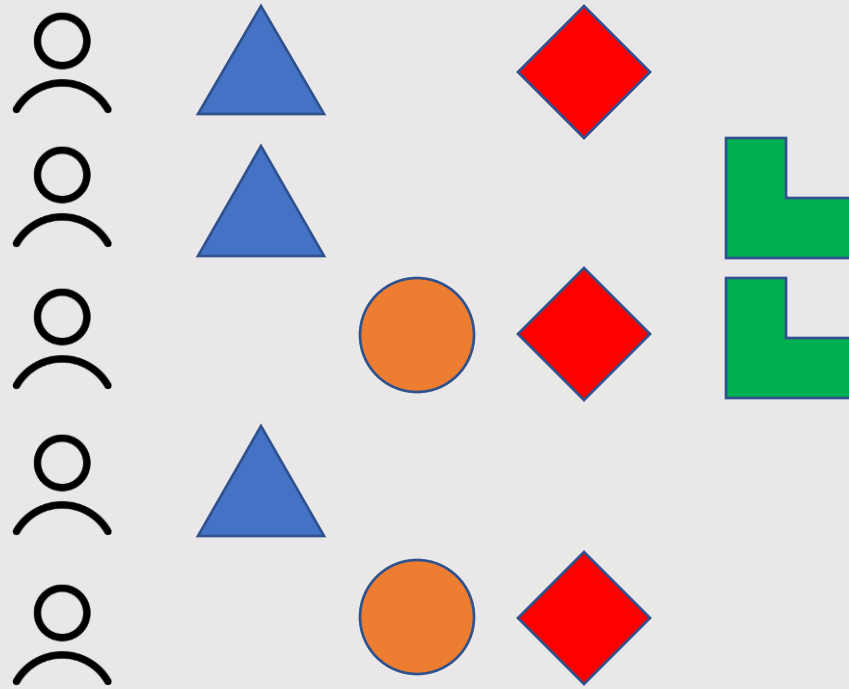


How are recommendations computed?

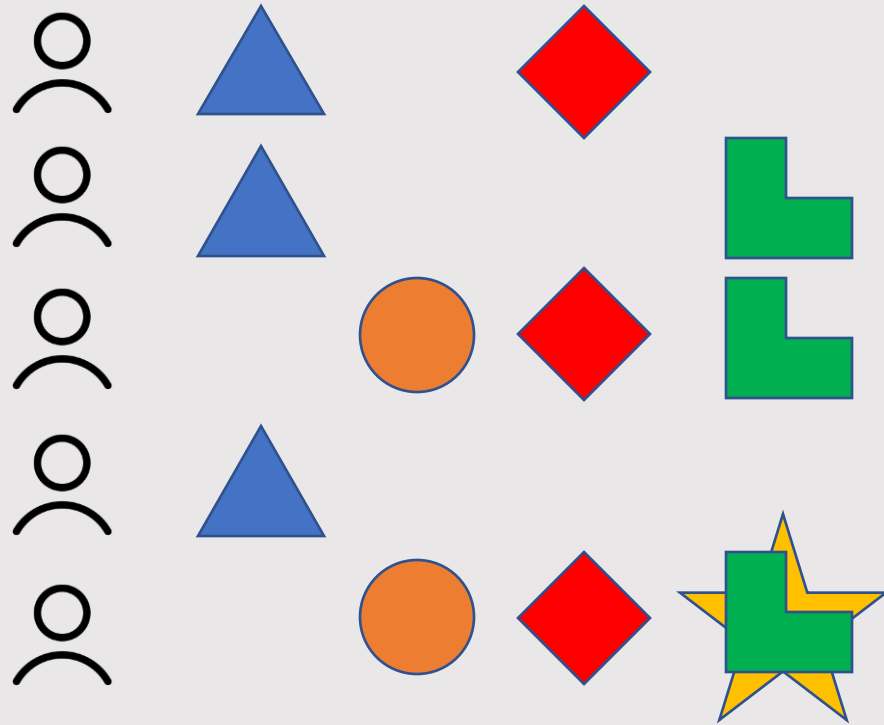
From the data, we look at **items frequently bought together**.

From there, we estimate the products the users are mostly likely to buy, based on their previous transactions

Suppose our customers bought the following products:

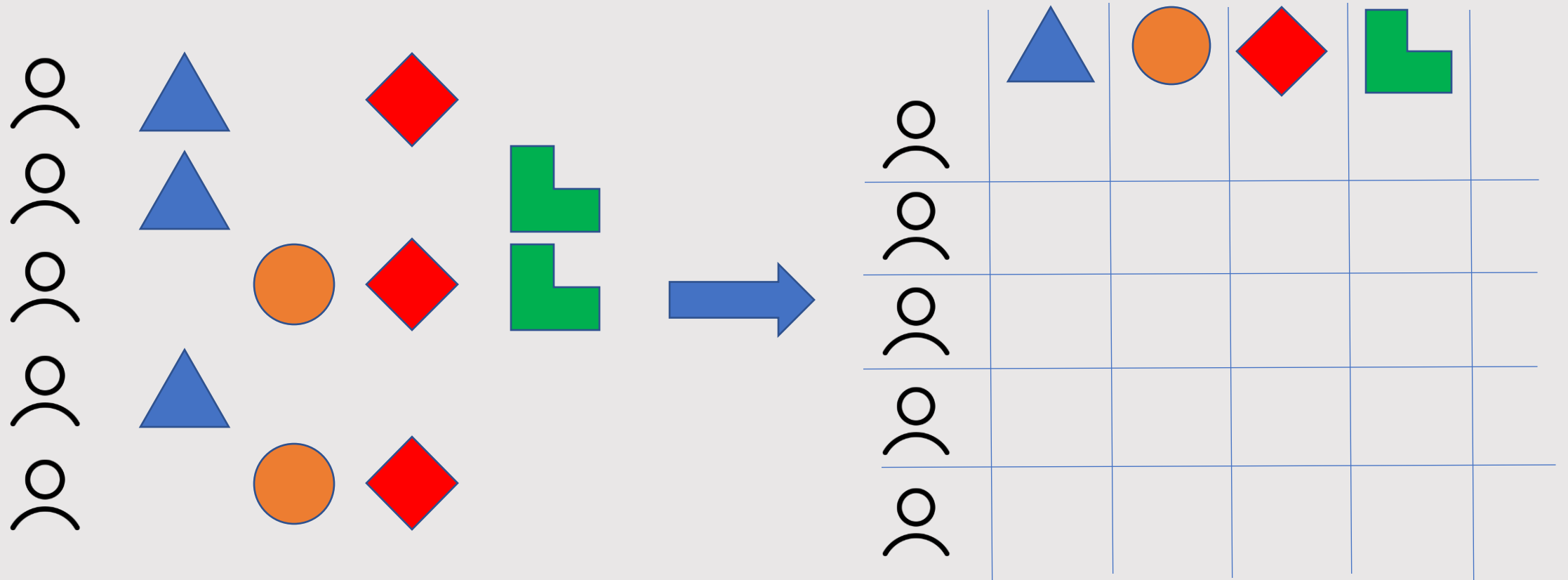


Suppose our customers bought the following products:

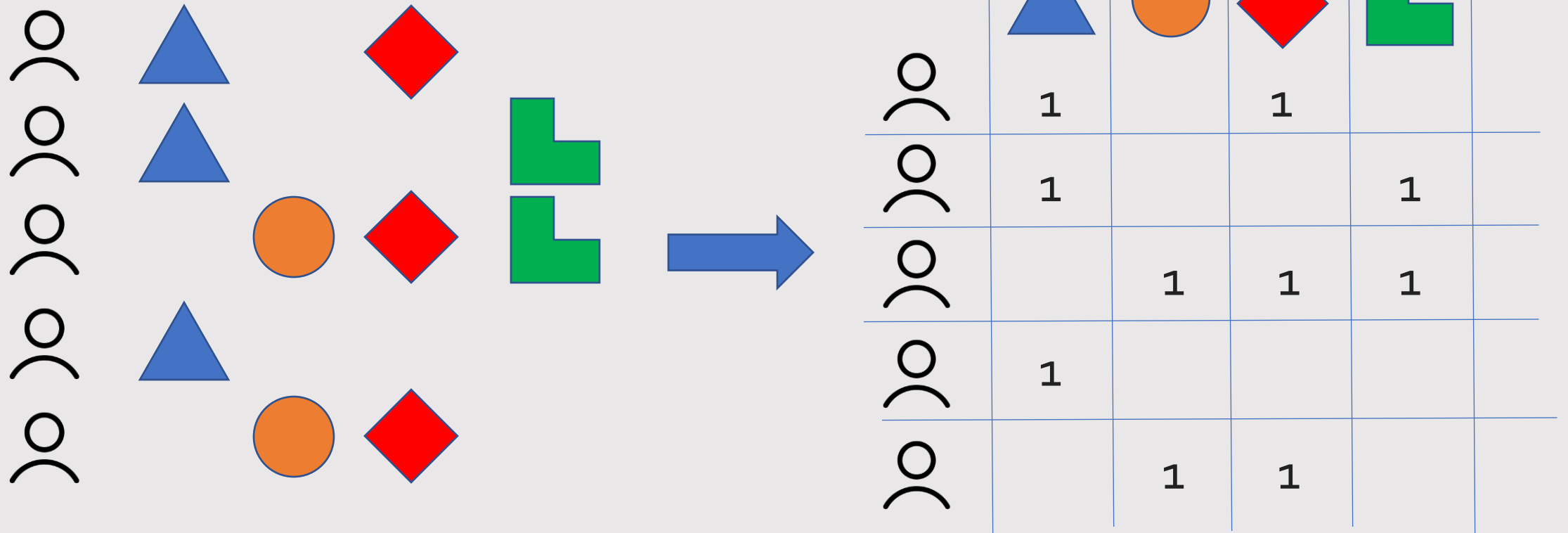


How do we transform it into a format we can work with?

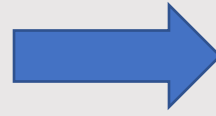
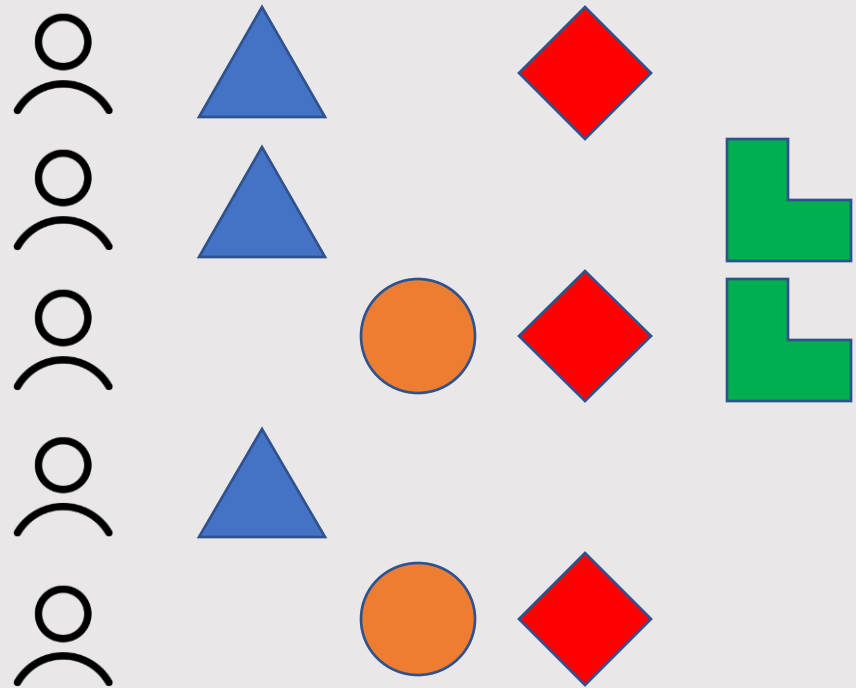
How do we transform it into a format we can work with? Matrices!












How do we transform it into a format we can work with? Matrices!














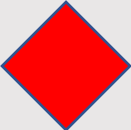






How do we transform it into a format we can work with? Matrices!



				
	1	0	1	0
	1	0	0	1
	0	1	1	1
	1	0	0	0
	0	1	1	0










This is the Affinity Matrix:

				
	1	0	1	0
	1	0	0	1
	0	1	1	1
	1	0	0	0
	0	1	1	0

				
	1	0	1	0
	1	0	0	1
	0	1	1	1
	1	0	0	0
	0	1	1	0



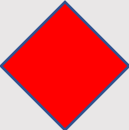











How Similar is  to ?

$$\frac{\text{person}(\text{blue triangle and orange circle})}{\text{person}(\text{blue triangle or orange circle})}$$

				
	1	0	1	0
	1	0	0	1
	0	1	1	1
	1	0	0	0
	0	1	1	0

How Similar is  to ?

$$\frac{\text{smiley face} (\text{blue triangle and green L-shape})}{\text{smiley face} (\text{blue triangle or green L-shape})} = \frac{1}{2}$$

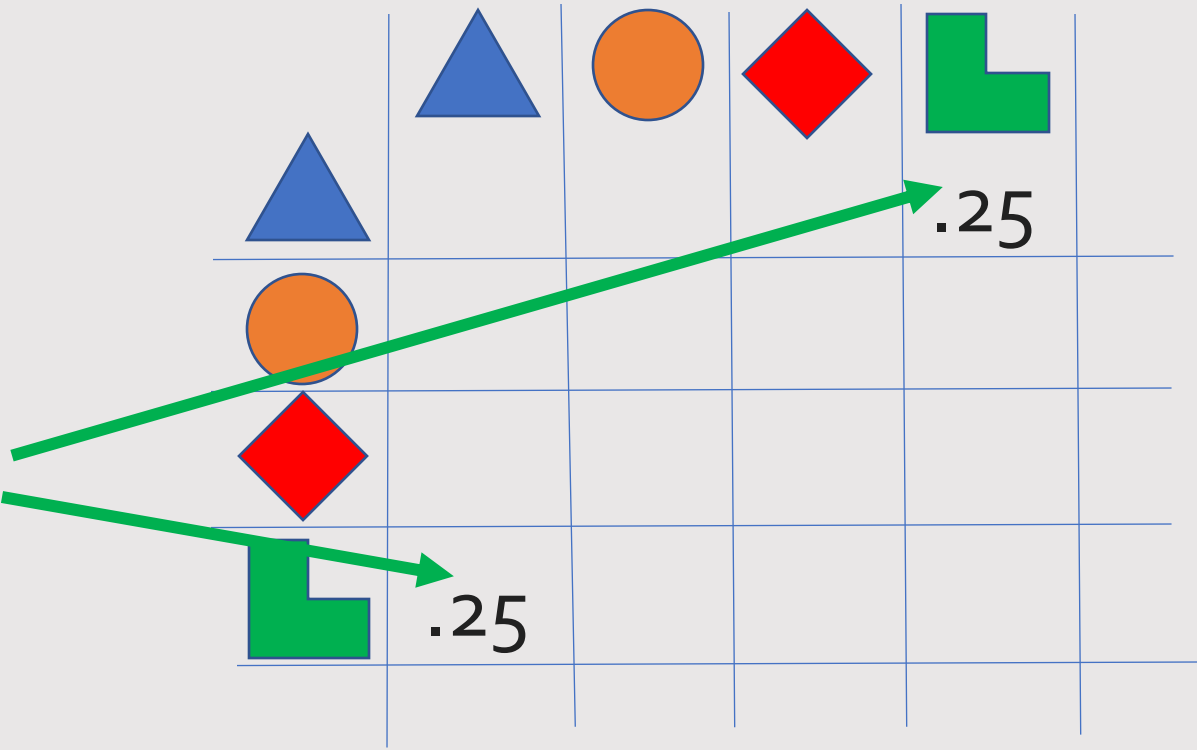
				
		0	1	0
		0	0	
	0	1	1	
		0	0	0
	0	1	1	0

How Similar is  to ?

$$\frac{\text{smiley face} (\text{blue triangle and green L-shape})}{\text{smiley face} (\text{blue triangle or green L-shape})} = \frac{1}{\text{4}}$$

How Similar is  to ?

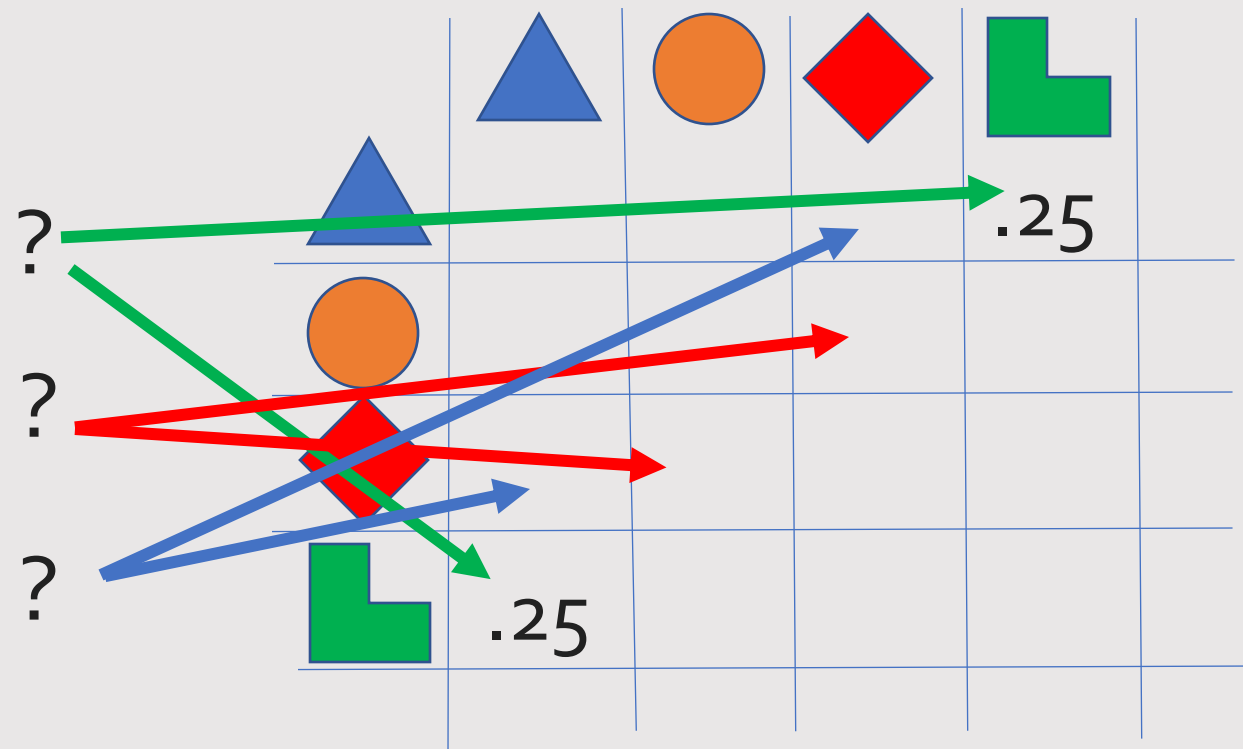
$$\frac{\text{number of (blue triangle and green L-shape)}}{\text{number of (blue triangle or green L-shape)}} = \frac{1}{4}$$



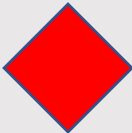



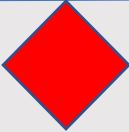



How Similar is  to  ?

How Similar is  to  ?

How Similar is  to  ?











					
	1	0	.2	.25	
	0	1	.66	.33	
	.2	.66	1	.25	
	.25	.33	.25	1	











How do we use the Similarity Matrix for Recommendations?




How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1











How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1









	
0	
1	
1	
0	

How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1









$$\begin{matrix} & \text{User} \\ \text{X} & \begin{matrix} 0 \\ 1 \\ 1 \\ 0 \end{matrix} \end{matrix} \begin{matrix} \\ \text{orange circle} \\ \text{red diamond} \\ \end{matrix}$$

How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1

$$\begin{array}{c}
 \text{User} \\
 \begin{array}{c} 0 \\ 1 \\ 1 \\ 0 \end{array}
 \end{array}
 \times
 \begin{array}{c}
 \text{Item} \\
 \begin{array}{c} \text{orange circle} \\ \text{red diamond} \end{array}
 \end{array}
 =
 \begin{array}{c}
 \begin{array}{c} ? \\ ? \\ ? \\ ? \end{array}
 \end{array}
 \times
 \begin{array}{c}
 \text{Item} \\
 \begin{array}{c} \text{blue triangle} \\ \text{orange circle} \\ \text{red diamond} \\ \text{green L-shape} \end{array}
 \end{array}$$









How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1

$$\begin{matrix}
 \text{User} \\
 \begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}
 \end{matrix}
 \times
 \begin{matrix}
 \text{Similarity Matrix} \\
 \begin{bmatrix} 1 & 0 & .2 & .25 \\ 0 & 1 & .66 & .33 \\ .2 & .66 & 1 & .25 \\ .25 & .33 & .25 & 1 \end{bmatrix}
 \end{matrix}
 =
 \begin{matrix}
 \text{Recommendation} \\
 \begin{bmatrix} 1 \times 0 + 0 \times 1 + .2 \times 1 + .25 \times 0 \\ 0 \times 0 + 1 \times 1 + .66 \times 1 + .33 \times 0 \\ .2 \times 0 + .66 \times 1 + 1 \times 1 + .25 \times 0 \\ .25 \times 0 + .33 \times 1 + .25 \times 1 + 1 \times 0 \end{bmatrix}
 \end{matrix}$$









The diagram illustrates the calculation of a recommendation score for a user based on their similarity to other users. The user's similarity vector is multiplied by the similarity matrix to produce a recommendation vector. The first row of the recommendation vector is highlighted with a green box, showing the calculation: $1 \times 0 + 0 \times 1 + .2 \times 1 + .25 \times 0$.

How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1









$$\begin{matrix} \text{X} & \begin{matrix} \text{O} \\ 0 \\ 1 \\ 1 \\ 0 \end{matrix} & \begin{matrix} \text{O} \\ \text{D} \end{matrix} & = & \begin{matrix} .2 \\ \text{O} \\ \text{O} \\ \text{D} \\ \text{L} \end{matrix} \end{matrix}$$

How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1









$$\begin{matrix}
 \text{X} & \begin{matrix} \text{orange circle} \\ 0 \\ 1 \\ 1 \\ 0 \end{matrix} & = & \begin{matrix} .2 \\ 1.66 \end{matrix} & \begin{matrix} \text{blue triangle} \\ \text{orange circle} \\ \text{red diamond} \\ \text{green L-shape} \end{matrix}
 \end{matrix}$$

How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1









$$\begin{matrix} \text{X} & \begin{matrix} \text{O} \\ 0 \\ 1 \\ 1 \\ 0 \end{matrix} & \begin{matrix} \text{O} \\ \text{D} \end{matrix} & = & \begin{matrix} .2 \\ 1.66 \\ 1.66 \end{matrix} & \begin{matrix} \text{O} \\ \text{D} \\ \text{L} \end{matrix} \end{matrix}$$

How do we use the Similarity Matrix for Recommendations?

				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1


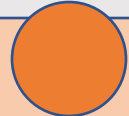
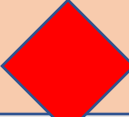

$$\begin{matrix}
 \text{X} & \begin{matrix} \text{O} \\ 0 \\ 1 \\ 1 \\ 0 \end{matrix} & \begin{matrix} \text{O} \\ \text{D} \end{matrix} & = & \begin{matrix} .2 \\ 1.66 \\ 1.66 \\ 0.59 \end{matrix} & \begin{matrix} \text{O} \\ \text{D} \\ \text{L} \end{matrix}
 \end{matrix}$$

How do we use the Similarity Matrix for Recommendations?







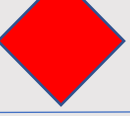

					
	1	0	.2	.25	
	0	1	.66	.33	
	.2	.66	1	.25	
	.25	.33	.25	1	

$$\begin{array}{c}
 \text{User} \\
 \begin{array}{c}
 0 \\
 1 \\
 1 \\
 0
 \end{array}
 \end{array}
 \times
 \begin{array}{c}
 \begin{array}{c}
 \text{orange circle} \\
 \text{red diamond}
 \end{array}
 \end{array}
 =$$

Highest scores for items that the user already bought


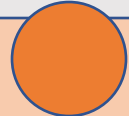
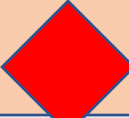

.2	
1.66	
1.66	
0.59	

How do we use the Similarity Matrix for Recommendations?

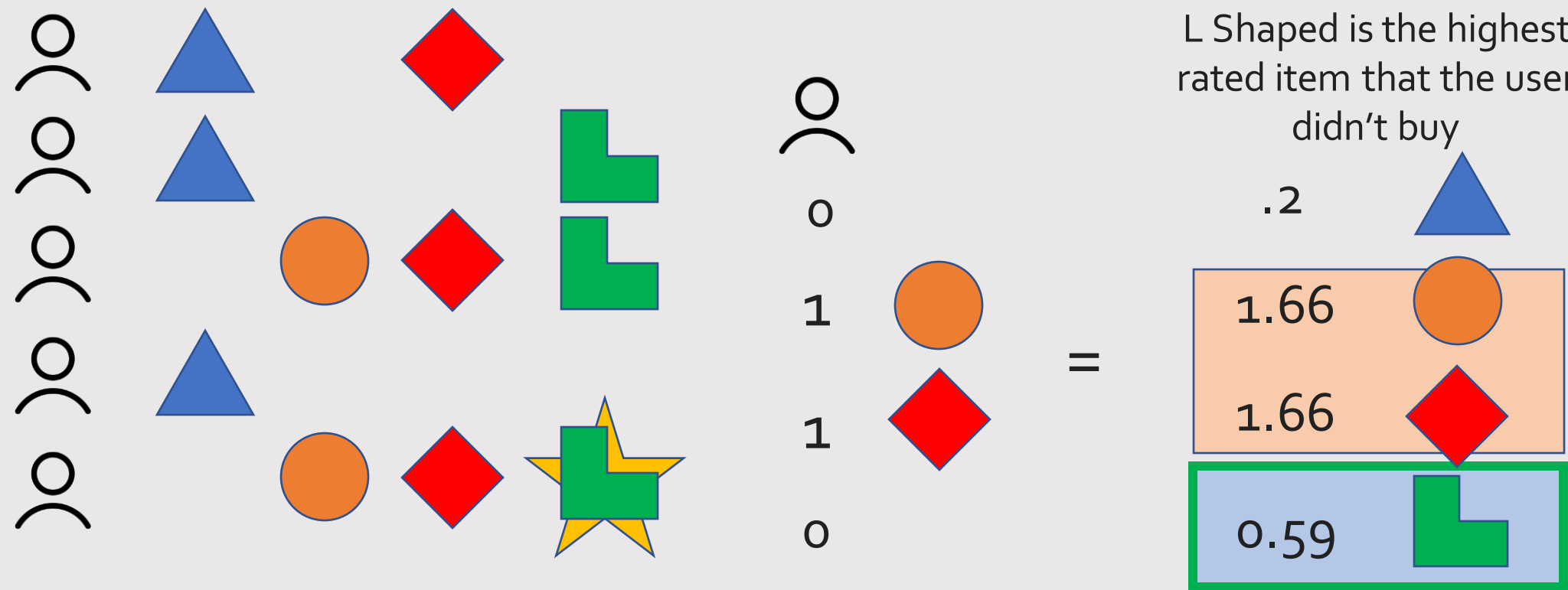
				
	1	0	.2	.25
	0	1	.66	.33
	.2	.66	1	.25
	.25	.33	.25	1

$$\begin{array}{c}
 \text{User} \\
 \begin{array}{c}
 0 \\
 1 \\
 1 \\
 0
 \end{array}
 \end{array}
 \times
 \begin{array}{c}
 \begin{array}{c}
 \text{orange circle} \\
 \text{red diamond}
 \end{array}
 \end{array}
 =$$

L Shaped is the highest rated item that the user didn't buy

.2	
1.66	
1.66	
0.59	

It worked!



Questions?