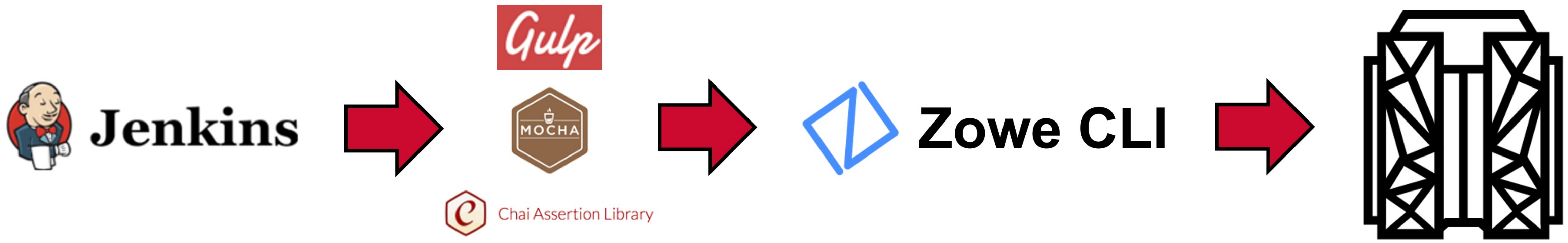
CA Brightside Infrastructure Workshop



Prerequisite Knowledge

- Required
  - A high-level understanding of what the Zowe Command Line Interface is and why it is useful
- Optional
  - Familiarity with IDEs
  - Familiarity with scripting
  - Familiarity with DevOps concepts
- Modern Tools/Languages used in this workshop
  - Zowe CLI
  - Jenkins
  - Eclipse Che
  - GitHub and Git client
  - Mocha (testing framework)
  - ooRexx (task runner)
  - JavaScript

Agenda

- Project Setup
- Use the command line interface interactively to apply maintenance to a mainframe application to better understand the automation that we will write
- Develop automation to apply maintenance to a mainframe application using a task runner and the Command Line Interface (CLI)
- Develop automation to test that maintenance has been successfully applied using a modern testing framework and the CLI
- Configure Jenkins and develop Jenkins pipeline to orchestrate the automation

Project Setup

Jenkins Access

- Jenkins Pipeline (or simply "pipeline") is a suite of plugins which supports implementing and integrating continuous delivery pipelines into Jenkins.
- A continuous delivery (CD) pipeline is an automated expression of your process for getting software from version control right through to your users and customers. Every change to your software (committed in source control) goes through a complex process on its way to being released. This process involves building the software in a reliable and repeatable manner, as well as progressing the built software (called a "build") through multiple stages of testing and deployment.
- Ensure you can access Jenkins at `http://mfwsone.broadcom.com/jenkins/`
- Ensure you can login
  - Username: `workshop_001`
  - Password: `001_workshop`

Eclipse Che Access & Setup

- Eclipse Che is an open-source, Java-based developer workspace server and online IDE. It includes a multi-user remote development platform.
- Ensure you can access Eclipse Che at `http://mfwsone.broadcom.com/dashboard/`
- Ensure you can login
  - Username: `workshop_001`
  - Password: `001_workshop`
- Select the workspace on the left side (it should have a green circle next to it)

Getting Started With the Terminal

- Open the terminal (Terminal -> Open terminal in specific container and select zowe/cli).
  - In the terminal, issue `cd /projects/Zowe-Maintenance-A-01`

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CLI - Configuration

- Within your Eclipse Che development environment, you will need to create profiles to interact with the z/OS Management Facility (z/OSMF) and CA OPS/MVS services on z/OS.
- Created to access different environments on the mainframe
  - Can connect to multiple LPARs with different usernames and passwords and ports
  - Multiple profiles can be created for an application
- Zowe V2 uses `zowe.config.json` to set up the profiles.
- Using the Zowe command line the first time, you will be prompted to enter credentials.
  - `cd /projects/Zowe-Maintenance-A-01`
  - `zowe files list ds CUST001.*`
  - You will be prompted for the
    - IP Address: `104.208.142.8`
    - Username: `CUST001`
    - Password: `CUST001`
  - If you make a mistake, you can run the command again, or issue `zowe config init`
  - Be sure you run a `zowe files list ds` command before accessing `rexx rexxfile`

CLI - Tips

- You can press the up arrow to retrieve previous commands in the console.
- You can append `-h` or `--help` to any Zowe command to learn more about command syntax and the available options.
- The environment has tab-enabled filename completion. You can use the tab key to complete the name of a file. For example, to change directories to a directory called `newdir` you can type `cd n` and hit the tab key. This would complete the command to `cd newdir`.
- The environments we are using are case-sensitive. If the directory starts with a capital Z, you must use a capital Z.

CLI - Validate z/OSMF Profile

- Verify connectivity to z/OSMF by issuing the following command:
  - `zowe zosmf check status`
- Verify you can list data sets by issuing the following command:
  - `zowe files list ds "CUST001.MTE.*"`
- Verify the zowe plugins are installed.
  - `zowe plugins list`

CLI - Validate CA OPS/MVS Profile

- Validate the CA OPS/MVS profile was successfully created to connect to the CA OPS/MVS instance by issuing the following command:
  - `zowe ops show resource GSV1001V`

Project Set Up Complete

Using Zowe CLI Interactively to Apply Maintenance to SYSVIEW

Use CLI to download software maintenance

- Typically, you would download software maintenance from some trusted server. For simplicity in this workshop, we will use the Zowe CLI to download the software maintenance from a location on z/OS.
- The Product Temporary Fix (PTF) to download is `SO07038` and it is located in USS under `/u/users/baumi07`. The PTF should be downloaded to `"bin/SO07038"`.
- To download the PTF, in the integrated terminal, issue:
  - `zowe files download uf "/u/users/baumi07/SO07038" -f "bin/SO07038" -b`
- Please confirm the file has been downloaded to a local folder named bin.

Use CLI to upload software maintenance patch to USS

- The PTF that you downloaded is the software maintenance that needs to be applied to SYSVIEW. We will use the Zowe CLI to upload the file to our home directory in USS.
- In the integrated terminal in Eclipse Che, issue:
  - `zowe files upload ftu "bin/SO07038" "/u/users/cust001/SO07038" -b`
- Please confirm the file has been uploaded by issuing the following command:
  - `zowe files list uss "/u/users/cust001"`

Review Workshop JCL

- All JCL for this workshop is in the `CUST001.MTE.JCL PDS`. You can easily download all members of this PDS via the CLI by issuing the following command:
  - `zowe files download am "CUST001.MTE.JCL" -e jcl`

Run System Modification Program Extended RECEIVE Job

- Submit the RECEIVE job by issuing the following command in the integrated terminal:
  - `zowe jobs submit ds "CUST001.MTE.JCL(RECEIVE)" -d "job-archive/receive" --rfj`
- The command will submit the job, await its completion, and download the spool output to the `job-archive/receive` directory.
- Review the output of the job for any ++HOLDDATA before proceeding `(./job-archive/receive/JOB*****/SMPEUCL/SMPRPT.txt).`
- To receive a response that is easy to parse, append `--rfj`. The Response Format JSON (rfj) flag sends the response in JSON format.
- **Note** that the JOB***** should be replaced by the `jobid` returned from the previous command.

Run SMPE APPLY CHECK Job

- Similar to RECEIVE, submit the APPLYCHK job by issuing the following command in the integrated terminal:
  - `zowe jobs submit ds "CUST001.MTE.JCL(APPLYCHK)" -d "job-archive/applyCheck"`
- Review the output of the job for any ++HOLDDATA before proceeding `(./job-archive/applyCheck/JOB*****/SMPEUCL/SMPRPT.txt).`
  - **Note** that the `JOB*****` should be replaced by the `jobid` returned from the previous command.
- Also see that we bypass Doc and Restart holds. We will automate resolving restart holds.
- **Note** that the module GSVCTIMR in the CNM4BLOD SYSLIB is a module impacted by this PTF.

Run SMPE APPLY Job

- Using your knowledge from the previous exercises, try to run a command that will submit `CUST001.MTE.JCL(APPLY)` and download the output to `job-archive/apply`
- The solution is on the next slide.

Run SMPE APPLY Job

- Similar to RECEIVE and APPLYCHK, submit the APPLY job by issuing the following command in the integrated terminal:
  - `zowe jobs submit ds "CUST001.MTE.JCL(APPLY)" -d "job-archive/apply"`
- Review the output of the job before proceeding `(./job-archive/apply/JOB*****/SMPEUCL/SMPRPT.txt).`
  - **Note** that the `JOB*****` should be replaced by the `jobid` returned from the previous command.

Shutdown SYSVIEW using OPS/MVS SSM

- The STCs managed by SSM required to run the SYSVIEW instance are GSV1001V and GSV1001U. Automation has already been written start & stop these resources.
- Run the following command to stop the resources:
  - `rexx rexxfile stop`
- `rexx rexxfile stop` runs these commands:
  - `zowe ops stop resource GSV1001U`
  - `zowe ops stop resource GSV1001V`
  - `zowe ops show resource`

Copy SMPE lib to the runtime environment

- To copy the SMPE lib to the runtime environment, we will submit an IEBCOPY job. A Rexx task has been created for you.
- To copy the SMPE lib to runtime environment, run the following command:
  - `rexx rexxfile copy`
- `rexx rexxfile copy` ensures successful completion, and logs output. It runs the following command:
  - `zowe jobs submit ds "CUST001.MTE.JCL(IEBCOPY)" -d "job-archive/copy"`

Use z/OSMF workflow to resolve holddata

- We had a restart hold on our PTF. We could resolve holddata via z/OSMF workflows. As an example, issue the following command to trigger a workflow:
  - `rexx rexxfile restartWorkflow`
- The automation runs the following Zowe CLI command:
  - `zowe zos-workflows start workflow-full --workflow-name restartSysview1 --wait`

APF authorization

- Before startup, the fixed module may require APF authorization. This process has also been scripted. Use the following command to complete APF Authorization:
  - `rexx rexxfile apf`
- The script issues the following command:
  - `zowe console issue command "SETPROG APF,ADD,DSNAME=PRODUCT.SVRUN1.MSTRBRS.CNM4BLOD,SMS" --console-name cust001`
- It also verifies the message ID CSV410I is present since the expected output is: `CSV410I SMS-MANAGED DATA SET PRODUCT.SVRUN1.MSTRBRS.CNM4BLOD ADDED TO APF LIST`

Restart SYSVIEW using OPS/MVS SSM

- Run the following command to start the resources:
  - `rexx rexxfile start`

Verify maintenance has been successfully applied

- To verify the maintenance has been applied, we will view the fix level of the particular module of interest, `GSVCTIMR`. In SYSVIEW, this can be accomplished by using the LISTDIR command:
  - `listdir PRODUCT.SVRUN1.MSTRBRS.CNM4BLOD(GSVCTIMR),,,modid`
- We have a job that will run this command in batch, `CUST001.MTE.JCL(CHECKVE)`. Try to submit this job and verify the FixLevel of GSVCTIMR is SO07038.
- Detailed instructions are provided on the next slide.

Verify maintenance has been successfully applied

- To submit the batch test and download the output, issue:
  - `zowe jobs submit ds "CUST001.MTE.JCL(CHECKVE)" -d "job-archive/version-check"`
- Manually verify that the fix level of `GSVCTIMR` is `SO07038` by reviewing `./job-archive/version-check/JOB*****/SYSVIEW/SYSPRINT.txt`.
  - **Note** that the `JOB*****` should be replaced by the `jobid` returned from the previous command.

Maintenance successfully applied!

Using Zowe CLI Programmatically to Automate the Application of Maintenance to SYSVIEW

Restore Maintenance Level to SYSVIEW

- Before automating the application of maintenance to SYSVIEW, we need to completely restore our previous maintenance level. This has been automated and the scripts are available for your review in `rexxfile.rex`
- To reset, issue:
  - `rexx rexxfile reset`

Review Steps to Interactively Apply Maintenance to SYSVIEW

- Some of these steps were already automated but this is the full list of manual commands needed:
  - `zowe files download uf "/u/users/baumi07/SO07038" -f "bin/SO07038" -b`
  - `zowe files upload ftu "bin/SO07038" "/u/users/cust001/SO07038" -b`
  - `zowe jobs submit ds "CUST001.MTE.JCL(RECEIVE)" -d "job-archive/receive"`
  - `zowe jobs submit ds "CUST001.MTE.JCL(APPLYCHK)" -d "job-archive/applyCheck"`
  - `zowe jobs submit ds "CUST001.MTE.JCL(APPLY)" -d "job-archive/apply"`
  - `zowe ops stop resource GSV1001U`
  - `zowe ops show resource GSV1001U`
  - `zowe ops stop resource GSV1001V`
  - `zowe ops show resource GSV1001V`
  - `zowe jobs submit ds "CUST001.MTE.JCL(IEBCOPY)" -d "job-archive/copy"`
  - `zowe console issue command "SETPROG APF,ADD,DSNAME=PRODUCT.SVRUN1.MSTRBRS.CNM4BLOD,SMS" --cn cust001`
  - `zowe ops start resource GSV1001V`
  - `zowe ops show resource GSV1001V`
  - `zowe ops start resource GSV1001U`
  - `zowe ops show resource GSV1001U`

How we can automate these tasks?

- Shell scripts, JavaScript, Python, etc.
- Modern task runners
- If your preferred scripting language is Rexx, you can make use of Open Object Rexx on your PC. Check out http://www.oorexx.org/ for more details.
  - ooRexx is 90% similar to z/OS standard REXX.
  - Fully compatible Windows & Linux scripting.

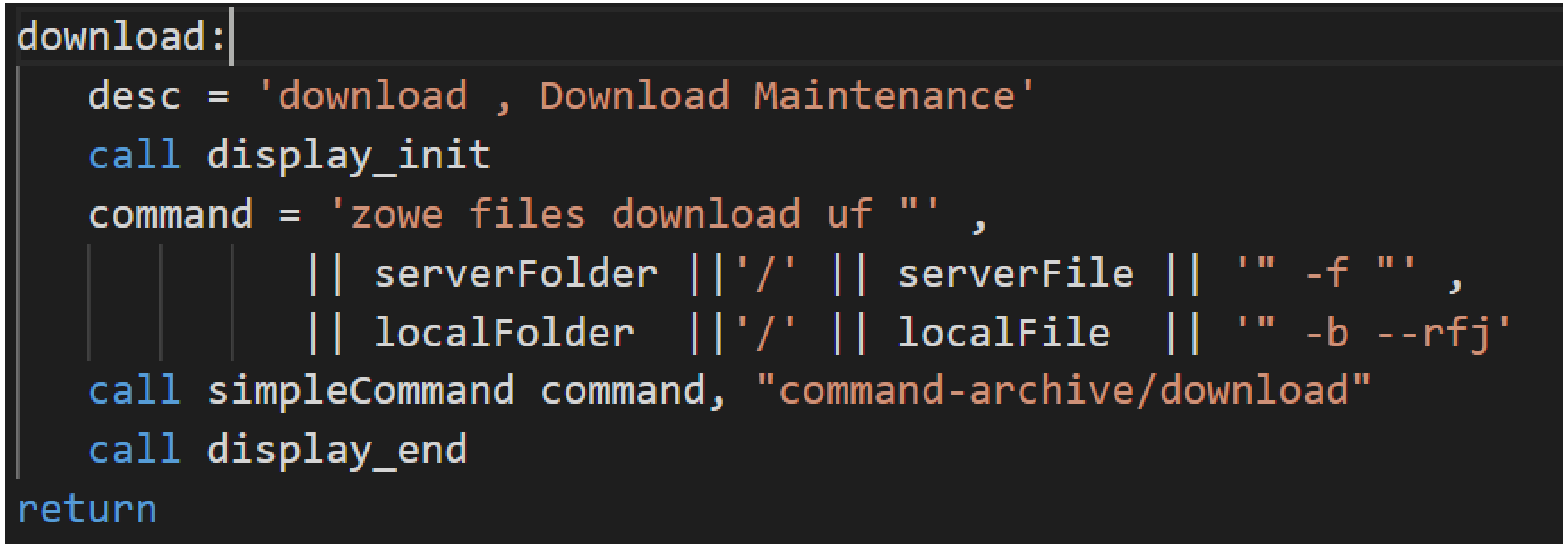
ooRexx: Getting Started

- Rexx tasks can be run form the command line in the following format:
  - `rexx <rexx-script.rex> <args>`
- Try issuing `rexx rexxfile help` in the integrated terminal.
- To help get you started, a few Rexx tasks have already been created for you.
  - `rexx rexxfile download` downloads the maintenance from a trusted location.
  - `rexx rexxfile receive` receives the maintenance into the SMPE environment
  - `rexx rexxfile applyCheck` checks the maintenance update
  - `rexx rexxfile start` starts the SYSVIEW SSM managed resources.
  - `rexx rexxfile stop` stops the SYSVIEW SSM managed resources.
- The scripts that power these commands are located in rexxfile.rex

Config file

- Using a config file simplifies the application. Instead of hardcoding everything, we have a file that contains variables in a single location.
- This allows us to use the same program on multiple applications, modifying a single file.
- Review config.json to view all the configurable variables for this project.

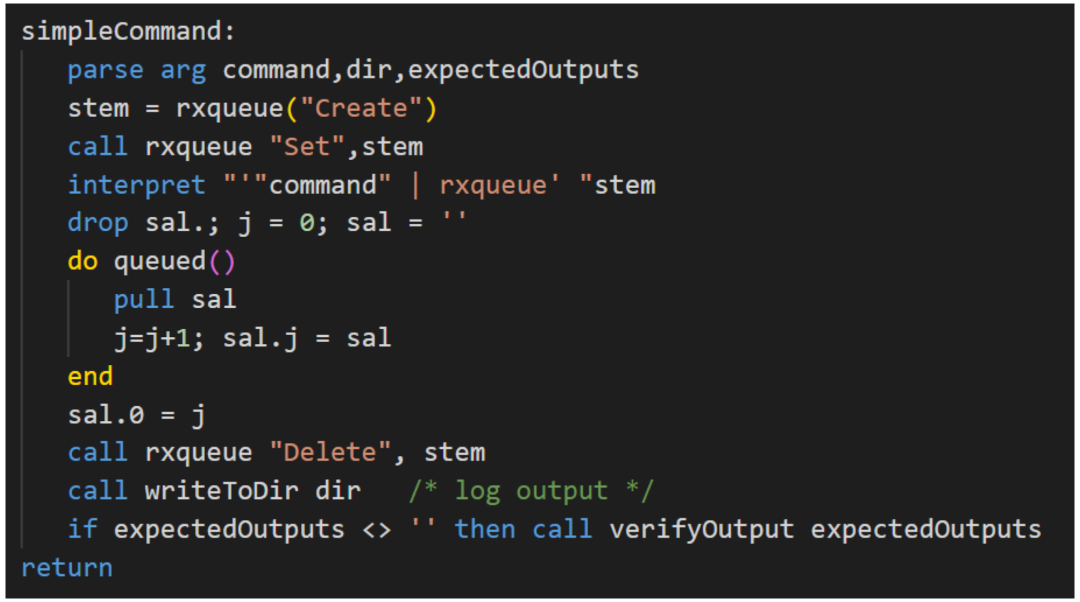
Rexxfile download



```
download:
    desc = 'download , Download Maintenance'
    call display_init
    command = 'zowe files download uf "' ,
              || serverFolder ||'/' || serverFile || '" -f "' ,
              || localFolder  ||'/' || localFile  || '" -b --rfj'
    call simpleCommand command, "command-archive/download"
    call display_end
return
```

- At the beginning and at the end of each subroutine there are calls to display the timestamp of the start and on the finish of the task.
- `rexxfile download` calls the `zowe files download uf` command. To make our rexxfile.rex easier to maintain and customize, the parameters from the config.json file are used here.
- The command is then passed into a simpleCommand function along with a directory to log the output to. Control will be returned when the upload task is complete. Let's investigate this function.

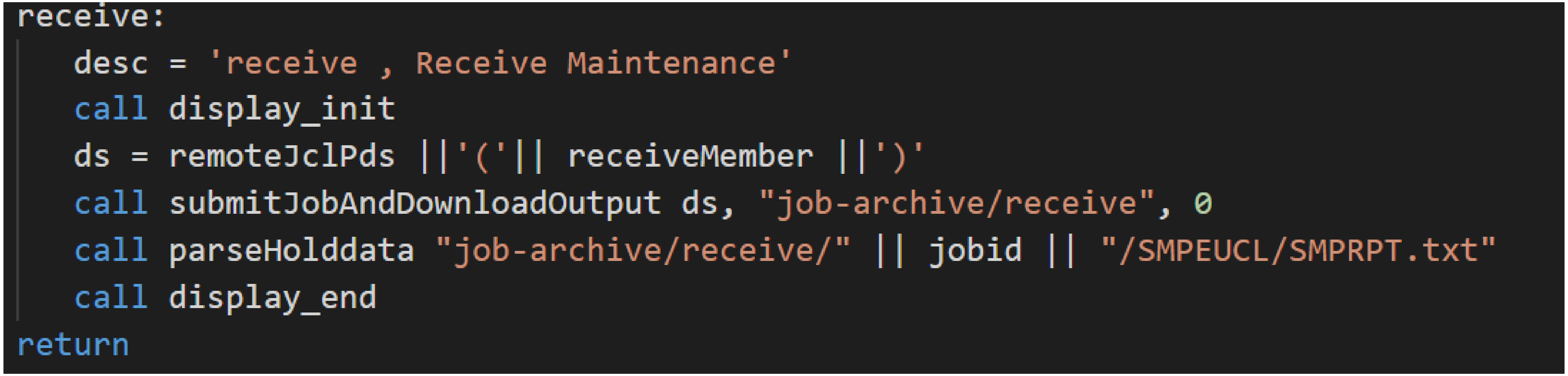
Rexxfile - simpleCommand function



```
simpleCommand:
   parse arg command,dir,expectedOutputs
   stem = rxqueue("Create")
   call rxqueue "Set",stem
   interpret "'"command" | rxqueue' "stem
   drop sal.; j = 0; sal = ''
   do queued()
      pull sal
      j=j+1; sal.j = sal
   end
   sal.0 = j
   call rxqueue "Delete", stem
   call writeToDir dir   /* log output */
   if expectedOutputs <> '' then call verifyOutput expectedOutputs
return
```

- `simpleCommand` provides logging and error handling for us. We send a command to run, a directory to log output to, and optionally a list of expected outputs from the command. `simpleCommand` then runs the command, logs the output, optionally verifies the output and makes the callback with appropriate error information. It should be used whenever you want to run a command, alert if the command has an error, and optionally alert if the output does not contain an expected output.

Rexxfile receive



```
receive:
    desc = 'receive , Receive Maintenance'
    call display_init
    ds = remoteJclPds ||'('|| receiveMember ||')'
    call submitJobAndDownloadOutput ds, "job-archive/receive", 0
    call parseHolddata "job-archive/receive/" || jobid || "/SMPEUCL/SMPRPT.txt"
    call display_end
return
```

- Rexxfile receive calls the `submitJobAndDownloadOutput` function with three arguments
  - The data set that contains the JCL to submit
  - The location to save the job output to
  - The maximum return code of the job that is acceptable
- Let's investigate the `submitJobAndDownloadOutput` function

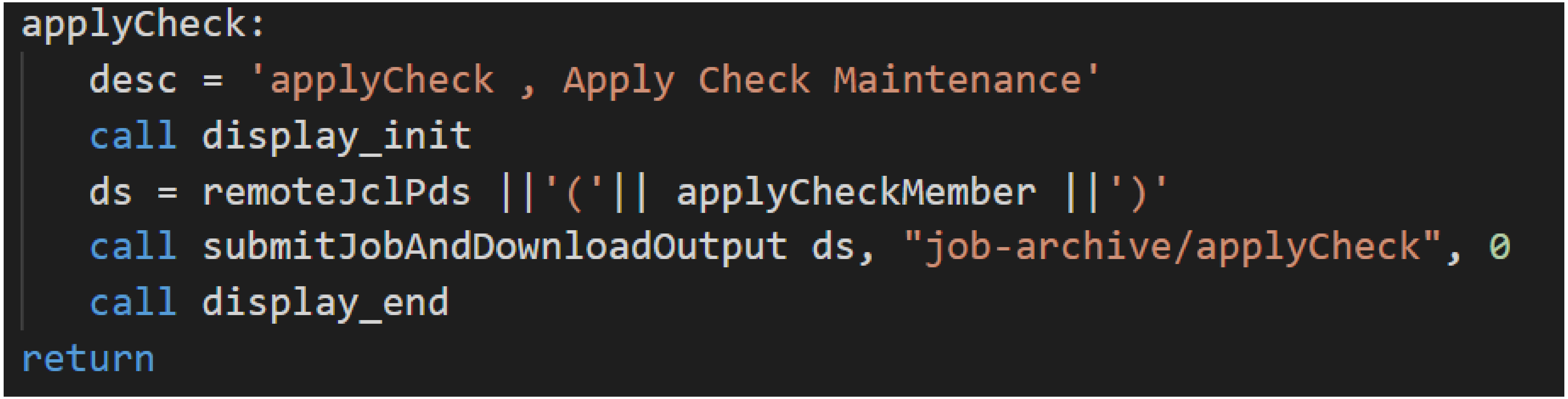
Rexxfile receive - submitJobAndDownloadOutput

- This function submits the job, awaits completion, downloads the output to the desired directory, logs the command output to a file, and verifies the condition code is less than some supplied value.
- It uses the `zowe jobs submit data-set` command.
- The script submits the command with the `--rfj` flag to receive the output in JSON format for easy parsing. The script ensures the job completes with a return code value less than or equal to the supplied `maxRC`, else it fails the task.
- This function should be called when you want to submit a job, download the output, and confirm the job completes with a satisfactory condition code.

Rexxfile receive - parseHolddata

- In the case of the receive task, the callback will parse the hold data. This function accepts one parameter, the local file path to read the holddata from. In this case, we point to the downloaded SMPRPT spool content.
- The function parses the holds and looks at SMP/E hold reason ids. It then creates a representative holddata/actions.json file. The contained JSON object has the following three Boolean properties
  - remainingHolds -> True designates there are holds that cannot be handled by automation and requires manual intervention
  - restart -> True designates automation needs to run to restart SYSVIEW
  - reviewDoc -> True designates a doc hold was found

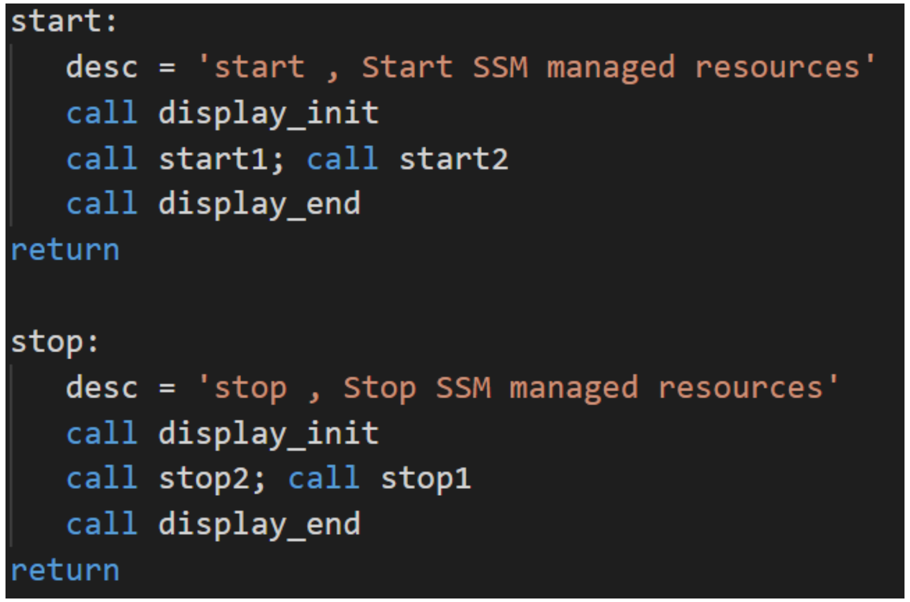
Rexxfile applyCheck



```
applyCheck:
    desc = 'applyCheck , Apply Check Maintenance'
    call display_init
    ds = remoteJclPds ||'('|| applyCheckMember ||')'
    call submitJobAndDownloadOutput ds, "job-archive/applyCheck", 0
    call display_end
return
```

- `rexx rexxfile applyCheck` is similar to `rexx rexxfile receive` but a little simpler since the callback to the `submitJobAndDownloadOutput` is just the callback that signals the rexx task's completion. In this case, we are concerned only with the return code and we are not parsing holddata.

Rexxfile start & stop

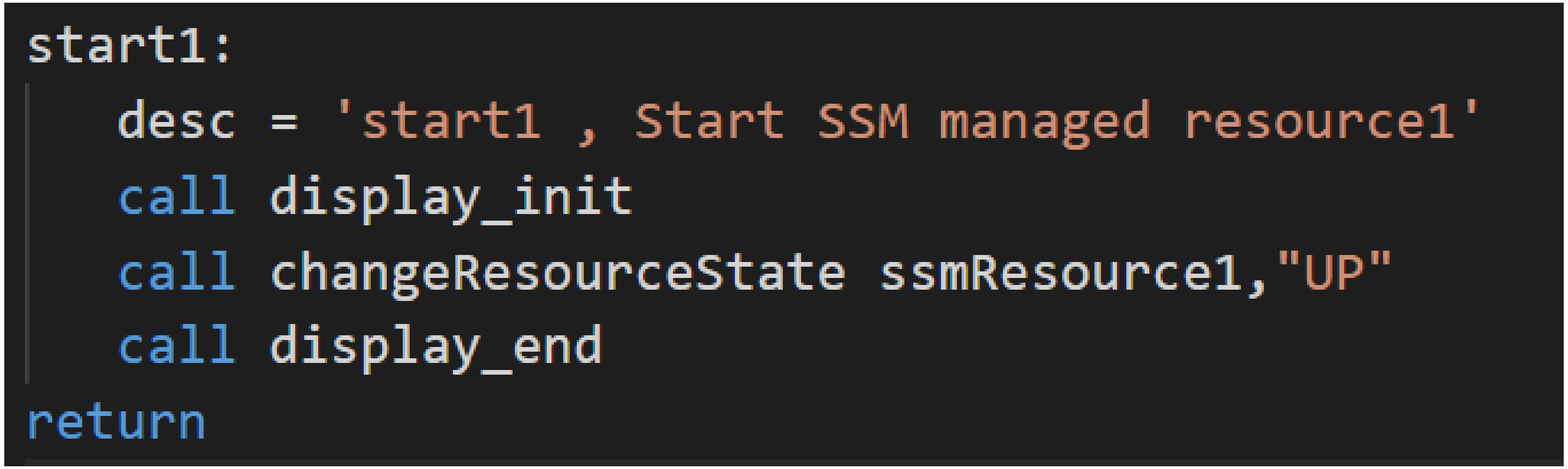


```
start:
    desc = 'start , Start SSM managed resources'
    call display_init
    call start1; call start2
    call display_end
return

stop:
    desc = 'stop , Stop SSM managed resources'
    call display_init
    call stop2; call stop1
    call display_end
return
```

- `Rexxfile start` and `stop` tasks combine multiple tasks into a single action. Two resources must be brought up to start SYSVIEW.
- `Rexxfile start` first starts `GSV1001V` then `GSV1001U`
- `Rexxfile stop` first stops `GSV1001U` then `GSV1001V`
- Let's investigate the `start1` task

Rexxfile start1



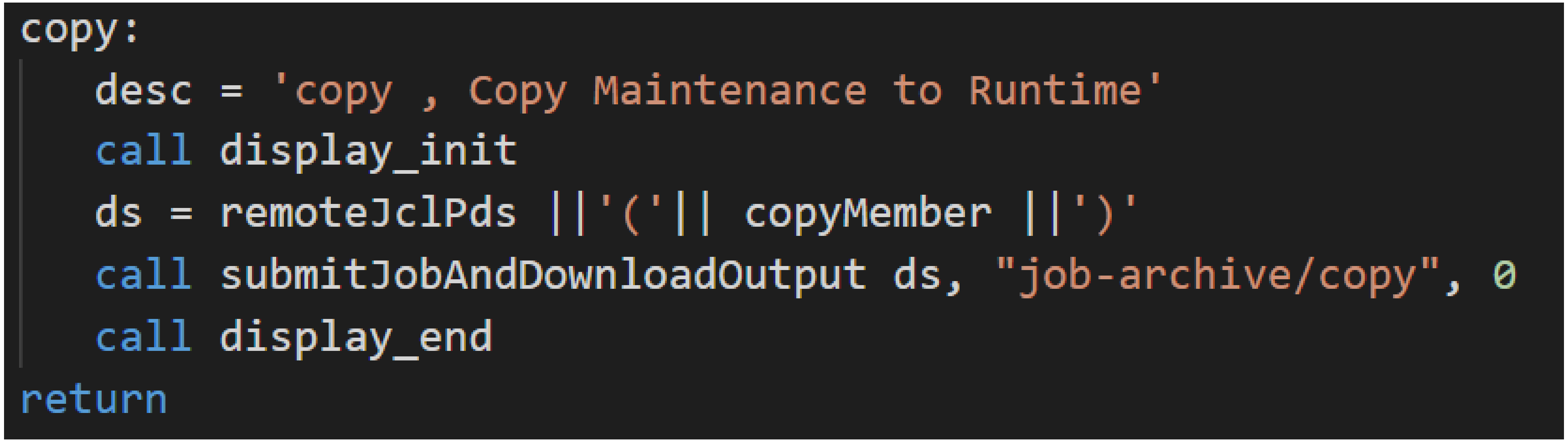
```
start1:
    desc = 'start1 , Start SSM managed resource1'
    call display_init
    call changeResourceState ssmResource1,"UP"
    call display_end
return
```

- `rexx rexxfile start1` calls the `changeResourceState` function with two arguments
  - The SSM managed resource to change the state of
  - The desired state ("UP" or "DOWN")
- Let's investigate the `changeResourceState` function

Rexxfile start1 - changeResourceState

- The function accepts up to three parameters:
  - The SSM managed resource to change the state of
  - The desired state ("UP" or "DOWN")
  - Optional parameter where you can supply the name of a data set to be APF authorized after the SSM state is changed. It could be useful when changing the desired state of a resource to "UP".
- Depending on the desired state, it either exercises the `zowe ops start resource` command or the `zowe ops stop resource` command. The function calls another function named `awaitSSMState` that polls the state of the resource using the `zowe ops show resource` command until the desired state or a timeout is reached. The output of each command issued is logged to a file. Finally, if the APF option is used, the function uses a `zowe console issue cmd` command to APF authorize a data set.
- This function should be used whenever you want to change the state of a SSM managed resource.

Rexxfile copy



```
copy:
    desc = 'copy , Copy Maintenance to Runtime'
    call display_init
    ds = remoteJclPds ||'('|| copyMember ||')'
    call submitJobAndDownloadOutput ds, "job-archive/copy", 0
    call display_end
return
```

- The `rexxfile copy` task handles copying the designated library from the SMP/E environment to the runtime environment.

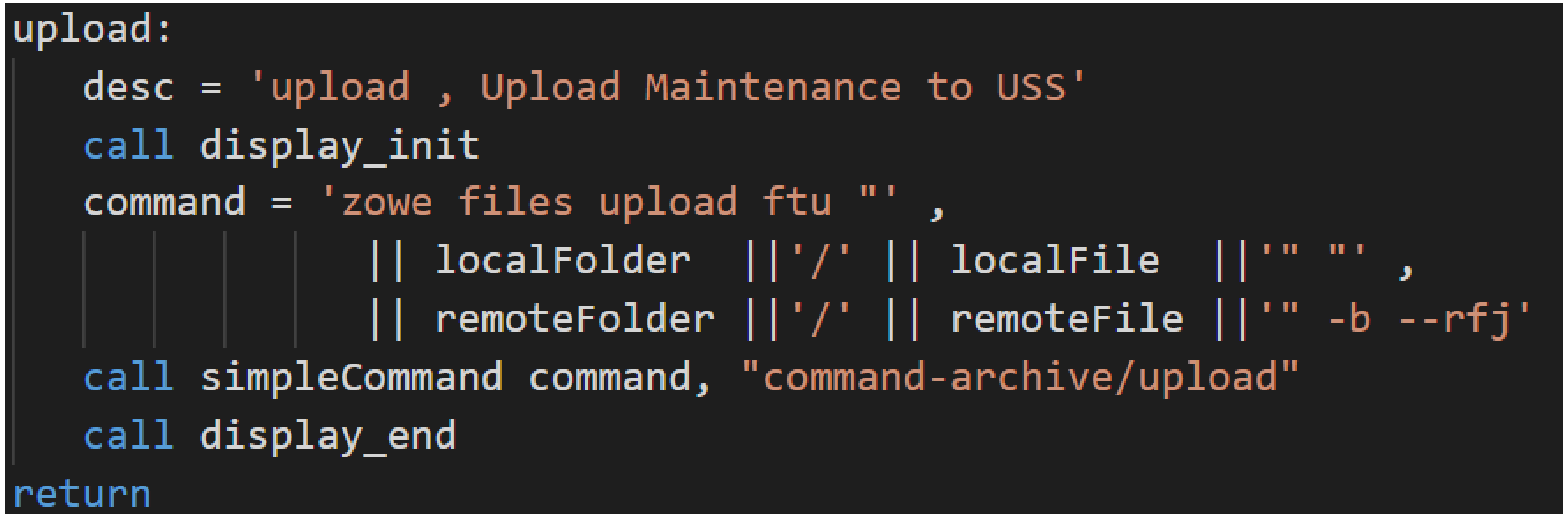
Let's Automate!

- Issue `rexx rexxfile download` to download the PTF.
- This task has already been automated:
  - `zowe files download uf "/u/users/baumi07/SO07038" -f "bin/SO07038" -b`

Rexxfile upload

- The next task to automate is:
  - `zowe files upload ftu "bin/SO07038" "/u/users/cust001/SO07038" -b --rfj`
- Use the `rexx rexxfile download` task as a template.
- When creating additional rexx tasks, try to keep them in alphabetical order in `rexxfile.rex`.
- First, you will need to change the data set your are submitting. You will need to review `config.json` to find the property that represents the local and remote locations.
- Second, you should change where you are storing the output from `command-archive/download` to `command-archive/upload`
- A completed solution is available for reference on the next slide.
- Try it out! Issue `rexx rexxfile upload` to execute the command.

Rexxfile upload



```
upload:
   desc = 'upload , Upload Maintenance to USS'
   call display_init
   command = 'zowe files upload ftu "' ,
                || localFolder  ||'/' || localFile  ||'" "' ,
                || remoteFolder ||'/' || remoteFile ||'" -b --rfj'
   call simpleCommand command, "command-archive/upload"
   call display_end
return
```

- `rexx rexxfile upload` uses the `zowe files upload ftu` command.
- Similar to the `rexx rexxfile download` task, the command is then passed into the `simpleCommand` function along with a directory to log the output to.

Receive and applyCheck!

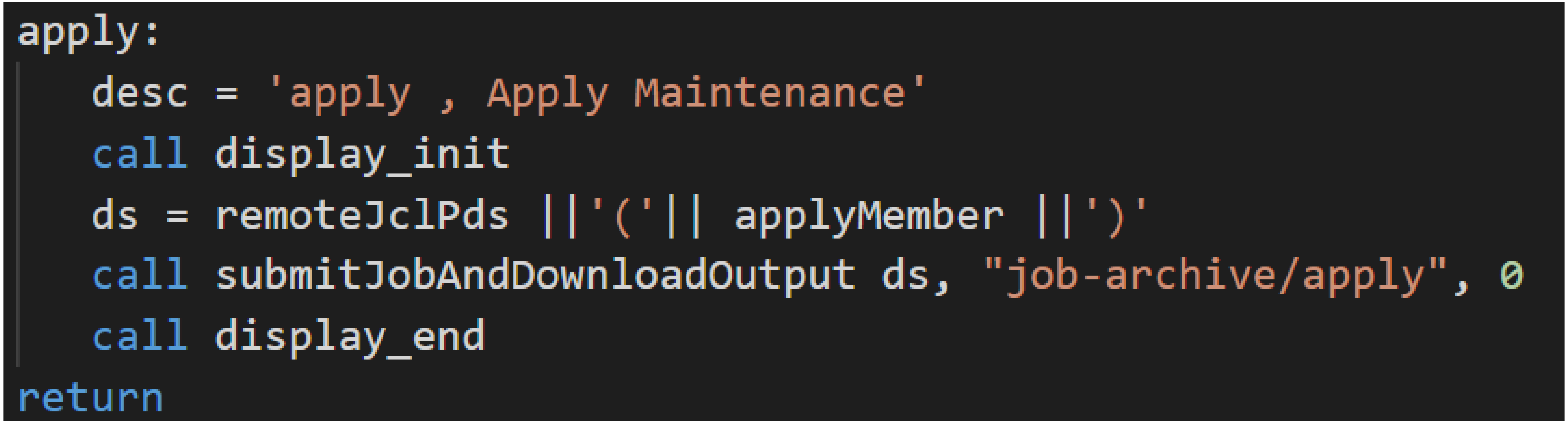
- The next couple tasks have already been automated:
  - `zowe jobs submit ds "CUST001.MTE.JCL(RECEIVE)" -d "job-archive/receive"`
  - `zowe jobs submit ds "CUST001.MTE.JCL(APPLYCHK)" -d "job-archive/applyCheck"`
- Issue `rexx rexxfile receive` to receive the maintenance into the SMPE environment.
- Issue `rexx rexxfile applyCheck` to check the maintenance update

Rexxfile apply

- The next task to automate is:
  - `zowe jobs submit ds "CUST001.MTE.JCL(APPLY)" -d "job-archive/apply"`
- Use the `rexx rexxfile receive` task as a template.
- First, you will need to change the data set your are submitting. You will need to review `config.json` to find the property that represents the APPLY member.
- Second, you should change where you are storing the output from `job-archive/receive` to `job-archive/apply`
- A completed solution is available for reference on the next slide.
- Try it out! Issue `rexx rexxfile apply` to exercise the automation.

Rexxfile apply

- Sample apply task:



```
apply:
    desc = 'apply , Apply Maintenance'
    call display_init
    ds = remoteJclPds ||'('|| applyMember ||')'
    call submitJobAndDownloadOutput ds, "job-archive/apply", 0
    call display_end
return
```

Rexxfile stop

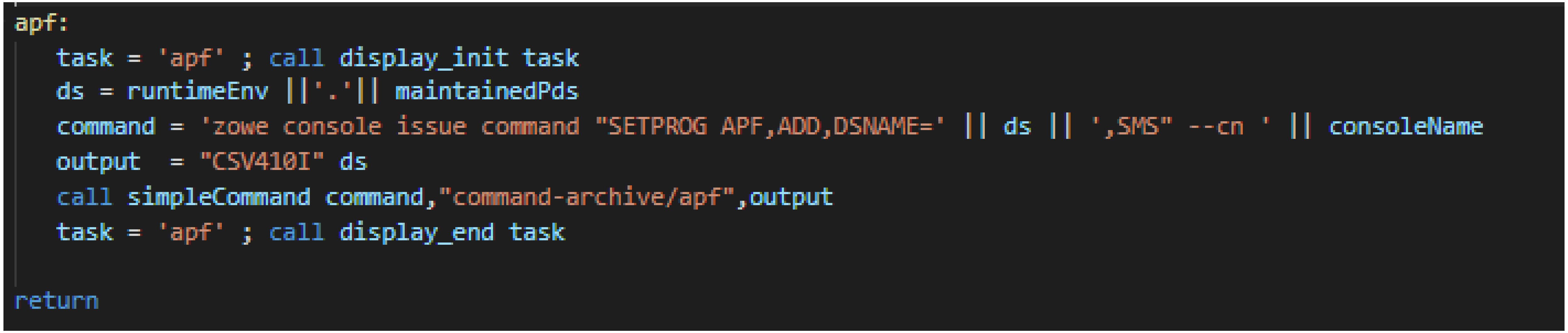
- Issue `rexx rexxfile stop` to stop the SYSVIEW resources.
- These tasks were executed for you in `rexx rexxfile stop`:
  - `zowe ops stop resource GSV1001U`
  - `zowe ops show resource GSV1001U`
  - `zowe ops stop resource GSV1001V`
  - `zowe ops show resource GSV1001V`

Rexxfile copy

- This task has also already been automated:
  - `zowe jobs submit ds "CUST001.MTE.JCL(IEBCOPY)" -d "job-archive/copy"`
- Run the following command to copy the SMPE lib to runtime environment:
  - `rexx rexxfile copy`

Rexxfile apf

- The final task to automate in this section was:
  - `zowe console issue command "SETPROG APF,ADD,DSNAME=PRODUCT.SVRUN1.MSTRBRS.CNM4BLOD,SMS" --cn cust001`
- This task has been automated for you. Notice how the task checks to ensure the data set name and correct message id are supplied in the output. Recall that we expected output to be:
  - `CSV410I SMS-MANAGED DATA SET PRODUCT.SVRUN1.MSTRBRS.CNM4BLOD ADDED TO APF LIST`
- To add CNM4BLOD to the APF list, run:
  - `rexx rexxfile apf`



```
apf:
   task = 'apf' ; call display_init task
   ds = runtimeEnv ||'.'|| maintainedPds
   command = 'zowe console issue command "SETPROG APF,ADD,DSNAME=' || ds || ',SMS" --cn ' || consoleName
   output  = "CSV410I" ds
   call simpleCommand command,"command-archive/apf",output
   task = 'apf' ; call display_end task

return
```

Rexxfile start

- Issue `rexx rexxfile start` to start the SYSVIEW resources.
- These commands are run in the start command:
    - `zowe ops start resource GSV1001V`
    - `zowe ops show resource GSV1001V`
    - `zowe ops start resource GSV1001U`
    - `zowe ops show resource GSV1001U`

Mission Complete: Delivery of Maintenance is Now Automated

Using Zowe CLI Programmatically to Verify the Successful Application of Maintenance to SYSVIEW

Review Steps to Verify Maintenance was Applied to SYSVIEW

- `zowe jobs submit ds "CUST001.MTE.JCL(CHECKVE)" -d "job-archive/version-check"`
- Manually verify that the fix level of `GSVCTIMR` is SO07038 by reviewing `./job-archive/version-check/JOB*****/SYSVIEW/SYSPRINT.txt`.
  - **Note** that the `JOB*****` should be replaced by the jobid returned from the previous command.

How we can automate this test?

- Shell scripts, JavaScript, Python, etc.
- Modern test frameworks like Mocha.js
  - https://mochajs.org/
  - Modern test frameworks have assertion libraries that make testing quick and easy.
- The tests are located in `test/test.js` from the project's root.

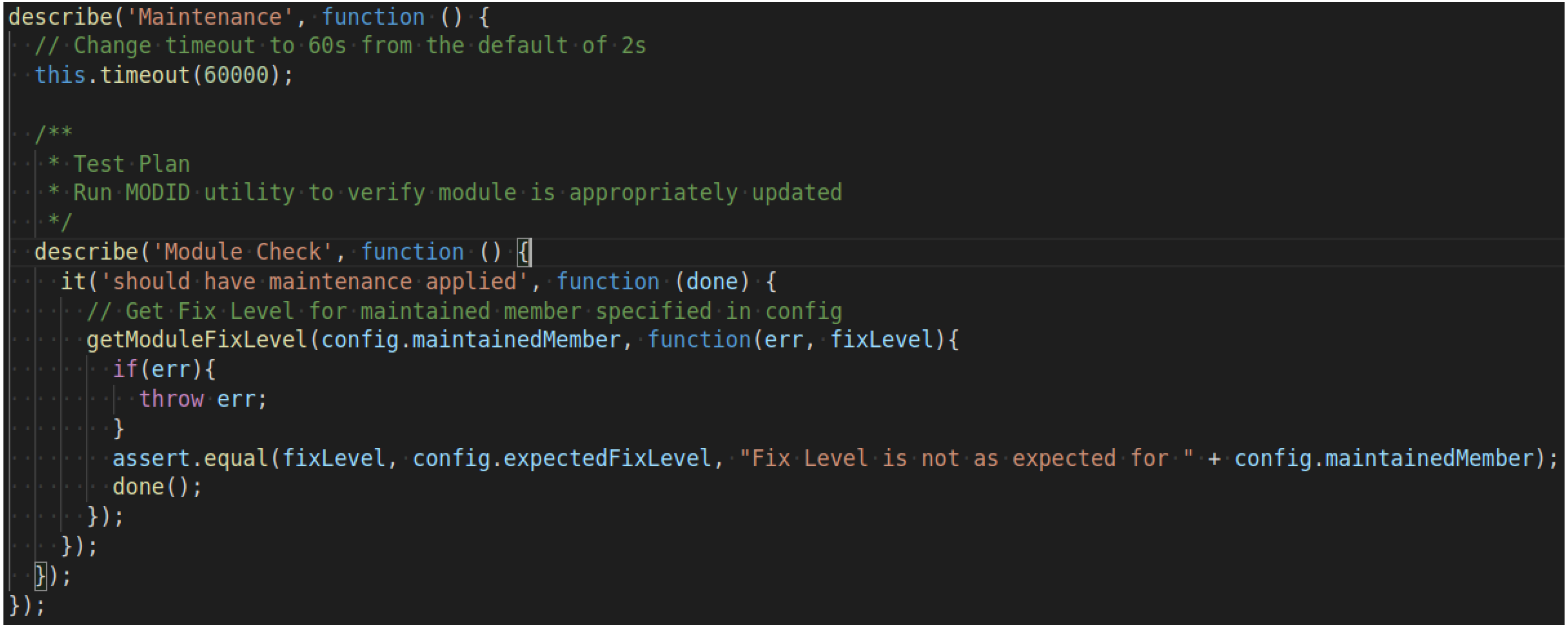
Mocha Tests

- Tests are located in test/test.js.
- Navigate to the describe Maintenance test suite. Under the project's test suite, there is a test plan titled Module Check where a single test resides: `it('should have maintenance applied'`...This test should verify the maintenance was applied successfully.
- This test calls `getModuleFixLevel` to retrieve the input module fix level.
  - The function returns an `awaitFixLevelCallback` which consists of an `Error` object in case something undesirable occurs and a string containing the `fixLevel` if the module is found in the table or null if not found.
  - The function:
    - Submits a job using the `zowe jobs submit data-set` command
    - Downloads the spool content
    - Logs the command output, and verifies the job completed with condition code 0.
    - Then the function parses the appropriate downloaded spool file, just like any other file, and returns the `fixLevel` if found, null if not found.

Assertion Libraries

- Assertion libraries are tools that are used to verify things are as we expect.
- Mocha can use the Chai Assertion Library
- To verify something is equal to a certain value, we can employ an assertion statement: `assert.equal(actual, expected, "message if not as expected");` For example, `assert.equal(banana.color, yellow, "Banana is no longer yellow");`
- Try adding the assertion in the test just before the `done()` is called.
- Test whether the actual `fixLevel` is equal to `config.expectedFixLevel` and if not, output the message `"Fix Level is not as expected for " + config.maintainedMember`
- A completed sample is provided on the next slide.

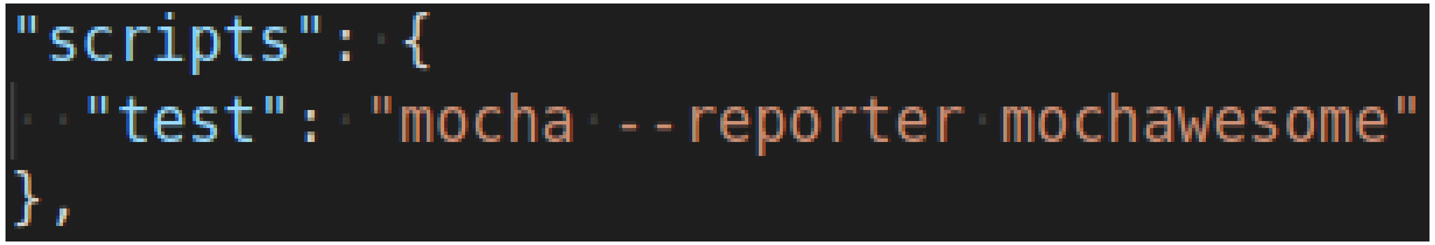
Complete Test



```javascript
describe('Maintenance', function () {
  // Change timeout to 60s from the default of 2s
  this.timeout(60000);

  /**
   * Test Plan
   * Run MODID utility to verify module is appropriately updated
   */
  describe('Module Check', function () {
    it('should have maintenance applied', function (done) {
      // Get Fix Level for maintained member specified in config
      getModuleFixLevel(config.maintainedMember, function(err, fixLevel){
        if(err){
          throw err;
        }
        assert.equal(fixLevel, config.expectedFixLevel, "Fix Level is not as expected for " + config.maintainedMember);
        done();
      });
    });
  });
});
```

Invoking the Test



```
"scripts": {
  "test": "mocha --reporter mochawesome"
},
```

- Npm scripts can be developed in package.json located at the project's root. **Note** the above snippet.
- This means that the test script can be invoked with `npm test`.
- **Note** that a reporter is also used to create graphical reports with no additional effort required by us.
- Give it a try! Run `npm test` in your terminal.

Viewing the Test Reports

- After the tests have run, a report should be generated. From the root directory, it is `mochawesome-report/mochawesome.html`. To view the report, right click on the html file and select `Open With>Preview`.

Application of maintenance to SYSVIEW is automated!

Orchestrating the Application of Maintenance to SYSVIEW via Jenkins

Restore Maintenance Level to SYSVIEW

- Before proceeding, issue `rexx rexxfile reset` to reset the maintenance level.

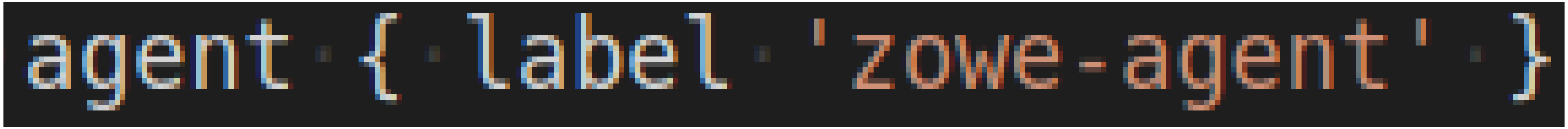
Jenkins Introduction

- Jenkins is an open source automation server commonly used for continuous integration testing.
- However, pipelines can be built to facilitate other automated tasks. It is useful for centralizing automation for multiple collaborators to develop, exercise, and manage.
- In this final section, we will construct a Jenkins pipeline that automate the delivery of maintenance to SYSVIEW using automation we have already developed. By developing a pipeline, we will have an audit trail and more transparency into the activities that are being performed.
- More information is available on Jenkins at https://jenkins.io/.

Jenkins Kickoff

- Navigate to our Jenkins instance at `http://mfwsone.broadcom.com/jenkins/`
- Login
  - Username: `workshop_001`
  - Password: `001_workshop`
- Click on the `workshop_001` project
- Click on the `master` branch
- Click on the `Build Now` button located in the top left navigation menu.
- Watch the pipeline progress in a modern view. Click the `Blue Ocean` button located in the top left navigation menu.
- The pipeline is just a template. You will need to fill in the details in this exercise.

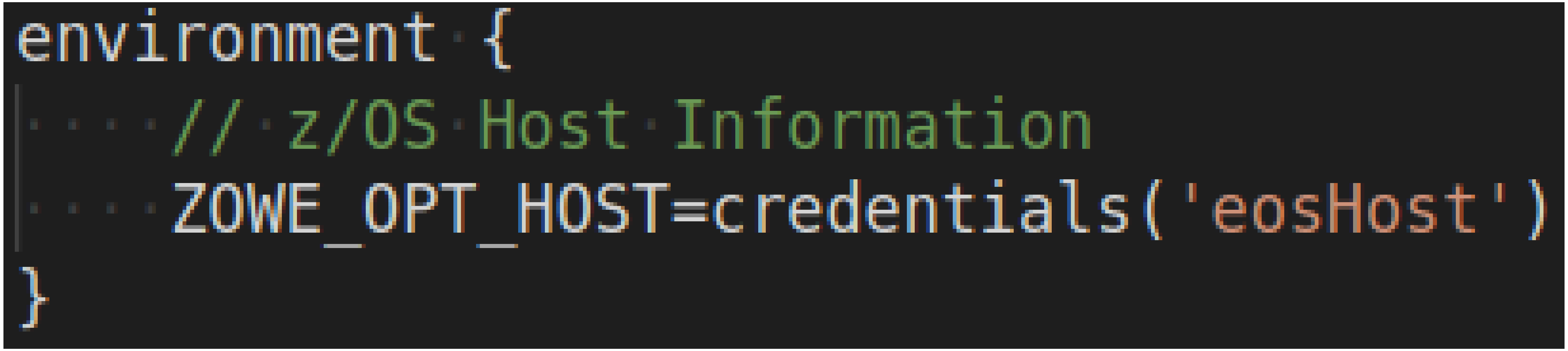
Jenkins Kickoff



```
agent { label 'zowe-agent' }
```

- The code that drives the Jenkins pipeline is contained within the Jenkinsfile at the project's root. Let's walk through this file to understand how it works.
- First, we have:
  - The agent directive dictates where the pipeline will run. In this case, the pipeline will run in a 'zowe-agent' which is the label to a docker container in our Jenkins configuration. This docker container contains the Zowe CLI as well as the necessary CA OPS/MVS for Zowe CLI plugin.

Jenkins Kickoff



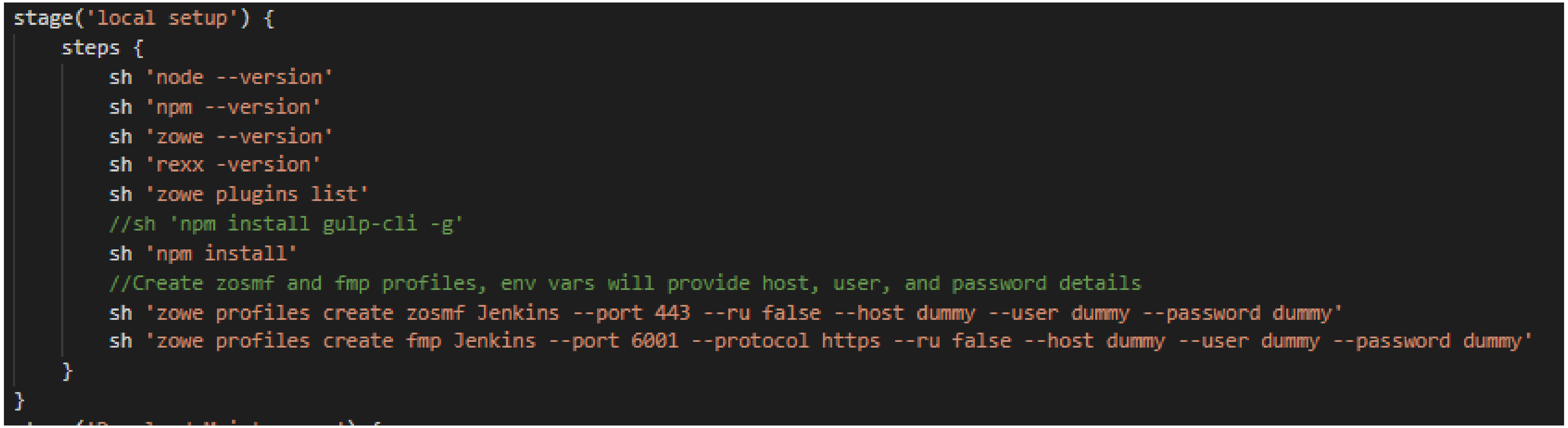
```
environment {
    // z/OS Host Information
    ZOWE_OPT_HOST=credentials('eosHost')
}
```

- Next, we have:
  - The environment directive allows for environment variables to be defined
  - **Note** that the directive supports a special helper method `credentials()` which is used to access Jenkins credentials by their unique identifier. In this case, a credential with ID of `eosHost` is accessed.
  - If you return to your workshop_001 project in the classic view (not Blue Ocean), you will see a `Credentials` button in the left side navigation. If you click that, you will be able to see two credentials scoped to your workshop_001 project. One is `eosHost`, and the other is `eosCreds`.

Command Line Precedence

- The CLI can receive options from three places. In order, they are
  - Directly on the command line (e.g. `--host myHost`)
  - Environment variables (`ZOWE_OPT_` followed by the option name, e.g. `ZOWE_OPT_HOST`)
  - Profiles (which you set up earlier in your Che environment)
- In this exercise, we will use `ZOWE_OPT_HOST`, `ZOWE_OPT_USER`, and `ZOWE_OPT_PASSWORD` to influence our commands.

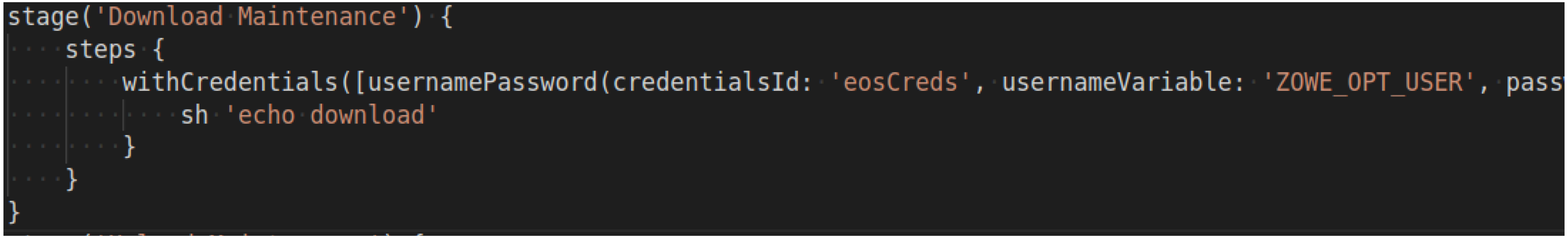
Jenkins Kickoff



```
stage('local setup') {
    steps {
        sh 'node --version'
        sh 'npm --version'
        sh 'zowe --version'
        sh 'rexx -version'
        sh 'zowe plugins list'
        //sh 'npm install gulp-cli -g'
        sh 'npm install'
        //Create zosmf and fmp profiles, env vars will provide host, user, and password details
        sh 'zowe profiles create zosmf Jenkins --port 443 --ru false --host dummy --user dummy --password dummy'
        sh 'zowe profiles create fmp Jenkins --port 6001 --protocol https --ru false --host dummy --user dummy --password dummy'
    }
}
```

- Next, we have:
  - Stages are logical sets of steps
  - In the `local setup` stage, we report the versions of Node, NPM, and Zowe CLI as well as the list of available Zowe CLI plugins in our `zowe-agent` environment.
  - ooRexx should be installed on our base operating system.
  - Finally, we set up our zosmf and fmp profiles. `dummy` is used for host, user, and password since we will provide this information via environment variables. The ops profile will be set up later. The ops profile does not currently expose its profile options on each command so we will need access to our user and password environment variables to create the ops profile.

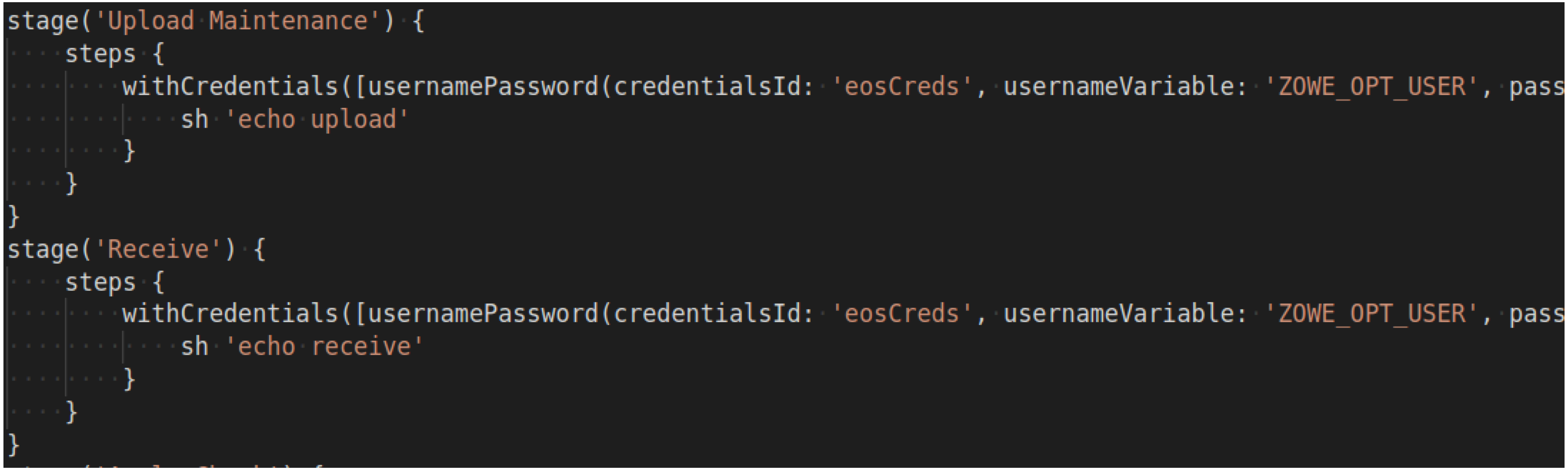
Jenkins Kickoff



```
stage('Download Maintenance') {
    steps {
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', pass
            sh 'echo download'
        }
    }
}
```

- Next, we have:
  - A stage for downloading the maintenance. Currently, the stages just echo their intention as output. We will be changing the content of these steps to make use of the automation we have already written.
  - Notice the script is run in a "withCredentials" block. Within these blocks, the code will have access the username and password variables that have been set up in Jenkins.

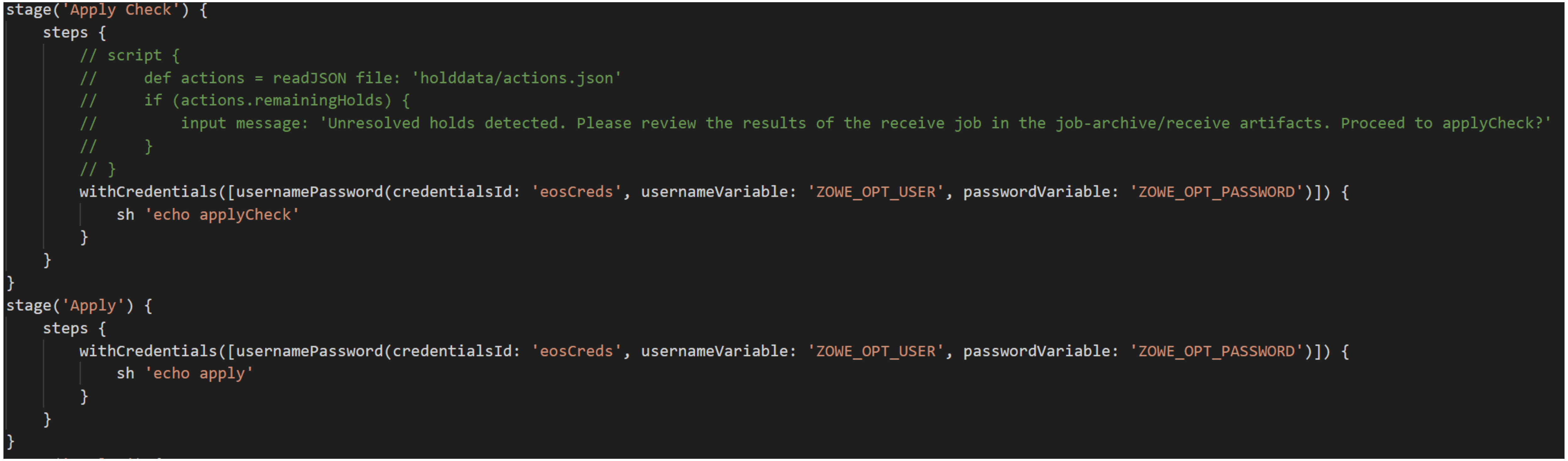
Jenkins Kickoff



```
stage('Upload Maintenance') {
    steps {
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', pass
            sh 'echo upload'
        }
    }
}
stage('Receive') {
    steps {
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', pass
            sh 'echo receive'
        }
    }
}
```

- Next, we have:
    - A stage for uploading maintenance to USS and a stage for receiving the maintenance into our SMP/E environment.

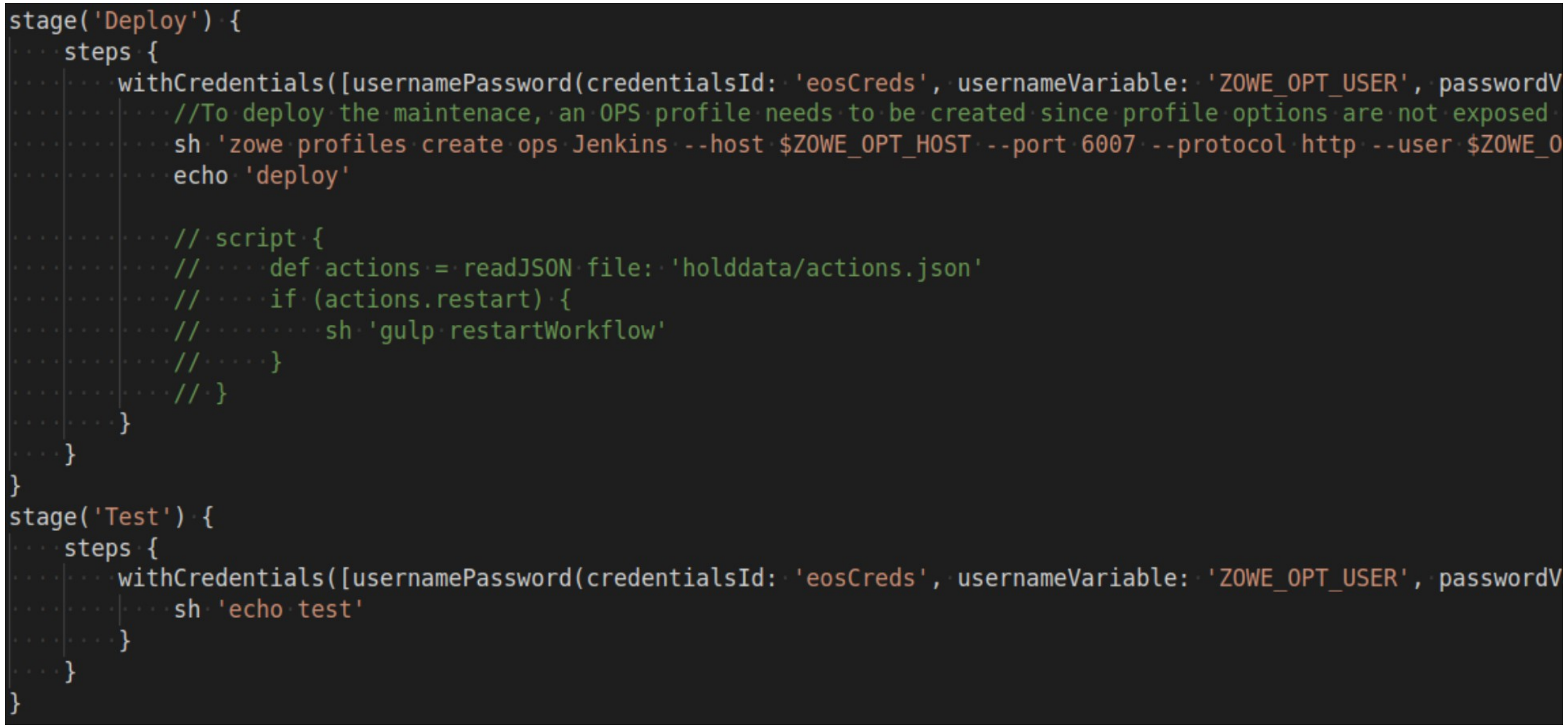
Jenkins Kickoff



```
stage('Apply Check') {
    steps {
        // script {
        //     def actions = readJSON file: 'holddata/actions.json'
        //     if (actions.remainingHolds) {
        //         input message: 'Unresolved holds detected. Please review the results of the receive job in the job-archive/receive artifacts. Proceed to applyCheck?'
        //     }
        // }
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', passwordVariable: 'ZOWE_OPT_PASSWORD')]) {
            sh 'echo applyCheck'
        }
    }
}
stage('Apply') {
    steps {
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', passwordVariable: 'ZOWE_OPT_PASSWORD')]) {
            sh 'echo apply'
        }
    }
}
```

- Next, we have:
  - A stage for applyCheck and a stage for Apply.
  - Notice the commented out input directive in the applyCheck stage in the case manual intervention is needed (holds that cannot be resolved by our automation exist). This section can now be uncommented.

Jenkins Kickoff

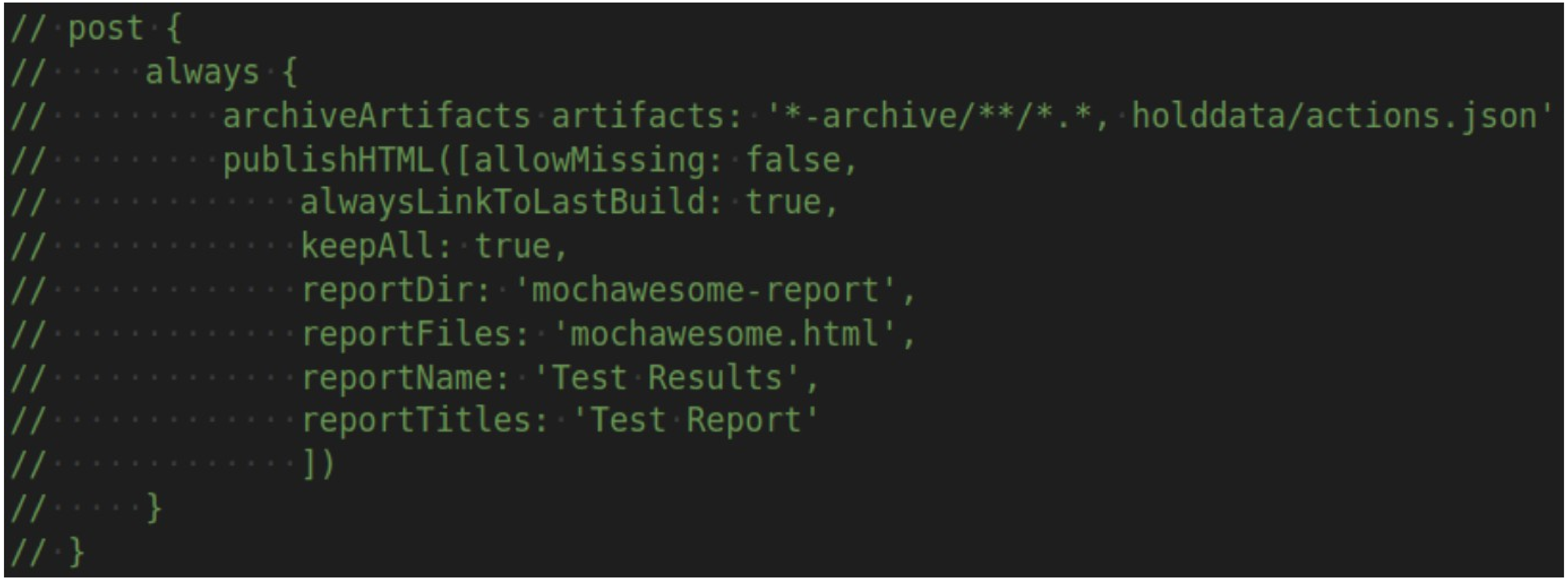


```
stage('Deploy') {
    steps {
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', passwordV
            //To deploy the maintenace, an OPS profile needs to be created since profile options are not exposed
            sh 'zowe profiles create ops Jenkins --host $ZOWE_OPT_HOST --port 6007 --protocol http --user $ZOWE_O
            echo 'deploy'

            // script {
            //     def actions = readJSON file: 'holddata/actions.json'
            //     if (actions.restart) {
            //         sh 'gulp restartWorkflow'
            //     }
            // }
        }
    }
}
stage('Test') {
    steps {
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', passwordV
            sh 'echo test'
        }
    }
}
```

- Next, we have:
  - A stage for Deploy and a stage for Test.
  - Notice in the Deploy stage, a zowe CLI profile is being created for OPS. This plugin does not currently expose all of its options on the command line so host, username, and password can not directly influence the commands. Therefore, we create an OPS profile with these values.
  - Also notice in the commented out section that we will check for restart holds and kickoff a workflow if needed. This section can now be uncommented.

Jenkins Kickoff



```
// post {
//     always {
//         archiveArtifacts artifacts: '*-archive/**/*.*, holddata/actions.json'
//         publishHTML([allowMissing: false,
//             alwaysLinkToLastBuild: true,
//             keepAll: true,
//             reportDir: 'mochawesome-report',
//             reportFiles: 'mochawesome.html',
//             reportName: 'Test Results',
//             reportTitles: 'Test Report'
//             ])
//     }
// }
```

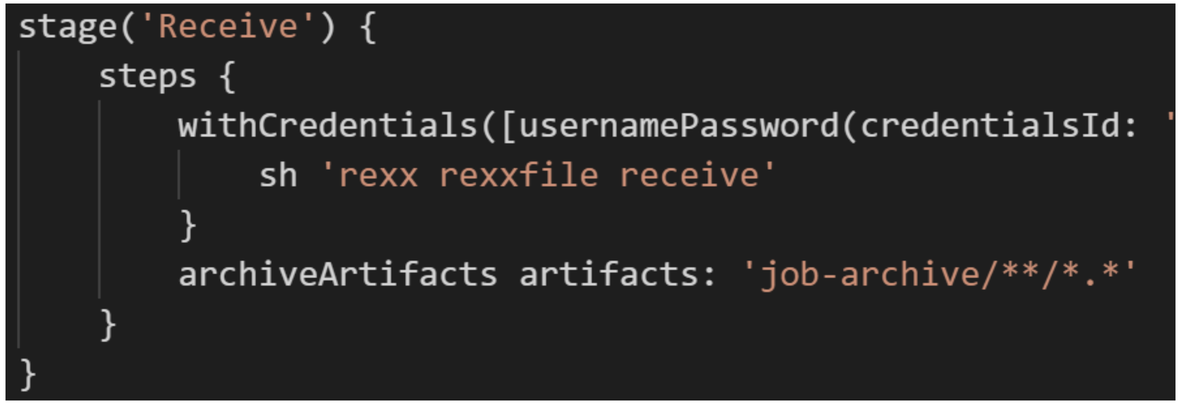
- Finally, we have:
  - A post stage to archive our artifacts for audit purposes. This stage can now be uncommented.

Jenkins: Download & Upload Maintenance Stages

- Replace the `echo download` command with `rexx rexxfile download` to make use of the existing automation to download the PTF
- Replace the `echo upload` command with `rexx rexxfile upload` to make use of the existing automation to upload the PTF to USS

Jenkins: Receive Stage

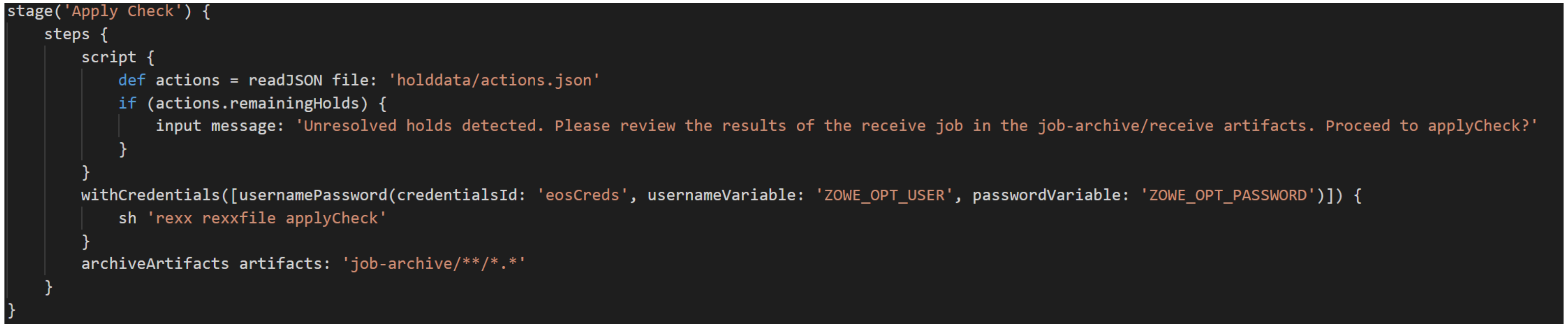
- Replace the `echo receive` command with `rexx rexxfile receive` to make use of the existing automation.
- Archive the artifacts of this stage. This can be done by adding: `archiveArtifacts artifacts: 'job-archive/**/*.*'` after the `withCredentials` block as shown below:



```
stage('Receive') {
    steps {
        withCredentials([usernamePassword(credentialsId: '
            sh 'rexx rexxfile receive'
        }
        archiveArtifacts artifacts: 'job-archive/**/*.*'
    }
}
```

Jenkins: applyCheck Stage

- Replace the `echo applyCheck` command with `rexx rexxfile applyCheck` to make use of the existing automation.
- Archive the artifacts of this stage.

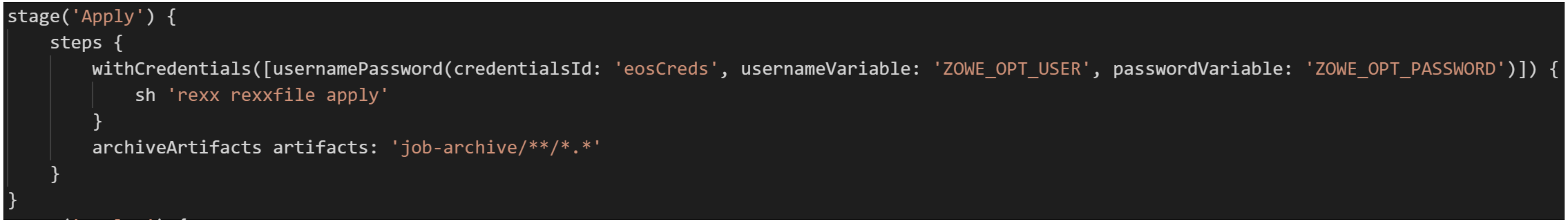


```
stage('Apply Check') {
    steps {
        script {
            def actions = readJSON file: 'holddata/actions.json'
            if (actions.remainingHolds) {
                input message: 'Unresolved holds detected. Please review the results of the receive job in the job-archive/receive artifacts. Proceed to applyCheck?'
            }
        }
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', passwordVariable: 'ZOWE_OPT_PASSWORD')]) {
            sh 'rexx rexxfile applyCheck'
        }
        archiveArtifacts artifacts: 'job-archive/**/*.*'
    }
}
```

Jenkins: Apply Stage

- Try completing the Apply stage. A completed solution is available on the next slide.

Jenkins: Apply Stage

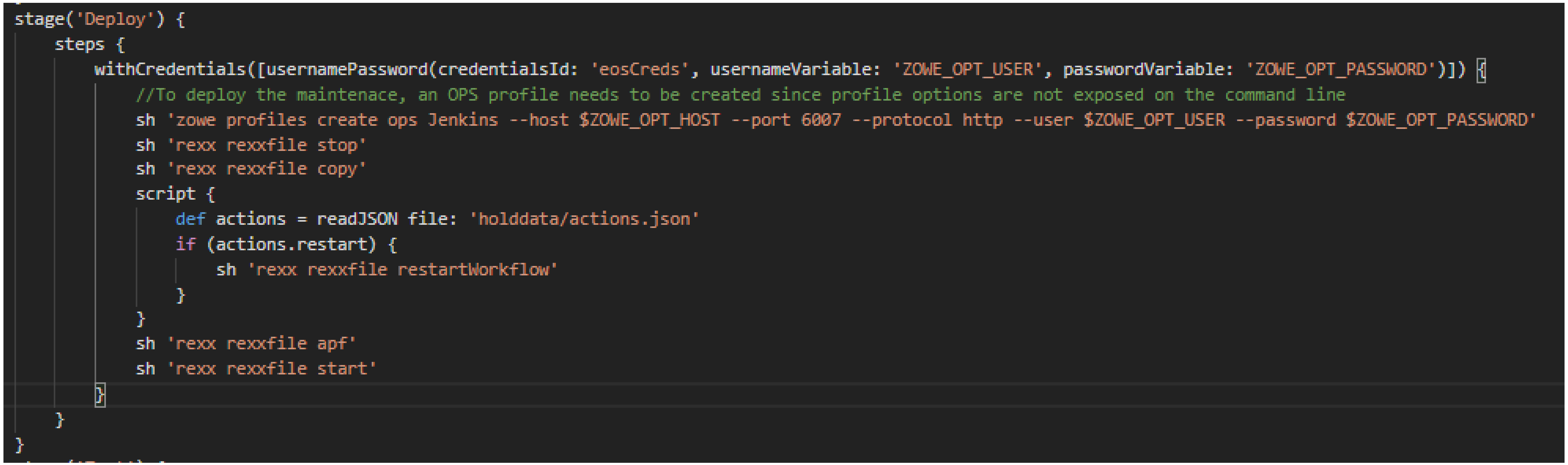


```
stage('Apply') {
    steps {
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', passwordVariable: 'ZOWE_OPT_PASSWORD')]) {
            sh 'rexx rexxfile apply'
        }
        archiveArtifacts artifacts: 'job-archive/**/*.*'
    }
}
```

Jenkins: Deploy Stage

- Try completing the Deploy stage.
  - A completed solution is available on the next slide.
  - Hint: you will need to make use of the `stop`, `copy`, `apf`, and `start` Rexx tasks you previously created.
  - The workflow is just a sample workflow for demonstration purposes. It does not actually restart SYSVIEW as we will be using the OPS/MVS plug-in to accomplish this via our script.
  - Please trigger the workflow after the copy but before the restart.

Jenkins: Deploy Stage



```
stage('Deploy') {
    steps {
        withCredentials([usernamePassword(credentialsId: 'eosCreds', usernameVariable: 'ZOWE_OPT_USER', passwordVariable: 'ZOWE_OPT_PASSWORD')]) {
            //To deploy the maintenace, an OPS profile needs to be created since profile options are not exposed on the command line
            sh 'zowe profiles create ops Jenkins --host $ZOWE_OPT_HOST --port 6007 --protocol http --user $ZOWE_OPT_USER --password $ZOWE_OPT_PASSWORD'
            sh 'rexx rexxfile stop'
            sh 'rexx rexxfile copy'
            script {
                def actions = readJSON file: 'holddata/actions.json'
                if (actions.restart) {
                    sh 'rexx rexxfile restartWorkflow'
                }
            }
            sh 'rexx rexxfile apf'
            sh 'rexx rexxfile start'
        }
    }
}
```

Jenkins: Test Stage

- Replace the `echo test` command with `npm test` to make use of the existing test automation

Push to GitHub

- Jenkins pulls the pipeline source from GitHub. Previously, you were only running the automation from within your Eclipse Che development environment. In order to update the source on GitHub, issue the following commands. Jenkins will pull code from GitHub, so these commands push the code there.
- To see what files have changed, issue: `git status`
- To commit your changes, issue: `git commit -a -m "Add Maintenance Deployment Automation"`
- To push your changes, issue: `git push`
- You may be prompted to enter your GitHub ID and password
  - Username: `zowe-001`
  - Password: `Zowe-Workshop-01`
- Make sure there are no errors in the output

Jenkins Pipeline Run

- Return to the master branch of your Jenkins project and click on the `Build Now` button located in the top left navigation menu.
- Watch the pipeline progress in a modern view. Click the `Blue Ocean` button located in the top left navigation menu.
- Work with the facilitator should any issues arise.

Maintenance has been deployed via Jenkins!

Thank You