Habib University
CSE 351 - Artificial Intelligence
Fall' 2019
Assignment 3

25 Points

Objective:

The objective of this assignment is to make student better understand the working of a collaborative filtering system to make recommendations. Students will gain hands-on experience of using gradient descent to perform matrix factorization.

You are implementing collaborative filtering to make recommendations to users U for items I. You decided to use a model based approach that applies matrix factorization to factorize a rating matrix (R) into User features (P) and Item features (Q) such that,

$$P \times Q = \hat{R} \cong R$$

where P is a $m \times k$ matrix and Q is $k \times n$ matrix and m, n and k represent no. of users, no. of items and no. of latent features respectively.

The predicted rating of an item j by user i is calculated as follows:

$$\hat{r}_{ij} = \sum_{k} p_{ik} q_{kj}$$

and error in this prediction is calculated as:

$$e_{ij}^2 = (r_{ij} - \sum_{k} p_{ik} q_{kj})^2$$

Q1.1 – Computing gradients [5 points]

You are applying gradient descent to minimize mean square error. Compute gradients and derive formulas to update p and q values.

Q1.2 - Adding biases [5 points]

There can be biases in user and item recommendations, which are handled by introducing user bias vector (bU) and item bias vector (bI). In the presence of these biases, rating r_{ij} is predicted as follows:

$$\hat{r}_{ij} = bu_i + bi_j + \sum_{k} p_{ik} q_{kj}$$

Derive formulas to update p, q, and biases during gradient descent.

Q 2 – Factorizing matrices using gradient descent [15 points]

In this question, you will implement gradient descent technique to perform matrix factorization. The code will be written in the attached python file (Ass3.py) that provides basic skeleton of your program.

Submission Instructions

Submissions will be made on LMS by the due date (announced on LMS). No email submission will be accepted. The submitted file should be in the form of a ZIP file named as **<studentid>_Ass3** containing a pdf document for Q1 and python code for Q2.