EECS 4313 Assignment 3
Data Flow Testing, Slice-Based Testing and Mutation Testing

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1.1 Data Flow Testing

1.1.1 Chosen Method

- **Class**: *net.sf.borg.common.DateUtil.java*
- **Method**: *minuteString(int mins)*
- **Method Description**: This method generate a human reable string for a particular number of minutes. It returns the string in terms of hours or minutes or both hours and mintues.
  - **mins** - The first argument is of type integer.

Following is the code snippet of the *minuteString* method:

```
public static String minuteString(int mins) {

  int hours = mins / 60;
  int minsPast = mins % 60;

  String minutesString;
  String hoursString;

  if (hours > 1) {
    hoursString = hours + " " +
       Resource.getResourceString("Hours");
  } else if (hours > 0) {
    hoursString = hours + " " +
       Resource.getResourceString("Hour");
  } else {
    hoursString = "";
  }

  if (minsPast > 1) {
    minutesString = minsPast + " " +
       Resource.getResourceString("Minutes");
  } else if (minsPast > 0) {
    minutesString = minsPast + " " +
       Resource.getResourceString("Minute");
  } else if (hours >= 1) {
    minutesString = "";
  } else {
    minutesString = minsPast + " " +
       Resource.getResourceString("Minutes");
  }

  // space between hours and minutes
  if (!hoursString.equals("") && !minutesString.equals(""))
    minutesString = " " + minutesString;

  return hoursString + minutesString;
}
```

1.1.2 Variable set

Following are the list of variables used in the *minuteString* method along with their types:

Variable Name	**Data Type**	**Is Primitive?**
mins	int	Yes
hours	int	Yes
minsPast	int	Yes
minutesString	String	No
hoursString	String	No

Table 1: List of variables for the minuteString method

Note: The last two variables, *minutesString* and *hoursString*, are **NOT** primitive types, and will **NOT** be used to perform the data flow analysis as specified by the instructor.

1.1.3 Program Segmentation

The following table 2 contains the *minuteString* method broken down into segments:

public static string minuteString(int mins) {	A

int hours = mins / 60;
int minsPast = mins % 60;
	B

String minutesString;
String hoursString;
	C

if (hours > 1) {	D
hoursString = hours + " " + Resource.getResourceString("Hours");	E
} else if (hours > 0) {	F
hoursString = hours + " " + Resource.getResourceString("Hour");	G
} else { hoursString = ""; }	H
if (minsPast > 1) {	I
minutesString = minsPast + " " + Resource.getResourceString("Minutes");	J
} else if (minsPast > 0) {	K
minutesString = minsPast + " " + Resource.getResourceString("Minute");	L
} else if (hours >= 1) {	M
minutesString = "";	N

} else {
minutesString = minsPast + " " + Resource.getResourceString("Minutes");
}
	O

if (!hoursString.equals("") && !minutesString.equals(""))	P
minutesString = " " + minutesString;	Q
return hoursString + minutesString;	R

Table 2: Program Segmentation for the minuteString method

1.1.4 Program graph

The following diagram 1 represents the control flow graph for the *minuteString* method:

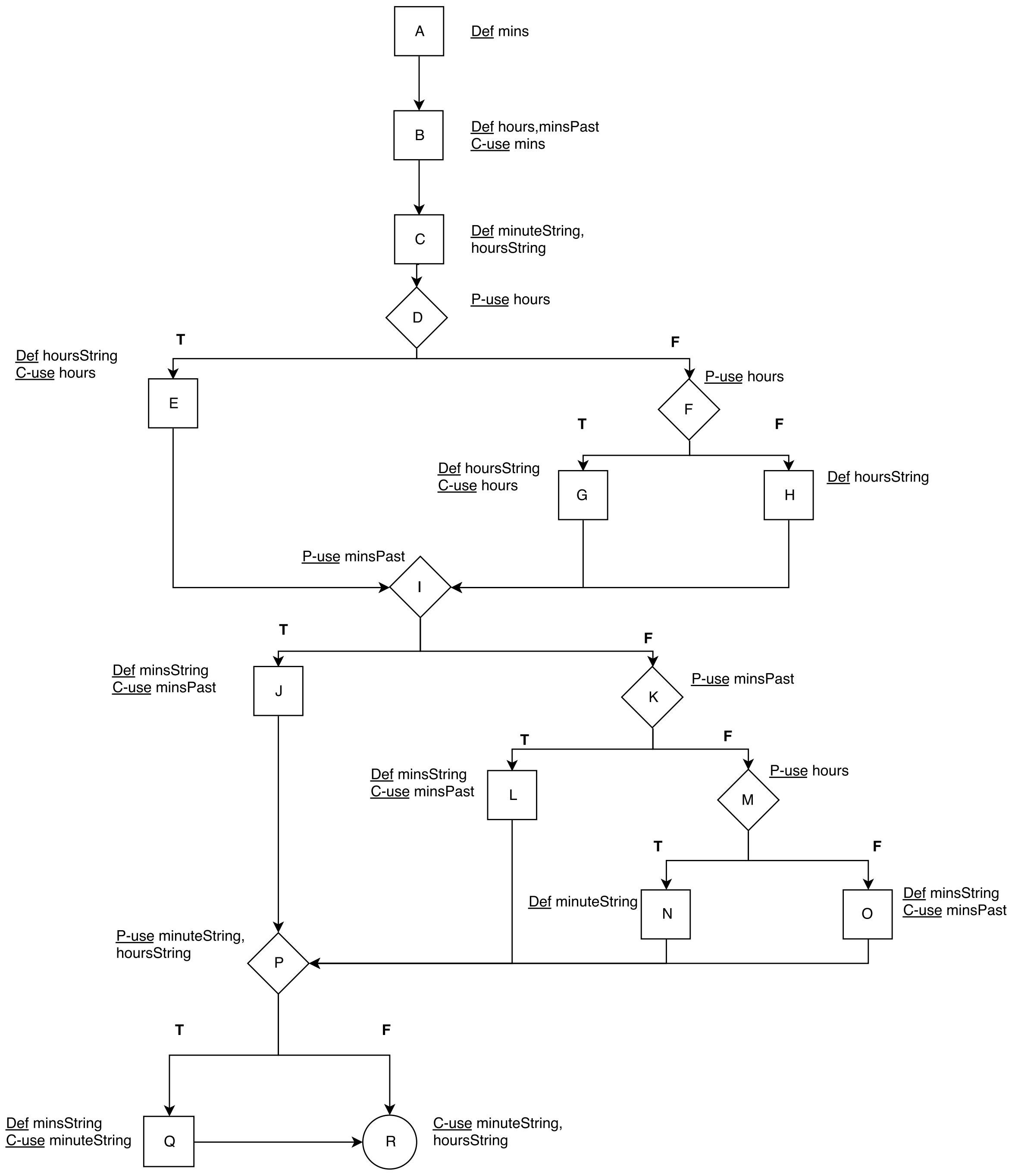


Figure 1: Control Flow Graph for the minuteString method

1.1.5 Data Flow Analysis

1. **du-paths for *mins***
   - **All-Defs**: *AB*
   - **All-C-Uses/Some-P-Uses**: *AB*
   - **All-P-Uses/Some-C-Uses**: *AB*
   - **All-Uses**: *AB*
2. **du-paths for *hours***
   - **All-Defs**: *BCD*
   - **All-C-Uses/Some-P-Uses**: *BCDE, BCDFG*
   - **All-P-Uses/Some-C-Uses**: *BCD, BCDF, BCDEIKM, BCDFGIKM, BCDFHIKM*
   - **All-Uses**: *BCD, BCDE, BCDF, BCDEIKM, BCDFG, BCDFGIKM, BCDFHIKM*
3. **du-paths for *minsPast***
   - **All-Defs**: *BCDEI*
   - **All-C-Uses/Some-P-Uses**: *BCDEIJ, BCDFGIJ, BCDFHIJ, BCDEIKL, BCDFGIKL, BCDFHIKL, BCDEIKMO, BCDFGIKMO, BCDFHIKMO*
   - **All-P-Uses/Some-C-Uses**: *BCDEI, BCDFGI, BCDFHI, BCDEIK, BCDFGIK, BCDFHIK*
   - **All-Uses**: *BCDEI, BCDEIJ, BCDFGIJ, BCDFHIJ, BCDEIKL, BCDFGIKL, BCDFHIKL, BCDEIKMO, BCDFGIKMO, BCDFHIKMO, BCDFGI, BCDFHI, BCDEIK, BCDFGIK, BCDFHIK*

1.1.6 Coverage Metrics

Following are the existing test cases from Assignment-2 and their coverage metrics using the data flow analysis for the *minuteString* method:

1. **Test Case 1**:
   - **Input**: mins = 60
   - **Path**: *ABCDEGIKMNPR*
   - **Coverage**: 100*(12/18) = 66.67%
2. **Test Case 2**:
   - **Input**: mins = 61

- **Path**: *ABCDFGIKLPQR*
- **Coverage**: 100*(14/18) = 77.78%

3. **Test Case 3**:
   - **Input**: mins = 75
   - **Path**: *ABCDFGIJPQR*
   - **Coverage**: 100*(15/18) = 83.33%
4. **Test Case 4**:
   - **Input**: mins = 180
   - **Path**: *ABCDEIKMNPR*
   - **Coverage**: 100*(16/18) = 88.88%
5. **Test Case 5**:
   - **Input**: mins = 121
   - **Path**: *ABCDEIKLPQR*
   - **Coverage**: 100*(16/18) = 88.88%
6. **Test Case 6**:
   - **Input**: mins = 145
   - **Path**: *ABCDEIJPQR*
   - **Coverage**: 100*(16/18) = 88.88%
7. **Test Case 7**:
   - **Input**: mins = 0
   - **Path**: *ABCDFHIOPR*
   - **Coverage**: 100*(18/18) = 100.0%

Rationale: The testing technique used for testing this method is *Equivalence Class Testing*. It is a suitable technique for this method since the argument is an integer which is an independent variable and the input range can be partitioned assuring disjointness and non-redundancy between each partition set. We have chosen the partition integer range based on usages of minute, minutes, hour, and hours. In order to partition the integer argument into hours and minutes, we divide the minutes by 60 to get the range of hours and the remainder (minutes % 60) to get the range of the minutes. By covering all the cases, where the given input returns a concatenation of hours and minutes string, we were able to reach a 100% coverage for this method.

- The data flow analysis you performed and the calculation of the coverage metrics. You must show which test cases are responsible for which dc-paths.
- A description of the test cases you added to improve coverage. If your coverage was already high, discuss how your testing was able to achieve this.
- The slices that you identified and the percentage of slices that your testing covers. You must show which test cases are responsible for which slices.
- A description of the test cases you added to improve slice coverage. If your coverage was already high, discuss how your testing was able to achieve this.
- Evaluate the effectiveness of your test cases using mutation testing. Discuss and address any issues if you have found in your written report.
- Attaching bug reports if bugs are discovered using your testing methods. You should use the same bug report format as in Assignment 1. Do not file these bug reports to the projects bug report system.
- An appendix with the specification of the methods you are testing

2 JPetStore

After exploring the JPetStore system, we came up with some realistic non-trivial test scenarios that can be carried out for load testing using JMeter. The following subsections cover each scenarios, description on how it was load tested and the result analysis of the load test.

Following are the system specifications for which the load test was conducted under:

- **Operating System**: Windows 10 Pro 64-bit (10.0, Build 16299)
- **Language**: English (Regional Setting: English)
- **System Manufacturer**: Hewlett-Packard
- **System Model**: HP 15 TouchSmart Notebook PC
- **BIOS**: F.10
- **Processor**: AMD A6-5200 APU with Radeon(TM) HD Graphics (4 CPUs), 2.0GHz
- **Memory**: 6144MB RAM
- **Java Version**: 1.8.0_151-b12
- **Apache Tomcat Version**: 7.0.85
- **JMeter Version**: 2.11 r1554548

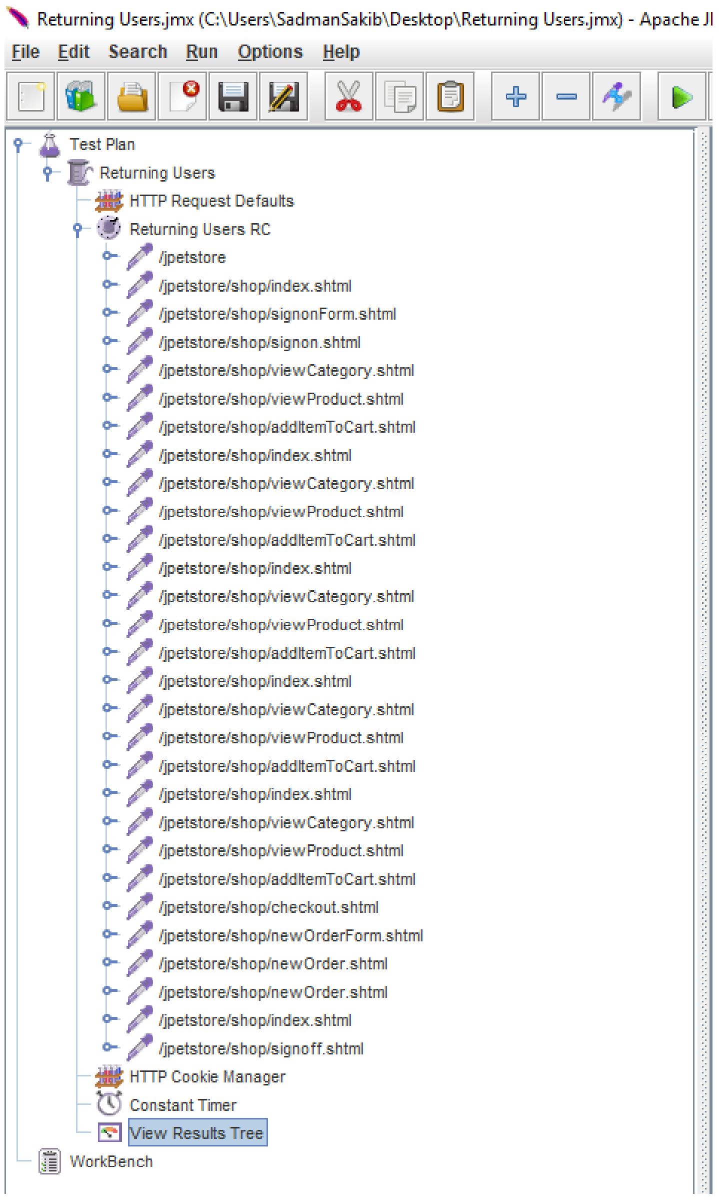
2.1 Scenario 1: Returning User

2.1.1 Overview

The first test scenario is for an existing user in the system. The testing scenario will consist of a returning user logging in, selecting one of each of the 5 possible items sold in JPetStore, adding the items to the cart, performing a checkout of the cart and finally logging out. The following describes an exact breakdown of the steps the load test will carry out:

- Access the JPetStore Homepage (`http://localhost:8080/jpetstore/`).
- Click *Enter the Store*.
- Click on the *Sign in* button.
- Enter sign-in credentials and click *Login* By default, we will be using *j2ee* user for this scenario.
- Go to the *Fish* section, select a fish item, add it to the cart and return to the main menu.
- Go to the *Dogs* section, select a dog item, add it to the cart and return to the main menu.
- Go to the *Reptiles* section, select a reptile item, add it to the cart and return to the main menu.
- Go to the *Cats* section, select a cat item, add it to the cart and return to the main menu.
- Go to the *Birds* section, select a bird item, add it to the cart.
- Proceed to checkout and follow the steps until the order has been placed.
- Return back to the main menu and sign out.

The following images depicts the Recording Controller for the test case scenario and the pages our load test will navigate through per each iteration:


Returning Users.jmx (C:\Users\SadmanSakib\Desktop\Returning Users.jmx) - Apache JI

```
Test Plan
  Returning Users
    HTTP Request Defaults
    Returning Users RC
      /jpetstore
      /jpetstore/shop/index.shtml
      /jpetstore/shop/signonForm.shtml
      /jpetstore/shop/signon.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/checkout.shtml
      /jpetstore/shop/newOrderForm.shtml
      /jpetstore/shop/newOrder.shtml
      /jpetstore/shop/newOrder.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/signoff.shtml
    HTTP Cookie Manager
    Constant Timer
    View Results Tree
WorkBench
```

Figure 2: Recording Controller for Returning User Scenario

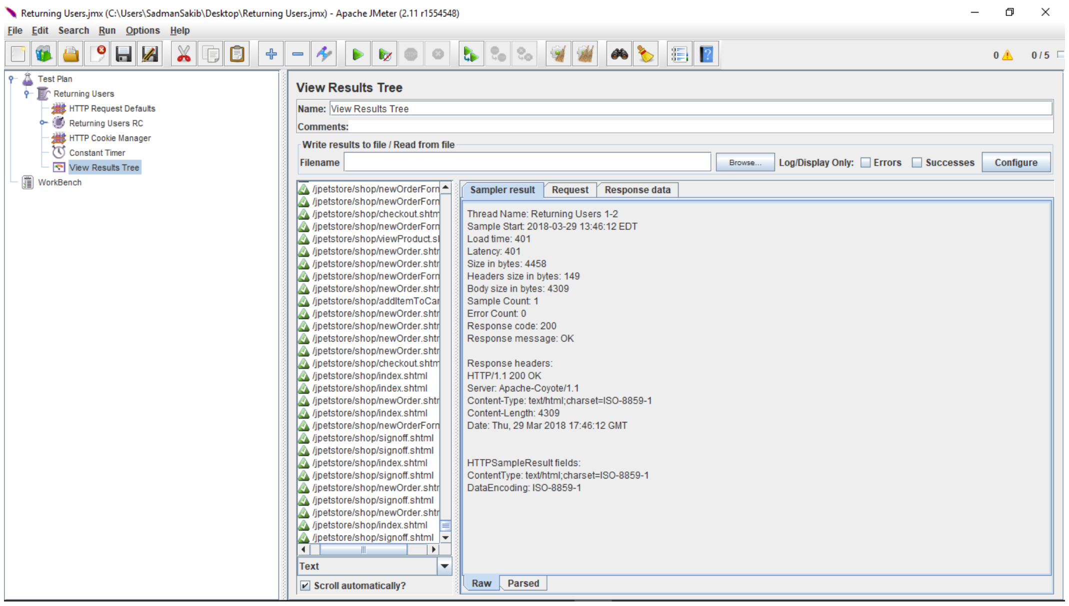
2.1.2 Load Test Properties

Following are the load test properties applied for testing this scenario:

- **Number of Thread (users)**: 5
- **Ramp-up Period (in seconds)**: 10
- **Loop Count**: 30
- **Thread Delay (in milliseconds)**: 1000

2.1.3 Executing Load Test

After setting up the load test plan using JMeter, we executed the test. The test run was for approximately 18 minutes completing all 30 iterations. The following diagrams show the result tree of the test run.



View Results Tree

Name: View Results Tree

Comments:

Write results to file / Read from file

Filename

```
/jpetstore/shop/newOrderForn
/jpetstore/shop/newOrderForn
/jpetstore/shop/checkout.shtm
/jpetstore/shop/newOrderForn
/jpetstore/shop/viewProduct.sl
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/newOrderForn
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/addItemToCar
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/checkout.shtm
/jpetstore/shop/index.shtml
/jpetstore/shop/index.shtml
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/index.shtml
/jpetstore/shop/newOrderForn
/jpetstore/shop/signoff.shtml
/jpetstore/shop/signoff.shtml
/jpetstore/shop/index.shtml
/jpetstore/shop/signoff.shtml
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/signoff.shtml
/jpetstore/shop/newOrder.shtr
/jpetstore/shop/index.shtml
/jpetstore/shop/signoff.shtml
```

```
Thread Name: Returning Users 1-2
Sample Start: 2018-03-29 13:46:12 EDT
Load time: 401
Latency: 401
Size in bytes: 4458
Headers size in bytes: 149
Body size in bytes: 4309
Sample Count: 1
Error Count: 0
Response code: 200
Response message: OK

Response headers:
HTTP/1.1 200 OK
Server: Apache-Coyote/1.1
Content-Type: text/html;charset=ISO-8859-1
Content-Length: 4309
Date: Thu, 29 Mar 2018 17:46:12 GMT


HTTPSampleResult fields:
ContentType: text/html;charset=ISO-8859-1
DataEncoding: ISO-8859-1
```

✓ Scroll automatically?

Figure 3: View Results Tree for Returning User Scenario

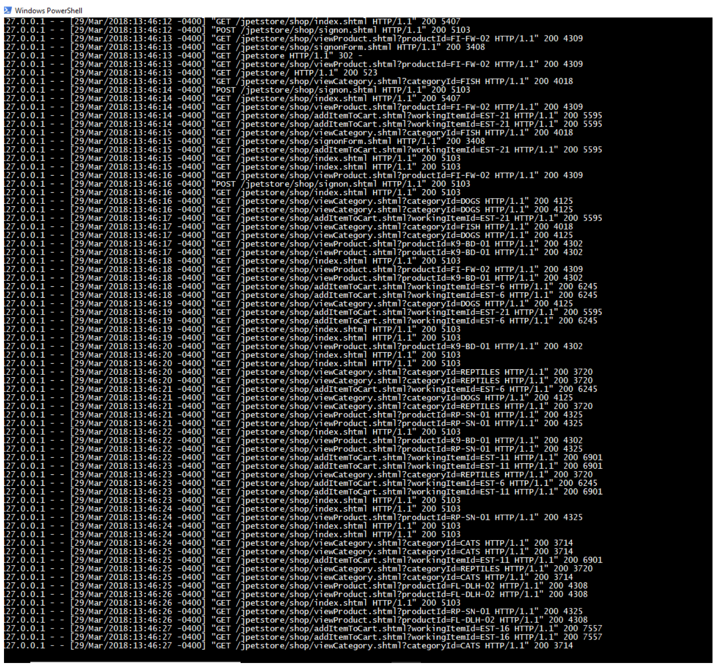
2.1.4 Analysing Load Test

The following statistics were gathered from the Apache access logs. The access log file was parsed to get the start of the load test and the end of the load test and the total time of the load test execution.

Within that timeframe, the total number of requests was found by simply executing: *wc -l ruser_log.txt*. The total number of GET and POST requests were found by executing *grep -c -w "GET" ruser_log.txt* and *grep -c -w "POST" ruser_log.txt* respectively.

- **Test Duration**: Approximately 18 minutes
- **Total Number of Requests**: 4714
- **Number of GET Requests**: 4399 (93% of all requests)
- **Number of POST Requests**: 315 (7% of all requests)
- **Success HTTP Codes**: 200 (Success) and 302 (Found)
- **Failure HTTP Codes**: None

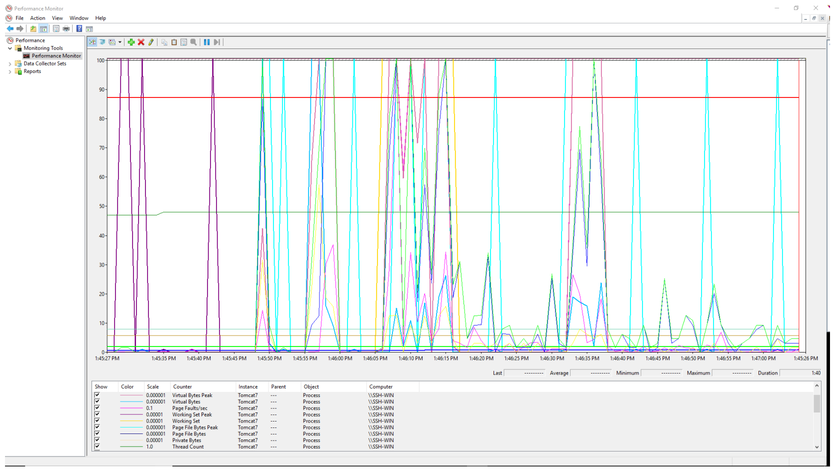
Following is a snapshot of the Apache access log:



```
27.0.0.1 - - [29/Mar/2018:13:46:12 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5407
27.0.0.1 - - [29/Mar/2018:13:46:12 -0400] "POST /jpetstore/shop/signon.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:13 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=FI-FW-02 HTTP/1.1" 200 4309
27.0.0.1 - - [29/Mar/2018:13:46:13 -0400] "GET /jpetstore/shop/signonForm.shtml HTTP/1.1" 200 3408
27.0.0.1 - - [29/Mar/2018:13:46:13 -0400] "GET /jpetstore HTTP/1.1" 302 -
27.0.0.1 - - [29/Mar/2018:13:46:13 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=FI-FW-02 HTTP/1.1" 200 4309
27.0.0.1 - - [29/Mar/2018:13:46:13 -0400] "GET /jpetstore/ HTTP/1.1" 200 523
27.0.0.1 - - [29/Mar/2018:13:46:13 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=FISH HTTP/1.1" 200 4018
27.0.0.1 - - [29/Mar/2018:13:46:14 -0400] "POST /jpetstore/shop/signon.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:14 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5407
27.0.0.1 - - [29/Mar/2018:13:46:14 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=FI-FW-02 HTTP/1.1" 200 4309
27.0.0.1 - - [29/Mar/2018:13:46:14 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-21 HTTP/1.1" 200 5595
27.0.0.1 - - [29/Mar/2018:13:46:14 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-21 HTTP/1.1" 200 5595
27.0.0.1 - - [29/Mar/2018:13:46:15 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=FISH HTTP/1.1" 200 4018
27.0.0.1 - - [29/Mar/2018:13:46:15 -0400] "GET /jpetstore/shop/signonForm.shtml HTTP/1.1" 200 3408
27.0.0.1 - - [29/Mar/2018:13:46:15 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-21 HTTP/1.1" 200 5595
27.0.0.1 - - [29/Mar/2018:13:46:15 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:15 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:16 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=FI-FW-02 HTTP/1.1" 200 4309
27.0.0.1 - - [29/Mar/2018:13:46:16 -0400] "POST /jpetstore/shop/signon.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:16 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:16 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=DOGS HTTP/1.1" 200 4125
27.0.0.1 - - [29/Mar/2018:13:46:16 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=DOGS HTTP/1.1" 200 4125
27.0.0.1 - - [29/Mar/2018:13:46:17 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-21 HTTP/1.1" 200 5595
27.0.0.1 - - [29/Mar/2018:13:46:17 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=FISH HTTP/1.1" 200 4018
27.0.0.1 - - [29/Mar/2018:13:46:17 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=DOGS HTTP/1.1" 200 4125
27.0.0.1 - - [29/Mar/2018:13:46:17 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=K9-BD-01 HTTP/1.1" 200 4302
27.0.0.1 - - [29/Mar/2018:13:46:17 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=K9-BD-01 HTTP/1.1" 200 4302
27.0.0.1 - - [29/Mar/2018:13:46:18 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:18 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=FI-FW-02 HTTP/1.1" 200 4309
27.0.0.1 - - [29/Mar/2018:13:46:18 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=K9-BD-01 HTTP/1.1" 200 4302
27.0.0.1 - - [29/Mar/2018:13:46:18 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-6 HTTP/1.1" 200 6245
27.0.0.1 - - [29/Mar/2018:13:46:18 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-6 HTTP/1.1" 200 6245
27.0.0.1 - - [29/Mar/2018:13:46:19 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=DOGS HTTP/1.1" 200 4125
27.0.0.1 - - [29/Mar/2018:13:46:19 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-21 HTTP/1.1" 200 5595
27.0.0.1 - - [29/Mar/2018:13:46:19 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-6 HTTP/1.1" 200 6245
27.0.0.1 - - [29/Mar/2018:13:46:19 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:19 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:20 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=K9-BD-01 HTTP/1.1" 200 4302
27.0.0.1 - - [29/Mar/2018:13:46:20 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:20 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:20 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=REPTILES HTTP/1.1" 200 3720
27.0.0.1 - - [29/Mar/2018:13:46:20 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=REPTILES HTTP/1.1" 200 3720
27.0.0.1 - - [29/Mar/2018:13:46:21 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-6 HTTP/1.1" 200 6245
27.0.0.1 - - [29/Mar/2018:13:46:21 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=DOGS HTTP/1.1" 200 4125
27.0.0.1 - - [29/Mar/2018:13:46:21 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=REPTILES HTTP/1.1" 200 3720
27.0.0.1 - - [29/Mar/2018:13:46:21 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=RP-SN-01 HTTP/1.1" 200 4325
27.0.0.1 - - [29/Mar/2018:13:46:21 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=RP-SN-01 HTTP/1.1" 200 4325
27.0.0.1 - - [29/Mar/2018:13:46:22 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:22 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=K9-BD-01 HTTP/1.1" 200 4302
27.0.0.1 - - [29/Mar/2018:13:46:22 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=RP-SN-01 HTTP/1.1" 200 4325
27.0.0.1 - - [29/Mar/2018:13:46:22 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-11 HTTP/1.1" 200 6901
27.0.0.1 - - [29/Mar/2018:13:46:23 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-11 HTTP/1.1" 200 6901
27.0.0.1 - - [29/Mar/2018:13:46:23 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=REPTILES HTTP/1.1" 200 3720
27.0.0.1 - - [29/Mar/2018:13:46:23 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-6 HTTP/1.1" 200 6245
27.0.0.1 - - [29/Mar/2018:13:46:23 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-11 HTTP/1.1" 200 6901
27.0.0.1 - - [29/Mar/2018:13:46:23 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:24 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:24 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=RP-SN-01 HTTP/1.1" 200 4325
27.0.0.1 - - [29/Mar/2018:13:46:24 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:24 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:24 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=CATS HTTP/1.1" 200 3714
27.0.0.1 - - [29/Mar/2018:13:46:25 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=CATS HTTP/1.1" 200 3714
27.0.0.1 - - [29/Mar/2018:13:46:25 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-11 HTTP/1.1" 200 6901
27.0.0.1 - - [29/Mar/2018:13:46:25 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=REPTILES HTTP/1.1" 200 3720
27.0.0.1 - - [29/Mar/2018:13:46:25 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=CATS HTTP/1.1" 200 3714
27.0.0.1 - - [29/Mar/2018:13:46:25 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=FL-DLH-02 HTTP/1.1" 200 4308
27.0.0.1 - - [29/Mar/2018:13:46:26 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=FL-DLH-02 HTTP/1.1" 200 4308
27.0.0.1 - - [29/Mar/2018:13:46:26 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
27.0.0.1 - - [29/Mar/2018:13:46:26 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=RP-SN-01 HTTP/1.1" 200 4325
27.0.0.1 - - [29/Mar/2018:13:46:26 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=FL-DLH-02 HTTP/1.1" 200 4308
27.0.0.1 - - [29/Mar/2018:13:46:27 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-16 HTTP/1.1" 200 7557
27.0.0.1 - - [29/Mar/2018:13:46:27 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-16 HTTP/1.1" 200 7557
27.0.0.1 - - [29/Mar/2018:13:46:27 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=CATS HTTP/1.1" 200 3714
```

Figure 4: Apache Access Log Snapshot for Returning User Scenario

Following is a snapshot of the Windows Performance Monitor and Java Monitor Console during the load test execution:



Show	Color	Scale	Counter	Instance	Parent	Object	Computer
✓	🟪	0.000001	Virtual Bytes Peak	Tomcat7	---	Process	\\SSH-WIN
✓	🟦	0.000001	Virtual Bytes	Tomcat7	---	Process	\\SSH-WIN
✓	🟪	0.1	Page Faults/sec	Tomcat7	---	Process	\\SSH-WIN
✓	🟪	0.00001	Working Set Peak	Tomcat7	---	Process	\\SSH-WIN
✓	🟨	0.00001	Working Set	Tomcat7	---	Process	\\SSH-WIN
✓	🟦	0.000001	Page File Bytes Peak	Tomcat7	---	Process	\\SSH-WIN
✓	🟦	0.000001	Page File Bytes	Tomcat7	---	Process	\\SSH-WIN
✓	🟫	0.00001	Private Bytes	Tomcat7	---	Process	\\SSH-WIN
✓	🟩	1.0	Thread Count	Tomcat7	---	Process	\\SSH-WIN

Figure 5: Windows Performance Monitor Snapshot for Returning User Scenario

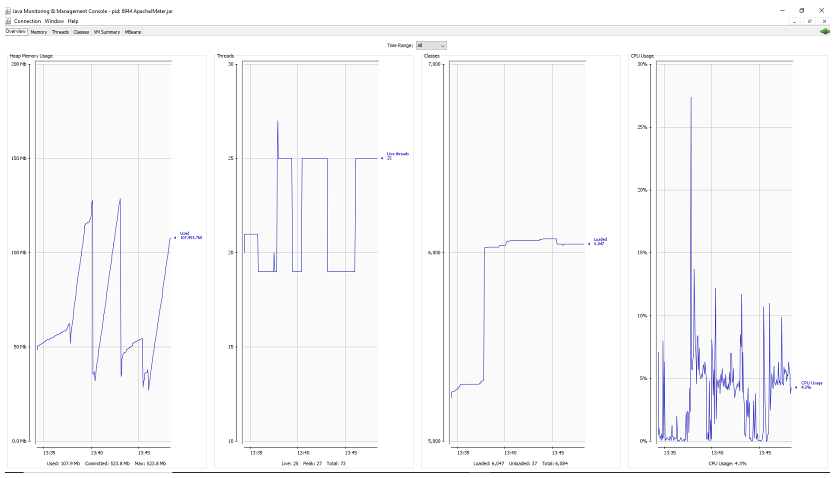

Java Monitoring & Management Console - pid: 6944 ApacheJMeter.jar
Connection Window Help
Overview Memory Threads Classes VM Summary MBeans
Time Range: All
Heap Memory Usage
Threads
Classes
CPU Usage
Used 107,903,760
Live threads 25
Loaded 6,047
CPU Usage 4.3%
Used: 107.9 Mb Committed: 523.8 Mb Max: 523.8 Mb
Live: 25 Peak: 27 Total: 73
Loaded: 6,047 Unloaded: 37 Total: 6,084
CPU Usage: 4.3%

Figure 6: JConsole Snapshot for Returning User Scenario

Conclusion: The load test scenario for returning user made about 4714 requests and the test ran for approximately 18 minutes. Despite some natural high spikes on the performance monitor and java monitor, the load test was carried out successfully without any crashes or unexpected behaviour in the application.

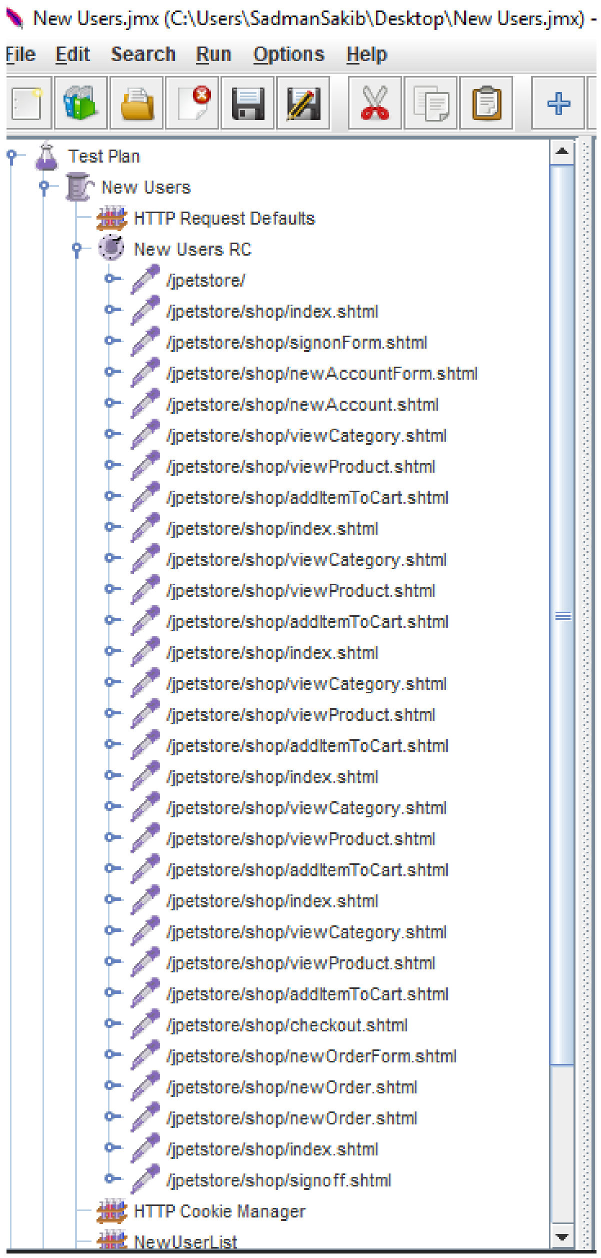
2.2 Scenario 2: New User

2.2.1 Overview

The second test scenario is for a new user in the system. The testing scenario will consist of registering a new user, selecting one of each of the 5 possible items sold in JPetStore, adding the items to the cart, performing a checkout of the cart and finally logging out. The following describes an exact breakdown of the steps the load test will carry out:

- Access the JPetStore Homepage (`http://localhost:8080/jpetstore/`).
- Click *Enter the Store*.
- Click on the *Sign in* button.
- Click *Register now*.
- Enter the sign-up credentials and click *Create Account*. The username and password for signing up would be loaded from a CSV file, whereas the other fields will be supplied the value of *abc*.
- Go to the *Fish* section, select a fish item, add it to the cart and return to the main menu.
- Go to the *Dogs* section, select a dog item, add it to the cart and return to the main menu.
- Go to the *Reptiles* section, select a reptile item, add it to the cart and return to the main menu.
- Go to the *Cats* section, select a cat item, add it to the cart and return to the main menu.
- Go to the *Birds* section, select a bird item, add it to the cart.
- Proceed to checkout and follow the steps until the order has been placed.
- Return back to the main menu and sign out.

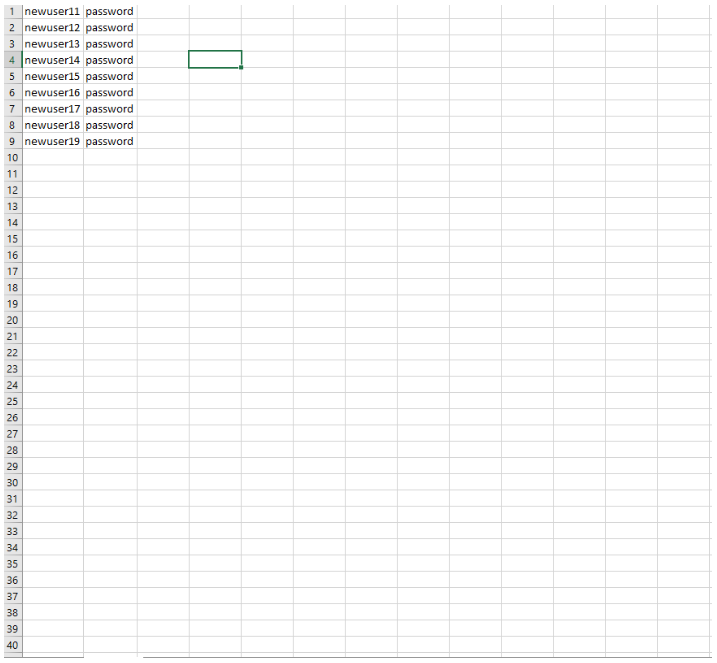
The following images depicts the Recording Controller for the test case scenario and the pages our load test will navigate through per each iteration:


New Users.jmx (C:\Users\SadmanSakib\Desktop\New Users.jmx) -
File Edit Search Run Options Help

```
Test Plan
  New Users
    HTTP Request Defaults
    New Users RC
      /jpetstore/
      /jpetstore/shop/index.shtml
      /jpetstore/shop/signonForm.shtml
      /jpetstore/shop/newAccountForm.shtml
      /jpetstore/shop/newAccount.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/checkout.shtml
      /jpetstore/shop/newOrderForm.shtml
      /jpetstore/shop/newOrder.shtml
      /jpetstore/shop/newOrder.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/signoff.shtml
    HTTP Cookie Manager
    NewUserList
```

Figure 7: Recording Controller for New User Scenario

The following images depicts the snapshot of the CSV file containing usernames and password for registering new users. On the POST request for registering a new user we load the credentials and use them through variable names such as ${username} and ${password}.



1	newuser11	password
2	newuser12	password
3	newuser13	password
4	newuser14	password
5	newuser15	password
6	newuser16	password
7	newuser17	password
8	newuser18	password
9	newuser19	password
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
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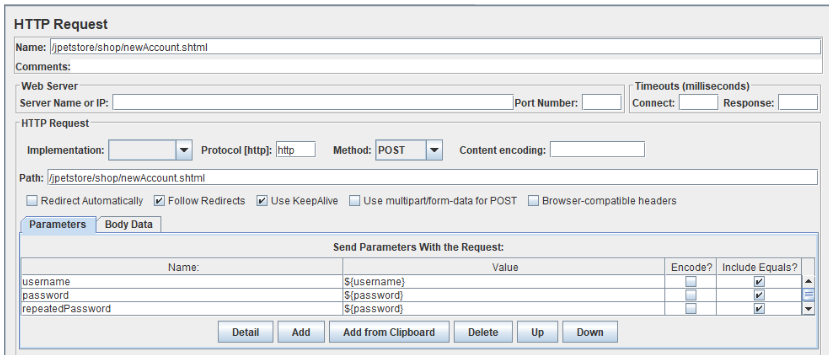
39		
40		

Figure 8: CSV Credential File for New User Scenario



HTTP Request

Name: /jpetstore/shop/newAccount.shtml

Comments:

Web Server

Server Name or IP: Port Number:

Timeouts (milliseconds)

Connect: Response:

HTTP Request

Implementation: Protocol [http]: http Method: POST Content encoding:

Path: /jpetstore/shop/newAccount.shtml

☐ Redirect Automatically ☑ Follow Redirects ☑ Use KeepAlive ☐ Use multipart/form-data for POST ☐ Browser-compatible headers

Send Parameters With the Request:

Name:	Value	Encode?	Include Equals?
username	${username}	☐	☑
password	${password}	☐	☑
repeatedPassword	${password}	☐	☑

Figure 9: HTTP Post Request for New User Scenario

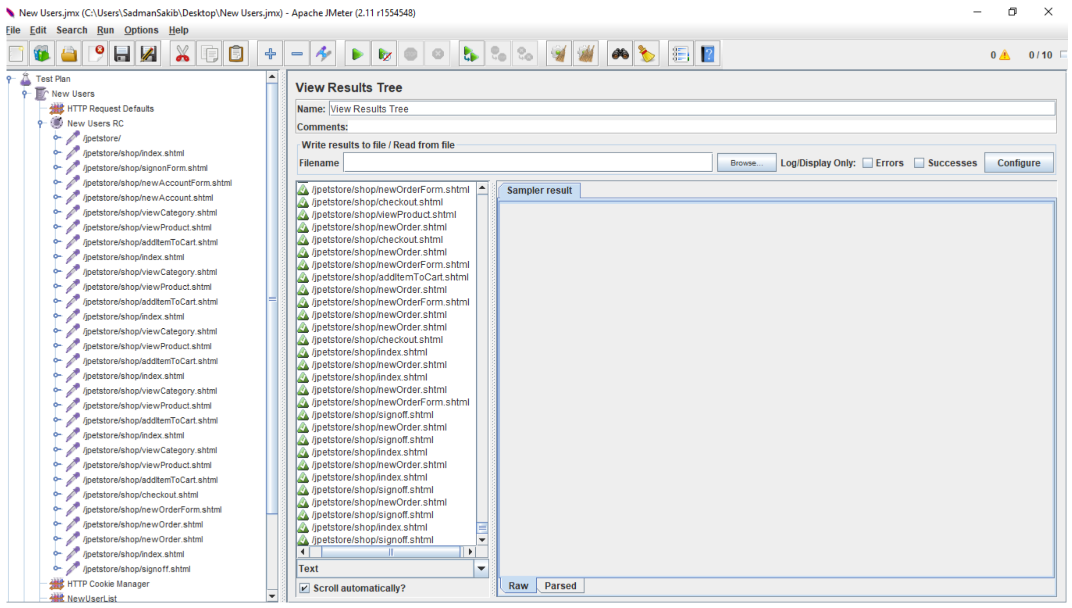
2.2.2 Load Test Properties

Following are the load test properties applied for testing this scenario:

- **Number of Thread (users)**: 5
- **Ramp-up Period (in seconds)**: 5
- **Loop Count**: 30
- **Thread Delay (in milliseconds)**: 1000

2.2.3 Executing Load Test

After setting up the load test plan using JMeter, we executed the test. The test run was for approximately 15 minutes completing all 30 iterations. The following diagrams show the result tree of the test run.



New Users.jmx (C:\Users\SadmanSakib\Desktop\New Users.jmx) - Apache JMeter (2.11 r1554548)

```
Test Plan
  New Users
    HTTP Request Defaults
    New Users RC
      /jpetstore/
      /jpetstore/shop/index.shtml
      /jpetstore/shop/signonForm.shtml
      /jpetstore/shop/newAccountForm.shtml
      /jpetstore/shop/newAccount.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/viewCategory.shtml
      /jpetstore/shop/viewProduct.shtml
      /jpetstore/shop/addItemToCart.shtml
      /jpetstore/shop/checkout.shtml
      /jpetstore/shop/newOrderForm.shtml
      /jpetstore/shop/newOrder.shtml
      /jpetstore/shop/newOrder.shtml
      /jpetstore/shop/index.shtml
      /jpetstore/shop/signoff.shtml
    HTTP Cookie Manager
    NewUserList
```

View Results Tree

Name: View Results Tree

Comments:

Write results to file / Read from file

Filename

```
/jpetstore/shop/newOrderForm.shtml
/jpetstore/shop/checkout.shtml
/jpetstore/shop/viewProduct.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/checkout.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/newOrderForm.shtml
/jpetstore/shop/addItemToCart.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/newOrderForm.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/checkout.shtml
/jpetstore/shop/index.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/index.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/newOrderForm.shtml
/jpetstore/shop/signoff.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/signoff.shtml
/jpetstore/shop/index.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/index.shtml
/jpetstore/shop/signoff.shtml
/jpetstore/shop/newOrder.shtml
/jpetstore/shop/signoff.shtml
/jpetstore/shop/index.shtml
/jpetstore/shop/signoff.shtml
```

Text

✓ Scroll automatically?

Figure 10: View Results Tree for New User Scenario

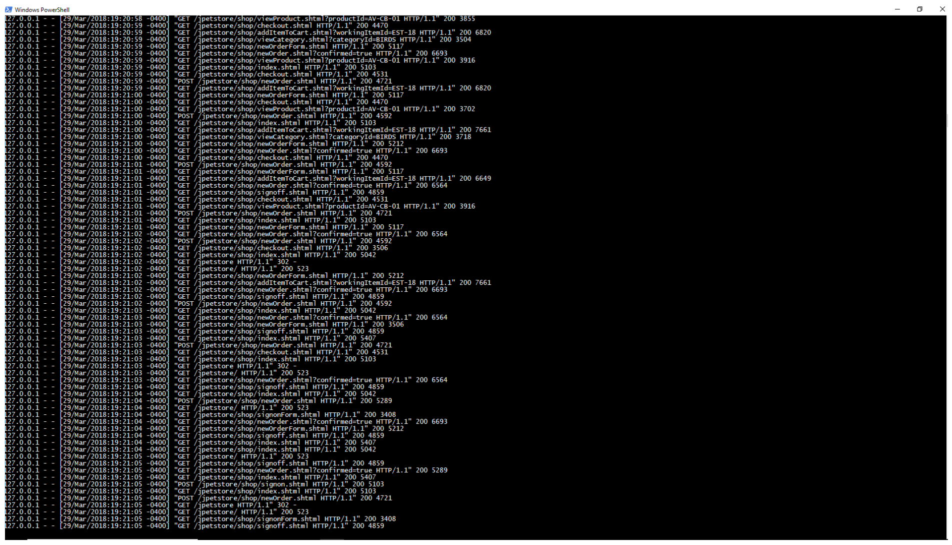
2.2.4 Analysing Load Test

The following statistics were gathered from the Apache access logs. The access log file was parsed to get the start of the load test and the end of the load test and the total time of the load test execution.

Within that timeframe, the total number of requests was found by simply executing: *wc -l nuser_log.txt*. The total number of GET and POST requests were found by executing *grep -c -w "GET" nuser_log.txt* and *grep -c -w "POST" nuser_log.txt* respectively.

- **Test Duration**: Approximately 15 minutes
- **Total Number of Requests**: 7500
- **Number of GET Requests**: 7000 (93% of all requests)
- **Number of POST Requests**: 500 (7% of all requests)
- **Success HTTP Codes**: 200 (Success) and 302 (Found)
- **Failure HTTP Codes**: None

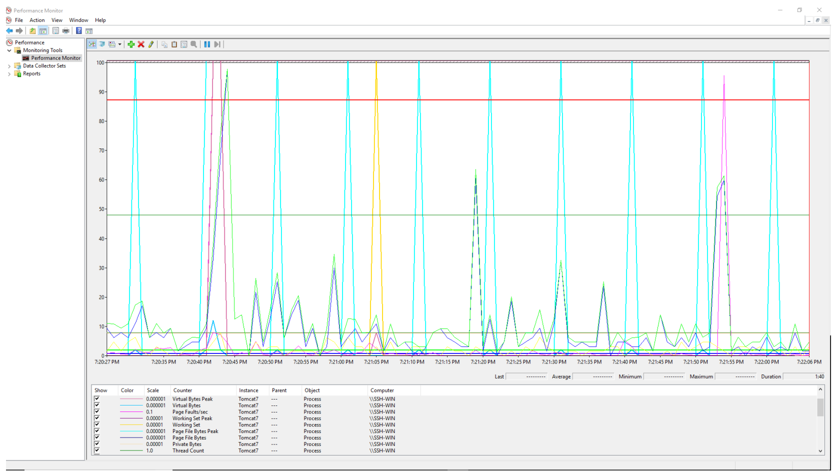
Following is a snapshot of the Apache access log:



```
127.0.0.1 - - [29/Mar/2018:19:20:58 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=AV-CB-01 HTTP/1.1" 200 3855
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/checkout.shtml HTTP/1.1" 200 4470
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-18 HTTP/1.1" 200 6820
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=BIRDS HTTP/1.1" 200 3504
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/newOrderForm.shtml HTTP/1.1" 200 5117
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 6693
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=AV-CB-01 HTTP/1.1" 200 3916
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/checkout.shtml HTTP/1.1" 200 4531
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 4721
127.0.0.1 - - [29/Mar/2018:19:20:59 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-18 HTTP/1.1" 200 6820
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/newOrderForm.shtml HTTP/1.1" 200 5117
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/checkout.shtml HTTP/1.1" 200 4470
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=AV-CB-01 HTTP/1.1" 200 3702
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 4592
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-18 HTTP/1.1" 200 7661
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/viewCategory.shtml?categoryId=BIRDS HTTP/1.1" 200 3718
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/newOrderForm.shtml HTTP/1.1" 200 5212
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 6693
127.0.0.1 - - [29/Mar/2018:19:21:00 -0400] "GET /jpetstore/shop/checkout.shtml HTTP/1.1" 200 4470
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 4592
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "GET /jpetstore/shop/newOrderForm.shtml HTTP/1.1" 200 5117
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-18 HTTP/1.1" 200 6649
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 6564
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "GET /jpetstore/shop/signoff.shtml HTTP/1.1" 200 4859
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "GET /jpetstore/shop/checkout.shtml HTTP/1.1" 200 4531
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "GET /jpetstore/shop/viewProduct.shtml?productId=AV-CB-01 HTTP/1.1" 200 3916
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 4721
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
127.0.0.1 - - [29/Mar/2018:19:21:01 -0400] "GET /jpetstore/shop/newOrderForm.shtml HTTP/1.1" 200 5117
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 6564
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 4592
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore/shop/checkout.shtml HTTP/1.1" 200 3506
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5042
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore HTTP/1.1" 302 -
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore/ HTTP/1.1" 200 523
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore/shop/newOrderForm.shtml HTTP/1.1" 200 5212
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore/shop/addItemToCart.shtml?workingItemId=EST-18 HTTP/1.1" 200 7661
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 6693
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "GET /jpetstore/shop/signoff.shtml HTTP/1.1" 200 4859
127.0.0.1 - - [29/Mar/2018:19:21:02 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 4592
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5042
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 6564
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/shop/newOrderForm.shtml HTTP/1.1" 200 3506
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/shop/signoff.shtml HTTP/1.1" 200 4859
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5407
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 4721
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/shop/checkout.shtml HTTP/1.1" 200 4531
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore HTTP/1.1" 302 -
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/ HTTP/1.1" 200 523
127.0.0.1 - - [29/Mar/2018:19:21:03 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 6564
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/shop/signoff.shtml HTTP/1.1" 200 4859
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5042
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 5289
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/ HTTP/1.1" 200 523
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/shop/signonForm.shtml HTTP/1.1" 200 3408
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 6693
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/shop/newOrderForm.shtml HTTP/1.1" 200 5212
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/shop/signoff.shtml HTTP/1.1" 200 4859
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5407
127.0.0.1 - - [29/Mar/2018:19:21:04 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5042
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore/ HTTP/1.1" 200 523
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore/shop/signoff.shtml HTTP/1.1" 200 4859
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore/shop/newOrder.shtml?confirmed=true HTTP/1.1" 200 5289
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5407
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "POST /jpetstore/shop/signon.shtml HTTP/1.1" 200 5103
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore/shop/index.shtml HTTP/1.1" 200 5103
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "POST /jpetstore/shop/newOrder.shtml HTTP/1.1" 200 4721
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore HTTP/1.1" 302 -
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore/ HTTP/1.1" 200 523
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore/shop/signonForm.shtml HTTP/1.1" 200 3408
127.0.0.1 - - [29/Mar/2018:19:21:05 -0400] "GET /jpetstore/shop/signoff.shtml HTTP/1.1" 200 4859
```

Figure 11: Apache Access Log Snapshot for New User Scenario

Following is a snapshot of the Windows Performance Monitor and Java Monitor Console during the load test execution:



Show	Color	Scale	Counter	Instance	Parent	Object	Computer
✓	—	0.000001	Virtual Bytes Peak	Tomcat7	---	Process	\\SSH-WIN
✓	—	0.000001	Virtual Bytes	Tomcat7	---	Process	\\SSH-WIN
✓	—	0.1	Page Faults/sec	Tomcat7	---	Process	\\SSH-WIN
✓	—	0.00001	Working Set Peak	Tomcat7	---	Process	\\SSH-WIN
✓	—	0.00001	Working Set	Tomcat7	---	Process	\\SSH-WIN
✓	—	0.000001	Page File Bytes Peak	Tomcat7	---	Process	\\SSH-WIN
✓	—	0.000001	Page File Bytes	Tomcat7	---	Process	\\SSH-WIN
✓	—	0.00001	Private Bytes	Tomcat7	---	Process	\\SSH-WIN
✓	—	1.0	Thread Count	Tomcat7	---	Process	\\SSH-WIN

Figure 12: Windows Performance Monitor Snapshot for New User Scenario

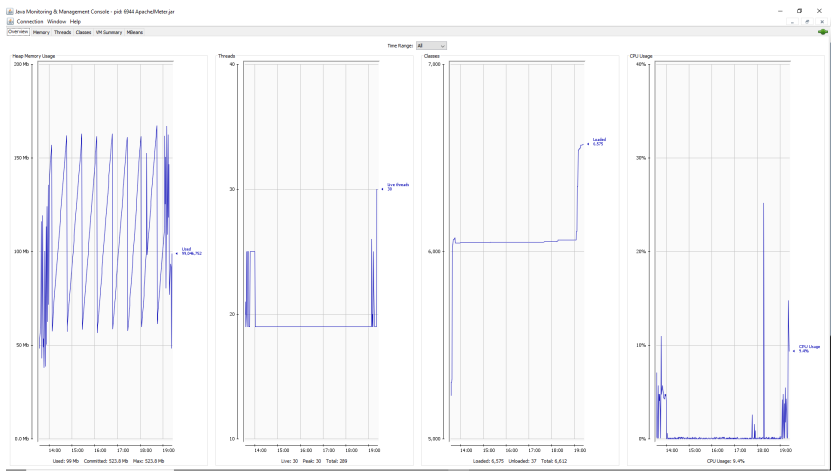

Java Monitoring & Management Console - pid: 6944 ApacheJMeter.jar
Overview
Memory
Threads
Classes
VM Summary
MBeans
Heap Memory Usage
Threads
Classes
CPU Usage
Used: 99 Mb Committed: 523.8 Mb Max: 523.8 Mb
Live: 30 Peak: 30 Total: 289
Loaded: 6,575 Unloaded: 37 Total: 6,612
CPU Usage: 9.4%

Figure 13: JConsole Snapshot for New User Scenario

Conclusion: The load test scenario for new user made about 7500 requests and the test ran for approximately 15 minutes. Despite some natural high spikes on the performance monitor and java monitor, the load test was carried out successfully without any crashes or unexpected behaviour in the application.