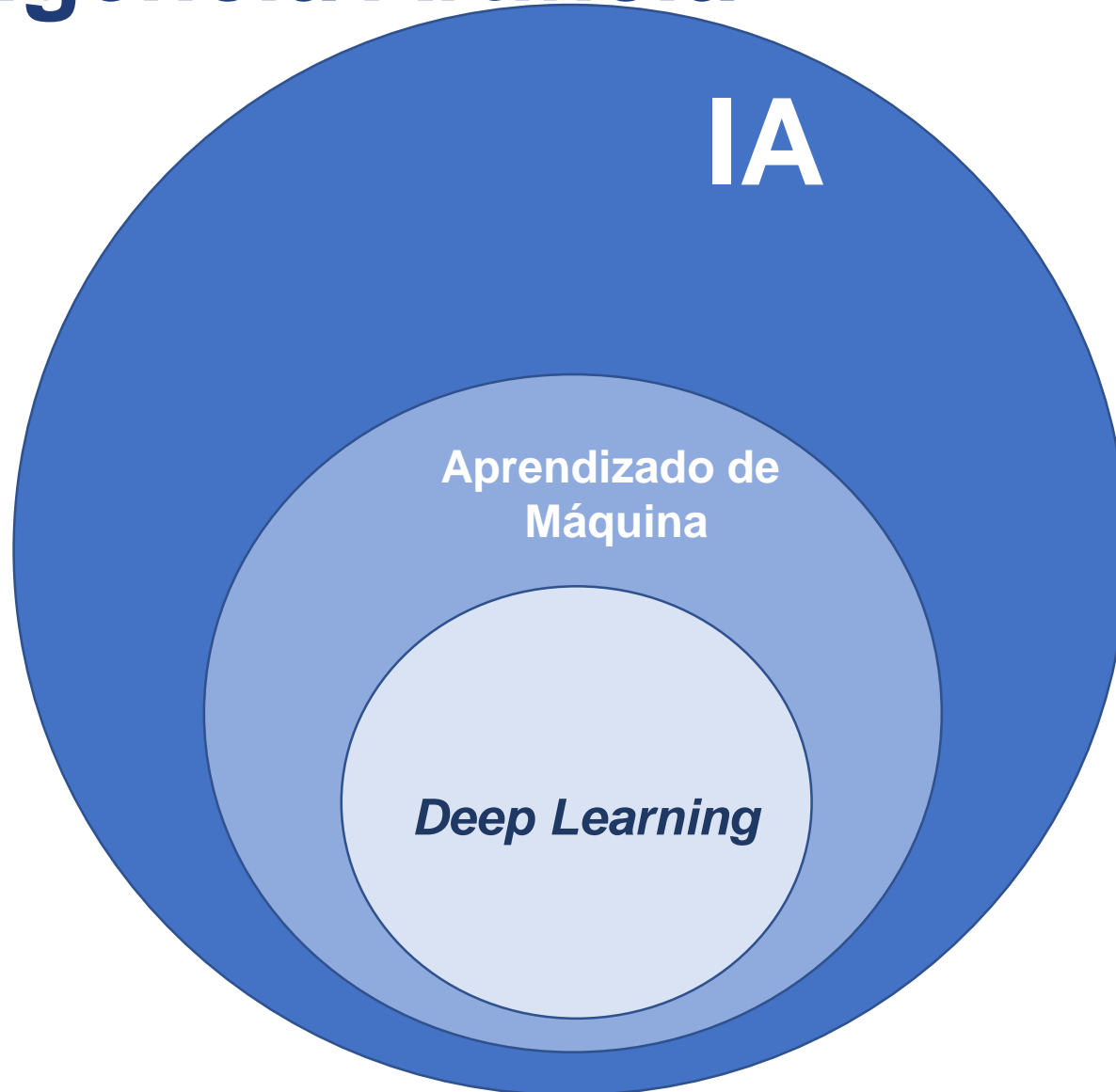
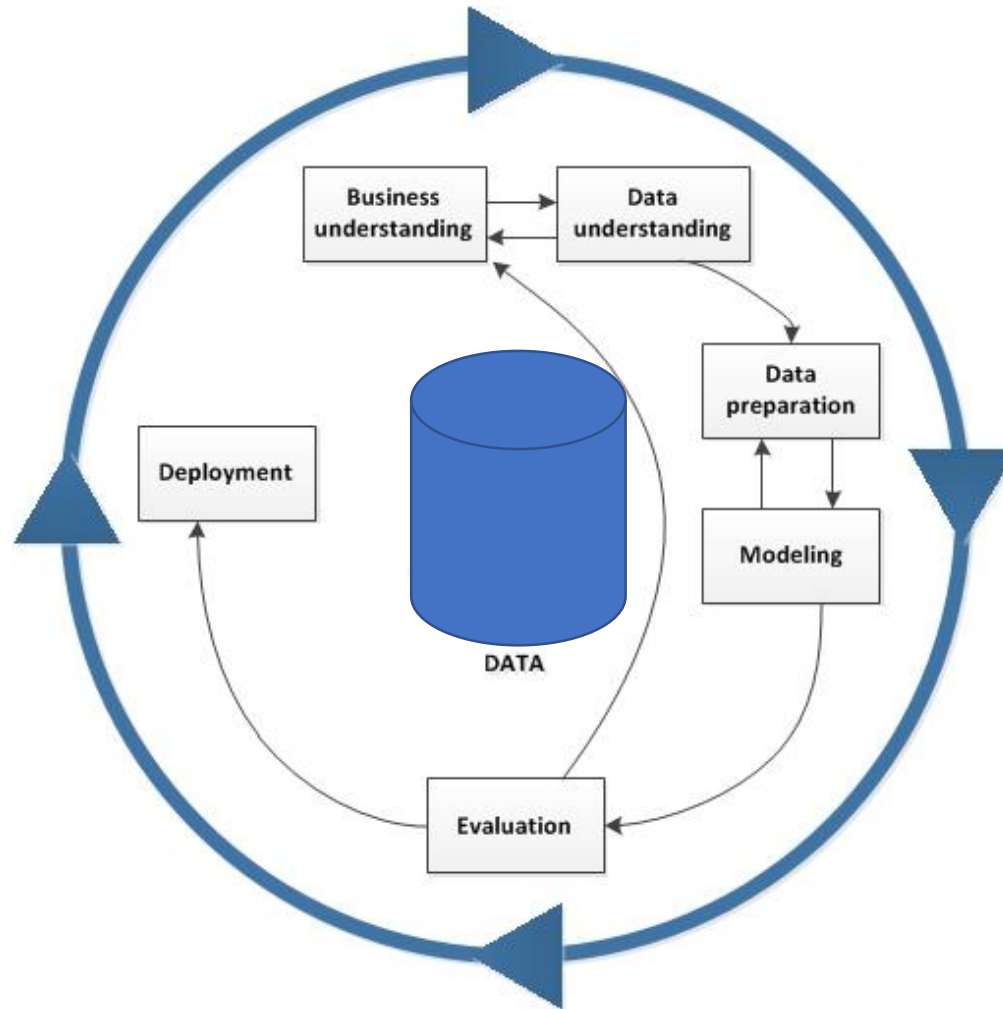


Algoritmos de Inteligência Artificial

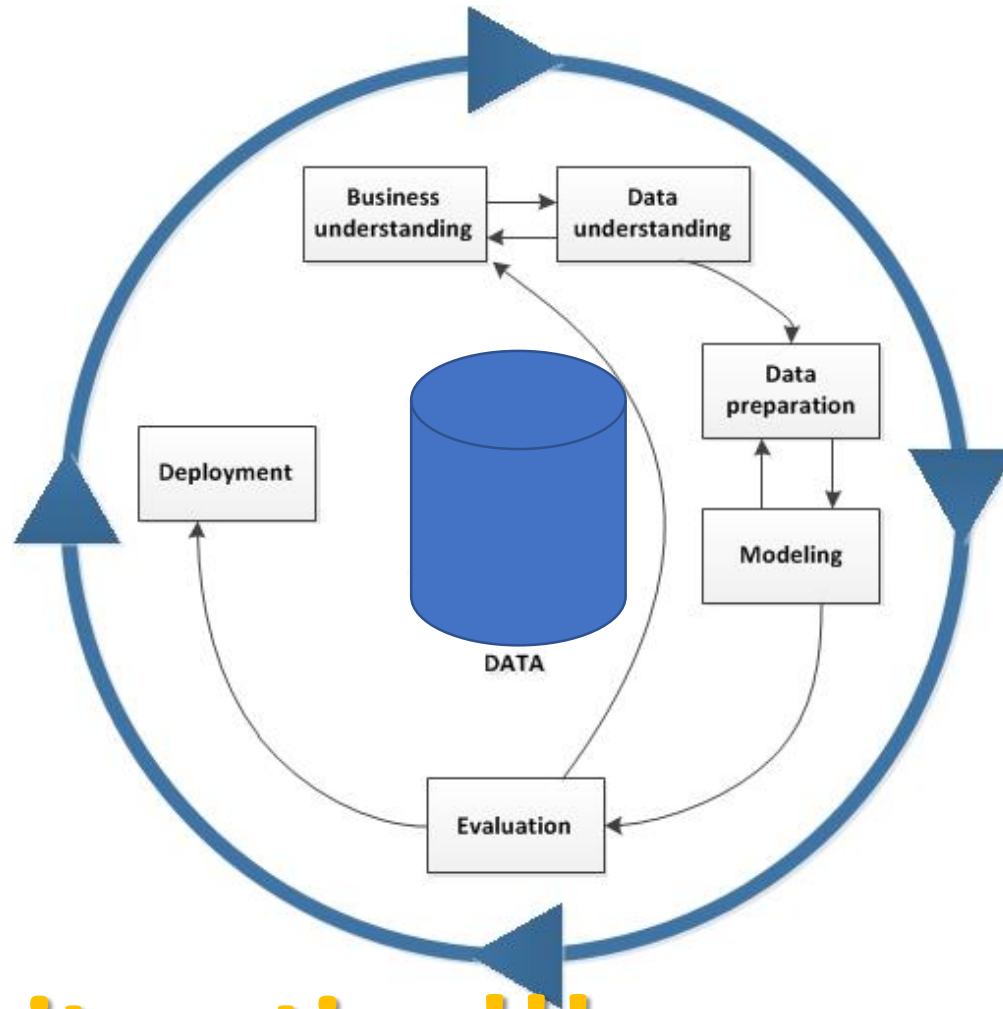
Inteligência Artificial



CRISP-DM

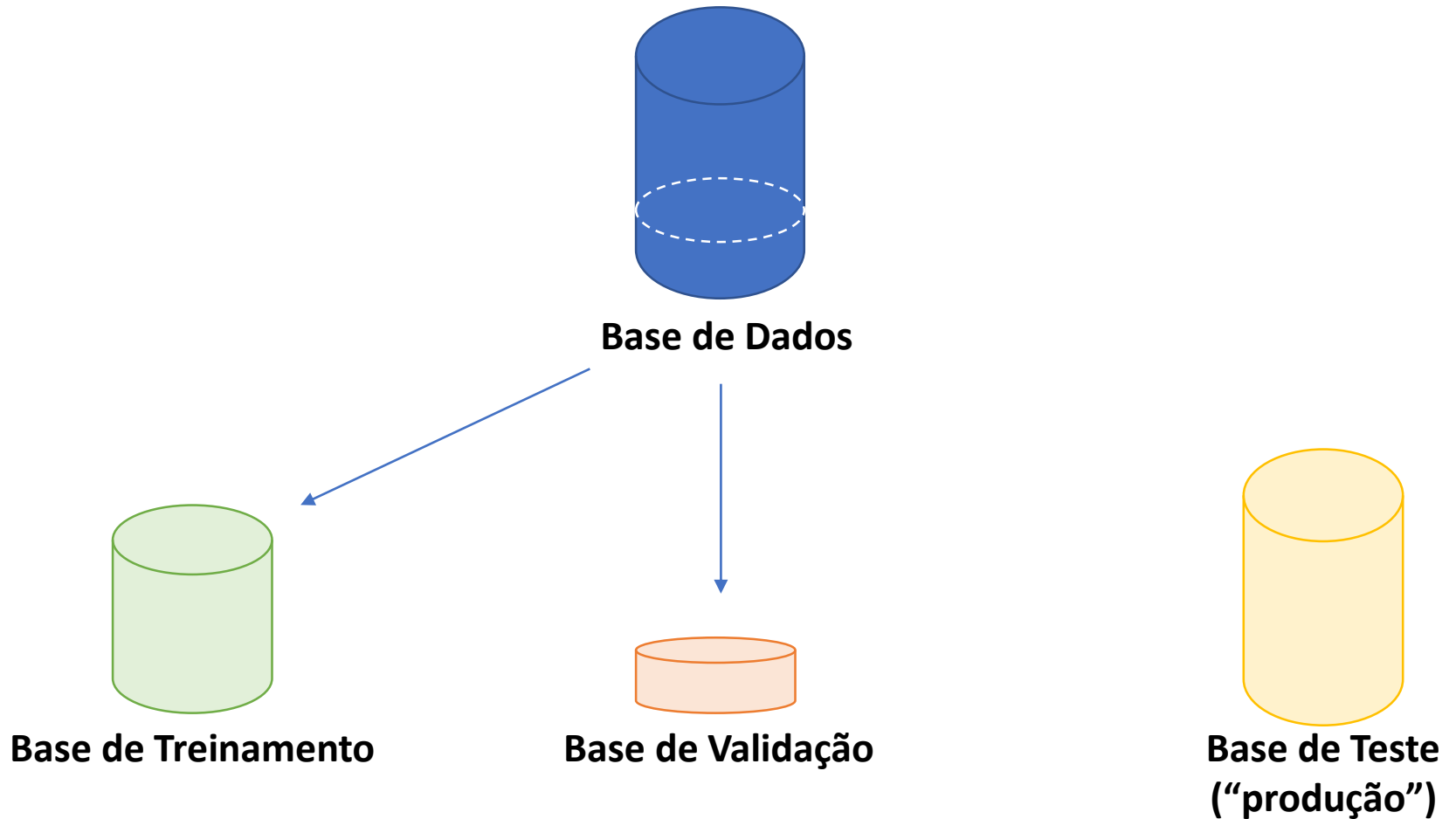


CRISP-DM



Processo iterativo!!!

Bases de Dados



Aprendizado de Máquina

- Definição:

Aprendizado de Máquina é a área da Ciência da Computação que foca em desenvolver métodos (algoritmos) capazes de aprender automaticamente a partir de experiência (dados), melhorando seus desempenhos.

- Diferentes abordagens:

- Aprendizado **supervisionado**;
- Aprendizado **não supervisionado**;
- Aprendizado **semi-supervisionado**.

Algoritmos

- Árvores de Decisão;
- XGBoost;
- k-NN;
- Redes Neurais Artificiais.

Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.

An orange oval shape with a thin orange border, containing the text "Jogador de basquete" in orange.

Jogador de
basquete

A green oval shape with a thin green border, containing the text "Pessoa comum" in green.

Pessoa
comum

Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.

Altura

Peso

% Massa
magra

Jogador de
basquete

Pessoa
comum

Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.

Altura
> 1,8 m

Peso

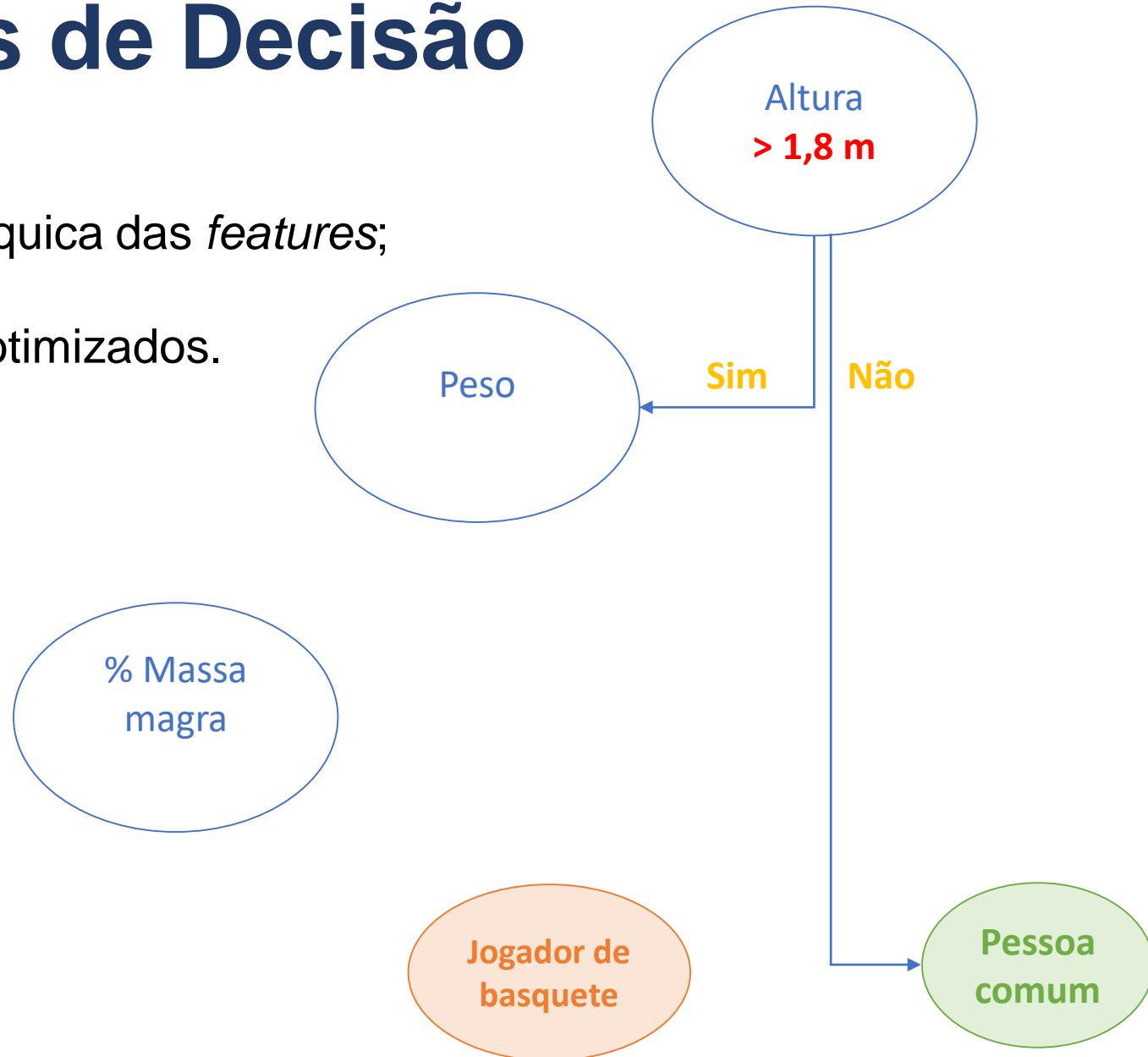
% Massa
magra

Jogador de
basquete

Pessoa
comum

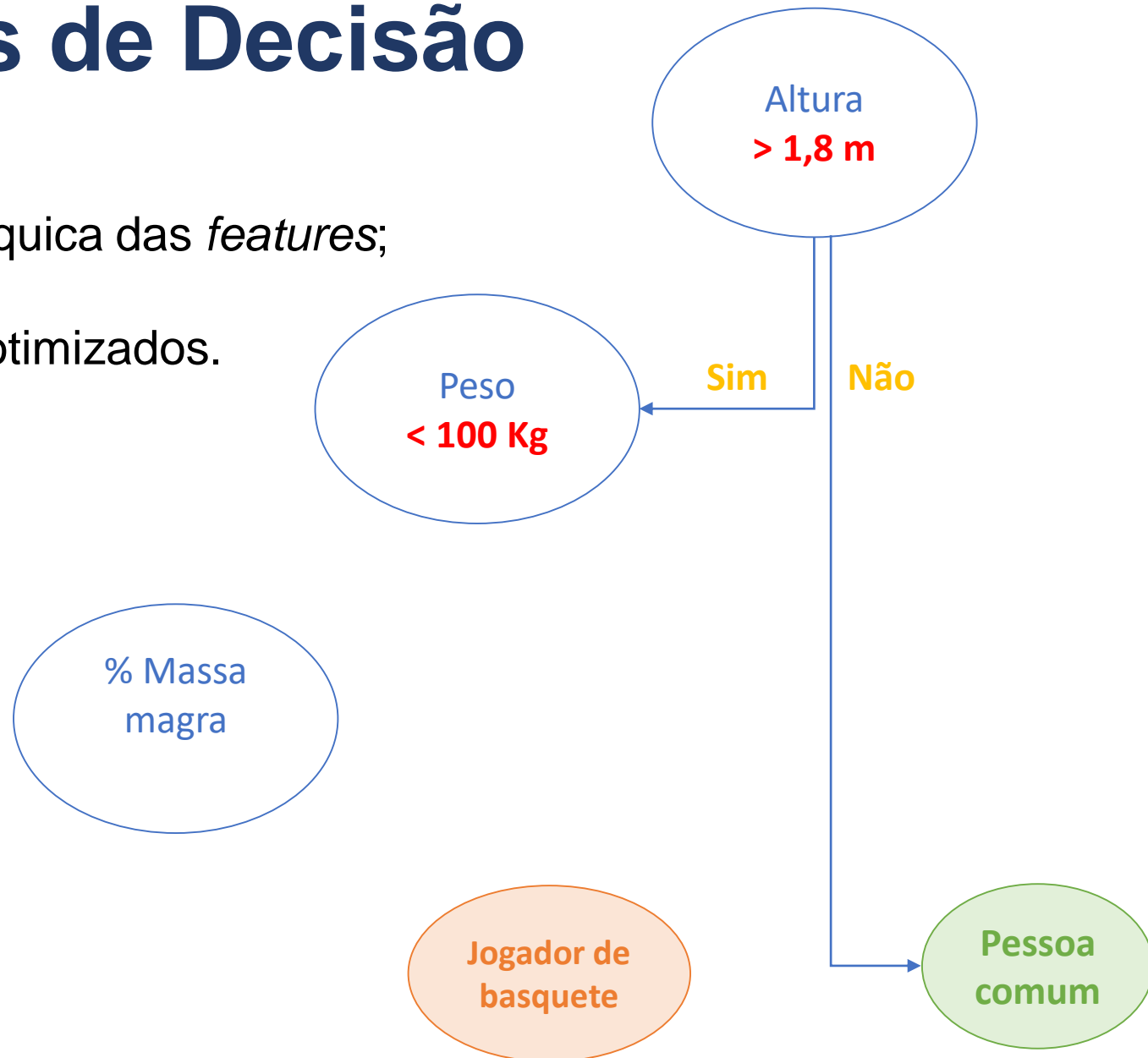
Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.



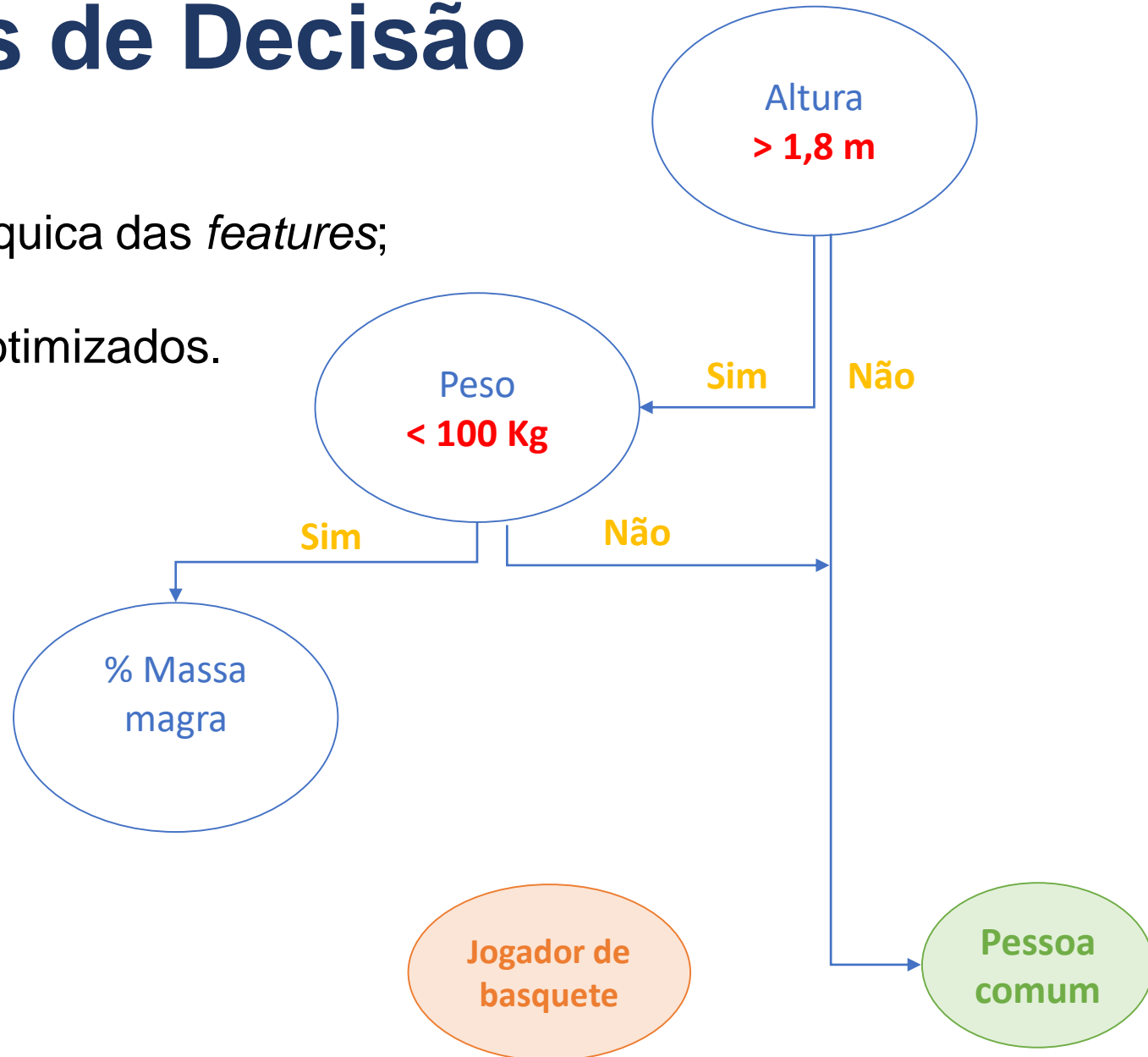
Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.



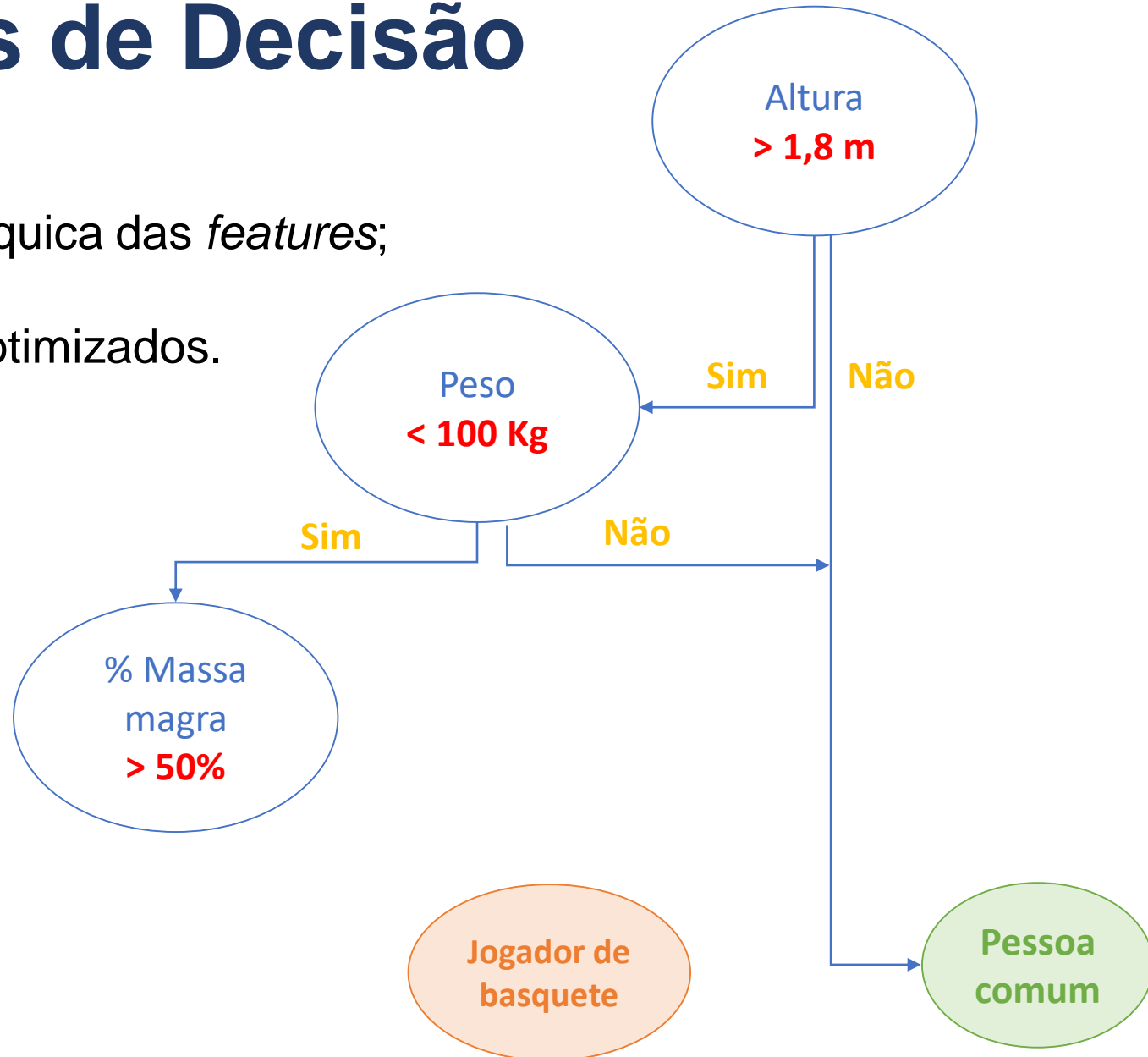
Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.



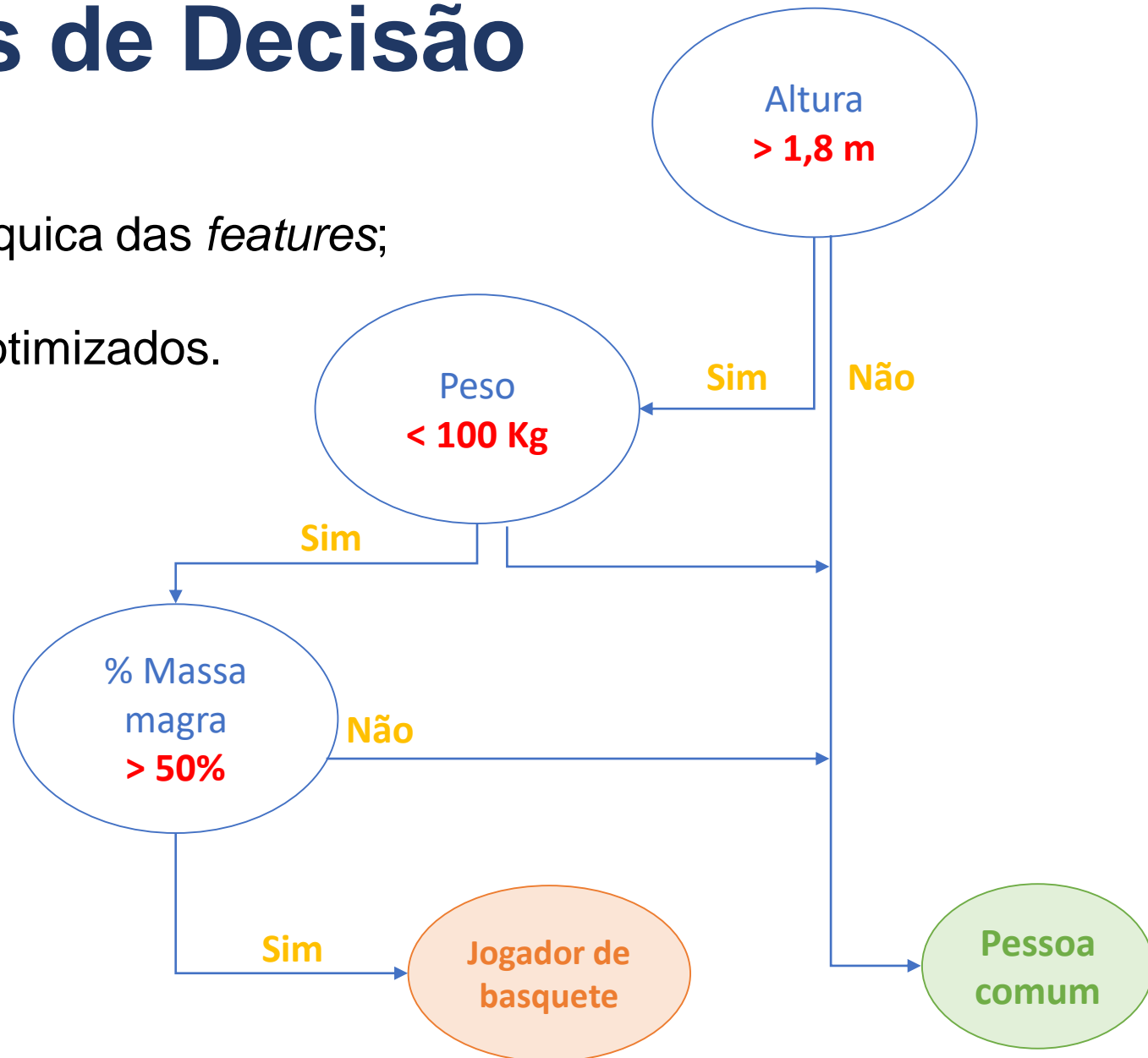
Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.



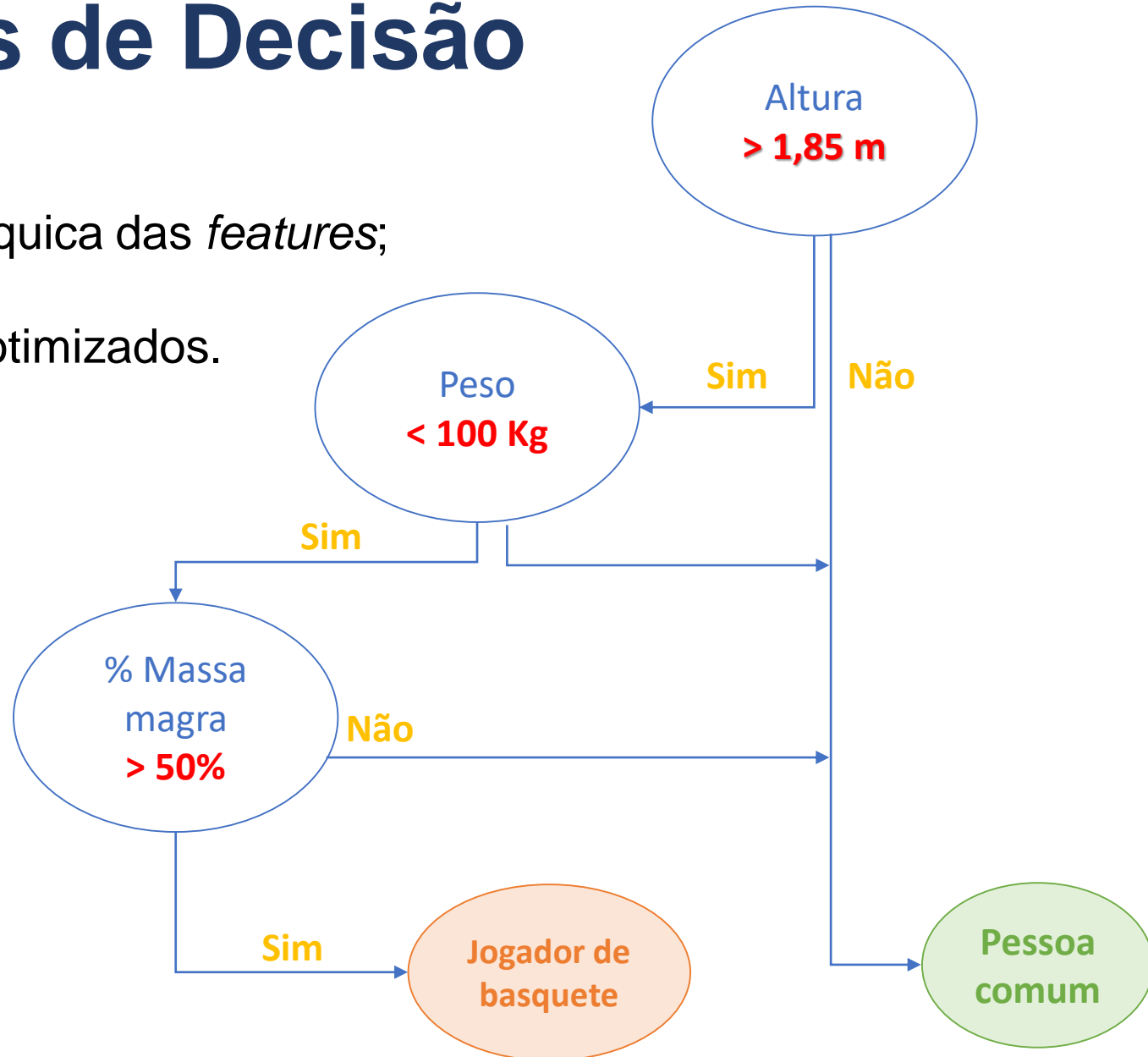
Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.



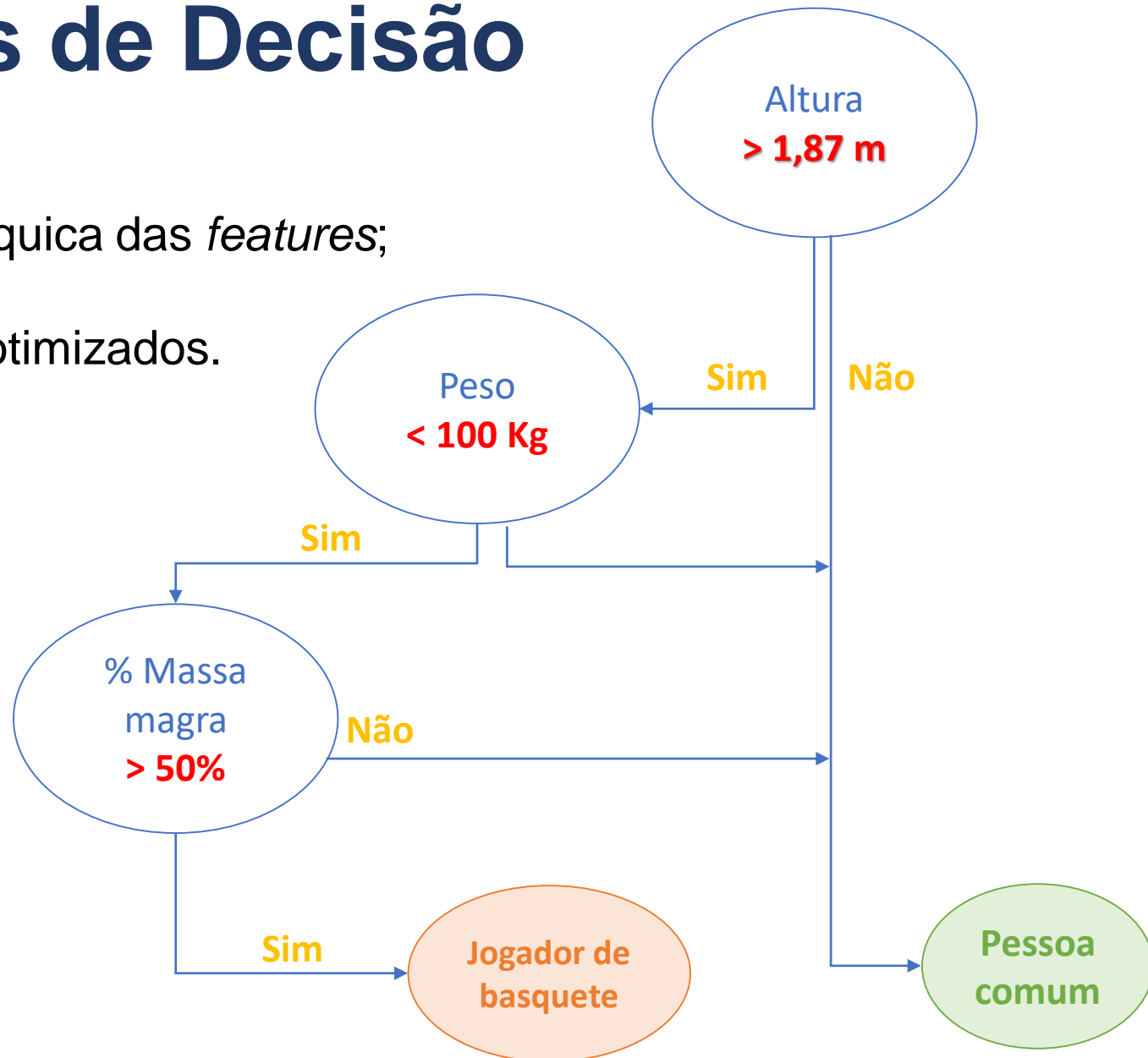
Árvores de Decisão

- Análise hierárquica das *features*;
- Limiares são otimizados.



Árvores de Decisão

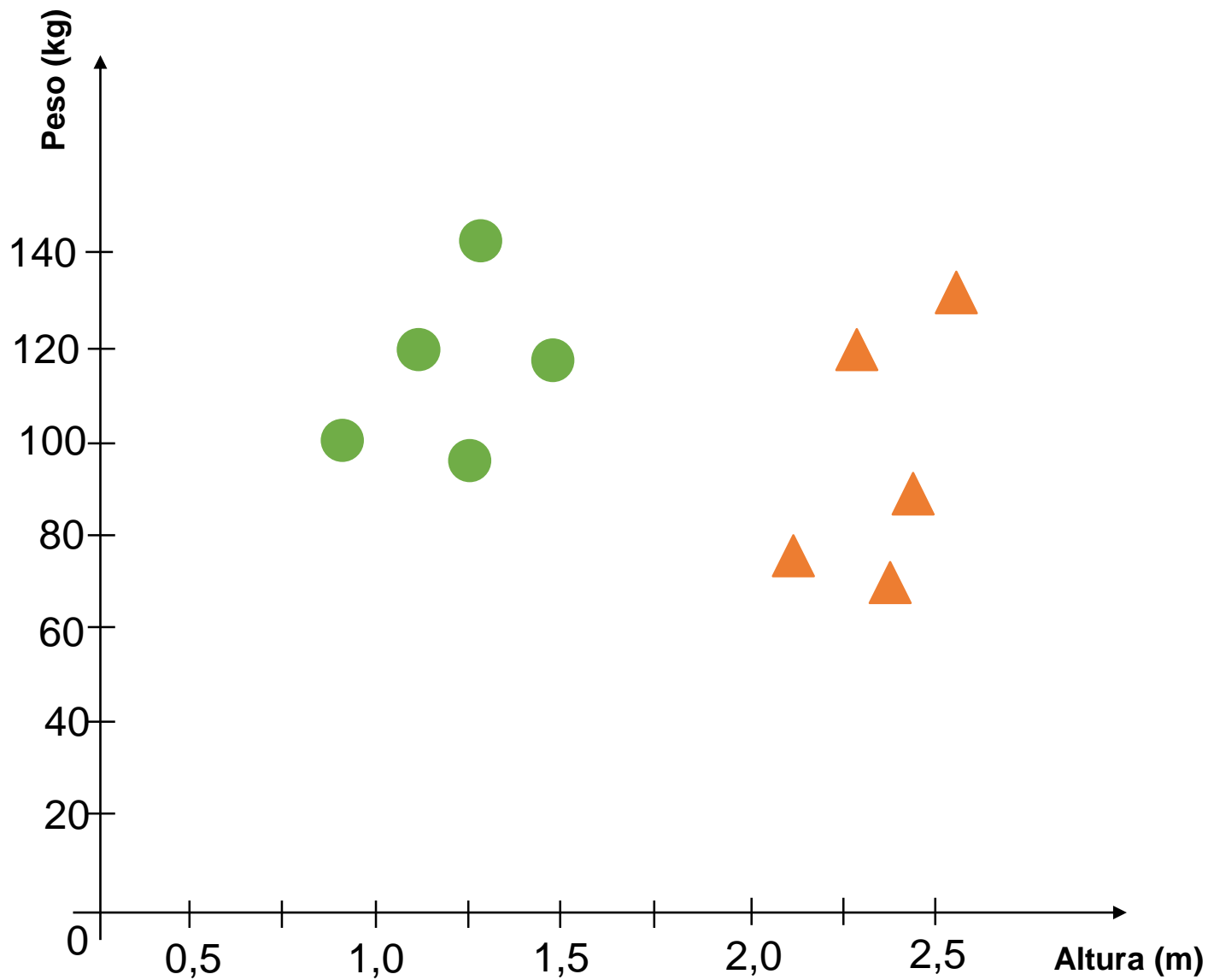
- Análise hierárquica das *features*;
- Limiares são otimizados.



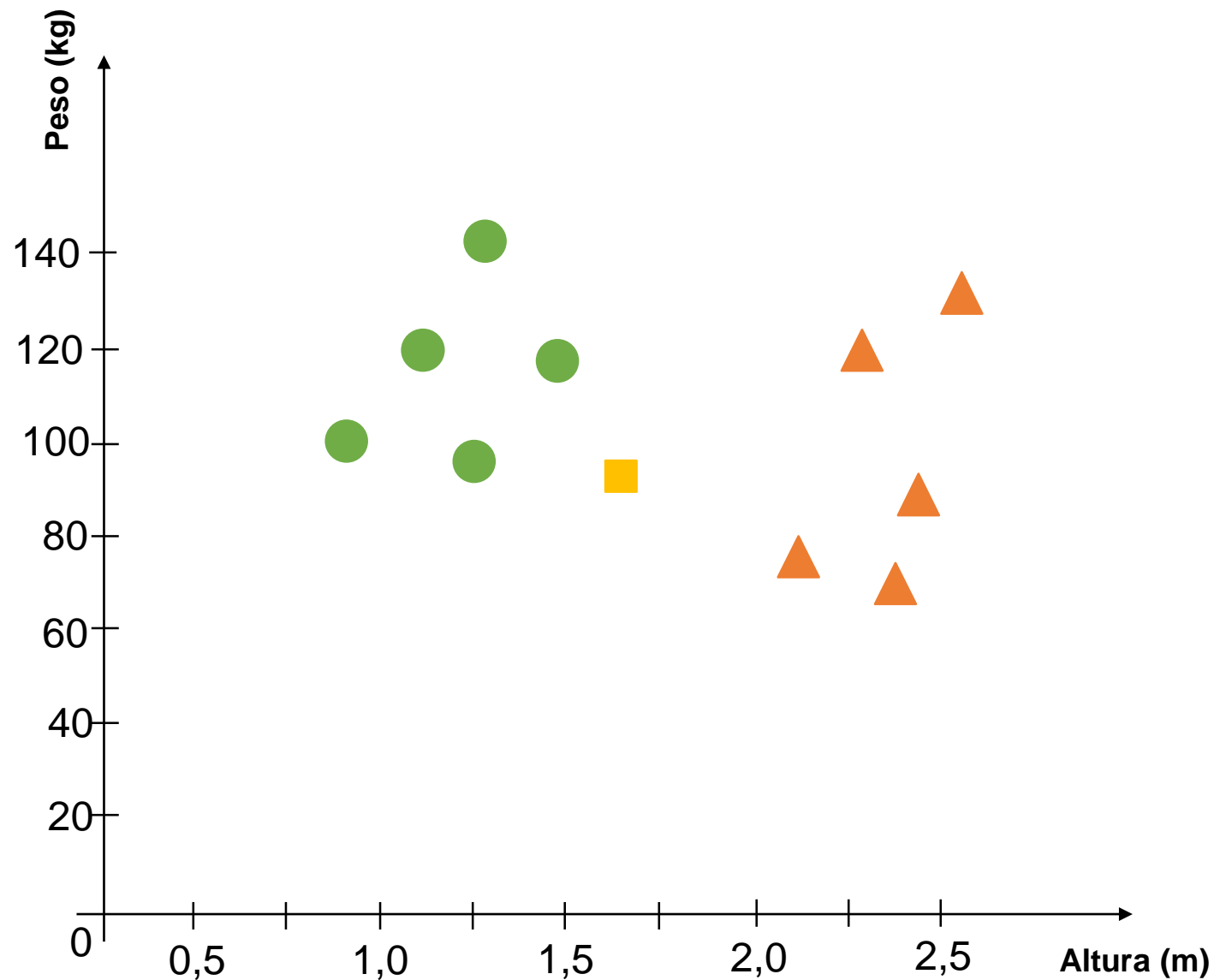
k-NN

- *k-Nearest Neighbors* (k-NN):
 - Definição do valor de k ;
 - Seleção das k amostras mais próximas (de acordo com alguma métrica de distância);
 - Classificação da amostra desconhecida como sendo da classe predominante entre as amostras vizinhas mais próximas.

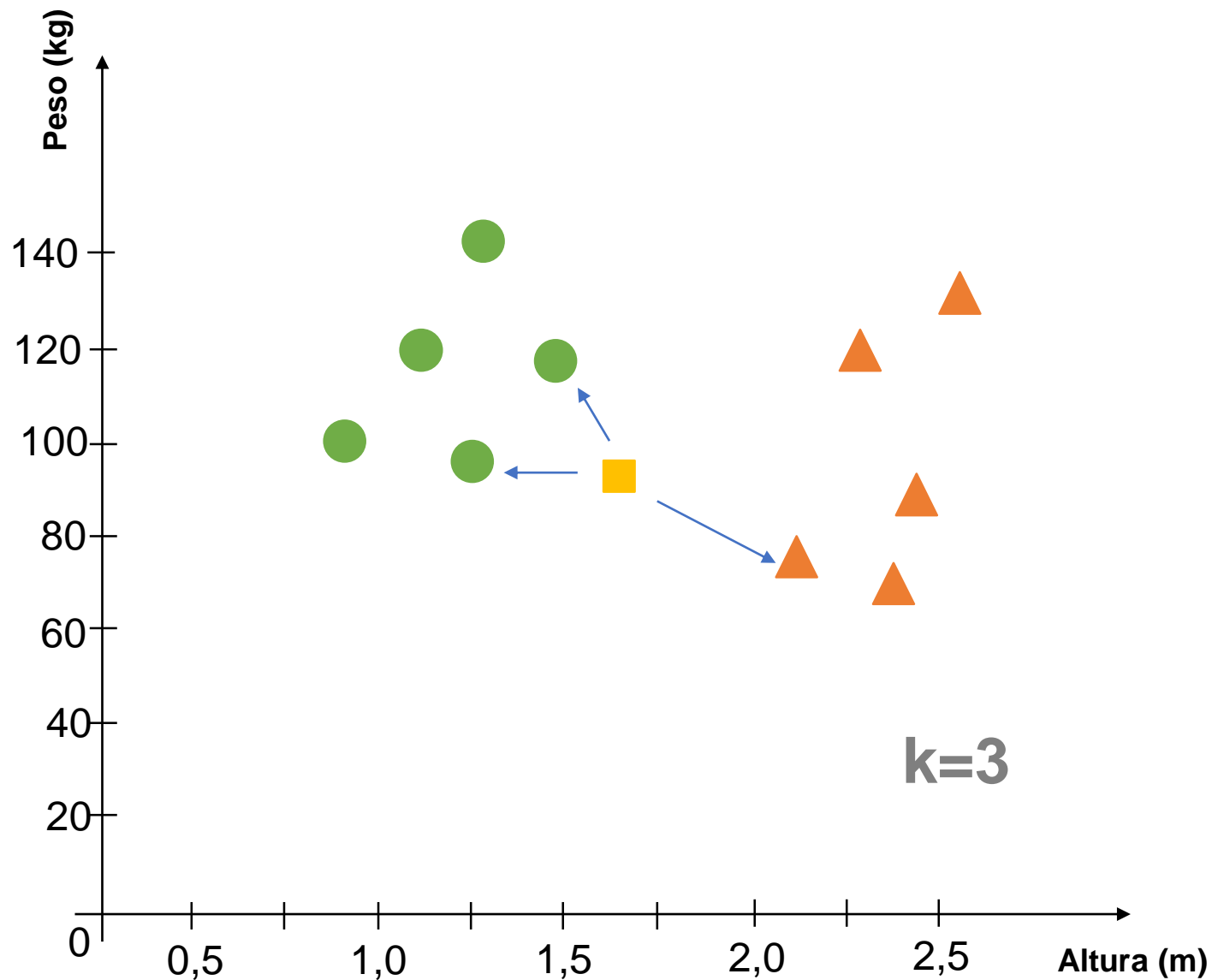
k-NN



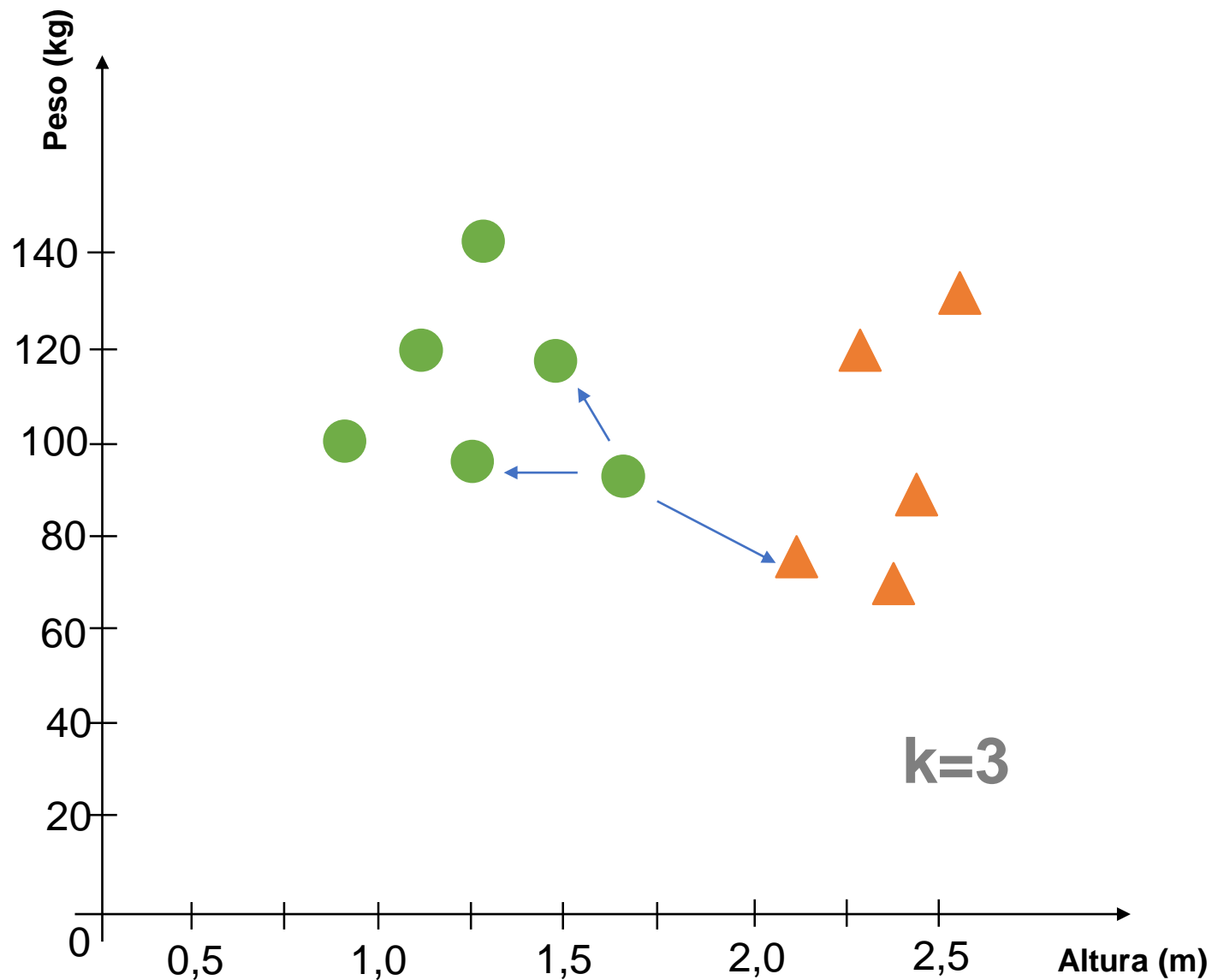
k-NN



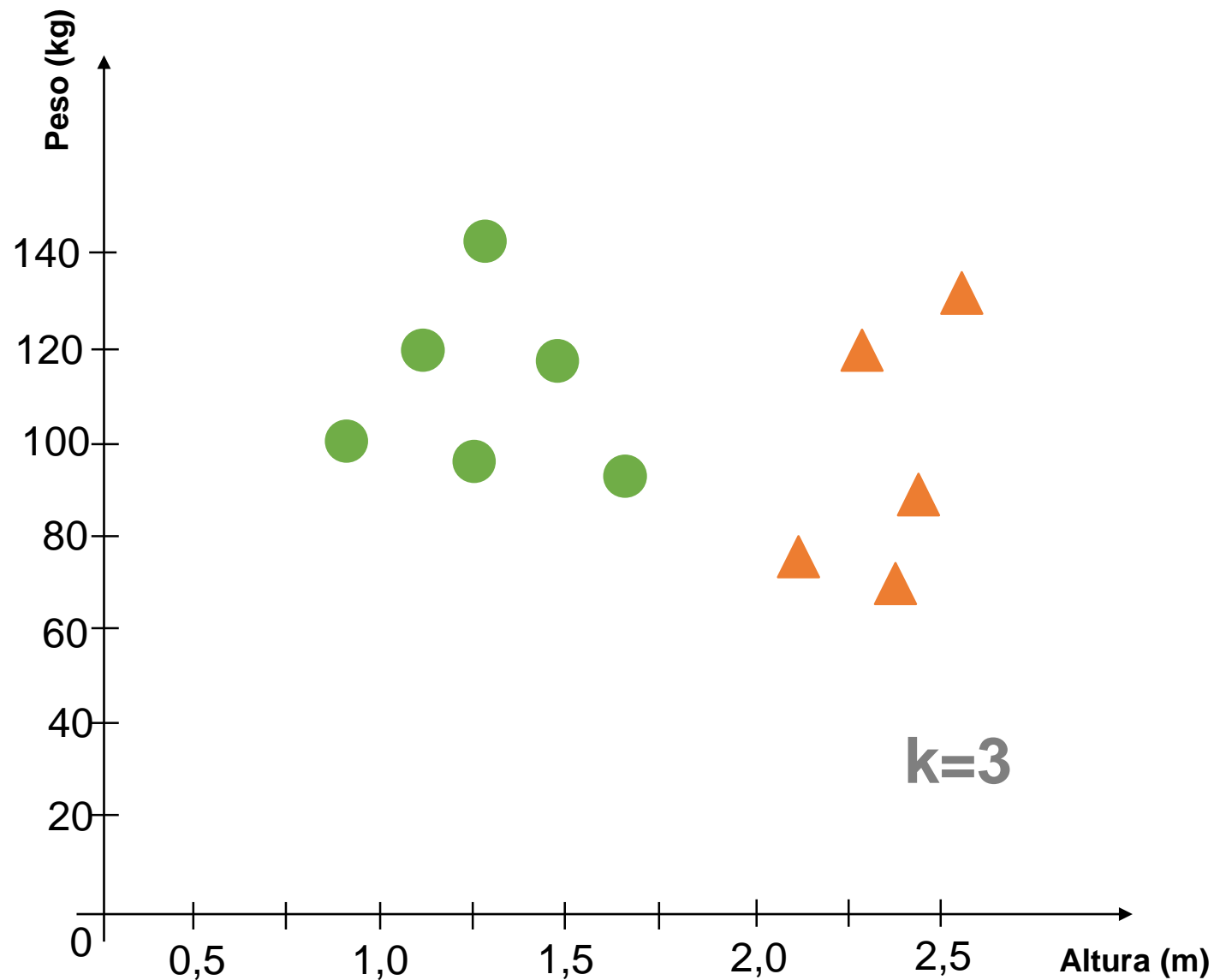
k-NN



k-NN

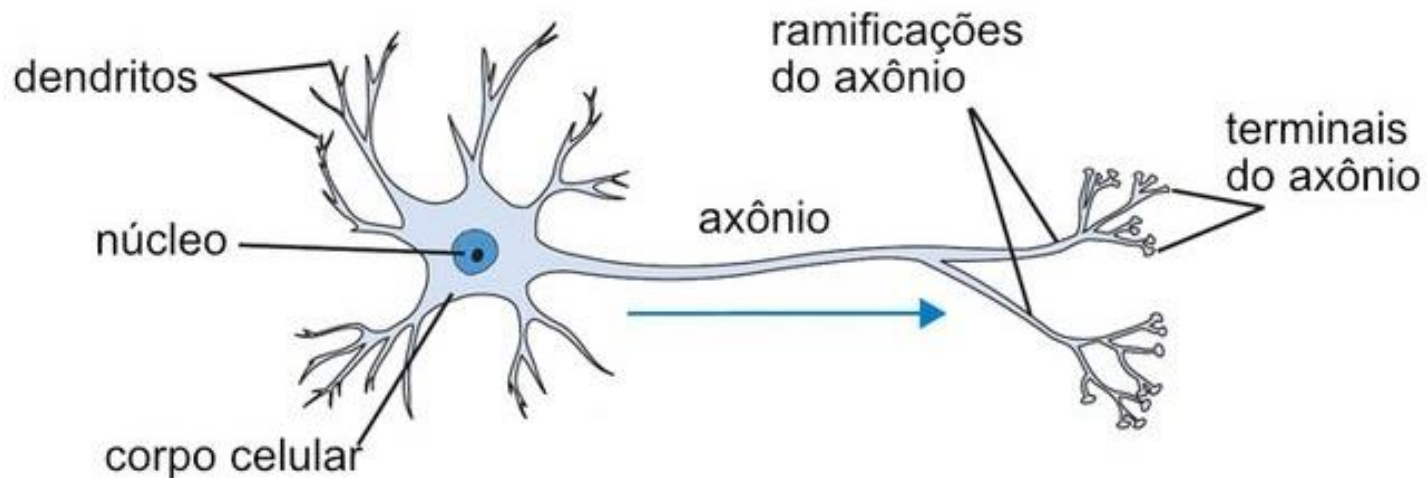


k-NN



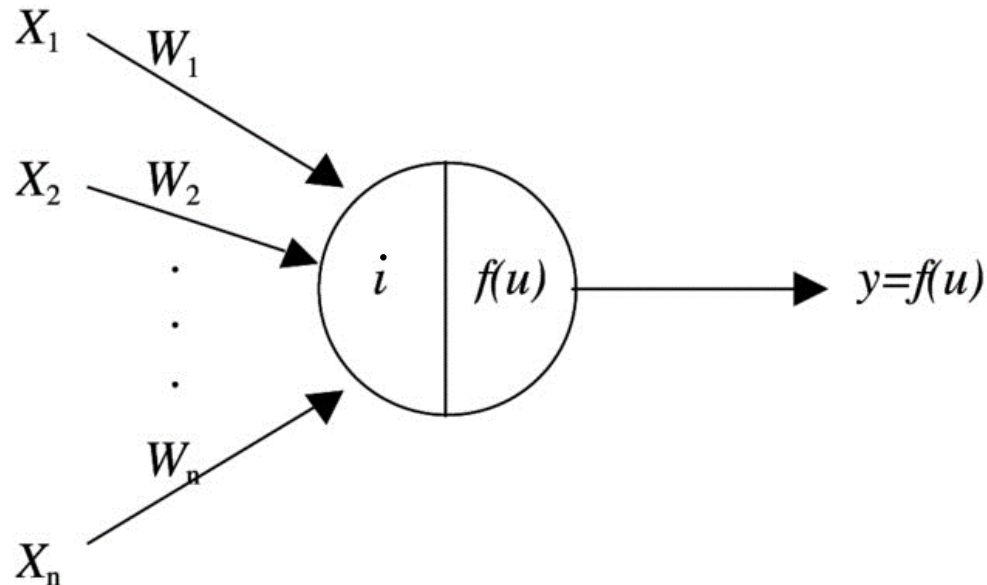
Redes Neurais Artificiais

- Cérebro humano:
 - 80 bilhões de neurônios;
 - Trilhões de conexões sinápticas.
- Neurônio: unidade elementar das redes neurais.



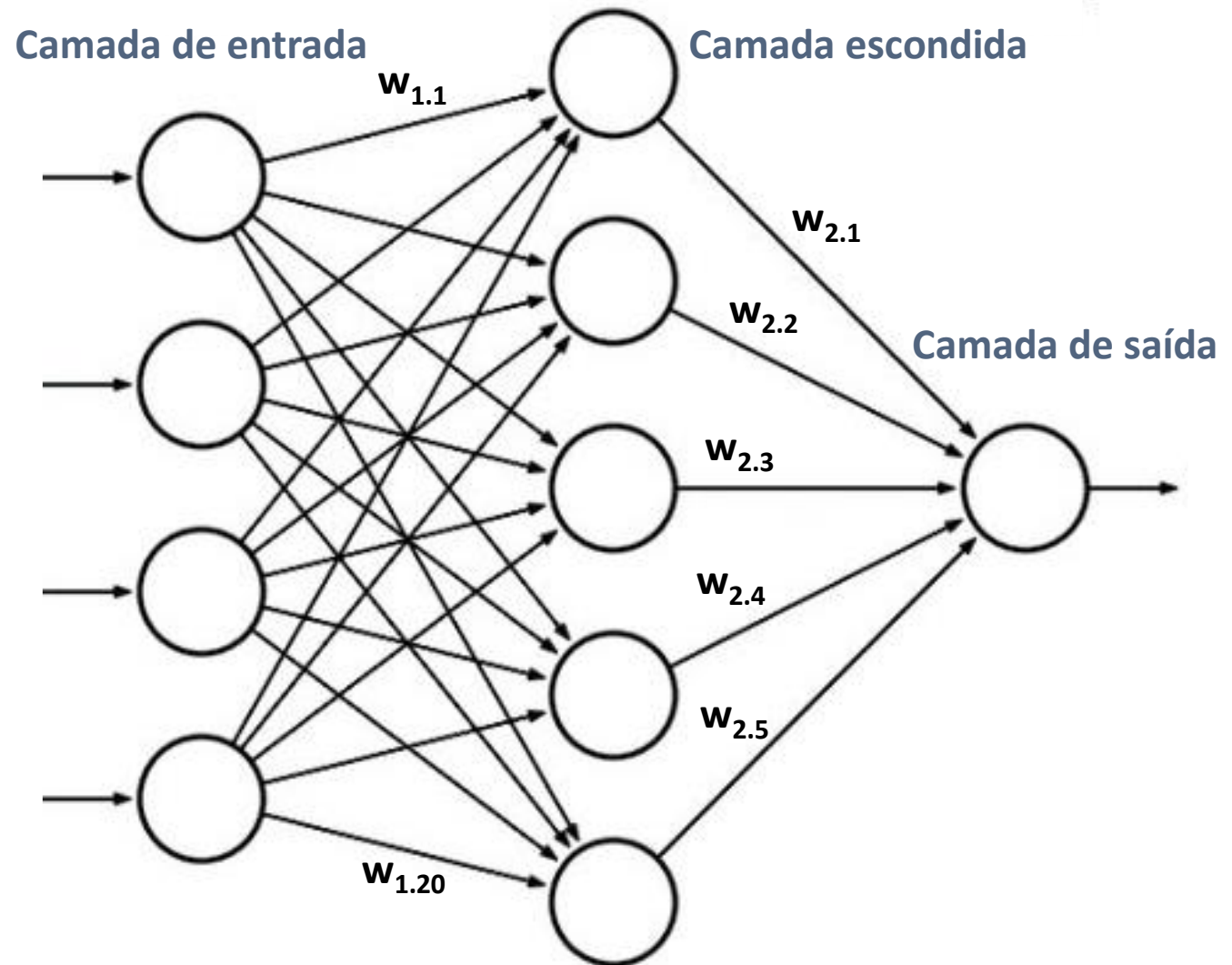
Redes Neurais Artificiais

- Primeiro modelo matemático - McCulloch e Pitts (1943):
 - Entradas;
 - Função de ativação (limiar de ativação);
 - Saída.



Redes Neurais Artificiais

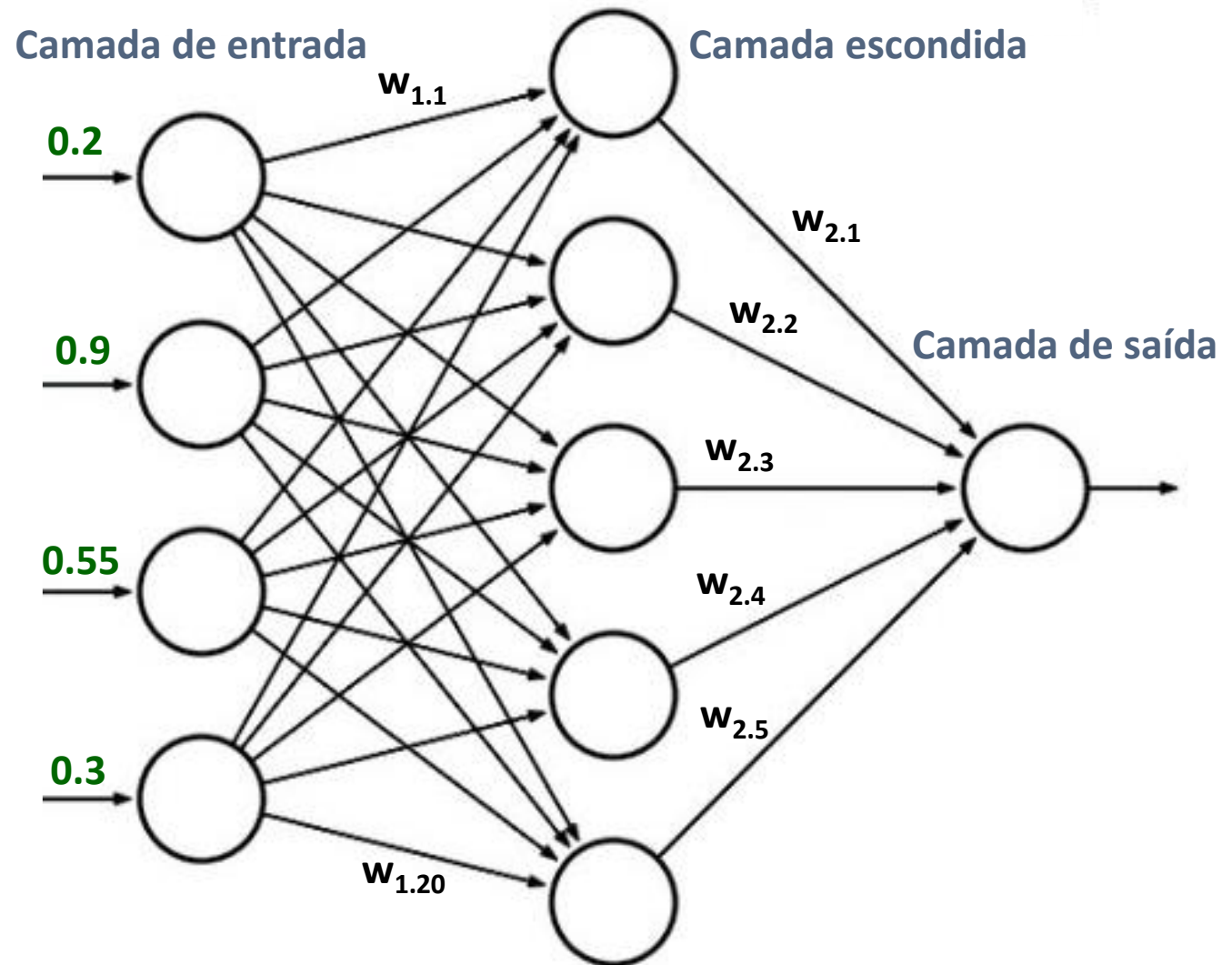
MLP



Redes Neurais Artificiais

MLP

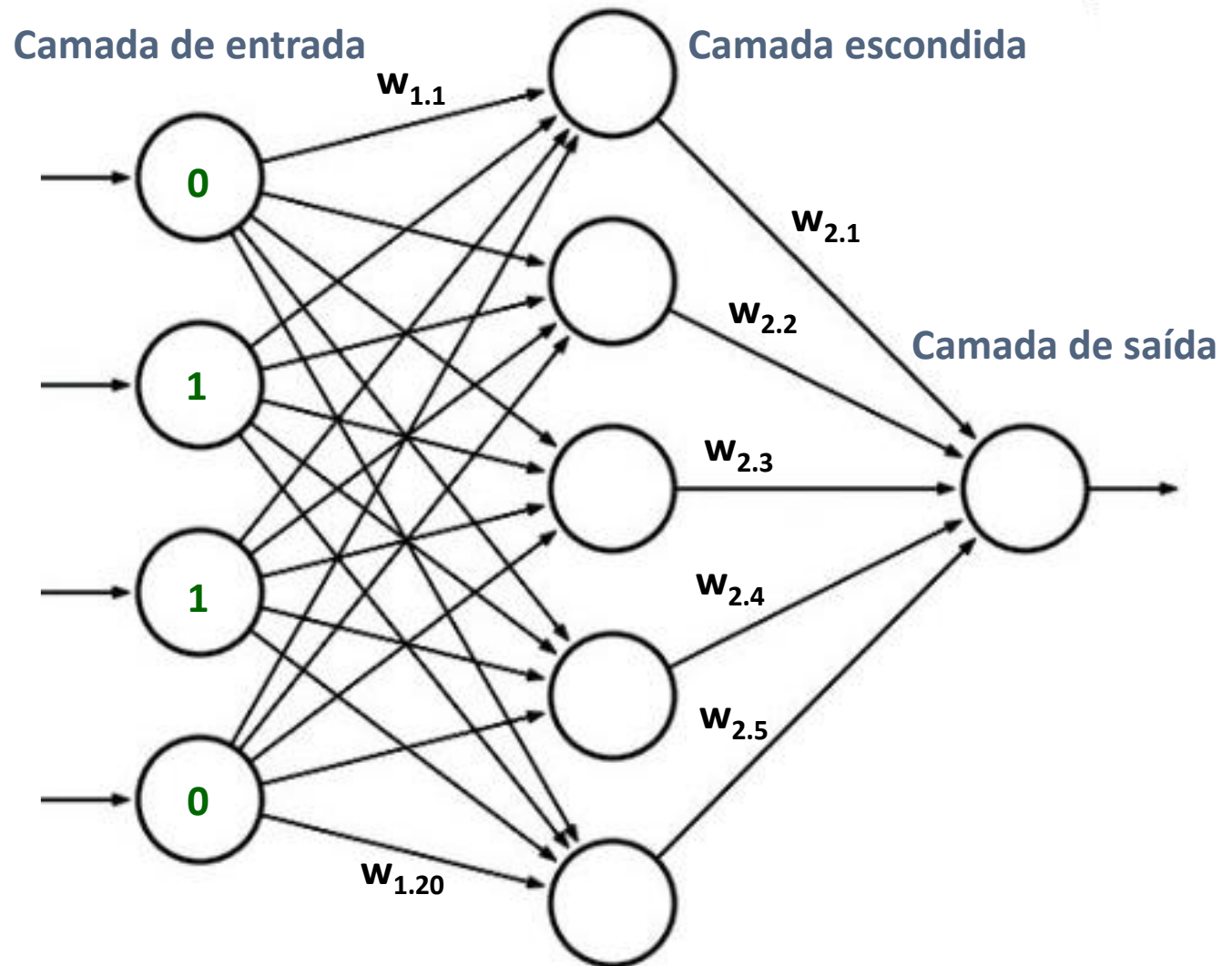
Backpropagation



Redes Neurais Artificiais

MLP

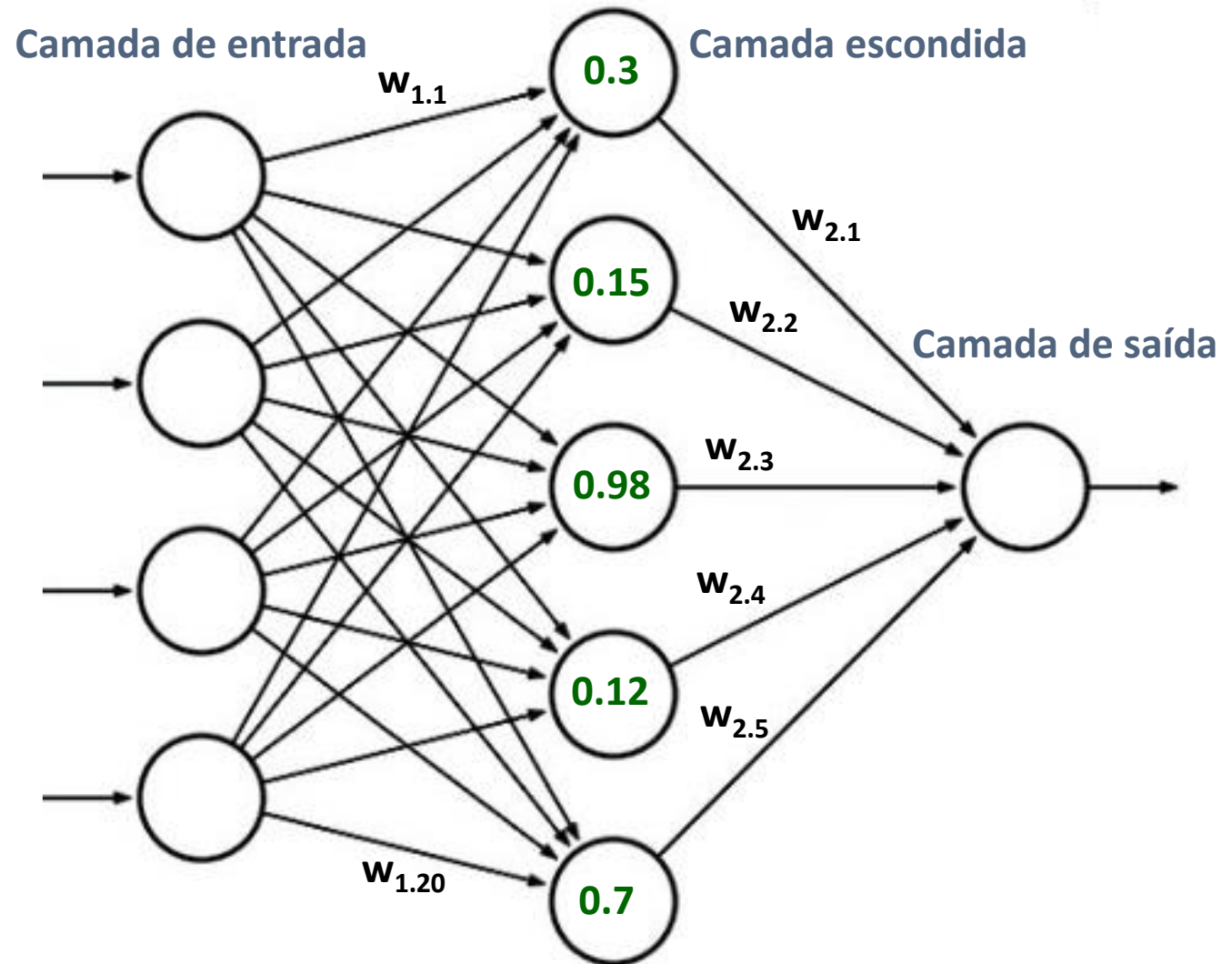
Backpropagation



Redes Neurais Artificiais

MLP

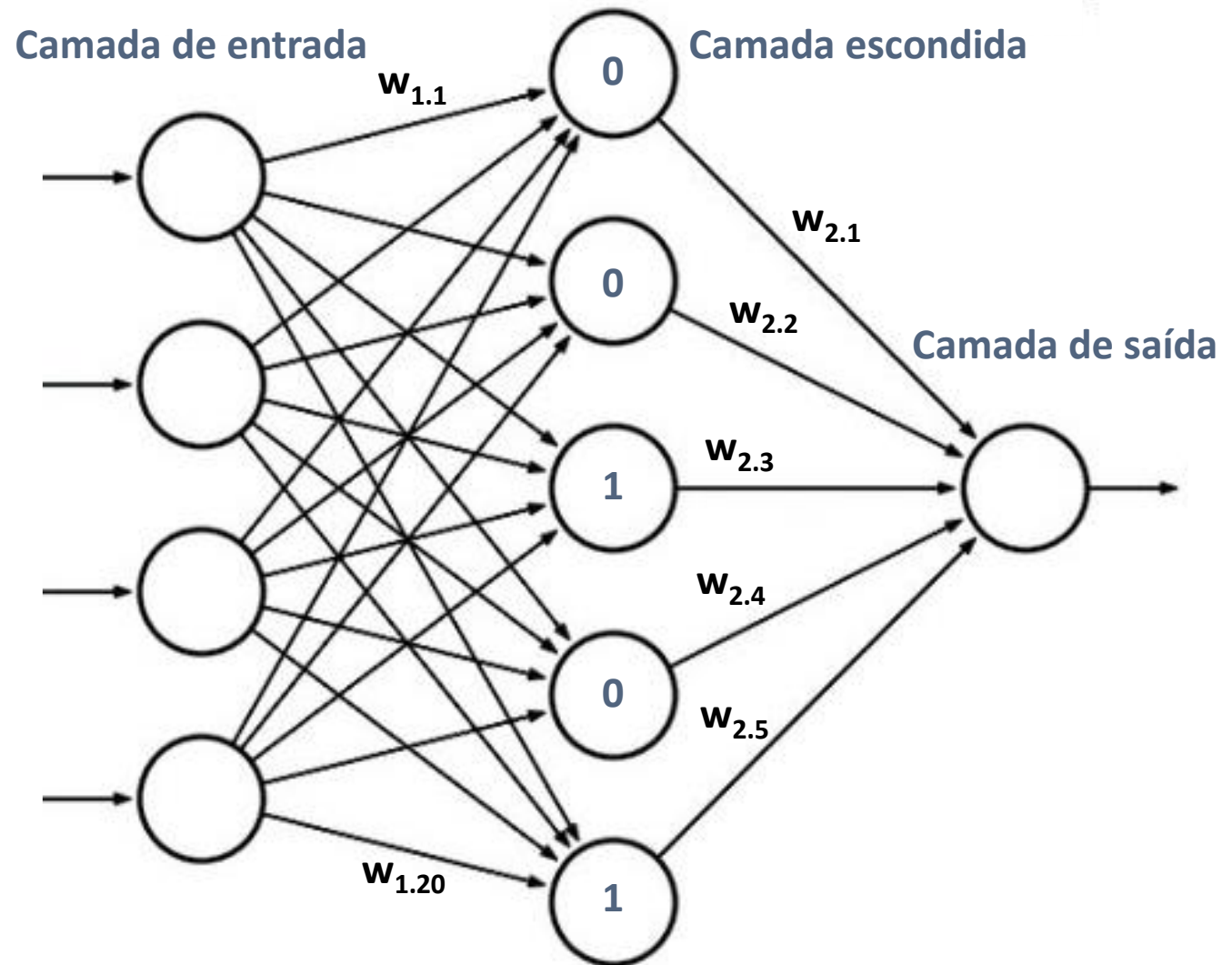
Backpropagation



Redes Neurais Artificiais

MLP

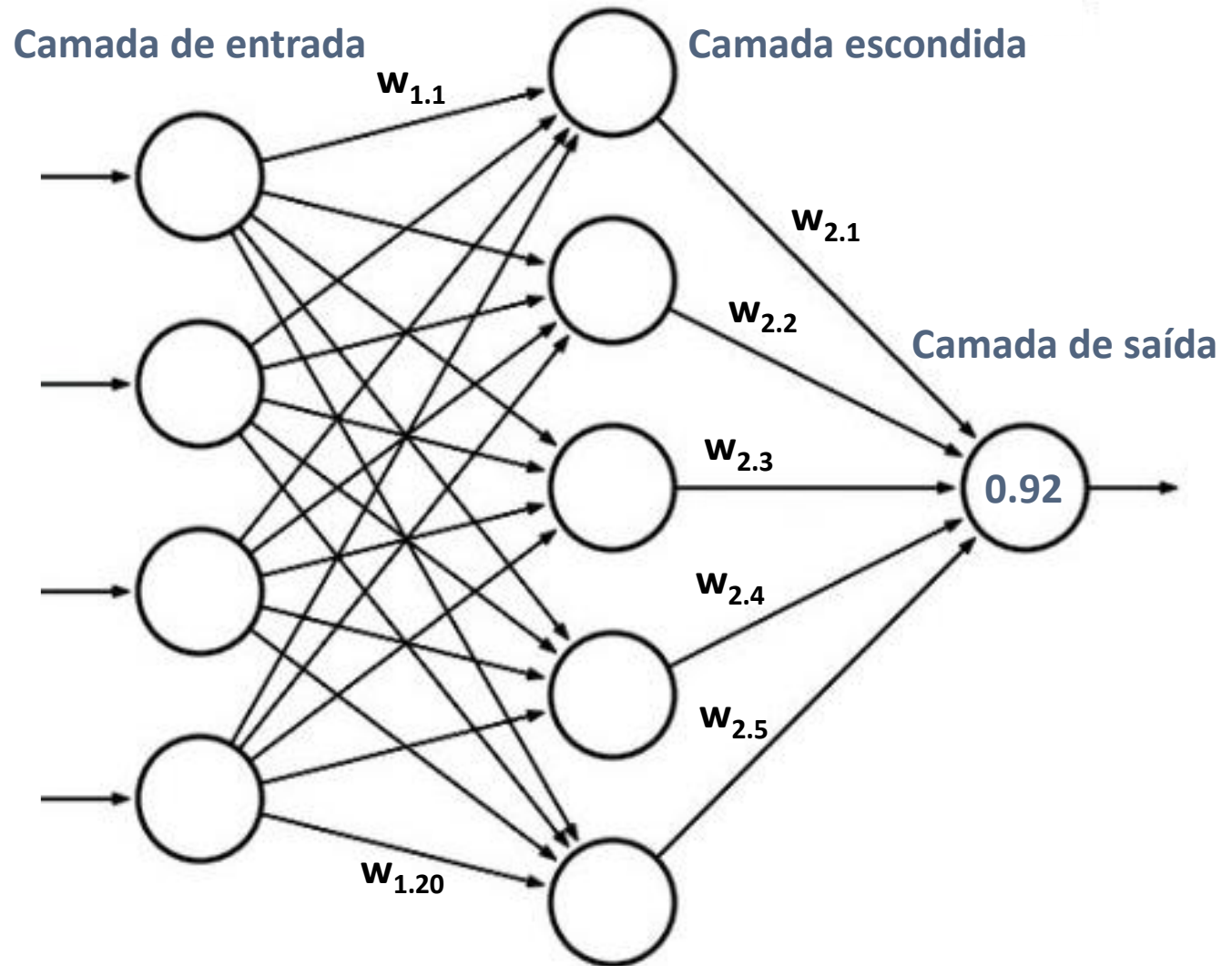
Backpropagation



Redes Neurais Artificiais

MLP

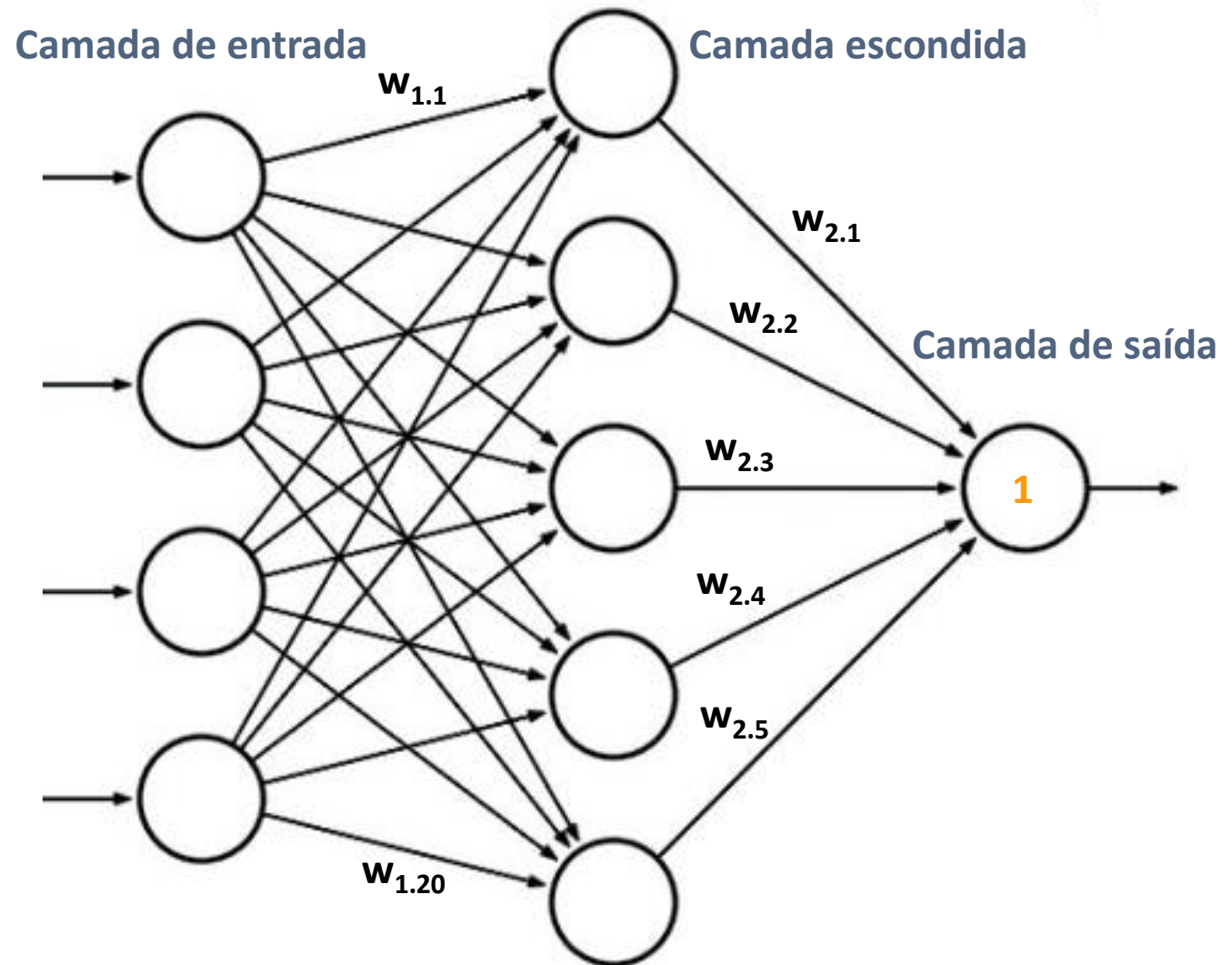
Backpropagation



Redes Neurais Artificiais

MLP

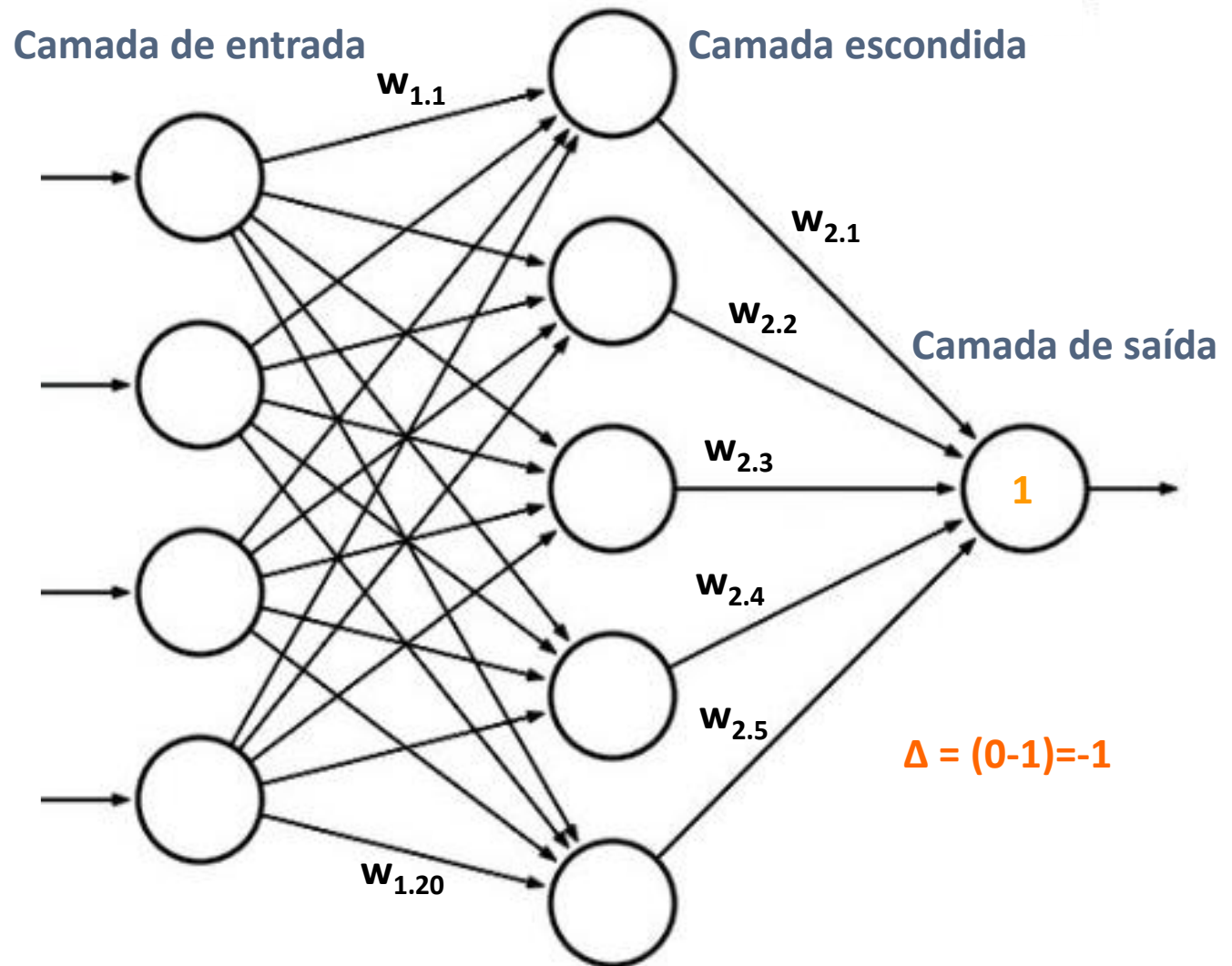
Backpropagation



Redes Neurais Artificiais

MLP

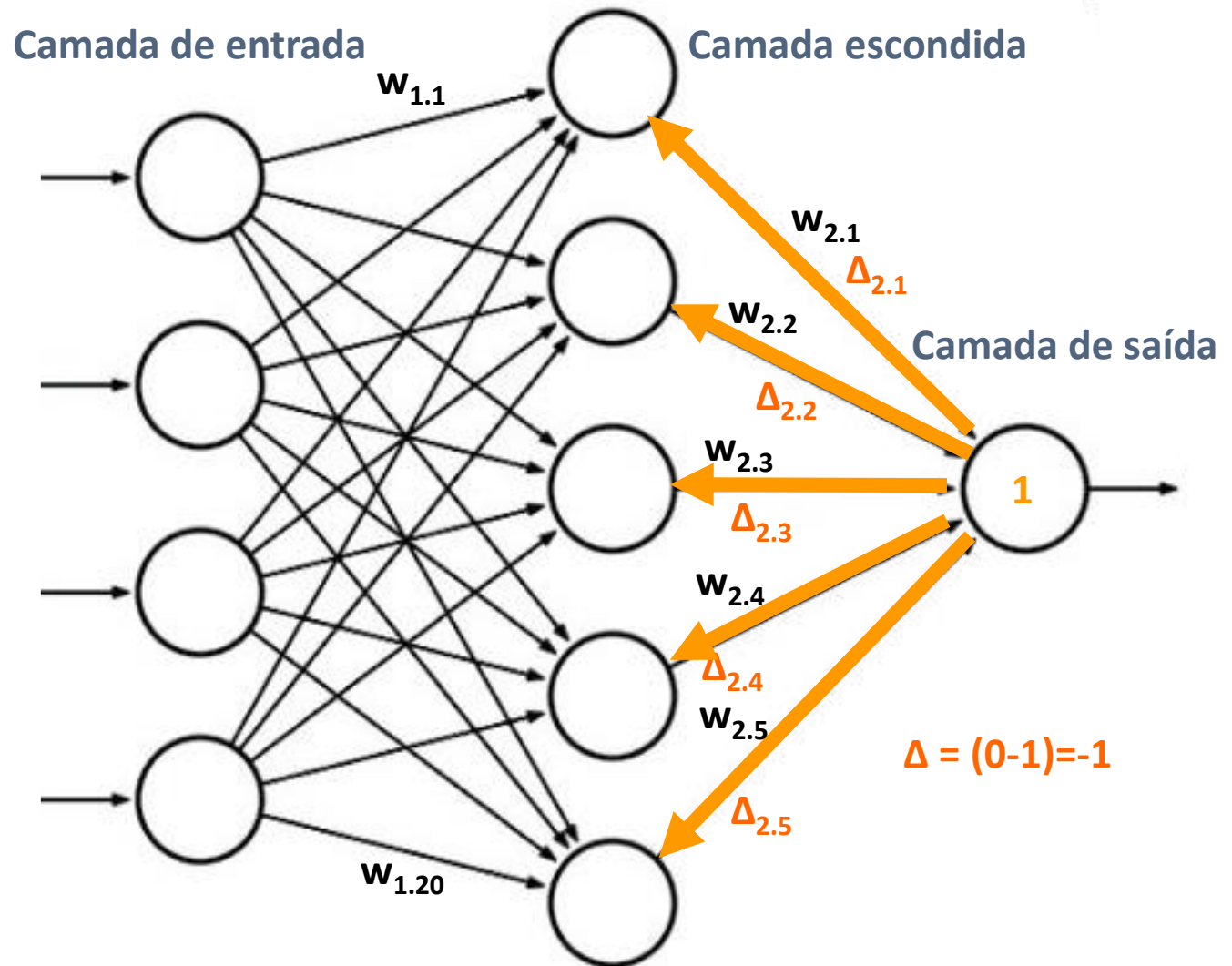
Backpropagation



Redes Neurais Artificiais

MLP

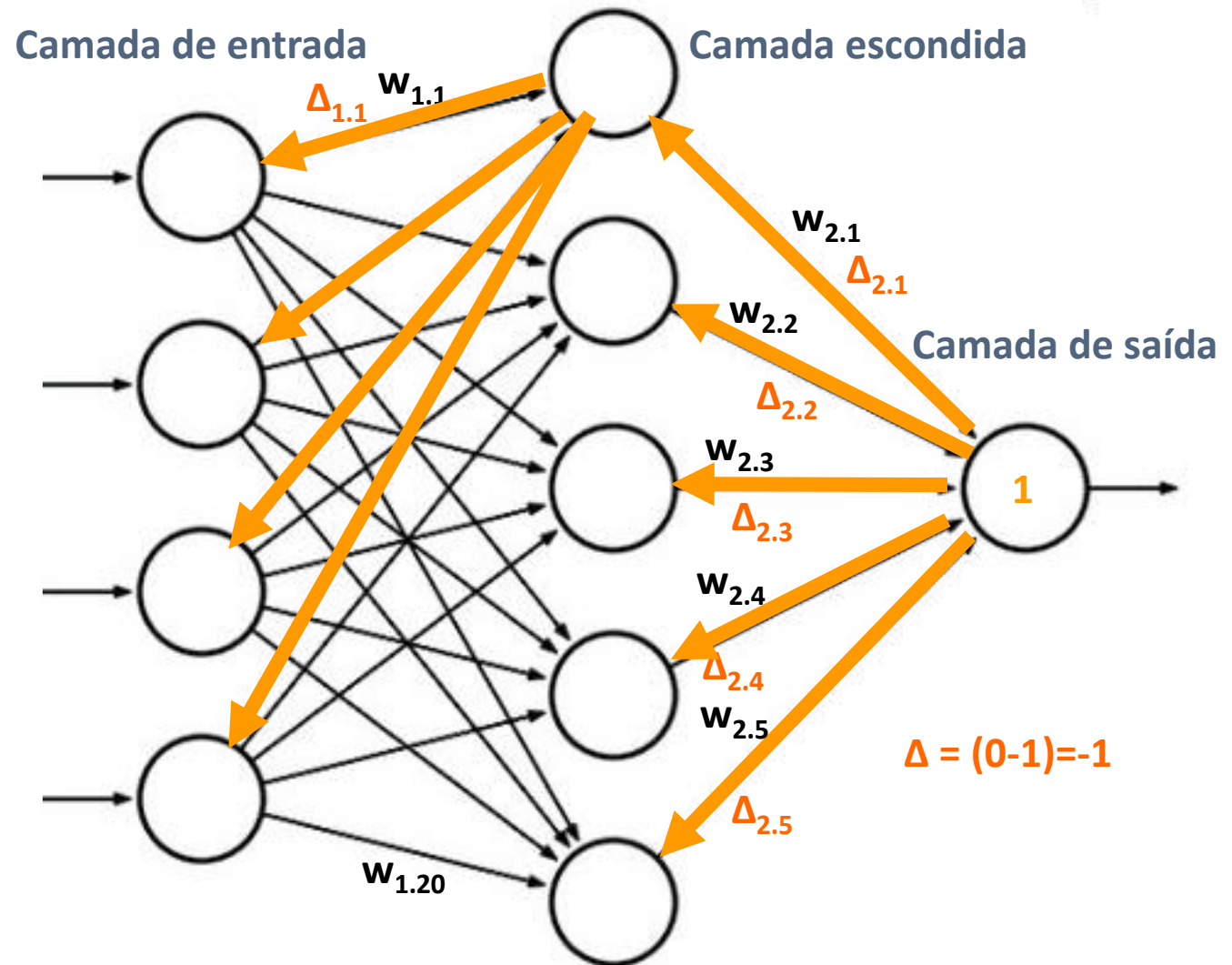
Backpropagation



Redes Neurais Artificiais

MLP

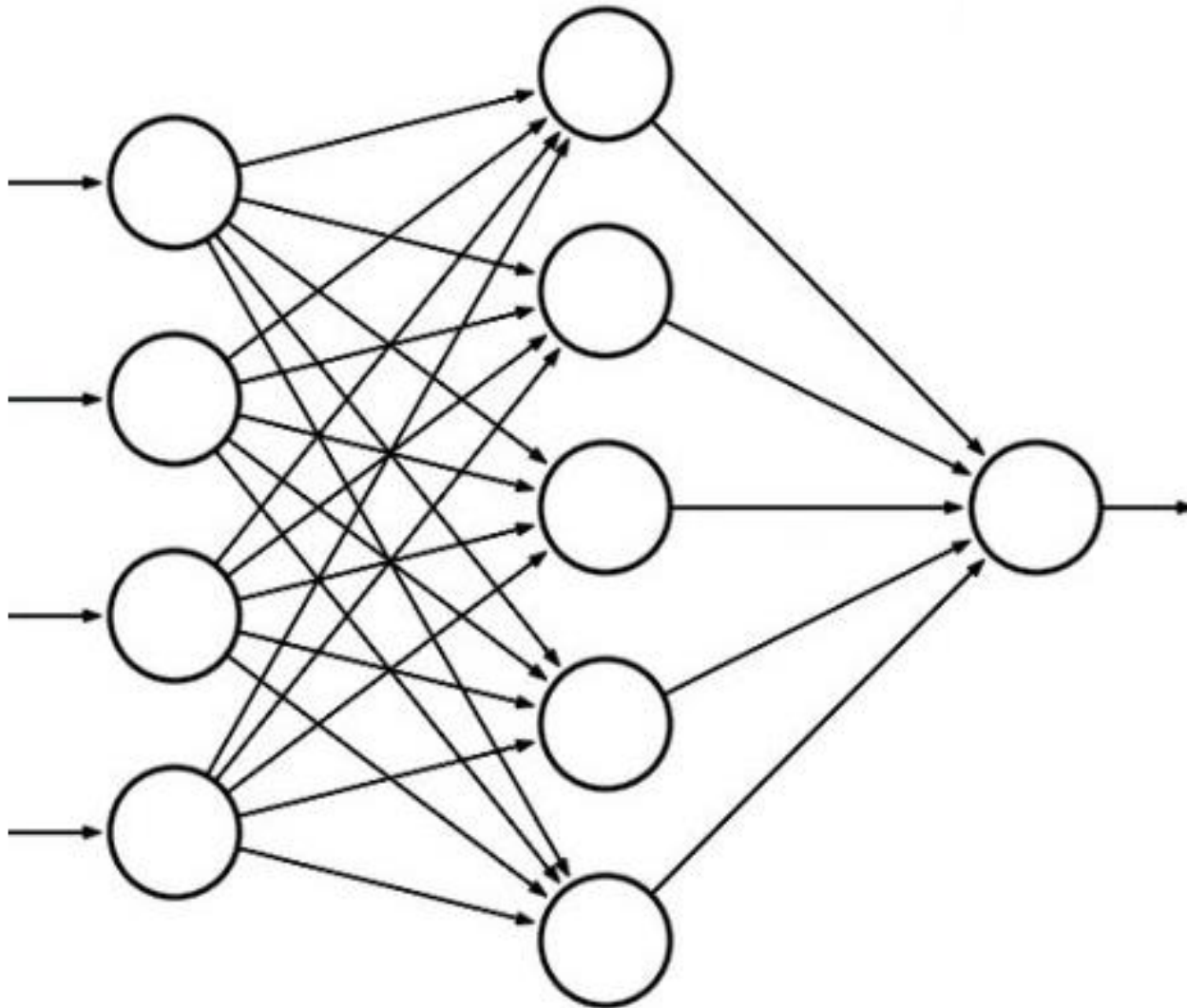
Backpropagation



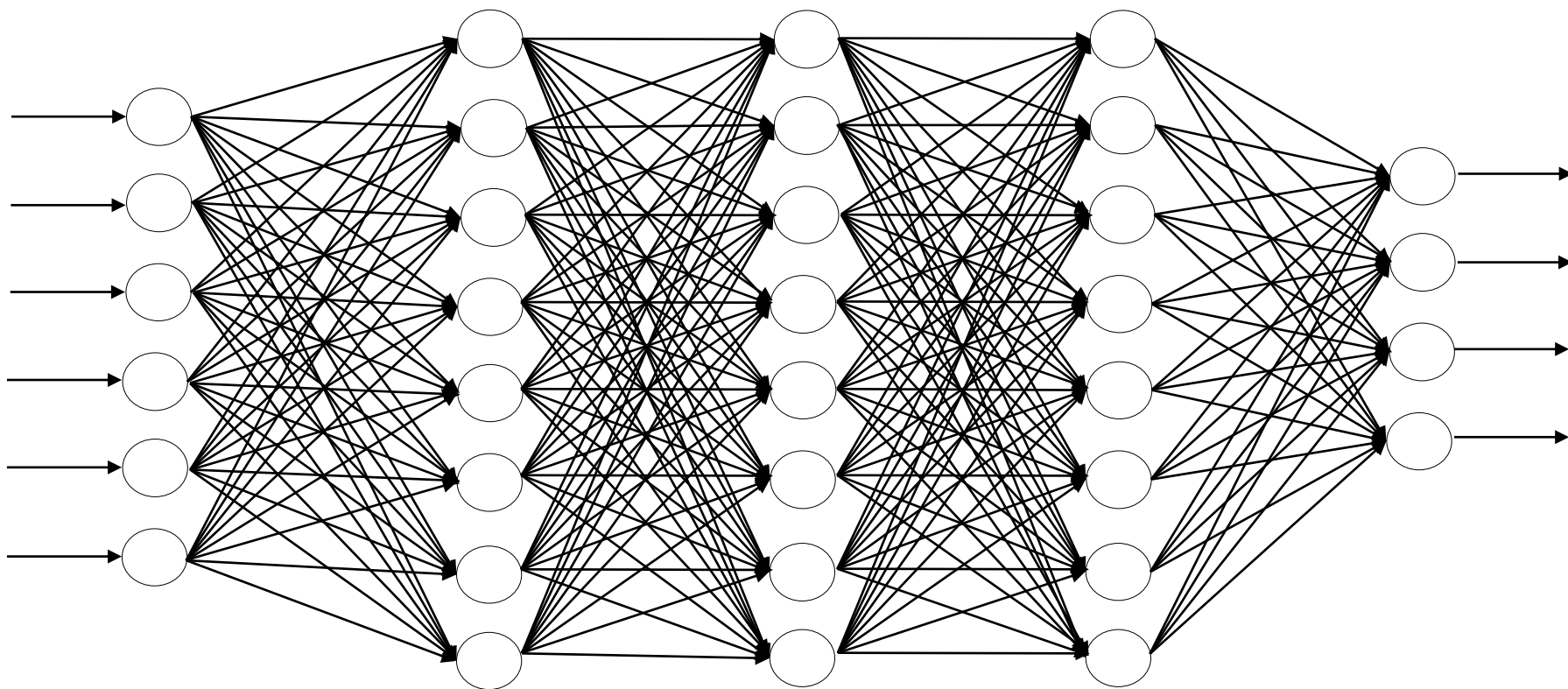
Deep Learning

- Redes neurais artificiais profundas (muitas camadas escondidas);
- Múltiplos níveis de características (diferentes representações dos dados originais);
- Mais camadas – características de mais alto nível (abstratas):
 - Robustez (ruído, transformações, etc.);
 - Vetores de características compactos (características relevantes).

Deep Learning



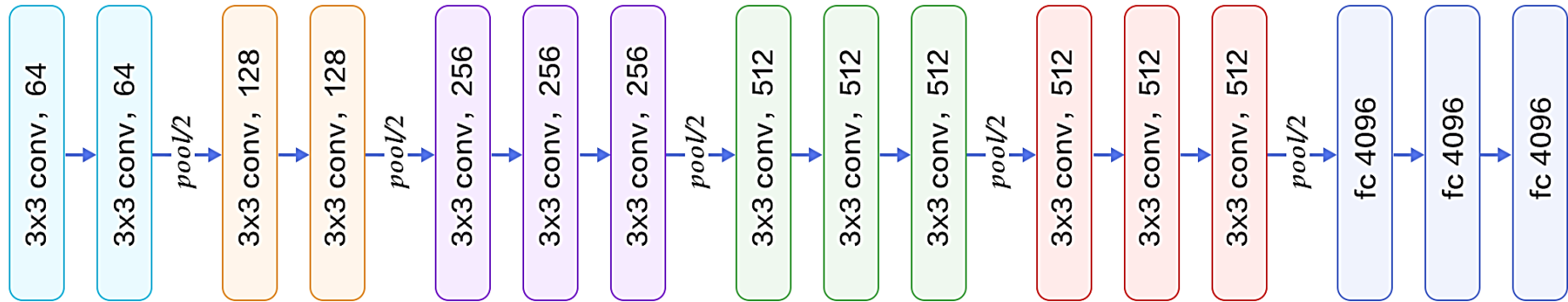
Deep Learning



Deep Learning

VGG-16

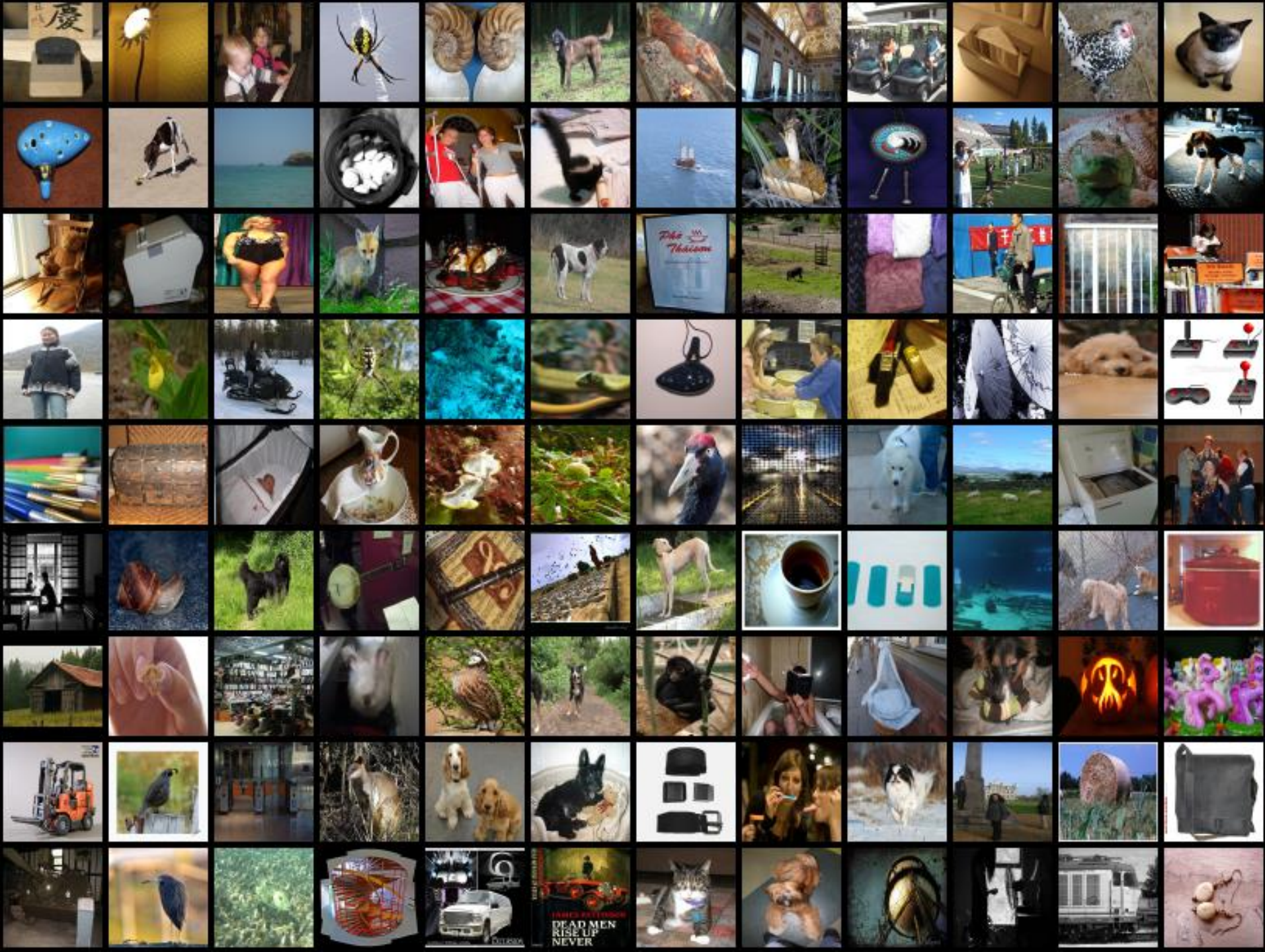
130 milhões de parâmetros



Deep Learning

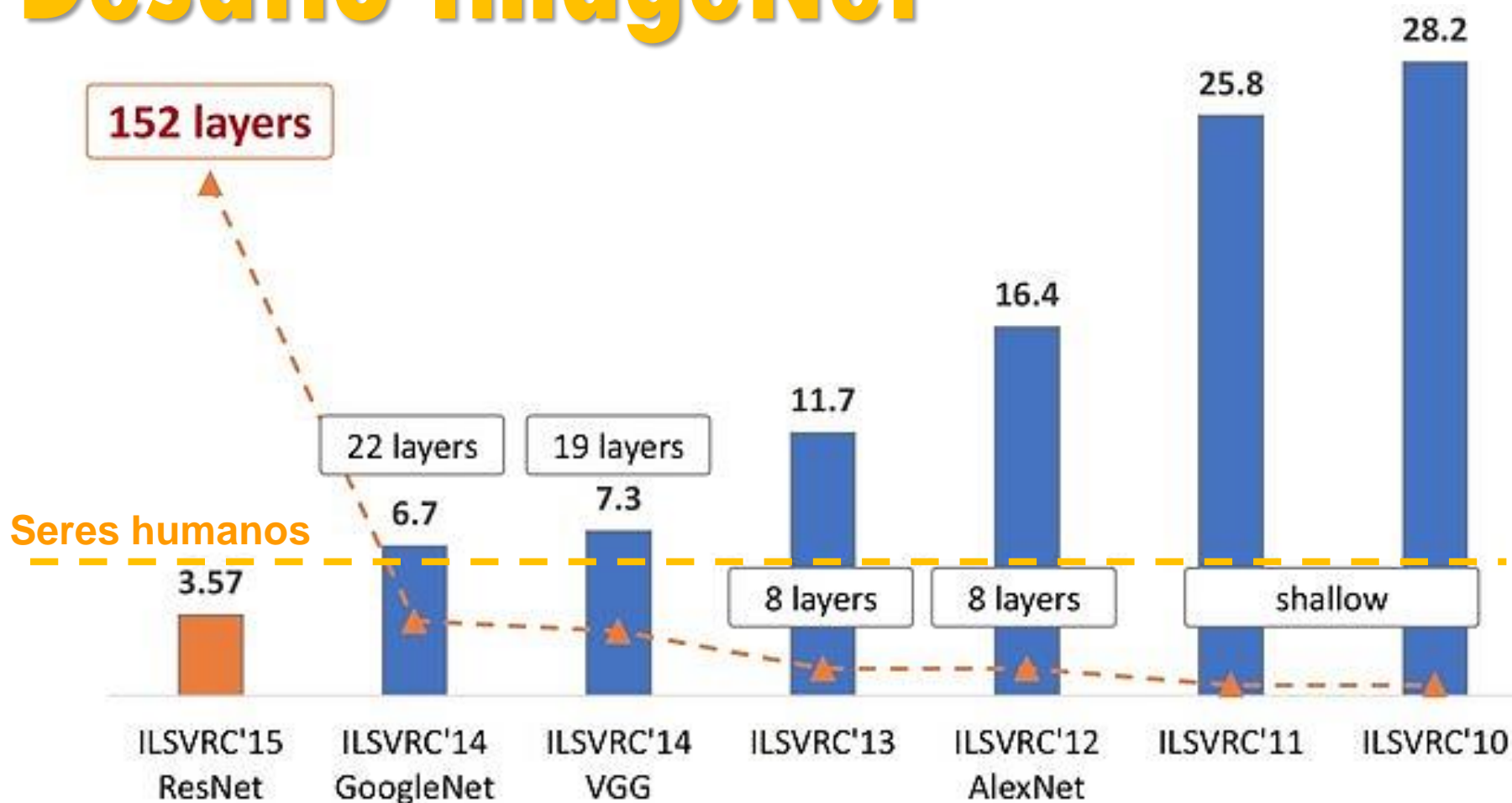
- Por que só agora?
 - Aumento do poder computacional (GPU);
 - Abundância de dados (quebra de *plateaus*);
 - Melhorias teóricas (funções de ativação, algoritmos de treinamento, etc.).





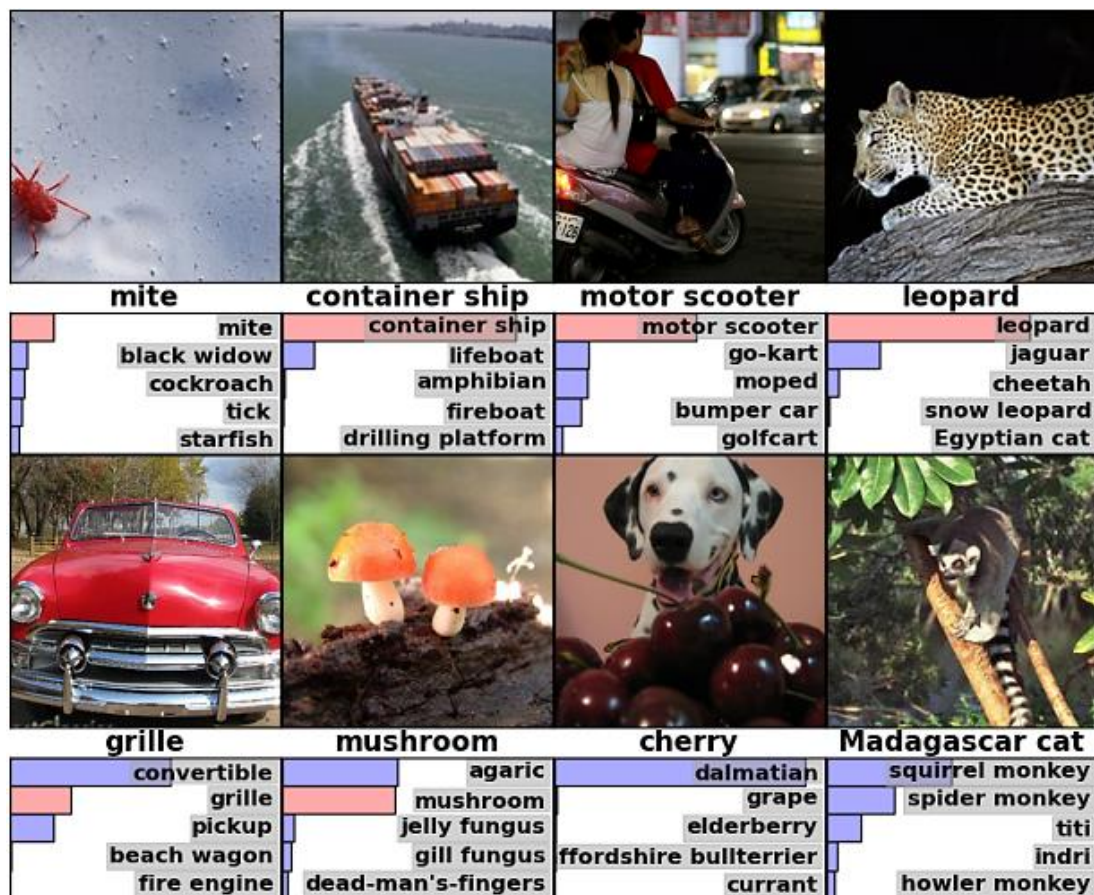
Deep Learning

Desafio ImageNet



Deep Learning

Desafio ImageNet



Deep Learning

- Modelos discriminativos e generativos;
- Generativos:
 - Foco em aprender a distribuição das amostras de treinamento;
 - Eliminação de ruído, reconstrução de sinal, inicialização de outros modelos, etc.
- Discriminativos:
 - Foco na classificação;
 - Saídas são probabilidades (pertencimento a classes).

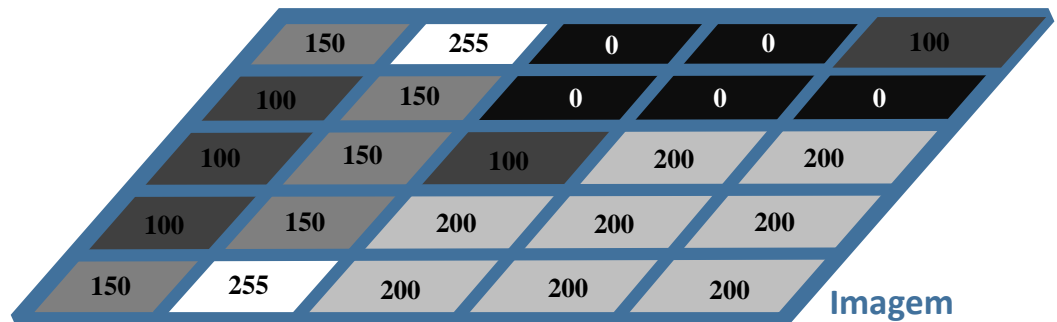
CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;
- Convolução ($k=3 \times 3$; $stride=1$):



A 3x3 kernel matrix, tilted at an angle, with an orange border. The values are arranged in a grid:

-0.1	0.12	0.15
0.5	0.5	0.8
0.3	0.25	-0.15



A 5x5 input image matrix, tilted at an angle, with a blue border. The values are arranged in a grid. The word "Imagem" is written in blue at the bottom right corner.

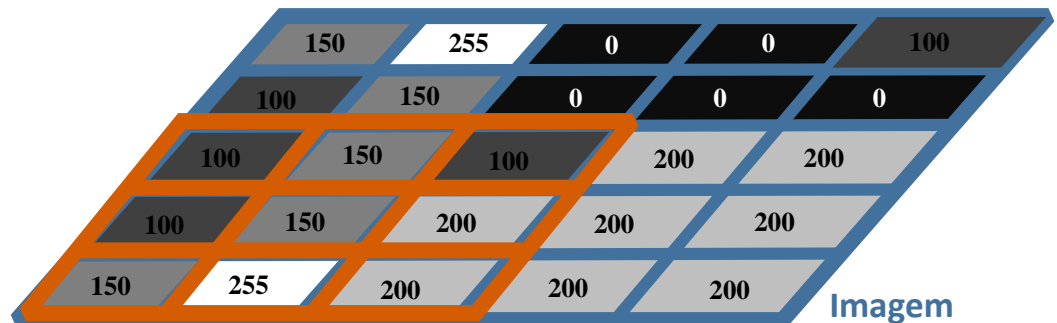
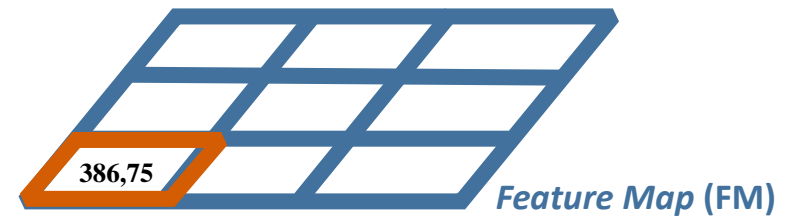
150	255	0	0	100
100	150	0	0	0
100	150	100	200	200
100	150	200	200	200
150	255	200	200	200

Imagem

CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

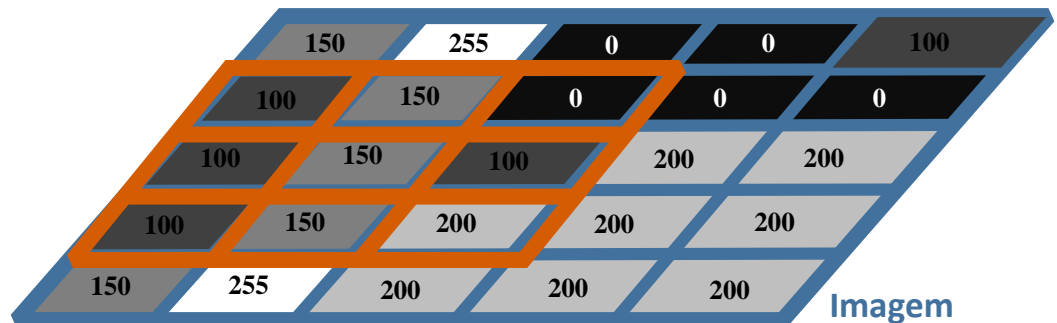
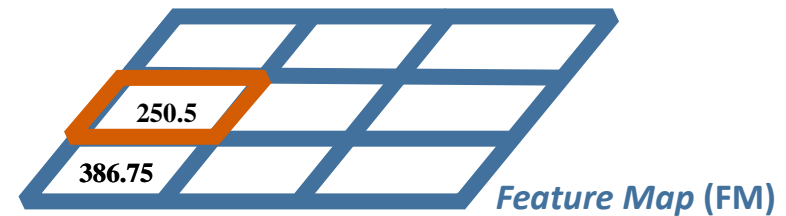
- Convolução ($k=3 \times 3$; $stride=1$):



CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

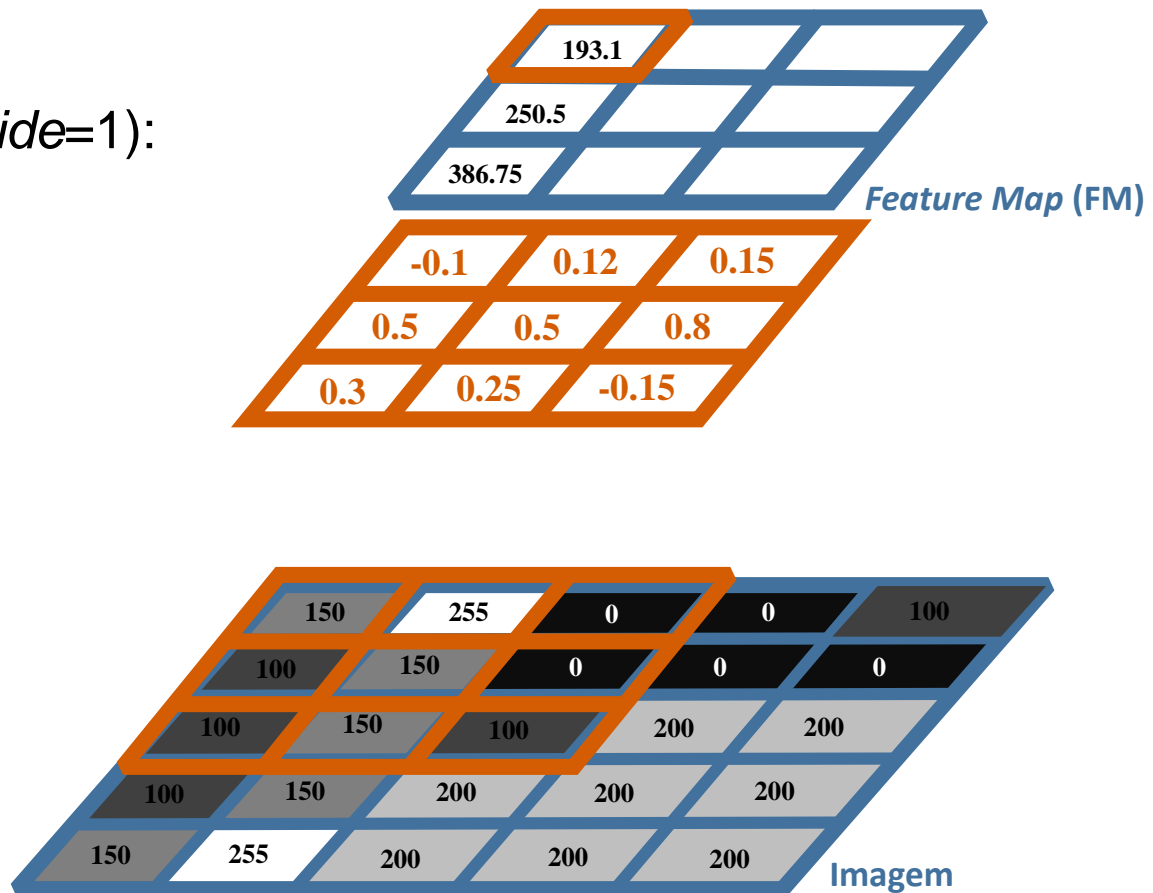
- Convolução ($k=3 \times 3$; $stride=1$):



CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

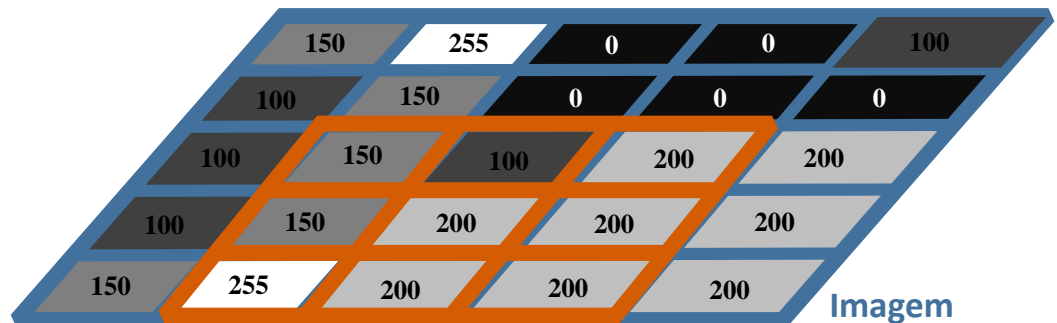
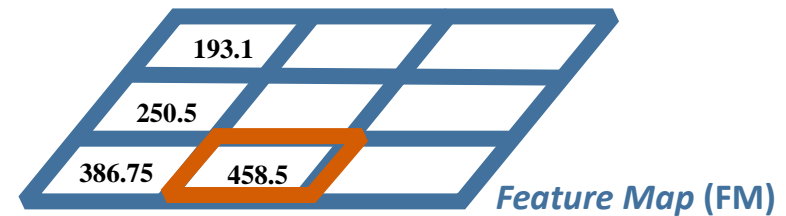
- Convolução ($k=3 \times 3$; $stride=1$):



CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

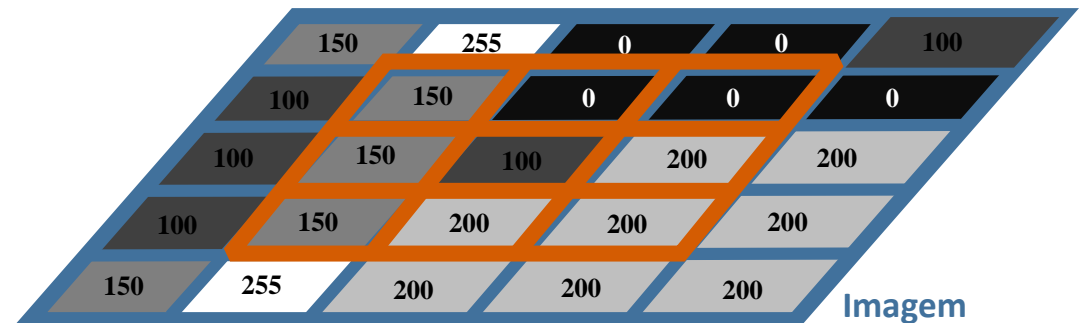
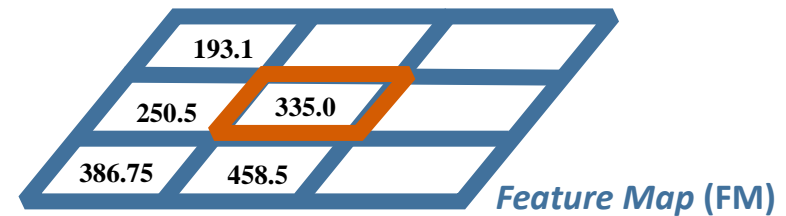
- Convolução ($k=3 \times 3$; $stride=1$):



CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

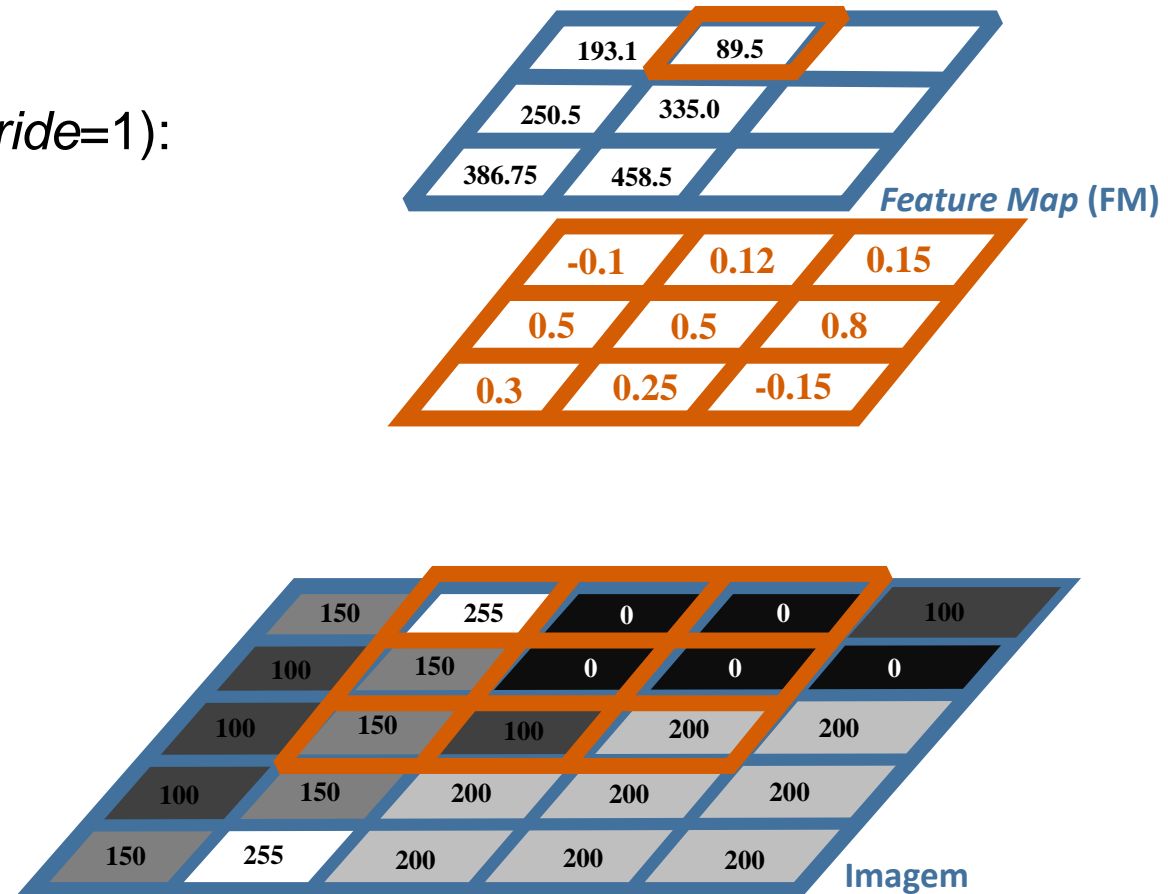
- Convolução ($k=3 \times 3$; $stride=1$):



CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

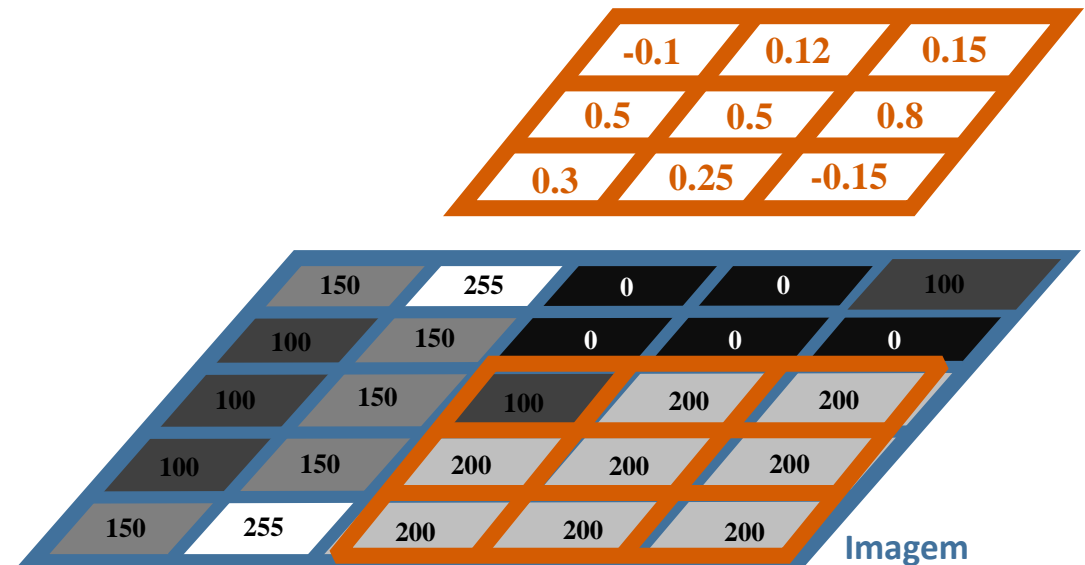
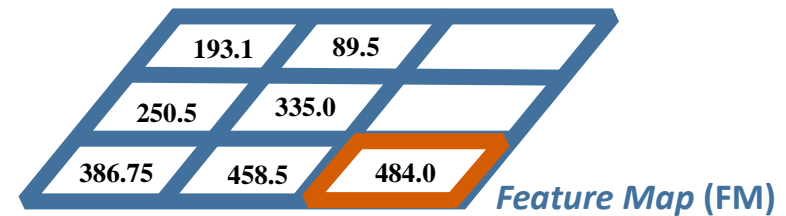
- Convolução ($k=3 \times 3$; $stride=1$):



CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

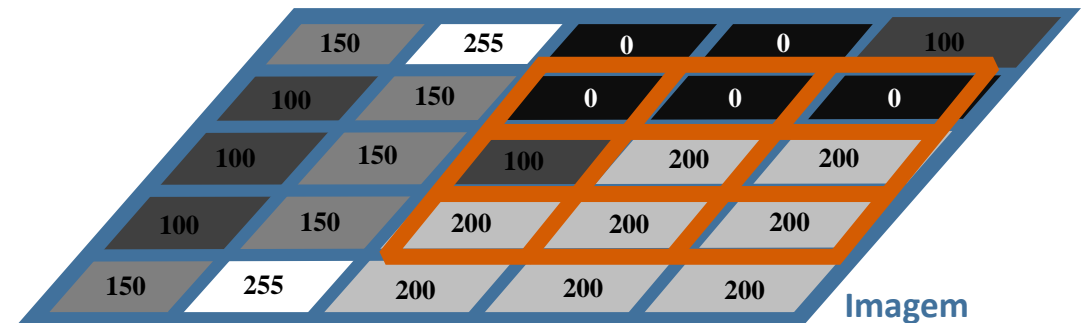
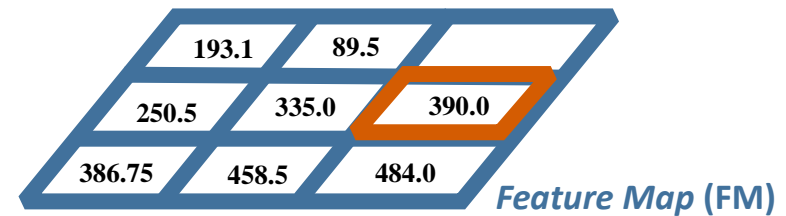
- Convolução ($k=3 \times 3$; $stride=1$):



CNN

- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

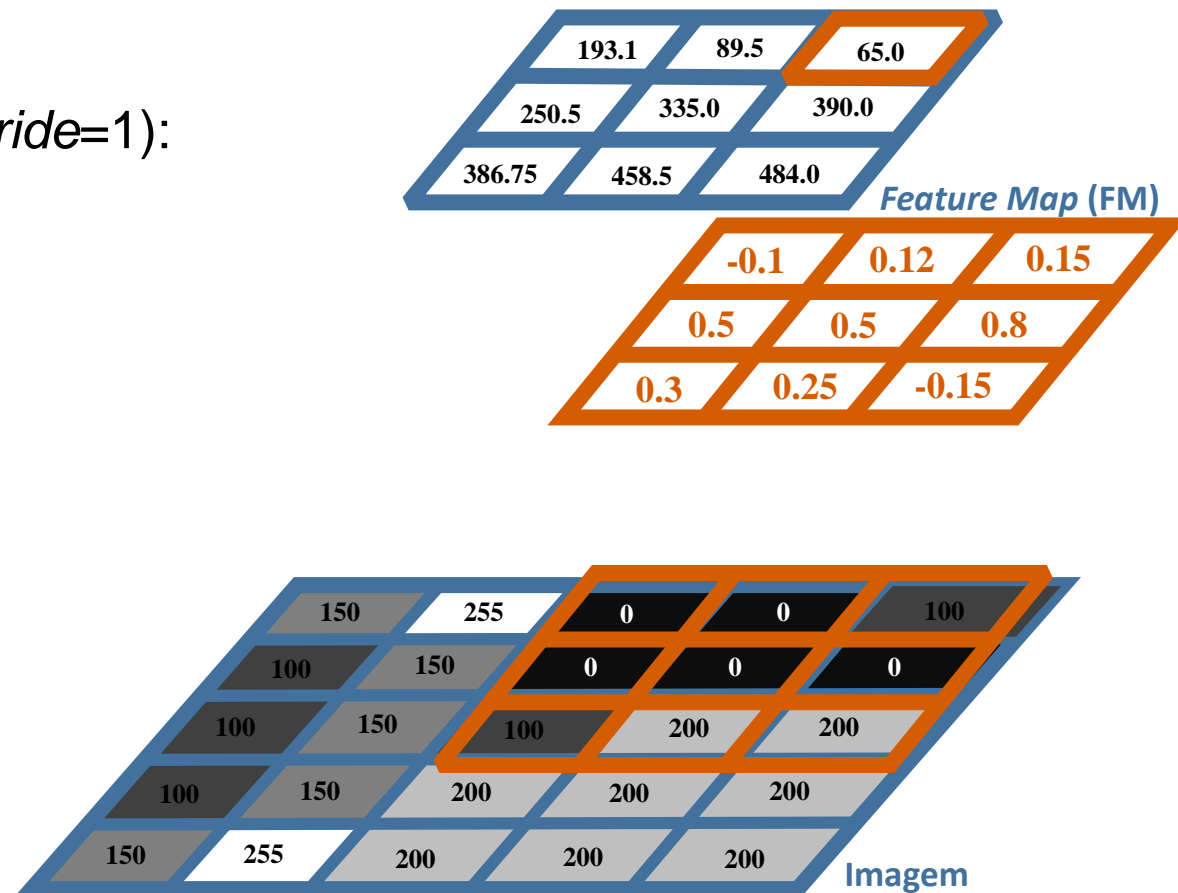
- Convolução ($k=3 \times 3$; $stride=1$):



CNN

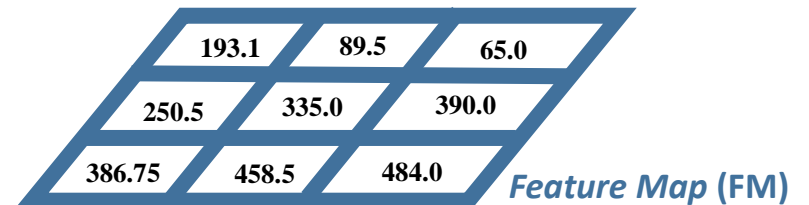
- *Convolutional Neural Networks* (CNN) – modelos discriminativos;

- Convolução ($k=3 \times 3$; $stride=1$):



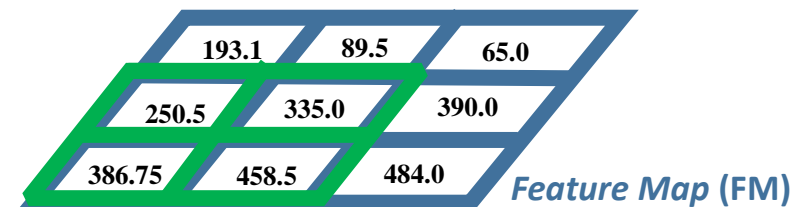
CNN

- *Pooling* ($k=2 \times 2$; $stride=1$):
 - MAX *pooling*;
 - AVG *pooling*.



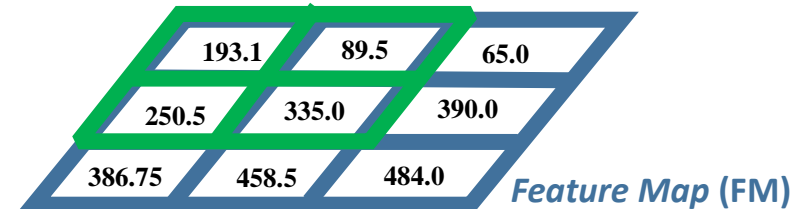
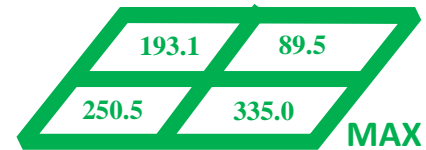
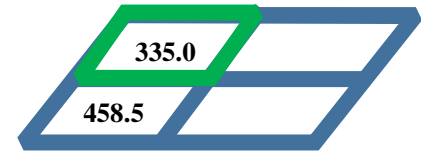
CNN

- *Pooling* ($k=2 \times 2$; $\text{stride}=1$):
 - MAX *pooling*;
 - AVG *pooling*.



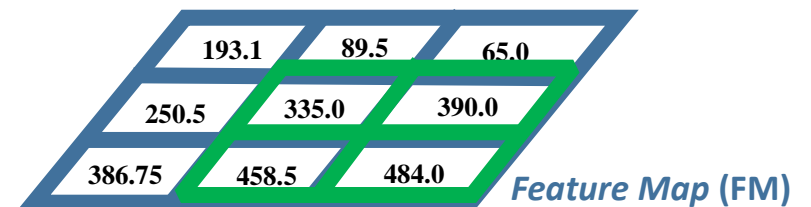
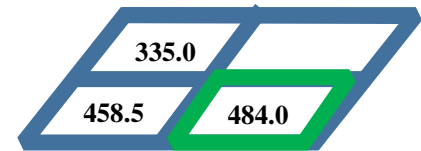
CNN

- *Pooling* ($k=2 \times 2$; $\text{stride}=1$):
 - MAX pooling;
 - AVG pooling.



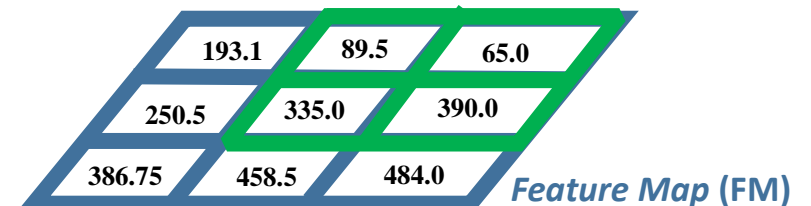
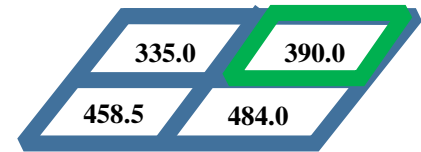
CNN

- *Pooling* ($k=2 \times 2$; $stride=1$):
 - MAX *pooling*;
 - AVG *pooling*.



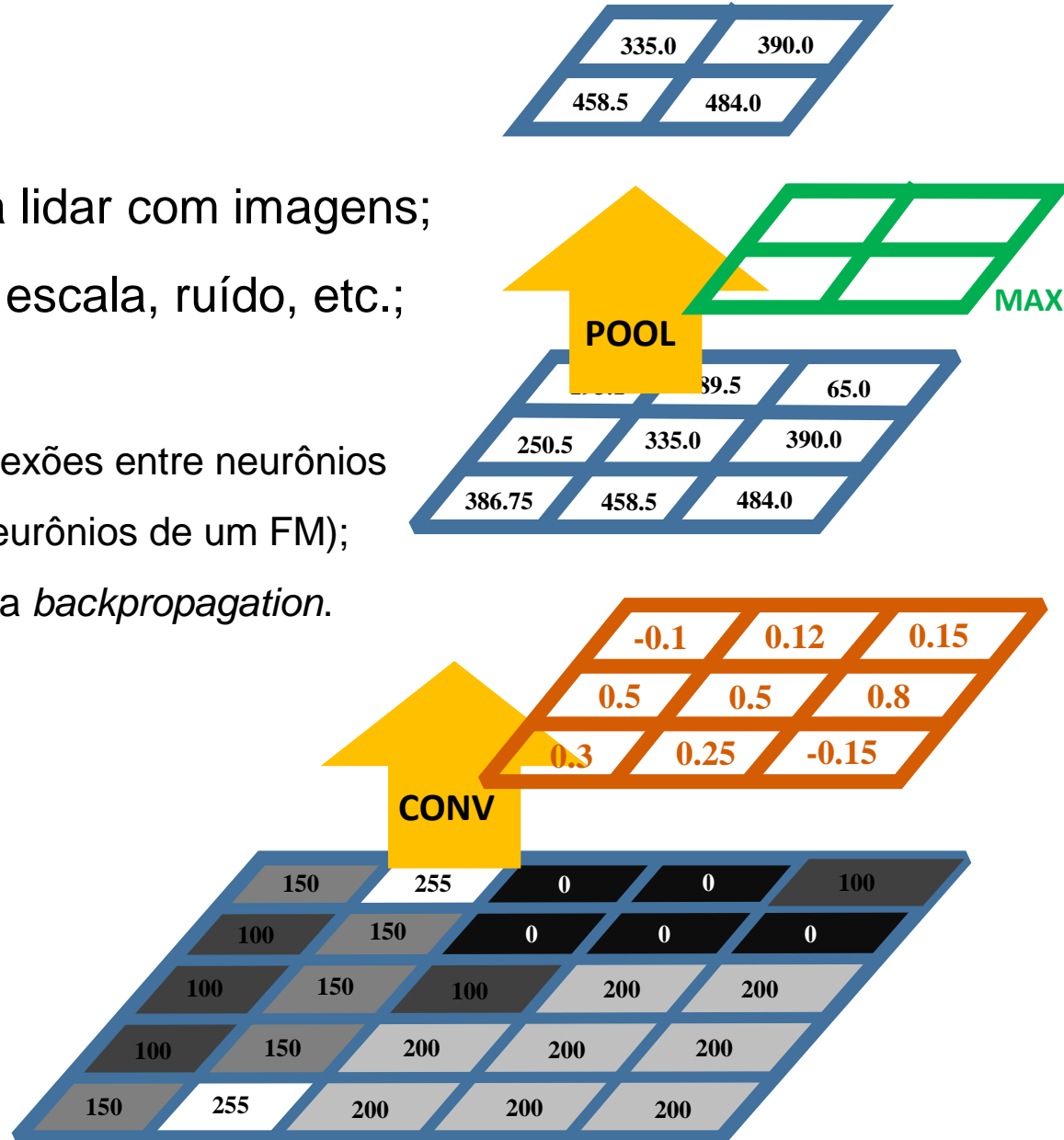
CNN

- *Pooling* ($k=2 \times 2$; $\text{stride}=1$):
 - MAX *pooling*;
 - AVG *pooling*.



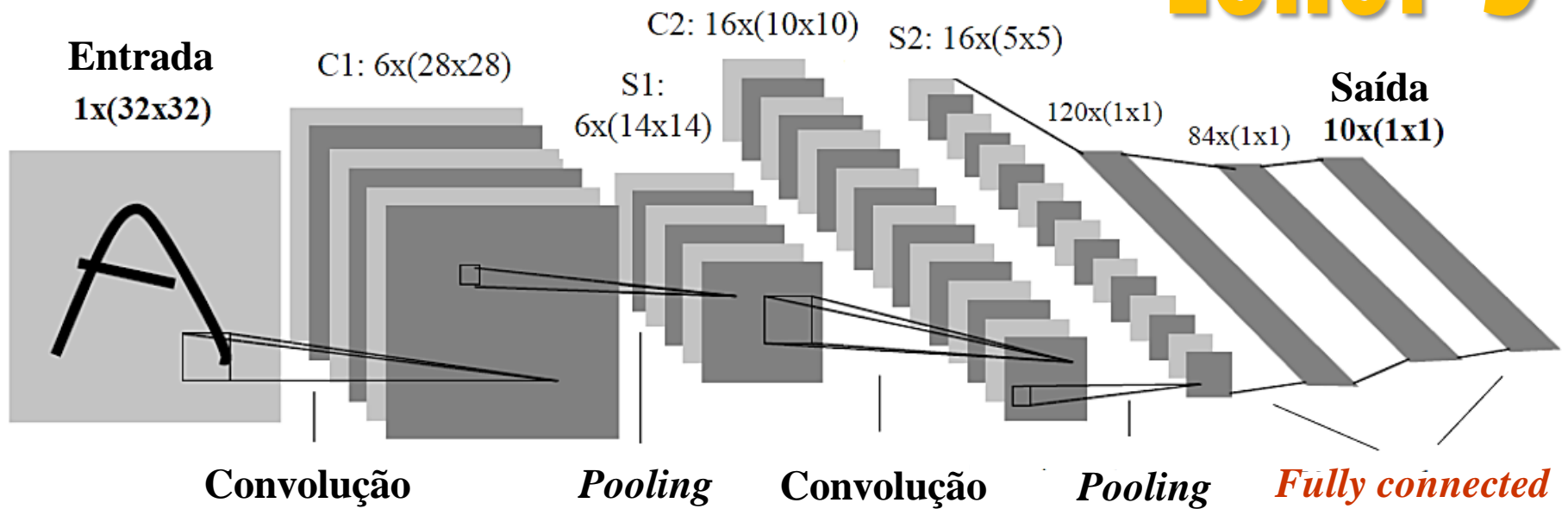
CNN

- *Kernels* 2D – bons para lidar com imagens;
- Robustez a translação, escala, ruído, etc.;
- Convolução:
 - Pesos dos *kernels* – conexões entre neurônios (compartilhados pelos neurônios de um FM);
 - Pesos são aprendidos via *backpropagation*.



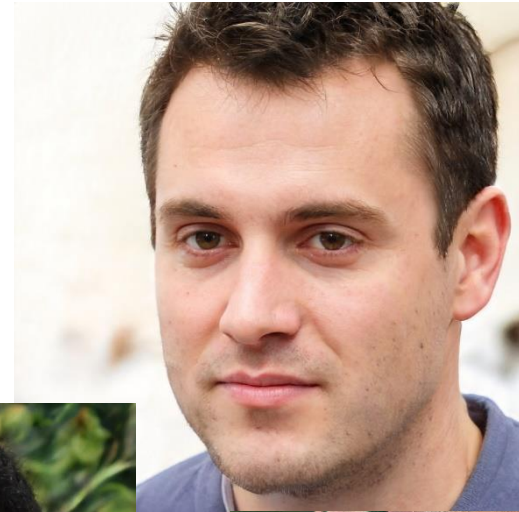
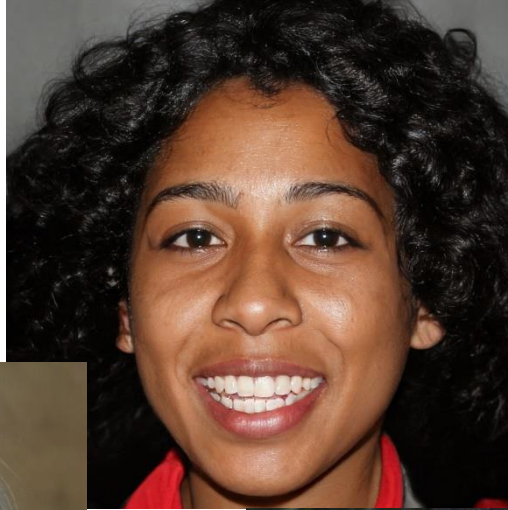
CNN

Lenet-5



Aplicações

- Visão Computacional;
- *Optical Character Recognition* (OCR);
- Processamento de Linguagens Naturais;
- Análise de movimentos/emoções;
- Carros/drones autônomos;
- Medicina;
- Humanos Digitais;
- Muitas outras.



Generative Adversarial Networks





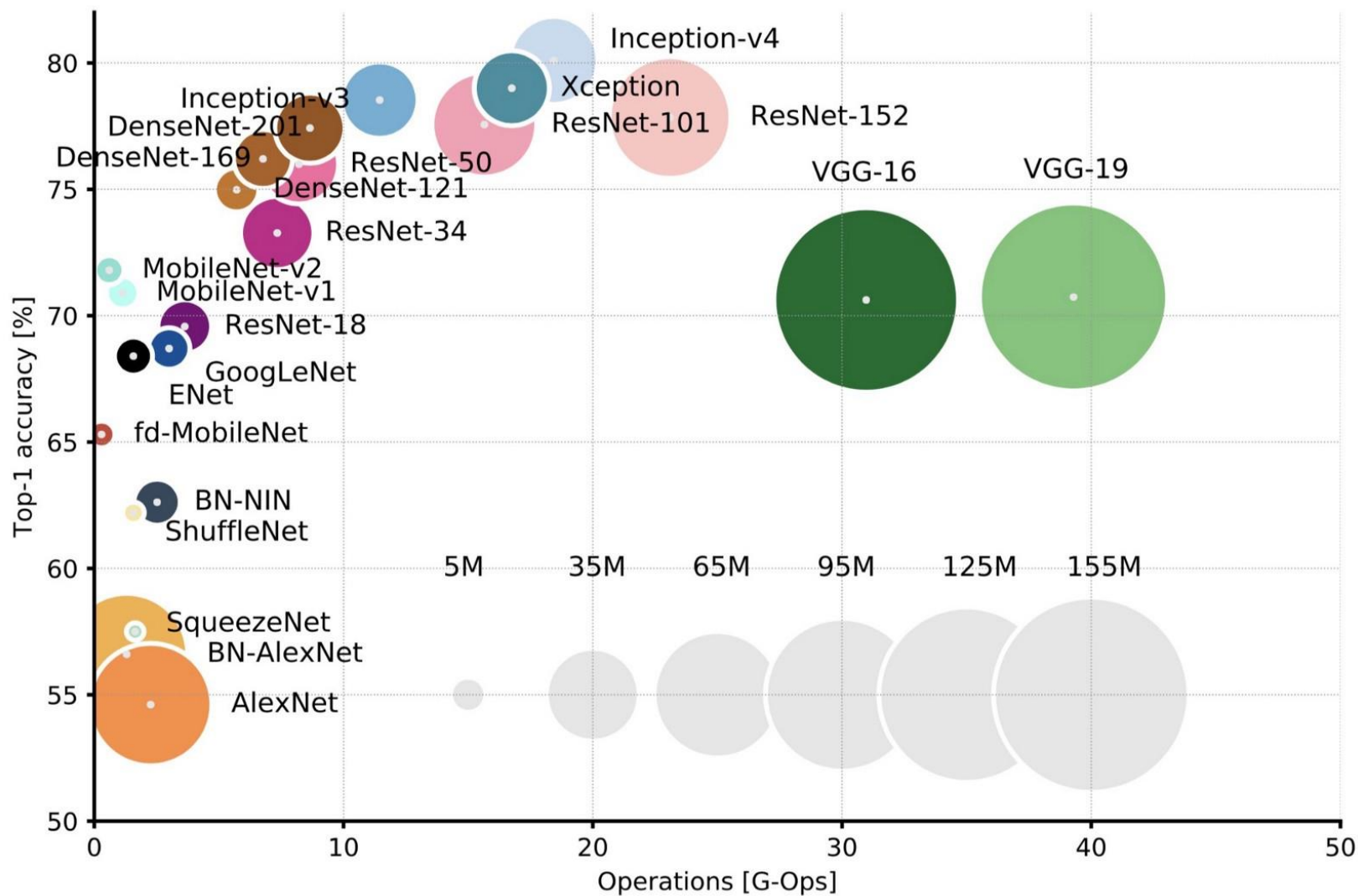
Gerador Automático de Texto

<https://textsynth.com/playground.html>

Dicas

- Faces sintéticas (www.thispersondoesnotexist.com);
- Checar pesos e *feature maps* (<http://scs.ryerson.ca/~aharley/vis/conv/>);
- Treinamento interativo de rede neural convencional (<https://playground.tensorflow.org/>);
- Acompanhar acurácia e *loss* treinamento e teste (validação);
- Usar modelos *default* (GoogleNet, MobileNet, Inception-v3, ResNet);
- Usar normalização, ReLU e Adam;
- Coursera – Especialização em *Deep Learning* (Andrew Ng – [Deeplearning.ai](https://www.deeplearning.ai)).

Dicas



Fonte: Towards Data Science

Tensorflow

- Desenvolvido pelo Google;
- Python – principal linguagem;
- Muitas bibliotecas disponíveis (Keras).

