

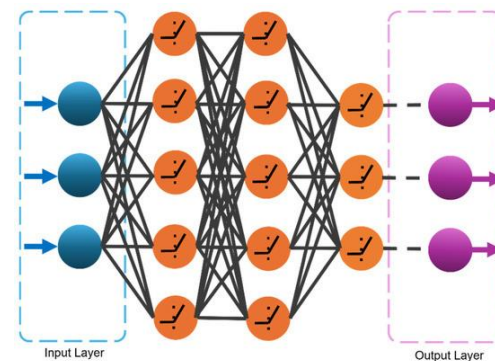
APR - Aprendizagem Profunda e por Reforço - 2025/26

Deep and Reinforcement Learning

Project 1

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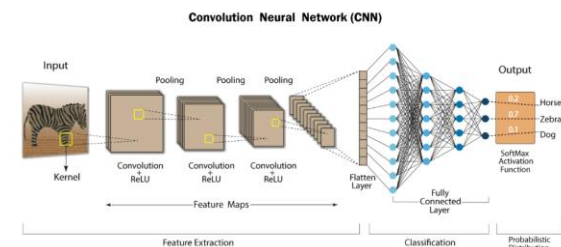


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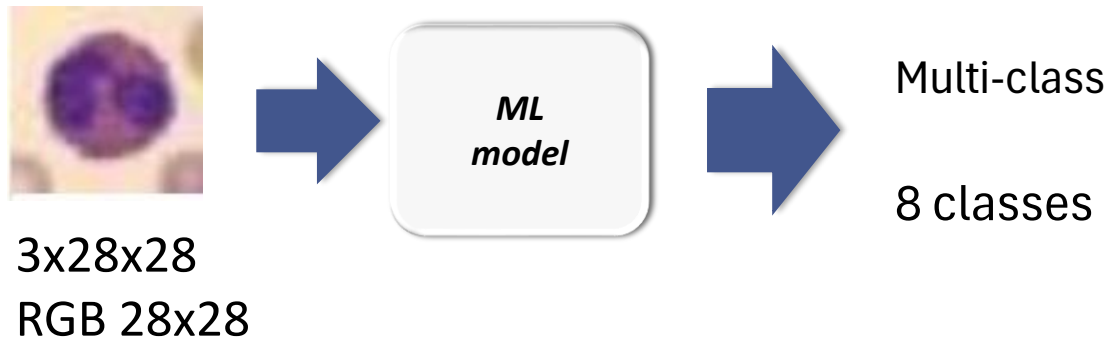


Contents

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

Goal

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



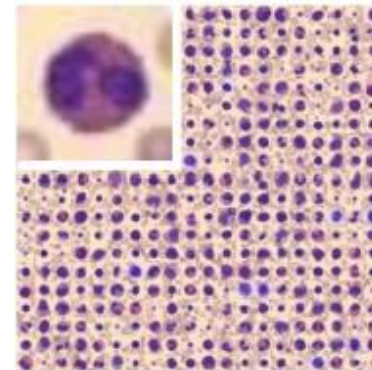
- **The main objectives of analyzing blood cell images are:**
 - **1. Cell classification**
 - Identify the type of cell (e.g., neutrophil, lymphocyte, etc.).
 - **2. Detection of abnormalities**
 - Identify infections, allergies, or blood disorders (leukemia, anemia, malaria, etc.).
 - **3. Automating 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.

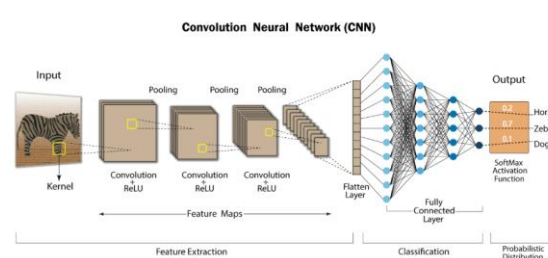
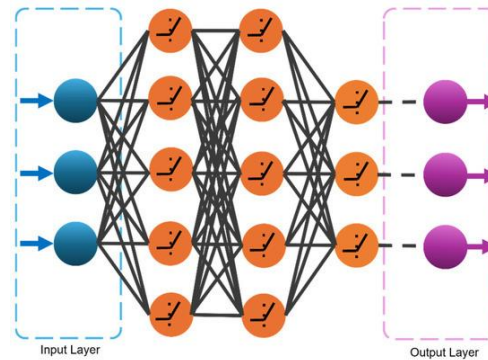
Potential Problem – Normally absent in peripheral blood or indicative of serious conditions.

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

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- **Machine learning model**
 - Multi-Layer Neural Network (MLNN)
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- **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)
```