In [61]:
```
# ISMET OKAN CELIK CWID:10472265
# Homework-6
```

In [62]:
```
import numpy as np

def matrix_factor(R, P, Q, K, steps, alpha, beta):
    for step in range(steps):
        for i in range(len(R)):
            for j in range(len(R[i])):
                if R[i][j] > 0:

                    error = R[i][j] - np.dot(P[i,:],Q[:,j])

                    for k in range(K):

                        Gradient1=(2 * error * Q[k][j] - beta * P[i][k])
                        Gradient2=(2 * error * P[i][k] - beta * Q[k][j])

                        P[i][k] = P[i][k] + alpha * Gradient1
                        Q[k][j] = Q[k][j] + alpha * Gradient2

    return np.dot(P,Q)
```

In [63]:
```
R=np.array([[5,3,0,1],
            [4,0,0,1],
            [1,1,0,5],
            [1,0,0,4],
            [0,1,5,4]])

nRow, nCol =np.shape(R)

K=2
P=np.random.rand(nRow,K)
Q=np.random.rand(K,nCol)

steps=5000
alpha=0.0002
beta=0.02
matrix_factor(R,P,Q,K,steps,alpha,beta)
```

Out[63]:
```
array([[4.98976305, 2.95093245, 3.70203646, 0.99907555],
       [3.96804363, 2.35676043, 3.14660231, 0.99731205],
       [1.05719027, 0.86114526, 5.53108792, 4.96318513],
       [0.97098939, 0.76185735, 4.49517705, 3.97299093],
       [1.66532768, 1.16841793, 4.92845397, 4.0300615 ]])
```

In [64]:
```
R=np.array([[4,3,0,1,2],
            [5,0,0,1,0],
            [1,2,1,5,4],
            [1,0,0,4,0],
            [0,1,5,4,0],
            [5,5,0,0,1]])

nRow, nCol =np.shape(R)

K=3
P=np.random.rand(nRow,K)
Q=np.random.rand(K,nCol)

steps=10000
alpha=0.0002
beta=0.02

matrix_factor(R, P, Q, K, steps, alpha, beta)
```

Out[64]:
```
array([[4.09241401, 2.85254863, 6.90775411, 1.08065887, 1.92029413],
       [4.96908051, 3.0748195 , 8.49080371, 0.97922711, 2.44811033],
       [0.99895706, 1.91978895, 1.03585545, 5.0111664 , 3.95609685],
       [1.01478272, 2.04082935, 1.13388427, 3.96604277, 2.73943112],
       [2.99102884, 1.08895343, 4.96054206, 3.94856785, 5.88043597],
       [4.91536202, 5.05241476, 7.93041823, 1.94434475, 1.04206555]])
```