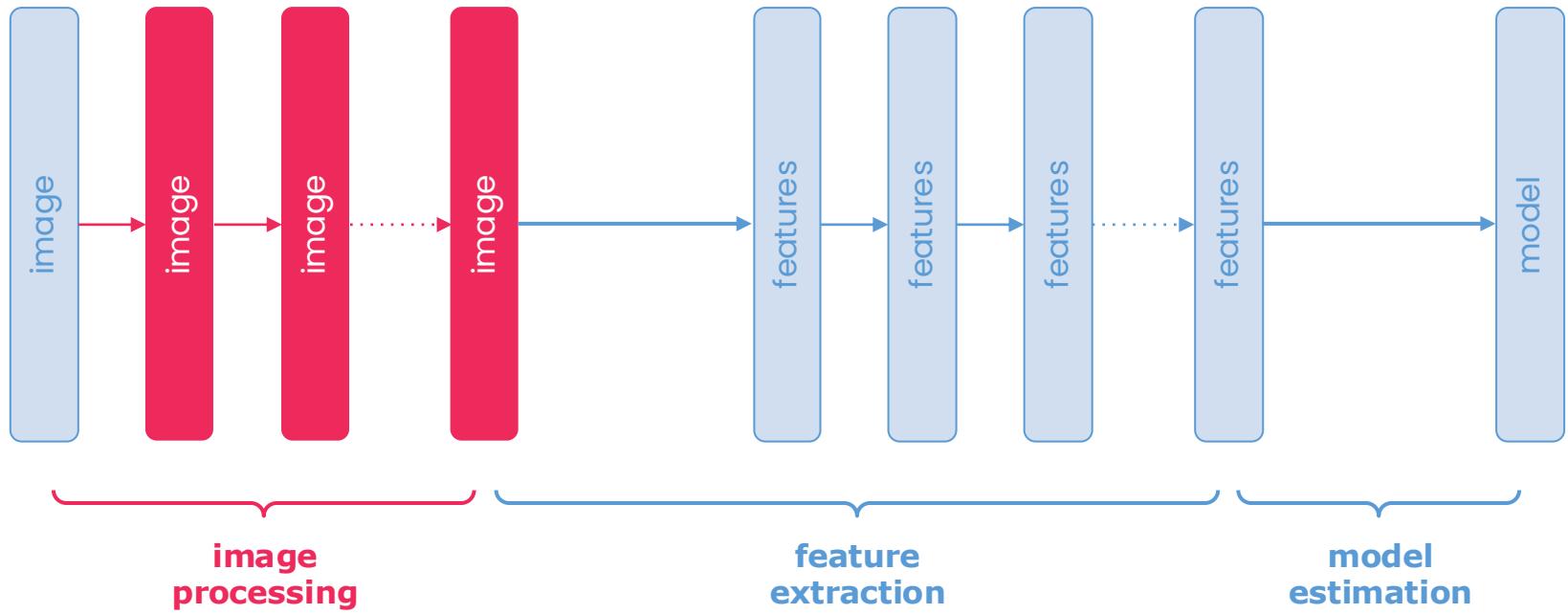
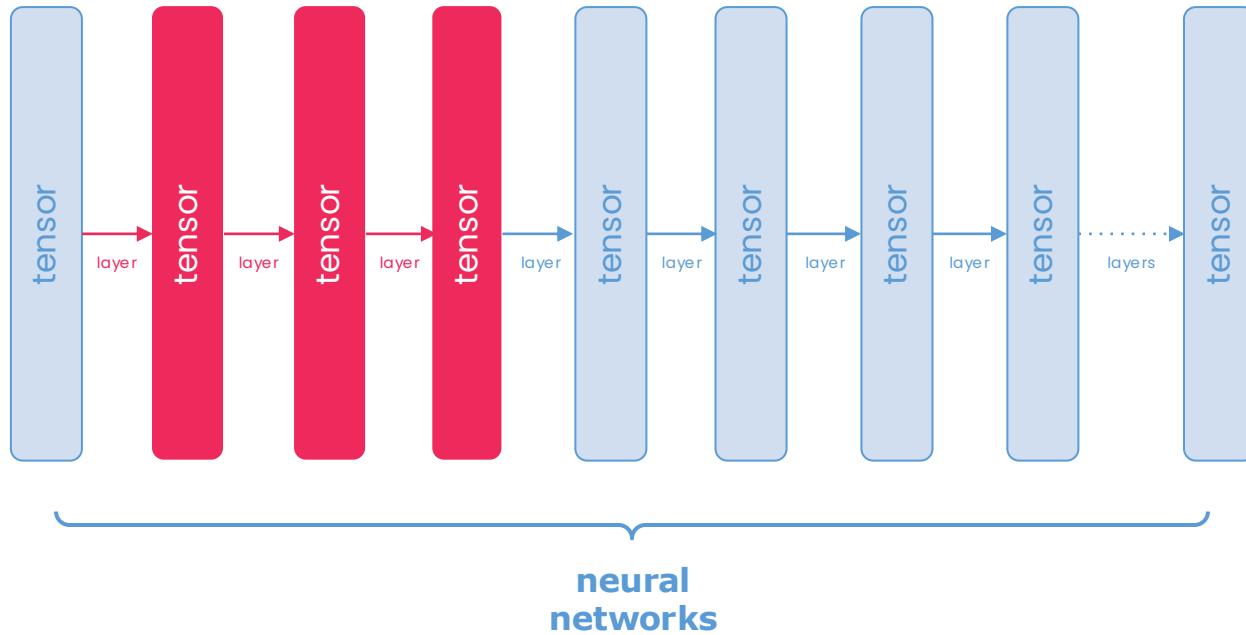


Insper

Computer Vision

## **Class 5: Slightly Less Basic Basics of Neural Networks**





# Neural network mysteries

- How can we separate a dataset in training data and testing data?
- **What is a hidden layer?**
- Does it matter if the input tensors are 3D, 2D, or 1D?
- What is a dense layer?
- How do we calculate the number of parameters in a dense layer?
- How do we calculate the number of steps in a training process?
- How do we calculate the number of steps in a testing process?
- Does the number of layers matter?
- Does the size of a dense layer matter?
- What exactly activation='relu' does?

# Neural network basics

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- **Output:** the tensor that represents the returned model.

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# Neural network basics

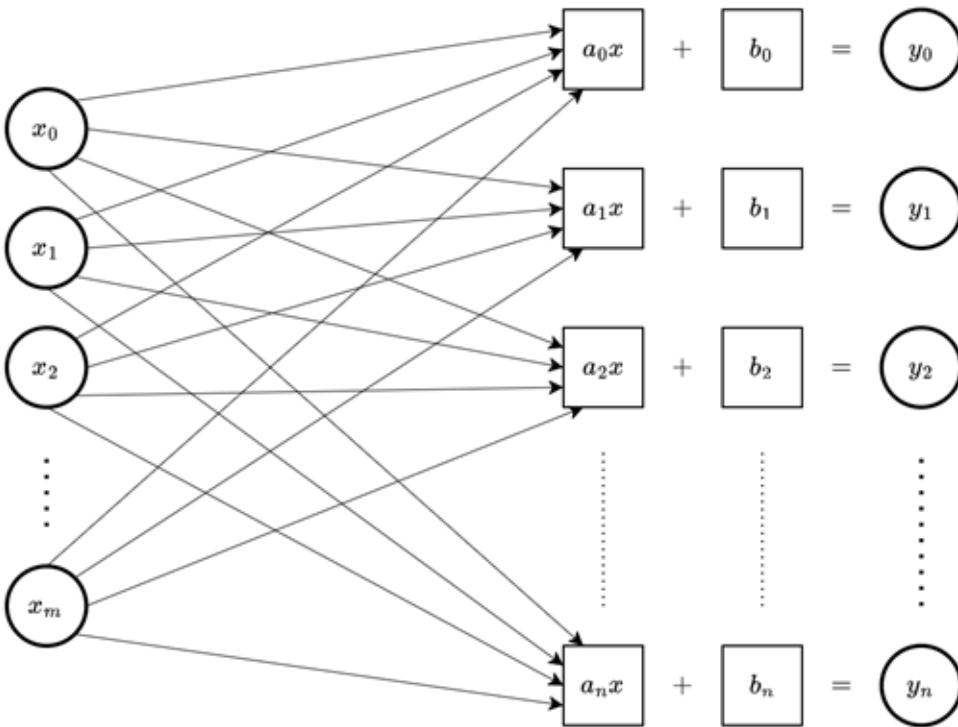
- **Input:** the tensor that represents the received image.
- **Output:** the tensor that represents the returned model.
- **Hidden:** one or more intermediate tensors.
  - Not easily interpretable in high-level terms.

# Neural network basics

- **Input:** the tensor that represents the received image.
- **Output:** the tensor that represents the returned model.
- **Hidden:** one or more intermediate tensors.
  - Not easily interpretable in high-level terms.
  - Calculation defined by trainable parameters.

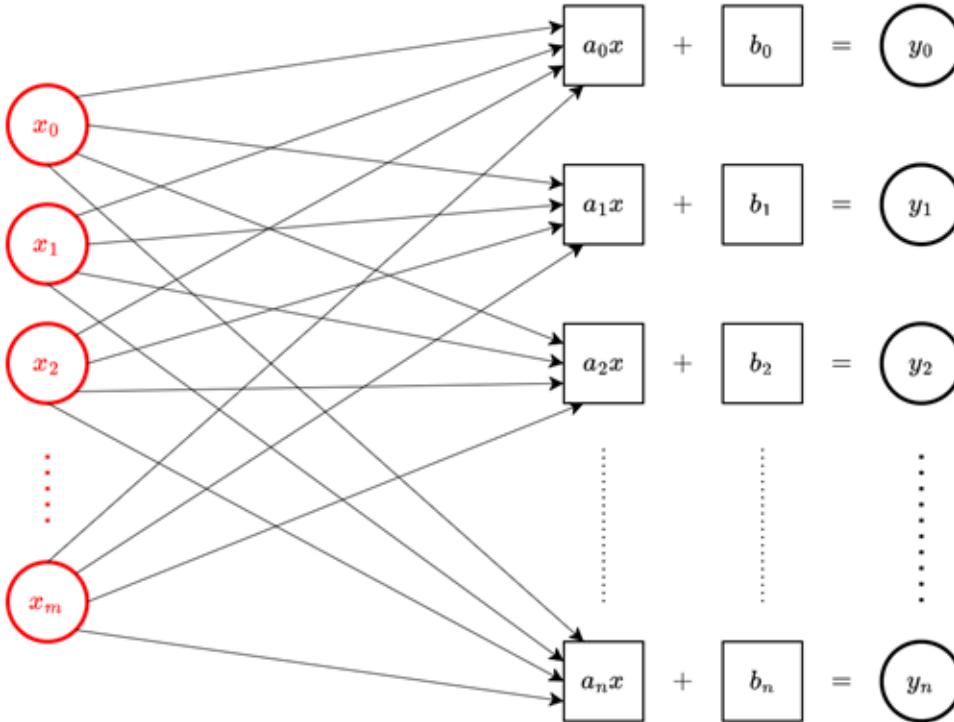
# Neural network mysteries

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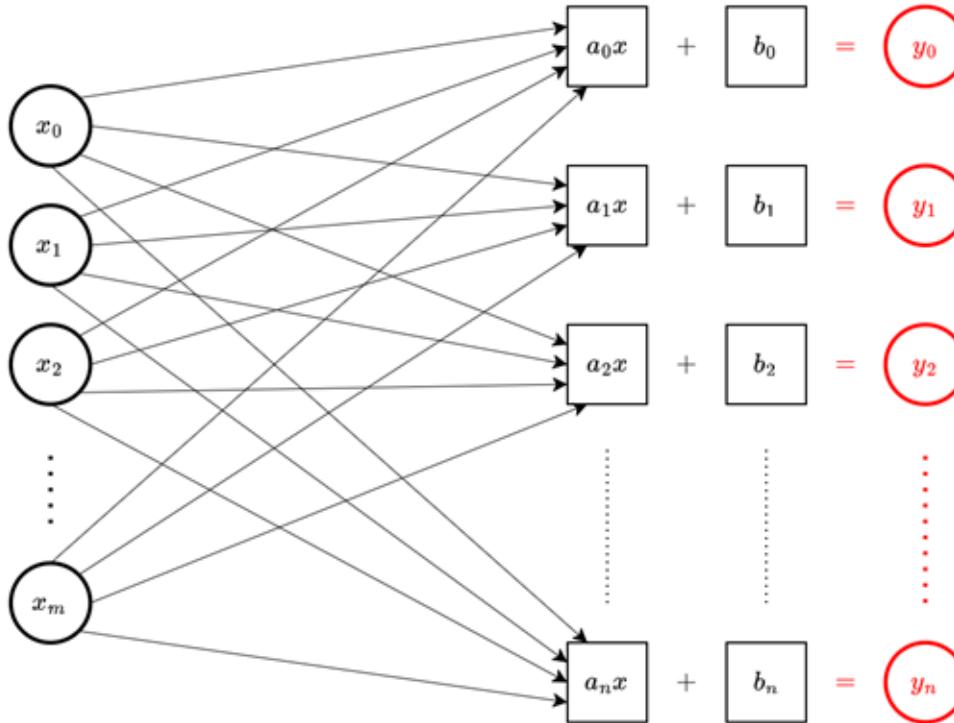
## Input neurons:

data tensor



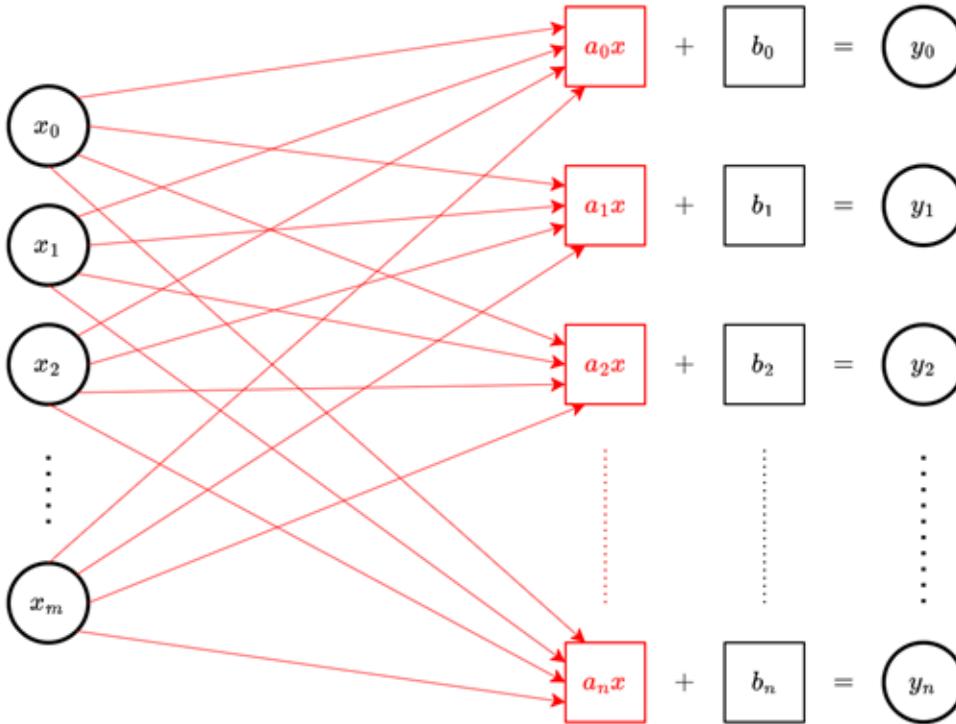
## Output neurons:

data tensor



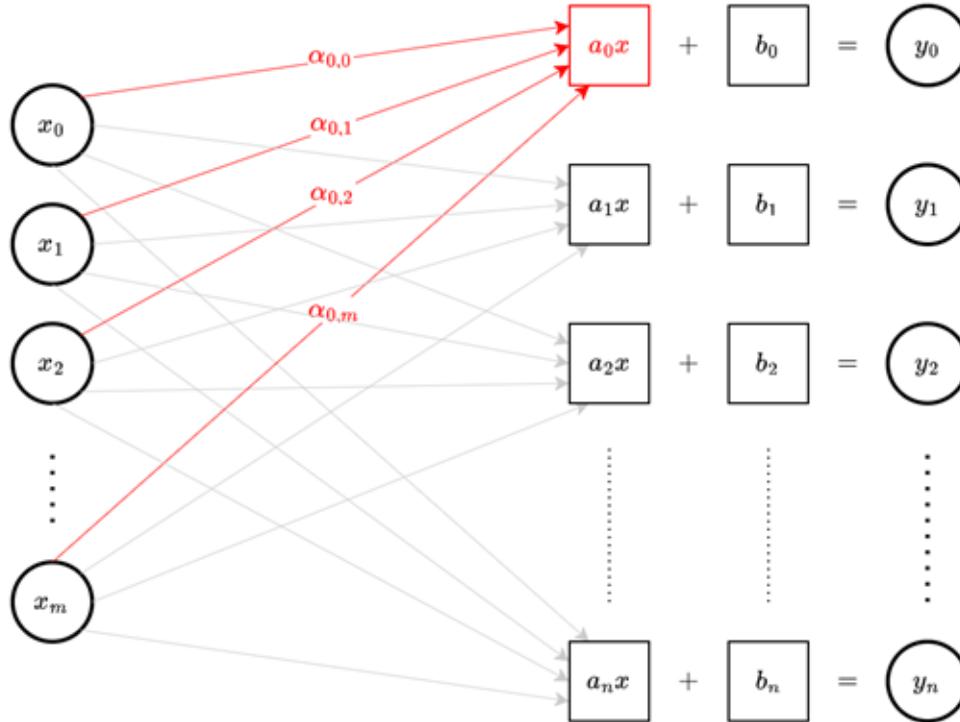
# Weights:

multiplicative constants



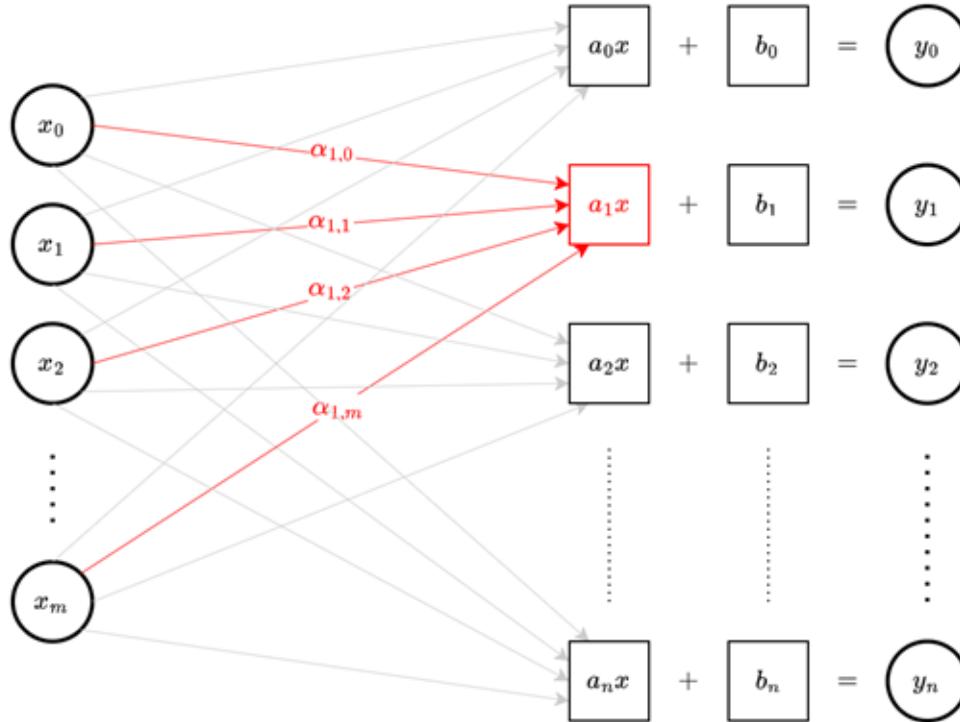
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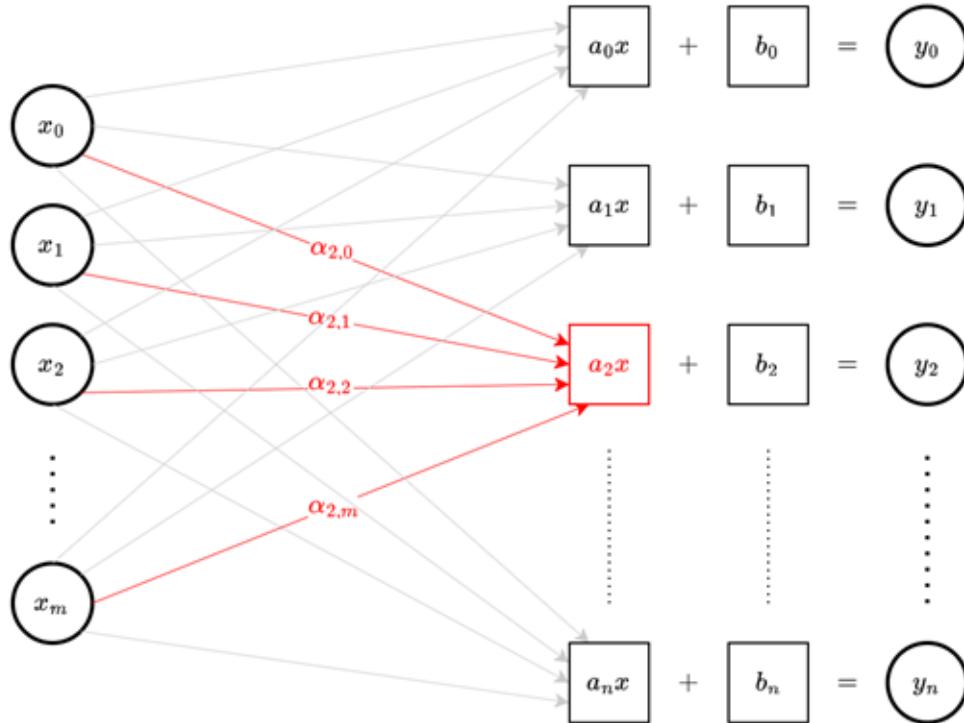
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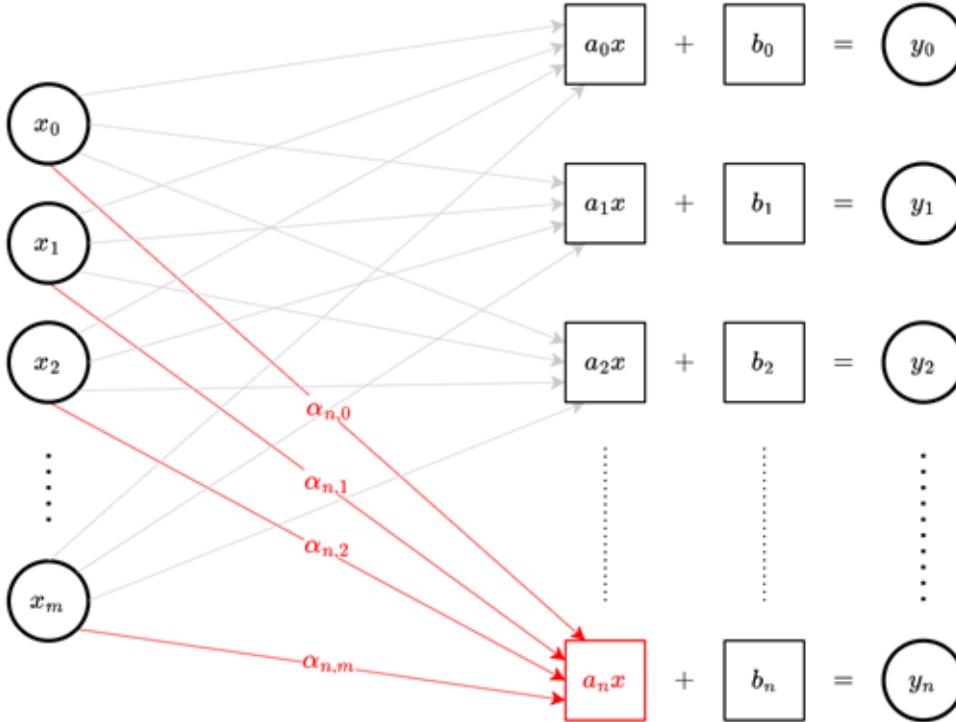
# Weights:

multiplicative constants



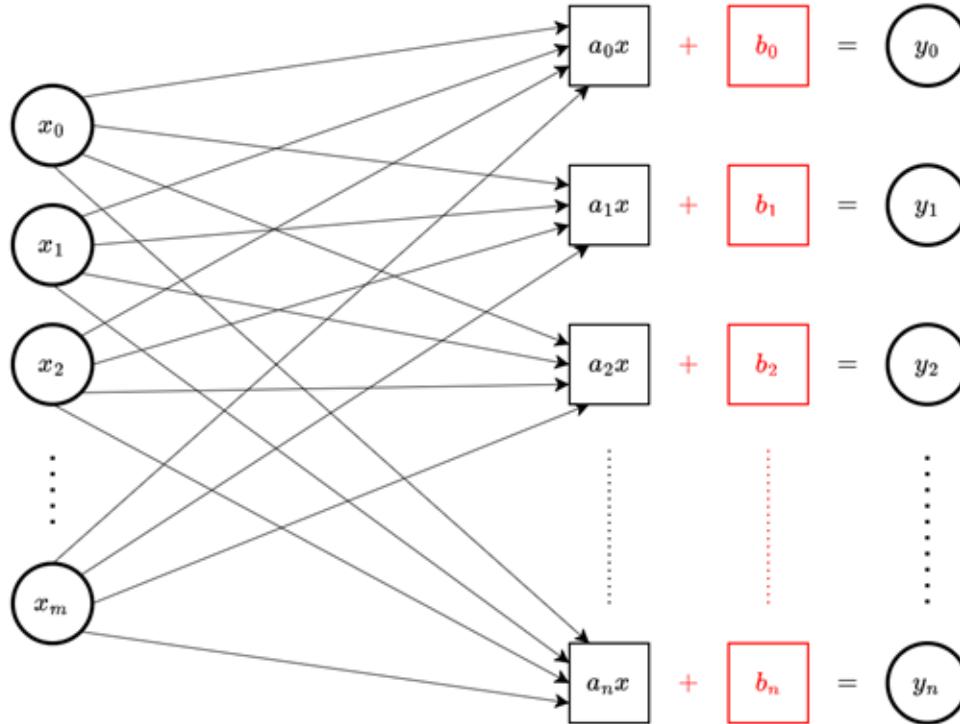
# Weights:

multiplicative constants



# Biases:

additive constants



# Neural network mysteries

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# Dense layer parameters

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- ...and  $n$  output neurons...
- ...we have  $mn$  weights...
- ...and  $n$  biases...
- ...for a total of  $mn+n$  parameters.

# Neural network mysteries

- How can we separate a dataset in training data and testing data?
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- What exactly activation='relu' does?

**demonstration**

# Toolkit

- **Language:** Python
- **Library:** Keras
- **Platform:** Google Colab

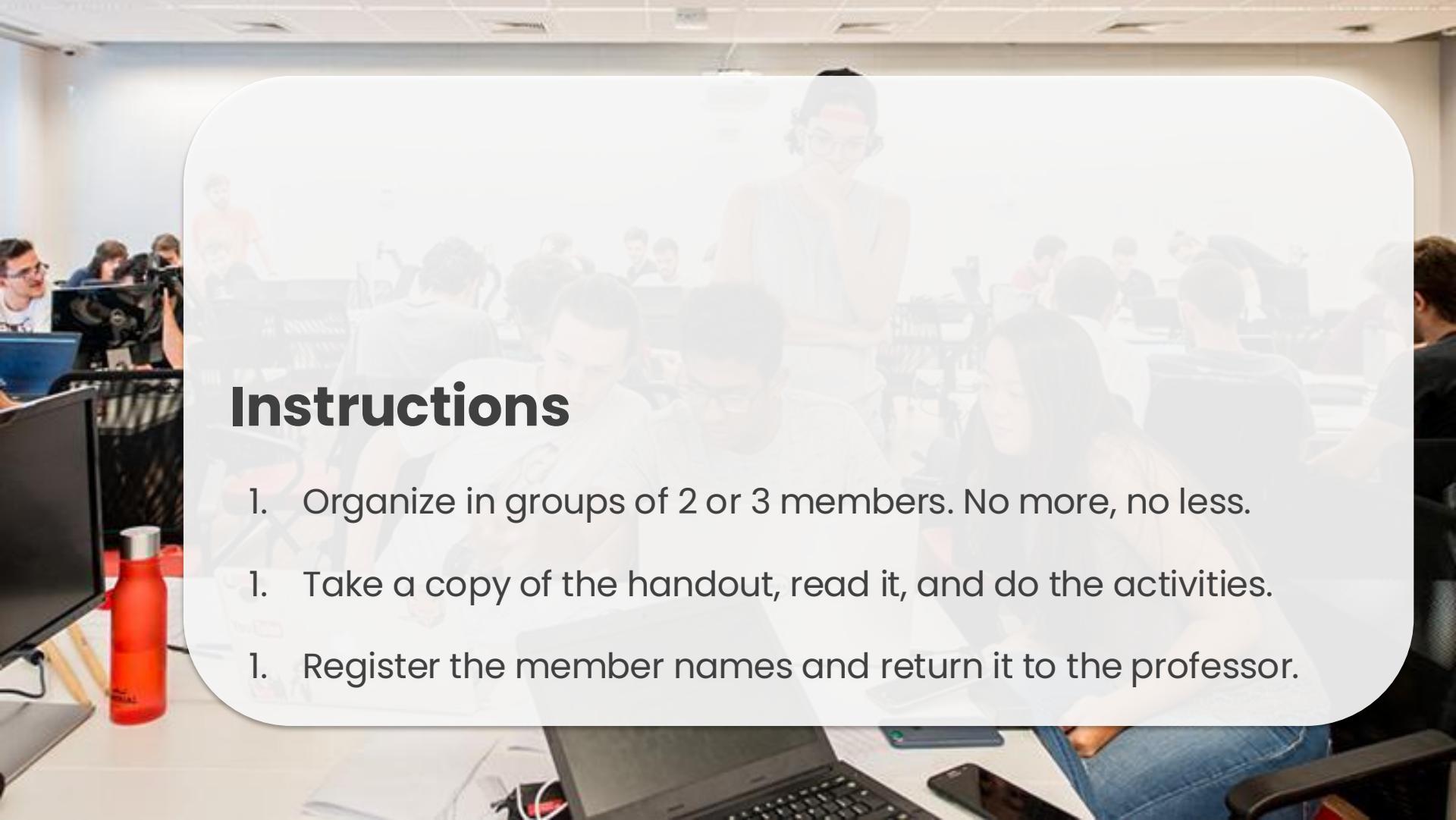
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- ~~Does the size of a dense layer matter?~~
- What exactly activation='relu' does?
- **Can classic vision algorithms be represented by dense layers?**
- In a dense layer, are all the weights and biases always necessary?

**handout**

# Toolkit

- **Language:** Mathematics
- **Library:** None
- **Platform:** Pencil and Paper

A blurred background image showing a classroom full of students sitting at desks, working on laptops. A female professor in a light-colored blazer and glasses stands in the center of the room, facing the class.

# Instructions

1. Organize in groups of 2 or 3 members. No more, no less.
1. Take a copy of the handout, read it, and do the activities.
1. Register the member names and return it to the professor.

# Neural network mysteries

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- ~~Can classic vision algorithms be represented by dense layers?~~
- ~~In a dense layer, are all the weights and biases always necessary?~~

# Next class:

- noise reduction.

# Credits

This material was based on the work of other professors, listed below.

- Fabio Miranda ([fabiomiranda@insper.edu.br](mailto:fabiomiranda@insper.edu.br))
- Raul Ikeda ([RaullGS@insper.edu.br](mailto:RaullGS@insper.edu.br))
- Fabio Ayres ([FabioJA@insper.edu.br](mailto:FabioJA@insper.edu.br))
- Igor Montagner ([IgorSM1@insper.edu.br](mailto:IgorSM1@insper.edu.br))
- Andrew Kurauchi ([AndrewTNK@insper.edu.br](mailto:AndrewTNK@insper.edu.br))
- Luciano Silva ([LucianoS4@insper.edu.br](mailto:LucianoS4@insper.edu.br))
- Tiago Sanches ([tiagoss4@insper.edu.br](mailto:tiagoss4@insper.edu.br))

Well, except for the errors. Any errors you might find are probably my fault.