**Due Date**: December 6th 2021 at 23:59.

**Part 1 – Stochastic Gradient Descent:**

1) Write the objective of a regression model with global bias, user bias, item bias and L2 regularization.
2) Write the update step for each parameter.
3) Write a pseudo code for the algorithm.
4) What hyper-parameters do you need to tune?
5) Explain how would you work with the validation set and how would you check for convergence?
6) How would you train the last \ best model?
7) Implement a SGD solution for the model and train it using the training and validation data. Explain the main work items you had to take.
8) What is the RMSE, MAE, R^2 and MPR (Mean Percentile Rank) of your model based on the validation set?
9) Submit the test result file according to the following instructions:
    a. The name of the file should be made from the student ID numbers separated with an underline. E.g., A_<id1>_<id2>_<id3>.csv
    b. The file content should be CSV in the same order as the test file you received and using the following format:
    User_ID_Alias, Movie_ID_Alias, Rating
    c. The report and the results should be emailed to: amitshreiber@mail.tau.ac.il

**Part 2 – Alternating Least Squares:**

1) Write the objective of a regression model with global bias, user bias, item bias and L2 regularization. Is there any difference from the SGD objective?
2) Write the update step for each parameter.
3) Write a pseudo code for the algorithm.
4) What hyper-parameters do you need to tune?
5) Explain how would you work with the validation set and how would you check for convergence?
6) Implement an ALS solution for the model and train it using the training and validation data. Explain the main work items you had to take.
7) What is the RMSE, MAE, R^2 and MPR (Mean Percentile Rank) of your model based on the validation set?
8) Compare the ALS and SGD solutions in terms of implementation, training and quality.
9) Submit the test result file according to the following instructions:
    a. The name of the file should be made from the student ID numbers separated with an underline. E.g., B_<id1>_<id2>_<id3>.csv
    b. The file content should be CSV in the same order as the test file you received and using the following format:
    User_ID_Alias, Movie_ID_Alias, Rating
    c. The report and the results should be emailed to: amitshreiber@mail.tau.ac.il