**Question(1.1):**

Let **P** and **Q** be the user-feature and movie-feature matrix, respectively.

Let,

Where, **R’** is our approximation for the given user rating matrix, **R**.

We define error at, i-th row and j-th column as,

**=** Our prediction for the value at ith-row and j-th column.

Could also be re-written as,

Where, the dot () is dot product operator. Replacing this in eq(1),

We now calculate, the calculate partial derivatives wrt each variable.

Now, to update values, we move in the direction specified,

i.e.

new\_value = current\_value – (learning\_rate \* direction of maximum change)

**Question(1.2):**

Now we introduce the bias vectors to our prediction. The updation formulae for Pi and Qj remain the same, while now we have updation terms for each bias vector.