JAVA PROGRAMMING:
Build a Recommendation System

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ASSIGNMENTS:

Assignment 1: First Ratings

Provided starter files can be found at:

http://www.dukelearntoprogram.com/course5/index.php

In this exercise, you will use the provided classes Movie.java, Rating.java, and Rater.java and read in and store information about movies and ratings of movies by different movie
raters to answer simple questions about both movies and ratings.

For this assignment you will be given three starter files.

The class Movie is a Plain Old Java Object (POJO) class for storing the data about one movie. It includes the following items:

Eight private variables to represent information about a movie including:

-id - a String variable representing the IMDB ID of the movie
-title - a String variable for the movie’s title
-year - an integer representing the year
-genres - one String of one or more genres separated by commas
-director - one String of one or more directors of the movie separated by commas
-country - one String of one or more countries the film was made in, separated by commas

-minutes - an integer for the length of the movie
-poster - a String that is a link to an image of the movie poster if one exists, or “N/A” if no poster exists
A constructor with eight parameters to initialize the private variables

Eight getter methods to return the private information such as the method getGenres that returns a String of all the genres for this movie.

A toString method for representing movie information as a String so it can easily be printed.

The class Rating is also a POJO class for storing the data about one rating of an item. It includes

Two private variables to represent information about a rating:

-item - a String description of the item being rated (for this assignment you should use the IMDB ID of the movie being rated)
-value - a double of the actual rating
A constructor with two parameters to initialize the private variables.

Two getter methods getItem and getValue.

A toString method to represent rating information as a String.

A compareTo method to compare this rating with another rating.

The class Rater keeps track of one rater and all their ratings. This class includes:

Two private variables:

-myID - a unique String ID for this rater
-myRatings - an ArrayList of Ratings
A constructor with one parameter of the ID for the rater.

A method addRating that has two parameters, a String named item and a double named rating. A new Rating is created and added to myRatings.

A method getID with no parameters to get the ID of the rater.

A method getRating that has one parameter item. This method returns the double rating of this item if it is in myRatings. Otherwise this method returns -1.

A method numRatings that returns the number of ratings this rater has.

A method getItemsRated that has no parameters. This method returns an ArrayList of Strings representing a list of all the items that have been rated.

---Data files

You'll use several data files for this project. There are multiple versions of each type of file or different sizes.
In creating recommendations you'll need two data files: one of movies, and one of ratings of these movies by different raters.

First there is a CSV file with movie data, the smallest of which is called ratedmovies_short.csv. The other similar files are larger,
so we have created this small file with just a few entries in it that you can use for testing.
Each file of this type has a header row as the first line,
first followed by one line for each movie. Shown below is this shorter file that has six lines, the header line first followed by six movies.

The lines are so long that they are wrapping in this document, each movie line is displayed here in two to three lines. For example the first movie has the IMDB number 0006414,
the name of the movie is “Behind the Screen,” and the movie was made in 1916 in the USA. The genres for this movie are Short, Comedy, and Romance. The director is Charles Chaplin,
and the length of the film is 30 minutes. The last item is a link to a .jpg image of a poster for the movie if one exists, or “N/A” if there is not one.

ratedmovies_short.csv:

```
id,title,year,country,genre,director,minutes,poster
0006414,"Behind the Screen",1916,"USA","Short, Comedy, Romance","Charles
  Chaplin",30,"http://ia.media-imdb.com/images/M
  /MV5BMTkyNDYyNTczNF5BMl5BanBnXkFtZTgwMDU2MzAwMzE@._V1_SX300.jpg"
0068646,"The Godfather",1972,"USA","Crime, Drama","Francis Ford Coppola",175
  ,"http://ia.media-imdb.com/images/M
  /MV5BMjEyMjcyNDI4MF5BMl5BanBnXkFtZTcwMDA5Mzg3OA@@._V1_SX300.jpg"
0113277,"Heat",1995,"USA","Action, Crime, Drama","Michael Mann",170,"http://ia
  .media-
imdb.com/images/M/MV5BMTM1NDc4ODkxNV5BMl5BanBnXkFtZTcwNTI4ODE3MQ
@@
  ._V1_SX300.jpg"
1798709,"Her",2013,"USA","Drama, Romance, Sci-Fi","Spike Jonze",126,"http://ia
  .media-
imdb.com/images/M/MV5BMjA1Nzk0OTM2OF5BMl5BanBnXkFtZTgwNjU2NjEwMDE@
  ._V1_SX300.jpg"
0790636,"Dallas Buyers Club",2013,"USA","Biography, Drama","Jean-Marc VallÃ©e"
  ,117,"N/A"
```

Next there is a CSV file with rating/rater data, the smallest of which is called ratings_short.csv. Again, the other similar files are quite large so we have created this small file
with just a few entries in it that you can use for testing. Each file of this type has a header first followed by one line for each rating.
Shown below is this shorter file that has eleven lines. The first line is the header. The second line shows the rater_id is 1, the IMDB movie ID is 0068646, the movie was rated a 10,
and the time was 1381620027.
ratings_short.csv:

```
rater_id,movie_id,rating,time
1,0068646,10,1381620027
1,0113277,10,1379466669
2,1798709,10,1389948338
2,0790636,7,1389963947
2,0068646,9,1382460093
3,1798709,9,1388641438
4,0068646,8,1362440416
4,1798709,6,1398043318
5,0068646,9,1364834910
5,1798709,8,1404338202
```

Assignment

In this assignment you will create a new class named FirstRatings to process the movie and ratings data and to answer questions about them.
You may find it helpful to use CSVParser and CSVRecord. Note that FirstRatings will need the following three import statements:

```
import edu.duke.*;
import java.util.*;
import org.apache.commons.csv.*;
```

Specifically for this assignment you will write the following methods in a new class named FirstRatings:

Write a method named loadMovies that has one parameter, a String named filename. This method should process every record from the CSV file whose name is filename, a file of movie information, and return an ArrayList of type Movie with all of the movie data from the file.

Write a void method named testLoadMovies that should do several things.

- Call the method loadMovies on the file ratedmovies_short.csv and store the result in an ArrayList local variable . Print the number of movies, and print each movie.
You should see there are five movies in this file, which are all shown above. After this works you should comment out the printing of the movies.
If you run your program on the file ratedmoviesfull.csv, you should see there are 3143 movies in the file.

- Add code to determine how many movies include the Comedy genre. In the file ratedmovies_short.csv, there is only one.

- Add code to determine how many movies are greater than 150 minutes in length. In the file ratedmovies_short.csv, there are two.

- Add code to determine the maximum number of movies by any director, and who the directors are that directed that many movies. Remember that some movies may have more than one director.
In the file ratedmovies_short.csv the maximum number of movies by any director is one, and there are five directors that directed one such movie.

In the FirstRatings class, write a method named loadRaters that has one parameter named filename. This method should process every record from the CSV file whose name is filename,
a file of raters and their ratings, and return an ArrayList of type Rater with all the rater data from the file.

Write a void method named testLoadRaters that should do several things.

- Call the method loadRaters on the file ratings_short.csv and store the result in a local ArrayList variable. Print the total number of raters. Then for each rater,
print the rater's ID and the number of ratings they did on one line, followed by each rating (both the movie ID and the rating given) on a separate line.
If you run your program on the file ratings_short.csv you will see there are five raters. After it looks like it works,
you may want to comment out the printing of each rater and their ratings. If you run your program on the file ratings.csv, you should get 1048 raters.

- Add code to find the number of ratings for a particular rater you specify in your code. For example, if you run this code on the rater whose rater_id is 2
for the file ratings_short.csv, you will see they have three ratings.

- Add code to find the maximum number of ratings by any rater. Determine how many raters have this maximum number of ratings and who those raters are.
If you run this code on the file ratings_short.csv, you will see rater 2 has three ratings, the maximum number of ratings of all the raters,
and that there is only one rater with three ratings.

- Add code to find the number of ratings a particular movie has. If you run this code on the file ratings_short.csv for the movie "1798709", you will see it was rated by four raters.

- Add code to determine how many different movies have been rated by all these raters. If you run this code on the file ratings_short.csv, you will see there were four movies rated.

Programming Exercise: Step Two

In this exercise, you will add to the programming project you did for the first assignment. You will continue to use the provided classes Movie.java, Rating.java, and Rater.java that were provided for the first assignment and you will also use the FirstRatings class you wrote to read in and store information about movies and ratings of movies by different movie raters. You will build on this assignment by calculating average ratings of movies. You will work with two new classes, **SecondRatings** which we will give you parts of, and a new class **MovieRunnerAverage**, which you will create.

Assignment

In this assignment you will modify a new class named **SecondRatings**, which has been started for you, to do many of the calculations focusing on computing averages on movie ratings. You will also create a second new class named **MovieRunnerAverage**, which you will use to test the methods you created in SecondRatings by creating a SecondRatings object in MovieRunnerAverage and calling its methods.

Specifically for this assignment you will write the following classes and methods:

- Note that the SecondRatings class has been started for you. This class includes two private variables, one named **myMovies** of type ArrayList of type Movie, and a second one named **myRaters** of type ArrayList of type Rater. A default constructor has also been created for you. Until you create the second constructor (see below), the class will not compile.
- Write an additional SecondsRating constructor that has two String parameters named **moviefile** and **ratingsfile**. The constructor should create a FirstRatings object and then call the **loadMovies** and **loadRaters** methods in FirstRatings to read in all the movie

and ratings data and store them in the two private ArrayList variables of the SecondRatings class, **myMovies** and **myRaters**.

- In the SecondRatings class, write a public method named **getMovieSize**, which returns the number of movies that were read in and stored in the ArrayList of type Movie.
- In the SecondRatings class, write a public method named **getRaterSize**, which returns the number of raters that were read in and stored in the ArrayList of type Rater.
- Create a new class named MovieRunnerAverage. In this class, create a void method named **printAverageRatings** that has no parameters. This method should:
    - Create a SecondRatings object and use the CSV filenames of movie information and ratings information from the first assignment when calling the constructor.
    - Print the number of movies and number of raters from the two files by calling the appropriate methods in the SecondRatings class. Test your program to make sure it is reading in all the data from the two files. For example, if you run your program on the files **ratings_short.csv** and **ratedmovies_short.csv**, you should see 5 raters and 5 movies.
    - We will add more code to this method in a bit.
- In the SecondRatings class, write a private helper method named **getAverageByID** that has two parameters: a String named **id** representing a movie ID and an integer named **minimalRaters**. This method returns a double representing the average movie rating for this ID if there are at least **minimalRaters** ratings. If there are not **minimalRaters** ratings, then it returns 0.0.
- In the SecondRatings class, write a public method named **getAverageRatings**, which has one int parameter named **minimalRaters**. This method should find the average rating for every movie that has been rated by at least **minimalRaters** raters. Store each such rating in a Rating object in which the movie ID and the average rating are used in creating the Rating object. The method **getAverageRatings** should return an ArrayList of all the Rating objects for movies that have at least the minimal number of raters

supplying a rating. For example, if **minimalRaters** has the value 10, then this method returns rating information (the movie ID and its average rating) for each movie that has at least 10 ratings. You should consider calling the private **getAverageByID** method.

- In the SecondRatings class, write a method named **getTitle** that has one String parameter named **id**, representing the ID of a movie. This method returns the title of the movie with that ID. If the movie ID does not exist, then this method should return a String indicating the ID was not found.
- In the MovieRunnerAverage class in the **printAverageRatings** method, add code to print a list of movies and their average ratings, for all those movies that have at least a specified number of ratings, sorted by averages. Specifically, this method should print the list of movies, one movie per line (print its rating first, followed by its title) in <u>sorted order</u> by ratings, lowest rating to highest rating. For example, if **printAverageRatings** is called on the files **ratings_short.csv** and **ratedmovies_short.csv** with the argument 3, then the output will display two movies:

```
8.25 Her
9.0 The Godfather
```

- In the SecondRatings class, write a method **getID** that has one String parameter named **title** representing the title of a movie. This method returns the movie ID of this movie. If the title is not found, return an appropriate message such as “NO SUCH TITLE.” Note that the movie title must be spelled exactly as it appears in the movie data files.
- In the MovieRunnerAverage class, write the void method **getAverageRatingOneMovie**, which has no parameters. This method should first create a SecondRatings object, reading in data from the movie and ratings data files. Then this method should print out the average ratings for a specific movie title, such as the movie “The Godfather”. If the **moviefile** is set to the file named **ratedmovies_short.csv**, and the **ratingsfile** is set to the file **ratings_short.csv**, then the average for the movie “The Godfather” would be 9.0.

Programming Exercise: Step Three

In this exercise you will continue to build on the program you wrote for the previous assignment. You will also use new classes we provide for this assignment. In this exercise you will make your program more efficient and also use filters to be able to ask questions about movies with several traits. You should begin by creating a new Java project and copying your Java code and the data directory from the last assignment, since you will be making several changes.

Assignment 1: Efficiency

In the first part of this assignment you will focus on making the program you have already written more efficient. You will start with your files from the previous assignment and make a **Rater** interface and then make a more efficient Rater class.

Specifically for this assignment, you will do the following.

- Change the name of the class Rater.java to PlainRater.java. Be sure to compile it to make sure your newly named class works—that you've made the changes necessary for the class to function with the name PlainRater.
- Create a new public interface named **Rater**. Add methods to this new interface by copying all the method signatures from the PlainRater class. Copy just the methods—do not include the constructors or the private instance variables. The first line of the interface should be:
  ```
  public interface Rater {
  ```
- Now add code to PlainRater so that it implements the Rater interface.
  ```
  public class PlainRater implements Rater
  ```
- After making that change, try compiling your FirstRatings.java program. In order to get FirstRatings.java to compile, you will need to make only one change. Where you have the code
  ```
  rater = new Rater();
  ```
  You'll need to change this so that you assign `new PlainRater()` to the **rater** object. After that change, compile FirstRatings. Try running your MovieRunnerAverage class; it should run as before.

- Create a new class named **EfficientRater**, and copy the PlainRater class into this class. You will make several changes to this class, including:
    - Change the ArrayList of type Rating private variable to a HashMap<String,Rating>. The key in the HashMap is a movie ID, and its value is a rating associated with this movie.
    - You will need to change **addRating** to instead add a new Rating to the HashMap with the value associated with the movie ID String item as the key in the HashMap.
    - The method **hasRating** should now be much shorter; it no longer needs a loop.
    - What other changes need to be made?
- Now change FirstRatings to use EfficientRater instead of PlainRater. You should now be able to compile FirstRatings and SecondRatings. Try running your MovieRunnerAverage class. It should run as before, but much faster.

Additional Starter Files for Assignment 2

For this part of the assignment you will be given several new files.

- The class **MovieDatabase**—This class is an efficient way to get information about movies. It stores movie information in a HashMap for fast lookup of movie information given a movie ID. The class also allows filtering movies based on queries. All methods and fields in the class are static. This means you'll be able to access methods in MovieDatabase without using **new** to create objects, but by calling methods like `MovieDatabase.getMovie("0120915")`. This class has the following parts:
    - A HashMap named **ourMovies** that maps a movie ID String to a Movie object with all the information about that movie.
    - A public **initialize** method with one String parameter named **moviefile**. You can call this method with the name of the file used to initialize the movie database.
    - A private **initialize** method with no parameters that will load the movie file **ratedmoviesfull.csv** if no file has been loaded. This method is called as a safety check with any of the other public methods to make sure there is movie data in the database.
    - A private **loadMovies** method to build the HashMap.
    - A **containsID** method with one String parameter named **id**. This method returns true if the **id** is a movie in the database, and false otherwise.
    - Several getter methods including **getYear**, **getTitle**, **getMovie**, **getPoster**, **getMinutes**, **getCountry**, **getGenres**, and **getDirector**. Each of these takes a movie ID as a parameter and returns information about that movie.
    - A **size** method that returns the number of movies in the database.
    - A **filterBy** method that has one Filter parameter named **f**. This method returns an ArrayList of type String of movie IDs that match the filtering criteria.
- The interface **Filter** has only one signature for the method **satisfies**. Any filters that implement this interface must also have this method.
    - The method **satisfies** has one String parameter named **id** representing a movie ID. This method returns true if the movie satisfies the criteria in the method and returns false otherwise.
- The class **TrueFilter** can be used to select every movie from MovieDatabase. It’s **satisfies** method always returns true.

- The class **YearsAfterFilter** is a filter for a specified year; it selects only those movies that were created on that year or created later then that year. If the year is 2000, then all movies created in the year 2000 and the years after (2001, 2002, 2003, etc) would be selected if used with **MovieDatabase.filterBy**.
- The class **AllFilters** combines several filters. This class has the following:
  - A private variable named **filters** that is an ArrayList of type Filter.
  - An **addFilter** method that has one parameter named **f** of type Filter. This method allows one to add a Filter to the ArrayList **filters**.
  - A **satisfies** method that has one parameter named **id** representing a movie ID. This method returns true if the movie satisfies the criteria of all the filters in the **filters** ArrayList. Otherwise this method returns false.

Assignment 2: Filters

This part of the assignment will focus on using the new class MovieDatabase, which uses a HashMap to store movie information so that looking up that information is more efficient. This part also filters movies based on several criteria to narrow down search results. We have given you the Filter interface and sample filters TrueFilter and YearAfterFilter, in addition to the AllFilters class for using multiple Filters. You will create some new Filters as described below. For example, you may want to get only those movies with the genre of comedy. You'll also answer questions using multiple Filters, such as finding all movies that are dramas that came out in 2000 or later.

Specifically for this assignment, you will do the following.

- Create a new class named **ThirdRatings**. Copy your code from SecondRatings into this class. Movies will now be stored in the MovieDatabase instead of in the instance variable **myMovies**, so you will want to remove the private variable **myMovies**. The constructor will no longer have a **moviefile** parameter—movies will be stored in the MovieDatabase class.
- ThirdRatings has only one private variable named **myRaters** to store an ArrayList of Raters.
- The default constructor should look like this:

```
public ThirdRatings() {
      this("ratings.csv");
}
```

- A second constructor should have only one String parameter named **ratingsfile**. This constructor should call the method **loadRaters** from the FirstRatings class to fill the **myRaters** ArrayList.
- You can remove all the methods that are movie specific, such as **getMovieSize**, **getID**, and **getTitle**.
- You will need to modify **getAverageRatings**. Note that **myMovies** no longer exists. Instead, you'll need to get all the movies from the MovieDatabase class and store them in an ArrayList of movie IDs. Thus, you will need to modify **getAverageRatings** to call MovieDatabase with a filter, and in this case you can use the TrueFilter to get every movie.

```
ArrayList<String> movies = MovieDatabase.filterBy(new TrueFilter());
```

Then for each movie ID in the ArrayList **movies**, you'll need to calculate its **averageRating** and return an ArrayList of Ratings for each movie that was rated by **minimalRaters**. Make sure this class compiles before moving on.

- Create a new class named **MovieRunnerWithFilters** that you will use to find the average rating of movies using different filters. Copy the **printAverageRatings** method from the MovieRunnerAverage class into this class. You will make several changes to this method:
  - Instead of creating a SecondRatings object, you will create a ThirdRatings object. Note that this only has one parameter, the name of a file with ratings data.
  - Print the number of raters after creating a ThirdsRating object.
  - You'll call the MovieDatabase **initialize** method with the **moviefile** to set up the movie database.
  - Print the number of movies in the database.
  - You will call **getAverageRatings** with a minimal number of raters to return an ArrayList of type Rating.
  - Print out how many movies with ratings are returned, then sort them, and print out the rating and title of each movie.
  - For example, if you run the **printAverageRatings** method on the files **ratings_short.csv** and **ratedmovies_short.csv** with a minimal rater of 1, you should see

```
read data for 5 raters
read data for 5 movies
found 4 movies
7.0 Dallas Buyers Club
8.25 Her
9.0 The Godfather
10.0 Heat
```

- You will use the YearsAfterFilter to calculate the number of movies in the database that have at least a minimal number of ratings and came out in a particular year or later.
  - In the ThirdRatings class, write a public helper method named **getAverageRatingsByFilter** that has two parameters, an int named **minimalRaters** for the minimum number of ratings a movie must have and a Filter named **filterCriteria**. This method should create and return an ArrayList of

type Rating of all the movies that have at least **minimalRaters** ratings and satisfies the filter criteria. This method will need to create the ArrayList of type String of movie IDs from the MovieDatabase using the **filterBy** method before calculating those averages.

- In the MovieRunnerWithFilters class, create a void method named **printAverageRatingsByYear** that should be similar to **printAverageRatings**, but should also create a YearAfterFilter and call **getAverageRatingsByFilter** to get an ArrayList of type Rating of all the movies that have a specified number of minimal ratings and came out in a specified year or later. Print the number of movies found, and for each movie found, print its rating, its year, and its title. For example, if you run the **printAverageRatingsByYear** method on the files **ratings_short.csv** and **ratedmovies_short.csv** with a minimal rater of 1 and the year 2000, you should see

```
read data for 5 raters
read data for 5 movies
found 2 movies
7.0 2013 Dallas Buyers Club
8.25 2013 Her
```

- Add a **GenreFilter**
  - Create a new class named **GenreFilter** that implements Filter. The constructor should have one parameter named **genre** representing one genre, and the **satisfies** method should return true if a movie has this genre. Note that movies may have several genres.
  - In the MovieRunnerWithFilters class, create a void method named **printAverageRatingsByGenre** that should create a GenreFilter and call **getAverageRatingsByFilter** to get an ArrayList of type Rating of all the movies that have a specified number of minimal ratings and include a specified genre. Print the number of movies found, and for each movie, print its rating and its title on one line, and its genres on the next line. For example, if you run the **printAverageRatingsByGenre** method on the files **ratings_short.csv** and **ratedmovies_short.csv** with a minimal rater of 1 and the genre “Crime”, you should see

```
read data for 5 raters
read data for 5 movies
found 2 movies
9.0 The Godfather
      Crime, Drama
10.0 Heat
      Action, Crime, Drama
```

- Add a **MinutesFilter**
  - Create a new class named **MinutesFilter** that implements Filter. Its **satisfies** method should return true if a movie's running time is at least **min** minutes and no more than **max** minutes.
  - In the MovieRunnerWithFilters class, create a void method named **printAverageRatingsByMinutes** that should create a MinutesFilter and call **getAverageRatingsByFilter** to get an ArrayList of type Rating of all the movies that have a specified number of minimal ratings and their running time is at least a minimum number of minutes and no more than a maximum number of minutes. Print the number of movies found, and for each movie print its rating, its running time, and its title on one line. For example, if you run the **printAverageRatingsByMinutes** method on the files **ratings_short.csv** and **ratedmovies_short.csv** with a minimal rater of 1, minimum minutes of 110, and maximum minutes of 170, then you should see

```
read data for 5 raters
read data for 5 movies
found 3 movies
7.0 Time: 117 Dallas Buyers Club
8.25 Time: 126 Her
10.0 Time: 170 Heat
```

- Add a **DirectorsFilter**
  - Create a new class named **DirectorsFilter** that implements Filter. The constructor should have one parameter named **directors** representing a list of directors separated by commas (Example: "Charles Chaplin,Michael Mann,Spike Jonze", and its **satisfies** method should return true if a movie has at least one of these directors as one of its directors. Note that each movie may have several directors.

- ○ In the MovieRunnerWithFilters class, create a void method named **printAverageRatingsByDirectors** that should create a DirectorsFilter and call **getAverageRatingsByFilter** to get an ArrayList of type Rating of all the movies that have a specified number of minimal ratings and include at least one of the directors specified. Print the number of movies found, and for each movie print its rating and its title on one line, and all its directors on the next line. For example, if you run the **printAverageRatingsByDirectors** method on the files **ratings_short.csv** and **ratedmovies_short.csv** with a minimal rater of 1 and the directors set to "Charles Chaplin,Michael Mann,Spike Jonze", you should see:

```
read data for 5 raters
read data for 5 movies
found 2 movies
8.25 Her
      Spike Jonze
10.0 Heat
      Michael Mann
```

  Note that the movie “Behind the Screen” with director “Charles Chaplin” does not appear because no one rated it.

- Now use the AllFilters class to combine asking questions about average ratings by genre and films on or after a particular year. You don’t need to create a new class.
  - ○ In the MovieRunnerWithFilters class, create a void method named **printAverageRatingsByYearAfterAndGenre** that should create an AllFilters object that includes criteria based on movies that came out in a specified year or later and have a specified genre as one of its genres. This method should call **getAverageRatingsByFilter** to get an ArrayList of type Rating of all the movies that have a specified number of minimal ratings and the two criteria based on year and genre. Print the number of movies found, and for each movie, print its rating, its year, and its title on one line, and all its genres on the next line. For example, if you run the **printAverageRatingsByYearAfterAndGenre** method on the files **ratings_short.csv** and **ratedmovies_short.csv** with a minimal rater of 1, the year set to 1980, and the genre set to “Romance”, then you should see:

```
read data for 5 raters
read data for 5 movies
1 movie matched
```

```
8.25 2013 Her
      Drama, Romance, Sci-Fi
```

- Use the AllFilters class to combine asking questions about average ratings by length of film in minutes and directors.
    - In the MovieRunnerWithFilters class, create a void method named **printAverageRatingsByDirectorsAndMinutes** that should create an AllFilters object that includes criteria based on running time (at least a specified minimum number of minutes and at most a specified maximum number of minutes), and directors (at least one of the directors in a list of specified directors—directors are separated by commas). This method should call **getAverageRatingsByFilter** to get an ArrayList of type Rating of all the movies that have a specified number of minimal ratings and the two criteria based on minutes and directors. Print the number of movies found, and for each movie, print its rating, its time length, and its title on one line, and all its directors on the next line. For example, if you run the **printAverageRatingsByDirectorsAndMinutes** method on the files **ratings_short.csv** and **ratedmovies_short.csv** with a minimal rater of 1, minimum minutes set to 30, maximum minutes set to 170, and the directors set to "Spike Jonze,Michael Mann,Charles Chaplin,Francis Ford Coppola", then you should see:

```
read data for 5 raters
read data for 5 movies
2 movies matched
8.25 Time: 126 Her
      Spike Jonze
10.0 Time: 170 Heat
      Michael Mann
```

Programming Exercise: Step Four

In this exercise you will continue to build on the program you wrote for the previous assignment. You will continue to make your program more efficient with a **RaterDatabase** class that is designed and implemented similarly to the MovieDatabase class you used recently—you will use both of these database classes in this assignment. You will also calculate a different kind of average movie rating, one based on weighting ratings made by raters who are more like you, or like any given rater—valuing their ratings more than raters who don't have your tastes in movies. To calculate these weighted averages you will need to calculate similarity scores for each rater to find out which raters you are more similar to than others, so you can weight ratings accordingly.

Additional File for Assignment

For this assignment you will be given one class **RaterDatabase**, which is an efficient way to get information about raters. This class contains:

- A HashMap named **ourRaters** that maps a rater ID String to a Rater object that includes all the movie ratings made by this rater.
- A public static **initialize** method with one String parameter named **filename**. You can call this method with the name of the file used to initialize the rater database.
- A private **initialize** method with no parameters that initializes the HashMap **ourRaters** if it does not exist.
- A public static void **addRatings** method that has one String parameter named **filename**. You could alternatively call this method to add rater ratings to the database from a file.
- A public static void **addRaterRating** method that has three parameters, a String named **raterID** representing a rater ID, a String named **movieID** that represents a movie ID, and a double named **rating** that is the rating the rater **raterID** has given to the movie **movieID**. This function can be used to add one rater and their movie rating to the database. Notice that the method **addRatings** calls this method.
- A method **getRater** has one String parameter named **id**. This method returns a Rater that has this ID.
- A method **getRaters** that has no parameters. This method returns an ArrayList of Raters from the database.

- A method **size** that has no parameters. This method returns the number of raters in the database.

Assignment

Specifically for this assignment you will do the following:

- Create a new project and copy over your classes from the last exercise.
- Create a new class named **FourthRatings**. Copy over the following methods from the class ThirdRatings and get FourthRatings to compile. Do not copy over any of the other methods. You should not copy, nor should you have any instance variables in FourthRatings—you'll use RaterDatabase and MovieDatabase static methods in place of instance variables—so where you have code with **myRaters**, you need to replace the code with calls to methods in the RaterDatabase class. The methods to copy into FourthRatings from ThirdRatings are below (you'll need to modify these after copying):
    - **getAverageByID**
    - **getAverageRatings**
    - **getAverageRatingsByFilter**
- Create a new class named **MovieRunnerSimilarRatings**. Copy the two methods **printAverageRatings** and **printAverageRatingsByYearAfterAndGenre** from MovieRunnerWithFilters to this new class and modify them to work with a FourthRatings object instead of a ThirdRatings object. You can copy more of the methods into your new Runner class, but these two should be enough to test that FourthRatings has been set up correctly. When you run these two you should get the same output you get when those methods run with the ThirdRatings object.
- In the FourthRatings class, write the following methods—two are private helper methods, and one is the method that will return movie recommendations based on similarities:
    - Write the private helper method named **dotProduct**, which has two parameters, a Rater named **me** and a Rater named **r**. This method should first translate a rating from the scale 0 to 10 to the scale -5 to 5 and return the dot product of the ratings of movies that they both rated. This method will be called by **getSimilarities**.
    - Write the private method named **getSimilarities**, which has one String parameter named **id**—this method computes a similarity rating for each rater in the RaterDatabase (except the rater with the ID given by the parameter) to see how similar they are to the Rater whose ID is the parameter to **getSimilarities**. This method returns an ArrayList of type Rating sorted by ratings from highest to

lowest rating with the highest rating first and only including those raters who have a positive similarity rating since those with negative values are not similar in any way. Note that in each Rating object the item field is a rater's ID, and the value field is the dot product comparison between that rater and the rater whose ID is the parameter to **getSimilarities**. Be sure not to use the **dotProduct** method with parameter **id** and itself!

- Write the public method named **getSimilarRatings**, which has three parameters: a String named **id** representing a rater ID, an integer named **numSimilarRaters**, and an integer named **minimalRaters**. This method should return an ArrayList of type Rating, of movies and their weighted average ratings using only the top **numSimilarRaters** with positive ratings and including only those movies that have at least **minimalRaters** ratings from those top raters. These Rating objects should be returned in sorted order by weighted average rating from largest to smallest ratings. This method is very much like the **getAverageRatings** method you have written previously. In particular this method should:
    - For every rater, get their similarity rating to the given parameter rater **id**. Include only those raters with positive similarity ratings—those that are more similar to rater **id**. Which method could you call?
    - For each movie, calculate a weighted average movie rating based on:
        - Use only the top (largest) **numSimilarRaters** raters.
        - For each of these raters, multiply their similarity rating by the rating they gave that movie. This will emphasize those raters who are closer to the rater **id**, since they have greater weights.
        - The weighted average movie rating for a particular movie is the sum of these weighted average ratings (for each rater multiply their similarity rating by their rating for the movie), divided by the total number of such ratings.
    - This method returns an ArrayList of Ratings for movies and their calculated weighted ratings, in sorted order.
- Write the public method **getSimilarRatingsByFilter**, which is similar to the **getSimilarRatings** method but has one additional Filter parameter named **filterCriteria** and uses that filter to access and rate only those movies that match the filter criteria.

- Add the following methods to the MovieRunnerSimilarRatings class.
    - Write a void method **printSimilarRatings** that has no parameters. This method creates a new FourthRatings object, reads data into the MovieDatabase and RaterDatabase, and then calls **getSimilarRatings** for a particular rater ID, a number for the top number of similar raters, and a number of minimal **rateSimilarRatings**, and then lists recommended movies and their similarity ratings. For example, using the files **ratedmoviesfull.csv** and **ratings.csv** and the rater ID 65, the number of minimal raters 5, and the number of top similar raters set to 20, the movie returned with the top rated average is “The Fault in Our Stars”.
    - Write a void method **printSimilarRatingsByGenre** that has no parameters. This method is similar to **printSimilarRatings** but also uses a genre filter and then lists recommended movies and their similarity ratings, and for each movie prints the movie and its similarity rating on one line and its genres on a separate line below it. For example, using the files **ratedmoviesfull.csv** and **ratings.csv**, the genre “Action”, the rater ID 65, the number of minimal raters set to 5, and the number of top similar raters set to 20, the movie returned with the top rated average is “Rush”.
    - Write a void method **printSimilarRatingsByDirector** that has no parameters. This method is similar to **printSimilarRatings** but also uses a director filter and then lists recommended movies and their similarity ratings, and for each movie prints the movie and its similarity rating on one line and its directors on a separate line below it. For example, using the files **ratedmoviesfull.csv** and **ratings.csv**, the directors “Clint Eastwood,Sydney Pollack,David Cronenberg,Oliver Stone”, the rater ID 1034, the number of minimal raters set to 3, and the number of top similar raters set to 10, the movie returned with the top rated average is “Unforgiven”.
    - Write a void method **printSimilarRatingsByGenreAndMinutes** that has no parameters. This method is similar to **printSimilarRatings** but also uses a genre filter and a minutes filter and then lists recommended movies and their similarity ratings, and for each movie prints the movie, its minutes, and its similarity rating on one line and its genres on a separate line below it. For example, using the files **ratedmoviesfull.csv** and **ratings.csv**, the genre “Adventure”, minutes

between 100 and 200 inclusive, the rater ID 65, the number of minimal raters set to 5, and the number of top similar raters set to 10, the movie returned with the top rated average is “Interstellar”.

- Write a void method **printSimilarRatingsByYearAfterAndMinutes** that has no parameters. This method is similar to **printSimilarRatings** but also uses a year-after filter and a minutes filter and then lists recommended movies and their similarity ratings, and for each movie prints the movie, its year, its minutes, and its similarity rating on one line. For example, using the files **ratedmoviesfull.csv** and **ratings.csv**, the year 2000, minutes between 80 and 100 inclusive, the rater ID 65, the number of minimal raters set to 5, and the number of top similar raters set to 10, the movie returned with the top rated average is “The Grand Budapest Hotel”.

Peer-graded Assignment: Step Five

Review criteria

You will submit your project by copying and pasting the link to the web page that runs your recommender. Reviewers will look at your project to confirm that all the required parts are complete.

Basic Requirements Checklist

- Does your program display a reasonable number of movies for the user to rate?
- Does your program successfully recommend at least one movie to the user?
- Does your program correctly display the results in an HTML table?

Instructions

For the last part of the capstone, you will integrate your recommender program with our course site. This will enable you to let a user run your program interactively on the internet. The user will be presented with a list of movies to rate, they will submit their ratings, and then a list of movies recommended for them by your program will be displayed.

You will be able to choose which movies the user is presented to rate, and how to display the recommended movies.

You will have to write a class that will allow the course site to run your recommender program, and then you will have to create a zip file of the code to be uploaded.

Write a Class

For this assignment you will be given one interface **Recommender**. You will have to write a class **RecommendationRunner** that implements **Recommender**. The two methods you will need to implement are:

- **getItemsToRate()**
- **printRecommendationsFor()**

When the user first visits the recommender site, our code will call the method **getItemsToRate()** to get a list of movies to display on the web page for users to rate.

After the user submits their ratings, our code will call the method **printRecommendationsFor()** to get your recommendations based on the user's ratings and display them.

Specifically, you should:

- Create a new class named **RecommendationRunner** that implements **Recommender**.
- Write the method **getItemsToRate()**. It returns a list of strings representing movie IDs that will be used to present movies to the user for them to rate.

  You can choose how to select movies for this list, for example, you could select recent movies, movies from a specific genre, randomly chosen movies, or something else.

  The movies returned by this method will be displayed on a web page, so the number of movies you choose to return may affect how long the page takes to load, and how willing users will be to rate the movies. 10-20 movies should be fine to get a good profile of the user's opinions, but 50 may be too many.
- Write the void method **printRecommendationsFor()**. It prints out an HTML table of movies recommended by your program for the user based on the movies they rated.
  It has one parameter **webRaterID**, a String that is the ID of the user, who has been added by our code to the **RaterDatabase** with the ratings they entered.
  To get the movies recommended by your program, you may want to use your **FourthRatings** class.
  Because the HTML printed by this method will be displayed on a webpage, the number of recommended movies you choose to display may affect how long the page takes to load.

  For example, you may want to display only the top 10-20 recommended movies, or to not include movies the user rated. In some rare cases there may not be any recommended movies, for example, if no movies were rated by the number of minimal raters specified in the recommender.

  If no movies are recommended, you should notify the user with a message. Whatever is printed by this method will be displayed on the web page: HTML, plain text, or debugging information.

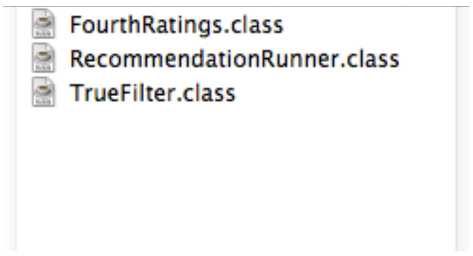
  If you want to style this HTML page, please include the CSS styling directly within the page using the **<style>** tag.

Create the zip file

To run your program on our course site, you will upload a single zip file containing some of your Java class files. You will need to include:

- **FourthRatings**
- **RecommendationRunner**
- Any other supporting classes you wrote and want to use (for example, if you use any of the filters you wrote, you will need to include them here).

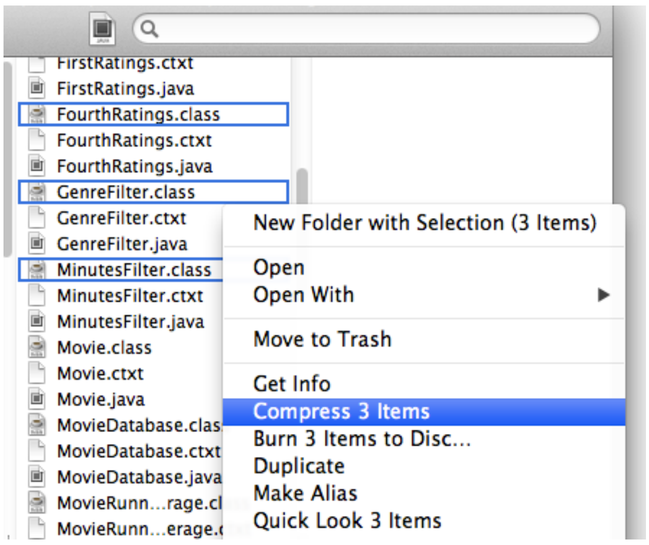
Note that you only need to include class files, not the original java files, so all files you include should have a .class extension. You do not need to include files we gave you such as **MovieDatabase**. Here is an example of the contents of the zip file:



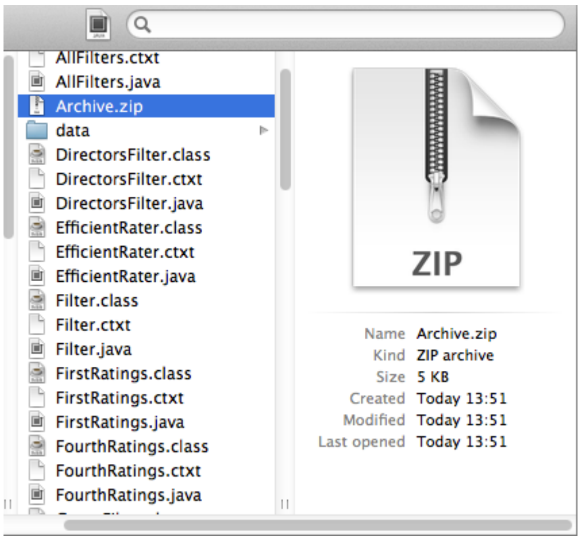
FourthRatings.class
RecommendationRunner.class
TrueFilter.class

In this case, the learner has chosen to include their **TrueFilter**. You may wish to include other filters you wrote.

To create a zip file on a Mac, select the files you would like to include in the zip file while holding the command key. Once you have selected all the files you would like to include, release the command key, and right-click on one of the selected items. You should see something like this:



Select ‘Compress n Items’ (n will be the number of items you have selected). You should now see a file Archive.zip in the same folder:



Name	Archive.zip
Kind	ZIP archive
Size	5 KB
Created	Today 13:51
Modified	Today 13:51
Last opened	Today 13:51

Run Your Code Online

To run your code online, upload your zip file at http://www.dukelearntoprogram.com/capstone/upload.php and press ‘Submit Code’. If there were no problems with your file, you should see a page with a link to click to run your program interactively.

Clicking this link calls the **getItemsToRate()** method, so you will see a page with movies to rate.
To share your program with others, copy the URL of this page with the list of movies to rate (not the upload page) and send it to whoever you would like to share your program with.