Capstone Retail Black Friday Project

Table Of Contents

1 Introduction

The Retail Black Friday project contains 5 major parts.

1. Cassandra CQL scripts to create the database schema, and CQL import scripts to populate it with seed data
2. An analytics Spark job with the source code available
3. A streaming data Spark job with the source code available
4. A sample Solr schema with a script to post it
5. A web project in the web-python directory - a simple Python / Flask project that runs against a local DSE node. This expects that you have a local DSE environment setup and running.
6. A web project in the web-java directory implemented with the same functionality as the web-python project.
7. The cash-register simulator implemented with JMeter

The Project is delivered in a fully configured VM, but can also be built manually from the GitHub repository. The instructions in Section 1 describe how to perform a manual installation. If you are working with the VM, proceed to Section 2.

2 Objectives

The objectives for this exercise are as follows:

1. Create or install the Capstone environment
2. Understand the different moving parts of the architecture:
    i. Cassandra database and retail data model
    ii. Spark Analytics and Spark streaming
    iii. Solr
    iv. JMeter
    v. Activemq
    vi. Web framework

3. Solr exercise – create an index on the receipts entity such that you are able to search all the receipts that contain a given product title (word/pattern).
4. Spark exercise – create a fraud detection job to detect credit cards that have been used in more than one state.
5. Data modelling exercise – design and implement a customer table. We will provide a CSV file containing names, and the data model already includes a table containing zip codes. You must extend the Meter receipts sampler so that it populates the customer table with customer names and zip codes, linked to the receipts.

3 Manual Installation

If you are not installing on a Mac skip to the section “All Platforms – Pre-requisites”.

3.1 Mac Pre-requisites

1. Install brew - the default Mac python won't work
2. Install wget:

```
brew install wget
```

3. Install brew's version of python:

```
brew install python
```

4. Install pip:

```
brew install pip
```

Now continue with the instructions below to install the pre-requisites for the project.

3.2 All Platforms – Pre-requisites

1. Verify you can run python:

```
python
exit()
```

2. Verify you can run pip:

```
pip -V
```

3. Install Python dependencies:

```
pip install flask
pip install blist
pip install cassandra-driver
pip install requests
```

4. Install sbt

For example, for Ubuntu:

```
echo "deb http://dl.bintray.com/sbt/debian /" | sudo tee -a
/etc/apt/sources.list.d/sbt.list
sudo apt-get update
sudo apt-get install sbt
```

5. Install JMeter

JMeter can be installed using:

```
sudo apt-get install jmeter
```

Alternatively it can be downloaded rom the Apache JMeter site: http://jmeter.apache.org/download_jmeter.cgi

You can create a JMeter directory at a location of your choice for JMeter, e.g. in your home directory.

6. Install the JMeter plugin for Cassandra

The JMeter plugin for Cassandra can be downloaded from the Github repository at:

https://github.com/slowenthal/jmeter-cassandra/releases

Follow the instructions in the README.md to download **jmeter-cassandra-0.9.1-bin.tar.gz**.

Untar the Cassandra plugin repo contents into the JMeter directory created in the previous step.

7. Download and install ActiveMQ

Apache ActiveMQ is an open source messaging server. JMeter will publish data to ActiveMQ queues. To do this, the `activeqm-all` jar file needs to be in the classpath of JMeter. Copy or link the jar to the jmeter/lib directory as shown below

   a. Download the latest release from http://activemq.apache.org/activemq-5111-release.html
   b. Create a directory in the location of your choice and untar the contents of the zip file.
   c. Copy or link `activemq-all-5.11.1.jar` to `<path>/apache-jmeter/lib/activemq-all-5.11.1.jar`

NB Activemq functions as pipe between JMeter and Spark streaming and is a more reliable technology than using sockets. JMeter uses it's own JMS publisher sampler (which can both publish and receive) to publish a string to the HotProducts queue.

8. Disable swapping

   Use the appropriate commands for your operating system to prevent swapping.

9. Ulimits

   If you will not be running the processes as the root account you must ensure the following ulimit settings are enabled:

```
max locked memory        (kbytes, -l) 64 ← should be unlimited
open files                       (-n) 4096 ← should be 100000
max user processes               (-u) 45488 ← should be 32768
```

   For example – update /etc/limits.conf with the following

```
#
# Added for Datastax Enterprise install
#
dse soft memlock unlimited
dse hard memlock unlimited
dse soft nofile 100000
dse hard nofile 100000
dse soft nproc 32768
dse hard nproc 32768
dse soft as unlimited
dse hard as unlimited
```

   Finally, check that `/etc/pam.d/login` is enabled for enforcing the limits

10. Install and configure NTP

    This step is only required for a clustered build. Skip this step on a single node installation.

11. Install & configure DSE

    a. Download the latest DSE release from www.datastax.com/downloads
    b. Create a single node cluster on the machine where the repo has been downloaded.

       As a minimum set the following parameters in Cassandra.yaml:

       - Listener address: 127.0.0.1
       - RPC address: 127.0.0.1
       - Set the data file locations with correct write permissions:
         - Cassandra data files `/var/lib/cassandra`
         - Spark data file location to `/var/lib/spark`

- Set the log file locations with correct write permissions:
  - Cassandra log files `/var/log/cassandra`
  - Spark log files `/var/log/spark`

NB We will need to run DSE with Spark and Cassandra simultaneously. In a packaged install you can configure DSE to start with Spark and Solr using `/etc/default/dse`

For tarball installs you use both the -s and -k flags when starting Cassandra.

12. Install Java JDK

a. Java JDKs can be downloaded from

http://www.oracle.com/technetwork/java/javase/downloads/index.html

- Java JDK 7u79 can be downloaded directly from:

  http://www.oracle.com/technetwork/java/javase/downloads/jdk7-downloads-1880260.html

- Java JDK 8u45 can be downloaded directly from:

  http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html

b. Run the JDK installer

c. Use the alternatives command to add a symbolic link to the Oracle JDK installation so that your system uses the Oracle JDK instead of the OpenJDK JRE.

For example, if your Oracle JDK has been installed in `/usr/java`:

```
# ls /usr/java
default  jdk1.7.0_67  jdk1.7.0_71  latest
```

The `alternatives` command will specify the default JDK to use:

```
 # alternatives --install /usr/bin/java java
/usr/java/jdk1.7.0_71/bin/java 200000
```

If more than one installation of java exists you can check that the correct version is in use:

```
# alternatives --config java
There are 6 programs which provide 'java'.
  Selection    Command
-----------------------------------------------
   1           /usr/lib/jvm/jre-1.7.0-openjdk.x86_64/bin/java
   2           /usr/lib/jvm/jre-1.6.0-openjdk.x86_64/bin/java
*  3           /usr/share/jdk_1.7.0.2
   4           /usr/share/jdk_1.7.0.2/bin/java
   5           /usr/share/jdk1.7
 + 6           /usr/share/jdk1.7/bin/java
```

```
Enter to keep the current selection[+], or type selection number: 6
```

Make sure your system is now using the correct JDK. For example:

```
# /usr/java/latest/bin/java -version
java version "1.7.0_71"
Java(TM) SE Runtime Environment (build 1.7.0_71-b14)
Java HotSpot(TM) 64-Bit Server VM (build 24.71-b04, mixed mode)
```

13. If you would like to run jupyter notebooks to help with spark development

```
pip install ipython
pip install notebook
```

Download and install the latest release from here according to the instructions:

```
https://github.com/slowenthal/spark-kernel/releases
```

3.3 Manual Installation – Configure The Project

The Retail project is designed to run on a single node configured for Cassandra, Spark, Solr and JMeter. This is the default configuration. If you will be using this configuration you can proceed to the section “How To Use The Project”.

Alternatively if you intend to run JMeter and the web components against a remote node running Cassandra, Spark and Solr you will need to adjust the configuration to set the correct destination IP address in the following files:

1. jmeter/scans.jmx
2. web/application.cfg

4 VM Installation

The pre-built and configured VM can be downloaded from here:

https://s3.amazonaws.com/datastaxtraining/VM/Capstone-VM-1.0.zip

a. When the download has completed, unzip the contents into a location of your choice. This will create a directory called “Retail Demo” containing a file called “Retail Demo.vbox”
b. Open the vbox file using Virtual Box to create the VM
   - Under the Machine menu select the add option and choose the vbox file provided
c. Ensure that you have at least 8GB and 3 CPU allocated to the VM
d. Start the VM – no login credentials are required
e. Ignore any warning messages relating to missing shared folders

5 How To Use The Project

The instructions below assume that you have either:

1. Created an environment containing all the pre-requisites and can successfully start Cassandra, Spark, Solr and JMeter, or

2. Downloaded and started the VM

Regardless of the machine type you will be using you must ensure that you have sufficient resources available to Spark Streaming, particularly CPU, but also memory. In oparticular, Spark Streaming requires 2 Spark Worker cores.

1. CPU – you will need to allocate at least three CPUs to your server environment by uncommenting and set SPARK_WORKER_CORES in `spark-env.sh` (in `<DSE_HOME>/resources/spark/conf`):

```
# Set the number of cores used by Spark Worker - if uncommented,
it overrides the setting initial_spark_worker_resources in
dse.yaml.
export SPARK_WORKER_CORES=3
```

2. Memory – we recommend that you allocate 8GB to your server environment. If you have less RAM available you may need to tweak SPARK_WORKER_MEMORY in `spark-env.sh` (in `<DSE_HOME>/resources/spark/conf`):

```
# Set the amount of memory used by Spark Worker - if uncommented,
it overrides the setting initial_spark_worker_resources in
dse.yaml.
# export SPARK_WORKER_MEMORY=2048m
```

5.1 Start the DSE services – Cassandra, Spark and Solr

a. Tarball install (manual install):

```
dse cassandra –k –s
```

The services can be stopped using:

```
dse cassandra-stop
```

b. Package install (VM)

```
service dse start   * Starting DSE daemon dse
DSE daemon starting with Solr enabled (edit /etc/default/dse to disable)
DSE daemon starting with Spark enabled (edit /etc/default/dse to disable)[ OK ]
```

NB the services will be autostarted when the VM is started. Use the following command to restart at any point:

```
service dse restart  *
```

5.2 Import the seed data into Cassandra

a. Navigate to the `<retail project>/cql` directory:

```
cd cql
```

b. Create the retail keyspace and tables:

```
cqlsh -f retail.cql
```

c. Import the seed data:

```
cqlsh -f import.cql
```

Note: in DSE 4.7.0, there is a bug which prevents the above command from running correctly. In that release, run the import as follows:

```
cat import.cql | cqlsh
```

This script will populate the following tables:

- suppliers
- products_by_id
- products_by_supplier
- products_by_category_name
- stores

It will also define the following hot products:

```
UPDATE retail.products_by_category_name SET is_hot = true WHERE category_name = 'notebooks';
UPDATE retail.products_by_category_name SET is_hot = true WHERE category_name = 'servers';
```

5.3 Import the sample Solr index

a. Navigate to the `<retail project>/solr` directory:

```
cd solr
```

b. Run the script to import the solr index:

```
./add-schema.sh products_by_id
```

Ensure that you see these three messages:

```
SUCCESS
SUCCESS
Created index.
```

5.4 Start the Python web project

The Python-based web services run as a Flask lightweight web framework.

a. Navigate to the `<retail project>/web-python` directory:

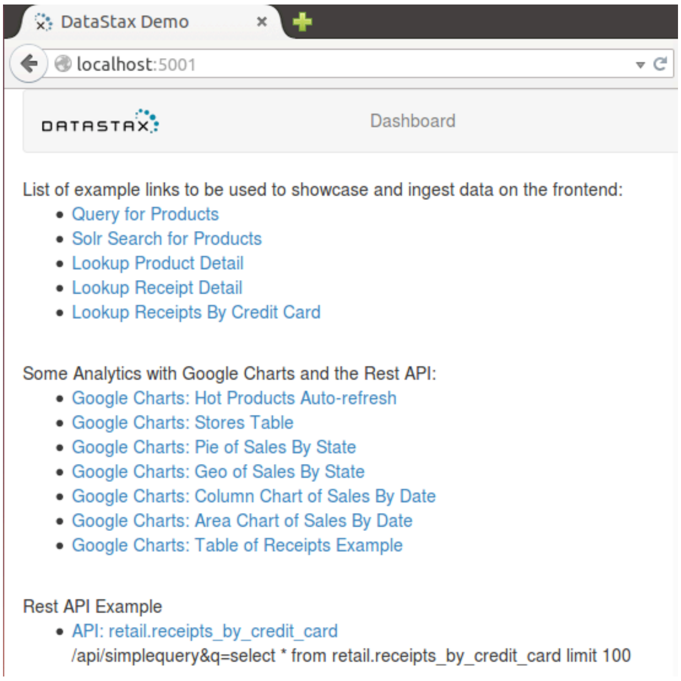
```
cd web-python
```

b. Start Flask web services in the background:

```
./run &
```

5.5 Verify that the Python web project is running

In the your browser navigate to the URL http://localhost:5001/ - you should see the following displayed:



List of example links to be used to showcase and ingest data on the frontend:

- Query for Products
- Solr Search for Products
- Lookup Product Detail
- Lookup Receipt Detail
- Lookup Receipts By Credit Card

Some Analytics with Google Charts and the Rest API:

- Google Charts: Hot Products Auto-refresh
- Google Charts: Stores Table
- Google Charts: Pie of Sales By State
- Google Charts: Geo of Sales By State
- Google Charts: Column Chart of Sales By Date
- Google Charts: Area Chart of Sales By Date
- Google Charts: Table of Receipts Example

Rest API Example

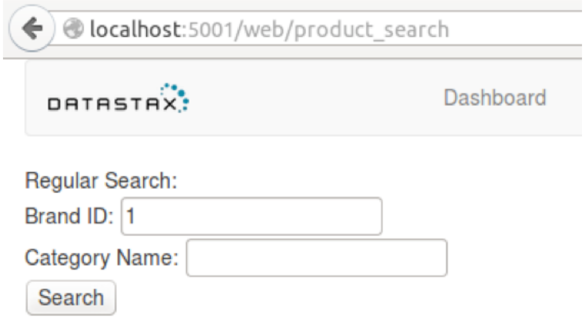
- API: retail.receipts_by_credit_card
  /api/simplequery&q=select * from retail.receipts_by_credit_card limit 100

Try out the pages that return the available seed data.

NB the “Lookup Receipt Detail”, “Lookup Receipts By Credit Card”, “Hot Product”, “Sales by State” and “Sales by Date” options will not return any data at this point as the underlying tables are not yet populated - this happens in the following steps.

a. Query For Products

Select “Query for Products” – enter (e.g. “1”) in the Brand ID field and click Search:

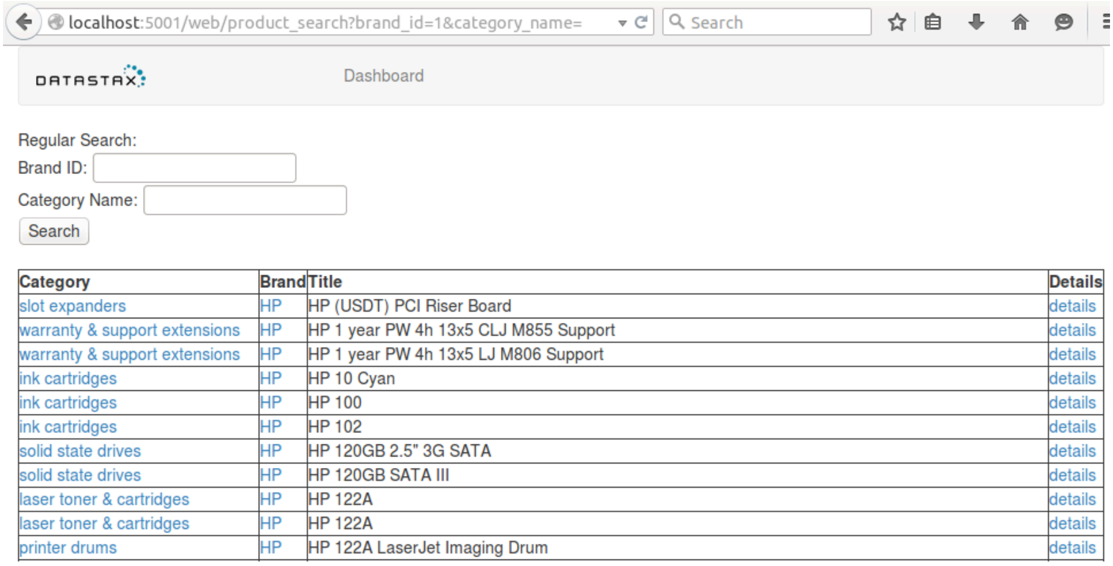


Regular Search:

Brand ID: 1

Category Name:

You will see a selection of products displayed for the product code entered:



Regular Search:
Brand ID:
Category Name:
Search

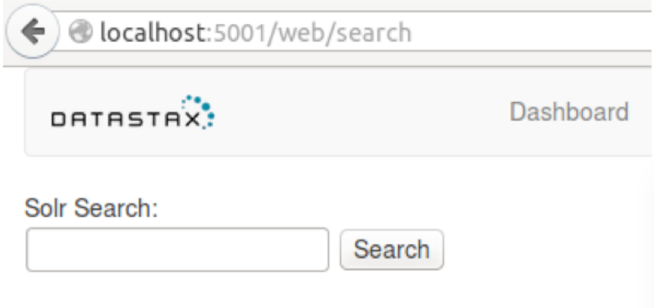
Category	Brand	Title	Details
slot expanders	HP	HP (USDT) PCI Riser Board	details
warranty & support extensions	HP	HP 1 year PW 4h 13x5 CLJ M855 Support	details
warranty & support extensions	HP	HP 1 year PW 4h 13x5 LJ M806 Support	details
ink cartridges	HP	HP 10 Cyan	details
ink cartridges	HP	HP 100	details
ink cartridges	HP	HP 102	details
solid state drives	HP	HP 120GB 2.5" 3G SATA	details
solid state drives	HP	HP 120GB SATA III	details
laser toner & cartridges	HP	HP 122A	details
laser toner & cartridges	HP	HP 122A	details
printer drums	HP	HP 122A LaserJet Imaging Drum	details

Try the Category Name search by entering one of the values returned in the search above (e.g. “slot expanders”).

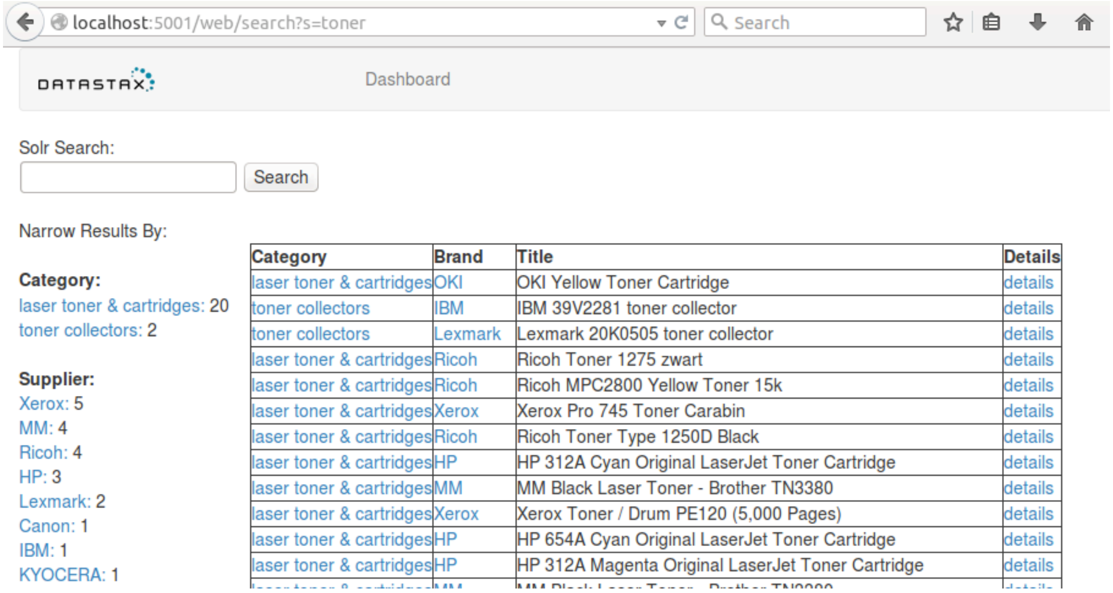
Note that you can also follow the hyperlinks of the displayed products (e.g. click “IBM” to see all the IBM products).

b. Solr Search for Products

Select “Solr search for Products” – enter (e.g. “toner”) in the Solr Search field and click Search:



You will see a selection of products displayed for the product type entered:



localhost:5001/web/search?s=toner

Solr Search:

Narrow Results By:

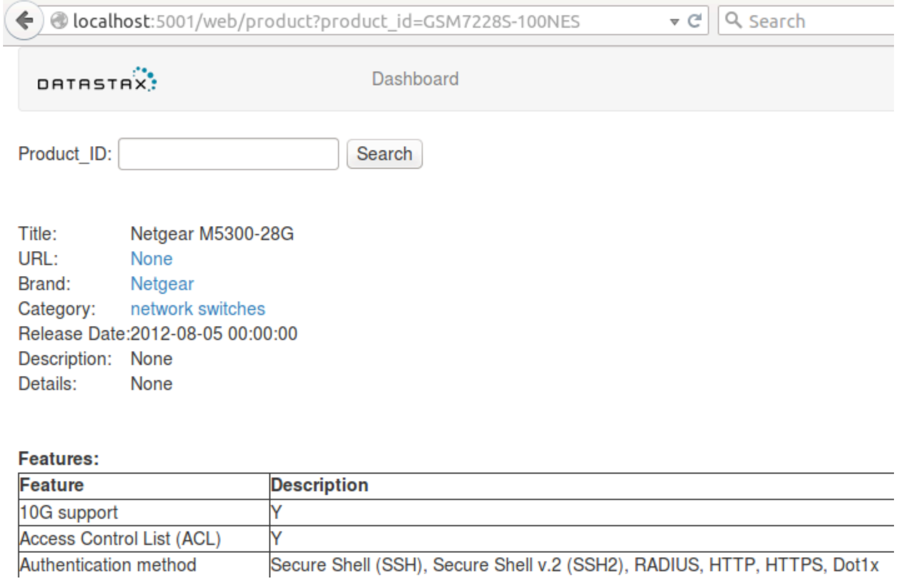
Category:
laser toner & cartridges: 20
toner collectors: 2

Supplier:
Xerox: 5
MM: 4
Ricoh: 4
HP: 3
Lexmark: 2
Canon: 1
IBM: 1
KYOCERA: 1

Category	Brand	Title	Details
laser toner & cartridges	OKI	OKI Yellow Toner Cartridge	details
toner collectors	IBM	IBM 39V2281 toner collector	details
toner collectors	Lexmark	Lexmark 20K0505 toner collector	details
laser toner & cartridges	Ricoh	Ricoh Toner 1275 zwart	details
laser toner & cartridges	Ricoh	Ricoh MPC2800 Yellow Toner 15k	details
laser toner & cartridges	Xerox	Xerox Pro 745 Toner Carabin	details
laser toner & cartridges	Ricoh	Ricoh Toner Type 1250D Black	details
laser toner & cartridges	HP	HP 312A Cyan Original LaserJet Toner Cartridge	details
laser toner & cartridges	MM	MM Black Laser Toner - Brother TN3380	details
laser toner & cartridges	Xerox	Xerox Toner / Drum PE120 (5,000 Pages)	details
laser toner & cartridges	HP	HP 654A Cyan Original LaserJet Toner Cartridge	details
laser toner & cartridges	HP	HP 312A Magenta Original LaserJet Toner Cartridge	details
laser toner & cartridges	MM	MM Black Laser Toner - Brother TN2220	details

c. Lookup Product Detail

You can find product ID’s by querying the product_id table in cqlsh. For example, search for “GSM7228S-100NES”:



localhost:5001/web/product?product_id=GSM7228S-100NES

Product_ID:

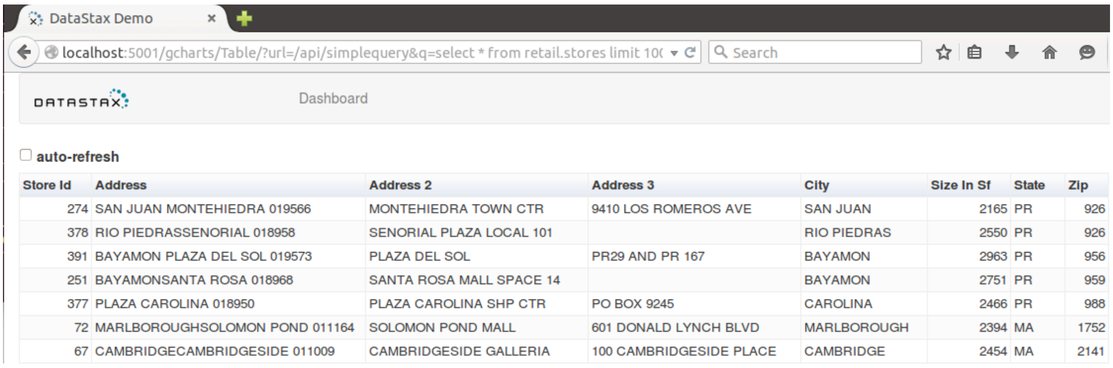
Title:	Netgear M5300-28G
URL:	None
Brand:	Netgear
Category:	network switches
Release Date:	2012-08-05 00:00:00
Description:	None
Details:	None

Features:

Feature	Description
10G support	Y
Access Control List (ACL)	Y
Authentication method	Secure Shell (SSH), Secure Shell v.2 (SSH2), RADIUS, HTTP, HTTPS, Dot1x

d. Google Charts: Stores Table

This is a query of the Stores table with the results presented in a table by Google Charts:


DataStax Demo
localhost:5001/gcharts/Table/?url=/api/simplequery&q=select * from retail.stores limit 10(
Search
DATASTAX
Dashboard

□ auto-refresh

Store Id	Address	Address 2	Address 3	City	Size In Sf	State	Zip
274	SAN JUAN MONTEHIEDRA 019566	MONTEHIEDRA TOWN CTR	9410 LOS ROMEROS AVE	SAN JUAN	2165	PR	926
378	RIO PIEDRASSENORIAL 018958	SENORIAL PLAZA LOCAL 101		RIO PIEDRAS	2550	PR	926
391	BAYAMON PLAZA DEL SOL 019573	PLAZA DEL SOL	PR29 AND PR 167	BAYAMON	2963	PR	956
251	BAYAMONSANTA ROSA 018968	SANTA ROSA MALL SPACE 14		BAYAMON	2751	PR	959
377	PLAZA CAROLINA 018950	PLAZA CAROLINA SHP CTR	PO BOX 9245	CAROLINA	2466	PR	988
72	MARLBOROUGHSOLOMON POND 011164	SOLOMON POND MALL	601 DONALD LYNCH BLVD	MARLBOROUGH	2394	MA	1752
67	CAMBRIDGECAMBRIDGESIDE 011009	CAMBRIDGESIDE GALLERIA	100 CAMBRIDGESIDE PLACE	CAMBRIDGE	2454	MA	2141

5.6 Simulate the Cash Registers Using JMeter

Transactions and receipts are generated using JMeter.

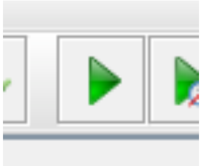
a. Navigate to the `<retail project>/jmeter` directory:

```
cd jmeter
```

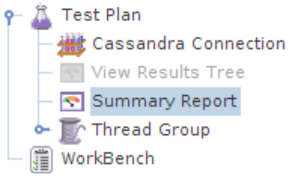
b. The JMeter executable is already in your path and can be started in the foreground using the GUI interface using the following command:

```
Jmeter -t scans.jmx
```

In the GUI you must start the JMeter data injection by pressing the start button:



You can track the activity during injection by clicking on Summary Report:



NB A small percentage of JMeter errors is acceptable (this is due to variations in the source data format) but high error levels indicate that there is a problem. However the JMS Publisher will always error when activemq is not running (you will start this in a later step for the Hot Products queue).

NB You can run JMeter in text mode by starting it with the –n option e.g.:

```
jmeter -n -t scans.jmx
```

You can also log output to a log file from the command line using the –l option e.g.:

```
jmeter -t scans.jmx -l scans.log
```

NB JMeter will insert a significant amount of data, so run it sparingly. A 1-2 hour run should be sufficient.

JMeter will insert records into the following tables;

- `receipts`
- `inventory_per_store`
- `receipts_by_credit_card`
- `receipts_by_store_date`

5.7 Build the Spark Analytics job

The Spark analytics job will roll up transactions into the analytics tables used by the charts:

- `sales_by_date`
- `sales_by_state`

a. Navigate to the `<retail project>/spark` directory:

b. Run sbt assembly from the prompt – it may take a few seconds to download required files and compile - this will compile any source files found in src/main/scala (RollupRetail.scala):

```
$ sbt assembly
…
[info] Done updating.
[info] Set current project to spark-retail (in build
file:/home/dse/retail/spark/)
[info] Packaging /root/retail/spark/target/scala-2.10/spark-retail-
assembly-1.0.jar ...
[info] Done packaging.
[success] Total time: 164 s, completed May 1, 2015 2:42:24 PM
```

c. You have now created the Spark jar file - exit sbt:

```
> exit
```

5.8 Submit the Spark Analytics job

This job will extract data from Cassandra, rollup the data and populate the analytics tables.

a. Navigate to the `<retail project>/spark` directory:

b. Submit the analytics job:

```
dse spark-submit --class RollupRetail target/scala-2.10/spark-retail-
assembly-1.0.jar
```

You could put this in a shell script for convenience (eg. run_spark.sh).

NB The following error message suggests that the spark workers have died (this can happen for example when you close the laptop) or that there is insufficient memory.

```
15/05/06 14:43:35 WARN TaskSchedulerImpl: Initial job has not accepted
any resources; check your cluster UI to ensure that workers are
registered and have sufficient memory
```

a. Check that you have 8GB allocated to the machine
b. Try restarting the spark workers using the command:

```
dsetool sparkworker restart
```

c. If that fails to resolve the problem, stop and restart DSE products:

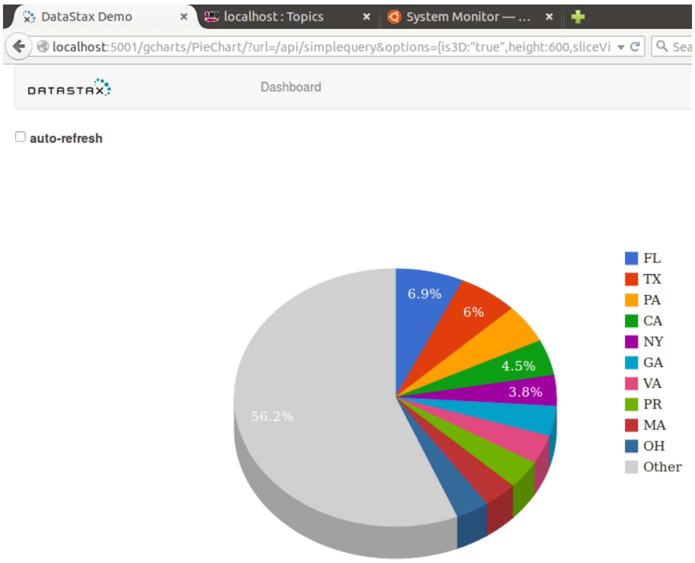
```
dse cassandra-stop
dse cassandra -k -s
```

d. If you are unable to resolve the problem using the methods above, restart the virtual machine (there is a lot of contention for resources when running DSE, Spark and Solr on the same machine).

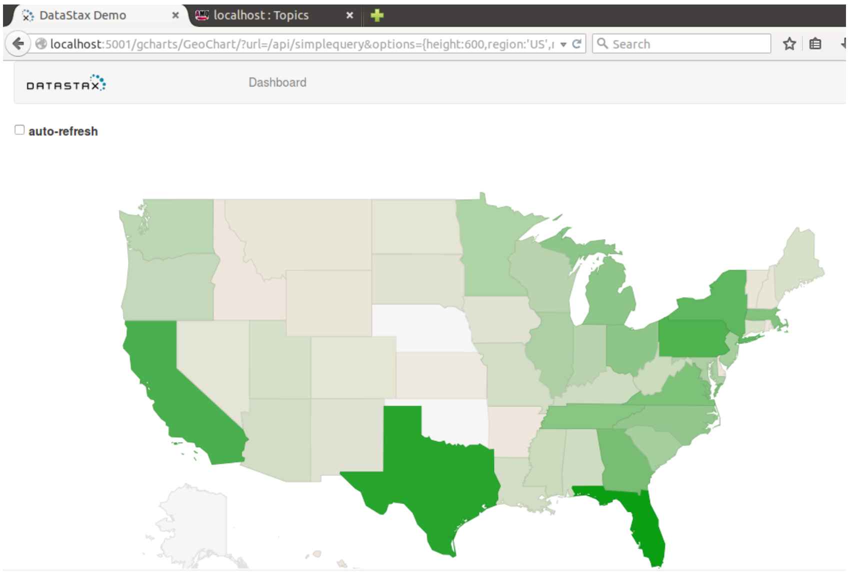
5.9 View the Charts

As data is progressively injected into Cassandra by JMeter you will be able to see more data reflected in the charts. Examples are shown below.

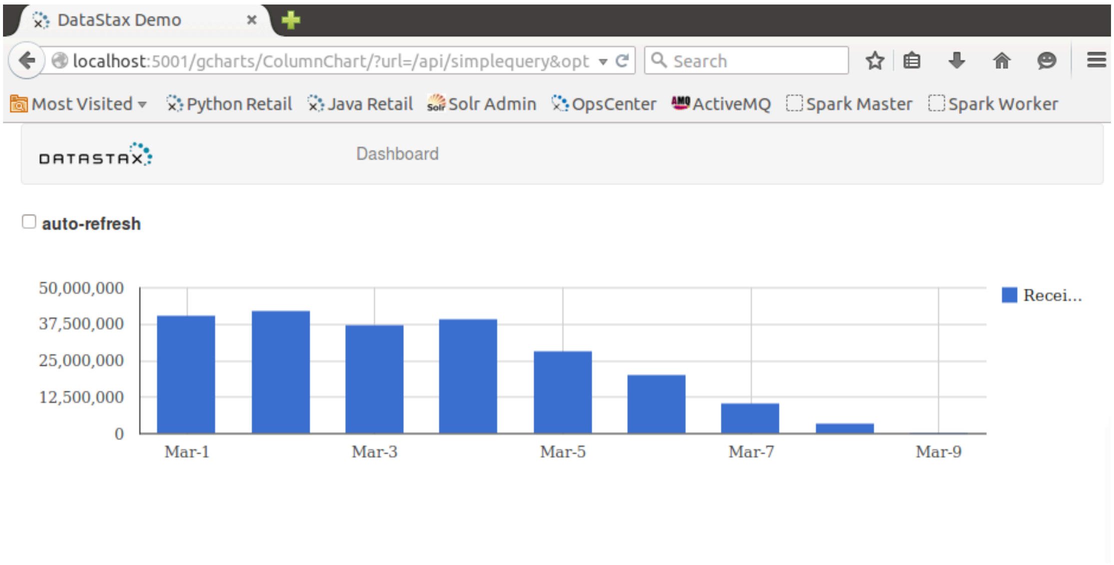
a. Pie of Sales By State (JMeter injection data)



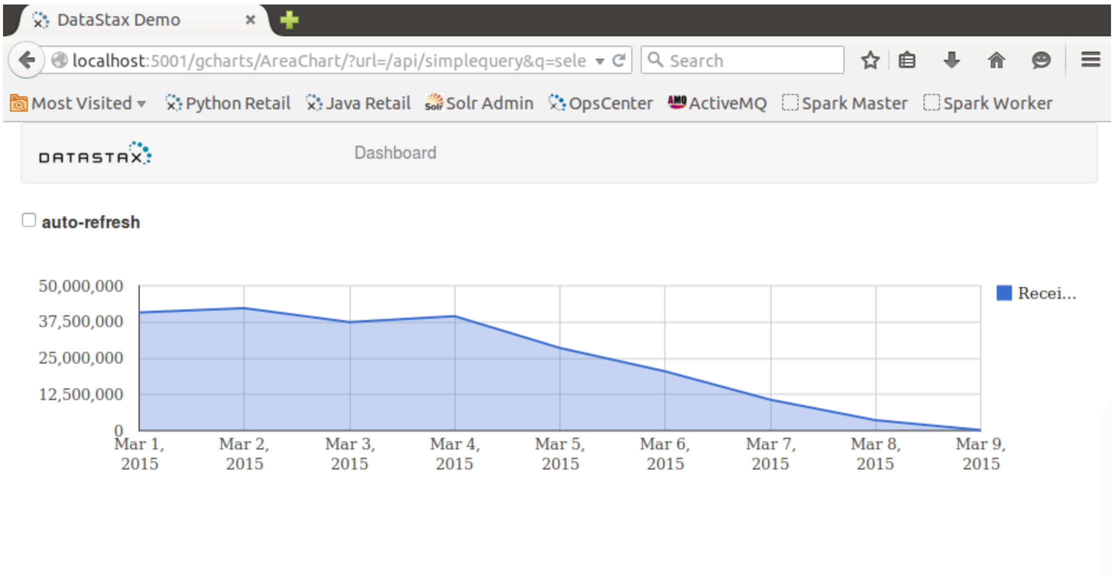
b. Geo of Sales By State (JMeter injection data)


DataStax Demo
localhost : Topics
localhost:5001/gcharts/GeoChart/?url=/api/simplequery&options={height:600,region:'US',r
Search
DATASTAX
Dashboard
□ auto-refresh

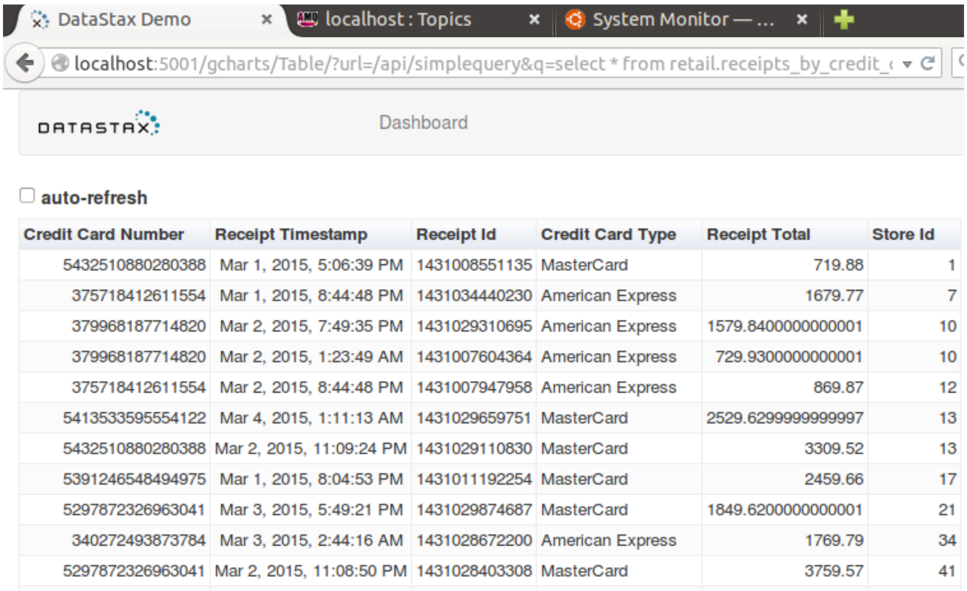
c. Column Chart of Sales By State (Spark Analytics rollup data)



d. Area Chart of Sales By State (Spark Analytics rollup data)



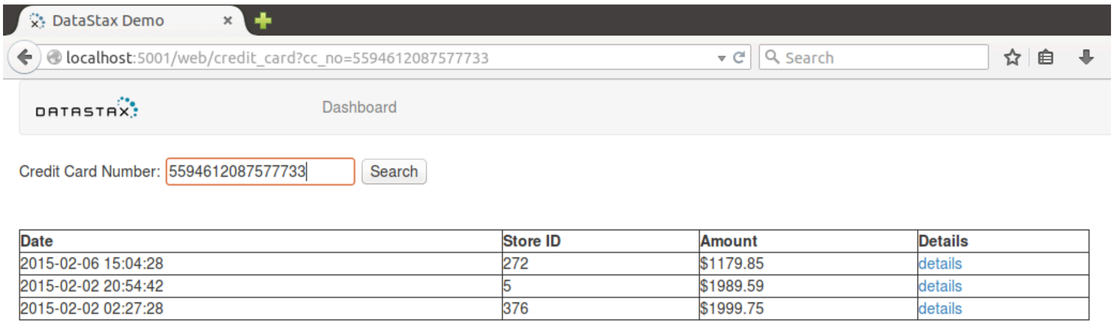
e. Table of Receipts Example (JMeter injection data)


DataStax Demo
localhost : Topics
System Monitor — ...
localhost:5001/gcharts/Table/?url=/api/simplequery&q=select * from retail.receipts_by_credit_(
DATASTAX
Dashboard
□ auto-refresh

Credit Card Number	Receipt Timestamp	Receipt Id	Credit Card Type	Receipt Total	Store Id
5432510880280388	Mar 1, 2015, 5:06:39 PM	1431008551135	MasterCard	719.88	1
375718412611554	Mar 1, 2015, 8:44:48 PM	1431034440230	American Express	1679.77	7
379968187714820	Mar 2, 2015, 7:49:35 PM	1431029310695	American Express	1579.8400000000001	10
379968187714820	Mar 2, 2015, 1:23:49 AM	1431007604364	American Express	729.9300000000001	10
375718412611554	Mar 2, 2015, 8:44:48 PM	1431007947958	American Express	869.87	12
5413533595554122	Mar 4, 2015, 1:11:13 AM	1431029659751	MasterCard	2529.6299999999997	13
5432510880280388	Mar 2, 2015, 11:09:24 PM	1431029110830	MasterCard	3309.52	13
5391246548494975	Mar 1, 2015, 8:04:53 PM	1431011192254	MasterCard	2459.66	17
5297872326963041	Mar 3, 2015, 5:49:21 PM	1431029874687	MasterCard	1849.6200000000001	21
340272493873784	Mar 3, 2015, 2:44:16 AM	1431028672200	American Express	1769.79	34
5297872326963041	Mar 2, 2015, 11:08:50 PM	1431028403308	MasterCard	3759.57	41

f. Receipts by Credit Card

The credit card transaction data can now be used in the Receipts by Credit Card page.



Credit Card Number: 5594612087577733 Search

Date	Store ID	Amount	Details
2015-02-06 15:04:28	272	$1179.85	details
2015-02-02 20:54:42	5	$1989.59	details
2015-02-02 02:27:28	376	$1999.75	details

5.10 Build the Spark Streaming job

a. Navigate to the `<retail project>/sparkstreaming` directory:
b. Run sbt from the prompt – it may take a few seconds to download required files:

```
$ sbt
```

c. When it finishes updating you will be returned to the prompt:

```
[info] Done updating.
[info] Set current project to spark-retail (in build
file:/home/dse/retail/spark/)
>
```

d. Run the assembly command – when it finishes exit from sbt:

```
[info] Packaging /root/retail/sparkstreaming/target/scala-2.10/spark-
streaming-retail-assembly-1.0.jar ...
[info] Done packaging.
[success] Total time: 20 s, completed May 8, 2015 2:56:19 PM
> exit
```

5.11 Start activemq

The Spark Streaming job receives data that JMeter publishes to the Hot Products queue managed by activemq. The activemq process must be running to receive the hot products from JMeter:

```
cd ~/activemq/bin
./activemq start
```

5.12 Submit the Spark Streaming job

a. Navigate to the `<retail project>/sparkstreaming` directory:
b. Submit the streaming job:

The Spark Streaming job will run continually, reading hot product events placed on the activemq message queue, and populate the table:

- `real_time_analytics`

```
dse spark-submit --class HotProductsStream target/scala-2.10/spark-streaming-retail-assembly-1.0.jar
```

NB Ensure that JMeter is running the data injection when the streaming job is sumitted.

c. View the Hot Products queue

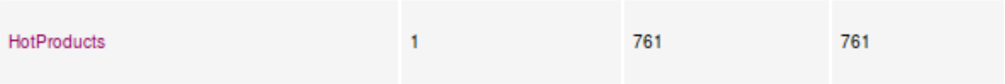
Navigate to the Hot Products web page. Click on "auto-refresh" to see the products updated in real-time.

Updates to the hot products page will occur in real-time e.g. if JMeter stops publishing hot products to the message queue, then so does the hot products display

Login in the activemq console as admin with the password admin to view the queue status:

http://localhost:8161/admin/topics.jsp

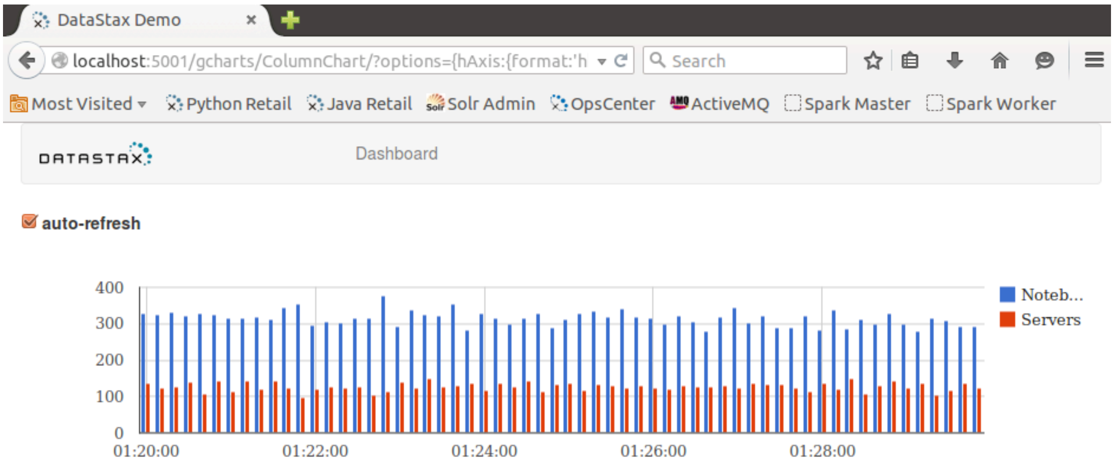
The topics tab will show a count of items published to the HotProducts queue for example



HotProducts	1	761	761

d. View the Hot Products page

Visit the Hot Products chart, and watch the sales of notebooks and servers.



NB you can change the products classed as "hot products" by changing the is_hot boolean on the products_by_category_name table. The JMeter script will also randomly update product "Hot Product" status.

5.13 Starting Jupyter Notebooks

a. Navigate to the jupyter directory
b. Run

```
ipython notebook --port 7001
```

6 Using the Java Web Framework

The Java web framework is provided as an alternative to Python to showcase development against Cassandra in Java. Version 8 of Java is required.

By default the VM is configured to use Java 7 (for DSE):

```
which java
/usr/bin/java
```

```
java -version
java version "1.7.0_71"
```

6.1 Set the Java 8 Environment

Open a new terminal to use the Java web framework and set the JAVA_HOME and PATH to point to the installation of Java 8.

If required you can preserve your current PATH as follows:

```
J7PATH=$PATH export J7PATH
J7JAVA_HOME=$JAVA_HOME export JAVA_HOME
```

a. Set the Java 8 environment:

```
JAVA_HOME=/usr/local/jdk-1.8.0_45 export JAVA_HOME
PATH=$JAVA_HOME/bin:$PATH export PATH
```

b. Check that Java 8 is enabled:

```
which java
/usr/local/jdk-1.8.0_45/bin/java
```

```
java -version
java version "1.8.0_45" Java(TM) SE Runtime Environment (build
1.8.0_45-b14) Java HotSpot(TM) 64-Bit Server VM (build 25.45-b02,
mixed mode)
```

c. Navigate to the `<retail project>/web-java` directory:
d. Run maven from the prompt – it may take a few seconds to download required files before successfully completing the build:

```
mvn install
```

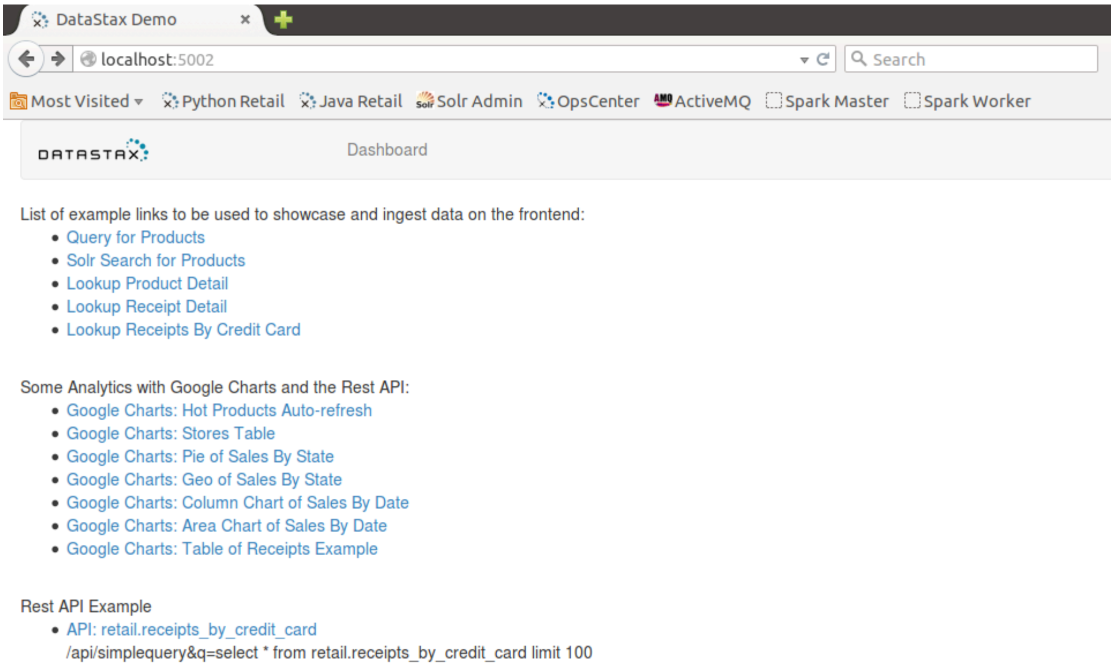
```
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS [INFO]
[INFO] ------------------------------------------------------------------------
[INFO] Total time: 13.207s [INFO] Finished at: Mon May 11 14:10:10 UTC 2015
[INFO] Final Memory: 15M/217M
[INFO] ------------------------------------------------------------------------
```

e. Run the compiled code:

```
java -cp "target/retail-1.0.jar:target/lib/*" StartJetty
```

6.2 Verify that the Java web project is running

In the your browser navigate to the URL http://localhost:5002/ - you should see the following displayed:



List of example links to be used to showcase and ingest data on the frontend:

- Query for Products
- Solr Search for Products
- Lookup Product Detail
- Lookup Receipt Detail
- Lookup Receipts By Credit Card

Some Analytics with Google Charts and the Rest API:

- Google Charts: Hot Products Auto-refresh
- Google Charts: Stores Table
- Google Charts: Pie of Sales By State
- Google Charts: Geo of Sales By State
- Google Charts: Column Chart of Sales By Date
- Google Charts: Area Chart of Sales By Date
- Google Charts: Table of Receipts Example

Rest API Example

- API: retail.receipts_by_credit_card
  /api/simplequery&q=select * from retail.receipts_by_credit_card limit 100

6.3 Test the web pages

Follow the instructions for the Python web project to check the functionality of the Java web project pages.

7 Appendix 1 – Schema Table Reference

7.1 Seeded Tables

The following tables are populated when the CQL import script is run:

- suppliers
- products_by_id
- products_by_supplier
- products_by_category_name
- stores

7.2 Jmeter Tables

The following tables are populated when the JMeter simulation is run:

- receipts
- inventory_per_store
- receipts_by_credit_card
- receipts_by_store_date

7.3 Spark Rollup Tables

The following tables are populated when the Spark Analytics job is run:

- sales_by_date
- sales_by_state

7.4 Spark Streaming Tables

The following table is populated when the Spark Streaming job is run:

- real_time_analytics

NB This is an unusual table as it contains timestamp as a clustering column, and quantity is a map of products and the quantities sold. The map is dynamic as in any time period the set of hot products can change.

7.5 Unused Tables

The following table is not currently used:

- Zipcodes

8 Appendix 2 – Python REST API Overview

8.1 Introduction

Under the retail directory web/routes are the basic files for the web project. It uses the familiar paradigm of Ruby on Rails or Play Framework of having a routes file that define what happens when the user navigates to different URL's.

1. **`index.py`** - this defines the basic index for the root URL of the project. It simply generates the html for the index web page.

2. **`web.py`** - this defines the basic rest endpoints for the project.

   For example navigate to http://localhost:5001/web/product_search. This calls the following route in `web.py`:

   ```
   GET /web/product_search HTTP/1.1" 200 -
   ```

   The templates under web/templates are basic jinja2 templates that are similiar to JSP's. Everything between {% %} is part of the script for that template. Then the content for the page gets pulled in where the {{ content }} is defined.

8.2 web-python/run

The run script invokes `application.py`

```
import application
application.start()
```

8.3 web-python/application.py

The `application.py` script pulls in the files that define the rest endpoints for the project.

```
from utils.JinjaHelper import makeURL
from routes import rest
from routes import web
from routes.index import index_api
from routes.rest import rest_api
from routes.google_charts import gcharts_api
from routes.web import web_api
```

```
app.register_blueprint(index_api)
app.register_blueprint(rest_api, url_prefix='/api')
app.register_blueprint(gcharts_api, url_prefix='/gcharts')
```

```
app.register_blueprint(web_api, url_prefix='/web')
```

8.4 web-python/routes/index.py

The `index.py` file defines the following `/web` endpoints.

8.4.1 Index Page

URL: http://localhost:5001/

```
"GET / HTTP/1.1"
```

Renders HTML template **web-python/templates/index.jinja2**

```
@index_api.route('/') def index():
return render_template('index.jinja2')
```

8.5 web-python/routes/web.py

8.5.1 Index Page

URL: http://localhost:5001/web

```
"GET /web/ HTTP/1.1"
```

Renders HTML template **web-python/templates/index.jinja2**

```
@web_api.route('/')
def index():
    return render_template('index.jinja2')
```

8.5.2 Product Search – "Query For Products"

URL: http://localhost:5001/web/product_search

```
"GET /web/product_search HTTP/1.1" 200 -
```

Renders HTML template **web-python/templates/product_list.jinja2**

```
@web_api.route('/product_search')
def search_for_products():
    return render_template('product_list.jinja2', products = results)
```

8.5.3 Product Detail – "Lookup Product Detail"

URL: http://localhost:5001/web/product

```
"GET /web/product HTTP/1.1" 200 -
```

Renders HTML template **web-python/templates/product_detail.jinja2**

```
@web_api.route('/product')
def find_product_by_id():
    return render_template('product_detail.jinja2', product = product,
features=features)
```

8.5.4 Receipt Detail – "Lookup Receipt Detail"

URL: http://localhost:5001/web/receipt

```
"GET /web/receipt HTTP/1.1"
```

Renders HTML template `web-python/templates/receipt_detail.jinja2`

```
@web_api.route('/receipt')
def find_receipt_by_id():
    return render_template('receipt_detail.jinja2', scans = results)
```

8.5.5 Credit Card Search – "Lookup Receipts By Credit Card"

URL: http://localhost:5001/web/credit_card

```
"GET /web/credit_card HTTP/1.1"
```

Renders HTML template `web-python/templates/credit_card_search.jinja2`

```
@web_api.route('/credit_card')
def find_receipt_by_credit_card():
    return render_template('credit_card_search.jinja2', receipts =
results)
```

8.5.6 Solr Search – "Solr Search for Products"

URL: http://localhost:5001/web/search

```
"GET /web/search HTTP/1.1" 200 -
```

Renders HTML template `web-python/templates/search_list.jinja2`

```
@web_api.route('/search')
def search():
    return render_template('search_list.jinja2',
                search_term = search_term,
                categories = filter_facets(facet_map['category_name']),
                suppliers = filter_facets(facet_map['supplier_name']),
                products = results,
                filter_by = filter_by)
```

8.6 web-python/routes/rest.py

The `simplequery` endpoint returns the query in JSON format.

URL: http://localhost:5001/web/search

```
"GET
/api/simplequery?q=select%20*%20from%20retail.receipts_by_credit_card%
20limit%20100 HTTP/1.1"
```

```
@rest_api.route('/simplequery')
def simplequery():
    # stick the description row up front, and dump it as json

    return dumps([description] + data, default=fix_json_format)
```

8.7 web-python/routes/google_charts.py

The Google Charts endpoint is used to visualise data using the Google Charts API.

There is only a single page that draws the charts. The URL takes the chart type. The template takes 4 parameters - the chart type, the package, chart options, and the URL where the chart gets the data.

```
supported_charts = {
    'GeoChart': 'geochart',
    'BarChart': 'corechart',
    'ColumnChart': 'corechart',
    'LineChart': 'corechart',
    'PieChart': 'corechart',
    'AreaChart': 'corechart'
}
```

```
@gcharts_api.route('/<chart_type>/')
def googlechart(chart_type='ColumnChart'):
    return render_template('google_charts.jinja2',
                           ajax_source=ajax_source,
                           chart_type=chart_type,
                           package=supported_charts[chart_type],
                           options=options)
```

The following sections describe the chart examples that have been provided.

8.7.1 "Stores Table"

```
"GET
/gcharts/Table/?url=/api/simplequery&q=select%20*%20from%20retail.stores%20lim
it%20100&order_col=zip"

"GET /api/simplequery?q=select+%2A+from+retail.stores+limit+100&order_col=zip”
```

8.7.2 "Pie of Sales By State"

```
"GET
/gcharts/PieChart/?url=/api/simplequery&options={height:600,sliceVisibilityThr
eshold:.03}&q=select%20state,%20receipts_total%20from%20retail.sales_by_state”

"GET
/api/simplequery?q=select+state%2C+receipts_total+from+retail.sales_by_state"
```

8.7.3 “Geo of Sales By State”

```
"GET
/gcharts/GeoChart/?url=/api/simplequery&options={height:600,region:%27US%27,re
solution:%27provinces%27}&q=select%20region,receipts_total%20from%20retail.sal
es_by_state”

"GET
/api/simplequery?q=select+region%2Creceipts_total+from+retail.sales_by_state"
```

8.7.4 Column of Sales By State

```
"GET /gcharts/ColumnChart/?url=/api/simplequery&options={hAxis:{format:%27MMM-
d%27}}&q=select%20sales_date,%20receipts_total%20from%20retail.sales_by_date%2
0where%20dummy=%27dummy%27%20order%20by%20sales_date"

"GET
/api/simplequery?q=select+sales_date%2C+receipts_total+from+retail.sales_by_da
te+where+dummy%3D%27dummy%27+order+by+sales_date"
```

8.7.5 Area Chart of Sales By Date

```
"GET
/gcharts/AreaChart/?url=/api/simplequery&q=select%20sales_date,%20receipts_tot
al%20from%20retail.sales_by_date%20%20where%20dummy=%27dummy%27%20order%20by%2
0sales_date"

"GET
/api/simplequery?q=select+sales_date%2C+receipts_total+from+retail.sales_by_da
te++where+dummy%3D%27dummy%27+order+by+sales_date"
```

8.7.6 Table of Receipts By Credit Card

```
"GET
/gcharts/Table/?url=/api/simplequery&q=select%20*%20from%20retail.receipts_by_
credit_card%20limit%20100&order_col=store_id HTTP/1.1”

"GET
/api/simplequery?q=select+%2A+from+retail.receipts_by_credit_card+limit+100&or
der_col=store_id"
```

8.7.7 Hot Products

```
"GET
/gcharts/ColumnChart/?options={hAxis:{format:%27hh:mm:ss%27}}&url=/api/realtim
e/hotproducts&minutes=10 HTTP/1.1" 200 - [[{"type": "datetime", "id":
"timewindow", "label": "Window"}, {"type": "number", "id": "No Products",
"label": "No Products"}]] “

"GET /api/realtime/hotproducts?minutes=10 HTTP/1.1"
```