CSE 158/258, DSC 256, MGTA 461, Fall 2023: Homework 3

Instructions

Please submit your solution **by Monday, Nov 13.** Submissions should be made on **gradescope**. Please complete homework **individually**.

These homework exercises are intended to help you get started on potential solutions to Assignment 1. We'll work directly with the Assignment 1 dataset to complete them, which is available from:
`http://cseweb.ucsd.edu/classes/fa23/cse258-a/files/assignment1.tar.gz`

You'll probably want to implement your solution by **modifying the baseline code provided** in the assignment directory.

You should submit two files:

`answers_hw3.txt` should contain a python dictionary containing your answers to each question. Its format should be like the following:

```
{ "Q1": 1.5, "Q2": [3,5,17,8], "Q2": "b", (etc.) }
```

The provided code stub demonstrates how to prepare your answers and includes an answer template for each question.

`homework3.py` A python file containing working code for your solutions. The autograder *will not execute your code*; this file is required so that we can assign partial grades in the event of incorrect solutions, check for plagiarism, etc. Your solution should **clearly document which sections correspond to each question and answer**. We may occasionally run code to confirm that your outputs match submitted answers, so **please ensure that your code generates the submitted answers.**

You may build your solution on top of the provided stub:

Homework 3 stub : `https://cseweb.ucsd.edu/classes/fa23/cse258-a/stubs/`

Each question is worth 1 mark.

Play prediction

Since we don't have access to the test labels, we'll need to simulate validation/test sets of our own.

So, let's split the training data ('train.json.gz') as follows:
(1) Reviews 1-165,000 for training
(2) Reviews 165,001-175,000 for validation
(3) Upload to gradescope for testing only when you have a good model on the validation set.

1. Although we have built a validation set, it only consists of positive samples. For this task we also need examples of user/item pairs that *weren't* played. For each entry (user,game) in the validation set, sample a negative entry by randomly choosing a game that user *hasn't* played.[1] Evaluate the performance (accuracy) of the baseline model on the validation set you have built (1 mark).

2. The existing 'played prediction' baseline just returns *True* if the item in question is 'popular,' using a threshold of the 50th percentile of popularity (`totalPlayed/2`). Assuming that the 'non-played' test examples are a random sample of user-game pairs, this threshold may not be the best one. See if you can find a better threshold and report its performance on your validation set (1 mark).

3. A stronger baseline than the one provided might make use of the Jaccard similarity (or another similarity metric).[2] Given a pair (u, g) in the validation set, consider all training items g' that user u has played. For each, compute the Jaccard similarity between g and g', i.e., users (in the training set) who have played g and users who have played g'. Predict as 'played' if the *maximum* of these Jaccard similarities exceeds a threshold (you may choose the threshold that works best). Report the performance on your validation set (1 mark).

[1] This is how I constructed the test set; a good solution should mimic this procedure as closely as possible so that your gradescope performance is close to their validation performance.

[2] Depending on the dataset, in practice this baseline is not always stronger than the one from Question 2.

4. Improve the above predictor by incorporating both a Jaccard-based threshold *and* a popularity based threshold. Report the performance on your validation set.[3]

5. To run our model on the *test* set, we'll have to use the files 'pairs_Played.txt' to find the reviewerID/itemID pairs about which we have to make predictions. Using that data, run the above model and upload your solution to the Assignment 1 gradescope. If you've already uploaded a better solution to gradescope, that's fine too!

Time played prediction

Let's start by building our training/validation sets much as we did for the first task. This time building a validation set is more straightforward: you can simply use part of the data for validation, and do not need to randomly sample non-played users/games.

Note that you should use the `time_transformed` field, which is computed as $\log_2(\text{time played} + 1)$. **This is the quantity we are trying to predict.**

6. Fit a predictor of the form

$$\text{time}(\text{user}, \text{item}) \simeq \alpha + \beta_{\text{user}} + \beta_{\text{item}},$$

by fitting the mean and the two bias terms as described in the lecture notes. Use a regularization parameter of $\lambda = 1$. Report the MSE on the validation set.

7. Report the user and game IDs that have the largest and smallest values of β.

8. Find a better value of λ using your validation set. Report the value you chose, its MSE, and upload your solution to the Assignment 1 gradescope.

[3]This could be further improved by treating the two values as features in a classifier — the classifier would then determine the thresholds for you!