**Mathematics**

**Matrix:** A matrix is a collection of numbers ordered in rows and columns.

A matrix can only contain numbers, symbols or expressions.

Matrices are main characters in mathematical operations.

1. Addition
2. Subtraction
3. Multiplication

**Rank 0 Tensor – Scaler** - All numbers we know from algebra are referred to as scalars in linear algebra. Scalar have 0 Dimension.

**Rank 1 Tensor – Vector** – A vector is practically the simplest linear algebraic object. Row vector or column Vector. Length - Df – the number of elements in a vector (length of vector is **m** in the below image)

**Rank 2 Tensor – Metrics**

**Rank 3 Tensor – Metrics –** A Collection of metrices

A close up of a sign

Description automatically generated



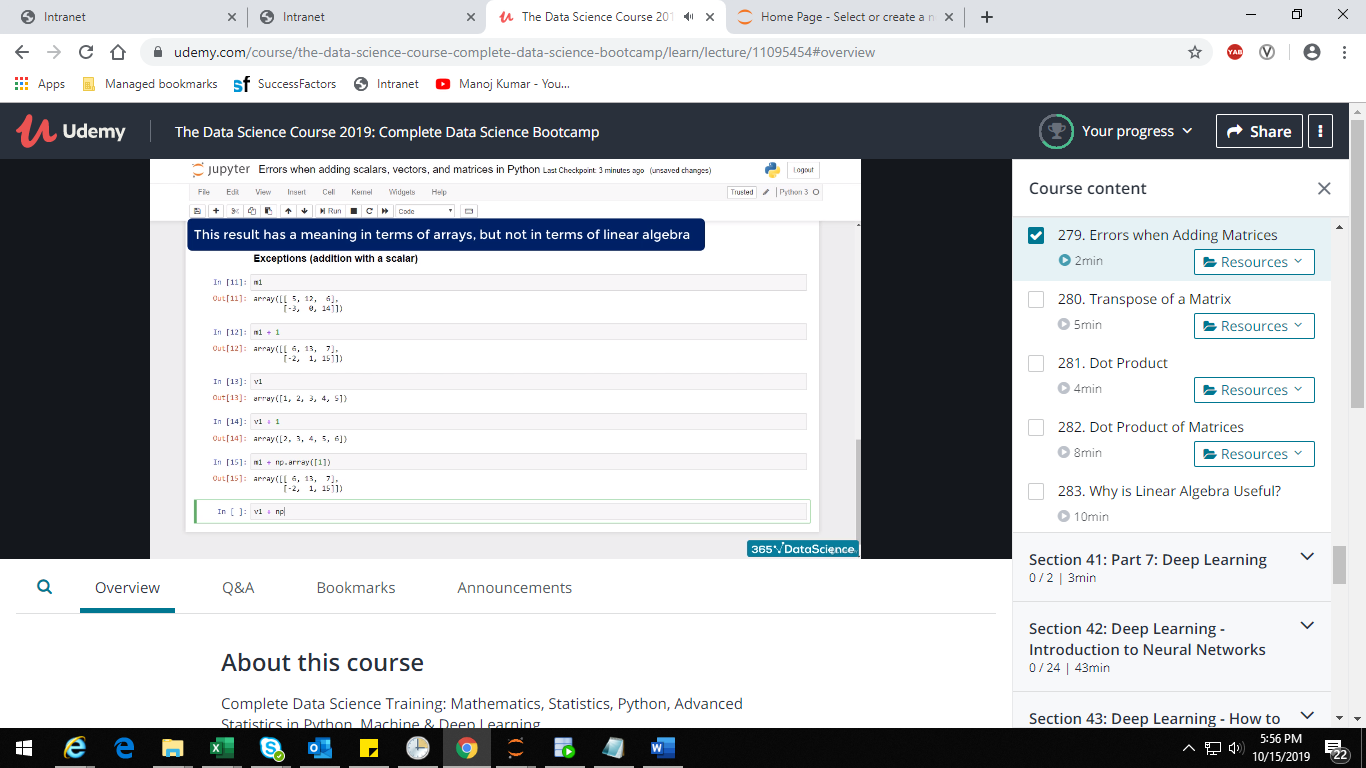
**Tensors**

A screenshot of a cell phone

Description automatically generated

**Addition and Substraction:-** The metrics has to be the same dimensions.





**Transposing Vectors:**

1. The values is not changing or transforming ; only their position is
2. Transposing the same vector (object) twice yields the initial vector (object)
3. A 3x1 matrix transposed into a 1x3 matrix
4. Transpose of mxn matrix into a nxm matrix



**Multiplication**

**Dot Product:-**

1. Dot Product (Inner or Scalar Product) :- the sum of the products of corresponding elements
   1. **Dot Product**

u = np.array([0,2,5,8])

v = np.array([20,3,4,-1])

np.dot(u,v) 🡺 18

* 1. **Scaler \* Scaler**

np.dot(5,6) 🡪 30

np.dot(10,-2) 🡪 -20

* 1. **Scaler \* Vector**

x 🡪 [2,8,-4]

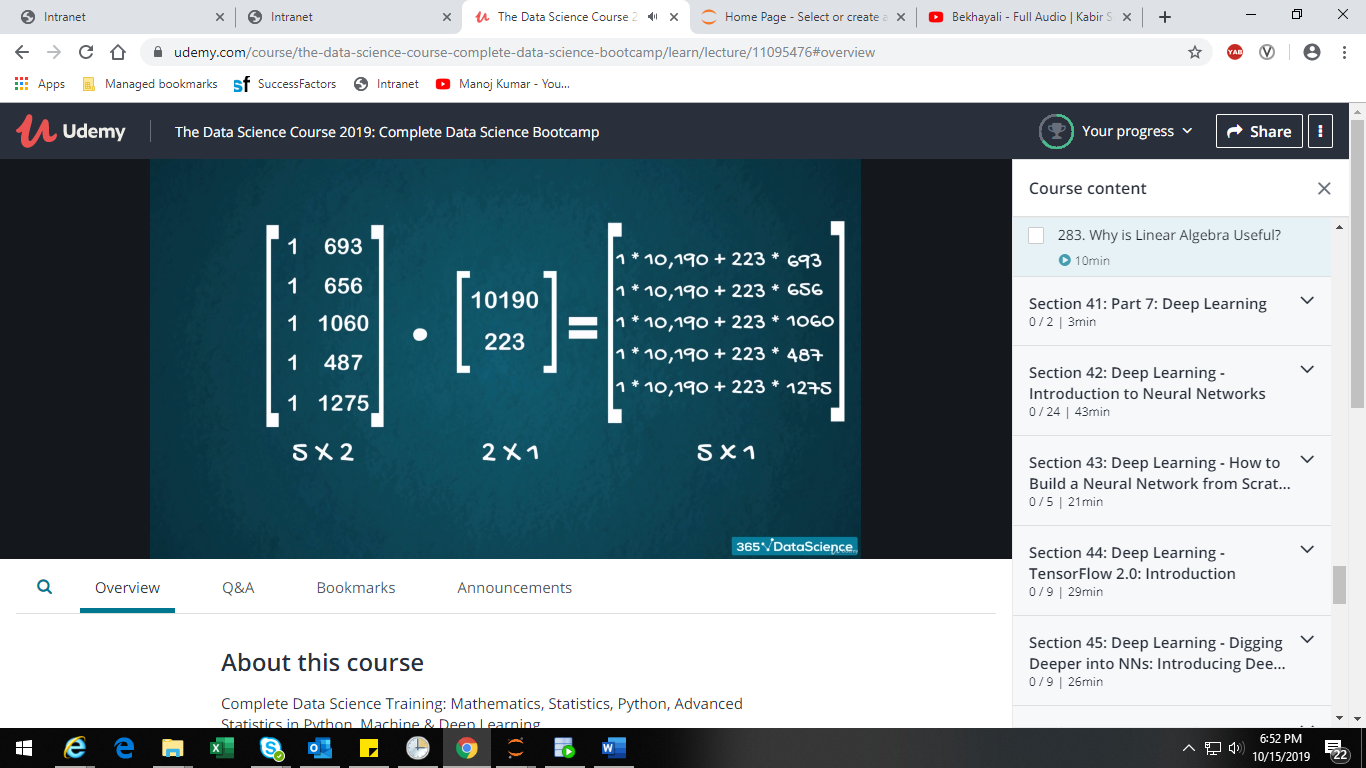
5\*x 🡪 [10,40,-20]

1. Outer Product

**Linear Algebra Use**

1. Application in Data Science
   1. Vectorized code 🡺 Whenever we are using linear algebra to compute many values simultaneously (Much fast, numpy)

10190 + 223\*(Size of Hours) (In $)



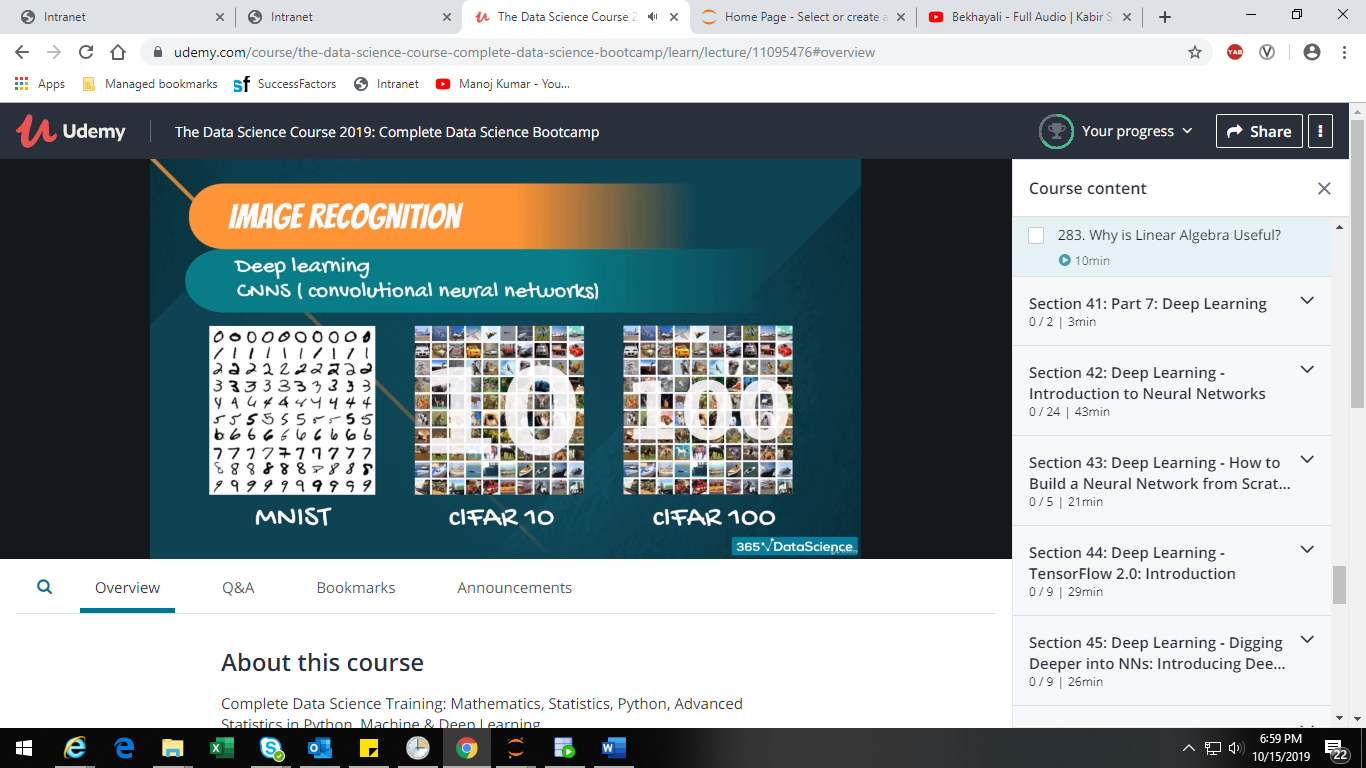
* 1. Image Recognition 🡪
     1. Deep Learning (Zoom in until we see pixels, Zoom out to reach the photo)

Picture 🡪 Algorithms 🡪 Identify the Object of Picture

Grayscale photo of dog (256 shades of gray 🡪 0 – White, 255 = totally blank)

Each picture breaks in binary codes and each binary code is to align with color

Color photo (RGB Scale, Tensor (3\*400\*400 Tensors) picture size – 400x400



* + 1. Deep neural networks
  1. Dimensionality Reduction
     1. Eigenvalues
     2. Eigenvectors

