

### Question 1:

To find  $P(r_{i2}=1 \mid X)$ :

$$P(X \mid r_{i2}=1) = P(r_{i2}=2 \mid r_{i2}=1) \times P(r_{i3}=1 \mid r_{i2}=1) \times P(r_{i4}=2 \mid r_{i2}=1)$$

$$P(X \mid r_{i2}=1) = \frac{0+0.01}{1+0.02} * \frac{1+0.01}{1+0.02} * \frac{0+0.01}{1+0.02} = 0.00009$$

$$P(r_{i2}=1) = \frac{1+0.01}{2+0.02} = 0.5$$

$$P(r_{i2}=1 \mid X) = 0.000045$$

### Question 2:

Normalized features:

	F1	F2	F3
P1	1	1	1
P2	0	0.952	1
R	1	0.823	0.96

$$\text{Sim}(\text{RF1}, \text{P1F1}) = 1 - |1-1| = 1, \text{Sim}(\text{RF2}, \text{P1F2}) = 1 - |0.823-1| = 0.823, \text{Sim}(\text{RF3}, \text{P1F3}) = 1 - |0.96-1| = 0.96$$

$$\text{Sim}(\text{RF1}, \text{P2F1}) = 1 - |1-0| = 0, \text{Sim}(\text{RF2}, \text{P2F2}) = 1 - |0.823-0.952| = 0.871, \text{Sim}(\text{RF3}, \text{P2F3}) = 1 - |0.96-1| = 0.96$$

$$\text{Sim}(\text{R}, \text{P1}) = \frac{1*1+2*0.823+1.5*0.96}{1+2+1.5} = 0.908$$

$$\text{Sim}(\text{R}, \text{P2}) = \frac{1*0+2*0.871+1.5*0.96}{1+2+1.5} = 0.707$$

**Property 1** will be recommended.

### Question 3:

- No. Because one or more of the products given by the factors do not match the corresponding interaction value in the original matrix.
- Yes. It suffers from cold start user problem since for a user with zero historical data, the appropriate values in the factorized matrices cannot be found unless a large error tolerance is accepted (highly uncommon).

### Question 4:

$$h1 = (0.5 \times 0.5) + (0.6 \times 0.6) + (0.8 \times 0.7) = 1.29$$

$$h2 = (0.5 \times 0.5) + (0.7 \times 0.8) + (0.8 \times 0.7) = 1.37$$

$$h3 = (0.6 \times 0.5) + (0.7 \times 0.8) + (0.9 \times 0.7) = 1.49$$

$$o1 = (0.5 \times 1.29) + (0.6 \times 1.37) + (0.8 \times 1.49) = 2.66$$

$$o2 = (0.5 \times 1.29) + (0.7 \times 1.37) + (0.8 \times 1.49) = 2.80$$

$$o3 = (0.6 \times 1.29) + (0.7 \times 1.37) + (0.9 \times 1.49) = 3.07$$

Predicted rating will be **3** since **o3** produces the highest value after this forward pass.

... EOF ...