CS 247 : Advanced Data Mining Learning **(Due: 11:59 pm 06/13/19)**

Homework Assignment #5

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Homework Policy:

- Read the ***Homework Submission Guidance*** carefully before you start working on the assignment, and before you make a submission.
- This is an individual homework. Please **DO NOT** collaborate with others.
- Write your answers in a **pdf** (typeset by LaTeX) and submit it to Gradescope.

Problem 1: Explicit Feedback Recommendation

1. Consider matrix factorization for explicit feedback recommendation task, the objective function could be defined as the square loss of predicted rating and the ground truth rating over every nonempty entry in the rating matrix, plus the regularization terms over the parameters, as stated in Page 25 in Slides 09. Bias terms over different users and items can be further added to the objective function, as stated in Page 28 of Slides 09. Please derive the stochastic gradient descent solution to the objective function with bias terms.
2. Implement both versions (with or without bias terms) of matrix factorization, and test on the provided dataset. Evaluate and compare the performance using RMSE and MAE. The dataset you will use is the MovieLens-1M dataset. Please see the details in the Jupyter-Notebook as usual.

Problem 2: Implicit Feedback Recommendation

1. Consider matrix factorization for implicit feedback recommendation task, derive the stochastic gradient descent solution to (1) logistic MF and (2) Bayesian Ranking approach (please add regularization terms on both approaches).
2. Implement both algorithms, and test over the provided dataset. Evaluate and compare the performance using Precision@5 and MRR. For this task, we will still use the MovieLens-1M dataset. Instead of treating the rating as an actually degree of likeness, we consider a "rate" as a "like" in the domain of implicit feedback recommendation.

Problem 3: Neural Network Interpretation of Collaborative Filtering

1. Interpret matrix factorization for explicit feedback recommendation (without bias) in a neural network framework. (Hint: treat each user and each item as one hot encoding vector.)
2. Inspired by previous interpretation, what if we have content information for items (e.g., text for news articles)? How can we revise the previous neural network architecture to incorporate the content information for items?