

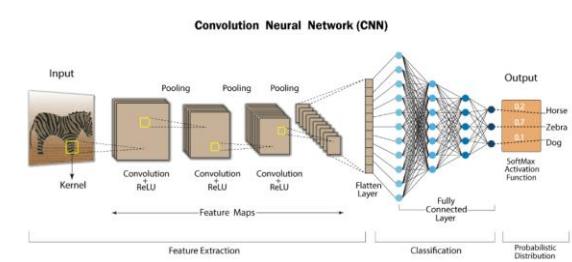
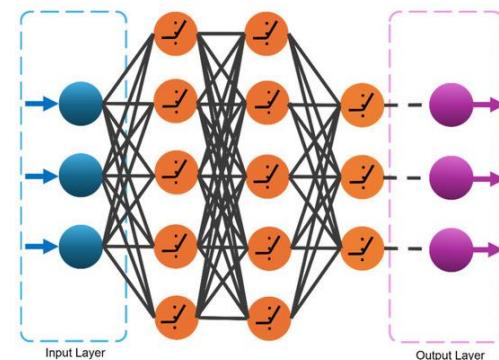
# APR - Aprendizagem Profunda e por Reforço - 2025/26

Deep and Reinforcement Learning

## Project 1

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# Contents

- 1| Objectives
- 2| Data
- 3| ML model
- 4| Evaluation

# Objective

## ► Goal

- Develop a Machine Learning model to discriminate (classify) blood cell images.
  - Multi-Layer Neural Network (MLNN)
  - Convolutional Neural Networks (CNNs)



3x28x28  
RGB 28x28



Multi-class  
8 classes

- **The main objectives of analyzing blood cell images are:**

- **1. Cell classification**

- Identify the type of cell (e.g., neutrophil, lymphocyte, etc.).

- **2. Detection of abnormalities**

- Identify infections, allergies, or blood disorders (leukemia, anemia, malaria, etc.).

- **3. Automating diagnosis**

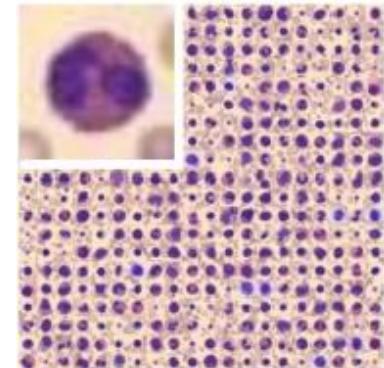
- Reduces human error and speeds up laboratory analysis.
    - Useful for telemedicine, remote labs, and large-scale screening

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## ► Goal

- <https://medmnist.com/>



3x28x28  
RGB 28x28



- 0: Basophil
- 1: Eosinophil
- 2: Erythroblast
- 3: Immature Granulocyte
- 4: Lymphocyte
- 5: Monocyte
- 6: Neutrophil
- 7: Platelet

N=17,092    11,959 / 1,712 / 3,421  
Training / Validation / Test

**Healthy / Normal** – Cells normally present in blood and part of proper function.

**Caution / Watch** – Normally healthy but high levels or unusual context may indicate mild issues.

**Potential Problem** – Normally absent in peripheral blood or indicative of serious conditions.

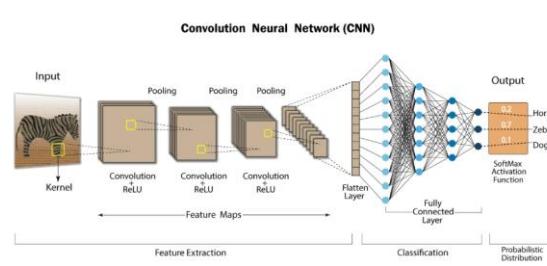
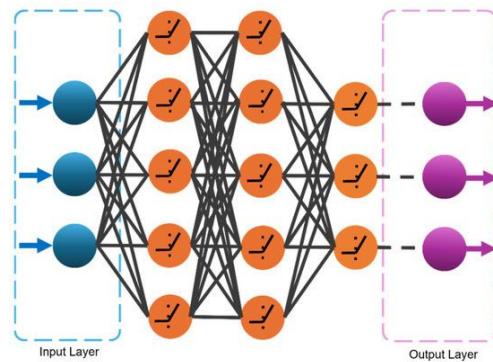
Code	Cell Type	Function / Meaning	Status
0	<b>Basophil</b>	Rare white blood cell; releases histamine during allergic & inflammatory responses.	<b>Caution</b> – Normal in small numbers; excess may indicate allergy/inflammation.
1	<b>Eosinophil</b>	Fights parasites & participates in allergic reactions.	<b>Caution</b> – Normal; very high levels may indicate allergy or parasitic infection.
2	<b>Erythroblast</b>	Immature red blood cell; normally in bone marrow.	<b>Potential Problem</b> – Presence in peripheral blood may indicate anemia or bone marrow disorders.
3	<b>Immature Granulocyte</b>	Young white blood cell (precursor of neutrophils, eosinophils, basophils).	<b>Potential Problem</b> – Normally absent; presence suggests infection or bone marrow disease.
4	<b>Lymphocyte</b>	Essential for adaptive immunity (B & T cells).	<b>Healthy</b> – Normal and beneficial; fights viruses and regulates immunity.
5	<b>Monocyte</b>	Becomes macrophage in tissues; clears debris & pathogens.	<b>Healthy</b> – Normal part of immune defense.
6	<b>Neutrophil</b>	Most common white blood cell; first line of defense against bacteria.	<b>Healthy</b> – Normal; moderate increase is okay in infections.
7	<b>Platelet</b>	Cell fragment essential for blood clotting.	<b>Healthy</b> – Normal; deficiency increases bleeding risk.

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- **Machine learning model**

- Multi-Layer Neural Network (MLNN)
- Convolutional Neural Networks (CNNs)



- **Model**
  - Number of layers
  - Activation functions
  - Number of convolutional layers
  - Filters
  - ...
- **Other**
  - Training / Validation / Test
  - Normalization
  - Back Propagation optimizers
  - Loss function
  - Metrics

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- **Report**

- Description of the approach to the problem
- Description of the general architecture of the methods used;
- Description of the experiment, including a table with the parameters used which should allow full replication;
- Description of the evaluation metrics used for the validation:
  - Quality of the final result, efficacy (Accuracy, F1Score, MSE,..)
  - Efficiency (Execution time, computational power)
  - Diversity (class balanced predictions)
  - ..

## ■ Components for evaluation

- Project 1: 3.5/20

- **Report**

- Deadline 31 October 2025

- **Defense**

- To be defined

- **Note**

- The focus **is not** on the numerical **metrics** achieved.
- The key aspect lies in the ability to interpret the models and **understand the processes** through which results are obtained.
- Quantitative metrics alone are not determinant to assess the final evaluation of the project.

- **AI tools**

- Clearly indicate when AI tools are used in any part of the work (e.g., text generation, code, data analysis).

...

## Train\_dataset

```
#Access a single image / label
image, label = train_dataset[2]           # image is a tensor , label is an int
print("Shape da imagem:", image.shape)
print("Classe:", label)

# Convert to NumPy array
image_array = image.numpy()
print("Size:", image_array.shape )

# Access a subset of images
img = train_dataset[1][0].numpy          # image
lab = train_dataset[1][1]                # label

startID = 10
endID  = 20
images_array = np.stack( [train_dataset[i][0].numpy() for i in range(startID, endID)])
labels_array = np.array( [train_dataset[i][1] for i in range(startID, endID)])

print("Size:", images_array.shape )
print(labels_array)
```