

INRAe



université
PARIS-SACLAY

> Neural networks: Technical jargon

Alberto TONDA, Ph.D. (Senior permanent researcher, DR)

*UMR 518 MIA-PS, INRAE, AgroParisTech, Université Paris-Saclay
UAR 3611, Institut des Systèmes Complexes de Paris Île-de-France*

> Outline

- What is jargon
- Neurons, units, filters, dimensions...?
- Names for types of layers
- Latent space, encoder, decoder

> Jargon = confusing terminology

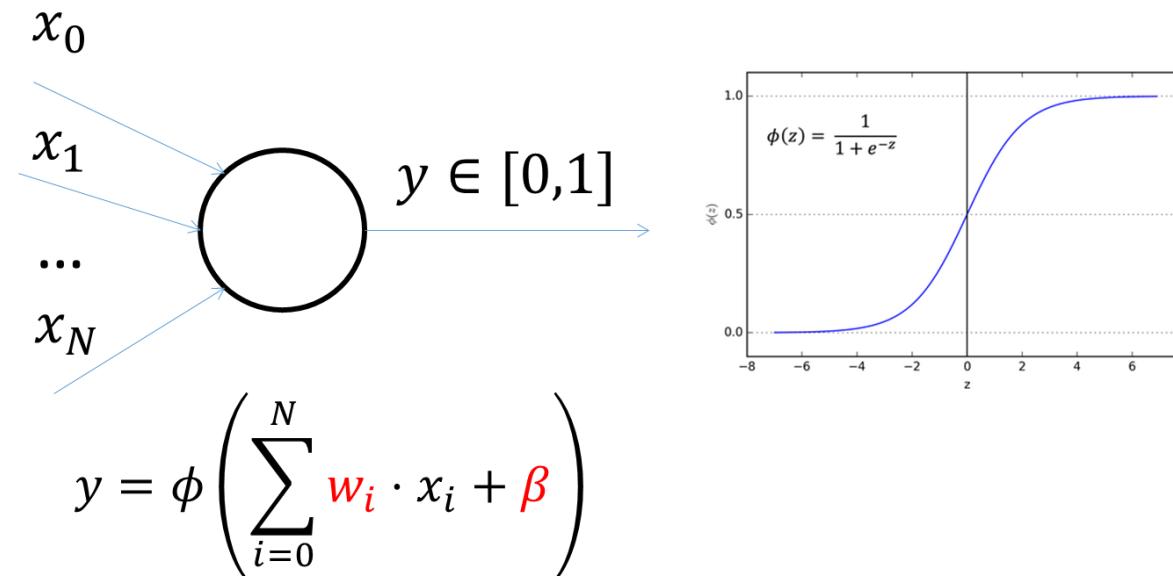
- Multiple sub-communities, using different terminology
- Different ways of viewing/formalizing *same thing*
 - Layers vs Modules
 - Units vs Filters vs Neurons
 - Fully connected layers, convolutional layers...?

> Neurons, units, filters, dimensions...?

- All terms describe **shape of tensors** in output to a module
- One **tensor dimension** depends on <term>
- Fundamental idea: **unitary operation**
 - The operation can be repeated several times by different units
 - Each unit will produce a new dimension in the output tensor

> Neurons, units, filters, dimensions...?

- “Neurons”
 - One neuron outputs **one value**, two neurons, two values, etc.
 - **Number of neurons** -> Output tensor dimension



> Neurons, units, filters, dimensions...?

- “Neurons”
 - One neuron outputs **one value**, two neurons, two values, etc.
 - **Number of neurons** -> Output tensor dimension

Linear module
10 “neurons”

Input: (n_features, n_samples)
Output: (**10**, n_samples)
Parameters: ?

> Neurons, units, filters, dimensions...?

- “Neurons”
 - One neuron outputs **one value**, two neurons, two values, etc.
 - **Number of neurons** -> Output tensor dimension

Linear module
10 “neurons”

Input: (n_features, n_samples)
Output: (10, n_samples)
Parameters: (n_features + 1) * 10

> Linear module + activation

- Structure often found in NNs of all kinds
- pytorch encodes it as a **linear module** followed by **activation**
- More “historical” names found in literature
 - Fully-connected (FC) layer
 - Multi-layer perceptron (MLP)
 - Feed-forward module (maybe more general)
- Only Linear modules and activations: **feed-forward NN**

> Neurons, units, filters, dimensions...?

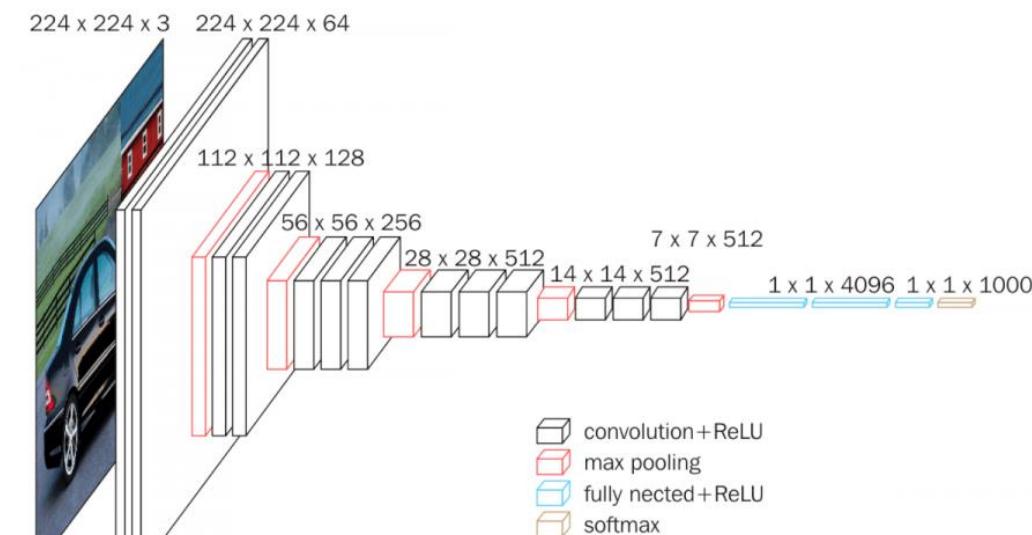
- “Filters” in CNNs
 - Each “filter” corresponds to a set of weights in a convolution
 - Each filter outputs the result of a single convolution
 - Terminology: number of channels == number of filters
- Output shape
 - Imagine an input tensor of one image $(1, c, h, w)$
 - Conv. module: padding=1, stride=1, kernel=3, out_channels=64
 - Size of the output tensor?

> Neurons, units, filters, dimensions...?

- “Filters” in CNNs
 - Each “filter” corresponds to a set of weights in a convolution
 - Each filter outputs the result of a single convolution
 - Terminology: number of channels == number of filters
- Output shape
 - Imagine an input tensor of one image $(1, c, h, w)$
 - Conv. module: padding=1, stride=1, kernel=3, out_channels=64
 - Shape of the output tensor: $(1, \textcolor{red}{64}, h, w)$

> Convolutional layer

- *Imprecise*, but generally a structure like
 - Convolutional module
 - Activation
 - Downscaling (MaxPooling, or AvgPooling)
- Sometimes it can be more complex
 - Convolutional module
 - Activation
 - Convolutional module
 - Activation
 - Convolutional module
 - Activation
 - Downscaling

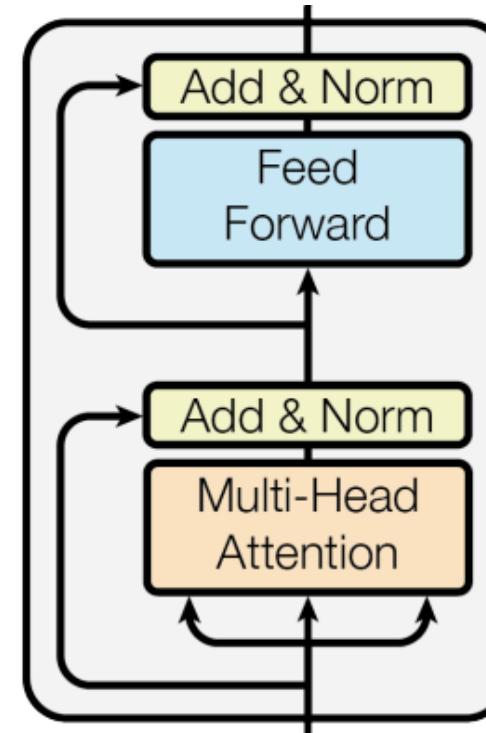


> Neurons, units, filters, dimensions...?

- “Units” in RNNs
 - Each “unit” corresponds to a set of weights
 - Size of the hidden state tensor == number of units
 - Output shape depends on number of units

> Transformer module/block

- Typical composition
 - Attention module
 - Addition and normalization
 - Linear module
 - Activation
 - Normalization



> Prediction, inference, forward pass...

- Used as synonyms
 - Forward pass: matrix multiplication from input to output
 - Inference: distinguish it from learning
 - Prediction: get outputs for values of one input sample

> Latent space, encoding, decoding

- Terminology from embeddings
- Encoder
 - Part of a NN which goes from high to low tensor dimensionality
 - Very often, from **relational data** to a **vectorial space** (1D tensor)
- Decoder
 - Part of NN which performs the opposite operation
- Latent space/bottleneck
 - Output tensors of the lowest-dimensionality point in the NN
 - Typically it's an embedding with some sort of semantics

INRAe



**université
PARIS-SACLAY**

➤ **Questions?**

Bibliography

Images and videos: unless otherwise stated, I stole them from the Internet. I hope they are not copyrighted, or that their use falls under the Fair Use clause, and if not, I am sorry. Please don't sue me.