RMIT UNIVERSITY

Practical Data Science with Python
COSC 2670/2738
Assignment 3

	Assessment Type	Individual
	Due Date	23:59 on the 11th of June, 2023
	Marks	30

Please read this carefully before attempting

This is an *individual* assignment. You may not collude with any other people, or plagiarise their work. You are expected to present the results of your own thinking and writing. Never copy other student's work (even if they "explain it to you first") and never give your written work to others. Keep any conversation high-level and never show your solution to others. Never copy from the Web or any other resource. Remember you are meant to generate the solution to the questions by yourself. Suspected collusion or plagiarism will be dealt with according to RMIT policy.

In the submission (your PDF file) you will be required to certify that the submitted solution *represents your own work only* by agreeing to the following statement:

> *I certify that this is all my own original work. If I took any parts from elsewhere, then they were non-essential parts of the assignment, and they are clearly attributed in our submission. I will show I agree to this honor code by typing "Yes":*

Introduction

In this assignment, you are given a specific data science problem and one (more) potential solution(s). You are required to implement the (these) solution(s), then complete the required tasks (as detailed below) successfully.

The "Practical Data Science" Canvas contains further announcements and a discussion board for this assignment. Please be sure to check these on a regular basis – it is your responsibility to stay informed with regards to any announcements or changes. Login through https://rmit.instructure.com/.

Where to Develop Your Code

You are encouraged to develop and test your code in the following environments: **Jupyter Notebook on Lab PCs**. (Or please use the Anaconda version as specified in the course announcement)

Jupyter Notebook on Lab PCs

On Lab Computer, you can find Jupyter Notebook via:

Start → All Programs → Jupyter Notebook - Anaconda

Then,

- Select New → Python 3
- The new created '*.ipynd' is created at the following location:
  - C:\Users\sXXXXXXX
  - where sXXXXXXX should be replaced with a string consisting of the letter "s" followed by your student number.

Academic integrity and plagiarism (standard warning)

Academic integrity is about honest presentation of your academic work. It means acknowledging the work of others while developing your own insights, knowledge and ideas. You should take extreme care that you have:

- Acknowledged words, data, diagrams, models, frameworks and/or ideas of others you have quoted (i.e. directly copied), summarised, paraphrased, discussed or mentioned in your assessment through the appropriate referencing methods
- Provided a reference list of the publication details so your reader can locate the source if necessary. This includes material taken from Internet sites. If you do not acknowledge the sources of your material, you may be accused of plagiarism because you have passed off the work and ideas of another person without appropriate referencing, as if they were your own.

RMIT University treats plagiarism as a very serious offence constituting misconduct. Plagiarism covers a variety of inappropriate behaviours, including:

- Failure to properly document a source
- Copyright material from the internet or databases
- Collusion between students

For further information on our policies and procedures, please refer to the following: https://www.rmit.edu.au/students/student-essentials/rights-and-responsibilities/academic-integrity.

General Requirements

This section contains information about the general requirements that your assignment must meet. *Please read all requirements carefully before you start.*

- You *must* include a plain text file called "readme.txt" with your submission. This file should include your name and student ID, and instructions for how to execute your submitted script files. This is important as *automation* is part of the 6th step of data science process, and will be assessed strictly.
- Please ensure that your submission follows the file naming rules specified in the tasks below. File names are case sensitive, i.e. if it is specified that the file name is `gryphon`, then that is exactly the file name you should submit; `Gryphon`, `GRYPHON`, `griffin`, and anything else but `gryphon` will be rejected.

Overview

Besides k nearest neighbour (KNN) based Collaborative Filtering, there is another well-known Collaborative Filtering method, named *Slope One*. Please find the details about *Slope One* in the report "Slope One Predictors for Online Rating-Based Collaborative Filtering", which is available in this assignment zip file.

In this assignment, you are required to combine the neighbourhood concept with Slope One scheme so as to improve recommendation quality. Specifically, you are required to implement a personalised weighted slope one method by introducing user similarity into *Weighted Slope One* method/scheme. This can be achieved by the following steps:

- Step 1: Read the report "Slope One Predictors for Online Rating-Based Collaborative Filtering" carefully, and especially pay attention to the *Weighted Slope One* Scheme. Note that we will use the math notations defined in this report in this assignment.
- Step 2: Replace the $dev_{j,i}$ definition in Section 3.4 of the given report (named "Slope One Predictors for Online Rating-Based Collaborative Filtering") as follows:

$$dev_{j,i} = \lambda \sum_{u \in S_{j,i}(\chi)} \frac{u_j - u_i}{card(S_{j,i}(\chi))} + (1-\lambda) \frac{\sum_{u \in S_{j,i}(\chi)} ((u_j - u_i) \cdot exp(sim(u,u')))}{\sum_{u \in S_{j,i}(\chi)} (exp(sim(u,u')) \cdot card(S_{j,i}(\chi)))}, \tag{1}$$

  where λ is a pre-defined parameter between 0 and 1, $S_{j,i}(\chi)$ denotes the set of all evaluations $u \in \chi$ such that they contain item i and j ($i \in S(u)$ and $j \in S(u)$), $exp()$ is the Exponential functions with bases 2, u' denotes the active user to whom we are making recommendation predictions, $sim(u,u')$ denotes the Centered Cosine Similarity between user u and u' as we defined in our course, and $\cdot$ denotes multiplication.
- Step 3: Finally, for the active user u', the prediction of his/her raring on item j in this personalised weighted slope one method is defined as follows:

$$P^{pwSl}(u')_j = \frac{\sum_{i \in S(u') - \{j\}} ((dev_{j,i} + u'_i) c_{j,i})}{\sum_{i \in S(u') - \{j\}} c_{j,i}}, \tag{2}$$

  where $c_{j,i} = card(S_{j,i}(\chi))$, and $i \in S(u') - \{j\}$ denotes the item i belongs to the set of items rated by u' (which is denoted as $S(u')$) but removing item j (which is the item we are trying to make prediction for this active user u' in this equation).

After completing these three steps, a personalised weighted slope one method is achieved, which would produce better recommendations than the Weighted Slope One method-/scheme in the given report.

Tasks

Task 1: Implementation

In this task, you are required to implement the above personalised weighted slope one method.

Note, you are required to implement your own implementation, and please do not use any other libraries that are related to Recommender Systems or Collaborative Filtering. If you use any of these libraries, your implementation part will be invalid.

We provide Python framework code (named *assignment3_framework.ipynb*) to help you get started, and this will also automate the correctness marking. The framework also includes the training data and the test data.

Please read the comments in the provided assignment framework carefully, and only put your own code in the provided cell as indicated (also as shown in Figure 1). Please DO NOT CHANGE anything else in the rest cells of the framework, otherwise they might cause errors during the automatic marking and make your submission invalid.

```
# Write your code here
# You are required to implement the required solution here.
# Then, evaluate your implementation by predicting the ratings in the test set (test_ds).
# Finally, save the corresponding MAE and RMSE of your implementation
# into the following defined corresponding variable.

MAE = 0 # 0 is an intial value, you need to update this with the actual perofrmance of your implementation.
RMSE = 0 # 0 is an intial value, you need to update this with the actual perofrmance of your implementation.
```

Figure 1: Where to put your implementation in the provided framework (*assignment3_framework.ipynb*)

Please provide detailed comments to explain your implementation. To what level of details should you provide in your solution? Please take the comments in the *ipynb* files in Week 10 (*knn_based_cf_updated.zip*) as examples for the level of detailed comments you are expected to put for your solution.

You might find the following information uesful:

- https://www.w3schools.com/python/python_comments.asp
- https://numpy.org/doc/stable/reference/generated/numpy.exp2.html#numpy.exp2

Task 2: Presentation

- The presentation should
  - Explain how the *Slope One Scheme* works by using your own language clearly and completely.
  - Explain why the *Weighted Slope One Scheme* works by using your own language clearly and completely.
  - Explain and discuss how the parameter λ affects the performance of the personalised weighted Slope One method clearly and completely.
- The presentation should be no more than 10 minutes.

- Your presentation slides should be:
  - Microsoft PowerPoint slides (with audio inserted for each slide by using: `Insert` $->$ `Audio` $->$ `Record Audio`).
  - or you can create your own presentation slides (e.g. PDF version) and please submit your own recording (in the format of mp4 or avi) of your presentation as well.

What to Submit, When, and How

The assignment is due at

23:59 on the 11th of June, 2023.

Assignments submitted after this time will be subject to standard late submission penalties.

The following files should be submitted:

- Notebook file containing your python implementation, 'Assignment3_framework.ipynb'.

For the notebook file, follow these steps before submission:

1. Main menu → Kernel → Restart & Run All
2. Wait till you see the output displayed properly. You should see all the data printed and graphs displayed.

- One of the following:
  - Your `Slides.pdf` file and your presentation recording in the required format. Or,
  - Your Microsoft PowerPoint slides (with audio inserted for each slide).
- The "readme.txt": includes your name and student ID, and instructions for how to execute your submitted script files.
- Please note: there is no need to submit the data sets, as you are not allowed to change them.

They must be submitted as ONE single zip file, named as your student number (for example, 1234567.zip if your student ID is s1234567). The zip file must be submitted in Canvas:

Assignments/Assignment 3.

Please do NOT submit other unnecessary files.