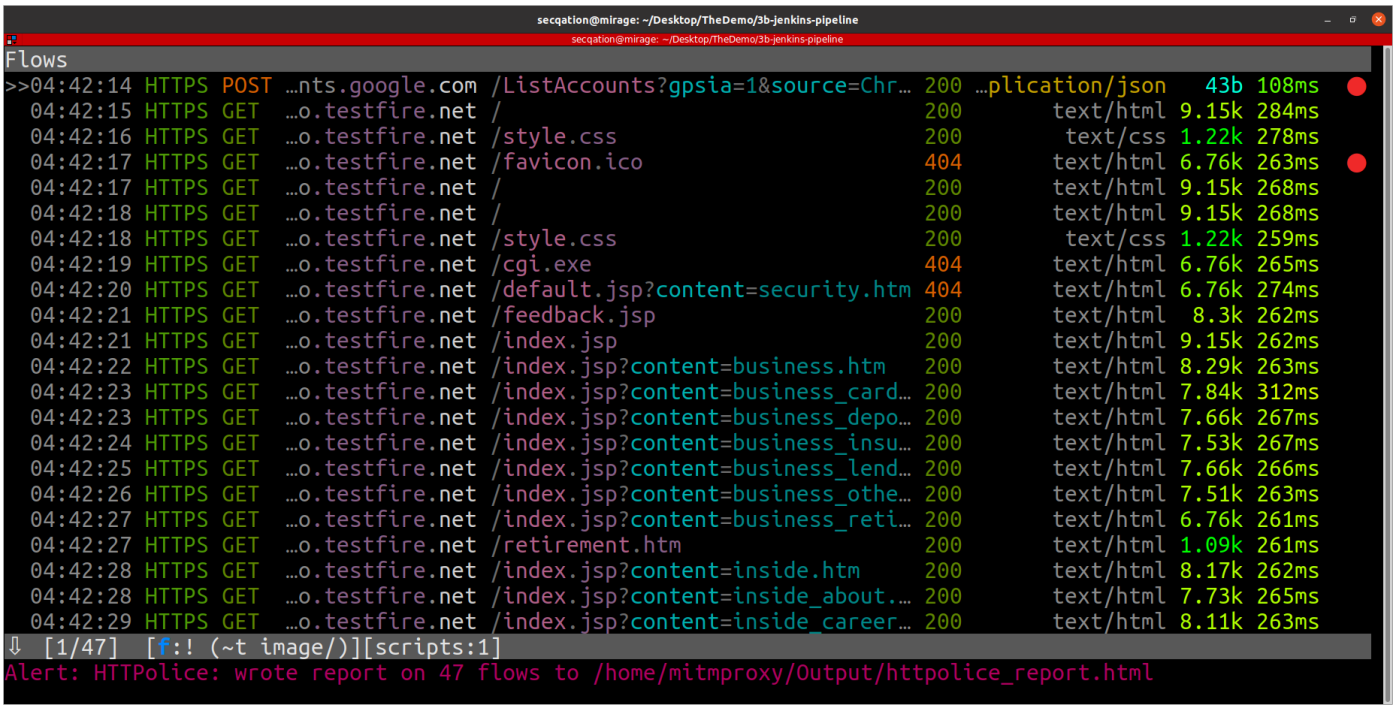


10. Export the filtered HTTP requests and responses using HTTPolice commad

```
: httpolice.report.html @shown /home/mitmproxy/Output/httpolice_report.html
```



11. Once the **HTML report** is exported, open it in a bowser (and analyze)



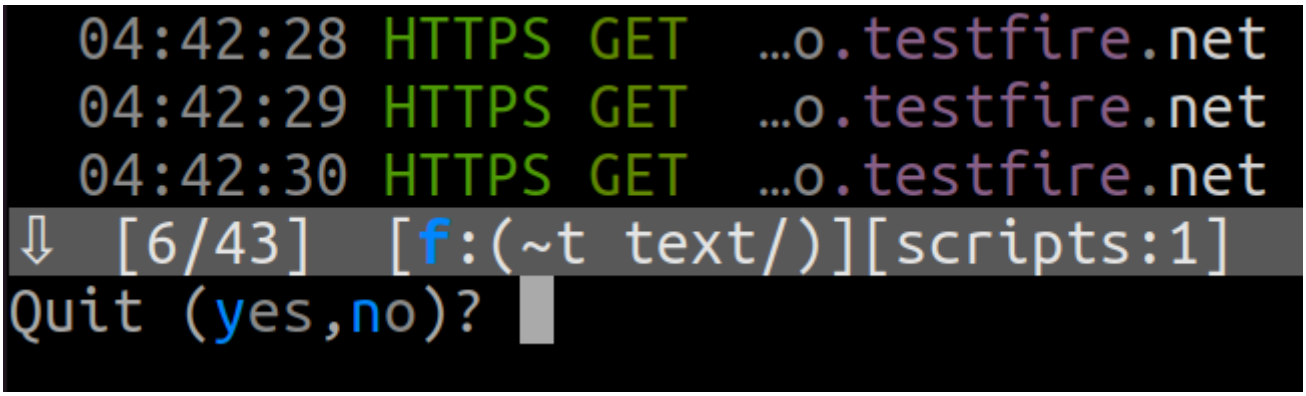

```
$ firefox httpolice_report.html
```

```
secqation@mirage:~/Desktop/TheDemo/3b-jenkins-pipeline/Output/mitmproxy$ ll
total 2964
drwxr-xr-x 2 secqation seqation    4096 Sep 26 14:08 ./
drwxr-xr-x 4 secqation seqation    4096 Sep 26 09:33 ../
-rw-r--r-- 1 secqation seqation  307522 Sep 26 14:06 httpolice_report.html
-rw-r--r-- 1 secqation seqation 2715309 Sep 26 09:33 traffic.mitm
secqation@mirage:~/Desktop/TheDemo/3b-jenkins-pipeline/Output/mitmproxy$ firefox httpolice_report.html
secqation@mirage:~/Desktop/TheDemo/3b-jenkins-pipeline/Output/mitmproxy$
```

file:///home/secqation/Desktop/TheDemo/3b-jenkins-pipeline/Output/mitmproxy/httpolice_report.html

```
GET / HTTP/1.1
Host: demo.testfire.net
Connection: keep-alive
Cache-Control: max-age=0
sec-ch-ua: "Chromium";v="92", " Not A;Brand";v="99", "Google Chrome";v="92"
sec-ch-ua-mobile: ?0
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Gecko)
   Chrome/92.0.4515.131 Safari/537.36
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image
   /apng,*/*;q=0.8,application/signed-exchange;v=b3;q=0.9
Sec-Fetch-Site: none
Sec-Fetch-Mode: navigate
Sec-Fetch-User: ?1
Sec-Fetch-Dest: document
Accept-Encoding: gzip, deflate, br
Accept-Language: en-US,en;q=0.9
Cookie: JSESSIONID=1995AC0B737607EC22B7A605411234F6


HTTP/1.1 StatusCode(200) OK
Server: Apache-Coyote/1.1
Content-Type: text/html;charset=ISO-8859-1
Transfer-Encoding: chunked
Date: Mon, 20 Sep 2021 04:42:18 GMT


Body after removing Transfer-Encoding, decoding from iso8859-1, and taking the first 1000 characters
<head>
        <title>Altoro Mutual</title>
  <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
  <link href="/style.css" rel="stylesheet" type="text/css" />
</head>
<body style="margin-top:5px;">

<div id="header" style="margin-bottom:5px; width: 99%;">
  <form id="frmSearch" method="get" action="/search.jsp">
```

12. Press **[Q]** key on keyboard. When promptetd, press **[Y]** key to exit the interactive mitmproxy shell



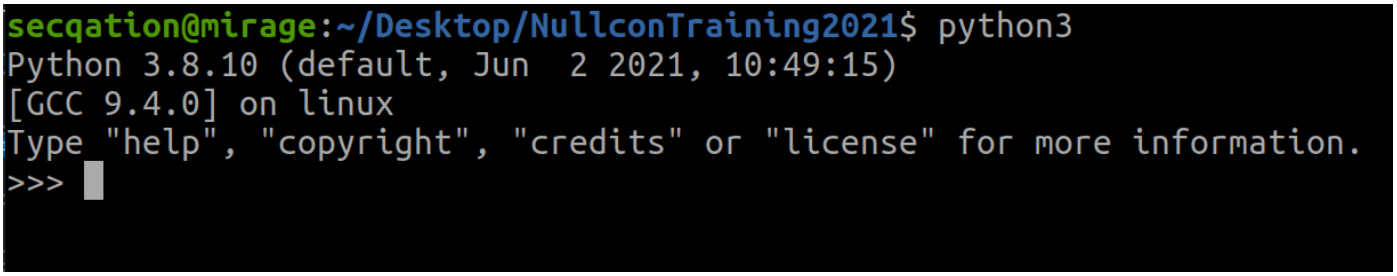
19.4 Reference

- https://httpolice.readthedocs.io/en/latest/index.html
- https://httpolice.readthedocs.io/en/latest/concepts.html
- https://httpolice.readthedocs.io/en/latest/quickstart.html#using-mitmproxy
- https://docs.mitmproxy.org/stable/concepts-filters/
- https://buildmedia.readthedocs.org/media/pdf/httpolice/0.7.0/httpolice.pdf

20. Basics of Python programming

20.1 Interpreter

1. Open a terminal by pressing **[CTRL]+[ALT]+[T]** keys
2. Type `python3` and press **[ENTER]**



3. Try out below mentioned examples, and understand what's happening.
4. To exit the interpreter, type `quit()` and press **[ENTER]**

20.2 Numerical Operators

- `+`, `-`, `*`, `/`, `//` (floor division), `%` (remainder), `**` (power), `=`

20.3 Strings

1. Run following two commands and explain the difference in output

```
>>> print('C:\some\name') >>> print(r'C:\some\name')
```

   Which of the above represents a **raw string**?
2. String literals can span **multiple lines** by using triple-quotes: `"""..."""` or `'''...'''`.
3. Strings can be **concatenated** with the `+` operator, and **repeated** with `*`

```
>>> 3 * 'un' + 'ium'
```

4. **Slicing**

```
>>> word = 'Python' >>> word[0:2] # characters from position 0 (included) to 2 (excluded) >>> word[2:5] # characters from position 2 (included) to 5 (
```

   Note how the start is always included, and the end always excluded. This makes sure that `s[:i]` + `s[i:]` is always equal to `s`:

```
 +---+---+---+---+---+---+
 | P | y | t | h | o | n |
 +---+---+---+---+---+---+
 0   1   2   3   4   5   6
-6  -5  -4  -3  -2  -1
```

20.4 Lists

```
>>> cubes = [1, 8, 27, 65, 125] >>> cubes.append(216) # add the cube of 6
```

```
>>> letters = ['a', 'b', 'c', 'd', 'e', 'f', 'g'] >>> letters[2:5] = ['C', 'D', 'E'] >>> letters[2:5] = [] >>> letters[:] = [] >>> len(letters)
```

20.5 Control Flow Tools

20.5.1 if

```
>>> x = int(input("Please enter an integer: ")) Please enter an integer: 42 >
```

20.5.2 for

```
>>> # Measure some strings: ... words = ['cat', 'window', 'defenestrate'] >>> for w in words: ... print(w, len(w)) ...
```

20.5.3 while

```
>>> # Fibonacci series: ... a, b = 0, 1 >>> while a < 1000: ... print(a, end=',') ... a, b = b, a+b ... 0,1,1,2,3,5,8,13,21,34,55,89,144,233,377,610,987,
```

20.5.4 range()

```
>>> for i in range(5): ... print(i) ... e changed to zero') ... elif x == 0:
```

```
>>> list(range(0, 10, 3)) [0, 3, 6, 9]
```

```
>>> a = ['Mary', 'had', 'a', 'little', 'lamb'] >>> for i in range(len(a)): ..
```

20.5.5 break

```
>>> for n in range(2, 10): ... for x in range(2, n): ... if n % x == 0: ... p
```

20.5.6 continue

```
>>> for num in range(2, 10): ... if num % 2 == 0: ... print("Found an even nu
```

20.6 Functions

```
>>> def fib(n): # write Fibonacci series up to n ... """Print a Fibonacci series up to n.""" ... a, b = 0, 1 ... while a < n: ... print(a, end=' ') ... a,
```

20.7 Default Argument Values

```
def ask_ok(prompt, retries=4, reminder='Please try again!'): while True: ok = input(prompt) if ok in ('y', 'ye', 'yes'): return True if ok in ('n', 'no',
```

This function can be called in several ways:

1. By giving only the **mandatory** argument:

```
ask_ok('Do you really want to quit?')
```

2. By giving one of the **optional** arguments:

```
ask_ok('OK to overwrite the file?', 2)
```

3. By giving **all** arguments:

```
ask_ok('OK to overwrite the file?', 2, 'Come on, only yes or no!')
```

20.8 Further Reading

- `https://docs.python.org/3/tutorial/introduction.html`

21. Example: Custom Keywords Library

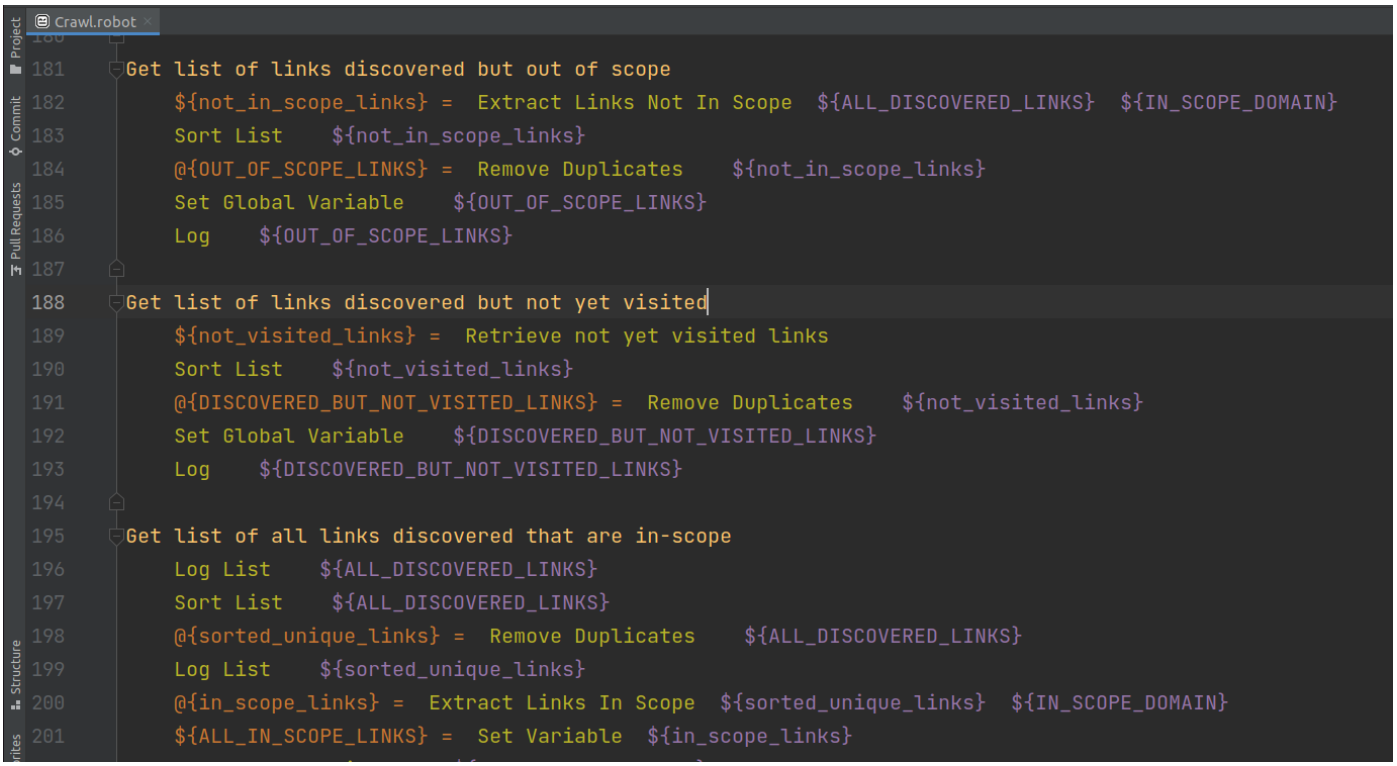
1. Create a python file, e.g., `reconnaisance.py`
2. Add python functions

```
import requests from bs4 import BeautifulSoup from tldextract import extract import re try: from urlparse import urljoin, urlparse # Python2 except Im
```

3. Import the library in your `.robot` file

```
3b-jenkins-pipeline > Input > robotframework > demo-test-suite > Resources > PageObjects > Reconnaisance.robot
1  *** Settings ***
2  Library     SeleniumLibrary
3  Library     ../../CustomLibraries/reconnaisance.py
4
5  *** Keywords ***
6  Read Source Code
7      [Arguments]  ${Target_URL}
8      ${current_url} =  Get Location
9      ${status} =  Run Keyword And Return Status    Should Be Equal    ${Target_URL}
10     IF    ${status} != ${True}
11         Go To    ${Target_URL}
12     END
13     ${source_code} =  Get Source
14     Return From Keyword  ${source_code}
15
16 Google search
17     [Arguments]  ${Target_Domain}
18     Go To    https://www.google.com/
19     ${search_box_element} =  Set Variable  xpath://input[@role="combobox"]
20     Input Text    ${search_box_element}    site:*.${Target_Domain}
21     Press Keys  ${search_box_element}  ENTER
22     Wait Until Page Contains    results
23     Capture Element Screenshot    xpath://body
24
```

4. Call custom keywords



5. Keyword output will be part of the finall report

KEYWORD Crawl . **Print crawl status**

Start / End / Elapsed: 20210919 13:37:20.256 / 20210919 13:37:20.529 / 00:00:00.273

KEYWORD Crawl . **Collect final statistics**

KEYWORD Collections . **Log List** ${VISITED_LINKS}

KEYWORD Collections . **Log List** ${DISCOVERED_BUT_NOT_VISITED_LINKS}

Documentation: Logs the length and contents of the `list` using given `level`.

Start / End / Elapsed: 20210919 13:37:20.526 / 20210919 13:37:20.526 / 00:00:00.000

13:37:20.526 INFO

```
List length is 25 and it contains following items:
0: https://demo.testfire.net/Privacypolicy.jsp?sec=Careers&template=US
1: https://demo.testfire.net/admin/clients.xls
2: https://demo.testfire.net/disclaimer.htm?url=http://www.microsoft.com
3: https://demo.testfire.net/disclaimer.htm?url=http://www.netscape.com
4: https://demo.testfire.net/high_yield_investments.htm
5: https://demo.testfire.net/index.jsp?content=inside_benefits.htm
6: https://demo.testfire.net/index.jsp?content=inside_community.htm
7: https://demo.testfire.net/index.jsp?content=inside_contact.htm#ContactUs
8: https://demo.testfire.net/index.jsp?content=inside_executives.htm
9: https://demo.testfire.net/index.jsp?content=inside_internships.htm
10: https://demo.testfire.net/index.jsp?content=inside_jobs.htm
11: https://demo.testfire.net/index.jsp?content=inside_trainee.htm
12: https://demo.testfire.net/index.jsp?content=pr/20060413.htm
13: https://demo.testfire.net/index.jsp?content=pr/20060518.htm
14: https://demo.testfire.net/index.jsp?content=pr/20060720.htm
15: https://demo.testfire.net/index.jsp?content=pr/20060817.htm
16: https://demo.testfire.net/index.jsp?content=pr/20060921.htm
17: https://demo.testfire.net/index.jsp?content=pr/20060928.htm
18: https://demo.testfire.net/index.jsp?content=pr/20061005.htm
19: https://demo.testfire.net/index.jsp?content=pr/20061109.htm
20: https://demo.testfire.net/index.jsp?content=security.htm#top
21: https://demo.testfire.net/inside_points_of_interest.htm
22: https://demo.testfire.net/my%20documents/JohnSmith/Bank%20Site%20Documents/grouplife.htm
23: https://demo.testfire.net/pr/communityannualreport.pdf
24: https://demo.testfire.net/survey_questions.jsp?step=a
```

KEYWORD Collections . **Log List** ${OUT_OF_SCOPE_LINKS}

KEYWORD Collections . **Log List** ${ALL_IN_SCOPE_LINKS}

KEYWORD Collections . **Log List** ${ALL_DISCOVERED_FORMS}

KEYWORD Collections . **Log List** ${ALL_FORMS_ATTRIBUTES_AND_INPUT_ELEMENTS}

22. When and How to Use Burp Suite

1. General Setup and Tool Overview
2. Attacking Web Applications using Burp Suite
3. Specific Attack Scenarios

22.1 Corresponding VM download links

- bsides-workshop-v0.2.0.ova
- c0c0n-training.ova

23. DVWA: Get Your Hands Dirty

Damn Vulnerable Web App (DVWA) is a PHP/MySQL web application that is damn vulnerable. Let's solve DVWA.

23.1 Pre-requisites

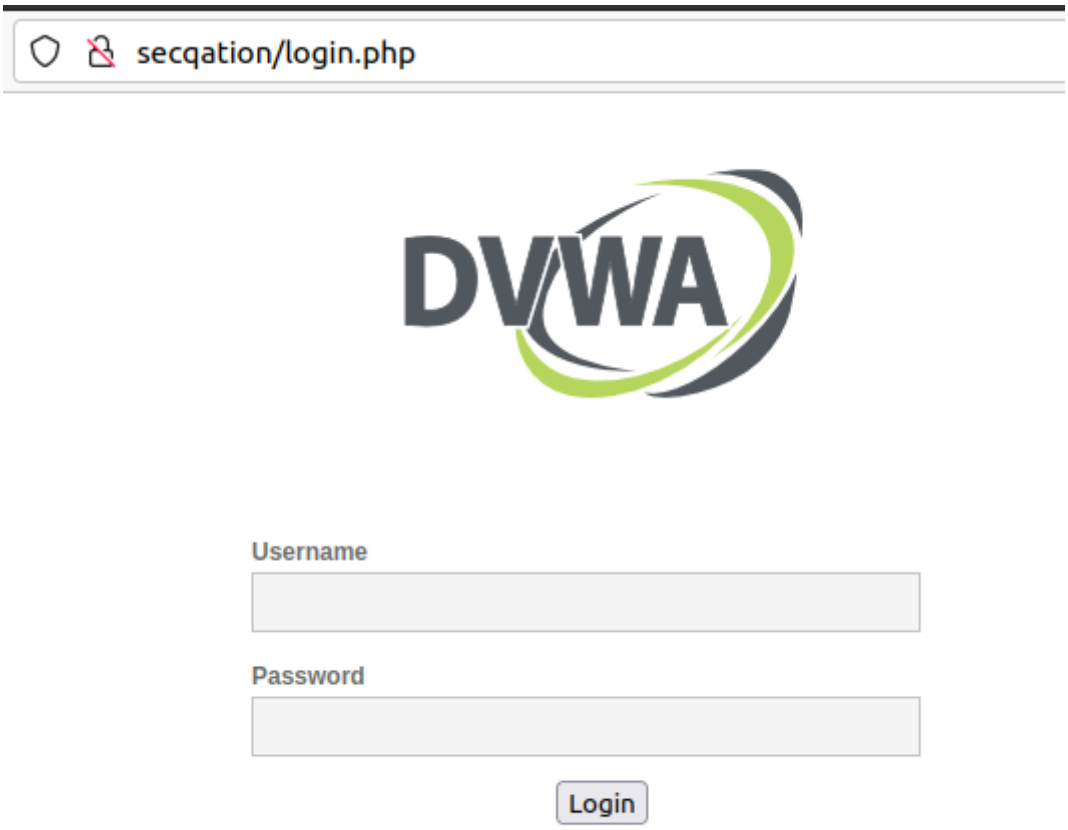
- Add following line to **/etc/hosts** file: `127.0.1.1 secqation.local`

23.2 Purely Manual Approach

1. Start your own vulnerable instance of DVWA

```
docker run --rm -it -p 80:80 vulnerables/web-dvwa
```

2. Go to http://secqation/login.php



3. Start hacking.

23.3 SecQAtion Approach

Let's make hacking DVWA a bit more interesting...

1. Go to `/home/secqation/Desktop/TheDemo/1-local-execution/demo-test-suite` folder path
2. Check the contents of **init.sh** file in **BashScripts** folder

```
mitmdump -p 8080 -w +traffic.mitm "! ~u firefox|ocsp|mozilla|googleapis" & robot -d ~/Desktop/TheDemo/1-local-execution/demo-test-suite/Results ~/Desk
```

   Notice the use of `${1:-App.robot}`. It says that if no parameter value is passed when calling the bash script, then **App.robot** test case should be executed by default. In case a specific filename is passed, then that specific test suite should be executed.
3. Check the contents of **Tests** folder

```
$ tree Tests/ Tests/ 01__setup_dvwa.robot 02__teardown_dvwa.robot 03__recon_base_url.robot App.robot
```

4. Check the contents of `.robot` files
   1. **Tests/01__setup_dvwa.robot**

```
*** Settings *** Resource ../Resources/App.robot Resource ../Resources/Common.robot Resource ../Data/Variables/global.robot Suite Setup Begin Web
```

   2. **Tests/02__teardown_dvwa.robot**

```
*** Settings *** Resource ../Resources/App.robot Resource ../Resources/Common.robot *** Test Cases *** Destroy DVWA Running Docker Instance Stop
```

   3. **Tests/03__recon_base_url.robot**

```
*** Settings *** Resource ../Resources/App.robot Resource ../Resources/Common.robot Resource ../Data/Variables/global.robot Suite Setup Begin Web
```

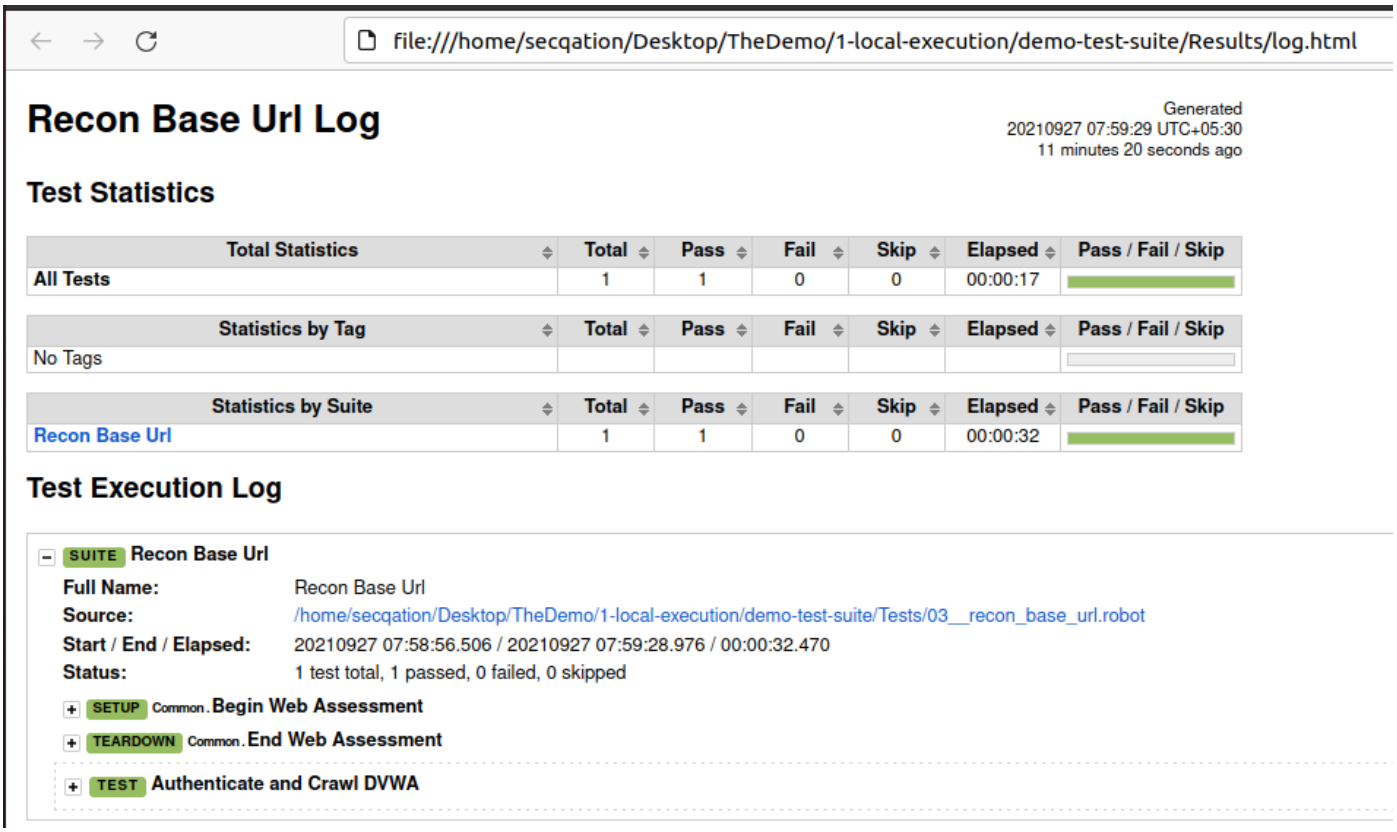
   4. **Tests/App.robot**

```
*** Settings *** Resource ../Resources/App.robot Resource ../Resources/Common.robot Resource ../Data/Variables/global.robot Suite Setup Setup for
```

5. Run following commands to setup DVWA and do a quick scan of the base URL

```
./BashScripts/init.sh 01__setup_dvwa.robot ./BashScripts/init.sh 03__recon_base_url.robot
```

6. Open the **log.html** file (from Results folder) in a browser window



7. Click on `Authenticate and Crawl DVWA`
8. Click on `App.Crawl ${Base_URL},${Target_Domain}`
9. Click on `Crawl.Print crawl status`
10. Click on `Collections.Log List ${ALL_IN_SCOPE_LINKS}`

TEST **Authenticate and Crawl DVWA**

Full Name: Recon Base Url.Authenticate and Crawl DVWA
Documentation: Assumptions - 1) DVWA server is up 2) DVWA setup has been completed successfully
Start / End / Elapsed: 20210927 07:59:10.938 / 20210927 07:59:28.190 / 00:00:17.252
Status: PASS

KEYWORD App. **Login to DVWA**

KEYWORD App. **Crawl** ${BASE_URL}, ${Target_Domain}

Start / End / Elapsed: 20210927 07:59:19.746 / 20210927 07:59:28.190 / 00:00:08.444

KEYWORD Crawl. **Reset global parameters**

KEYWORD Crawl. **Set target** ${Target_Domain}

KEYWORD BuiltIn. **Log** ${CURRENT_URL}

KEYWORD BuiltIn. **Log** ${CURRENT_PAGE_SOURCE_CODE}

KEYWORD SeleniumLibrary. **Capture Element Screenshot** xpath://body

KEYWORD Crawl. **Start crawling** ${Target_URL}, ${Target_Domain}

KEYWORD Crawl. **Print crawl status**

Start / End / Elapsed: 20210927 07:59:27.541 / 20210927 07:59:28.190 / 00:00:00.649

KEYWORD Crawl. **Collect final statistics**

KEYWORD Collections. **Log List** ${VISITED_LINKS}

KEYWORD Collections. **Log List** ${DISCOVERED_BUT_NOT_VISITED_LINKS}

KEYWORD Collections. **Log List** ${OUT_OF_SCOPE_LINKS}

KEYWORD Collections. **Log List** ${ALL_IN_SCOPE_LINKS}

Documentation: Logs the length and contents of the `list` using given `level`.
Start / End / Elapsed: 20210927 07:59:28.186 / 20210927 07:59:28.186 / 00:00:00.000

07:59:28.186 INFO
```
List length is 21 and it contains following items:
0: http://secqation.local/
1: http://secqation.local/about.php
2: http://secqation.local/instructions.php
3: http://secqation.local/logout.php
4: http://secqation.local/phpinfo.php
5: http://secqation.local/security.php
6: http://secqation.local/setup.php
7: http://secqation.local/vulnerabilities/brute/
8: http://secqation.local/vulnerabilities/captcha/
9: http://secqation.local/vulnerabilities/csp/
10: http://secqation.local/vulnerabilities/csrf/
11: http://secqation.local/vulnerabilities/exec/
12: http://secqation.local/vulnerabilities/fi/?page=include.php
13: http://secqation.local/vulnerabilities/javascript/
14: http://secqation.local/vulnerabilities/sqli/
15: http://secqation.local/vulnerabilities/sqli_blind/
16: http://secqation.local/vulnerabilities/upload/
17: http://secqation.local/vulnerabilities/weak_id/
18: http://secqation.local/vulnerabilities/xss_d/
19: http://secqation.local/vulnerabilities/xss_r/
20: http://secqation.local/vulnerabilities/xss_s/
```

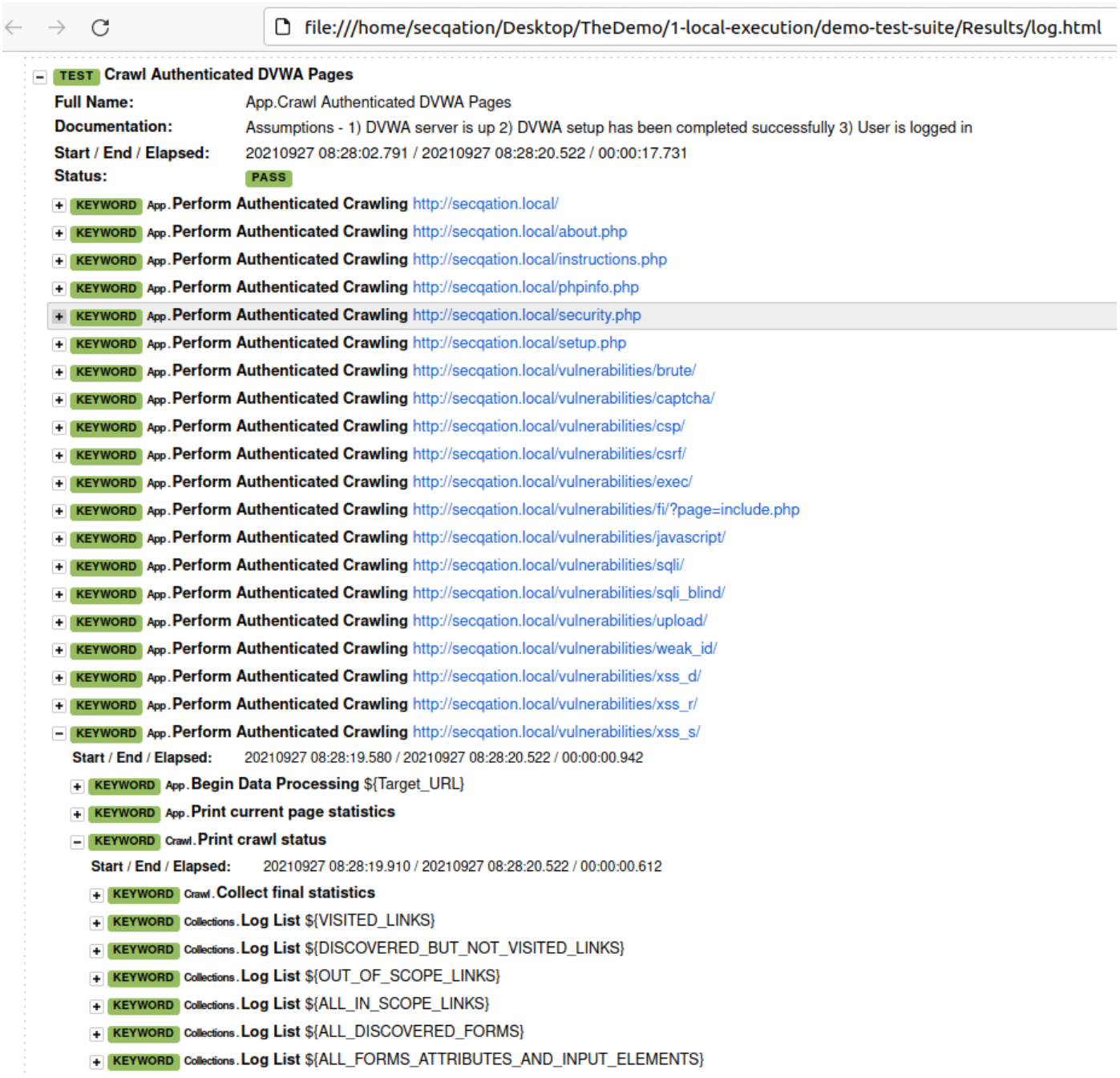
11. Copy the list of all in-scope URLs
12. Open **Tests/App.robot** test file, and pass this copied list of URLs as an argument to the `Perform Authenticated Crawling` test template

```
*** Settings ***
Resource        ../Resources/App.robot
Resource        ../Resources/Common.robot
Resource        ../Data/Variables/global.robot
Suite Setup     Setup for Authenticated Crawling of DVWA Pages
Suite Teardown  End Web Assessment

*** Test Cases ***
Crawl Authenticated DVWA Pages
    [Documentation]     Assumptions -
    ...                 1) DVWA server is up
    ...                 2) DVWA setup has been completed successfully
    ...                 3) User is logged in
    [Template]  Perform Authenticated Crawling
    http://secqation.local/
    http://secqation.local/about.php
    http://secqation.local/instructions.php
    http://secqation.local/phpinfo.php
    http://secqation.local/security.php
    http://secqation.local/setup.php
    http://secqation.local/vulnerabilities/brute/
    http://secqation.local/vulnerabilities/captcha/
    http://secqation.local/vulnerabilities/csp/
```

13. Switch to command line interface and run following command

```
$ cd ~/Desktop/TheDemo/1-local-execution/demo-test-suite $ ./BashScripts/init.sh
```

14. Refresh **log.html** page in your browser to see updated results



15. Expand respective keywords to see detailed scan report of various URLs that were passed to the test template **Perform Authenticated Crawling**

KEYWORD App . **Perform Authenticated Crawling** http://secqation.local/vulnerabilities/xss_r/

KEYWORD App . **Perform Authenticated Crawling** http://secqation.local/vulnerabilities/xss_s/

Start / End / Elapsed: 20210927 08:28:19.580 / 20210927 08:28:20.522 / 00:00:00.942

KEYWORD App . **Begin Data Processing** ${Target_URL}

KEYWORD App . **Print current page statistics**

Start / End / Elapsed: 20210927 08:28:19.793 / 20210927 08:28:19.910 / 00:00:00.117

KEYWORD BuiltIn . **Log** ${CURRENT_URL}

Documentation: Logs the given message with the given level.

Start / End / Elapsed: 20210927 08:28:19.794 / 20210927 08:28:19.794 / 00:00:00.000

08:28:19.794 INFO http://secqation.local/vulnerabilities/xss_s/

KEYWORD BuiltIn . **Log** ${CURRENT_PAGE_SOURCE_CODE}

KEYWORD Collections . **Log List** ${ALL_DISCOVERED_LINKS}

KEYWORD SeleniumLibrary . **Capture Element Screenshot** xpath://body

Documentation: Captures a screenshot from the element identified by `locator` and embeds it into log file.

Start / End / Elapsed: 20210927 08:28:19.796 / 20210927 08:28:19.909 / 00:00:00.113

08:28:19.909 INFO

KEYWORD Crawl . **Print crawl status**

Start / End / Elapsed: 20210927 08:28:19.910 / 20210927 08:28:20.522 / 00:00:00.612

KEYWORD Crawl . **Collect final statistics**

KEYWORD Collections . **Log List** ${VISITED_LINKS}

KEYWORD Collections . **Log List** ${DISCOVERED_BUT_NOT_VISITED_LINKS}

KEYWORD Collections . **Log List** ${OUT_OF_SCOPE_LINKS}

KEYWORD Collections . **Log List** ${ALL_IN_SCOPE_LINKS}

KEYWORD Collections . **Log List** ${ALL_DISCOVERED_FORMS}

KEYWORD Collections . **Log List** ${ALL_FORMS_ATTRIBUTES_AND_INPUT_ELEMENTS}

16. Locate **mitmproxy_httpolice.py** file

```
$ sudo apt install mlocate $ locate mitmproxy_httpolice.py
```

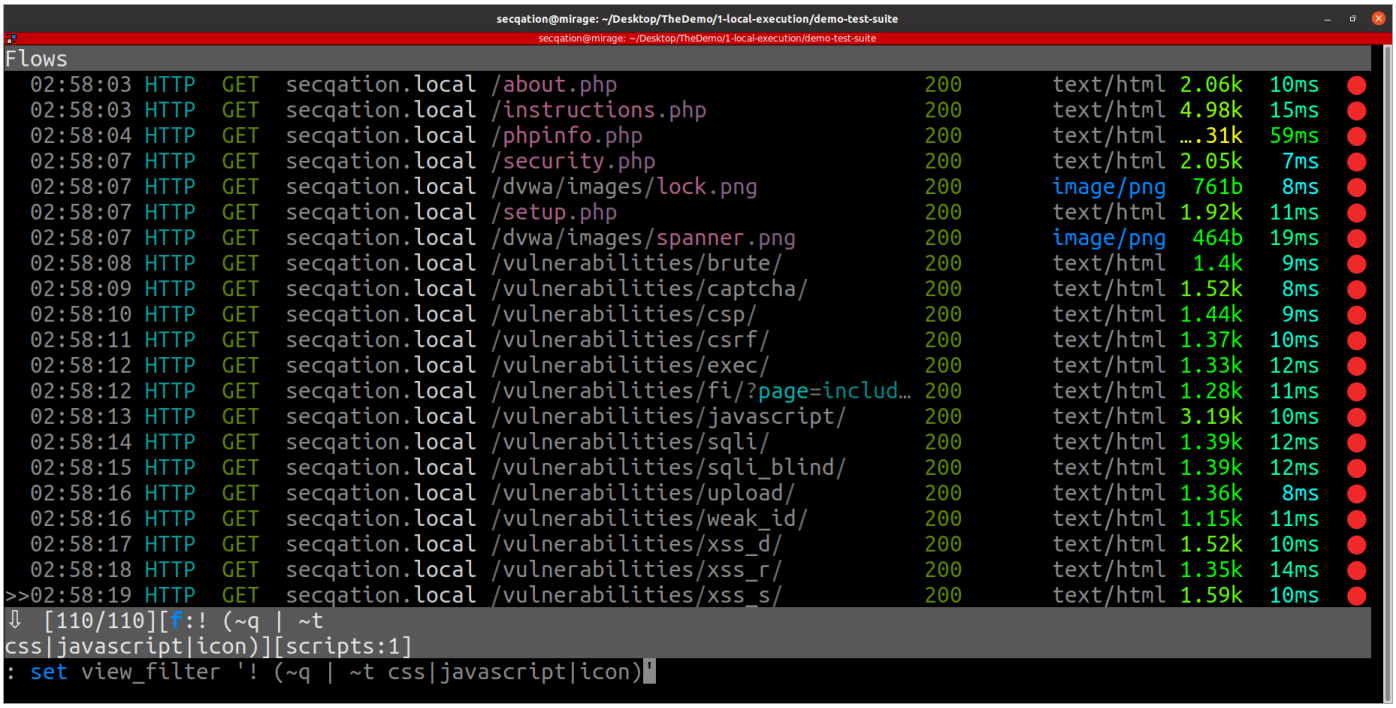
17. Check the contents of `docker-compose-httpolice.yml` file. Ensure that the **volume mappings** are correct.

```
version: "3.9" services: HTTPolice: build: context: . dockerfile: ./Input/HTTPolice/Dockerfile image: httpolice:latest container_name: httpolice volum
```

18. Run following command

```
docker-compose -f docker-compose-httpolice.yml run HTTPolice
```

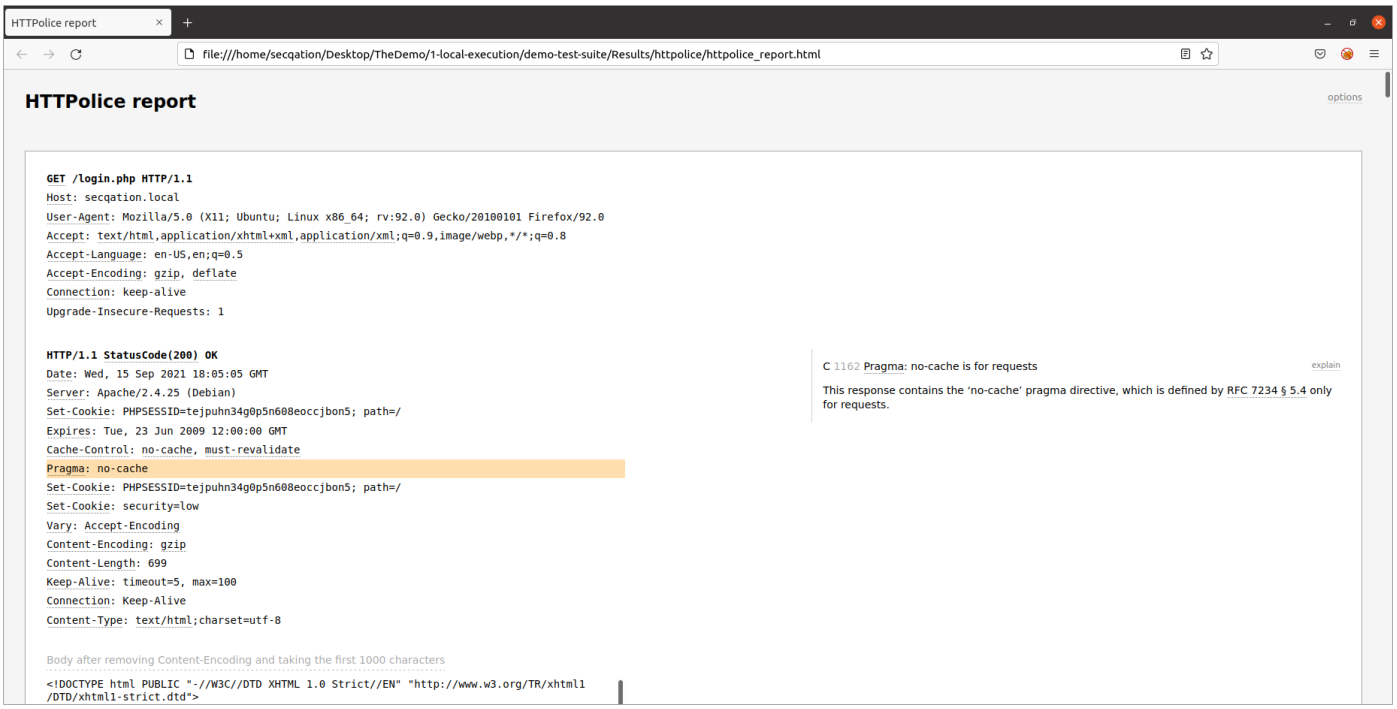
19. Press `[F]` key to set a filter expression
20. Enter `'! (~q | ~t css|javascript|icon)'` as the filter expression. This will remove any request without a response or any request that has it's content type set as css, javascript or icon.



21. Run following command to export the HTML report for filtered traffic

```
: httpolice.report.html @shown /home/mitmproxy/Output/httpolice/httpolice_report.html
```

22. Press `[Q]` key followed by `[Y]` key to exit mitmproxy
23. Access the exported HTML report from path `./Results/httpolice/httpolice_report.html`



24. If you find an interesting request, copy and paste it in Burp Suite's Repeater/ Intruder tool
25. Ask doubts, if any.

Hope you have learned something interesting.
Happy Hacking... the SecQAtion way!!

23.4 References:

- https://github.com/digininja/DVWA