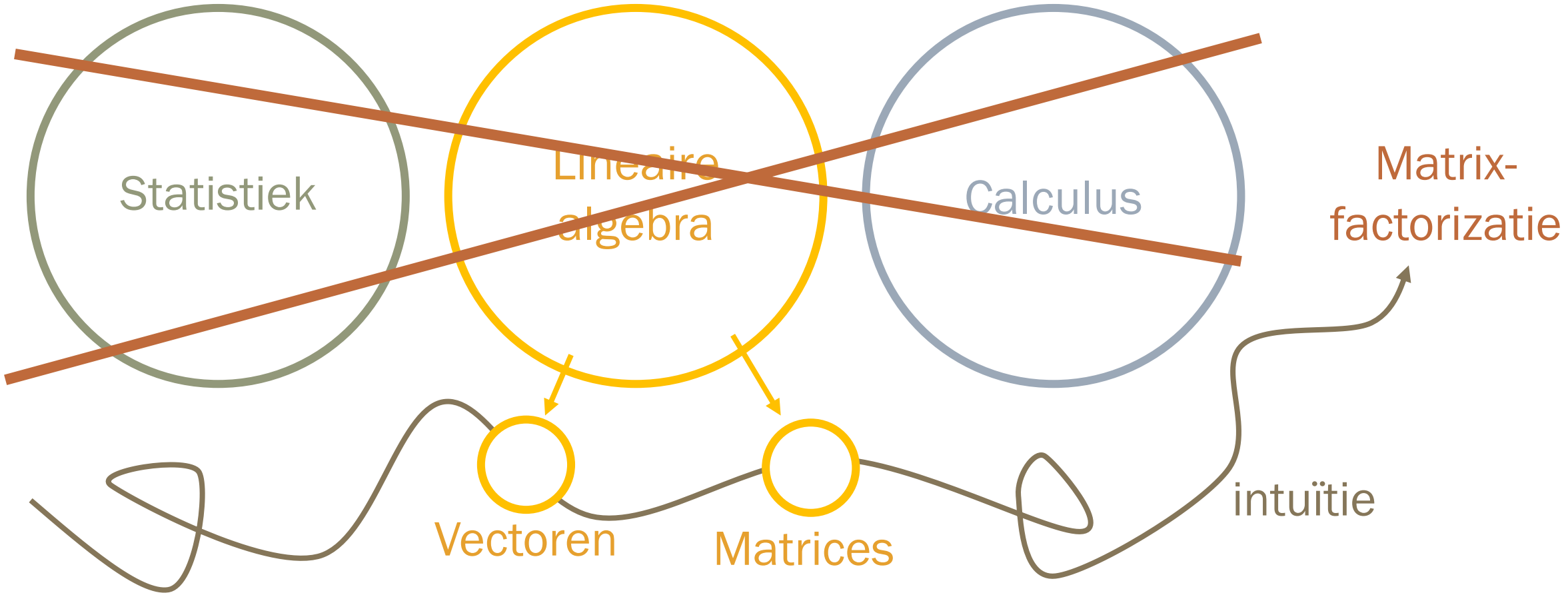
Collectieve Intelligentie

SIMON PAUW

MATRICES EN INPRODUCT

Recap


Statistiek
Lineaire algebra
Calculus
Matrix-factorizatie
Vectoren
Matrices
intuïtie

Hoe deelnemen?

1 Ga naar wooclap.com

2 Voer de code van het evenement in de bovenste banner in

Evenementcode
CI03

Klik op het geprojecteerd scherm om de vraag te activeren

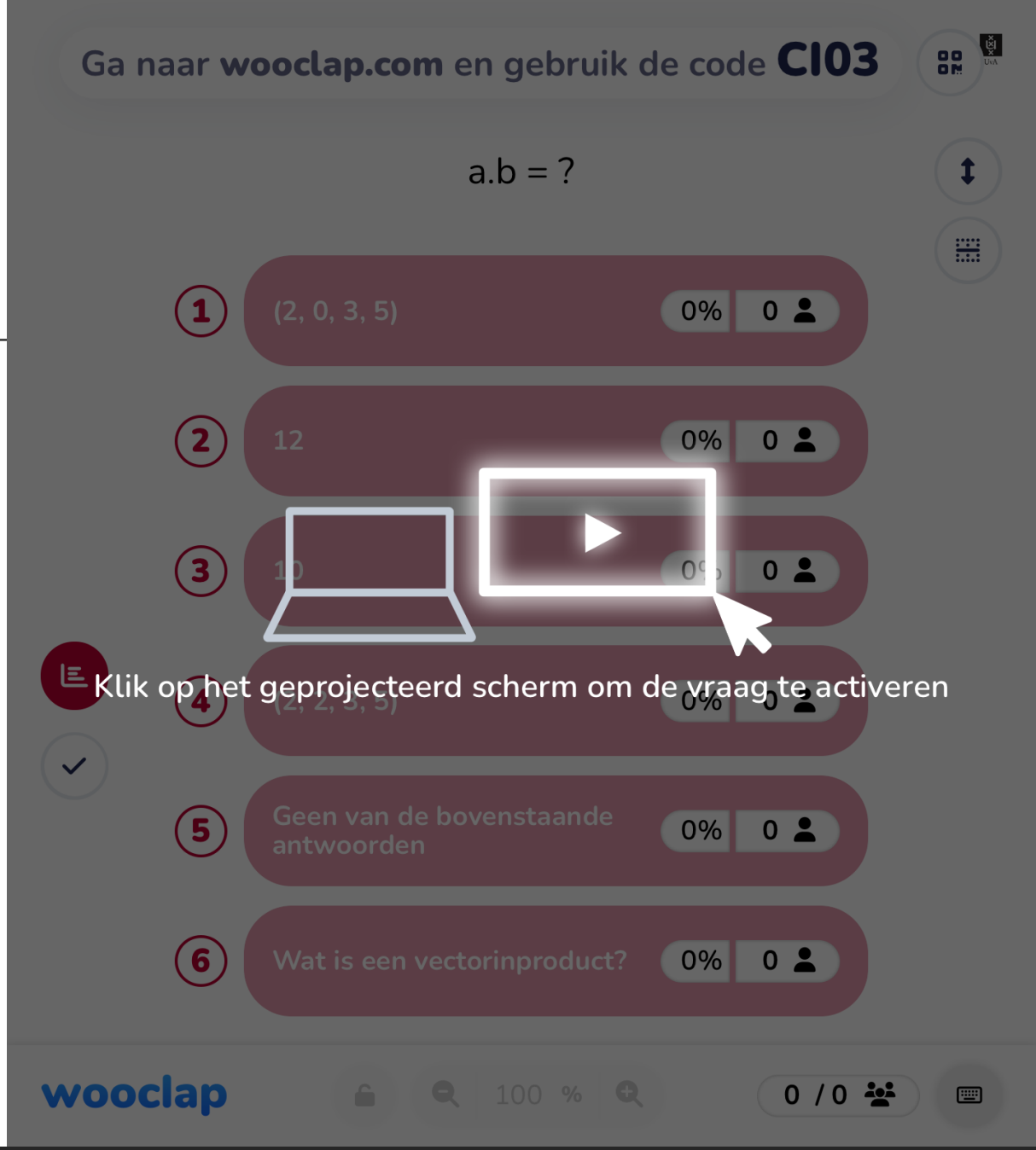
Antwoorden per sms inschakelen

Deelnamelink kopiëren

Vector inproduct

$$a = \begin{pmatrix} 2 \\ 2 \\ 3 \\ 5 \end{pmatrix} \qquad b = \begin{pmatrix} 1 \\ 0 \\ 1 \\ 1 \end{pmatrix}$$

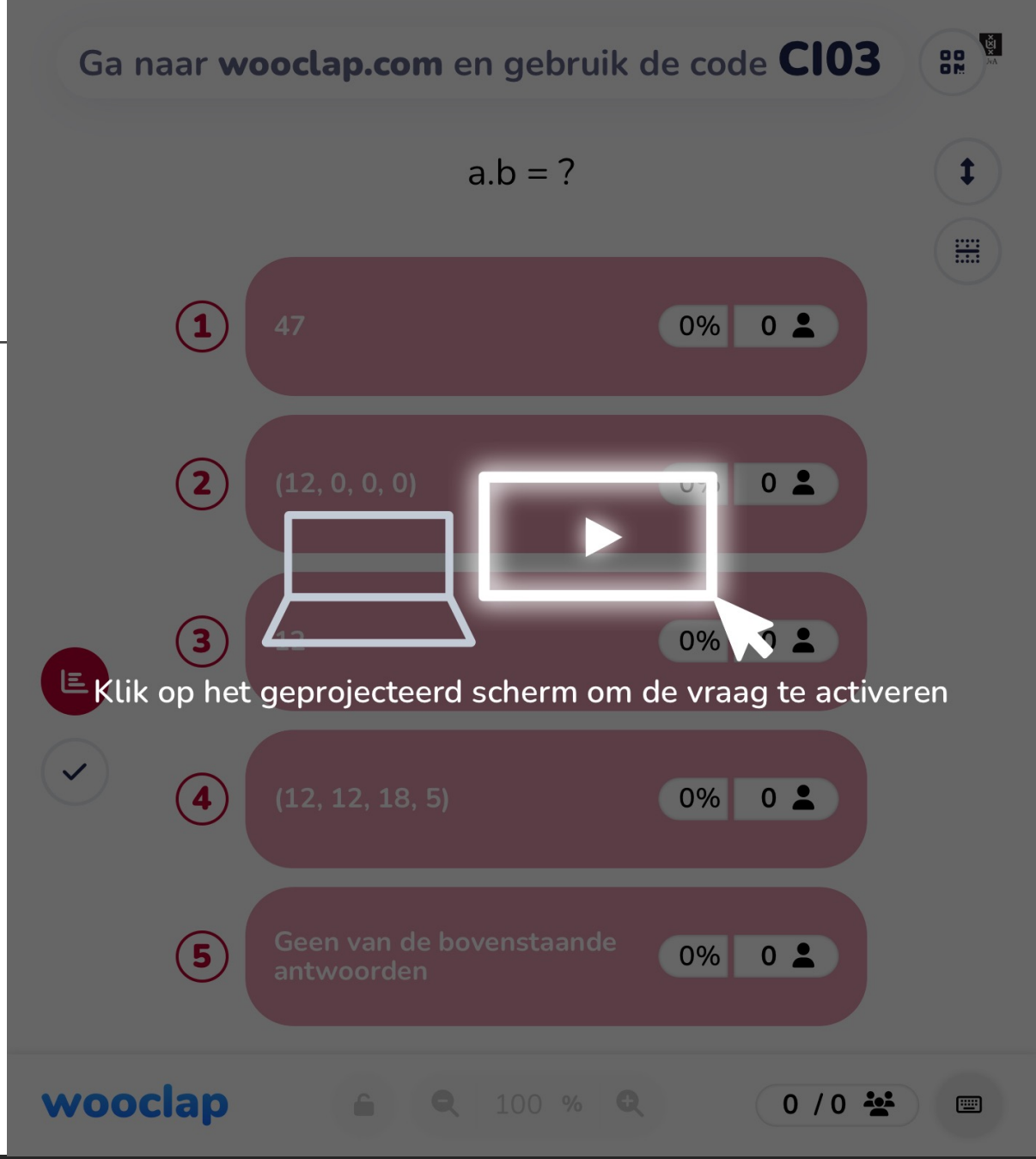
$$a \cdot b = ?$$



Vector inproduct

$$a = \begin{pmatrix} 6 \\ 0 \\ 0 \\ 5 \end{pmatrix} \qquad b = \begin{pmatrix} 2 \\ 12 \\ 18 \\ 0 \end{pmatrix}$$

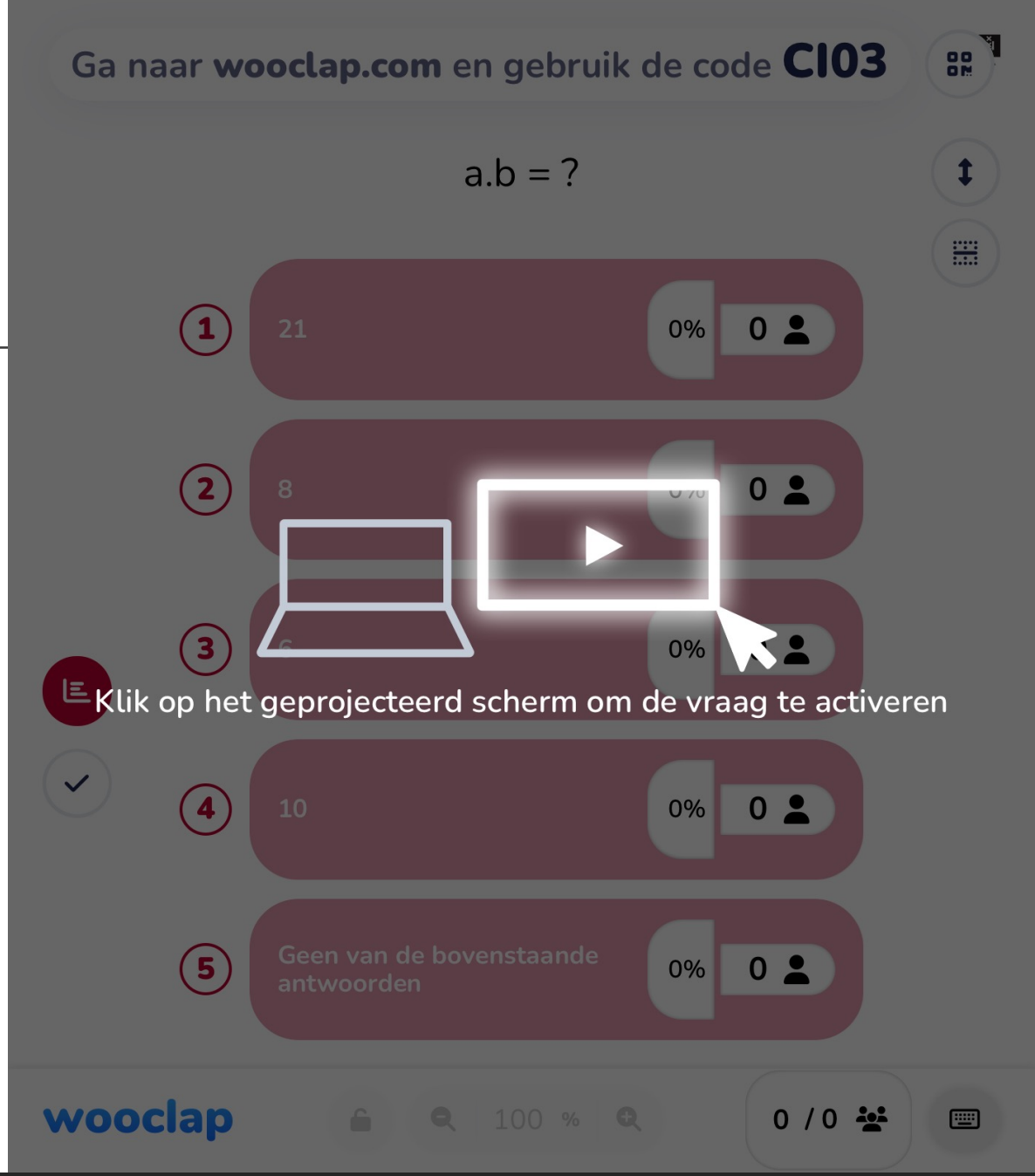
$$a \cdot b = ?$$



Vector inproduct

$$a = \begin{pmatrix} 6 \\ 1 \\ 1 \\ 5 \end{pmatrix} \qquad b = \begin{pmatrix} 3 \\ 2 \\ 1 \end{pmatrix}$$

$$a \cdot b = ?$$



Herhaling vector inproduct

	Meike	Lars	Rudolf
Titanic	0.9	0.5	0.9
Luca	0.7	0.8	0.7
The Great Dictator	1.0	0.3	0.8

$$\cos(l,d) = \frac{\sum_{i=1}^{n} l_i \cdot d_i}{\sqrt{\sum_{i=1}^{n} l_i^2} \cdot \sqrt{\sum_{i=1}^{n} d_i^2}}$$

$$\cos(\text{Luca}, \text{The Great Dictator}) = \frac{0.7 \cdot 1.0 + 0.8 \cdot 0.3 + 0.7 \cdot 0.8}{\sqrt{0.7 \cdot 0.7 + 0.8 \cdot 0.8 + 0.7 \cdot 0.7} \cdot \sqrt{1.0 \cdot 1.0 + 0.3 \cdot 0.3 + 0.8 \cdot 0.8}}$$

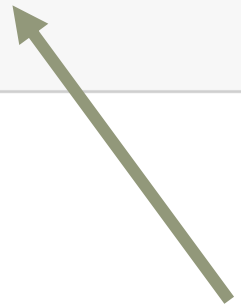
$$\text{l} = \begin{pmatrix} 0.7 \\ 0.8 \\ 0.7 \end{pmatrix} \qquad \text{d} = \begin{pmatrix} 1.0 \\ 0.3 \\ 0.8 \end{pmatrix}$$

$$\cos(l,d) = \frac{l \cdot d}{\sqrt{l \cdot l} \cdot \sqrt{d \cdot d}}$$

Inproduct in Pandas: @

```
1  s1 = pd.Series([1, 2, 3])
2  s2 = pd.Series([100, 10, 1])
3
4  inproduct = s1 @ s2
5  print(inproduct)
```

```
123
```



Vectoren

	Meike	Lars	Rudolf	...
Titanic	0.9	0.5	0.9	
Luca	0.7	0.8	0.7	
The Great Dictator	1.0	0.3	0.8	
...				

$$l = \begin{pmatrix} 0.7 \\ 0.8 \\ 0.7 \end{pmatrix} \qquad d = \begin{pmatrix} 1.0 \\ 0.3 \\ 0.8 \end{pmatrix}$$

Vectoren → Similarities → Voorspelde ratings (KNN) → Aanbevelingen

CBF: Genres

1	Action	Adventure	Comedy	Drama	Fantasy	Musical	Sci-Fi	Thriller
Inception	1	1	0	0	0	0	1	1
Frozen	0	1	1	0	1	1	0	0
Blade Runner	1	0	0	1	0	0	1	1

Vectoren → Similarities → Voorspelde ratings (KNN) → Aanbevelingen

Matrices

Vandaag

Matrices (2D-vectoren)

Module 3:

- Similarities: Comedy films lijken op comedy films

Module 4:

- Mensen die van comedy films houden, vinden een comedy film waarschijnlijk goed

CBF: Matrices

1	Action	Adventure	Comedy	Drama	Fantasy	Musical	Sci-Fi	Thriller
Inception	1	1	0	0	0	0	1	1
Frozen	0	1	1	0	1	1	0	0
Blade Runner	1	0	0	1	0	0	1	1

Vectoren → Similarities → Voorspelde ratings (KNN) → Aanbevelingen

CBF: Matrices

1	Action	Adventure	Comedy	Drama	Fantasy	Musical	Sci-Fi	Thriller
Inception	1	1	0	0	0	0	1	1
Frozen	0	1	1	0	1	1	0	0
Blade Runner	1	0	0	1	0	0	1	1

Vectoren → ~~Similarities~~ → Voorspelde ratings (knn) → Aanbevelingen

CBF: Matrices

1	Action	Adventure	Comedy	Drama	Fantasy	Musical	Sci-Fi	Thriller
Inception	1	1	0	0	0	0	1	1
Frozen	0	1	1	0	1	1	0	0
Blade Runner	1	0	0	1	0	0	1	1

Filmgenres als vectoren

movieName	drama	thriller	comedy
Babe	1	0	0
Inception	1	1	0
A.I. Artificial Intelligence	1	0	0
Ace Ventura: Pet Detective	0	0	1
Bad Boys	1	0	1
Changing Lanes	0	0	0
Dumb & Dumber	0	0	1
Event Horizon	0	1	0
Full Metal Jacket	1	1	0
I, Robot	0	1	0

Cut out the middle man: profielen matchen (met het matrix inproduct)

movieName	drama	thriller	comedy
Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I. Artificial Intelligence	0.67	0.46	0.22
Ace Ventura: Pet Detective	0.05	0.18	0.95
Bad Boys	0.71	0.42	0.78
Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

userId	drama	thriller	comedy
6	0.71	-0.65	0.56
7	0.85	0.22	0.18
8	0.89	-0.75	0.71
10	-0.02	0.20	0.02
11	0.94	0.33	0.07
12	0.94	0.18	0.29
13	0.75	0.75	0.29
14	0.07	0.04	0.49
15	0.52	0.42	-0.13
16	0.51	0.42	-0.31

Voorspelde ratings

userId	6	7	8	10	11	12	13	14	15	16
movieName										
Babe	0.62	0.75	0.80	0.04	0.80	0.86	0.84	0.27	0.42	0.34
Inception	0.10	0.82	0.18	0.18	0.93	0.89	1.29	0.30	0.66	0.57
A.I. Artificial Intelligence	0.30	0.71	0.41	0.08	0.80	0.78	0.91	0.17	0.51	0.47
Ace Ventura: Pet Detective	0.45	0.25	0.58	0.05	0.17	0.35	0.45	0.48	-0.02	-0.19
Bad Boys	0.67	0.84	0.87	0.09	0.86	0.97	1.07	0.45	0.44	0.30
Changing Lanes	0.26	0.53	0.35	0.08	0.58	0.60	0.75	0.23	0.35	0.28
Dumb & Dumber	0.45	0.22	0.58	0.05	0.13	0.32	0.42	0.50	-0.06	-0.24
Event Horizon	-0.44	0.18	-0.50	0.15	0.25	0.16	0.58	0.07	0.30	0.29
Full Metal Jacket	0.12	0.68	0.19	0.09	0.80	0.72	0.89	0.07	0.57	0.56
I, Robot	-0.21	0.57	-0.20	0.20	0.67	0.60	1.11	0.24	0.55	0.48

Filmgenres als vectoren

movieName	drama	thriller	comedy
Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I. Artificial Intelligence	0.67	0.46	0.22
Ace Ventura: Pet Detective	0.05	0.18	0.95
Bad Boys	0.71	0.42	0.78
Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

$$m_{\text{inception}} = \begin{pmatrix} 0.63 \\ 0.92 \\ 0.44 \end{pmatrix}$$

Filmgenres als vectoren

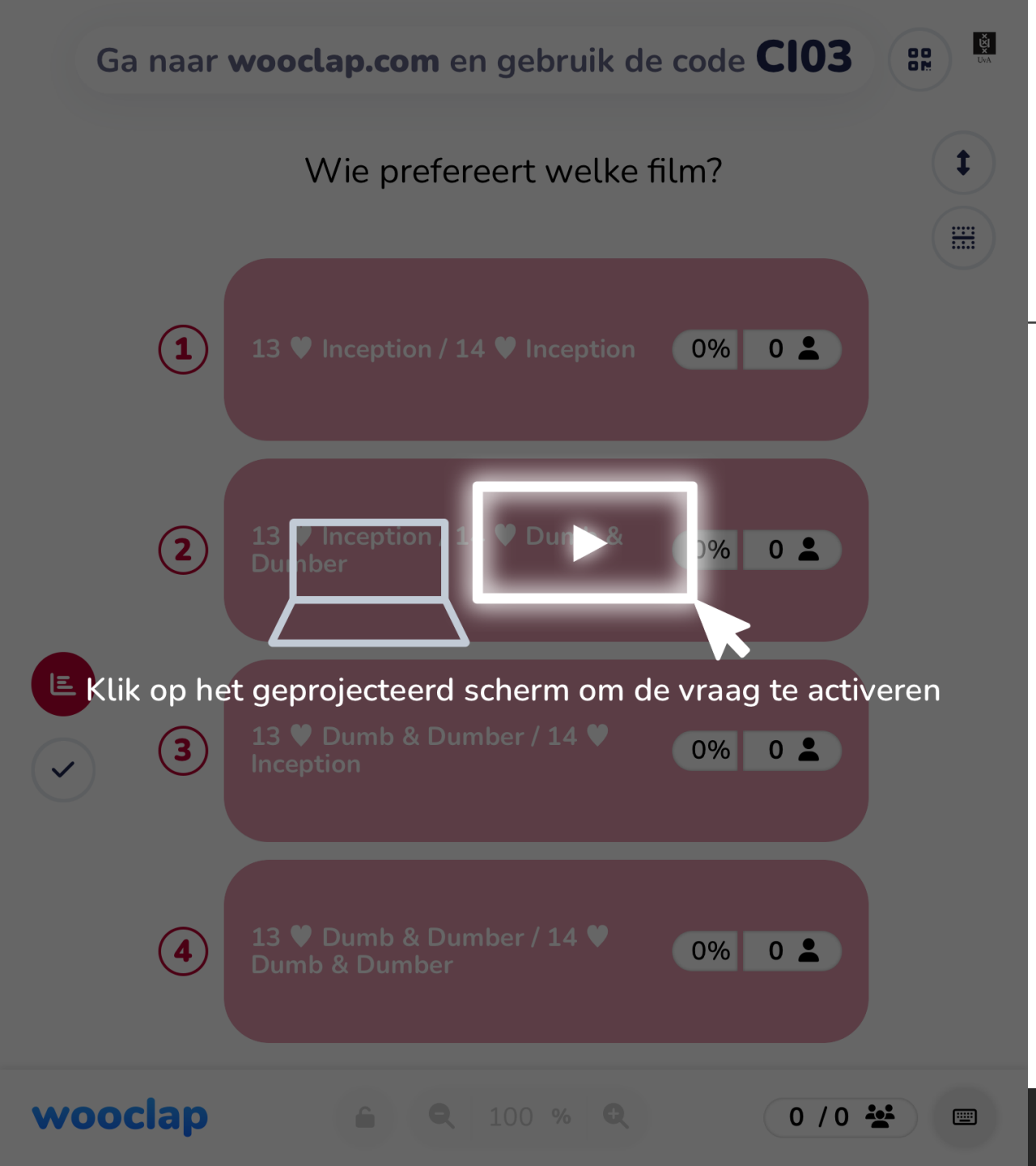
$$u_{13} = \begin{pmatrix} 0.75 \\ 0.75 \\ 0.29 \end{pmatrix}$$

userId	drama	thriller	comedy
6	0.71	-0.65	0.56
7	0.85	0.22	0.18
8	0.89	-0.75	0.71
10	-0.02	0.20	0.02
11	0.94	0.33	0.07
12	0.94	0.18	0.29
13	0.75	0.75	0.29
14	0.07	0.04	0.49
15	0.52	0.42	-0.13
16	0.51	0.42	-0.31

Filmgenres als vectoren

drama
thriller
comedy

$$u_{13} = \begin{pmatrix} 0.75 \\ 0.75 \\ 0.29 \end{pmatrix} \qquad m_{\text{inception}} = \begin{pmatrix} 0.63 \\ 0.92 \\ 0.44 \end{pmatrix}$$



Wie prefereert welke film?

$$u_{13} = \begin{pmatrix} 0.75 \\ 0.75 \\ 0.29 \end{pmatrix}$$

$$u_{14} = \begin{pmatrix} 0.07 \\ 0.04 \\ 0.49 \end{pmatrix}$$

$$m_{\text{inception}} = \begin{pmatrix} 0.63 \\ 0.92 \\ 0.44 \end{pmatrix}$$

$$m_{\text{dumb\&dumber}} = \begin{pmatrix} 0.00 \\ 0.17 \\ 1.00 \end{pmatrix}$$

Vraag

Hoe kunnen we aan de hand van twee vectoren een rating voorspellen?

drama
thriller
comedy

$$u_{13} = \begin{pmatrix} 0.75 \\ 0.75 \\ 0.29 \end{pmatrix} \qquad m_{\text{inception}} = \begin{pmatrix} 0.63 \\ 0.92 \\ 0.44 \end{pmatrix}$$

Filmgenres als vectoren

drama
thriller
comedy

$$u_{13} = \begin{pmatrix} 0.75 \\ 0.75 \\ 0.29 \end{pmatrix} \qquad m_{\text{inception}} = \begin{pmatrix} 0.63 \\ 0.92 \\ 0.44 \end{pmatrix} \qquad m_{\text{dumb\&dumber}} = \begin{pmatrix} 0.00 \\ 0.17 \\ 1.00 \end{pmatrix}$$

$$\text{predicted rating} = u_{13} \cdot m_{\text{inception}} = 0.75 \cdot 0.63 + 0.75 \cdot 0.92 + 0.29 \cdot 0.44 = 1.29$$

$$\text{predicted rating} = u_{13} \cdot m_{\text{dumb\&dumber}} = 0.75 \cdot 0.00 + 0.75 \cdot 0.17 + 0.29 \cdot 1.00 = 0.42$$

Filmgenres matrix inproduct

userId	6	7	8	10	11	12	13	14	15	16
movieName										
Babe	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Inception	.....	.....	.....	.....	.....	.....	1.29	.....	.....	.....
A.I. Artificial Intelligence	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ace Ventura: Pet Detective	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bad Boys	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Changing Lanes	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dumb & Dumber	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Event Horizon	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Full Metal Jacket	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
I, Robot	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

$$\text{predicted rating} = u_{13} \cdot m_{\text{inception}} = 0.75 \cdot 0.63 + 0.75 \cdot 0.92 + 0.29 \cdot 0.44 = 1.2901$$

Filmgenres matrix inproduct

$$\begin{pmatrix} \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & 1.29 & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \end{pmatrix}$$

$$\text{predicted rating} = u_{13} \cdot m_{\text{inception}} = 0.75 \cdot 0.63 + 0.75 \cdot 0.92 + 0.29 \cdot 0.44 = 1.29$$

Filmgenres matrix inproduct

	6	7	8	10	11	12	13	14	15	16
Babe	…	…	…	…	…	…	…	…	…	…
Inception	…	…	…	…	…	…	1.29	…	…	…
A.I.	…	…	…	…	…	…	…	…	…	…
Ace Ventura	…	…	…	…	…	…	…	…	…	…
Bad Boys	…	…	…	…	…	…	…	…	…	…
Changing Lanes	…	…	…	…	…	…	…	…	…	…
Dumb & Dumber	…	…	…	…	…	…	…	…	…	…
Event Horizon	…	…	…	…	…	…	…	…	…	…
Full Metal Jacket	…	…	…	…	…	…	…	…	…	…
I, Robot	…	…	…	…	…	…	…	…	…	…

$$\text{predicted rating} = u_{13} \cdot m_{\text{inception}} = 0.75 \cdot 0.63 + 0.75 \cdot 0.92 + 0.29 \cdot 0.44 = 1.29$$

Filmgenres matrix inproduct

	6	7	8	10	11	12	13	14	15	16
Babe	…	…	…	…	…	…	…	…	…	…
Inception	…	…	…	…	…	…	$u_{13} \cdot m_{\text{in}}$	…	…	…
A.I.	…	…	…	…	…	…	…	…	…	…
Ace Ventura	…	…	…	…	…	…	…	…	…	…
Bad Boys	…	…	…	…	…	…	…	…	…	…
Changing Lanes	…	…	…	…	…	…	…	…	…	…
Dumb & Dumber	…	…	…	…	…	…	…	…	…	…
Event Horizon	…	…	…	…	…	…	…	…	…	…
Full Metal Jacket	…	…	…	…	…	…	…	…	…	…
I, Robot	…	…	…	…	…	…	…	…	…	…

$$\text{predicted rating} = u_{13} \cdot m_{\text{inception}} = 0.75 \cdot 0.63 + 0.75 \cdot 0.92 + 0.29 \cdot 0.44 = 1.29$$

Filmgenres als vectoren

movieName	drama	thriller	comedy
Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I. Artificial Intelligence	0.67	0.46	0.22
Ace Ventura: Pet Detective	0.05	0.18	0.95
Bad Boys	0.71	0.42	0.78
Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

$$m_{ba} = \begin{pmatrix} 0.74 \\ 0.22 \\ 0.43 \end{pmatrix} \quad m_{in} = \begin{pmatrix} 0.63 \\ 0.92 \\ 0.44 \end{pmatrix} \quad m_{ir} = \begin{pmatrix} 0.34 \\ 1.00 \\ 0.35 \end{pmatrix}$$

$$u_6 = \begin{pmatrix} 0.71 \\ -0.6 \\ 0.56 \end{pmatrix} \quad u_7 = \begin{pmatrix} 0.85 \\ 0.22 \\ 0.18 \end{pmatrix} \quad u_{16} = \begin{pmatrix} 0.51 \\ 0.42 \\ -0.3 \end{pmatrix}$$

userId	drama	thriller	comedy
6	0.71	-0.65	0.56
7	0.85	0.22	0.18
8	0.89	-0.75	0.71
10	-0.02	0.20	0.02
11	0.94	0.33	0.07
12	0.94	0.18	0.29
13	0.75	0.75	0.29
14	0.07	0.04	0.49
15	0.52	0.42	-0.13
16	0.51	0.42	-0.31

Filmgenres matrix inproduct

$$m_{ba} = \begin{pmatrix} 0.74 \\ 0.22 \\ 0.43 \end{pmatrix}$$

$$u_6 = \begin{pmatrix} 0.71 \\ -0.6 \\ 0.56 \end{pmatrix}$$

$$m_{in} = \begin{pmatrix} 0.63 \\ 0.92 \\ 0.44 \end{pmatrix}$$

$$\begin{array}{l} \\ \text{Babe} \\ \text{Inception} \\ \ldots \\ \text{I, Robot} \end{array} \begin{array}{c} \begin{array}{cccc} 6 & 7 & \ldots & 16 \end{array} \\ \begin{pmatrix} u_6 \cdot m_{\text{ba}} & u_7 \cdot m_{\text{ba}} & \cdots & u_{16} \cdot m_{\text{ba}} \\ u_6 \cdot m_{\text{in}} & u_7 \cdot m_{\text{in}} & \cdots & u_{16} \cdot m_{\text{in}} \\ \vdots & \vdots & \ddots & \vdots \\ u_6 \cdot m_{\text{ir}} & u_7 \cdot m_{\text{ir}} & \cdots & u_{16} \cdot m_{\text{ir}} \end{pmatrix} \end{array}$$

$$u_7 = \begin{pmatrix} 0.85 \\ 0.22 \\ 0.18 \end{pmatrix}$$

$$m_{ir} = \begin{pmatrix} 0.34 \\ 1.00 \\ 0.35 \end{pmatrix}$$

$$u_{16} = \begin{pmatrix} 0.51 \\ 0.42 \\ -0.3 \end{pmatrix}$$

$$u_6 \cdot m_{ba} = 0.71 \cdot 0.74 + -0.6 \cdot 0.22 + 0.56 \cdot 0.43 = 0.62$$

Filmgenres matrix inproduct

	6	7	8	10	11	12	13	14	15	16
Babe	0.62	0.75	0.80	0.04	0.80	0.86	0.84	0.27	0.42	0.34
Inception	0.10	0.82	0.18	0.18	0.93	0.89	1.29	0.30	0.66	0.57
A.I.	0.30	0.71	0.41	0.08	0.80	0.78	0.91	0.17	0.51	0.47
Ace Ventura	0.45	0.25	0.58	0.05	0.17	0.35	0.45	0.48	0.00	−0.2
Bad Boys	0.67	0.84	0.87	0.09	0.86	0.97	1.07	0.45	0.44	0.30
Changing Lanes	0.26	0.53	0.35	0.08	0.58	0.60	0.75	0.23	0.35	0.28
Dumb & Dumber	0.45	0.22	0.58	0.05	0.13	0.32	0.42	0.50	−0.1	−0.2
Event Horizon	−0.4	0.18	−0.5	0.15	0.25	0.16	0.58	0.07	0.30	0.29
Full Metal Jacket	0.12	0.68	0.19	0.09	0.80	0.72	0.89	0.07	0.57	0.56
I, Robot	−0.2	0.57	−0.2	0.20	0.67	0.60	1.11	0.24	0.55	0.48

$$u_{13} \cdot m_{\text{in}} = 0.75 \cdot 0.63 + 0.75 \cdot 0.92 + 0.29 \cdot 0.44 = 1.29$$

Filmgenres als vectoren

movieName	drama	thriller	comedy
Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I. Artificial Intelligence	0.67	0.46	0.22
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Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

userId	drama	thriller	comedy
6	0.71	-0.65	0.56
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Filmgenres als vectoren

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Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

userId	6	7	8	10	11	12	13	14	15	16
drama	0.71	0.85	0.89	-0.02	0.94	0.94	0.75	0.07	0.52	0.51
thriller	-0.65	0.22	-0.75	0.20	0.33	0.18	0.75	0.04	0.42	0.42
comedy	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	-0.13	-0.31

userId	6	7	8	10	11	12	13	14	15	16
drama	0.71	0.85	0.89	-0.02	0.94	0.94	0.75	0.07	0.52	0.51
thriller	-0.65	0.22	-0.75	0.20	0.33	0.18	0.75	0.04	0.42	0.42
comedy	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	-0.13	-0.31

movieName	drama	thriller	comedy
Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I. Artificial Intelligence	0.67	0.46	0.22
Ace Ventura: Pet Detective	0.05	0.18	0.95
Bad Boys	0.71	0.42	0.78
Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

movieName	6	7	8	10	11	12	13	14	15	16
Babe	0.62	0.75	0.80	0.04	0.80	0.86	0.84	0.27	0.42	0.34
Inception	0.10	0.82	0.18	0.18	0.93	0.89	1.29	0.30	0.66	0.57
A.I. Artificial Intelligence	0.30	0.71	0.41	0.08	0.80	0.78	0.91	0.17	0.51	0.47
Ace Ventura: Pet Detective	0.45	0.25	0.58	0.05	0.17	0.35	0.45	0.48	-0.02	-0.19
Bad Boys	0.67	0.84	0.87	0.09	0.86	0.97	1.07	0.45	0.44	0.30
Changing Lanes	0.26	0.53	0.35	0.08	0.58	0.60	0.75	0.23	0.35	0.28
Dumb & Dumber	0.45	0.22	0.58	0.05	0.13	0.32	0.42	0.50	-0.06	-0.24
Event Horizon	-0.44	0.18	-0.50	0.15	0.25	0.16	0.58	0.07	0.30	0.29
Full Metal Jacket	0.12	0.68	0.19	0.09	0.80	0.72	0.89	0.07	0.57	0.56
I, Robot	-0.21	0.57	-0.20	0.20	0.67	0.60	1.11	0.24	0.55	0.48

userId	6	7	8	10	11	12	13	14	15	16
drama	0.71	0.85	0.89	-0.02	0.94	0.94	0.75	0.07	0.52	0.51
thriller	-0.65	0.22	-0.75	0.20	0.33	0.18	0.75	0.04	0.42	0.42
comedy	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	-0.13	-0.31

movieName	drama	thriller	comedy
Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I. Artificial Intelligence	0.67	0.46	0.22
Ace Ventura: Pet Detective	0.05	0.18	0.95
Bad Boys	0.71	0.42	0.78
Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

movieName	userId 6	7	8	10	11	12	13	14	15	16
Babe	0.62	0.75	0.80	0.04	0.80	0.86	0.84	0.27	0.42	0.34
Inception	0.10	0.82	0.18	0.18	0.93	0.89	1.29	0.30	0.66	0.57
A.I. Artificial Intelligence	0.30	0.71	0.41	0.08	0.80	0.78	0.91	0.17	0.51	0.47
Ace Ventura: Pet Detective	0.45	0.25	0.58	0.05	0.17	0.35	0.45	0.48	-0.02	-0.19
Bad Boys	0.67	0.84	0.87	0.09	0.86	0.97	1.07	0.45	0.44	0.30
Changing Lanes	0.26	0.53	0.35	0.08	0.58	0.60	0.75	0.23	0.35	0.28
Dumb & Dumber	0.45	0.22	0.58	0.05	0.13	0.32	0.42	0.50	-0.06	-0.24
Event Horizon	-0.44	0.18	-0.50	0.15	0.25	0.16	0.58	0.07	0.30	0.29
Full Metal Jacket	0.12	0.68	0.19	0.09	0.80	0.72	0.89	0.07	0.57	0.56
I, Robot	-0.21	0.57	-0.20	0.20	0.67	0.60	1.11	0.24	0.55	0.48

$$u_8 \cdot m_{\text{ir}} = 0.89 \cdot 0.34 + -0.75 \cdot 1.00 + 0.71 \cdot 0.35 = -0.20$$

	6	7	8	10	11	12	13	14	15	16
	0.71	0.85	0.89	0.00	0.94	0.94	0.75	0.07	0.52	0.51
	−0.6	0.22	−0.7	0.2	0.33	0.18	0.75	0.04	0.42	0.42
	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	−0.1	−0.3
Babe	0.74	0.22	0.43	0.62	0.75	0.80	0.04	0.80	0.86	0.84	0.27	0.42	0.34
Inception	0.63	0.92	0.44	0.10	0.82	0.18	0.18	0.93	0.89	1.29	0.30	0.66	0.57
A.I.	0.67	0.46	0.22	0.30	0.71	0.41	0.08	0.80	0.78	0.91	0.17	0.51	0.47
Ace Ventura	0.05	0.18	0.95	0.45	0.25	0.58	0.05	0.17	0.35	0.45	0.48	0.00	−0.2
Bad Boys	0.71	0.42	0.78	0.67	0.84	0.87	0.09	0.86	0.97	1.07	0.45	0.44	0.30
Changing Lanes	0.44	0.41	0.38	0.26	0.53	0.35	0.08	0.58	0.60	0.75	0.23	0.35	0.28
Dumb & Dumber	0.00	0.17	1.00	0.45	0.22	0.58	0.05	0.13	0.32	0.42	0.50	−0.1	−0.2
Event Horizon	0.00	0.74	0.08	−0.4	0.18	−0.5	0.15	0.25	0.16	0.58	0.07	0.30	0.29
Full Metal Jacket	0.66	0.53	0.00	0.12	0.68	0.19	0.09	0.80	0.72	0.89	0.07	0.57	0.56
I, Robot	0.34	1.00	0.35	−0.2	0.57	−0.2	0.20	0.67	0.60	1.11	0.24	0.55	0.48

$$u_8 \cdot m_{\text{ir}} = 0.89 \cdot 0.34 + -0.75 \cdot 1.00 + 0.71 \cdot 0.35 = -0.20$$

Ga naar **wooclap.com** en gebruik de code **CI03**

(i) Wat komt er op de plek van het vraagteken te staan?

Tijd om te stemmen!

0

antwoorden gekregen

Klik op het geprojecteerd scherm om de vraag te activeren

wooclap

100 %

0

$$\begin{array}{c} \\ \text{Film 1} \\ \text{Film 2} \\ \text{Film 3} \end{array} \begin{pmatrix} 1.0 & 0.0 & 0.0 \\ 0.5 & 0.5 & 0.0 \\ 0.0 & 0.0 & 1.0 \end{pmatrix} \begin{array}{c} \begin{array}{ccc} \text{drama} & \text{thriller} & \text{comedy} \end{array} \\ \begin{pmatrix} 0.5 & 0.0 & 0.0 \\ 0.5 & 1.0 & 1.0 \\ 0.0 & 0.0 & 1.0 \end{pmatrix} \end{array} \begin{array}{c} \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \begin{pmatrix} 0.5 & 0.0 & 0.0 \\ 0.5 & ? & 0.5 \\ 0.0 & 0.0 & 1.0 \end{pmatrix} \end{array}$$

Ga naar **wooclap.com** en gebruik de code **CI03**

(ii) Wat komt er op de plek van het vraagteken te staan?

Klik op het geprojecteerd scherm om de vraag te activeren

0 antwoorden gekregen

wooclap

100 %

0

$$\begin{array}{c} \\ \text{Film 1} \\ \text{Film 2} \\ \text{Film 3} \end{array} \begin{array}{c} \begin{array}{cc} \text{drama} & \text{sci-fi} \end{array} \\ \begin{pmatrix} 1.0 & 0.0 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix} \end{array} \begin{array}{c} \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \begin{pmatrix} 0.5 & 0.5 & 0.0 \\ 0.0 & 0.5 & 1.0 \end{pmatrix} \\ \begin{pmatrix} 0.5 & 0.0 & 0.0 \\ 0.5 & ? & 0.5 \\ 0.0 & 0.0 & 1.0 \end{pmatrix} \end{array}$$

userId	drama	thriller	comedy
6	0.71	-0.65	0.56
7	0.85	0.22	0.18
8	0.89	-0.75	0.71
10	-0.02	0.20	0.02
11	0.94	0.33	0.07
12	0.94	0.18	0.29
13	0.75	0.75	0.29
14	0.07	0.04	0.49
15	0.52	0.42	-0.13
16	0.51	0.42	-0.31

userId	6	7	8	10	11	12	13	14	15	16
drama	0.71	0.85	0.89	-0.02	0.94	0.94	0.75	0.07	0.52	0.51
thriller	-0.65	0.22	-0.75	0.20	0.33	0.18	0.75	0.04	0.42	0.42
comedy	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	-0.13	-0.31

Transponeren

$$U$$

$$\begin{pmatrix} 0.71 & -0.6 & 0.56 \\ 0.85 & 0.22 & 0.18 \\ 0.89 & -0.7 & 0.71 \\ 0.00 & 0.2 & 0.02 \\ 0.94 & 0.33 & 0.07 \\ 0.94 & 0.18 & 0.07 \\ 0.75 & 0.75 & 0.29 \\ 0.07 & 0.04 & 0.49 \\ 0.52 & 0.42 & -0.1 \\ 0.51 & 0.42 & -0.3 \end{pmatrix}$$

$$U^T$$

$$\begin{pmatrix} 0.71 & 0.85 & 0.89 & 0.00 & 0.94 & 0.94 & 0.75 & 0.07 & 0.52 & 0.51 \\ -0.6 & 0.22 & -0.7 & 0.2 & 0.33 & 0.18 & 0.75 & 0.04 & 0.42 & 0.42 \\ 0.56 & 0.18 & 0.71 & 0.02 & 0.07 & 0.29 & 0.29 & 0.49 & -0.1 & -0.3 \end{pmatrix}$$

	6	7	8	10	11	12	13	14	15	16
U^T	0.71	0.85	0.89	0.00	0.94	0.94	0.75	0.07	0.52	0.51
	−0.6	0.22	−0.7	0.2	0.33	0.18	0.75	0.04	0.42	0.42
	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	−0.1	−0.3

Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I.	0.67	0.46	0.22
Ace Ventura	0.05	0.18	0.95
Bad Boys	0.71	0.42	0.78
Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

M

$\hat{R}$	0.62	0.75	0.80	0.04	0.80	0.86	0.84	0.27	0.42	0.34
	0.10	0.82	0.18	0.18	0.93	0.89	1.29	0.30	0.66	0.57
	0.30	0.71	0.41	0.08	0.80	0.78	0.91	0.17	0.51	0.47
	0.45	0.25	0.58	0.05	0.17	0.35	0.45	0.48	0.00	−0.2
	0.67	0.84	0.87	0.09	0.86	0.97	1.07	0.45	0.44	0.30
	0.26	0.53	0.35	0.08	0.58	0.60	0.75	0.23	0.35	0.28
	0.45	0.22	0.58	0.05	0.13	0.32	0.42	0.50	−0.1	−0.2
	−0.4	0.18	−0.5	0.15	0.25	0.16	0.58	0.07	0.30	0.29
	0.12	0.68	0.19	0.09	0.80	0.72	0.89	0.07	0.57	0.56
	−0.2	0.57	−0.2	0.20	0.67	0.60	1.11	0.24	0.55	0.48

$$M \cdot U^T = \hat{R}$$

$$B = \begin{pmatrix} | & | & & | \\ b_1 & b_2 & \cdots & b_n \\ | & | & & | \end{pmatrix}$$

$$A = \begin{pmatrix} - & a_1 & - \\ - & a_2 & - \\ & \vdots & \\ - & a_n & - \end{pmatrix} \qquad C = \begin{pmatrix} a_1 \cdot b_1 & a_1 \cdot b_2 & \cdots & a_1 \cdot b_n \\ a_2 \cdot b_1 & a_2 \cdot b_2 & \cdots & a_2 \cdot b_n \\ \vdots & \vdots & \ddots & \vdots \\ a_n \cdot b_1 & a_n \cdot b_2 & \cdots & a_n \cdot b_n \end{pmatrix}$$

$$A \cdot B = C$$

userId	6	7	8	10	11	12	13	14	15	16
drama	0.71	0.85	0.89	-0.02	0.94	0.94	0.75	0.07	0.52	0.51
thriller	-0.65	0.22	-0.75	0.20	0.33	0.18	0.75	0.04	0.42	0.42
comedy	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	-0.13	-0.31

movieName	drama	thriller	comedy
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Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

movieName	userId	6	7	8	10	11	12	13	14	15	16
Babe		0.62	0.75	0.80	0.04	0.80	0.86	0.84	0.27	0.42	0.34
Inception		0.10	0.82	0.18	0.18	0.93	0.89	1.29	0.30	0.66	0.57
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Bad Boys		0.67	0.84	0.87	0.09	0.86	0.97	1.07	0.45	0.44	0.30
Changing Lanes		0.26	0.53	0.35	0.08	0.58	0.60	0.75	0.23	0.35	0.28
Dumb & Dumber		0.45	0.22	0.58	0.05	0.13	0.32	0.42	0.50	-0.06	-0.24
Event Horizon		-0.44	0.18	-0.50	0.15	0.25	0.16	0.58	0.07	0.30	0.29
Full Metal Jacket		0.12	0.68	0.19	0.09	0.80	0.72	0.89	0.07	0.57	0.56
I, Robot		-0.21	0.57	-0.20	0.20	0.67	0.60	1.11	0.24	0.55	0.48

```
1 user_matrix_transposed = user_matrix.T
2 predicted_ratings = movie_matrix @ user_matrix_transposed
```

$$A = \begin{pmatrix} 1.0 & 0.0 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix}$$

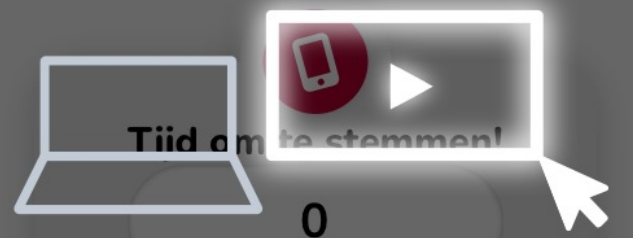
$$B = \begin{pmatrix} 0.5 & 1.0 & 0.0 \\ 0.0 & 0.5 & 1.0 \end{pmatrix}$$

$$A \cdot B = C$$

$$C = \begin{pmatrix} 0.5 & 0.0 & 0.0 \\ 0.5 & ? & 0.5 \\ 0.0 & 0.0 & 1.0 \end{pmatrix}$$

Ga naar **wooclap.com** en gebruik de code **CI03**

(iii) Wat komt er op de plek van het vraagteken te staan?



0

Klik op het geprojecteerd scherm om de vraag te activeren
antwoorden gekregen

wooclap

100 %

0

$$A = \begin{pmatrix} 1.0 & 0.0 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix}$$

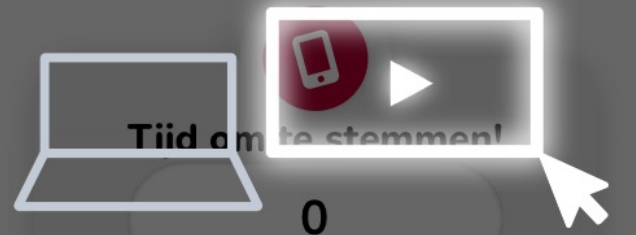
$$B = \begin{pmatrix} 0.5 & 1.0 & 0.0 \\ 0.0 & 0.4 & 1.0 \end{pmatrix}$$

$$B \cdot A = C$$

$$C = \begin{pmatrix} 1.0 & 1.0 \\ 0.2 & ? \end{pmatrix}$$

Ga naar **wooclap.com** en gebruik de code **CI03**

(v) Wat komt er op de plek van het vraagteken te staan?



0

Klik op het geprojecteerd scherm om de vraag te activeren
antwoorden gekregen

wooclap

100 %

0

$$A = \begin{pmatrix} 1.0 & 0.0 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix}$$

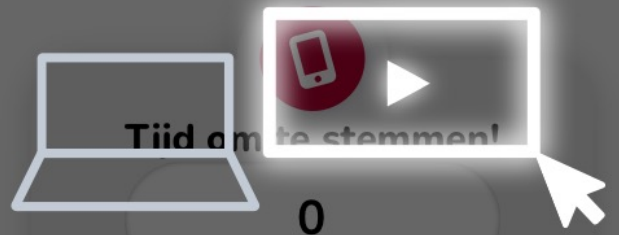
$$B = \begin{pmatrix} 0.5 & 1.0 & 0.6 & 0.2 & 0.0 \\ 0.0 & 0.5 & 0.4 & 0.9 & 1.0 \end{pmatrix}$$

$$A \cdot B = C$$

$$C = \begin{pmatrix} 0.5 & 0.0 & 0.6 & 0.2 & 0.0 \\ 0.5 & 1.0 & 0.7 & 1.0 & 0.5 \\ 0.0 & 0.0 & ? & 0.9 & 1.0 \end{pmatrix}$$

Ga naar **wooclap.com** en gebruik de code **CI03**

(iv) Wat komt er op de plek van het vraagteken te staan?



0

Klik op het geprojecteerd scherm om de vraag te activeren
antwoorden gekregen

wooclap 100 % 0

Dimensies

$A \cdot B = C$

$$B \begin{pmatrix} 0.5 & 1.0 & 0.6 & 0.2 & 0.0 \\ 0.0 & 0.5 & 0.4 & 0.9 & 1.0 \end{pmatrix}$$

b

$$A \begin{pmatrix} 1.0 & 0.0 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix} \quad \text{h} \quad C \begin{pmatrix} 0.5 & 0.0 & 0.6 & 0.2 & 0.0 \\ 0.5 & 1.0 & 0.7 & 1.0 & 0.5 \\ 0.0 & 0.0 & ? & 0.9 & 1.0 \end{pmatrix}$$

Hoeveel kolommen en rijen heeft C?

$$A = \begin{pmatrix} 1.0 & 0.0 \\ 0.3 & 0.1 \\ 0.1 & 0.2 \\ 1.0 & 0.7 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix}$$

$$B = \begin{pmatrix} 0.5 & 1.0 & 0.6 & 0.2 & 0.0 \\ 0.0 & 0.5 & 0.4 & 0.9 & 1.0 \end{pmatrix}$$

$$A \cdot B = C$$

Ga naar **wooclap.com** en gebruik de code **CI03**

(i) Hoeveel kolommen en rijen heeft C?

1 rijen = 2, kolommen = 2 — 0% — 0

2 rijen = 6, kolommen = 5 — 0%

0

Klik op het geprojecteerd scherm om de vraag te activeren

3 rijen = 5, kolommen = 6 — 0% — 0

wooclap

100 %

0 / 0

Hoeveel kolommen en rijen heeft C?

$$A = \begin{pmatrix} 0.5 & 1.0 & 0.6 & 0.2 & 0.0 \\ 0.0 & 0.5 & 0.4 & 0.9 & 1.0 \end{pmatrix}$$

$$B = \begin{pmatrix} 1.0 & 0.0 \\ 0.3 & 0.1 \\ 1.0 & 0.7 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix}$$

$$A \cdot B = C$$

Ga naar **wooclap.com** en gebruik de code **CI03**

(ii) Hoeveel kolommen en rijen heeft C?

0

Klik op het geprojecteerd scherm om de vraag te activeren
antwoorden gekregen

wooclap

100 %

0

Hoeveel kolommen en rijen heeft C?

$$A = \begin{pmatrix} 1.0 & 0.0 \\ 0.3 & 0.1 \\ 0.1 & 0.2 \\ 1.0 & 0.7 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix}$$

$$B = \begin{pmatrix} 0.5 & 1.0 & 0.6 & 0.2 & 0.0 \\ 0.2 & 0.4 & 0.6 & 0.1 & 0.7 \\ 0.0 & 0.5 & 0.4 & 0.9 & 1.0 \end{pmatrix}$$

$$A \cdot B = C$$

Ga naar **wooclap.com** en gebruik de code **CI03**

(iii) Hoeveel kolommen en rijen heeft C?

0

Klik op het geprojecteerd scherm om de vraag te activeren
antwoorden gekregen

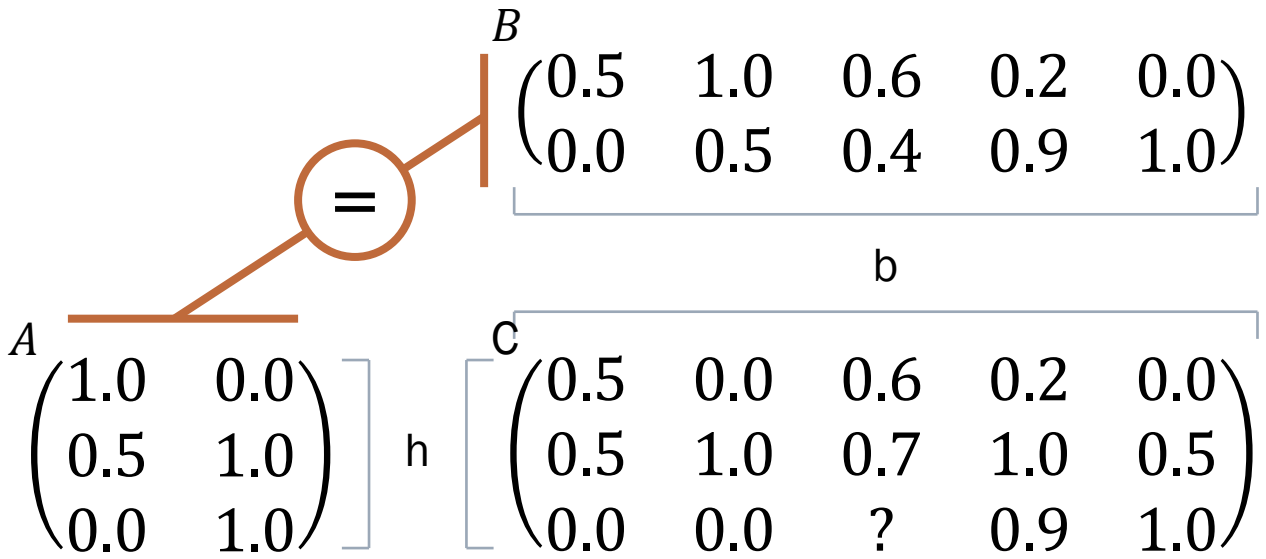
wooclap

100 %

0

Dimensies

$A \cdot B = C$



$$B = \begin{pmatrix} 0.5 & 1.0 & 0.6 & 0.2 & 0.0 \\ 0.0 & 0.5 & 0.4 & 0.9 & 1.0 \end{pmatrix}$$

$$A = \begin{pmatrix} 1.0 & 0.0 \\ 0.5 & 1.0 \\ 0.0 & 1.0 \end{pmatrix}$$

$$C = \begin{pmatrix} 0.5 & 0.0 & 0.6 & 0.2 & 0.0 \\ 0.5 & 1.0 & 0.7 & 1.0 & 0.5 \\ 0.0 & 0.0 & ? & 0.9 & 1.0 \end{pmatrix}$$

Wat heb je geleerd

movieName	drama	thriller	comedy
Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I. Artificial Intelligence	0.67	0.46	0.22
Ace Ventura: Pet Detective	0.05	0.18	0.95
Bad Boys	0.71	0.42	0.78
Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

userId	drama	thriller	comedy
6	0.71	-0.65	0.56
7	0.85	0.22	0.18
8	0.89	-0.75	0.71
10	-0.02	0.20	0.02
11	0.94	0.33	0.07
12	0.94	0.18	0.29
13	0.75	0.75	0.29
14	0.07	0.04	0.49
15	0.52	0.42	-0.13
16	0.51	0.42	-0.31

User matrix op z'n kant

movieName	drama	thriller	comedy
Babe	0.74	0.22	0.43
Inception	0.63	0.92	0.44
A.I. Artificial Intelligence	0.67	0.46	0.22
Ace Ventura: Pet Detective	0.05	0.18	0.95
Bad Boys	0.71	0.42	0.78
Changing Lanes	0.44	0.41	0.38
Dumb & Dumber	0.00	0.17	1.00
Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

userId	6	7	8	10	11	12	13	14	15	16
drama	0.71	0.85	0.89	-0.02	0.94	0.94	0.75	0.07	0.52	0.51
thriller	-0.65	0.22	-0.75	0.20	0.33	0.18	0.75	0.04	0.42	0.42
comedy	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	-0.13	-0.31

userId	6	7	8	10	11	12	13	14	15	16
drama	0.71	0.85	0.89	-0.02	0.94	0.94	0.75	0.07	0.52	0.51
thriller	-0.65	0.22	-0.75	0.20	0.33	0.18	0.75	0.04	0.42	0.42
comedy	0.56	0.18	0.71	0.02	0.07	0.29	0.29	0.49	-0.13	-0.31

movieName	drama	thriller	comedy
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Event Horizon	0.00	0.74	0.08
Full Metal Jacket	0.66	0.53	0.00
I, Robot	0.34	1.00	0.35

movieName	userId	6	7	8	10	11	12	13	14	15	16
Babe		0.62	0.75	0.80	0.04	0.80	0.86	0.84	0.27	0.42	0.34
Inception		0.10	0.82	0.18	0.18	0.93	0.89	1.29	0.30	0.66	0.57
A.I. Artificial Intelligence		0.30	0.71	0.41	0.08	0.80	0.78	0.91	0.17	0.51	0.47
Ace Ventura: Pet Detective		0.45	0.25	0.58	0.05	0.17	0.35	0.45	0.48	-0.02	-0.19
Bad Boys		0.67	0.84	0.87	0.09	0.86	0.97	1.07	0.45	0.44	0.30
Changing Lanes		0.26	0.53	0.35	0.08	0.58	0.60	0.75	0.23	0.35	0.28
Dumb & Dumber		0.45	0.22	0.58	0.05	0.13	0.32	0.42	0.50	-0.06	-0.24
Event Horizon		-0.44	0.18	-0.50	0.15	0.25	0.16	0.58	0.07	0.30	0.29
Full Metal Jacket		0.12	0.68	0.19	0.09	0.80	0.72	0.89	0.07	0.57	0.56
I, Robot		-0.21	0.57	-0.20	0.20	0.67	0.60	1.11	0.24	0.55	0.48

```
1 user_matrix_transposed = user_matrix.T
2 predicted_ratings = movie_matrix @ user_matrix_transposed
```

Vragen?

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