Exercise

Jill designs Solar panels as a hobby.

- On April 1st, Jill's "Mark I" design begins generating power: 1 kJ/day
- On May 1st, her "Mark 2" design begins generating 4 kJ of power per day.

1. What day is it when Jill's Mark II design has generated as much total energy as the Mark I design

2. How much total energy has both generated by that day?

3. What would the solutions to (1.) and (2.) be if Mark II design generated 1 kJ of power per day?

Solutions

1) 40 days from April 1st, which is May 10th
2) 40kJ generated by each design for a total of 80kJ
3. No solutions

IInd Exercise

- Alex builds two types of wind tubines as a hobby

- On March 1st, Alex's "Model A" wind tubine begins generating power 2kJ/day
- On April 1st, Alex's "Model B" wind tubine begins generating power: 5kJ/day

1) On what day will Model B have generated as much total energy as Model A.

2) Total energy generated by tubines by that day.

Dimensions	Mathematical Name	Description
0	Scalar	magnitude only
1	Vector	array
2	Matrix	flat table e.g., square
3	3-tensor	3D table e.g., cube
n	n-tensor	higher dimensional

Scalars

- No dimensions
- Single number
- Denoted in lowercase, italics, e.g. x
- Should be typed, like all other tensors: e.g., int, float32

Note

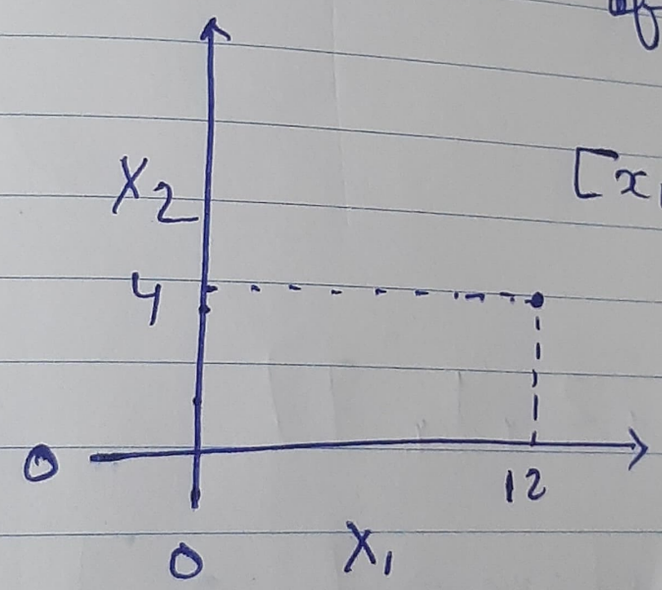
Scalars are primary use for multiplication

Wherever we multiply scalars with matrix or vectors, we scale every element of vectors or matrix.

e.g. Temp, Speed, Mass, Distance, Energy, Time etc.

Vectors

- One dimensional array of numbers
- Denoted in lowercase, italics, bold, e.g: x
- Arranged in an order, so element can be accessed by its index.
- Elements are scalars so not bold, e.g, second element of $\boldsymbol{x}$ is x_2



$[x_1\ x_2] = [12\ 4]$

- Representing a point in space:
  - Vector of length two represents location in 2D matrix
  - Length of three represents location in 3D cube [shown

- Length of n - represents location in n - dimensional tensor

Numpy

to transpose

```
x = np.array([[[]]])
x.shape → (1,3)
y = x.T
y.shape
        ↳ (3,1)
```

[3, 2, 4, 7]

Transpose →

$$\begin{bmatrix} 3 \\ 2 \\ 4 \\ 7 \end{bmatrix}$$

Mesh -> 3 / day

Tensors

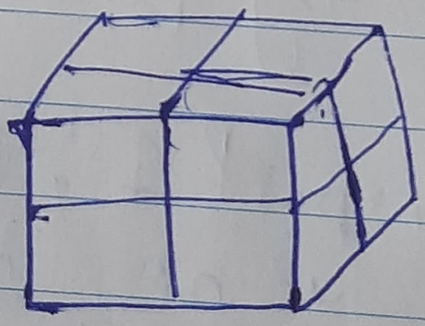
"ML generalization of vectors and matrices to any number of dimensions"

scalar x

vector $[x_1 \quad x_2 \quad x_3]$

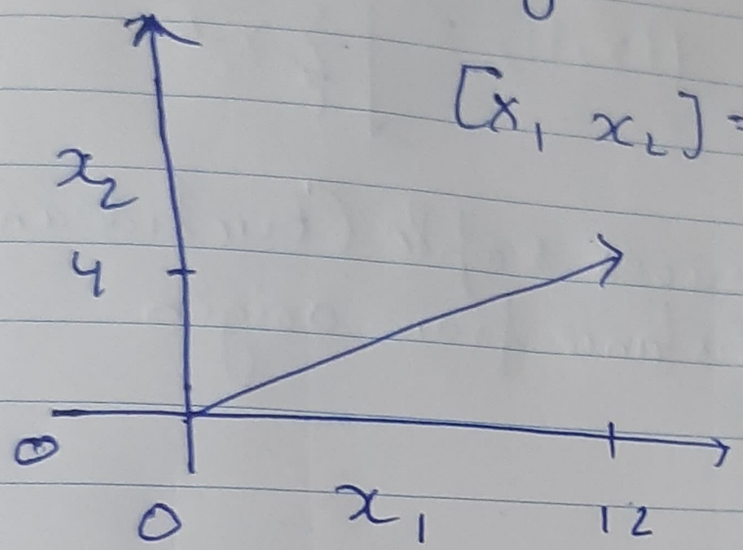
matrix $\begin{bmatrix} x_{11} & x_{12} \\ x_{21} & x_{212} \end{bmatrix}$

3-tensor



• Norms

Vectors represent a magnitude and direction from origin



Norms are functions that quantify vector magnitude