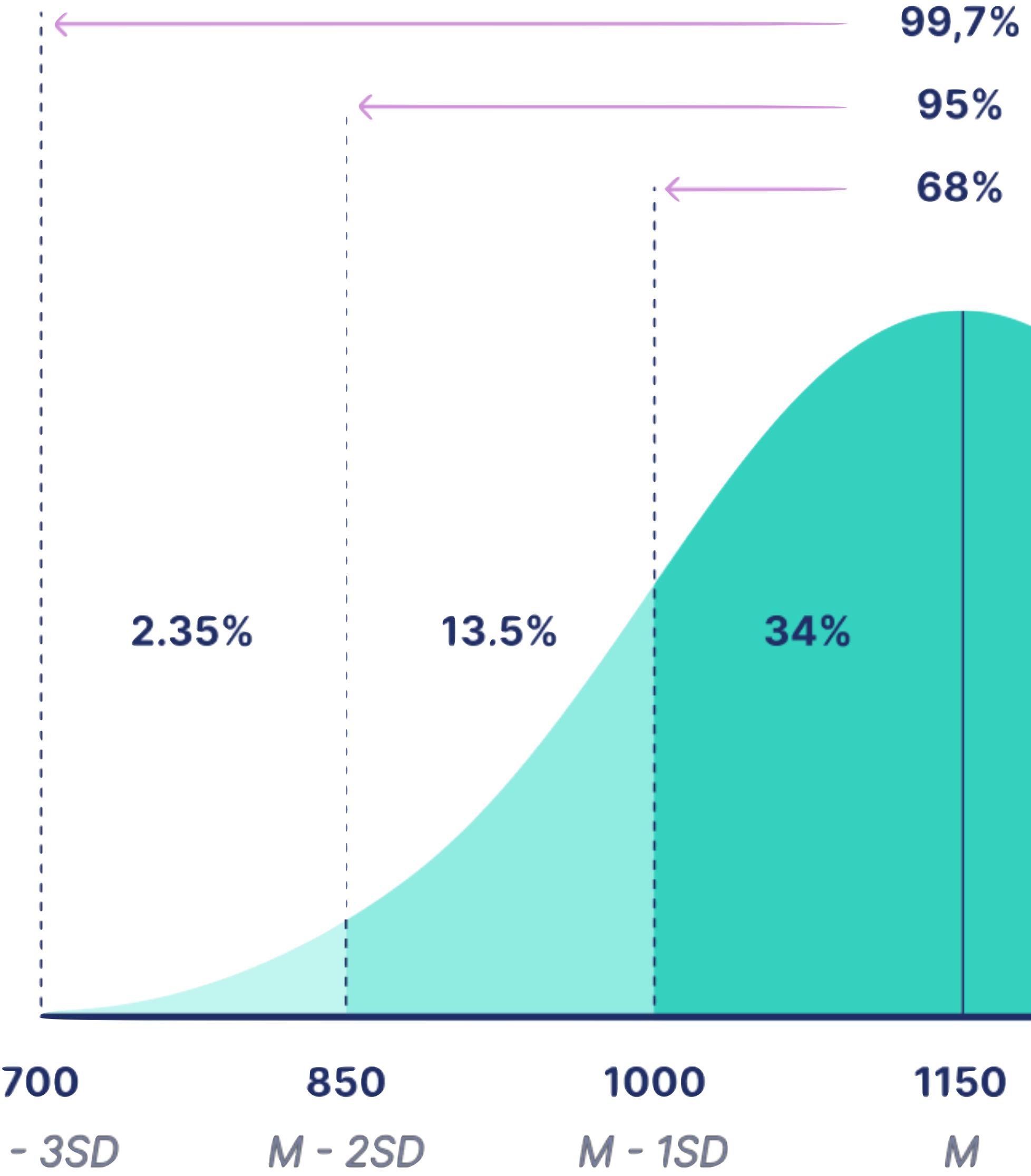


CLASS 7

CATCHUP MATRIX AND VECTOR OPERATIONS +
OLS PROBLEM + EXERCISES FOR REVIEW

AGENDA

- Recap of class 6
 - Matrix compatibility
 - Transposing
 - Showing inversion
- Exercises for review introduced 
- Break
- You guys do some exercises
- OLS problem walkthrough



MATRIX MULTIPLICATION (PT. 1/3)

? DISCUSS WITH YOUR NEIGHBOUR: WHEN CAN I MULTIPLY TWO MATRICES?

COMPATIBILITY
STATUS

?

?

MATRIX MULTIPLICATION (PT. 1/3)

? DISCUSS WITH YOUR NEIGHBOUR: WHEN CAN I MULTIPLY TWO MATRICES?

COMPATIBILITY
STATUS

Two matrices can be multiplied, if

The number of columns in the **1st** matrix
equals number of rows in the **2nd**

?

MATRIX MULTIPLICATION (PT. 1/3)

? DISCUSS WITH YOUR NEIGHBOUR: WHEN CAN I MULTIPLY TWO MATRICES?

COMPATIBILITY STATUS

Two matrices can be multiplied, if

The number of columns in the **1st** matrix
equals number of rows in the **2nd**

? DISCUSS WITH YOUR NEIGHBOR:
CAN I MULTIPLY THESE?

1 $C = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}, D = \begin{pmatrix} 5 & 6 & 7 \\ 8 & 9 & 10 \\ 11 & 12 & 13 \end{pmatrix}$

2 $A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}, B = \begin{pmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{pmatrix}$

MATRIX MULTIPLICATION (PT. 1/3)

? DISCUSS WITH YOUR NEIGHBOUR: WHEN CAN I MULTIPLY TWO MATRICES?

Two matrices can be multiplied, if

The number of columns in the **1st** matrix
equals number of rows in the **2nd**

COMPATIBILITY
STATUS

? DISCUSS WITH YOUR NEIGHBOR:
CAN I MULTIPLY THESE?

1 $C = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}, D = \begin{pmatrix} 5 & 6 & 7 \\ 8 & 9 & 10 \\ 11 & 12 & 13 \end{pmatrix}$

C (2x2) and D (3x2)

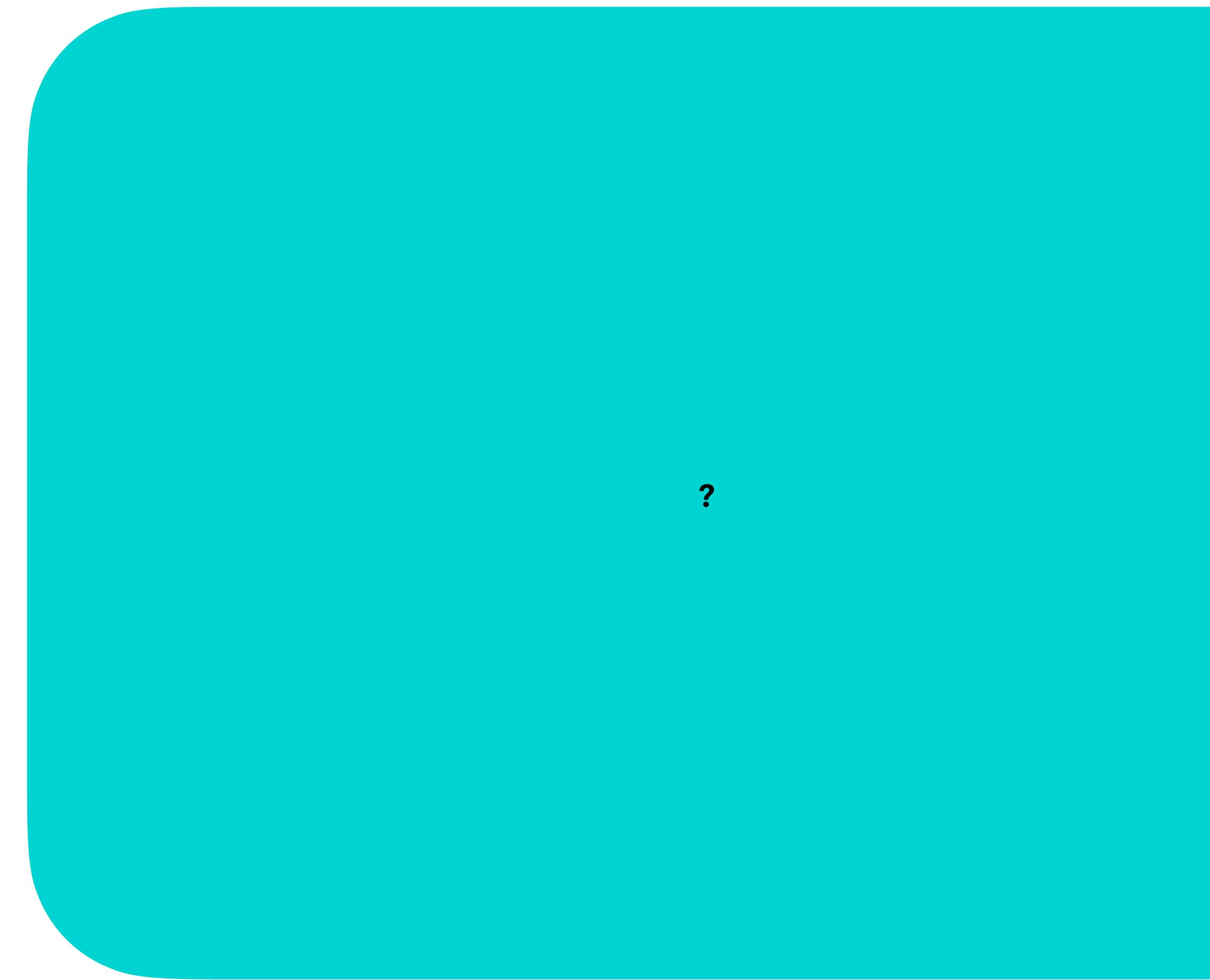
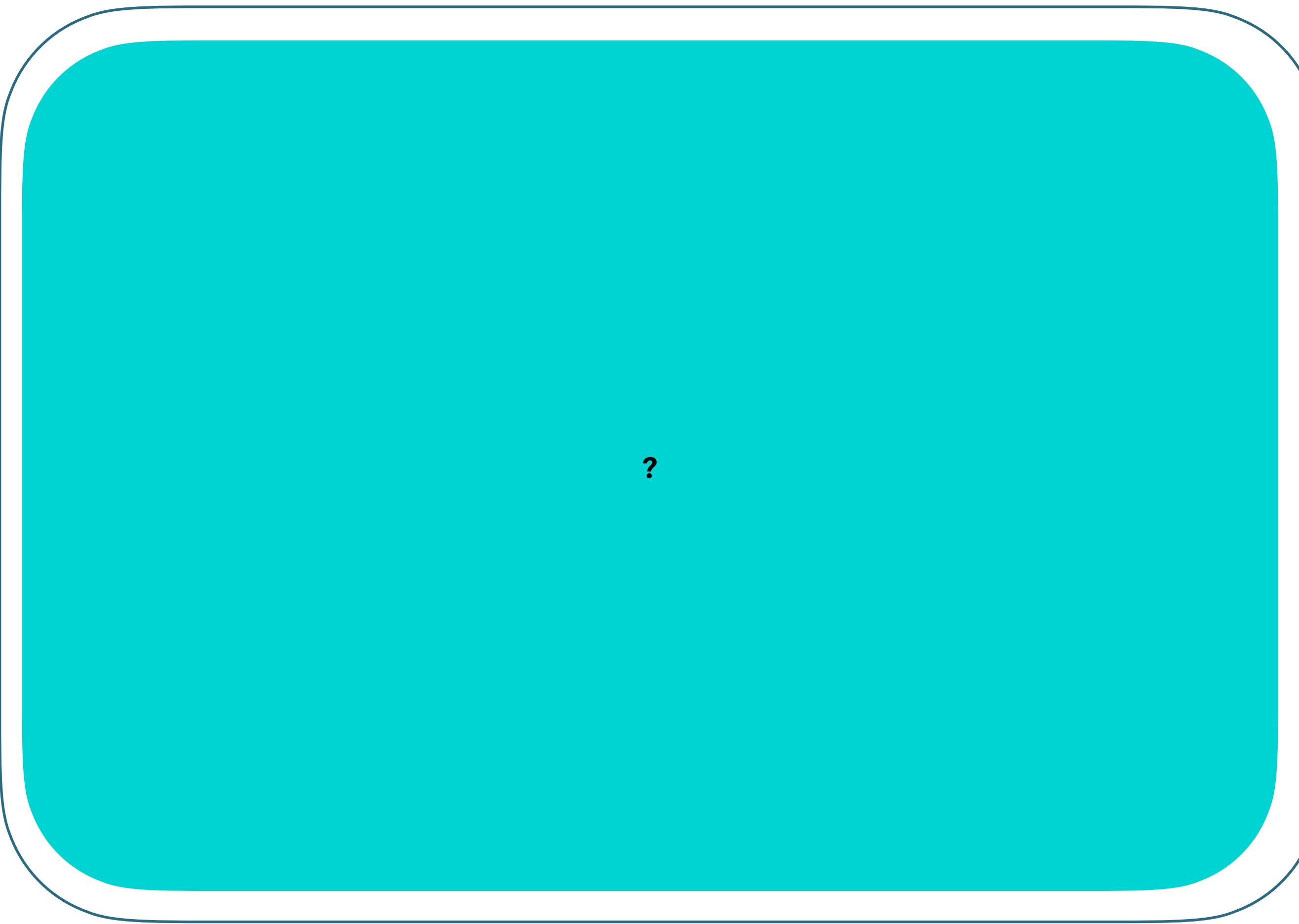
2 $A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}, B = \begin{pmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{pmatrix}$

A (2x3) and B (3x2)



MATRIX MULTIPLICATION (PT. 2/3)

? DISCUSS WITH YOUR NEIGHBOUR: WHAT DIMENSIONS SHOULD THE PRODUCT MATRIX HAVE?



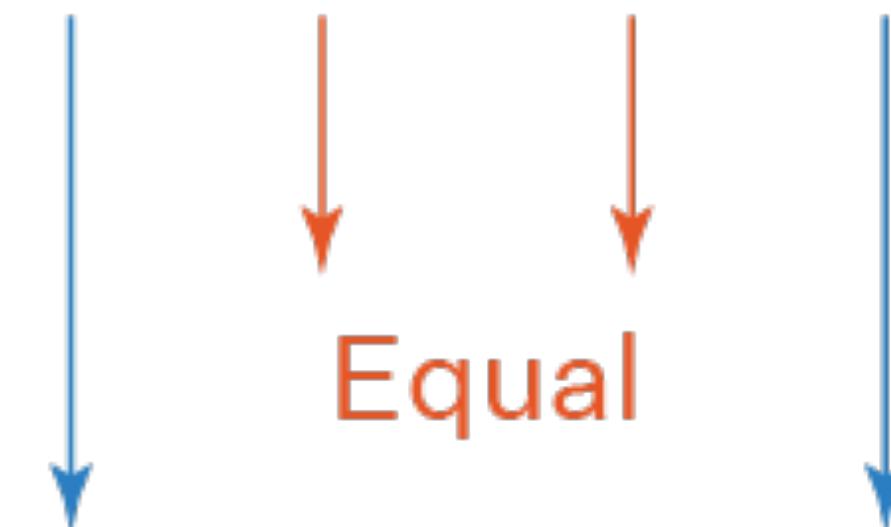
MATRIX MULTIPLICATION (PT. 2/3)

? DISCUSS WITH YOUR NEIGHBOUR: WHAT DIMENSIONS SHOULD THE PRODUCT MATRIX HAVE?

Rule For Matrix Multiplication



$$A \quad . \quad B = AB$$
$$m \times n \quad n \times p \quad m \times p$$



Dimensions of AB

<https://www.cuemath.com/algebra/multiplication-of-matrices/>

?

MATRIX MULTIPLICATION (PT. 2/3)

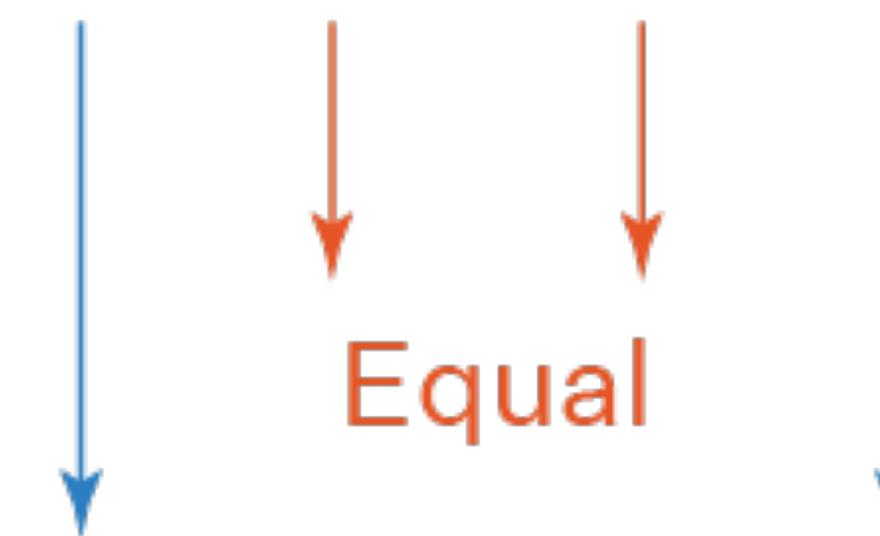
? DISCUSS WITH YOUR NEIGHBOUR: WHAT DIMENSIONS SHOULD THE PRODUCT MATRIX HAVE?

Rule For Matrix Multiplication



$$A \cdot B = AB$$

$m \times n$ $n \times p$ $m \times p$



Dimensions of AB

<https://www.cuemath.com/algebra/multiplication-of-matrices/>

? WHAT DIMENSIONS WILL A^*B HAVE?

1

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}, B = \begin{pmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{pmatrix}$$

A (2x3) and B (3x2)

? WHAT DIMENSIONS WILL E^*F HAVE?

3

$$E = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}, F = \begin{pmatrix} 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 \end{pmatrix}$$

E (3x2) and F (2x4)

?

MATRIX MULTIPLICATION (PT. 2/3)

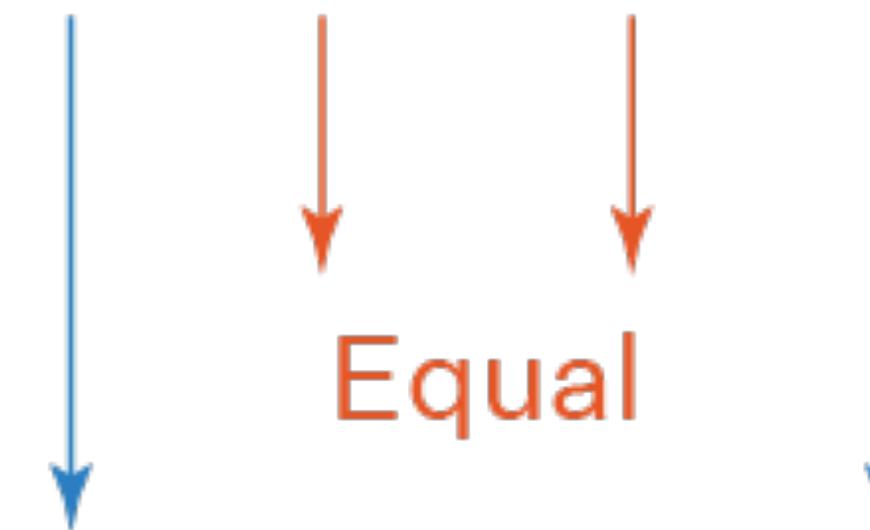
? DISCUSS WITH YOUR NEIGHBOUR: WHAT DIMENSIONS SHOULD THE PRODUCT MATRIX HAVE?

Rule For Matrix Multiplication



$$A \cdot B = AB$$

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Dimensions of AB

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$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}, B = \begin{pmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{pmatrix}$$

A (2x3) and B (3x2)

? WHAT DIMENSIONS WILL E^*F HAVE?

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$$E = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}, F = \begin{pmatrix} 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 \end{pmatrix}$$

E (3x2) and F (2x4)

? CALCULATE THE PRODUCTS AB AND EF

MATRIX MULTIPLICATION (PT. 2/3)

1 $A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 11 & 12 \end{pmatrix}, B = \begin{pmatrix} 7 & 8 \\ 9 & 10 \end{pmatrix}$

A (2x3) and B (3x2)

$$AB = \begin{pmatrix} 58 & 64 \\ 139 & 154 \end{pmatrix}$$

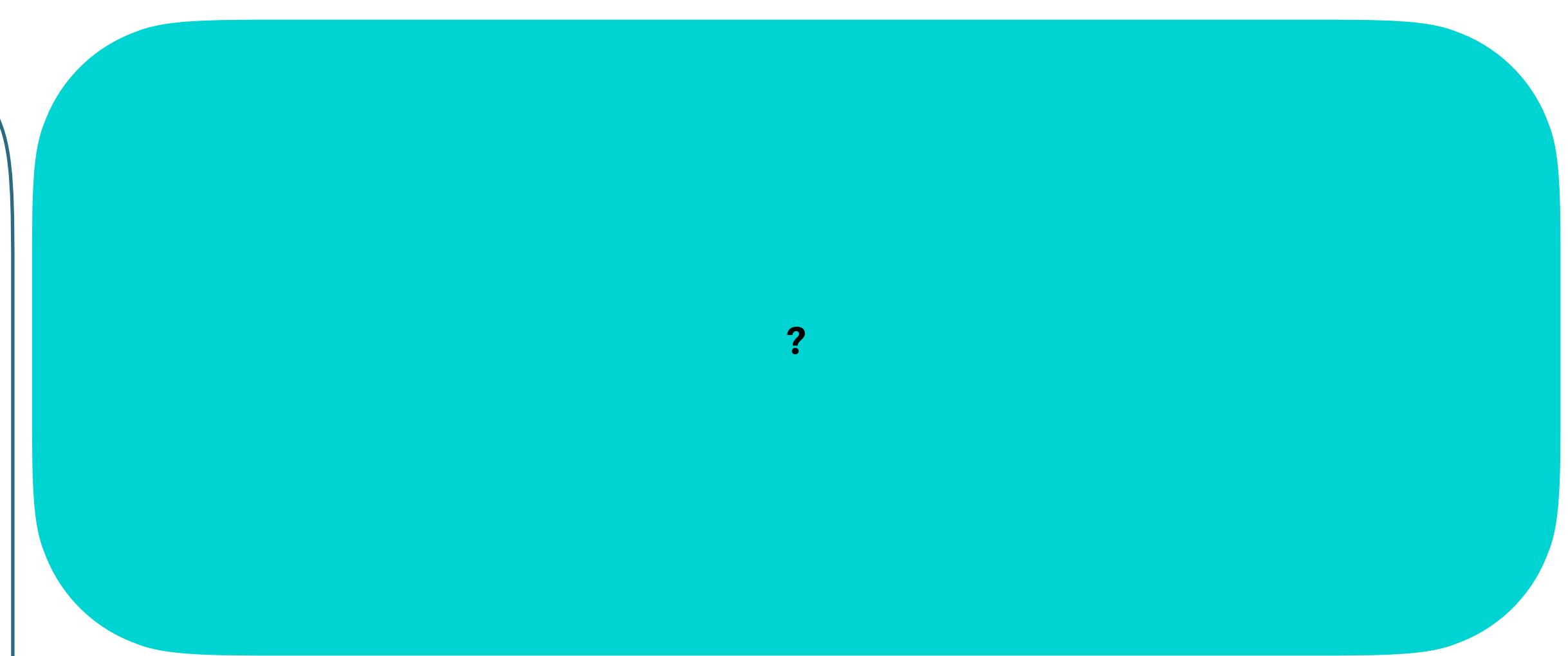
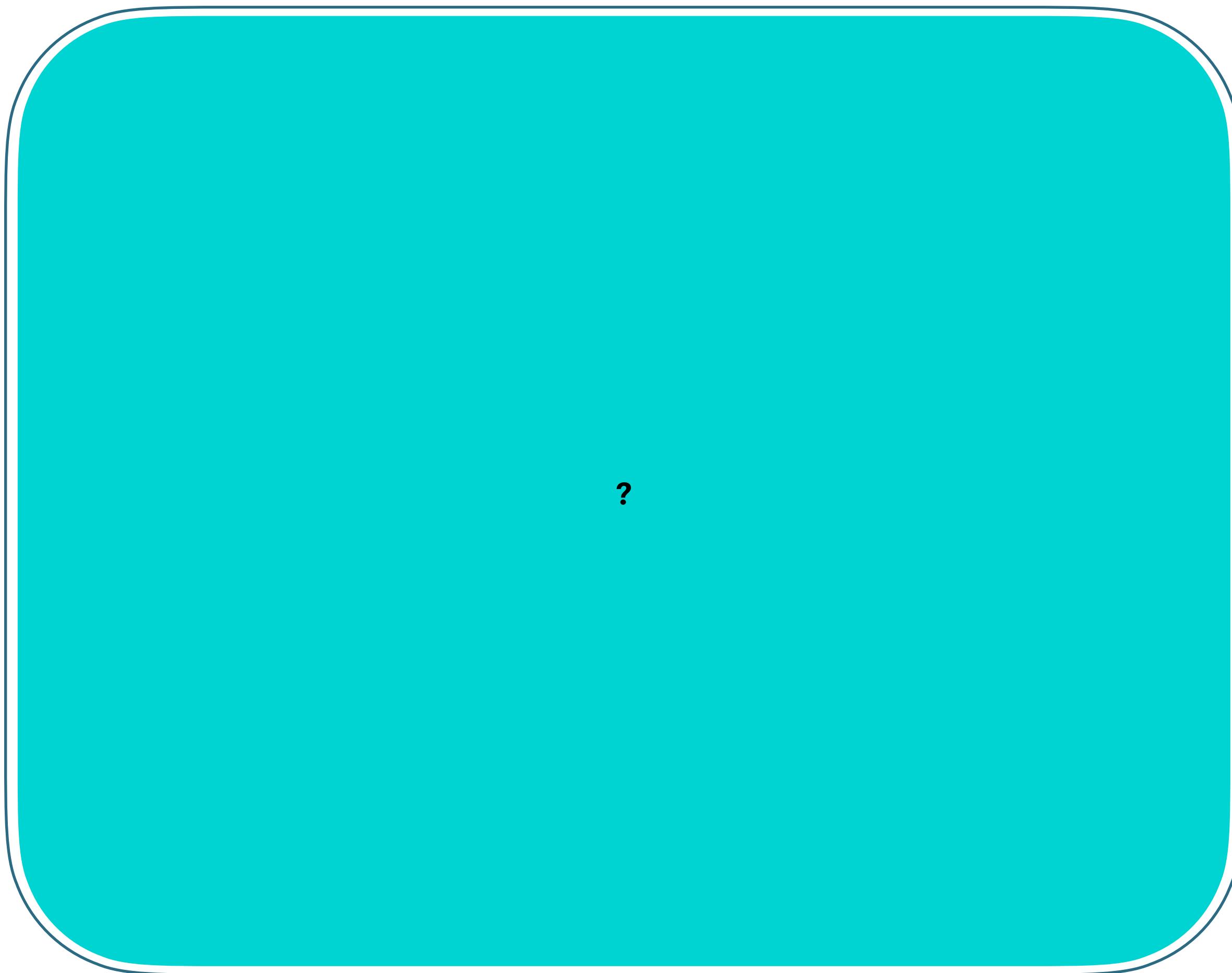
3 $E = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}, F = \begin{pmatrix} 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 \end{pmatrix}$

E (3x2) and F (2x4)

$$EF = \begin{pmatrix} 29 & 32 & 35 & 38 \\ 65 & 72 & 79 & 86 \\ 101 & 112 & 123 & 134 \end{pmatrix}$$

MATRIX MULTIPLICATION (PT. 3/3)

? DISCUSS WITH YOUR NEIGHBOUR: HOW TO TRANSPOSE A MATRIX?



MATRIX MULTIPLICATION (PT. 3/3)

? DISCUSS WITH YOUR NEIGHBOUR: HOW TO TRANSPOSE A MATRIX?

You transpose a matrix by flipping a matrix on its diagonal:

Transpose of a Matrix



$$A = \begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}_{2 \times 3}$$

$$A^T = \begin{bmatrix} a & d \\ b & e \\ c & f \end{bmatrix}_{3 \times 2}$$

<https://www.cuemath.com/algebratranspose-of-a-matrix/>

?

MATRIX MULTIPLICATION (PT. 3/3)

? DISCUSS WITH YOUR NEIGHBOUR: HOW TO TRANSPOSE A MATRIX?

You transpose a matrix by flipping a matrix on its diagonal:

Transpose of a Matrix



$$A = \begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}_{2 \times 3}$$

$$A^T = \begin{bmatrix} a & d \\ b & e \\ c & f \end{bmatrix}_{3 \times 2}$$

<https://www.cuemath.com/algebra/transpose-of-a-matrix/>

? IN GROUPS

TRANSPOSE THE FOLLOWING MATRICES:

1

$$F = \begin{pmatrix} 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 \end{pmatrix}$$

2

$$D = \begin{pmatrix} 5 & 6 & 7 \\ 8 & 9 & 10 \\ 11 & 12 & 13 \end{pmatrix}$$

INVERSION

HOW TO INVERT A MATRIX: THERE ARE MANY WAYS

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

The inverse of a matrix is found using the following formula:

$$A^{-1} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}^{-1} \quad \text{https://byjus.com/math/inverse-matrix/}$$

$$A^{-1} = \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

In R:

```
A <- matrix(c(4, 7, 2, 6), nrow=2)
```

```
A_inv <- solve(A)
```

(There's also a method using the "reduced row echelon form" to find the inverse which we will cover lastly today if time)

$$R_2 - 2R_1 \left[\begin{array}{cc|cc} 1 & -1 & 1 & 0 \\ 0 & 1 & -2 & 1 \end{array} \right]$$

$$R_1 + R_2 \left[\begin{array}{cc|cc} 1 & 0 & -1 & 1 \\ 0 & 1 & -2 & 1 \end{array} \right]$$

<https://www.analyzemath.com/linear-algebra/matrices/find-matrix-inverse-using-row-operations.html>

BREAK

The image shows a Spotify interface displaying a public playlist. The title of the playlist is "methods 2222222". Below the title, it says "what will the vibes be?". The playlist was created by Pernille Brams and has 8 likes. It contains 33 songs, with a total duration of 1 hr 55 min. The interface includes a play button, shuffle, repeat, and download icons. A search bar and a "Custom order" button are also visible. The table below lists the first three songs:

#	Title	Album	Added by	Length
1	The Spins	K.I.D.S. (Deluxe)	Pernille Bra...	3:16
2	Himmeldiskoteket	Isas Stepz (Musikken ...)	Pernille Bra...	3:37
3	Sinner	Prelude to Ecstasy	forao.reka2...	2:56

Collab: <https://open.spotify.com/playlist/5UUiKD15vyFwymQ4qLur9V?si=cf80f6c72721427c&pt=a27065eeba53e23fe2dd160612aa5598>

EXERCISES

The image shows a Spotify interface displaying a public playlist. The playlist is titled "methods 2222222" and has a description "what will the vibes be?". It was created by Pernille Brams and 8 others, with 8 likes and 33 songs, lasting 1 hr 55 min. The playlist cover features four small images: a person sitting on a couch with a boombox, a girl in a pink dress, a group of people at a party, and a close-up of a face.

Public Playlist
methods 2222222
what will the vibes be?
Pernille Brams and 8 others • 8 likes • 33 songs, 1 hr 55 min

#	Title	Album	Added by	L
1	The Spins E Mac Miller, Empire ...	K.I.D.S. (Deluxe)	Pernille Bra...	3:16
2	Himmeldiskoteket Isas Stepz	Isas Stepz (Musikken ...)	Pernille Bra...	3:37
3	Sinner	Prelude to Ecstasy	forao.reka2...	2:56

Collab: <https://open.spotify.com/playlist/5UUiKD15vyFwymQ4qLur9V?si=cf80f6c72721427c&pt=a27065eeba53e23fe2dd160612aa5598>