Data Visualization & Advanced MongoDB Data Analytics

Tutorial – 4

CSP 584 – Enterprise Web Application

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- Presentation By

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Mongo DB Find/Query Data:

- Use ‘find’ method to query MongoDB to retrieve data from a collection

- ‘find’ can be used with a single collection.

- Using queries, you can either return;
    - All the documents in a collection
    - Only the documents that match a certain filter/criteria

Find all documents in a collection:

- In order to find all the documents in a collection, use the ‘find’ query without any parameters

- dbCursor - is a variable of type DBCursor, this variable can be used as an iterator and print all the values from the collection

- myReviews – Collection that has been used in the Application.

- find() – is an empty query, this will return all the documents from the given collection

- Example:
  - DBCursor dbCursor = myReviews.find();

Create a ‘query’

- A query can be created in the following way;

```
BasicDBObject query = new BasicDBObject();
```

- Now, once the query object is created, you can add multiple conditions in the following way;

```
query.put(Key, Value);
```

In order to find specific documents in a collection, use find along with some query values

- Example : Return the documents where the product name is ‘XBOX_ONE’ :

```
query.put(“productName”, “XBOX_ONE”);
DBCursor dbCursor = myReviews.find(query);
```

Operators

- You can use different operators to conveniently filter the data based on different requirements

- Suppose, we want to filter only those reviews from our collection which have a rating of more than 3, we need to use ‘$gt’ (greater than)

- Example Return the documents where the review rating is above 3

```
BasicDBObject query = new BasicDBObject();
query.put("reviewRating", new BasicDBObject("$gt", 3));
DBCursor dbCursor = myReviews.find(query);
```

- Please refer this link for more information: https://docs.mongodb.org/manual/reference/operator/query/

Limit and Sort

- ‘limit()’ accepts an integer value

- ‘sort()’ accepts an object of type DBObject

- Example: Return top 5 products based on maximum rating

```
int returnLimit = 5;
Created a new sort object
DBObject sort = new BasicDBObject();
Specify the field that you want to sort on, and the direction of the sort
sort.put("reviewRating",-1);

dbCursor = myReviews.find(query).limit(returnLimit).sort(sort);
```

Aggregation in MongoDB:

- The aggregate method accepts as its argument an array of stages, where each stage, processed sequentially, describes a data processing step.

- More information on aggregation can be found here: https://docs.mongodb.org/getting-started/java/aggregation/

Stages in Aggregation – $match

- $match – This is similar to ‘Where’ in SQL

- Example Match the documents where rating is 5:
    - DBObject match = new BasicDBObject("$match", new BasicDBObject("reviewRating", 5));

- Matching stage is optional

Stages in Aggregation – $group

- $group – This is similar to SQL’s ‘GROUP BY’ clause

- Example grouping based on retailer city:

```
DBObject groupFields = new BasicDBObject("_id", 0);
groupFields.put(“_id", "$retailerCity");
groupFields.put("count", new BasicDBObject("$sum", 1))
DBObject group = new BasicDBObject("$group", groupFields);
```

Group by is done on retailer city fields using _id as key to group by

Increment the count by 1 using $sum command

Stages in Aggregation – $project

- $project – This is similar to ‘SELECT’ in SQL

- Vertically Slicing Data from the Original Database.

- Example Getting count based on retailer city :

```
DBObject projectFields projectFields = new BasicDBObject("_id", 0);
projectFields.put(“city", "$_id");
projectFields.put("Review Count", "$count");
DBObject project = new BasicDBObject("$project", projectFields);
```

Project Fields which we want to dis play in the output

Stages in Aggregation – $limit and $sort

Example: Return top 5 products based on maximum rating;

```
DBObject sort = new BasicDBObject();
```

Specify the field that you want to sort on, and the direction of the sort

```
sort.put("reviewRating",-1);
```

```
DBObject limit=new BasicDBObject();
DBObject orderby=new BasicDBObject();
```

Adding sort object in DbObject

```
orderby=new BasicDBObject("$sort",sort);
```

```
limit=new BasicDBObject("$limit",5);
aggregate = myReviews.aggregate(group,project,orderby,limit);
```

Final Stage in Aggregation:

- Now that we are done with the different stages, it is time to run the query

- Example;

```
AggregationOutput aggregate = myReviews.aggregate(match,group,project,orderby,limit);
for (DBObject result : aggregate.results()) {
        BasicDBObject bobj = (BasicDBObject) result;
        System.out.println(bobj.getString("City"));
        System.out.println(bobj.getString("Review Count"));
}
```

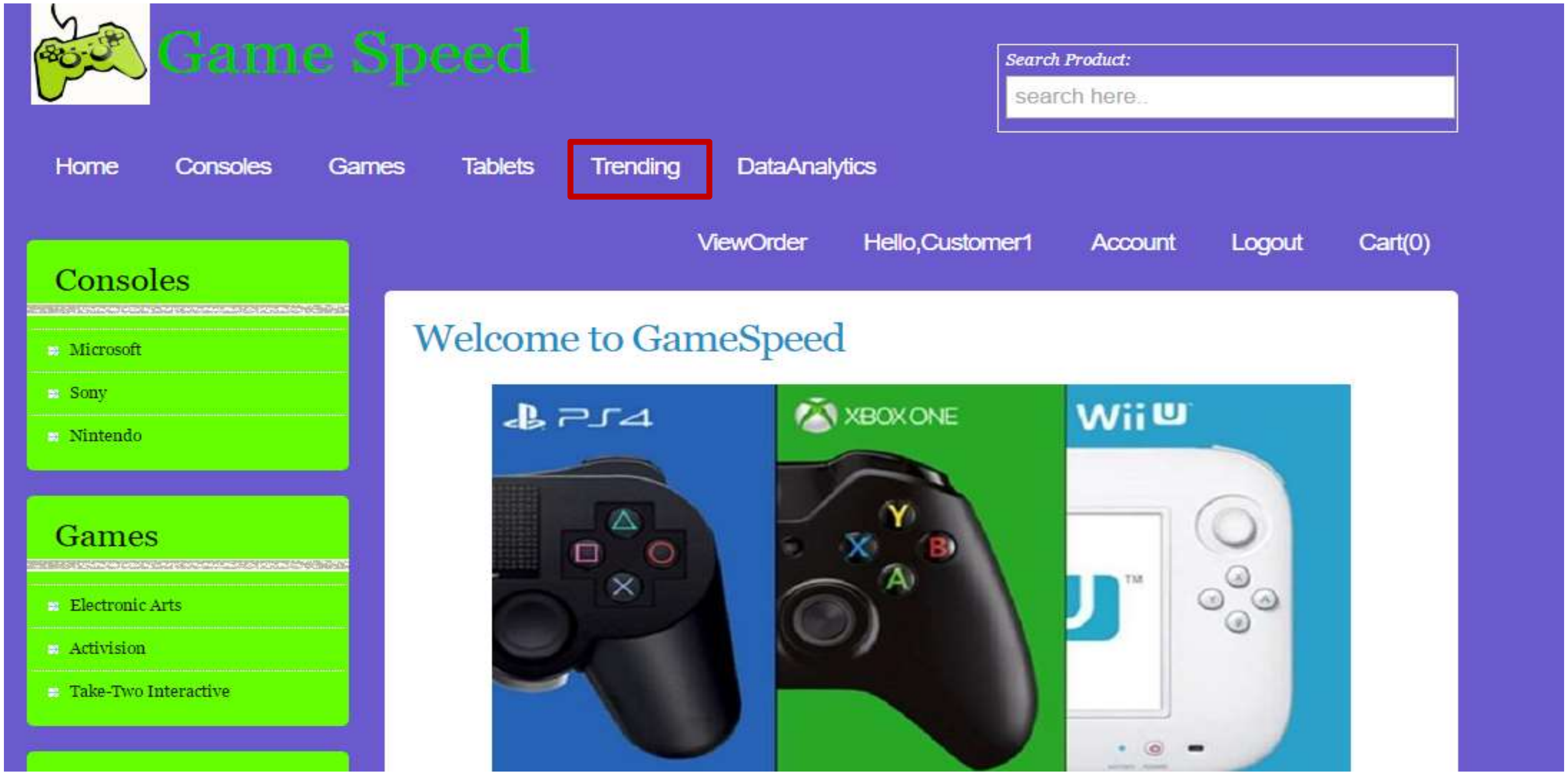
- Once the aggregate function is run, you can iterate through the result and print the required fields

Data Analytics:

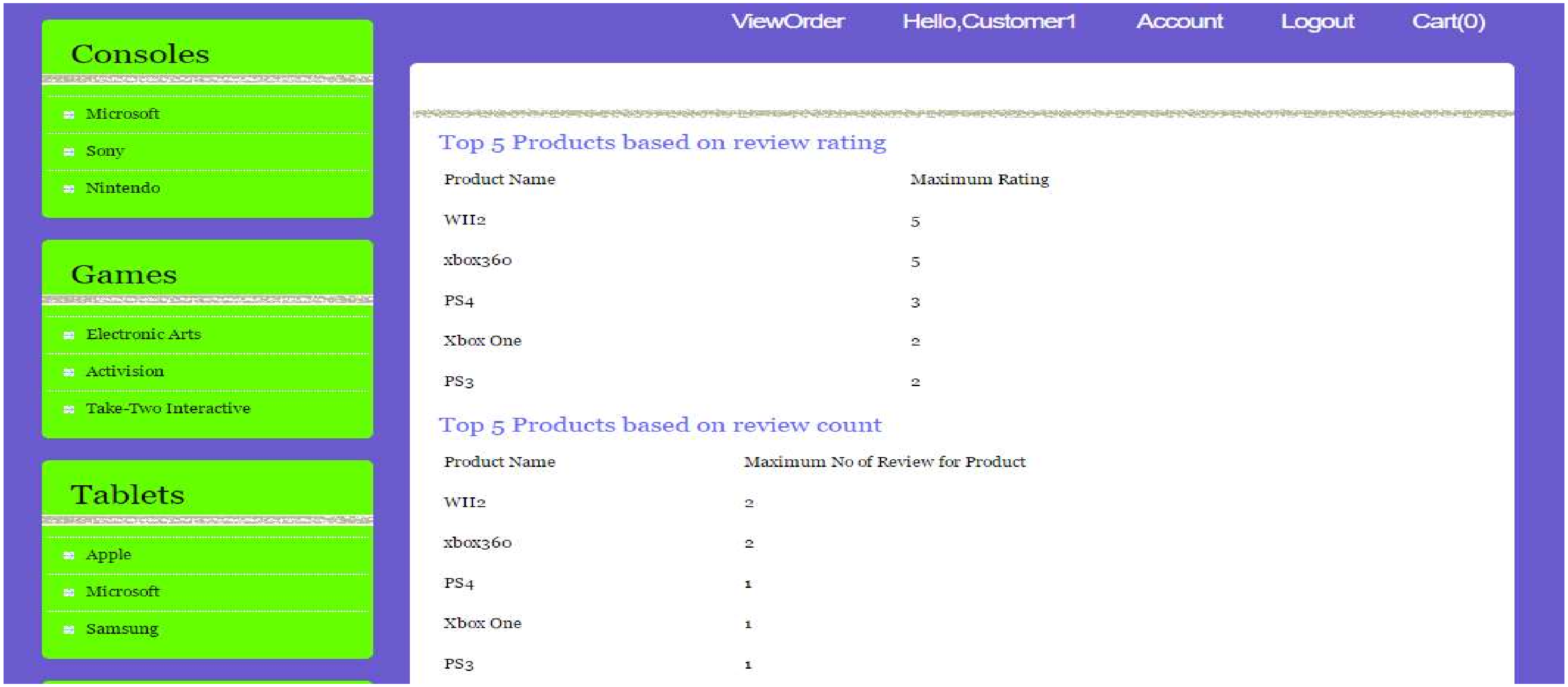
- We can use complex queries in Mongo DB to perform data analysis on the collection.
- This tutorial will demonstrate a few scenarios where you can construct dynamic queries and display the result.
- All the queries are created dynamically based on the filters selected on the screen.

Trending link:

Clicking on the trending button will take us to the page where we will display
Top five most liked products,
Top five most reviewed products regardless of the rating
Top 5 zip code based on no of products reviewed



Trending link for user – Query Outputs :



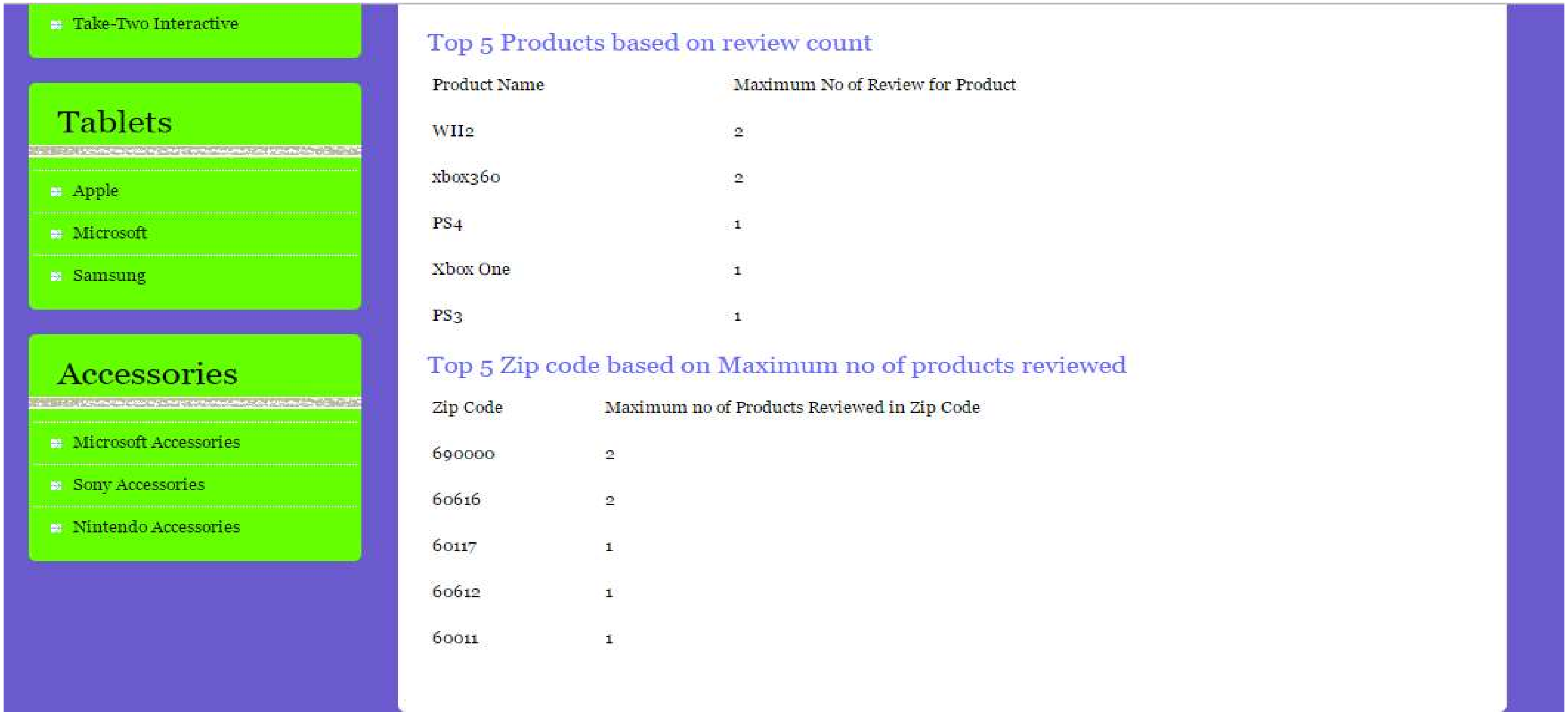
Top 5 Products based on review rating

Product Name	Maximum Rating
WII2	5
xbox360	5
PS4	3
Xbox One	2
PS3	2

Top 5 Products based on review count

Product Name	Maximum No of Review for Product
WII2	2
xbox360	2
PS4	1
Xbox One	1
PS3	1

Trending link for user – Query Outputs :



Top 5 Products based on review count

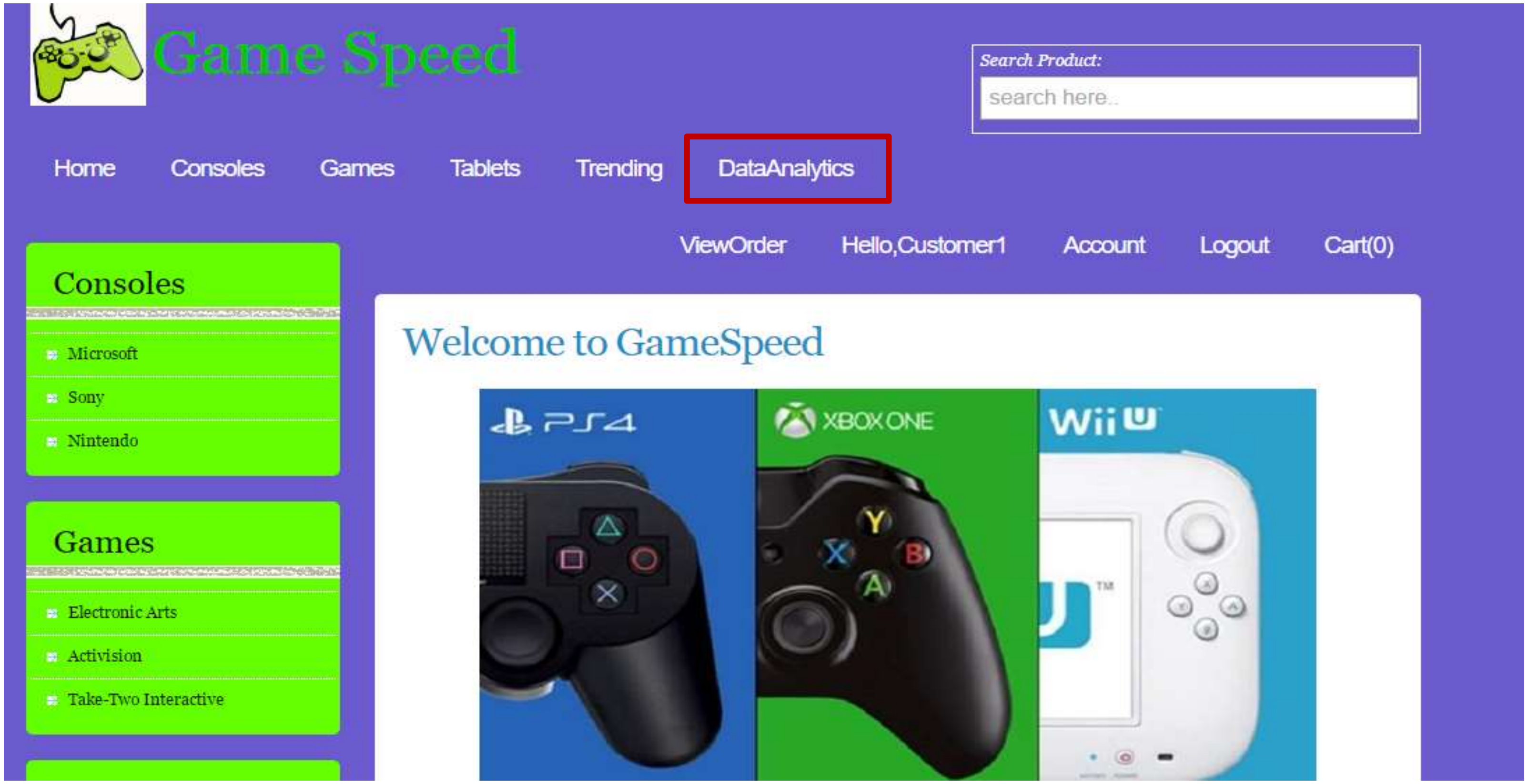
Product Name	Maximum No of Review for Product
WII2	2
xbox360	2
PS4	1
Xbox One	1
PS3	1

Top 5 Zip code based on Maximum no of products reviewed

Zip Code	Maximum no of Products Reviewed in Zip Code
690000	2
60616	2
60117	1
60612	1
60011	1

Data Analytics

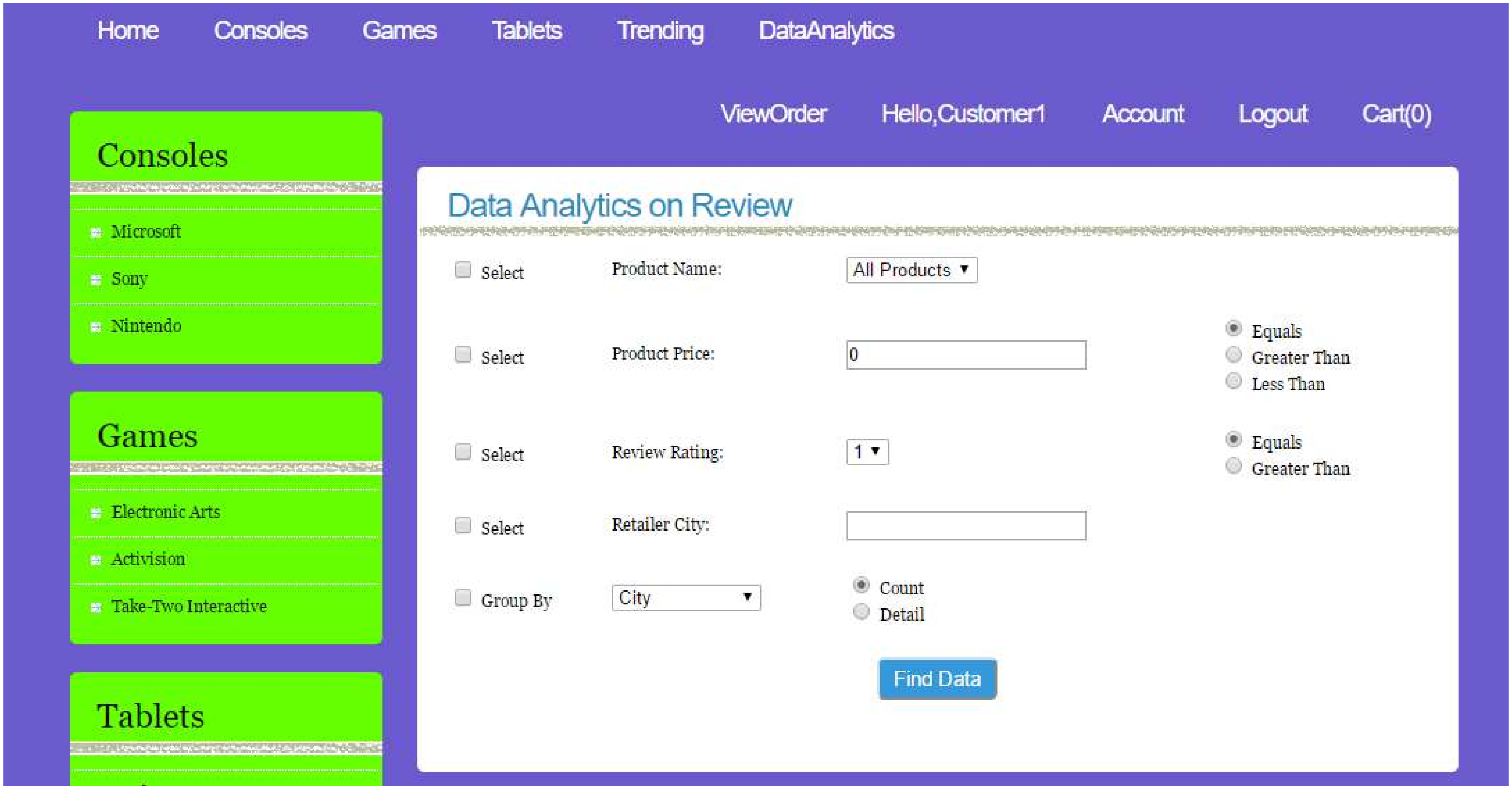
- Clicking on the data analytics link will take us to data analytics page where we can perform analytics required



Welcome to GameSpeed

Data Analytics – Store Manager

- This page will contain all fields for selection by which we can perform data analytics



Data Analytics on Review

☐ Select Product Name: All Products ▾

☐ Select Product Price: 0 ● Equals ○ Greater Than ○ Less Than

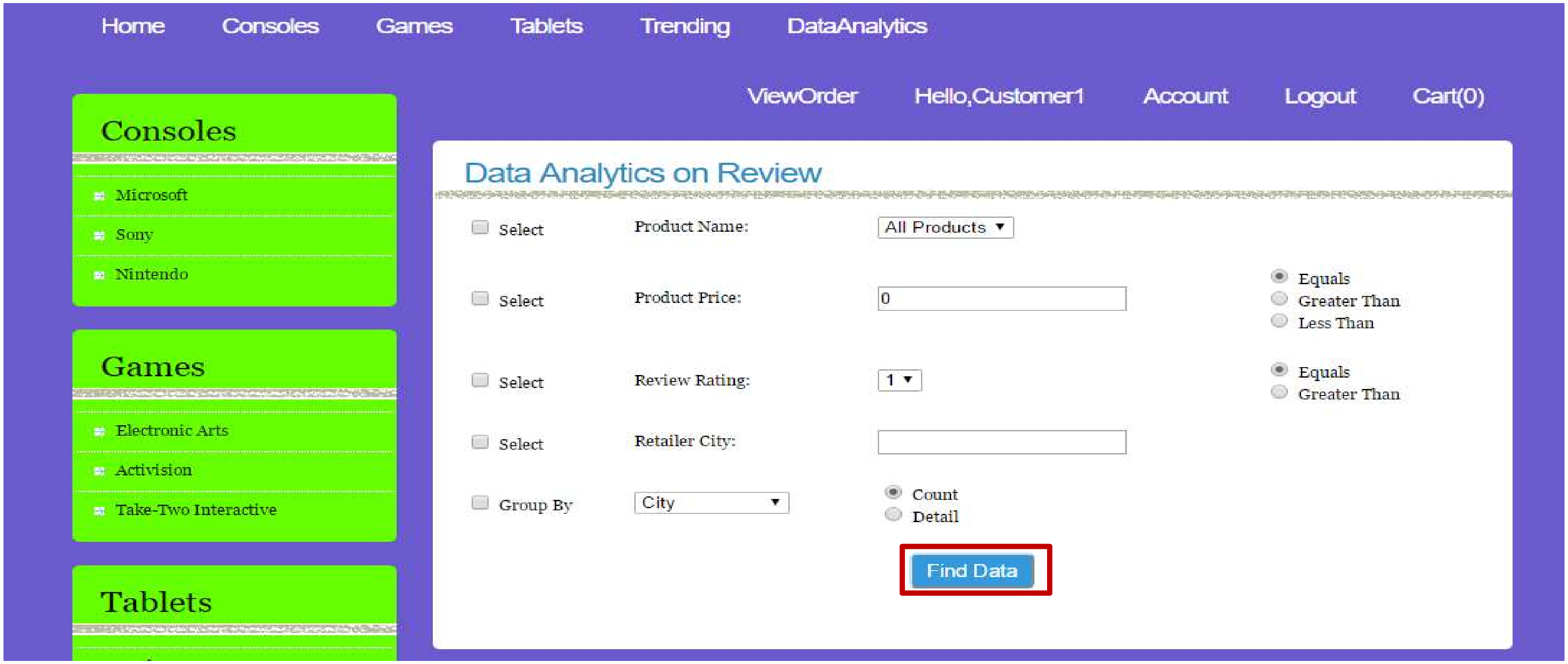
☐ Select Review Rating: 1 ▾ ● Equals ○ Greater Than

☐ Select Retailer City:

☐ Group By City ▾ ● Count ○ Detail

Query 1 – Print the list of all the reviews

- Press the find data button without any selection and you will get list of all reviews



Data Analytics on Review

□ Select Product Name: All Products ▾

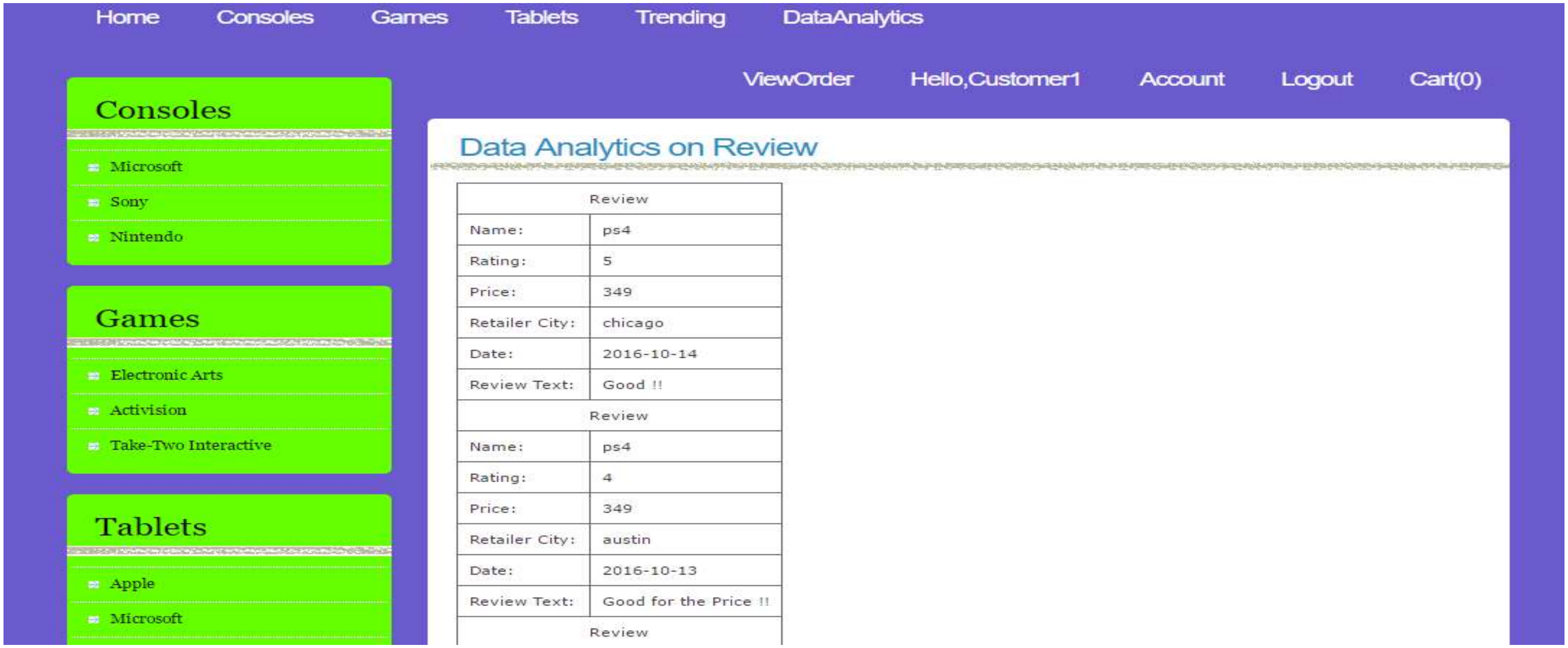
□ Select Product Price: 0 ● Equals ○ Greater Than ○ Less Than

□ Select Review Rating: 1 ▾ ● Equals ○ Greater Than

□ Select Retailer City:

□ Group By City ▾ ● Count ○ Detail

Result 1 - Print the list of all the reviews

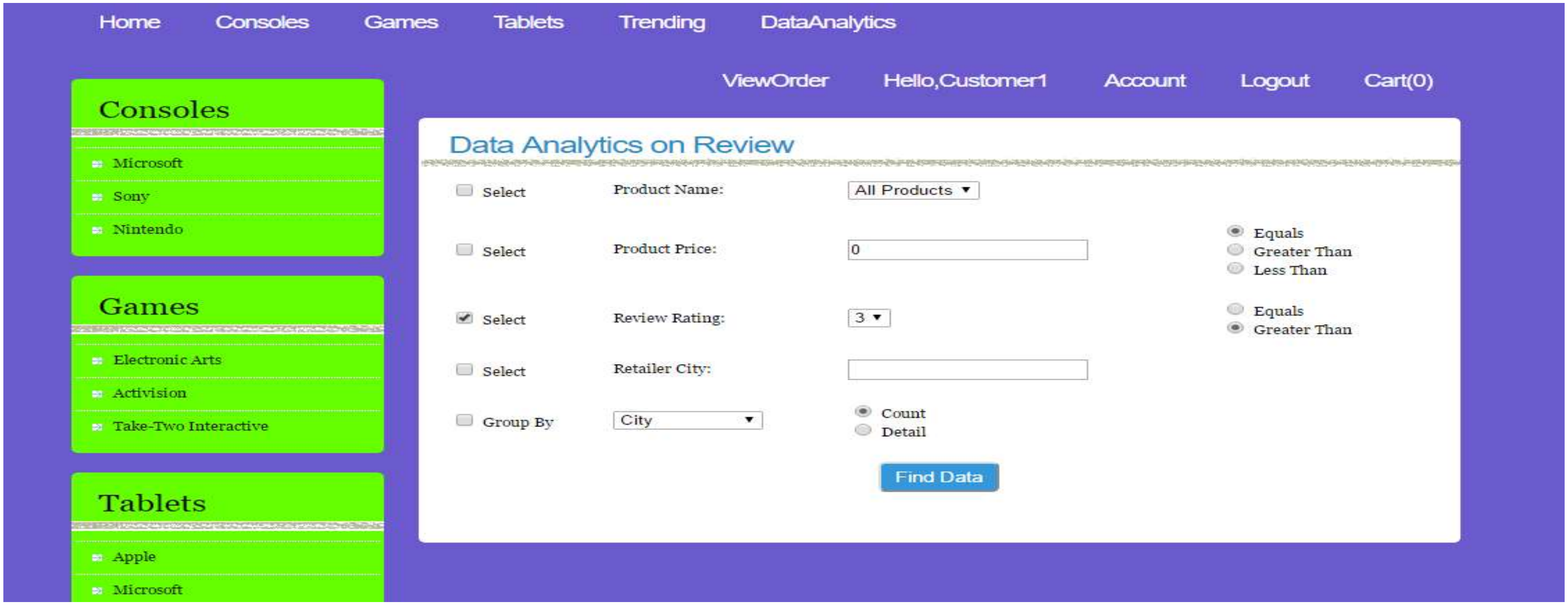


Data Analytics on Review

Review	
Name:	ps4
Rating:	5
Price:	349
Retailer City:	chicago
Date:	2016-10-14
Review Text:	Good !!
Review	
Name:	ps4
Rating:	4
Price:	349
Retailer City:	austin
Date:	2016-10-13
Review Text:	Good for the Price !!
Review	

Query 2 – Print a list of reviews where rating is more than 3

- Select the filter for rating and option greater than



Data Analytics on Review

☐ Select Product Name: All Products ▾

☐ Select Product Price: 0 ● Equals ○ Greater Than ○ Less Than

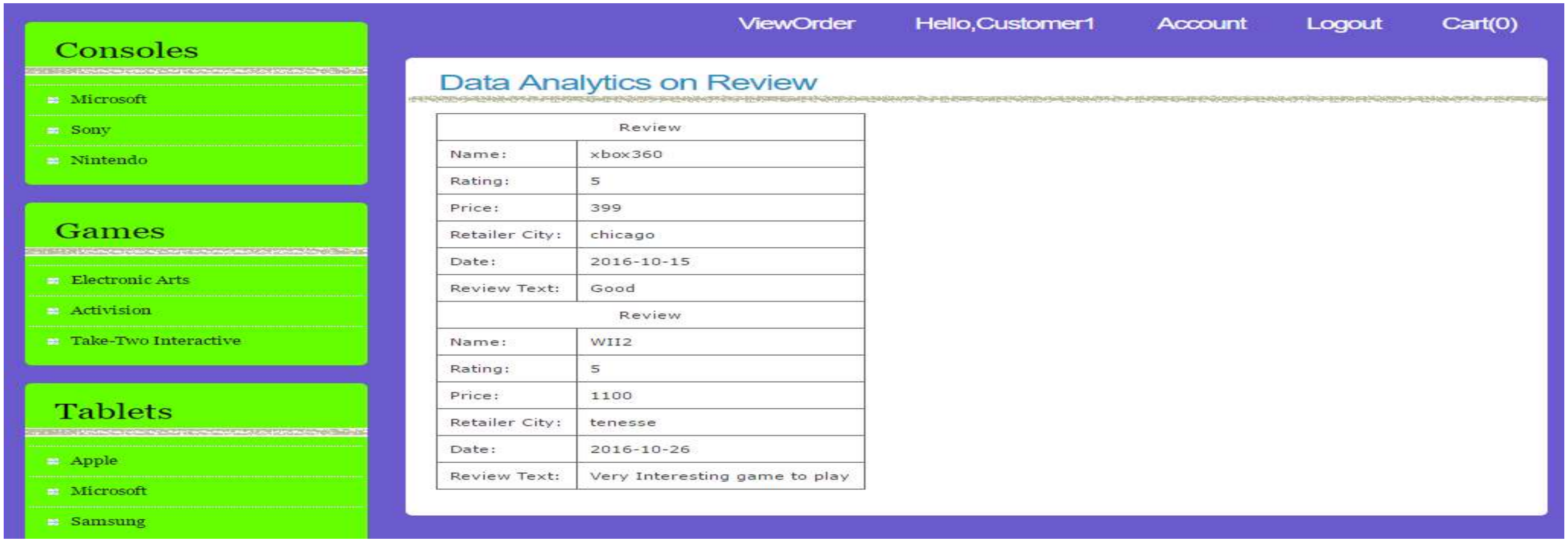
☑ Select Review Rating: 3 ▾ ○ Equals ● Greater Than

☐ Select Retailer City:

☐ Group By City ▾ ● Count ○ Detail

Result 2 - Print a list of reviews where rating is more than 3

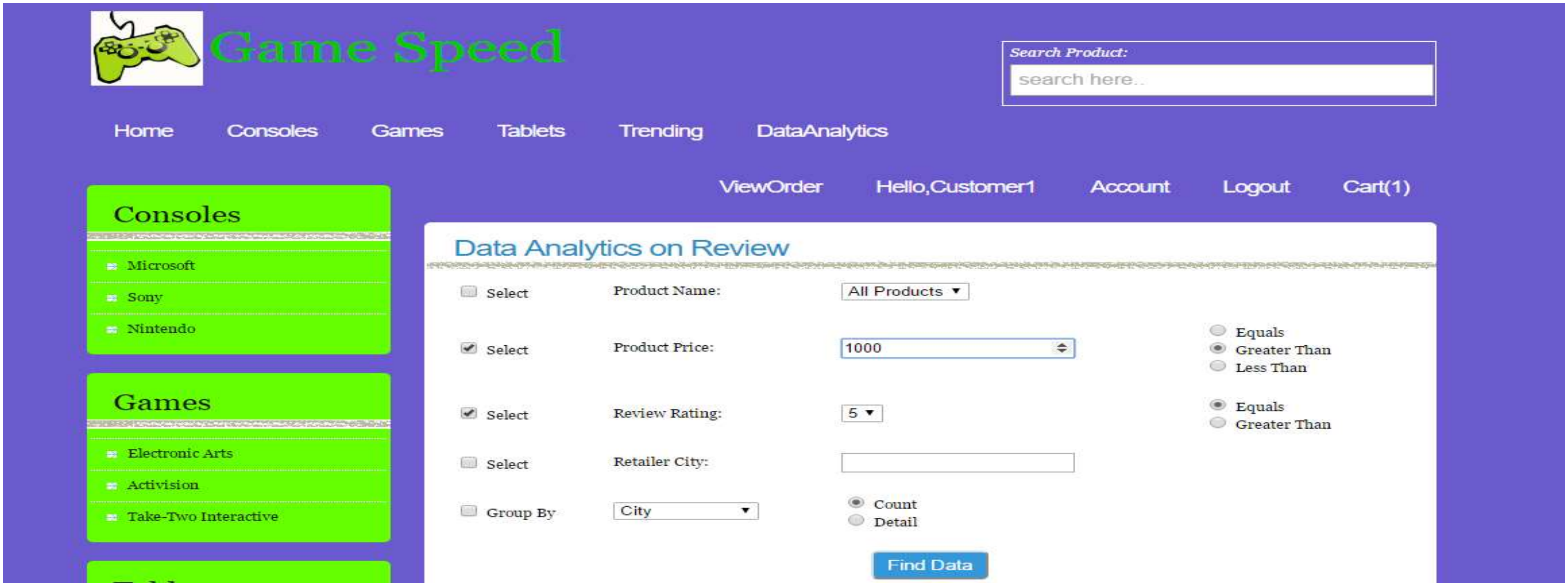
Only reviews with rating greater than 3 will be displayed



Data Analytics on Review

Review	
Name:	xbox360
Rating:	5
Price:	399
Retailer City:	chicago
Date:	2016-10-15
Review Text:	Good
Review	
Name:	WII2
Rating:	5
Price:	1100
Retailer City:	tenesse
Date:	2016-10-26
Review Text:	Very Interesting game to play

Query 3 - Get a list of products that got review rating 5 and price more than thousand

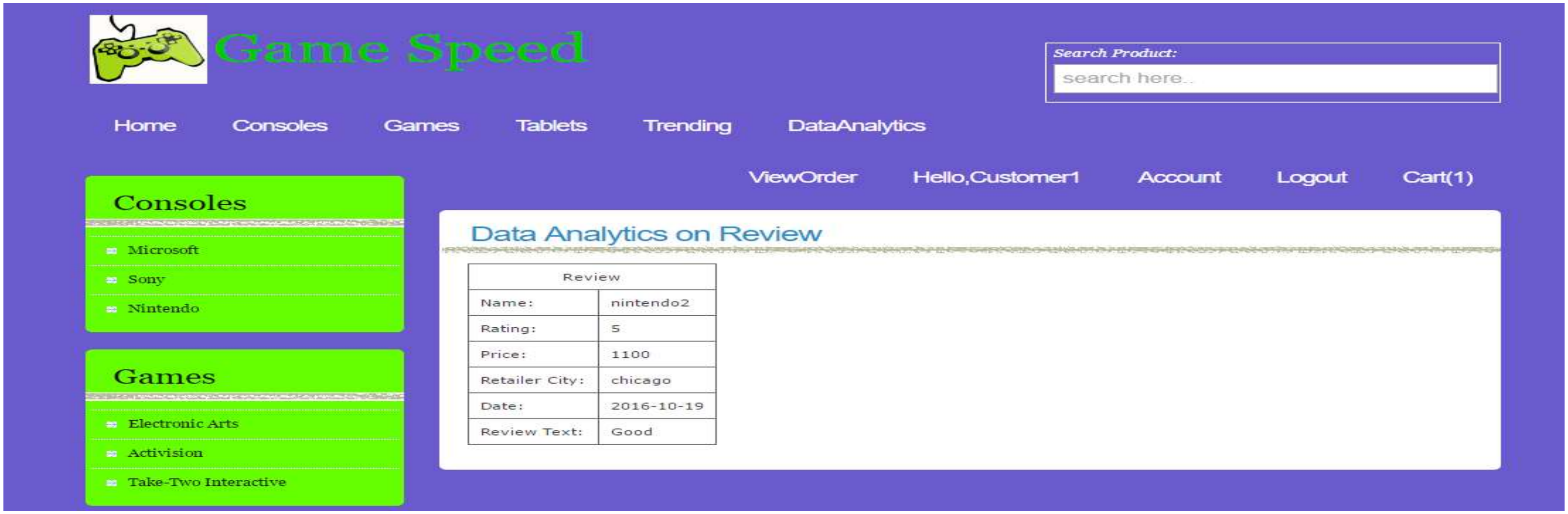


Data Analytics on Review

☐ Select	Product Name:	All Products ▼	
☑ Select	Product Price:	1000	○ Equals ● Greater Than ○ Less Than
☑ Select	Review Rating:	5 ▼	● Equals ○ Greater Than
☐ Select	Retailer City:		
☐ Group By	City ▼	● Count ○ Detail	

Result 3 - Get a list of products that got review rating 5 and price more than thousand

Data will be displayed with the particular review which we added that has price greater than 1000 and rating 5

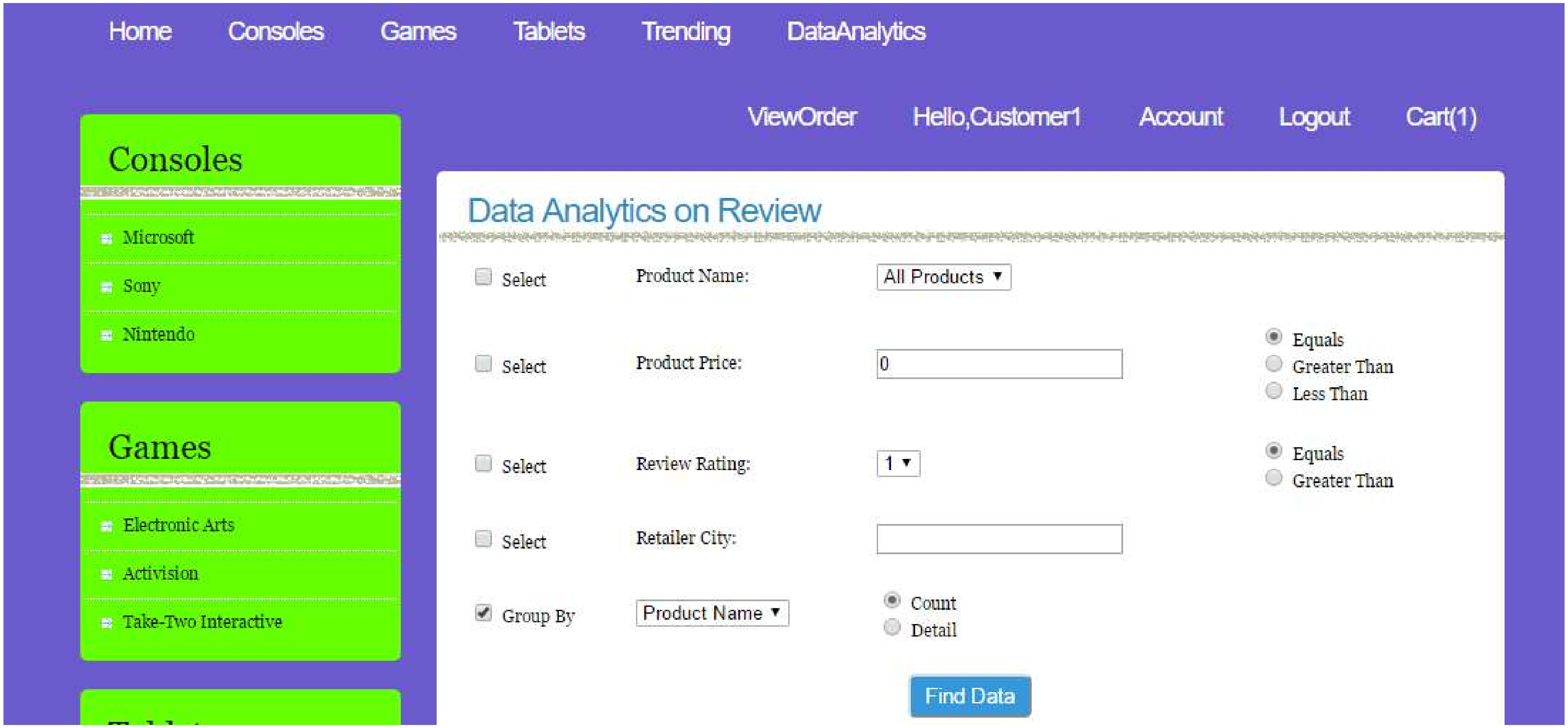


Data Analytics on Review

Review	
Name:	nintendo2
Rating:	5
Price:	1100
Retailer City:	chicago
Date:	2016-10-19
Review Text:	Good

Query 4 - Print a list of how many reviews for every product

Select the group by filter to get count based on products



Data Analytics on Review

☐ Select Product Name: All Products ▾

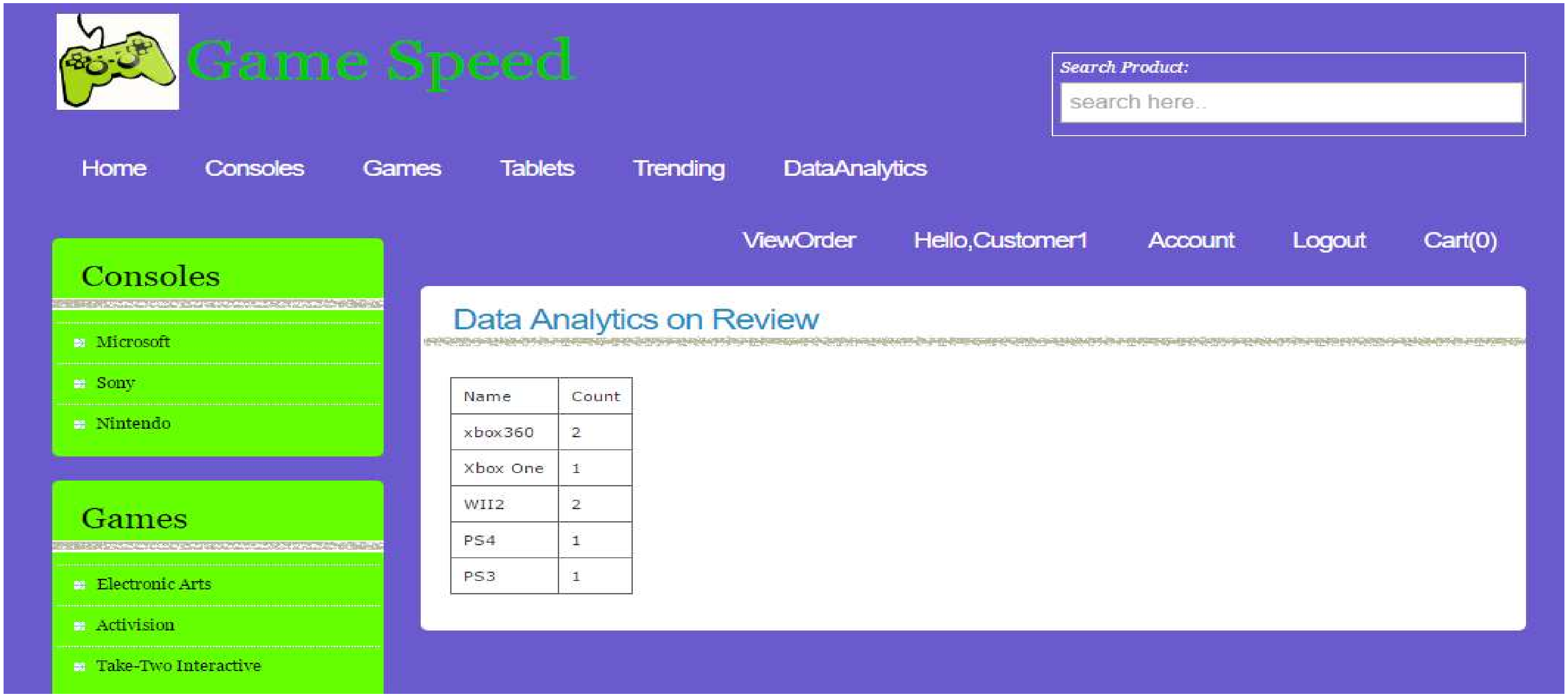
☐ Select Product Price: 0 ● Equals ○ Greater Than ○ Less Than

☐ Select Review Rating: 1 ▾ ● Equals ○ Greater Than

☐ Select Retailer City:

☑ Group By Product Name ▾ ● Count ○ Detail

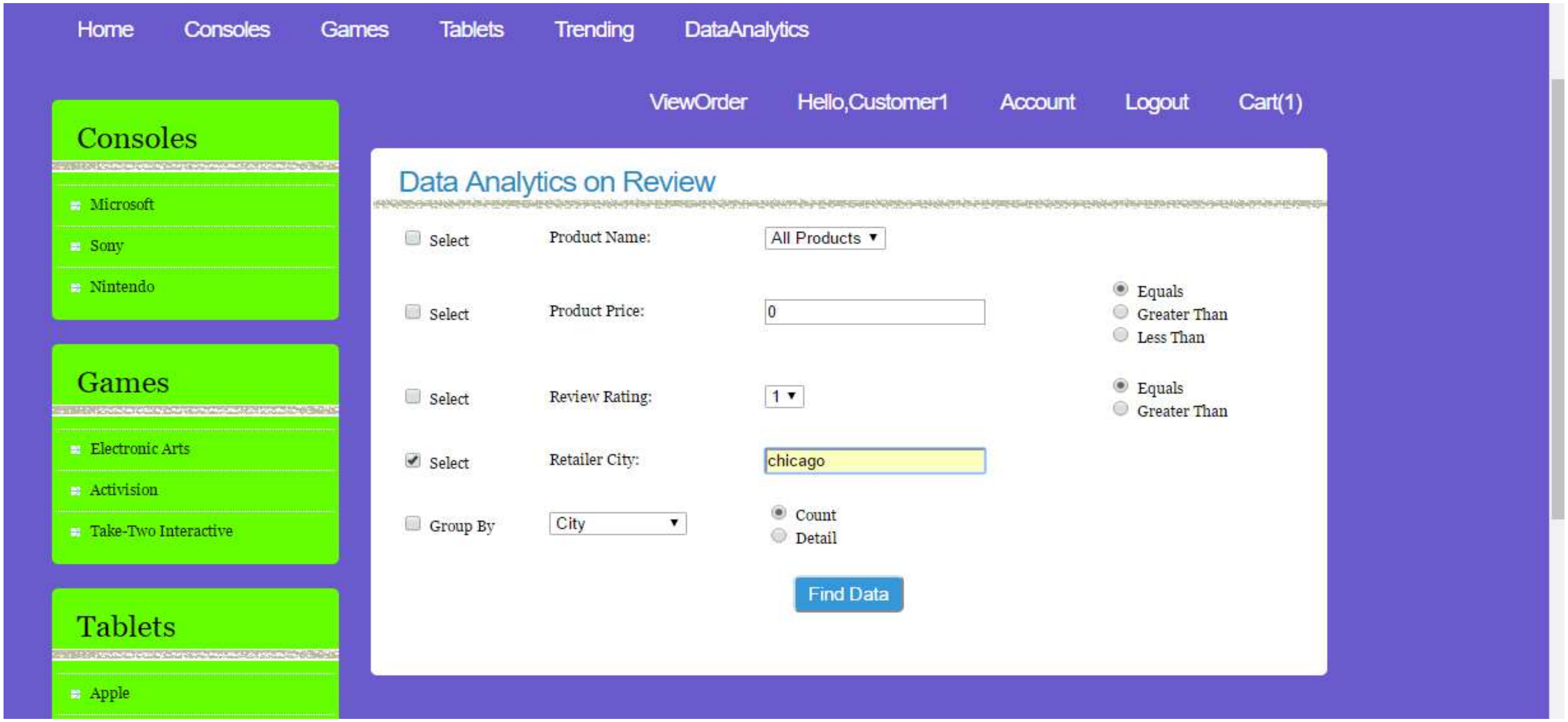
Result 4 - Print a list of how many reviews for every product



Data Analytics on Review

Name	Count
xbox360	2
Xbox One	1
WII2	2
PS4	1
PS3	1

Query 5 - Get the list of reviews for shoppers in Chicago

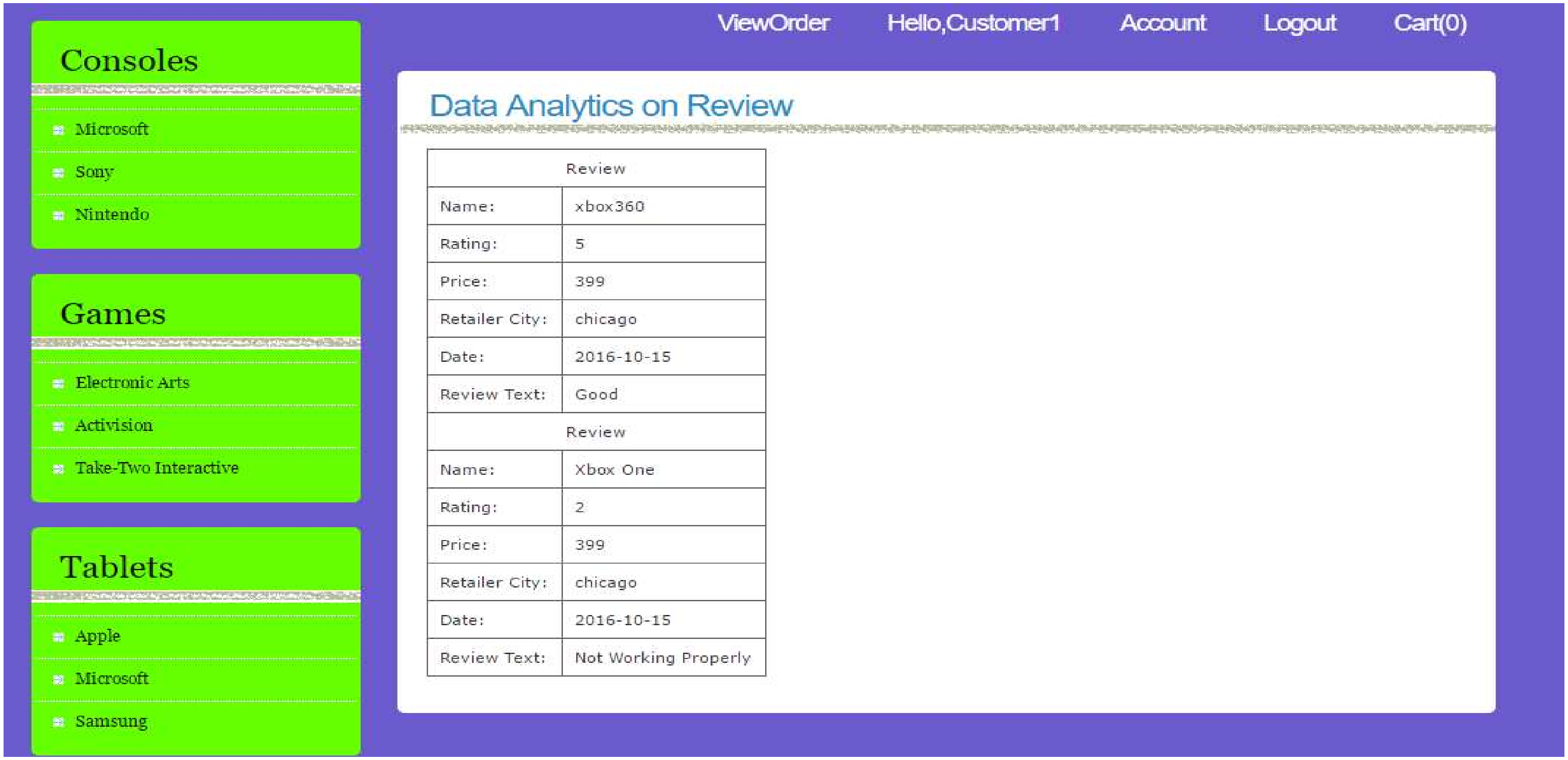


Data Analytics on Review

□ Select	Product Name:	All Products ▾	
□ Select	Product Price:	0	● Equals ○ Greater Than ○ Less Than
□ Select	Review Rating:	1 ▾	● Equals ○ Greater Than
☑ Select	Retailer City:	chicago	
□ Group By	City ▾	● Count ○ Detail	

Find Data

Result 5 - Get the list of reviews for shoppers in Chicago



Data Analytics on Review

Review	
Name:	xbox360
Rating:	5
Price:	399
Retailer City:	chicago
Date:	2016-10-15
Review Text:	Good
Review	
Name:	Xbox One
Rating:	2
Price:	399
Retailer City:	chicago
Date:	2016-10-15
Review Text:	Not Working Properly

Sample Code: Top five zip-codes where maximum number of products sold

```
pw.print("<table id='bestseller'>");
        groupFields = new BasicDBObject("_id", 0);
        groupFields.put("count",new BasicDBObject("$sum",1));
        groupFields.put("_id", "$zipCode");
        group = new BasicDBObject("$group", groupFields);
        sort = new BasicDBObject();
        projectFields.put("value", "$_id");
        projectFields.put("ReviewValue","$count");
        project = new BasicDBObject("$project", projectFields);
        sort.put("ReviewValue",-1);
        orderby=new BasicDBObject("$sort",sort);
        limit=new BasicDBObject("$limit",5);
        aggregate = myReviews.aggregate(group,project,orderby,limit);
        constructGroupByContent(aggregate,pw);
  pw.print("</table>");
```

Sample Code: Top five zip-codes where maximum number of products sold

```
public void constructGroupByContent(AggregationOutput aggregate, PrintWriter pw)
{

    for (DBObject result : aggregate.results()) {
        BasicDBObject bobj = (BasicDBObject) result;
    String tableData = "<tr><td> "+bobj.getString("value")+"</td>&nbsp"
                    +    "<td>"+bobj.getString("ReviewValue")+"</td></tr>";
                    pw.print(tableData);
    }
}
```

Sample Code for list of reviews where rating greater than 3:

```
int reviewRating = Integer.parseInt(request.getParameter("reviewRating"));
String compareRating = request.getParameter("compareRating");
String[] filters = request.getParameterValues("queryCheckBox");
myReviews=MongoDBDataStoreUtilities.getConnection();
BasicDBObject query = new BasicDBObject();
boolean noFilter = false;
boolean filterByRating = false;
if(filters != null){
        for (int i = 0; i < filters.length; i++) {
            //Check what all filters are ON
            //Build the query accordingly
            switch (filters[i]){
                case "reviewRating":
                    filterByRating = true;
                    if (compareRating.equals("EQUALS_TO")) {
                        query.put("reviewRating", reviewRating);
                    }else{
                    query.put("reviewRating", new BasicDBObject("$gt", reviewRating));
                    }
                    break;} }}
DBCursor dbCursor = myReviews.find(query);
constructTableContent(dbCursor, pw);
```

Sample Code for list of reviews where rating greater than 3

```
    public void constructTableContent(DBCursor dbCursor,PrintWriter pw)
    {
        String tableData = "";
        pw.print("<table class='gridtable'>");
        while (dbCursor.hasNext())
        {
            BasicDBObject bobj = (BasicDBObject) dbCursor.next();
            tableData =   "<tr><td align='center' colspan='2'>Review</td></tr><tr><td>Name: </td><td>" +
bobj.getString("productName") + "</td></tr>"
                        + "<tr><td>Rating:</td><td>" + bobj.getString("reviewRating") + "</td></tr>"
                        + "<tr><td>Date:</td><td>" + bobj.getString("reviewDate") + "</td></tr>"
                        + "<tr><td>Review Text:</td><td>" + bobj.getString("reviewText")+"</td><tr>";
            pw.print(tableData);
        }
            pw.print("</table>");
        //No data found
        if(dbCursor.count() == 0)
        {
            tableData = "<h2>No Data Found</h2>";
            pw.print(tableData);
        }
    }
```

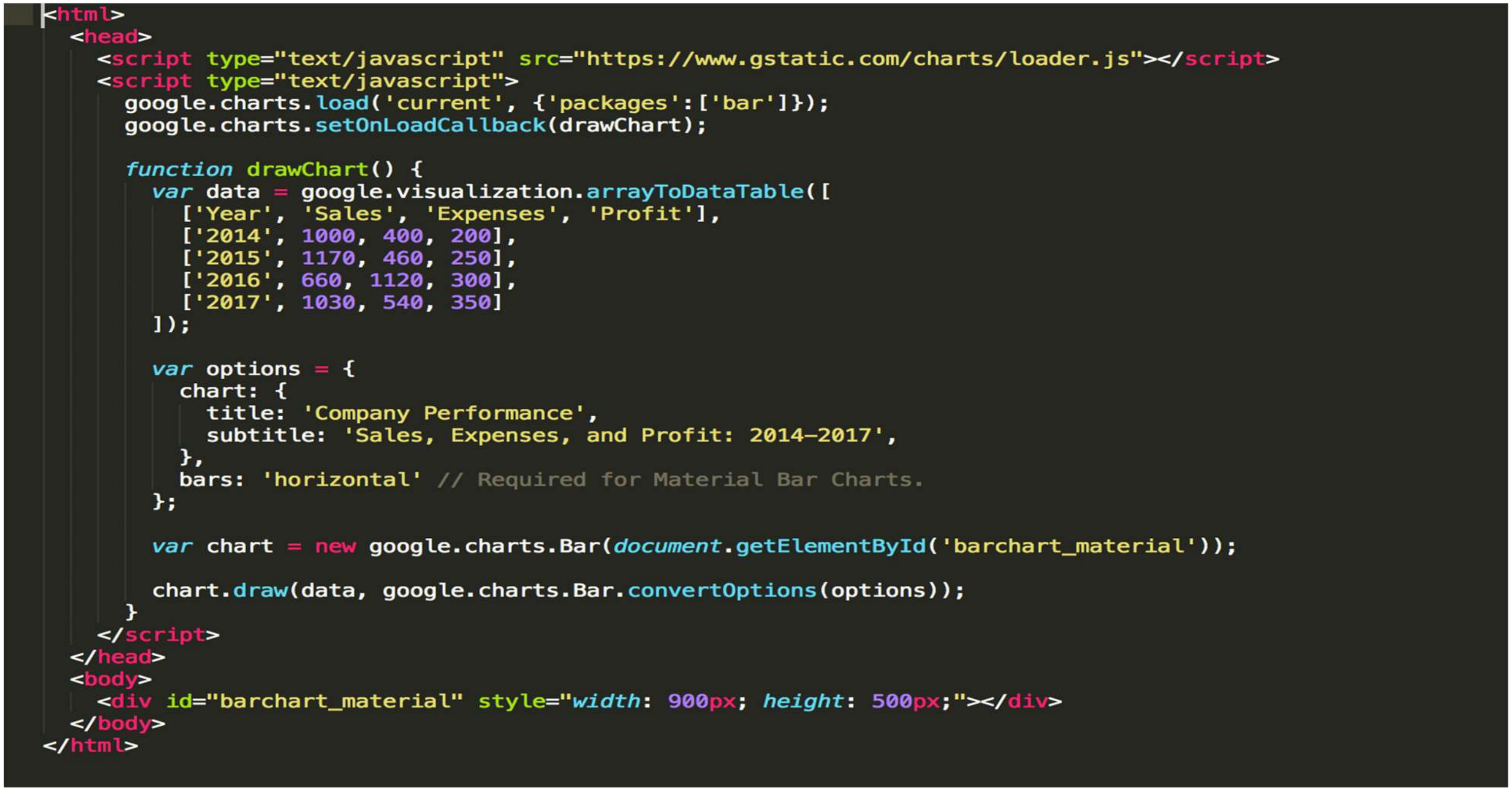
Data Visualization Using Google Charts

- Google Charts provides a perfect way to visualize data on your website.
- The most common way to use Google Charts is with simple JavaScript that you embed in your web page.
- Load Google Chart libraries, list the data to be charted, select options to customize the chart, and finally create a chart object with an id that you choose.
- Then, later in the web page, create a <div>with that id to display the Google Chart.
- Charts are exposed as JavaScript classes, and Google Charts provides many chart types – We are interested in Bar Charts.
- All chart types are populated with data using the Data Table class, making it easy to switch between chart types as you experiment to find the ideal appearance
- Visit this page for details: https://developers.google.com/chart/interactive/docs/gallery/barchart

Implementation Details

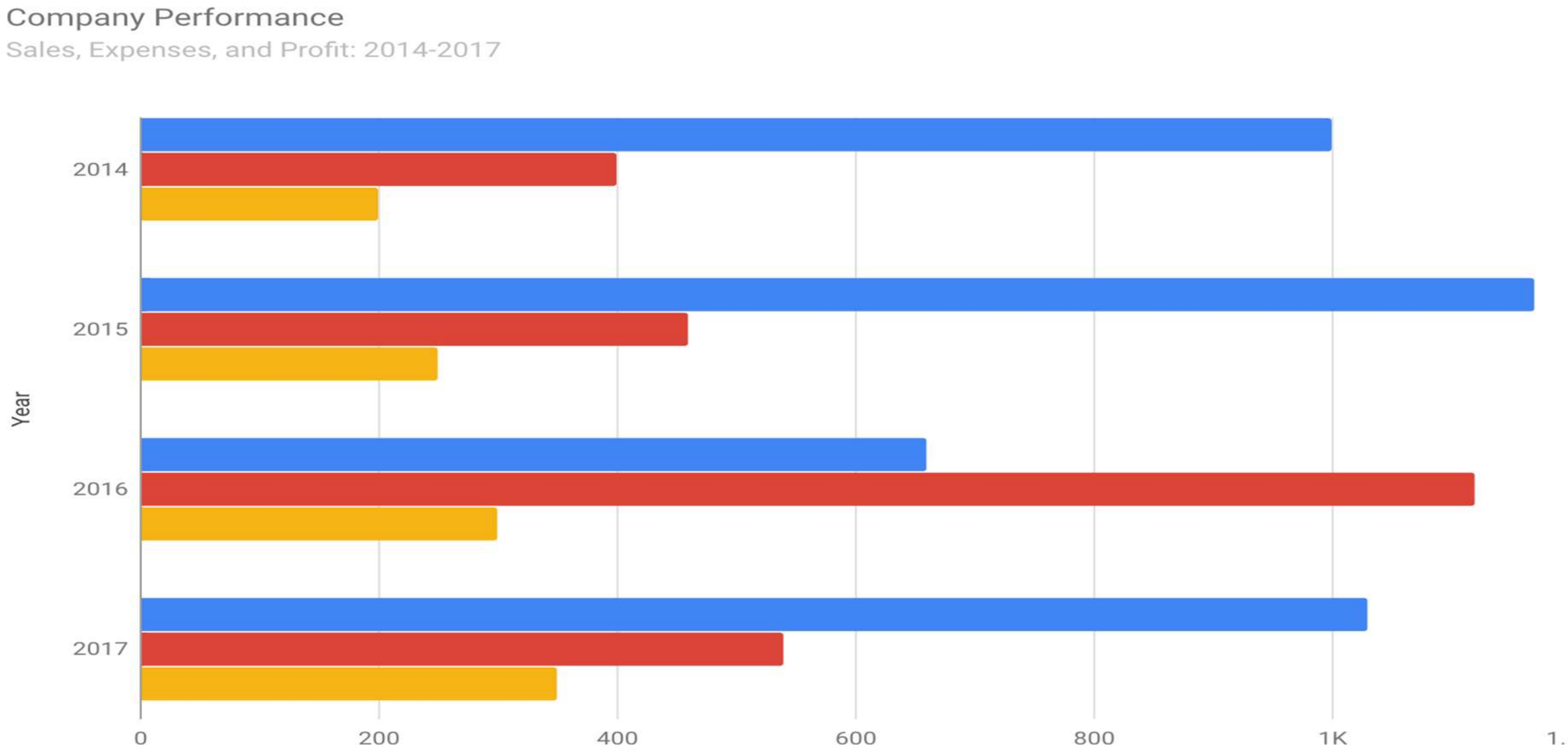
- **Gson** - is a Java library provided by google that can be used to convert Java Objects into their JSON representation. It can also be used to convert a JSON string to an equivalent Java object.
- You can download the jar file here: http://mvnrepository.com/artifact/com.google.code.gson/gson/2.3.1
- Make sure to place 'gson-2.3.1.jar' jar file in lib folder of Tomcat. And do not forget to include its path while compiling the code.
- Create two new files namely 'Datavisualization.java' and 'Datavisualization.js' (We need this to draw the chart).

Code sample to plot Bar Chart

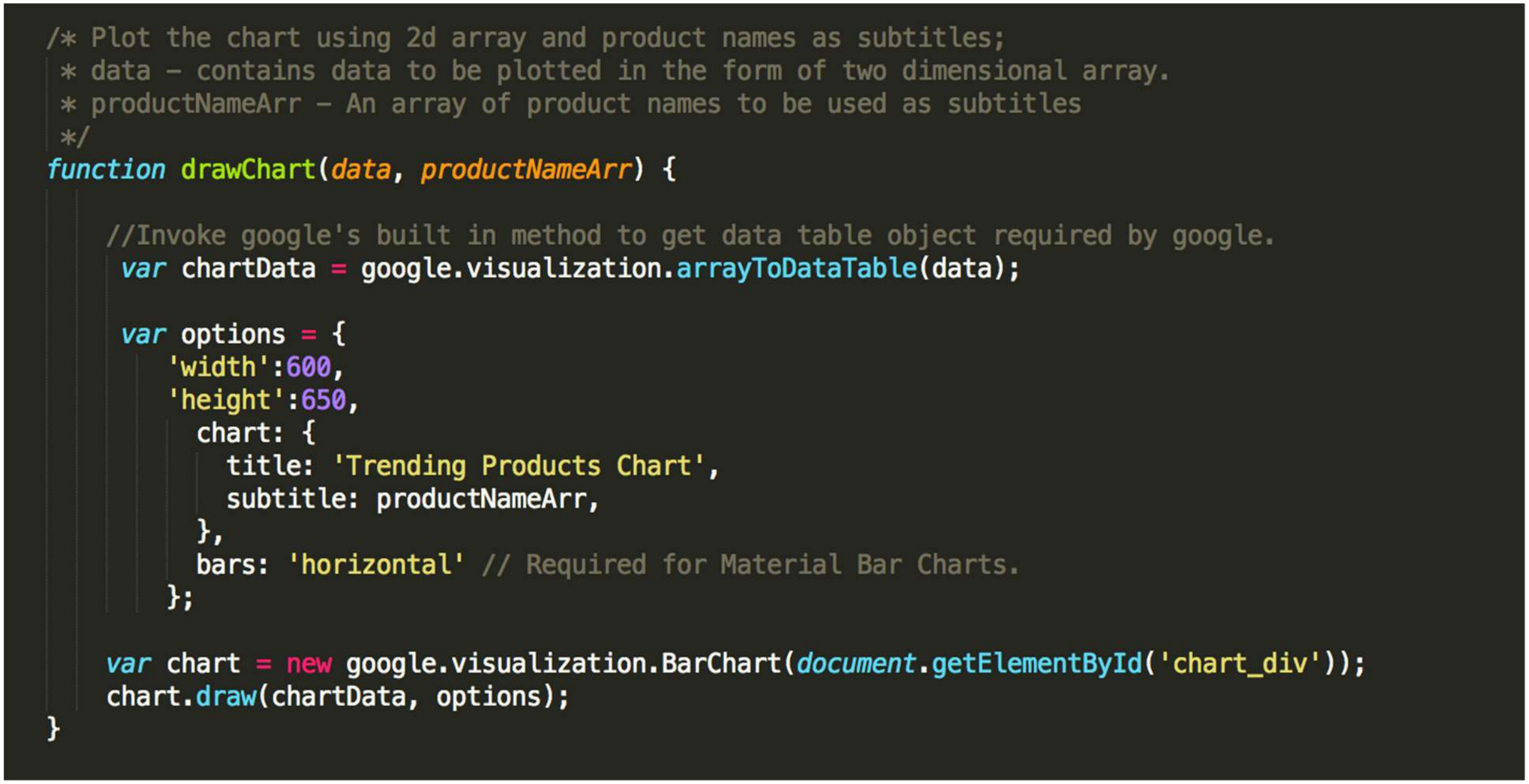


```
<html>
  <head>
    <script type="text/javascript" src="https://www.gstatic.com/charts/loader.js"></script>
    <script type="text/javascript">
      google.charts.load('current', {'packages':['bar']});
      google.charts.setOnLoadCallback(drawChart);

      function drawChart() {
        var data = google.visualization.arrayToDataTable([
          ['Year', 'Sales', 'Expenses', 'Profit'],
          ['2014', 1000, 400, 200],
          ['2015', 1170, 460, 250],
          ['2016', 660, 1120, 300],
          ['2017', 1030, 540, 350]
        ]);

        var options = {
          chart: {
            title: 'Company Performance',
            subtitle: 'Sales, Expenses, and Profit: 2014-2017',
          },
          bars: 'horizontal' // Required for Material Bar Charts.
        };

        var chart = new google.charts.Bar(document.getElementById('barchart_material'));

        chart.draw(data, google.charts.Bar.convertOptions(options));
      }
    </script>
  </head>
  <body>
    <div id="barchart_material" style="width: 900px; height: 500px;"></div>
  </body>
</html>
```

Sample Bar Chart



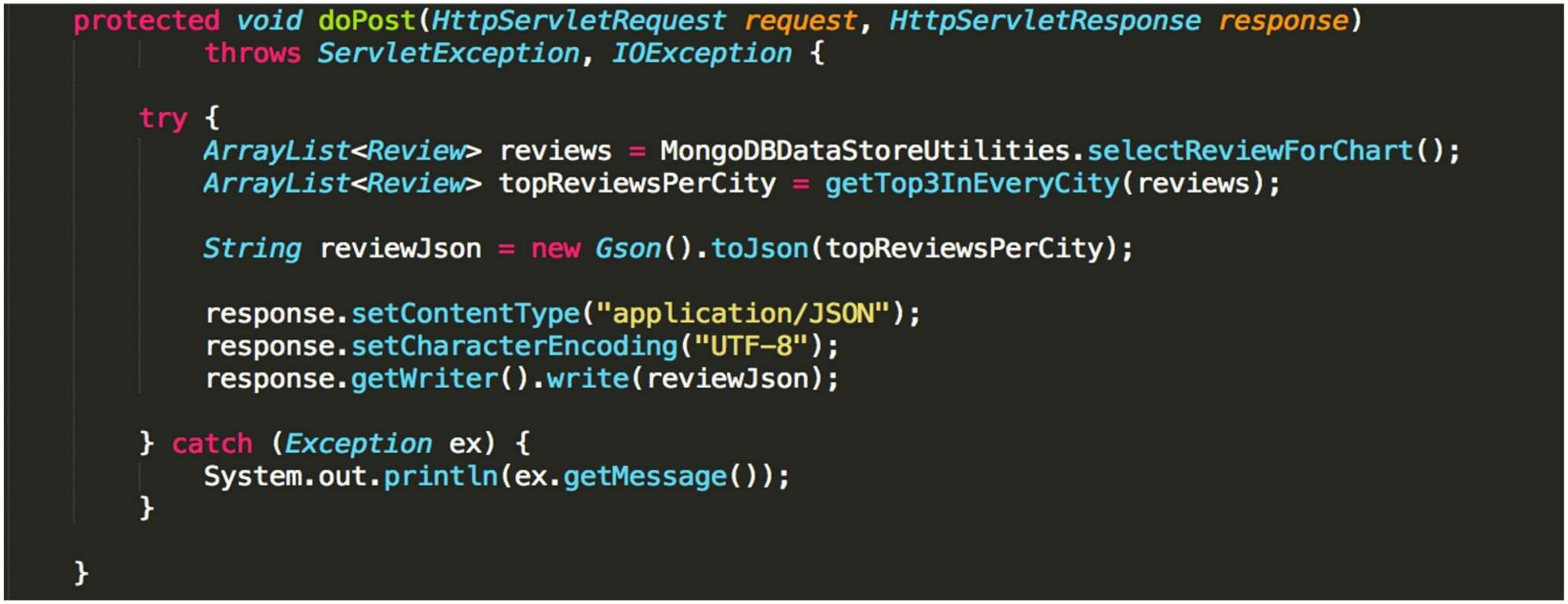
‘DataVisualization.js’



```
/* Plot the chart using 2d array and product names as subtitles;
 * data - contains data to be plotted in the form of two dimensional array.
 * productNameArr - An array of product names to be used as subtitles
 */
function drawChart(data, productNameArr) {

    //Invoke google's built in method to get data table object required by google.
     var chartData = google.visualization.arrayToDataTable(data);

     var options = {
        'width':600,
        'height':650,
          chart: {
            title: 'Trending Products Chart',
            subtitle: productNameArr,
          },
          bars: 'horizontal' // Required for Material Bar Charts.
        };

    var chart = new google.visualization.BarChart(document.getElementById('chart_div'));
    chart.draw(chartData, options);
}
```

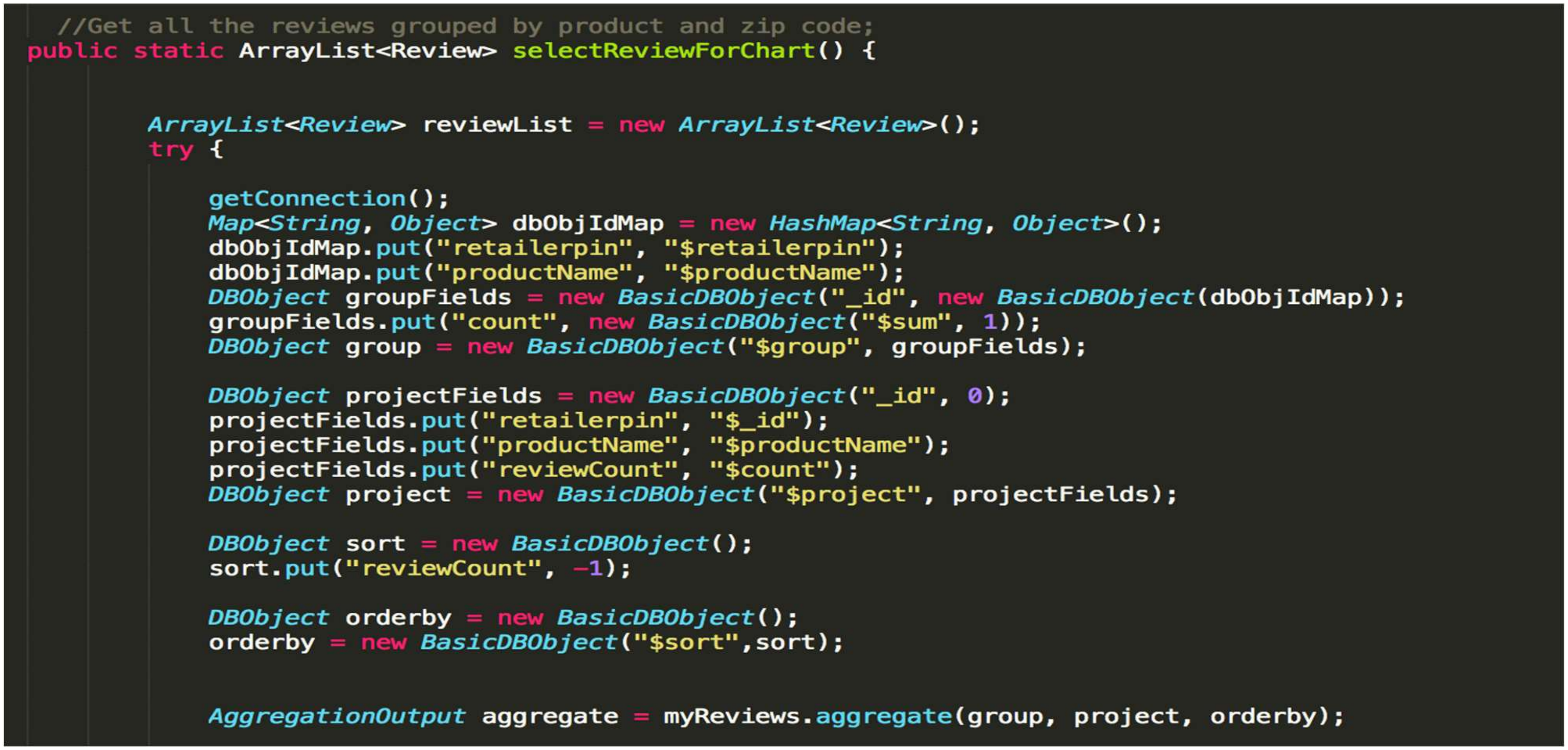
‘DataVisualization.java’

Make an Ajax call to get the data required to plot the chart. Gson is used here to convert Java collection to JSON.



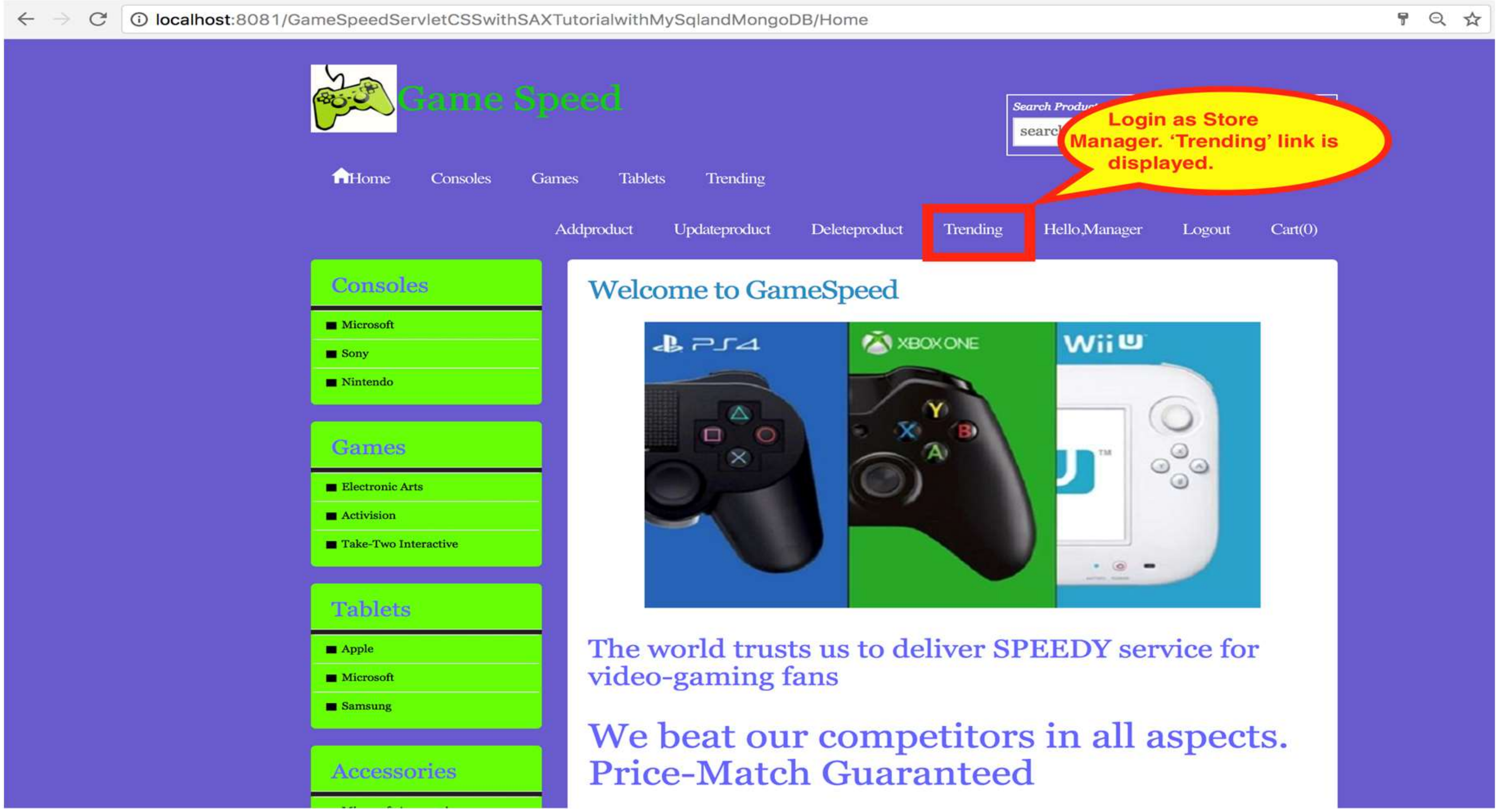
```java
protected void doPost(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {

    try {
        ArrayList<Review> reviews = MongoDBDataStoreUtilities.selectReviewForChart();
        ArrayList<Review> topReviewsPerCity = getTop3InEveryCity(reviews);

        String reviewJson = new Gson().toJson(topReviewsPerCity);

        response.setContentType("application/JSON");
        response.setCharacterEncoding("UTF-8");
        response.getWriter().write(reviewJson);

    } catch (Exception ex) {
        System.out.println(ex.getMessage());
    }

}
```

‘MongoDBDataStoreUtilities.java’



```
    //Get all the reviews grouped by product and zip code;
public static ArrayList<Review> selectReviewForChart() {


        ArrayList<Review> reviewList = new ArrayList<Review>();
        try {

            getConnection();
            Map<String, Object> dbObjIdMap = new HashMap<String, Object>();
            dbObjIdMap.put("retailerpin", "$retailerpin");
            dbObjIdMap.put("productName", "$productName");
            DBObject groupFields = new BasicDBObject("_id", new BasicDBObject(dbObjIdMap));
            groupFields.put("count", new BasicDBObject("$sum", 1));
            DBObject group = new BasicDBObject("$group", groupFields);

            DBObject projectFields = new BasicDBObject("_id", 0);
            projectFields.put("retailerpin", "$_id");
            projectFields.put("productName", "$productName");
            projectFields.put("reviewCount", "$count");
            DBObject project = new BasicDBObject("$project", projectFields);

            DBObject sort = new BasicDBObject();
            sort.put("reviewCount", -1);

            DBObject orderby = new BasicDBObject();
            orderby = new BasicDBObject("$sort",sort);


            AggregationOutput aggregate = myReviews.aggregate(group, project, orderby);
```

Login as Store Manager – 'Trending' link is displayed



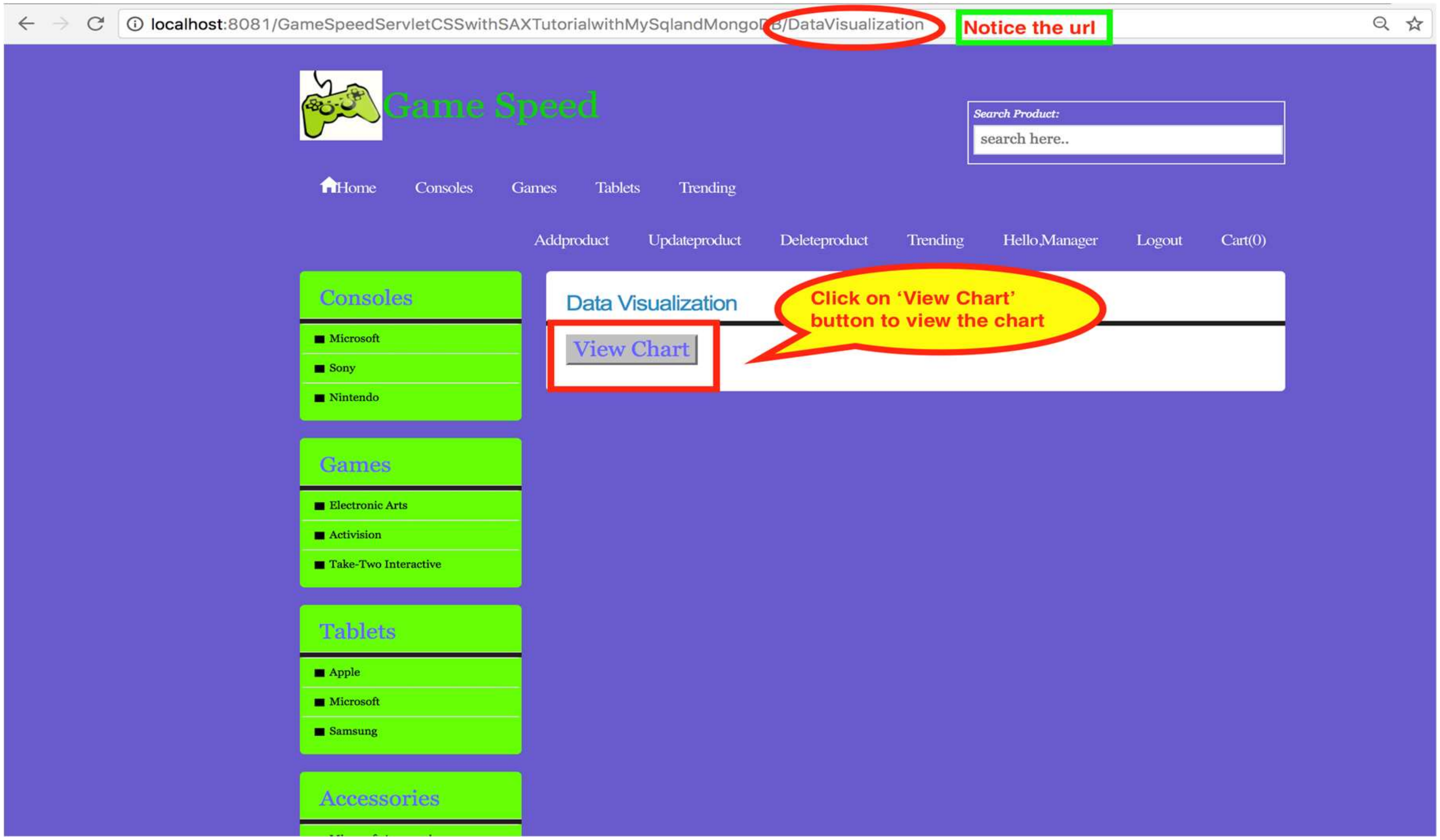
Login as Store Manager. 'Trending' link is displayed.

Welcome to GameSpeed

The world trusts us to deliver SPEEDY service for video-gaming fans

We beat our competitors in all aspects. Price-Match Guaranteed

Click ‘Trending’ link

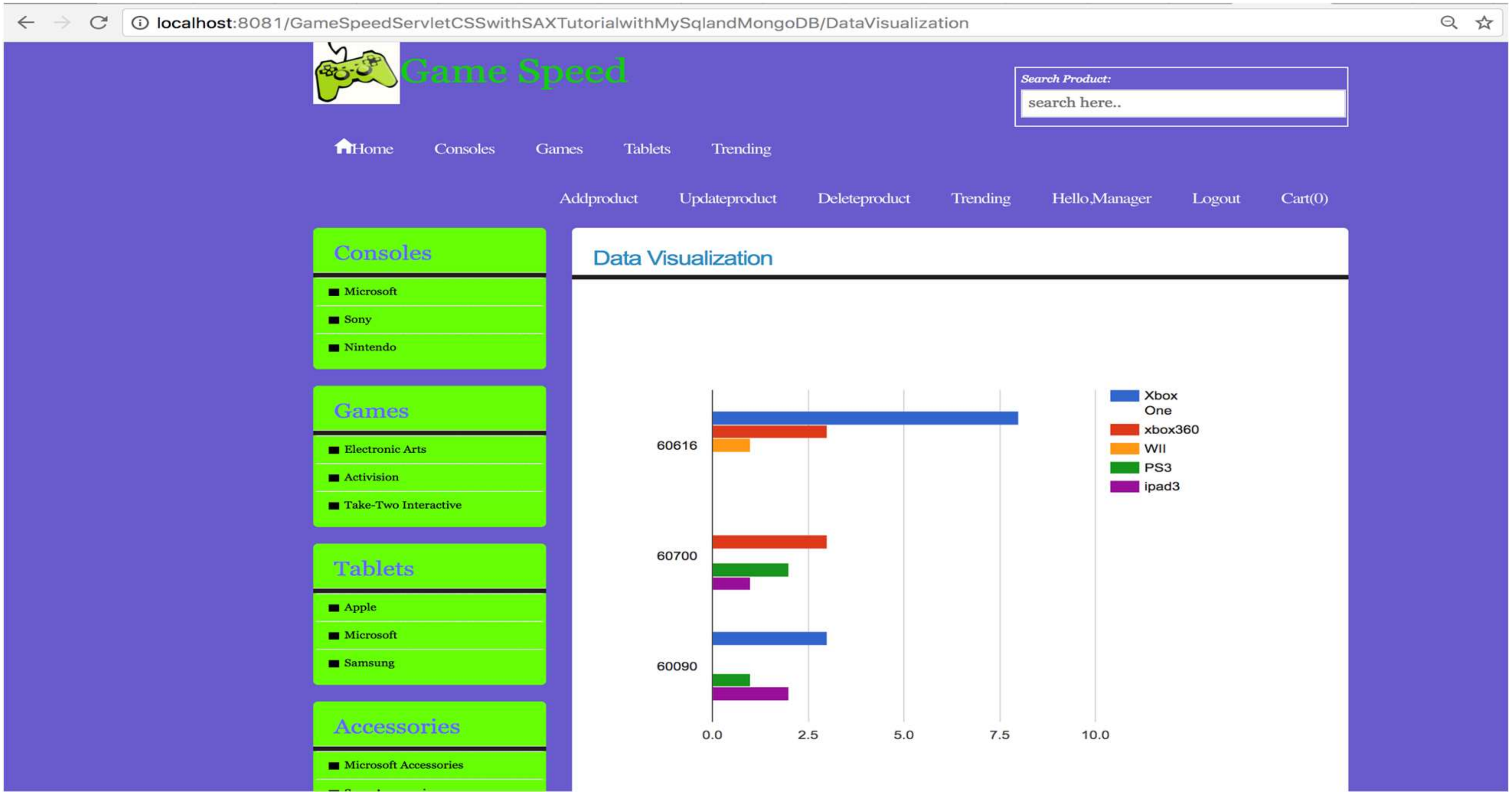


localhost:8081/GameSpeedServletCSSwithSAXTutorialwithMySqlandMongoDB/DataVisualization

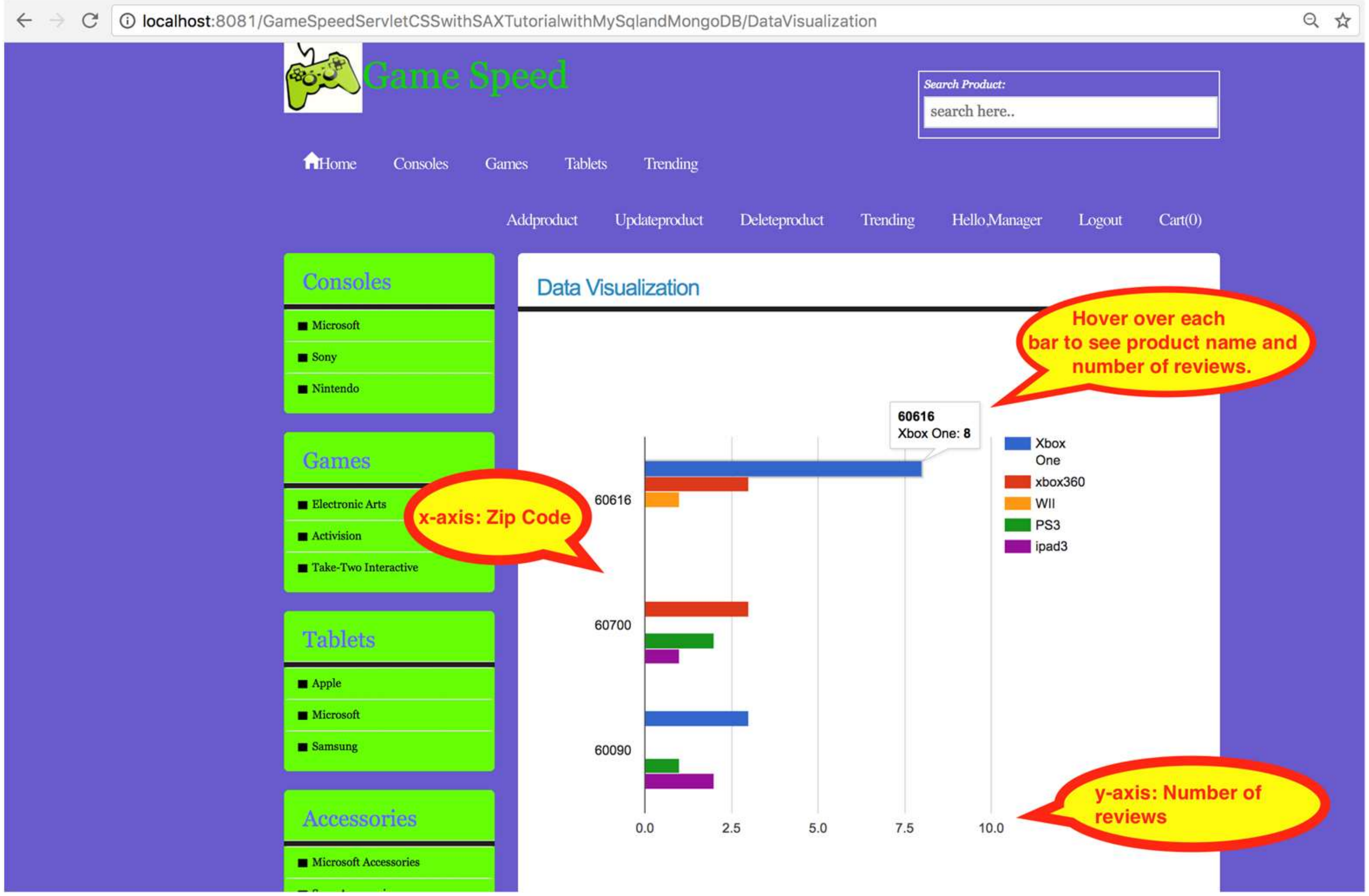
Notice the url

Click on ‘View Chart’ button to view the chart

Data Visualization – Bar Chart of top 3 most liked products in every city



X-axis: Zip Code, Y-axis: Number of reviews



localhost:8081/GameSpeedServletCSSwithSAXTutorialwithMySqlandMongoDB/DataVisualization

Hover over each bar to see product name and number of reviews.

x-axis: Zip Code

y-axis: Number of reviews

Questions?