Version 1.0 16 May 2017

EH2745 Computer Applications for Power Systems

Assignment II

Overview

The purpose of Assignment II is to let you use the K-Nearest Neighbour algorithm to analyze a database from a sample power system. You will use the skills you have acquired in Java programming and Machine learning to implement the algorithm and solve this problem.

As well as in Assignment I, you are free to work on your own or in groups of two.

Assignment

A database of measurements has been developed from conducting power flow on a sample 9 bus system. The sample 9 bus system has been extracted from CIM XML. The data represents a number of different operational states in the system, these states are listed below.

- High load rate during peak hours
- Shut down of generator for maintenance
- Low load rate during night
- Disconnection of a line for maintenance

The data is made available to you as a relational database and can be downloaded from the KTH Social pages.

Task 1: k-Means Clustering

Develop a k-Means clustering algorithm and use it to identify the operational states in the database. Choose a suitable label for the states and link each cluster to one of the scenarios mentioned above with logical reason.

Task 2: k-NN Classification

Develop a Java application to identify a previously unknown state of the system based on voltage measurements using a k-NN algorithm. Validate the developed model with the Test Set. Also provided.

The assignment is graded as **Pass** by a group that submits a Java program in accordance with the requirements stated above.

To **Pass with distinction** and gain bonus points for the exam, the quality of the solution should exceed those requirements. Examples of factors that determine the quality of the solution are:

- Adherence to good programming style
- Flexibility of the program to allow other input data
- Presentation of results, and interaction with the program in a GUI

Database and ancillary documents

In Annex 1, the information about the 9 bus power system is provided to help you gain a better understanding of the system.

In Annex 2, the guide will show how to import the database to MySQL Workbench on your computers.

Submission of solutions

The screencast in which you present your solution shall be uploaded on youtube and you will provide us with link to it. It is necessary that in your screencast you run your code and show the results as a proof that your code is working.

June 13th 2017 at 23:59

In the screencast, each group member must present approximately 50% of the work. In addition, you are requested to upload the source code of your solution as an Eclipse archive on github.

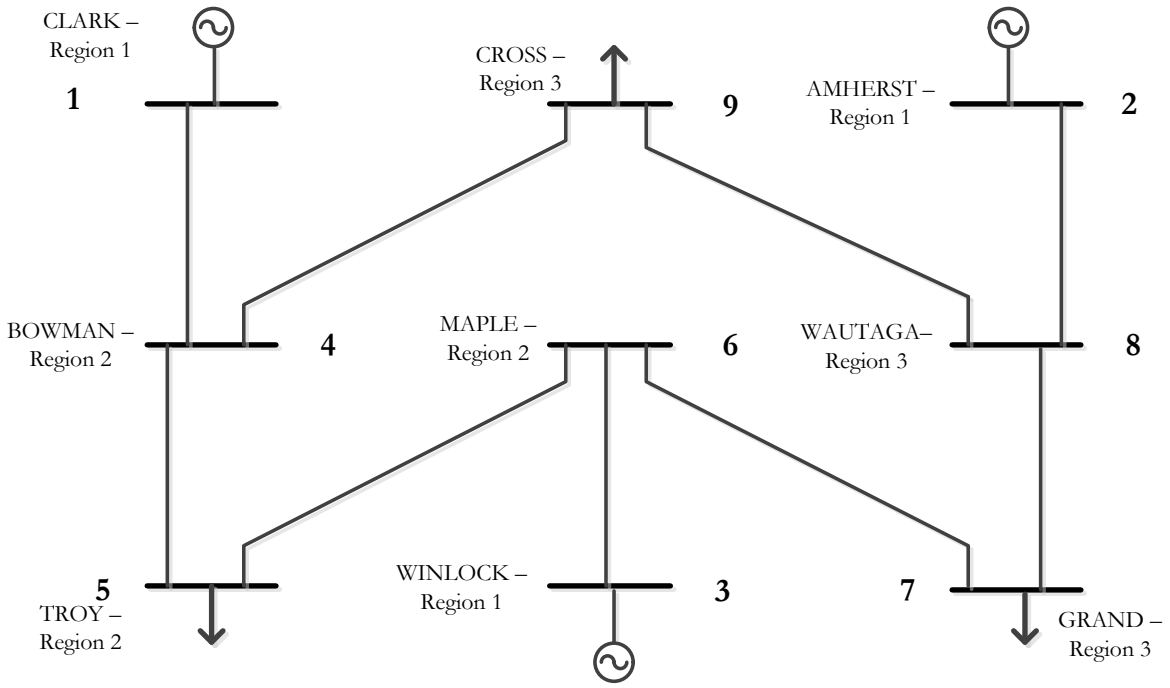
Also, with the source code, include a *1-2 page explanation* of how you identified and labeled the power system states.

References and plagiarism

Please note that when solving the assignments co-operation between students is allowed and even encouraged. However, the project groups are responsible for the content of their own program and plagiarism will result in an immediate failing of the assignment in addition to a written report to KTH's central disciplinary committee. This means that all groups should **write their own programs.** You are not allowed to source code from other groups and you are not allowed to copy source code from the internet.

Annex 1: Power System information

The single line diagram of the 9 bus system is shown below along with the active and reactive power of the load and generation busses. These are all the information you need regarding the power system. Unlike Assignment I, knowledge of line impedances or the y matrix is not needed.



Load Bus number	Active Power (Pd) (MW)	Reactive Power (Qd) (MVar)
5	90	30
7	100	35
9	125	50

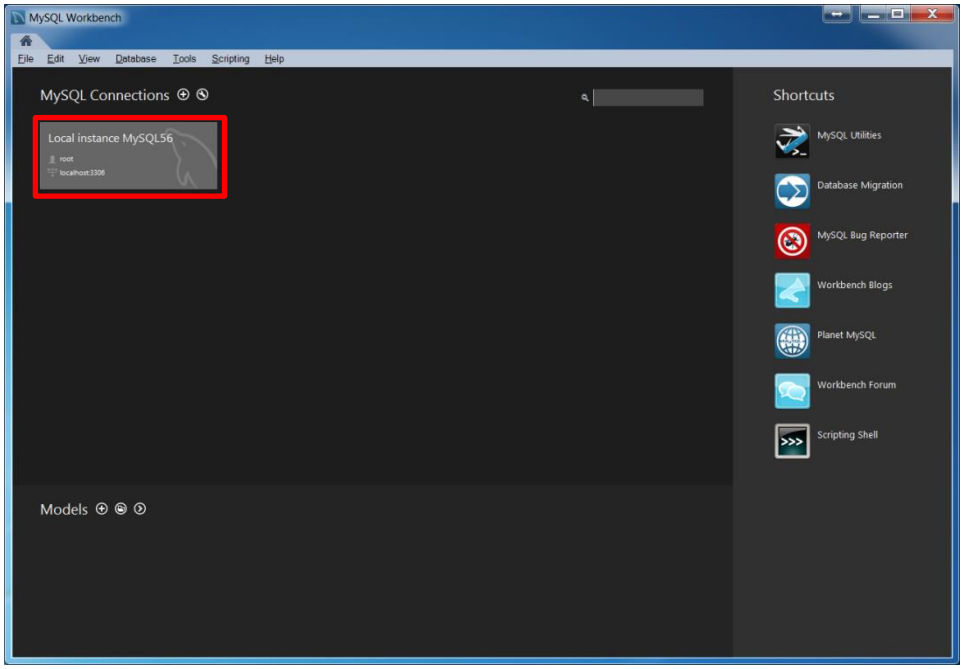
Generation Bus Number	Active Power (Pg) (MW)	Reactive Power (Qg) (MVar)
1	0	0
2	163	0
3	85	0

Bus 1 is the slack bus along with generation capable of supplying the system should another generation falls out of the operation.

Annex 2: SQL Data Import Guide

Follow the guide to successfully import the SQL file and create the database.

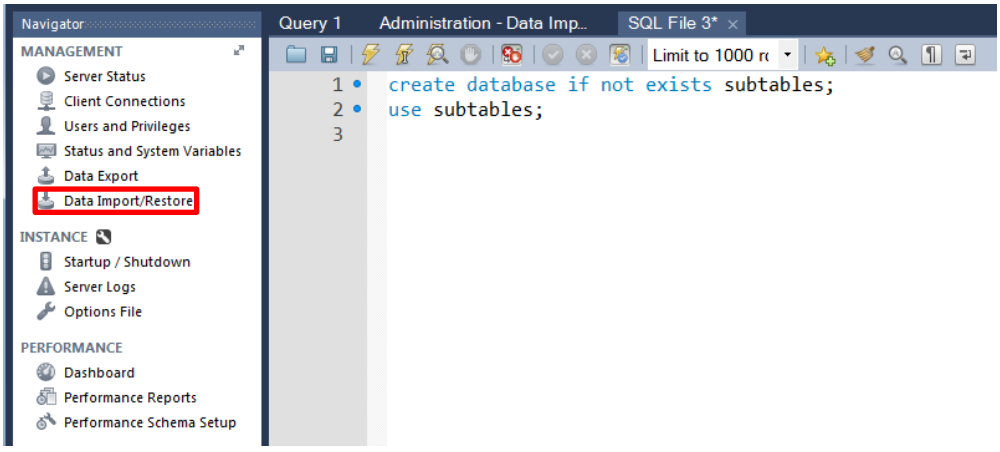
Step 1. Save the file "Assignment2_data.sql" to a folder on your PC.
Step 2. Start the MySQL Workbench and start your server.



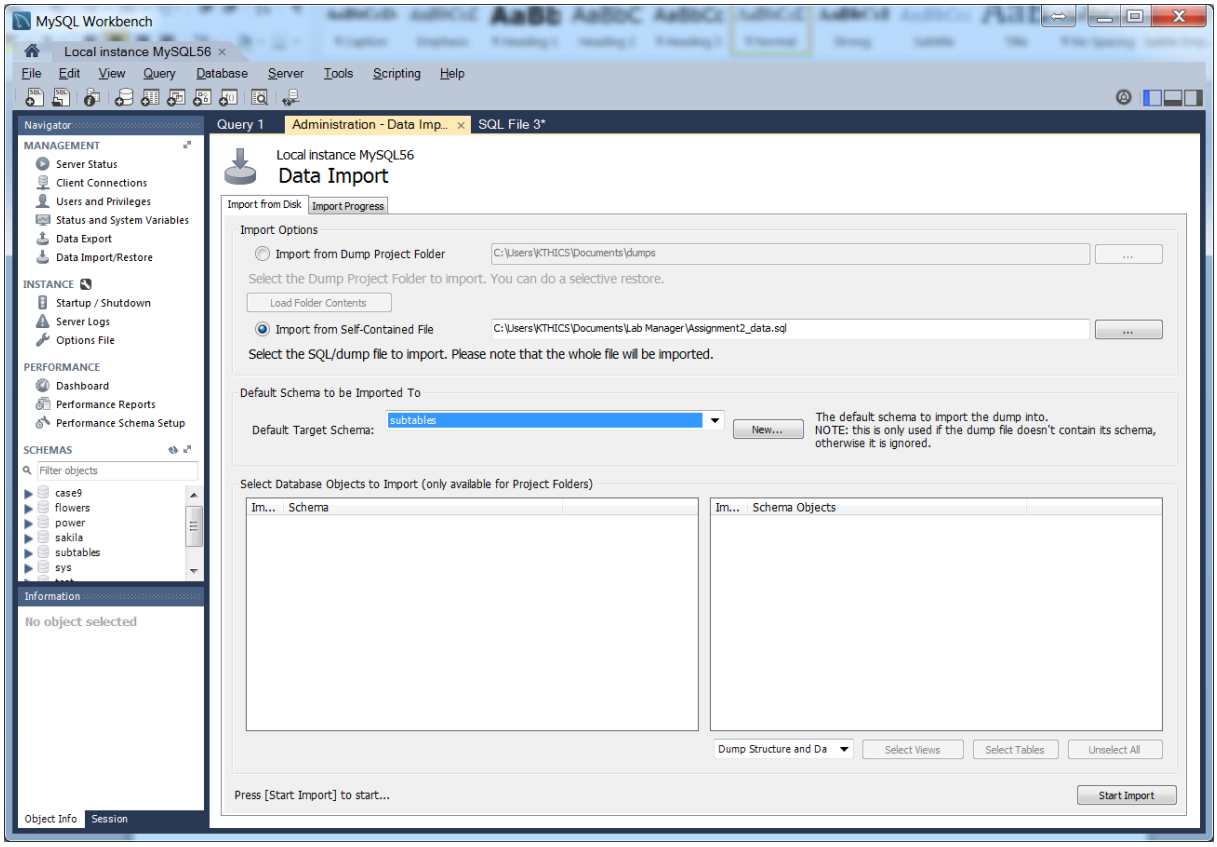
Step 3. Choose "New Query Tab" to write an SQL script. You have to create a separate database to store imported data. Write the following two lines and execute them.

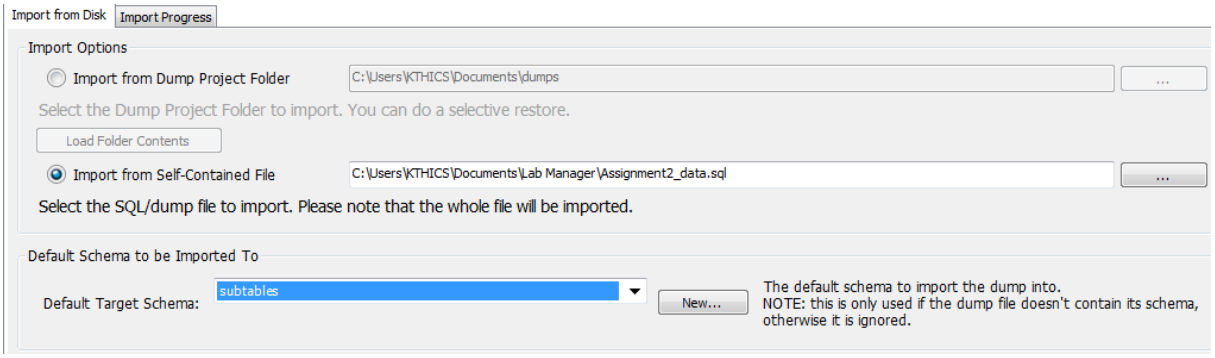
```
create database if not exists subtables;

use subtables;
```

"subtables" is the name of the database but a name of the database can be changed to any name so create one of your own choice. On the Navigator panel, choose "Data Import/ Restore".

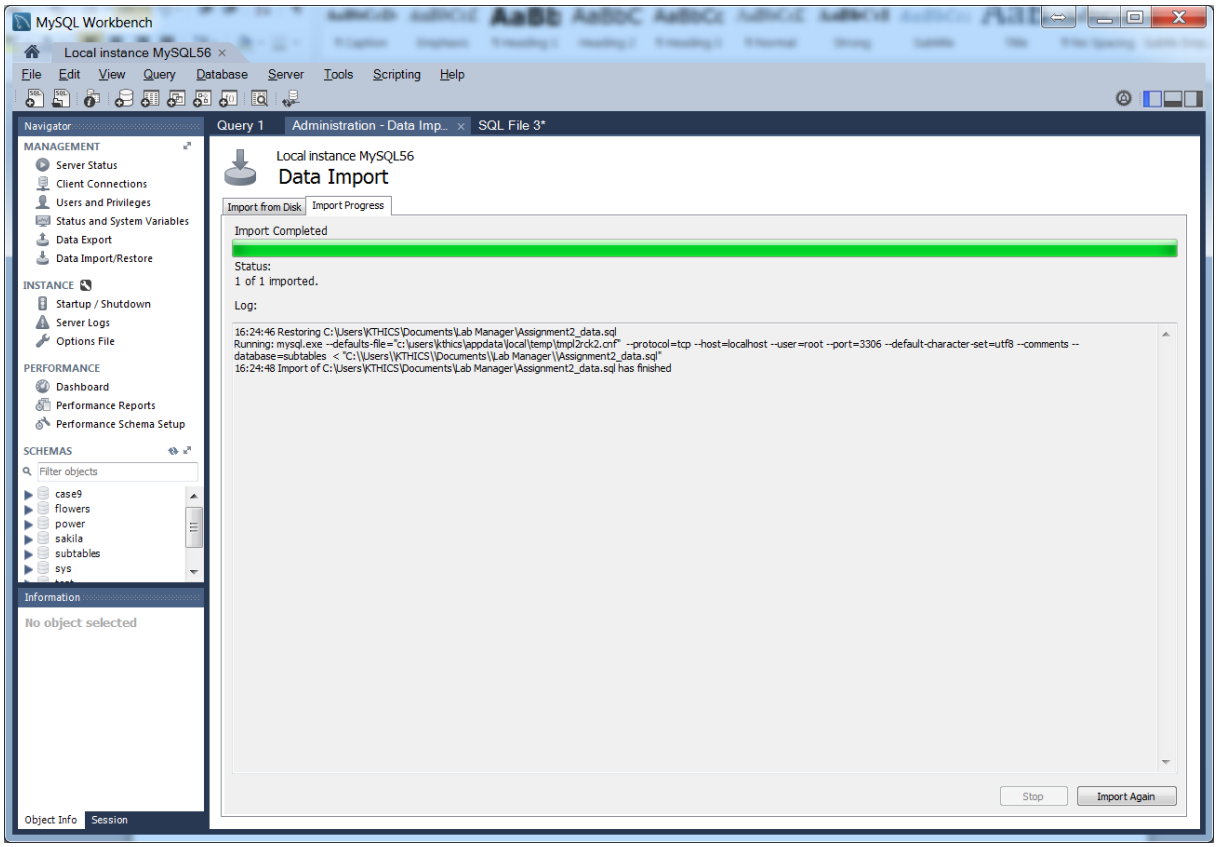


Step 4. Once the "Administration – Data Import" tab opens, choose "Import from Self-Contained File". Then click on the button next to the folder bar to choose the file you just saved. On the "Default Target Schema" section choose the database "subtables" or whatever database name you created in Step 3.



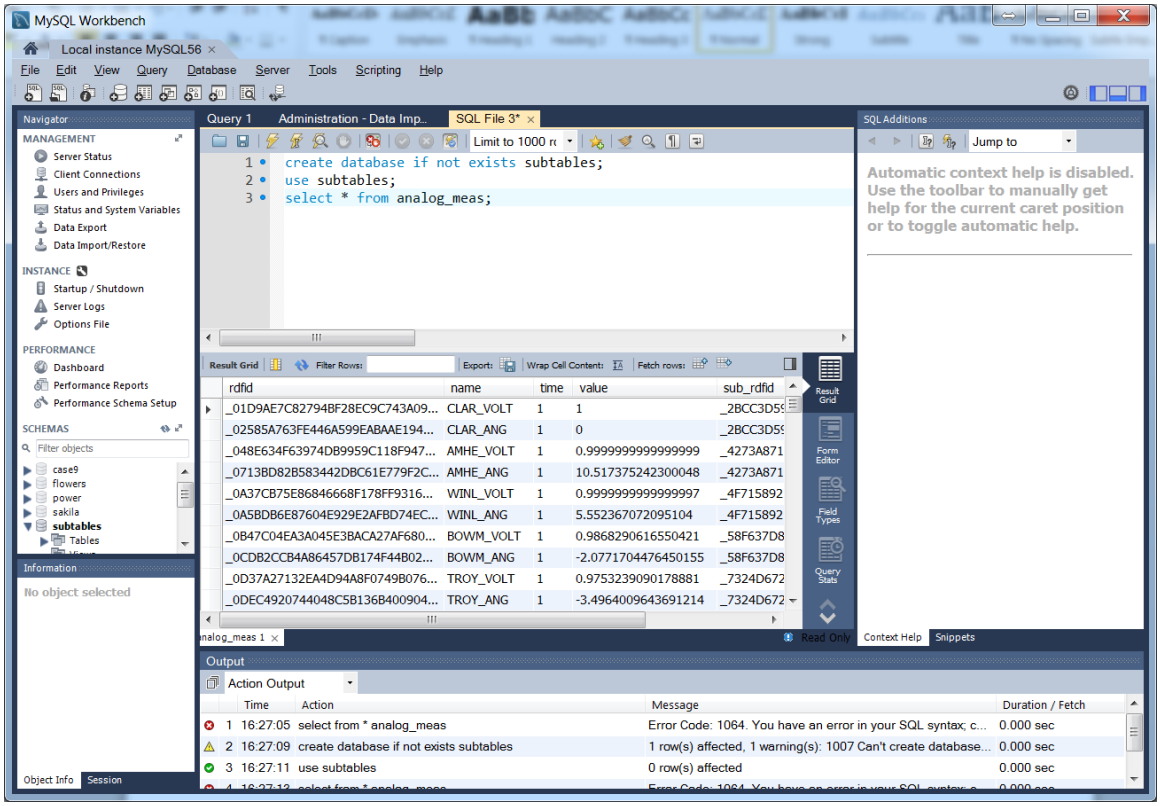


Step 5. Now click on "Start Import" on the bottom of the screen. If you see the message below, you have successfully imported the SQL database.



Step 6. In order to view the database, go back to the SQL script you made for "subtables" and just write the following line and execute it.

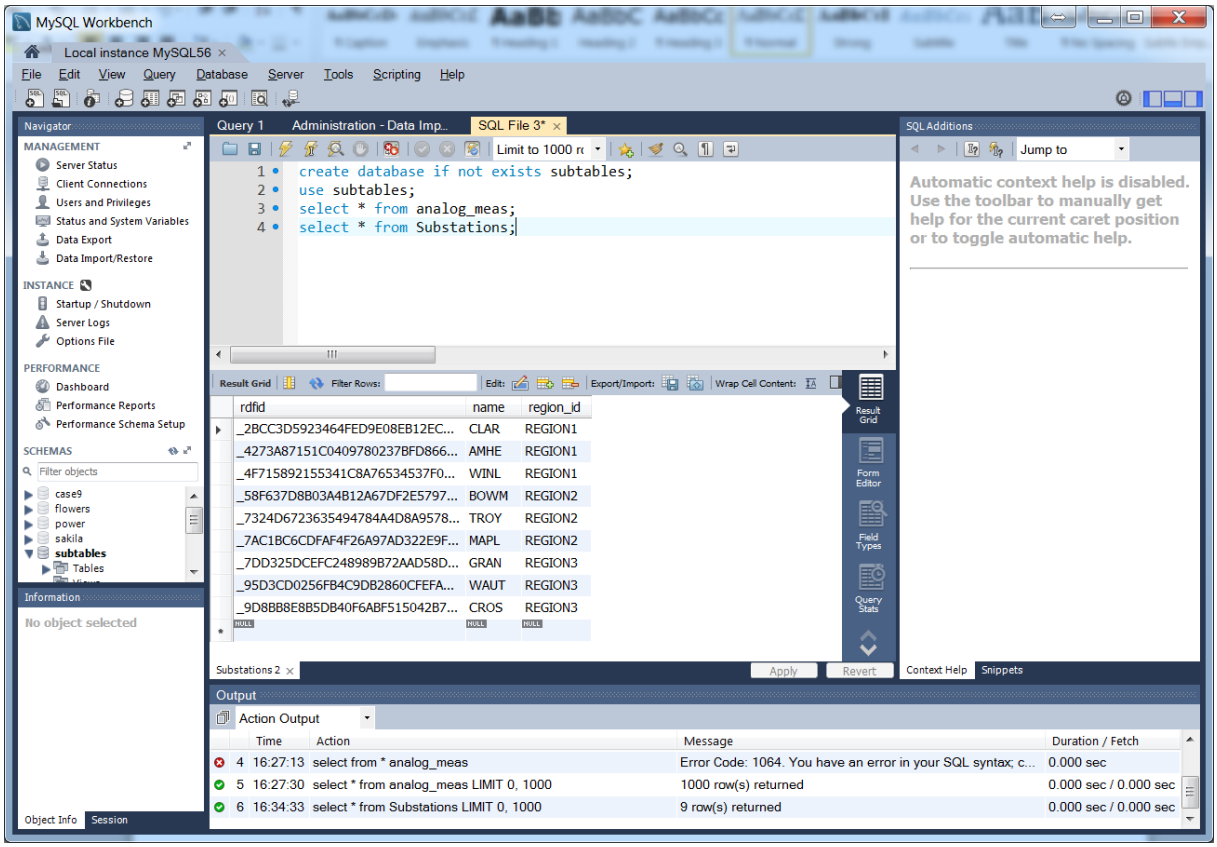
```
select * from analog_meas;
```



The first column of the table shows the rdf_ID of the voltage amplitude or angle associated with the current bus. The second column indicates what kind of measurement is being shown. Given that these are results from a power flow calculations, the measurements are related to voltage or angle. The third column shows the value of the voltage or angle. The last column is the rdf_ID of the substation (or bus in this case) from which the measurement is taken.

If you wish to view the information about the 9 bus (or 9 substation) just type the following line and execute.

```
select * from Substations;
```



Now you have all the information you need to complete the assignment. Good luck!