

PROGRAMMING IN C

Wed 14 Nov 2018

PROBLEM

WRITE a progs. that (lang. C)

- 1) Defines matrices (2x2)
- 2) Implements multiplication of
2 such matrices
- 3) Implements addition of
2 such matrices

(Hint: Define it as an
array of 4 #'s)

What are those things (called matrices) (sing. matrix)?

First nothing to do with the film series in

Definition A matrix is an arrangement of numbers in a rectangular
form

Ex.: A 2×2 matrix has 2 rows & 2 columns

$$\begin{pmatrix} 3 & 1 \\ 2 & 1.5 \end{pmatrix}$$

Ex:

Ex: A 3×2 matrix has 3 rows & 2 columns

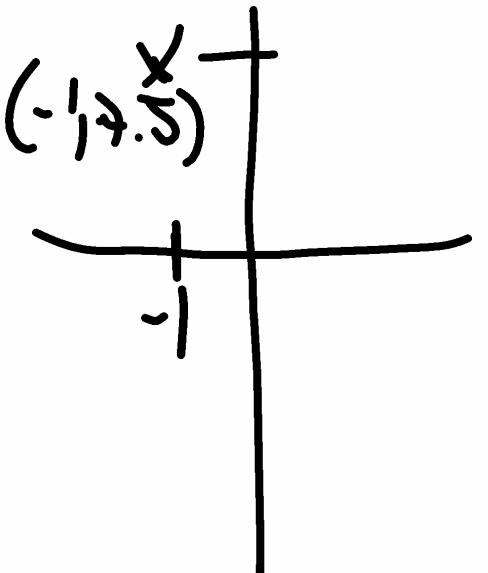
$$\begin{pmatrix} 1 & \frac{1}{2} \\ \frac{3}{4} & 5 \\ 7.3 & -1 \end{pmatrix}$$

Ex: A 2×3 matrix has 2 rows & 3 columns

$$\begin{pmatrix} 5 & -1 & 2 \\ \frac{7}{3} & -4 & 0 \end{pmatrix}$$

Arrangements of #'s are not rare. We have already seen in math that a point on the plane is given by

2 #'s arranged as an ordered pair (x, y) . Eg: $(-1, 2.5)$



Example: A Gates in

Quantum Computation are **Square** matrices

And X, Y, Z, H these are 2×2 matrices

But CNOT is 4×4 matrix

Multiplication of 2x2 matrices:

Ex: $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ $B = \begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix}$

$$A \cdot B = \left(\begin{array}{cc|cc} 1 & 2 & 5 & 6 \\ 3 & 4 & 7 & 8 \end{array} \right) = \begin{pmatrix} 1 \cdot 5 + 2 \cdot 7 \\ 3 \cdot 5 + 4 \cdot 7 \end{pmatrix} = \begin{pmatrix} 1 \cdot 6 + 2 \cdot 8 \\ 3 \cdot 6 + 4 \cdot 8 \end{pmatrix} =$$
$$= \begin{pmatrix} 19 & 22 \\ 43 & 50 \end{pmatrix}$$

Diagram illustrating the multiplication process:

- Matrix A is shown as $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$. The columns are labeled with arrows pointing to $1, 2$ and $3, 4$.
- Matrix B is shown as $\begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix}$. The rows are labeled with arrows pointing to $5, 6$ and $7, 8$.
- The product $A \cdot B$ is calculated as follows:
 - Top-left element: $1 \cdot 5 + 2 \cdot 7$ (highlighted in yellow)
 - Top-right element: $3 \cdot 5 + 4 \cdot 7$ (highlighted in green)
 - Bottom-left element: $1 \cdot 6 + 2 \cdot 8$ (highlighted in red)
 - Bottom-right element: $3 \cdot 6 + 4 \cdot 8$ (highlighted in blue)
- The final result is $\begin{pmatrix} 19 & 22 \\ 43 & 50 \end{pmatrix}$, where each element is highlighted with a different color.

Exer6x: What's $B \cdot A$?

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

$$B = \begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix}$$

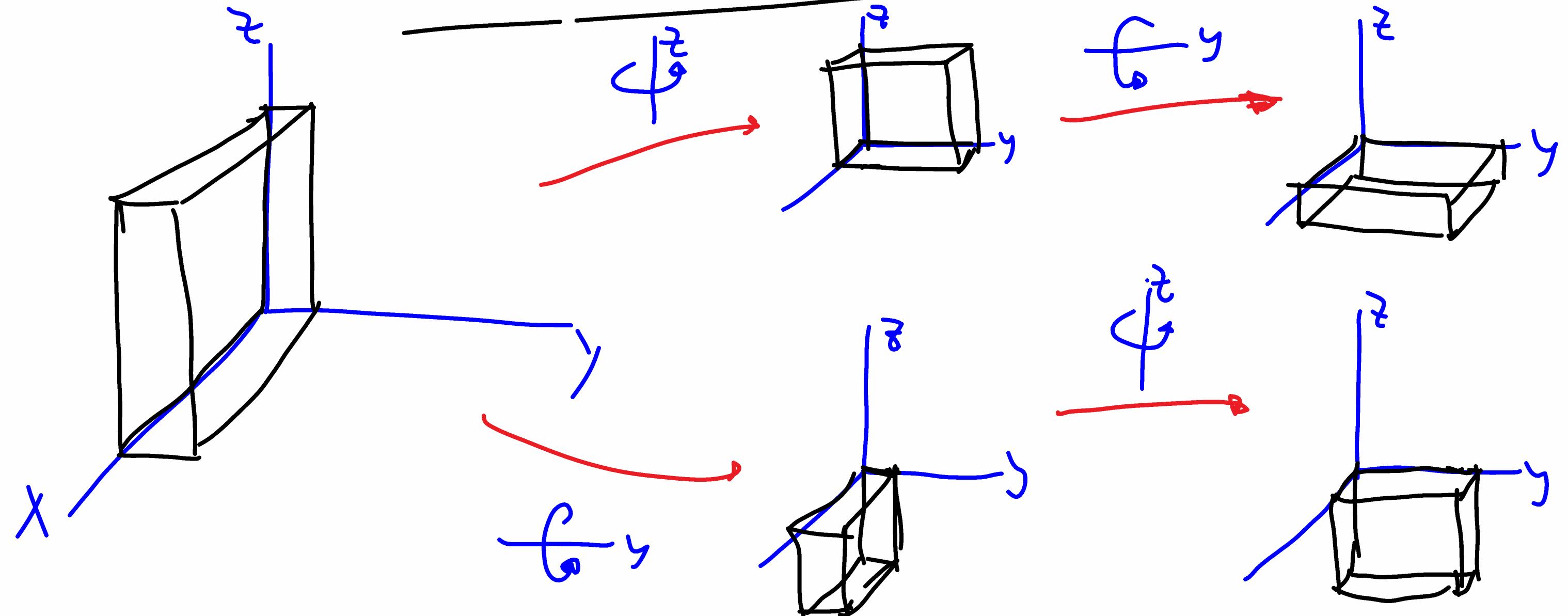
$$B \cdot A = \begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = \begin{pmatrix} 5 \cdot 1 + 6 \cdot 3 & 5 \cdot 2 + 6 \cdot 4 \\ 7 \cdot 1 + 8 \cdot 3 & 7 \cdot 2 + 8 \cdot 4 \end{pmatrix}$$

$$= \begin{pmatrix} 23 & 34 \\ 31 & 46 \end{pmatrix}$$

NOTICE

$A \cdot B \neq B \cdot A$!!

MATRIX MULTIPLICATION HAS TO DO WITH ROTATIONS



MATRIX ADDITION

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \quad B = \begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix}$$

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