CSSE477 – Final Project

Software Architecture

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The content is stored at .\csse477FinalProject\edu.rosehulman.sws\Reports\Milestone<X>

Change History

10/18/2015 Version 1.0: Original Document for Milestone 1

- Original UML Diagram
- Explanation of design patterns used
- Potential Design Improvements
- Test Report for Milestone 1

10/25/2015 Version 2.0: Expanded for Milestone 2

- Creation of Change History
- Updated UML Diagram and UML Description
- Updated Architecture Diagram
- Potential Improvements
- Test Report for Milestone 2
- Created Milestone 2 Feature Listing

11/01/2015 Version 3.0: Expanded for Milestone 3

- Updates to Change History
- Minor tweaks to UML Diagram
- Re-formatted to meet specifications
- Tactics and Feature Listing updates
- Architectural Evaluation and Improvements

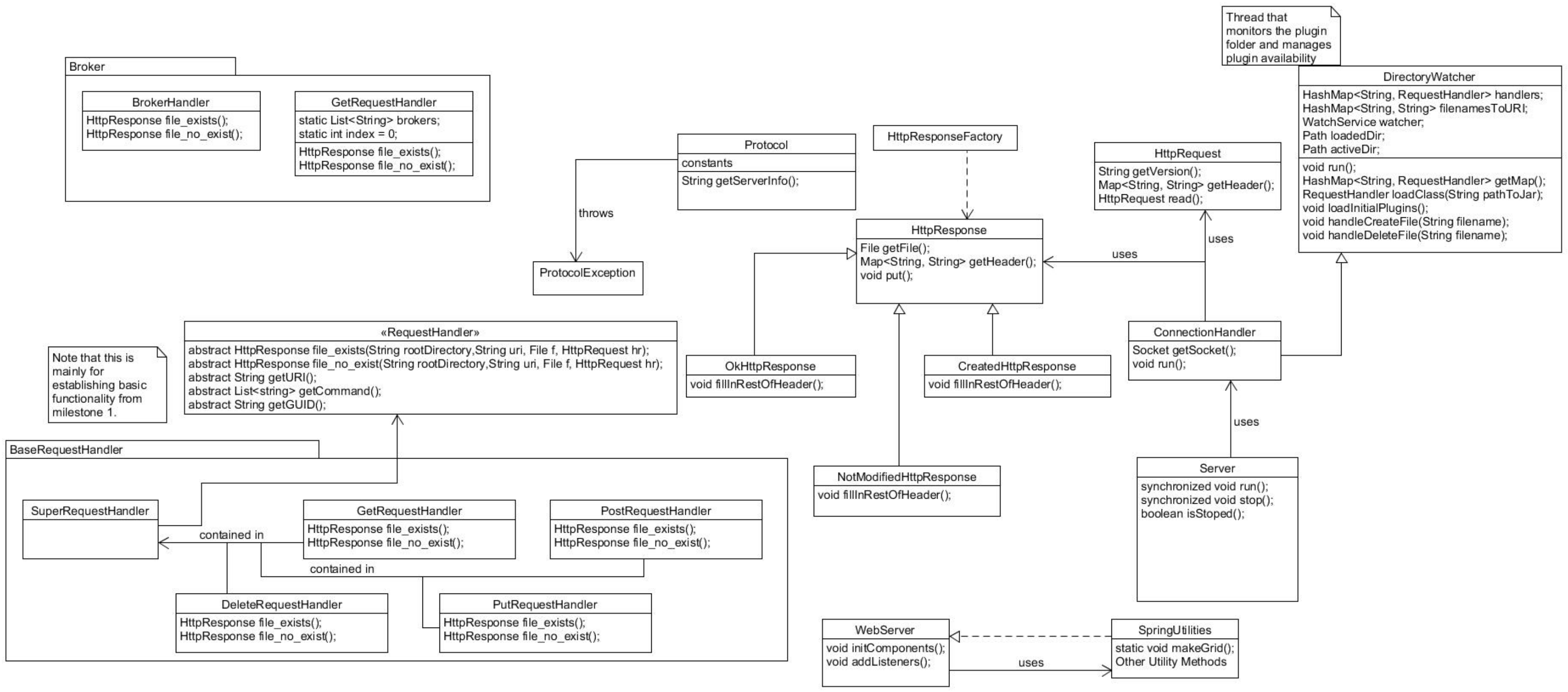
11/01/2015 Version 4.0: Expanded for Milestone 4

- Updates to Change History
- Minor tweaks to old sections

- Added Sample Application Section
- Added Experimentation with Scaling section
- Updates to Future Improvements

Design

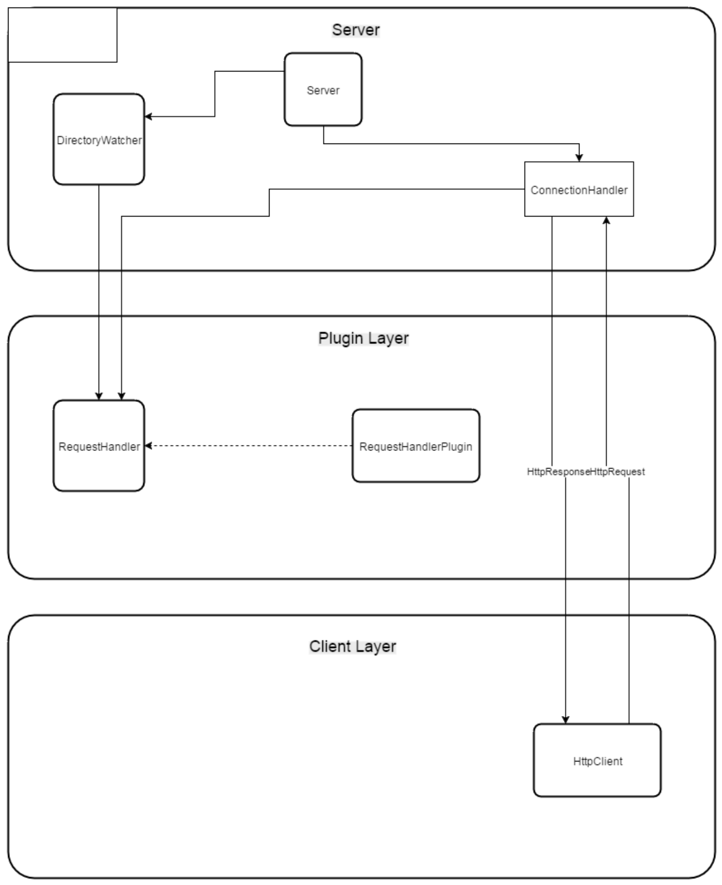
1. UML Diagram



Broker
BrokerHandler
HttpResponse file_exists();
HttpResponse file_no_exist();
GetRequestHandler
static List<String> brokers;
static int index = 0;
HttpResponse file_exists();
HttpResponse file_no_exist();
Protocol
constants
String getServerInfo();
throws
ProtocolException
HttpResponseFactory
HttpResponse
File getFile();
Map<String, String> getHeader();
void put();
HttpRequest
String getVersion();
Map<String, String> getHeader();
HttpRequest read();
uses
uses
Thread that monitors the plugin folder and manages plugin availability
DirectoryWatcher
HashMap<String, RequestHandler> handlers;
HashMap<String, String> filenamesToURI;
WatchService watcher;
Path loadedDir;
Path activeDir;
void run();
HashMap<String, RequestHandler> getMap();
RequestHandler loadClass(String pathToJar);
void loadInitialPlugins();
void handleCreateFile(String filename);
void handleDeleteFile(String filename);
«RequestHandler»
abstract HttpResponse file_exists(String rootDirectory,String uri, File f, HttpRequest hr);
abstract HttpResponse file_no_exist(String rootDirectory,String uri, File f, HttpRequest hr);
abstract String getURI();
abstract List<string> getCommand();
abstract String getGUID();
Note that this is mainly for establishing basic functionality from milestone 1.
OkHttpResponse
void fillInRestOfHeader();
CreatedHttpResponse
void fillInRestOfHeader();
ConnectionHandler
Socket getSocket();
void run();
uses
NotModifiedHttpResponse
void fillInRestOfHeader();
Server
synchronized void run();
synchronized void stop();
boolean isStoped();
BaseRequestHandler
SuperRequestHandler
contained in
GetRequestHandler
HttpResponse file_exists();
HttpResponse file_no_exist();
PostRequestHandler
HttpResponse file_exists();
HttpResponse file_no_exist();
contained in
DeleteRequestHandler
HttpResponse file_exists();
HttpResponse file_no_exist();
PutRequestHandler
HttpResponse file_exists();
HttpResponse file_no_exist();
WebServer
void initComponents();
void addListeners();
uses
SpringUtilities
static void makeGrid();
Other Utility Methods

For this milestone we used plug-in architecture to attach the RequestHandler(s) into a SuperRequestHandler. We used the DirectoryWatcher class to dynamically track changes to the plug-in folder.

2. Architecture Diagram



Tactics/Feature Listing

1. Original Design/MS1 Functionality	Implementation: Team
2. DirectoryWatcher	Implementation: Austin May
3. Plug-in Architecture	Implementation: Jonathan Taylor/Zach Haloski
4. Architectural Evaluations Section	Implementation: Team
5. Performance Scenarios	Implementation: Team
6. Code Updates based on Scenarios	Implementation: Jonathan Taylor/Austin May
7. Server Javascript	Implementation: Jonathan Taylor
8. Put/Get Handlers	Implementation: Austin May
9. Delete/Post Handlers	Implementation: Zach Haloski
10. LoadBalancer	Implementation: Team
11. Reformatting of Report	Implementation: Zach Haloski

Architectural Evaluations and Improvements

Availability Scenario 1

1. Source: File System

   Stimulus: Exception

   Environment: Normal operation

   Artifact: Malformed jar

   Response: System handles the fault without failing

   Response Measurement: Rate that the system handles the fault without failing

2. Test Plan

   Load 10 malformed jars into the server one after the other. Measure the number of jars that cause the server to crash.

3. Baseline

   0%. All faults turn into failures

4. Improvement tactics

   We will put a try-catch around our server code. We will handle the malformed jar exceptions by deleting the jar from the file system.

5. Results

   Our server improved from an availability of 0% after getting a malformed jar exception to 100% after applying our handling tactic.

Availability Scenario 2

1. Source: People/Connections

   Stimulus: Large amount of connections

   Environment: Overloaded operation

   Artifact: Server

   Response: System remains available when it gets more requests than it can handle

   Response Measurement: Rate that the system handles the fault without failing

2. Test Plan

   Do a DDoS attack on the server and measure the rate at which it doesn't crash.

3. Baseline

   0%. All faults turn into failures

4. Improvement tactics

   We will throttle the number of incoming connections we receive, and stop receiving connections when we get close to a number that will crash our server. We will test to find this number by doing DDoS attacks with various amounts of requests.

5. Results

Our server improved from an availability of 0% after handling a large amount of clients, to 100% availability up to 100 connections.

<u>Performance Scenario 1</u>

1. Source: People/Connections

   Stimulus: Large amount of connections

   Environment: Overloaded operation

   Artifact: Server

   Response: System retains a latency of under 100 ms.

   Response Measurement: Measuring of the latency for the responses in the overloaded state

2. <u>Test Plan</u>

   Do a DDoS attack on the server and measure the latency of our responses.

3. <u>Baseline</u>
   Average Latency of x milliseconds
4. <u>Improvement tactics</u>

   We will throttle the number of incoming connections we receive, and queue receiving connections when we get close to a number that will crash our server. We will test to find this number by doing DDoS attacks with various amounts of requests.

5. <u>Results</u>

   Our server improved from an average latency of x ms to an average latency of 1.6 ms.

<u>Performance Scenario 2</u>

1. Source: People/Connections

   Stimulus: Normal Get Request

   Environment: Normal operation

   Artifact: Server

Response: System retains a latency of under 100 ms.

Response Measurement: Measuring of the latency for the responses in the overloaded state

2. <u>Test Plan</u>

   Do a normal request and measure the latency.

3. <u>Baseline</u>
   Average Latency of x milliseconds
4. <u>Improvement tactics</u>

   We will add additional threading to our handling code in order to reduce the latency that the requests have.

5. <u>Results</u>

   Our server improved from an average latency of x ms to an average latency of 1.6 ms.

<u>Security Scenario 1</u>

1. Source: People/Connections

   Stimulus: Large amount of connections

   Environment: Overloaded operation

   Artifact: Server

   Response: System is able to handle DDoS attacks

   Response Measurement: System doesn’t fail as a result of a DDoS attack

2. <u>Test Plan</u>

   Do a DDos attack on the server and measure the latency of our responses.

3. <u>Baseline</u>
   Server crashed due to a DDoS attack

4. Improvement tactics

   We will throttle the number of incoming connections we receive, and queue receiving connections when we get close to a number that will crash our server. We will test to find this number by doing DDoS attacks with various amounts of requests.

5. Results

   Our server didn't crash after doing a DDoS attack.

Security Scenario 2

1. Source: File System

   Stimulus: Plugin Jar

   Environment: Normal operation

   Artifact: Server

   Response: System will not load jars that have a guid that it doesn't know about.

   Response Measurement: Percentage of jars that the server doesn't allow that have improper guids.

2. Test Plan

   Load some "malicious" jars that our server doesn't know about and test how many of them the server loads.

3. Baseline
   Our server adds every jar that adheres to our plugin interface to the server's list of plugins.
4. Improvement tactics

   We will add a guid to our plugin interface. If a plugin tries to join our server and doesn't have a guid in our list we will delete the plugin from our list.

5. Results

   Our server didn't add the x number of plugins to our server.

Sample Application API

We created a web based way to view, add, remove, and modify the server’s files.

F1 – Logging in to a repo
Method: GET
URI: /manage/
Request Body:
<none>
Response Body:
{
“code”: 200,
“message”: “Ok”,
}
Development Status: DONE

F2 – View a file
Method: GET
URI: /’file id’
Request Body:
{
}
Response Body:
{
“code”: 200,
“message”: “Ok”,
“body”:
[
“text”: “filetext”
]
}
Development Status: DONE

F3 – Post a file
Method: POST
URI: /
Request Body:
{
“file”: “filename”
}
Response Body:
{
“code”: 200,
“message”: “Ok”,
“filename”:“filename.txt”
}
Development Status: DONE

F4 – Delete a file
Method: ‘file id’
URI: /’fileid’
Request Body:
<empty>
Response Body:
{
“code”: 200,
“message”: “Ok”,
}
Development Status: DOING

F5 – Put a file
Method: PUT
URI: /’fileid’

Request Body:
{
}
Response Body:
{
“code”: 200,
“message”: “Ok”,
[
“text”: “new filetext”
]
}
Development Status: Done

Experimentation with Scaling

Availability Scenario 1

1. Source: File System

   Stimulus: Exception

   Environment: Normal operation

   Artifact: File System

   Response: System handles the fault without failing

   Response Measurement: System doesn’t crash when an exception occurs during a file operation

2. Test Plan

   Delete a file. This will cause an exception as the connection is using the file at the time it tries to be deleted. Test to see if the server is still available after the fault

3. Baseline

100%. Despite the faults, the server remains available.

4. Scalability

   Scaling from one server to two, using a load balancer.

5. Results

   Our server remained at 100% availability.

Performance Scenario 1

1. Source: People/Connections

   Stimulus: Large amount of connections

   Environment: Overloaded operation

   Artifact: Server

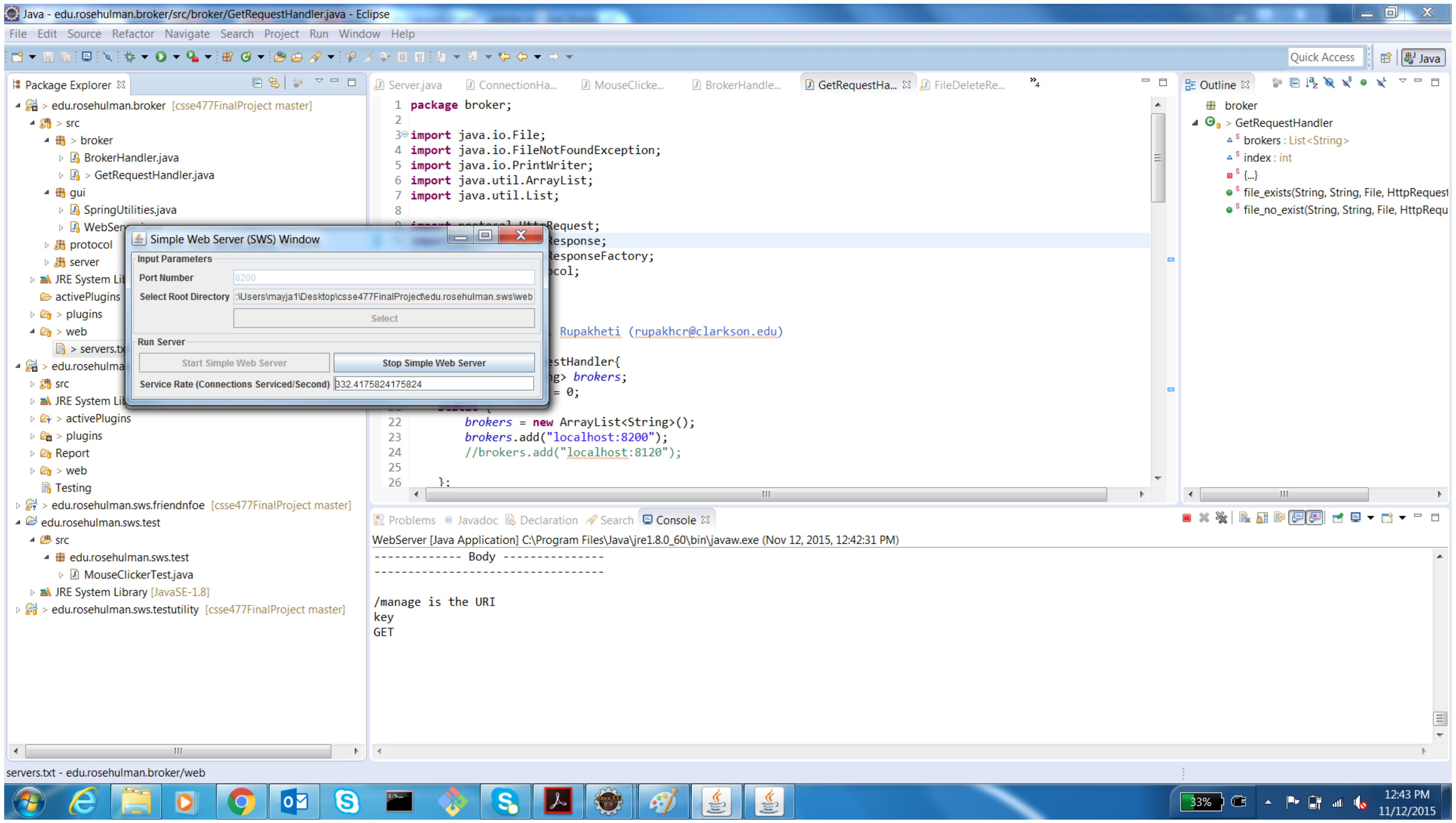
   Response: Server latency remains under 100 ms.

   Response Measurement: Measuring of the latency for the responses in the overloaded state

2. Test Plan

   Use a mouse clicker to press the get request button 1000 times on our web page and measure the response rate.

3. Baseline
   With our initial setup below is the connections per second that we serviced:



```
package broker;

import java.io.File;
import java.io.FileNotFoundException;
import java.io.PrintWriter;
import java.util.ArrayList;
import java.util.List;

...Request;
...esponse;
...esponseFactory;
...ocol;

... Rupakheti (rupakhcr@clarkson.edu)

...estHandler{
...g> brokers;
... = 0;

        brokers = new ArrayList<String>();
        brokers.add("localhost:8200");
        //brokers.add("localhost:8120");

    };
```

Port Number: 8200
Select Root Directory: :\Users\mayja1\Desktop\csse477FinalProject\edu.rosehulman.sws\web
Service Rate (Connections Serviced/Second): 332.4175824175824

```
WebServer [Java Application] C:\Program Files\Java\jre1.8.0_60\bin\javaw.exe (Nov 12, 2015, 12:42:31 PM)
------------- Body ---------------
---------------------------------

/manage is the URI
key
GET
```

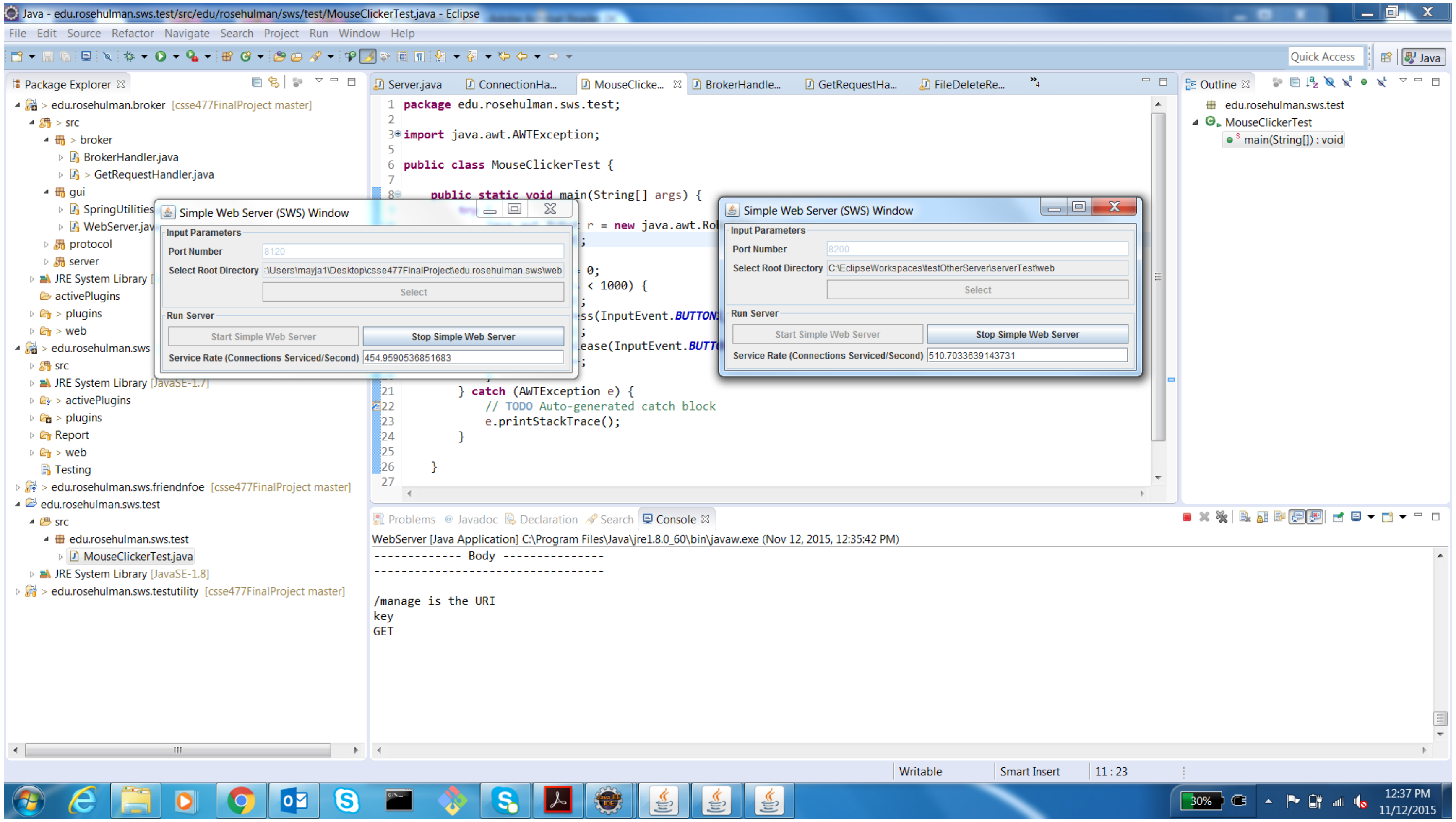
This is 332 connections per second.

4. Scaling

We scaled from one server to two servers using a load balancer

5. Results

Using two servers, below is our measured latency:


Java - edu.rosehulman.sws.test/src/edu/rosehulman/sws/test/MouseClickerTest.java - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
Server.java
ConnectionHa...
MouseClicke...
BrokerHandle...
GetRequestHa...
FileDeleteRe...
Outline
Problems
Javadoc
Declaration
Search
Console

```
package edu.rosehulman.sws.test;

import java.awt.AWTException;

public class MouseClickerTest {

    public static void main(String[] args) {
```

```
        } catch (AWTException e) {
            // TODO Auto-generated catch block
            e.printStackTrace();
        }

    }
```

Simple Web Server (SWS) Window

Input Parameters

Port Number: 8120

Select Root Directory: :\Users\mayja1\Desktop\csse477FinalProject\edu.rosehulman.sws\web

Run Server

Service Rate (Connections Serviced/Second): 454.9590536851683

Simple Web Server (SWS) Window

Input Parameters

Port Number: 8200

Select Root Directory: C:\EclipseWorkspaces\testOtherServer\serverTest\web

Run Server

Service Rate (Connections Serviced/Second): 510.7033639143731

```
WebServer [Java Application] C:\Program Files\Java\jre1.8.0_60\bin\javaw.exe (Nov 12, 2015, 12:35:42 PM)
------------- Body ---------------
----------------------------------

/manage is the URI
key
GET
```

This is 454 connections per second for one of our servers and 510 connections per second for our other server, which is an improvement over the baseline.

Security Scenario 1

1. Source: File System

   Stimulus: Delete request

   Environment: normal operation

   Artifact: files.txt file

   Response: Though files.txt is deleted, server responds by recreating the file

   Response Measurement: System doesn't fail as a result of the files.txt file being deleted

2. Test Plan

   Our delete mechanism allows the users to delete the files from the server. If the user deletes the files.txt file, this removes functionality from our server. Our server should respond by recreating the file.

3. Baseline
   Server recreated the files.txt when it was deleted.
4. Scaling

   We will scale from one server to two.

5. Results

   Both servers were able to recreate the files.txt even when it was deleted.

Potential Future Improvements

Handle having two plug-ins with the same URI if they implement different methods.

Maintain connections better for people who are trying to connect.

Ensure that we don't continue stale connections that do not have activity for long periods of time.