AMA 564 Deep Learning

2025 Spring

Tutorial 1

20 Jan 2023

Tensor: the data type for deep learning

Typical dataset: 2D matrix, 2D Array

Columns: Covariates
Row: Instances

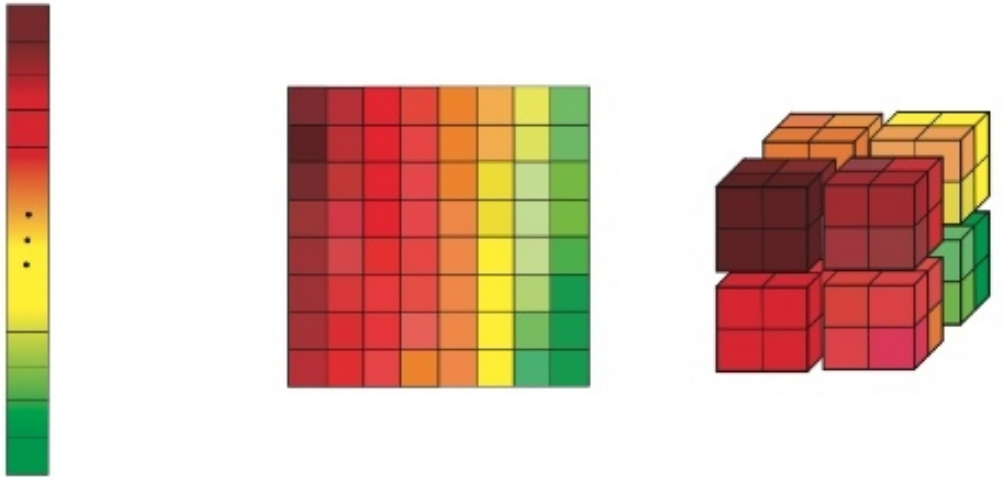
	Sex	Race	Height	Income	Marital Status	Years of Educ.	Liberal-ness
R1001	M	1	70	50	1	12	1.73
R1002	M	2	72	100	2	20	4.53
R1003	F	1	55	250	1	16	2.99
R1004	M	2	65	20	2	16	1.13
R1005	F	1	60	10	3	12	3.81
R1006	M	1	68	30	1	9	4.76
R1007	F	5	66	25	2	21	2.01
R1008	F	4	61	43	1	18	1.27
R1009	M	1	69	67	1	12	3.25

Source: http://www.analytictech.com/networks/kindsofmatrices.htm

Deep learning dataset: Tensor, Multi-dimensional Array

tensor = multidimensional array

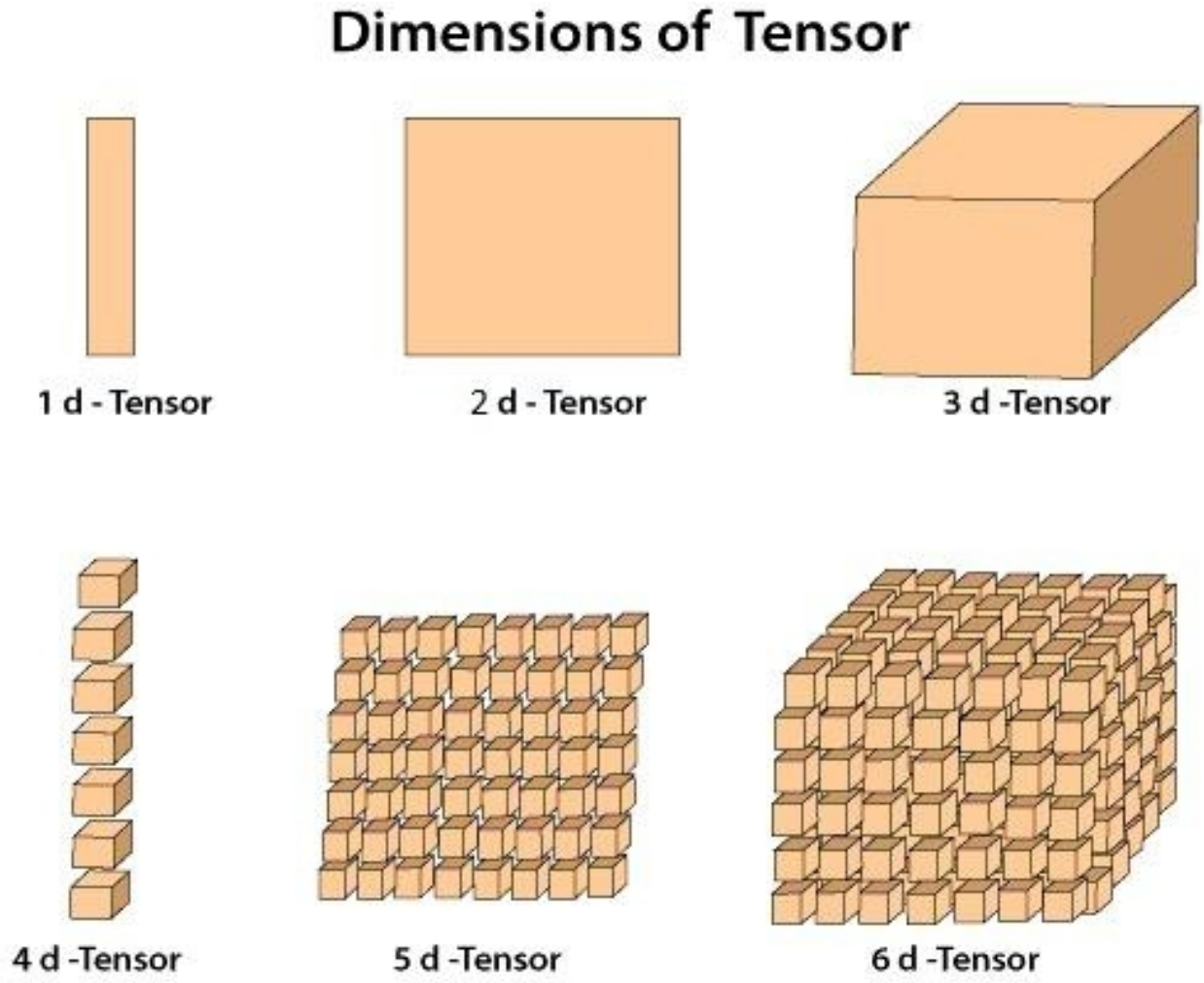
vector | matrix | tensor



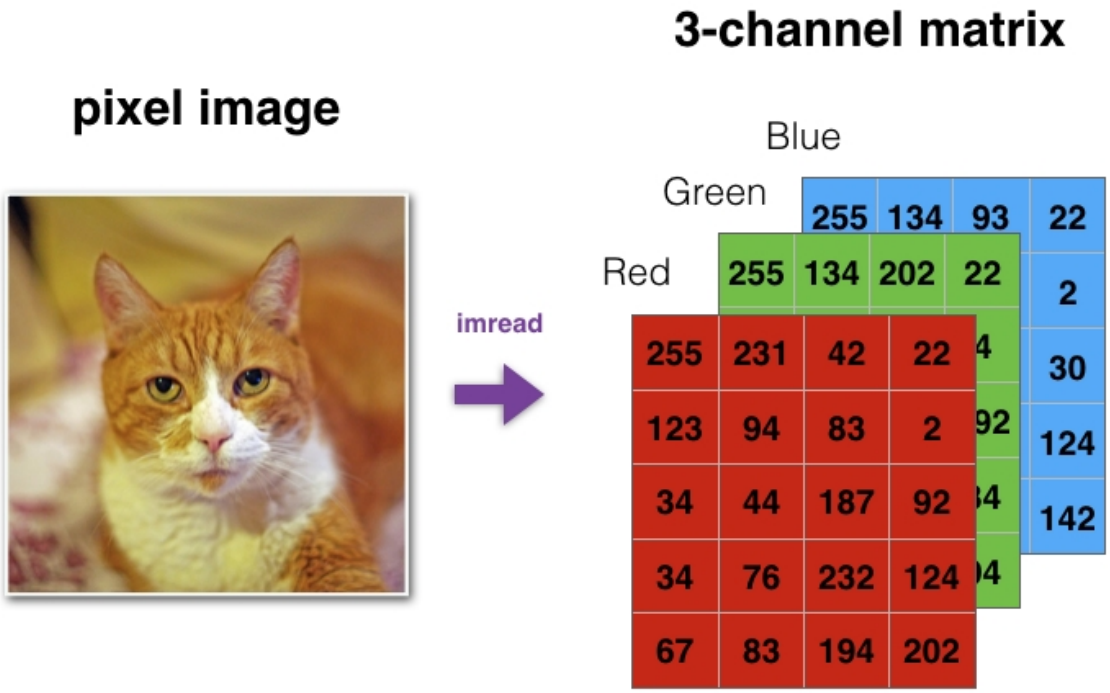
$\mathbf{v} \in \mathbb{R}^{64}$ $X \in \mathbb{R}^{8x8}$ $\mathcal{X} \in \mathbb{R}^{4x4x4}$

Source: https://www.i2tutorials.com/what-do-you-mean-by-tensor-and-explain-about-tensor-datatype-and-ranks/

Deep learning dataset: Tensor, Multi-dimensional Array

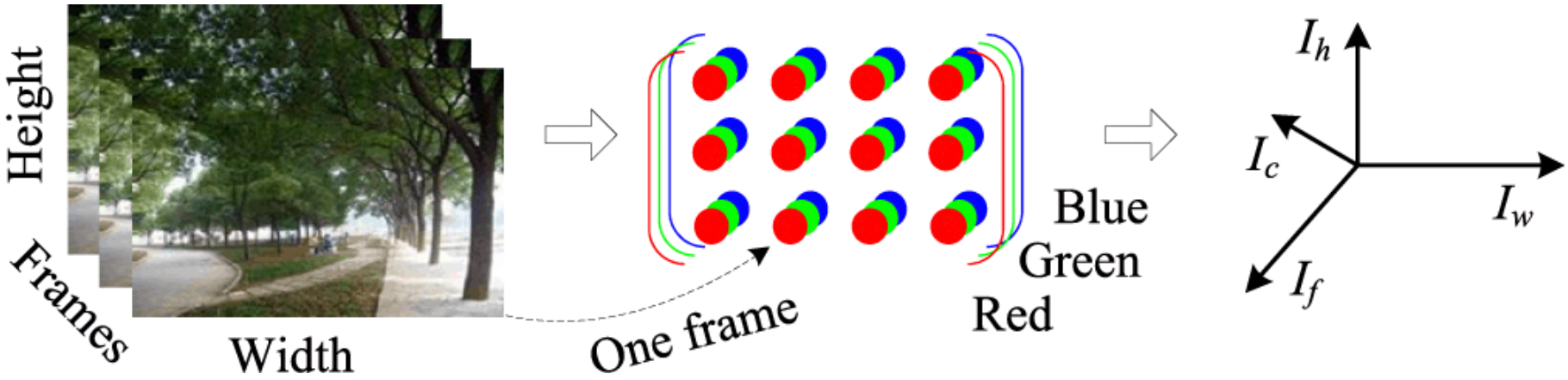


Example: Colored Image is a 3D Tensor



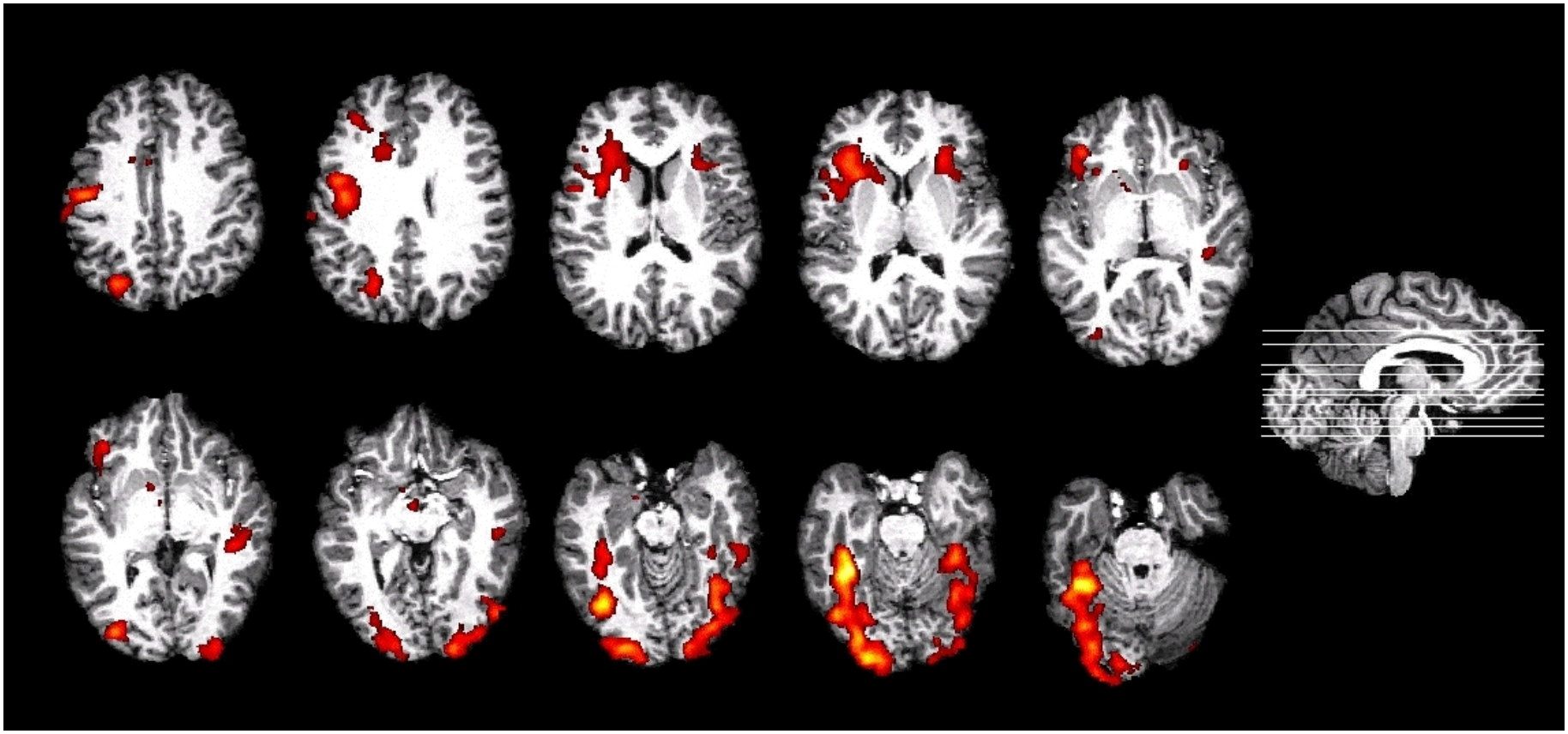
Source: https://github.com/y33-j3T/Coursera-DeepLearning/tree/master/Neural%20Networks%20and%20Deep%20Learning/Week%202

Example: Colored Video is a 4D Tensor



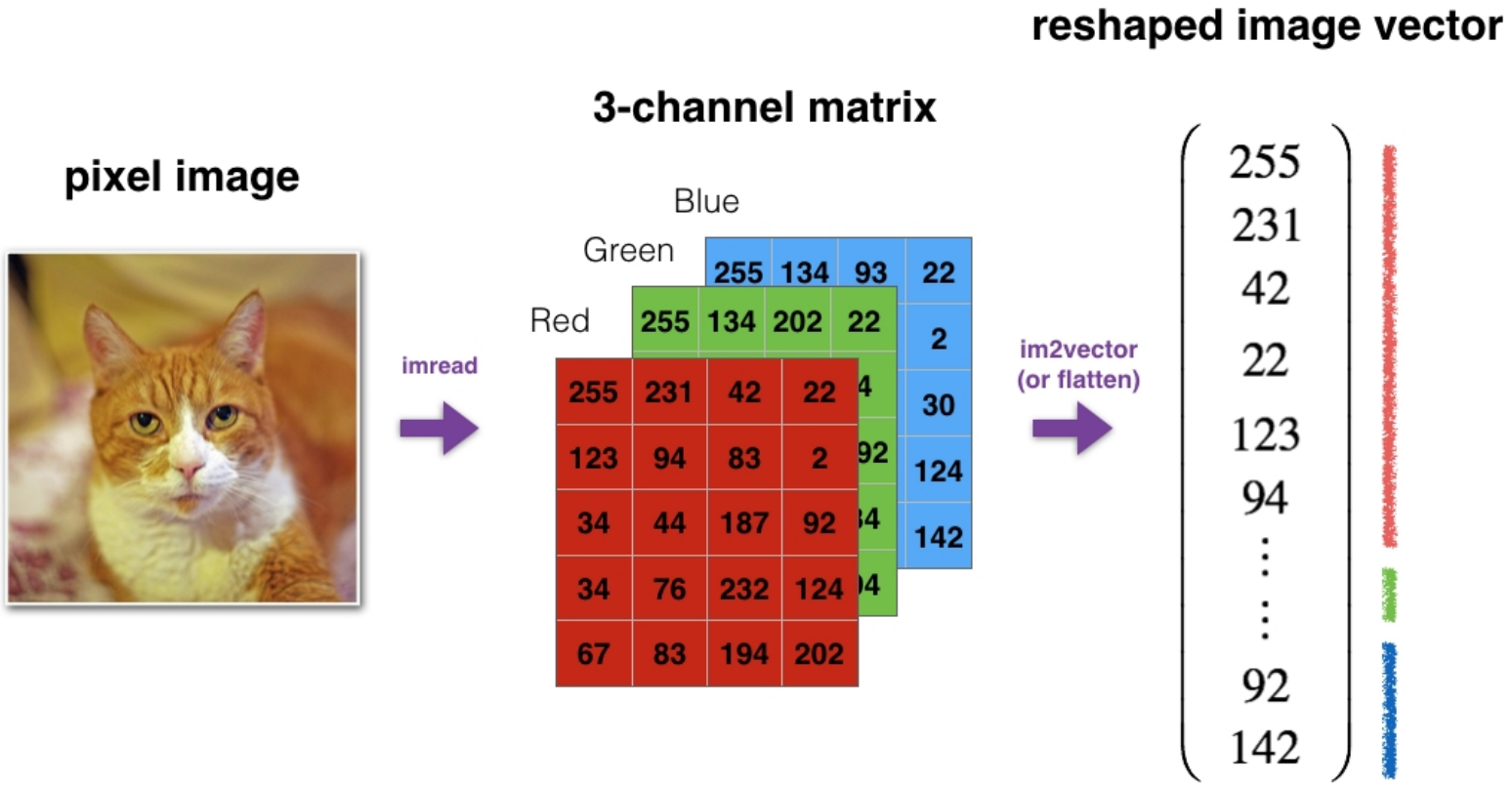
Source:https://www.computer.org/csdl/journal/ec/2014/03/06832490/13rRUB7a15h

Example: Brain fMRI data can be 4D Tensor (3D time-varying)



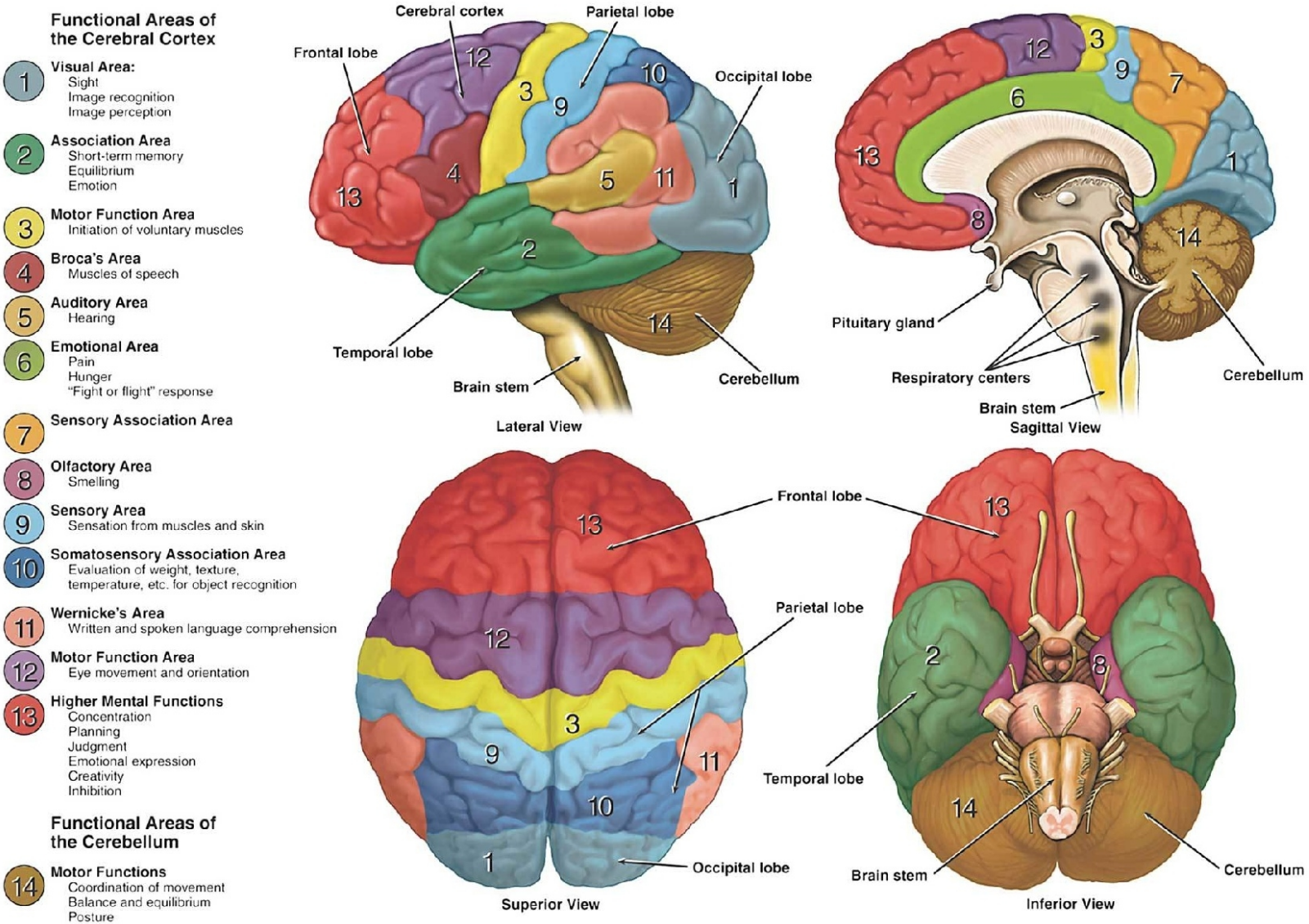
Source:https://med.nyu.edu/thesenlab/research-0/research-functional-magnetic-resonance-imaging-fmri/

Can we reshape the tensor into a vector?



Source: https://github.com/y33-j3T/Coursera-DeepLearning/tree/master/Neural%20Networks%20and%20Deep%20Learning/Week%202

Shall we reshape the tensor into a vector?



Tensor Operations

- Tensor has kinds of operations:
  Addition, Entry-wise multiplication, Kronecker Product
  Reshape, Squeeze, Unsqueeze, Stack
  PyTorch documents: https://pytorch.org/docs/stable/tensors.html

- It is important to understand the structure of Tensor

- In practice, be careful when operating on Tensor.
  Bug happens a lot !