

Visão Computacional

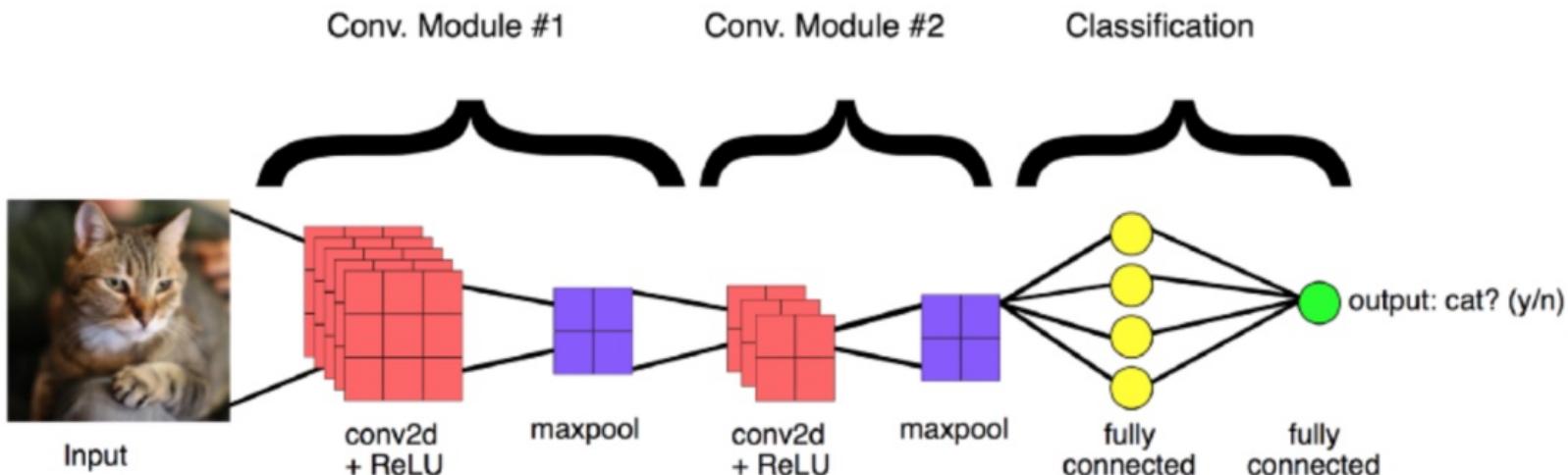
Organização e Visão Geral

Pontifícia Universidade Católica de Campinas

Prof. Dr. Denis M. L. Martins

Motivação e Aplicações

Problemas Complexos



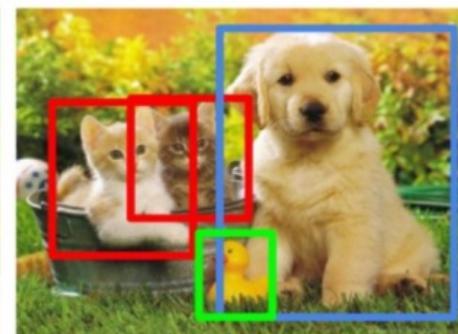
Classification



Classification + Localization



Object Detection

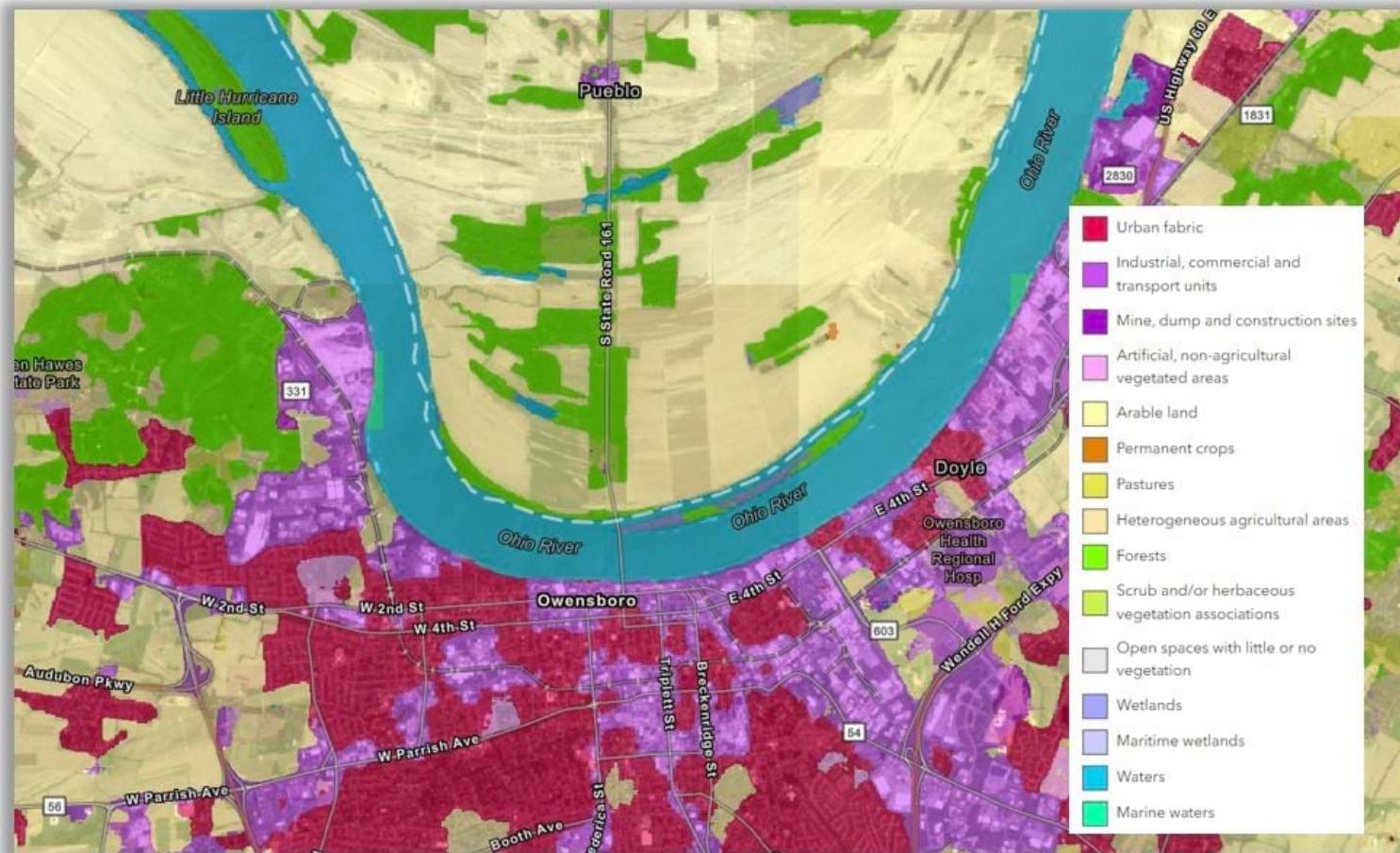


Instance Segmentation



Fonte da Imagem: Shunmugaraj @LinkedIn

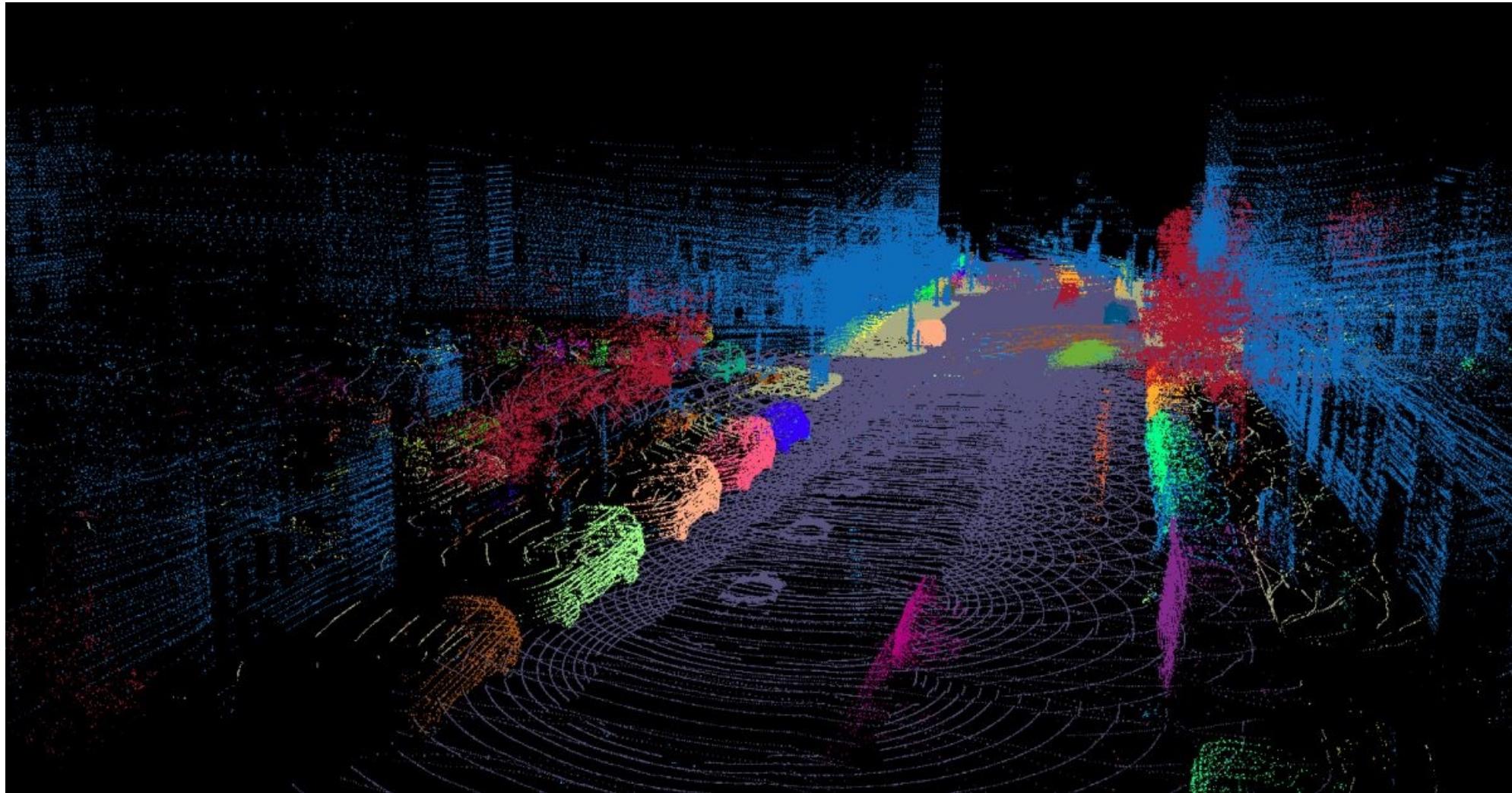
Land cover maps



Understanding land cover change using Sentinel-2 imagery

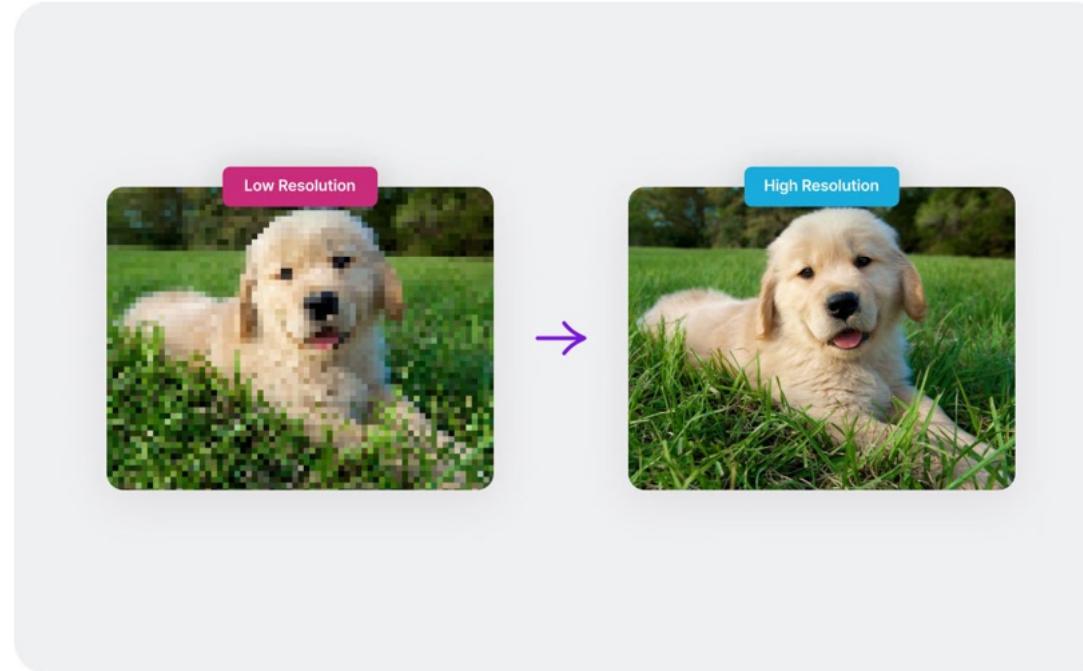
Fonte da Imagem: [Kate Fickas, Vinay Viswambharan, and Priyanka Tuteja @ArcGIS Blog](#)

Point Cloud Data



Fonte da Imagem: [Tom Staelens @Segments.ai](#). Veja também: [Generation of a 3D point Cloud](#) 

Super-Resolution

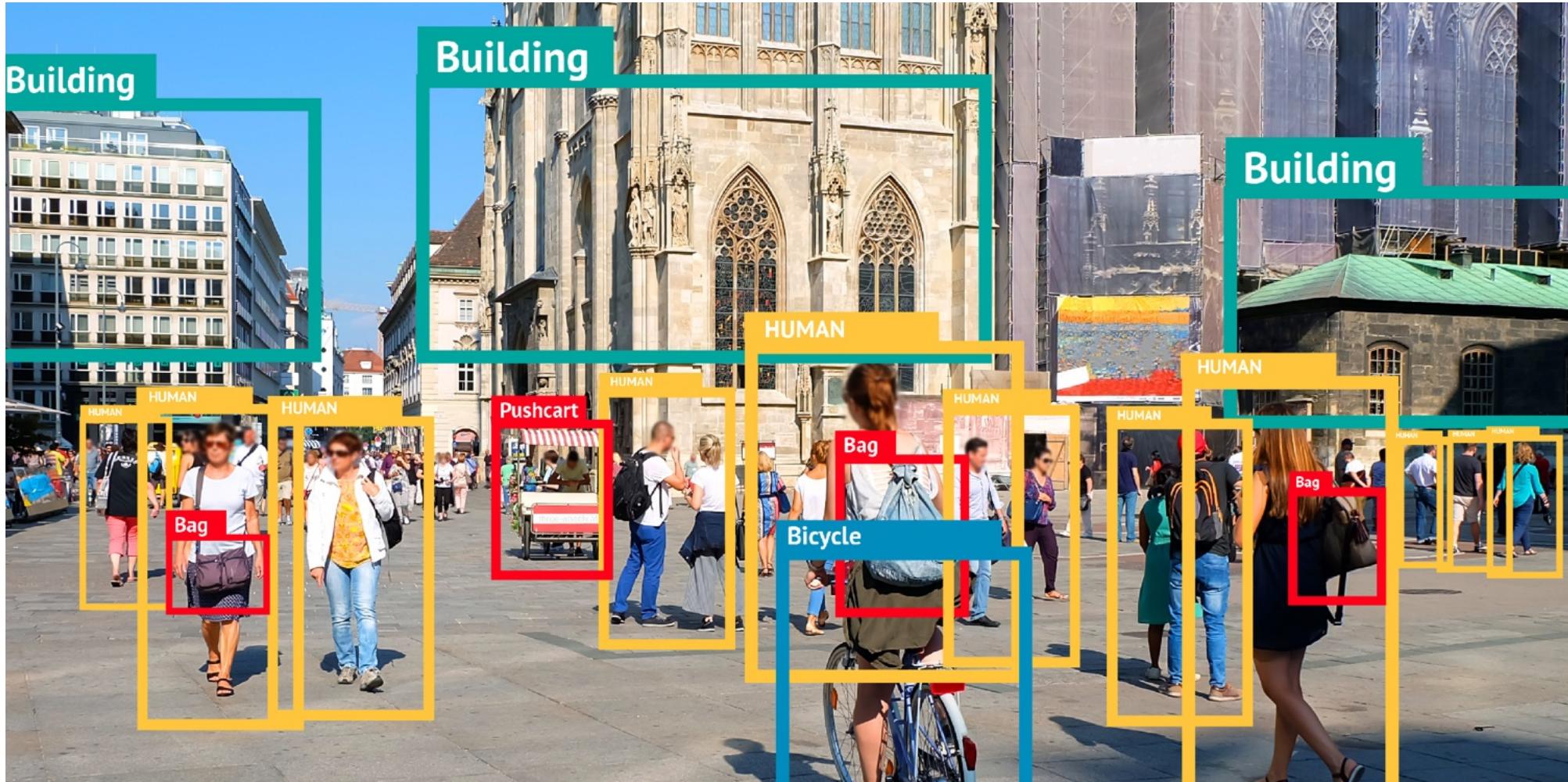


v7

Fonte da Imagem: [Rohit Kundu @v7Labs](#)

- NVIDIA DLSS 3.5 [YouTube](#)
- Network architecture for single image super-resolution [YouTube](#)

Object Detection



Fonte da Imagem: [Patrick @GoogleColab](#). Veja também: [Yolo Object Detection](#)

Visão Geral e Organização

Objetivo da Disciplina

- **Objetivo Teórico:** Compreender as técnicas computacionais, os desafios e as aplicações de aprendizado de máquina para o processamento e análise de imagens.
- **Objetivo Prático:** Criar modelos computacionais que sejam capazes de **entender** o conteúdo visual em imagens.



Ementa e Escopo

- **Aquisição e Pré-processamento de Imagens:** Como capturamos, representamos e preparamos imagens para análise.
- **Extração de Características:** Identificação de padrões relevantes nas imagens.
- **Reconhecimento de Objetos/Padrões:** Classificar e identificar objetos dentro da imagem.
- **Segmentação:** Dividir a imagem em regiões significativas.



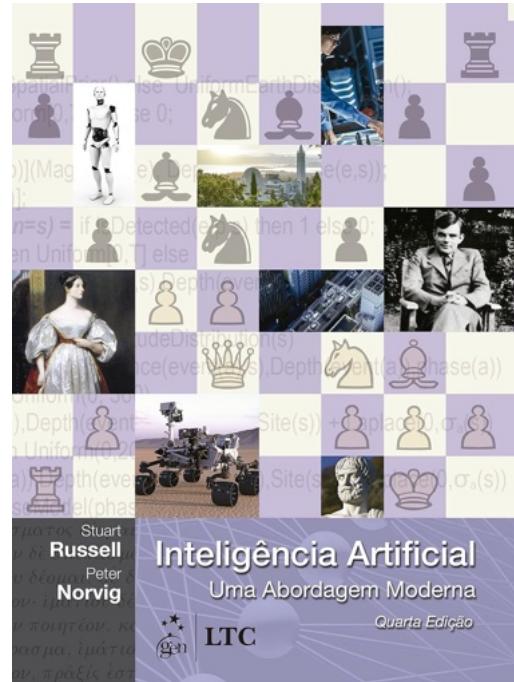
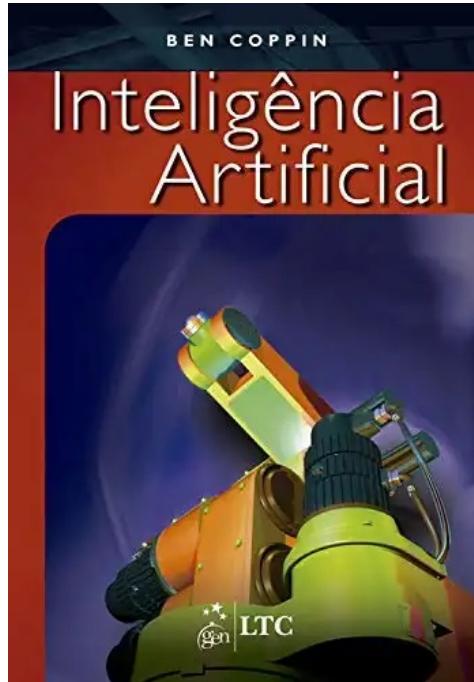
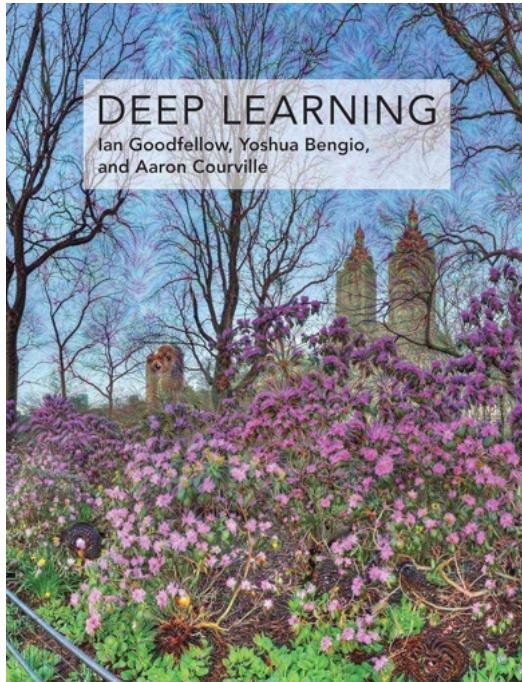
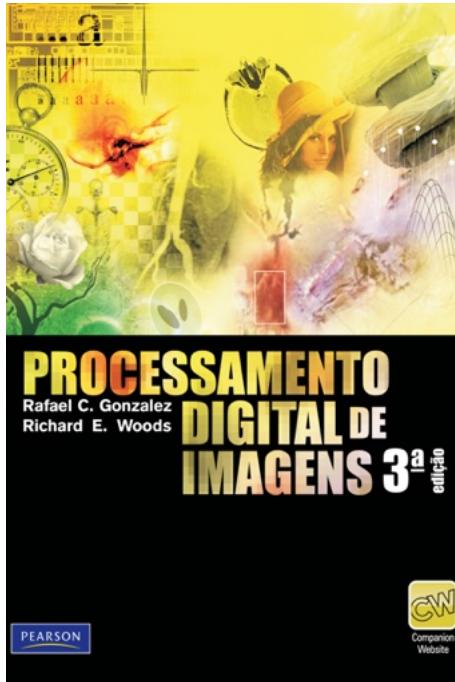
Organização da Disciplina

- **Aulas Teóricas:** Apresentação de conceitos fundamentais, operações e modelos.
- **Práticas:** Desenvolvimento de código e realização de atividades.
- Material de aula
 - Slides
 - Jupyter Notebook/Google Colab
- Ferramentas
 - Python e PyTorch
 - GitHub
- **Atividades Práticas:** Submissão de código e documentação.
- **Trabalho Final:** Projeto de implementação realizado em grupo.
 - Temas e grupos serão definidos mais tarde

Avaliação

- **Prova:** **03/11/2025** → Multipla Escolha (estilo ENADE) e Discursivas/Resolução de Problemas.
- **Cálculo da Média:**
 - Média Teórica (MT): Nota da Prova
 - Média Prática (MP): $0,4 \times \text{Atividades Práticas} + 0,6 \times \text{Trabalho Final}$
 - Se MT e MP $\geq 5,0$ então:
 - **Média Final (MF) = $0,4 \times MT + 0,6 \times MP$.**
 - Se MT e/ou MP $< 5,0$ então:
 - **MF = min(MT, MP)**
- **Prova de Recuperação:** **03/12/2025**
 - Apenas para alunos com MT $< 5,0$.
 - Todo o conteúdo da disciplina.
 - Substitui MT. Ainda assim, MF = min(MT, MP).

Bibliografia Básica

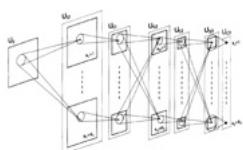


- Gonzalez, Rafael C., and Richard C. Woods. Processamento digital de imagens. 3.ed. São Paulo, SP: Pearson, 2010.
- Goodfellow, Ian, et al. Deep learning. Vol. 1. No. 2. Cambridge: MIT press, 2016: <https://www.deeplearningbook.org/>
- COPPIN, Ben. Inteligência artificial. Rio de Janeiro, RJ: GEN LTC, 2010.
- RUSSEL, S. J., NORVIG, P. Inteligência Artificial: Uma Abordagem Moderna. GEN LTC. 4a. Edição, 2022.

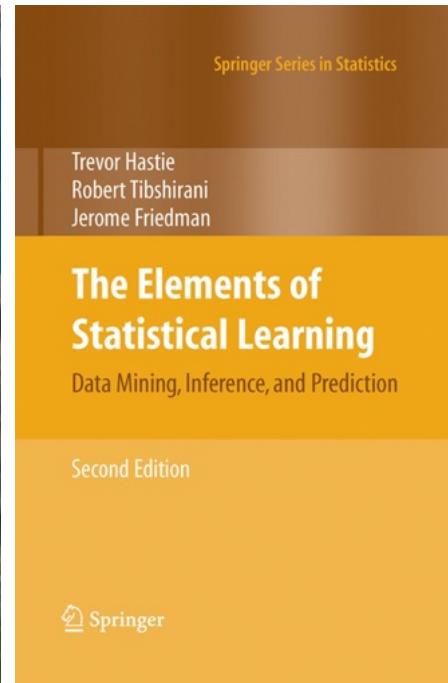
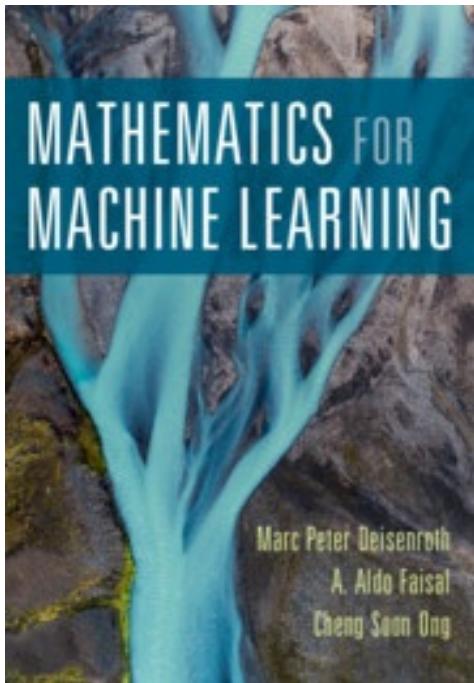
Bibliografia Complementar

The Little Book
of
Deep Learning

François Fleuret



UNIVERSITÉ
DE GENÈVE



- The Little Book of Deep Learning: <https://fleuret.org/francois/lbdl.html>
- Mathematics of Machine Learning: <https://mml-book.github.io/>
- The Elements of Statistical Learning: <https://hastie.su.domains/ElemStatLearn/>

Top 10 fastest growing skills by 2030



1. AI and big data
2. Networks and cybersecurity
3. Technological literacy
4. Creative thinking
5. Resilience, flexibility and agility
6. Curiosity and lifelong learning
7. Leadership and social influence
8. Talent management
9. Analytical thinking
10. Environmental stewardship

Cognitive skills Self-efficacy Working with others Management skills Technology skills Ethics

Note: The skills selected by surveyed organizations to be increasing most rapidly in importance by 2030.

Source: World Economic Forum. (2025). Future of Jobs Report 2025.

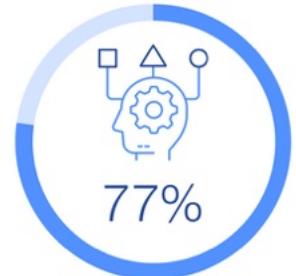
Contexto da Disciplina

Trabalhabilidade > Empregabilidade

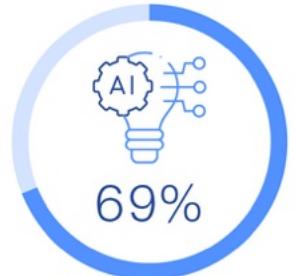
"In the next five years, 170 million jobs are projected to be created and 92 million jobs to be displaced (...)." - [The Future of Jobs - Report 2025, WEF](#).

Como se preparar para posições de trabalho que **ainda não existem?**

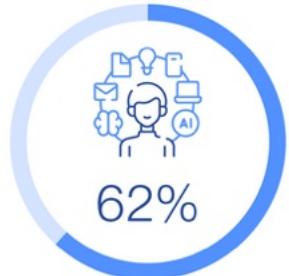
How will businesses respond to AI developments?



Reskilling and upskilling existing workforce to better work alongside AI



Hiring new people with skills to design AI tools and enhancements appropriate for the organization-specific skills



Hiring new people with skills to better work alongside AI



Re-orienting the organization to target new business opportunities created by AI



Transitioning people from jobs that AI will cause to decline, to other roles within the organization



Downsizing workforce where AI can replicate people's work

Contexto da Disciplina (cont.)

"Hiring new people with skills to design AI tools and enhancements appropriate for the organization-specific skills" - [The Future of Jobs - Report 2025, WEF](#).

Conceitos iniciais

Artificial intelligence

in its broadest sense is a range of techniques to enable software to approximate human thinking and behaviours.

Machine learning

is a subset of AI and uses advanced algorithms to detect patterns in large datasets to allow software to learn and adapt.

Neural networks

are machine learning programs that process inputs and generate outputs through interconnected nodes or artificial neurons. These nodes loosely model the neurons in a brain.

Deep learning

All deep learning systems are made of neural networks. They can recognise complex data patterns.

General-purpose AI

operates on the foundations of machine learning and deep learning. It can handle a broad range of tasks.

Generative AI

is one subset of general purpose AI and can generate text, images, video, sound, etc.

AI

Machine
learning

Neural
networks

Deep
learning

General-
purpose AI

Generative
AI

Large
language
models

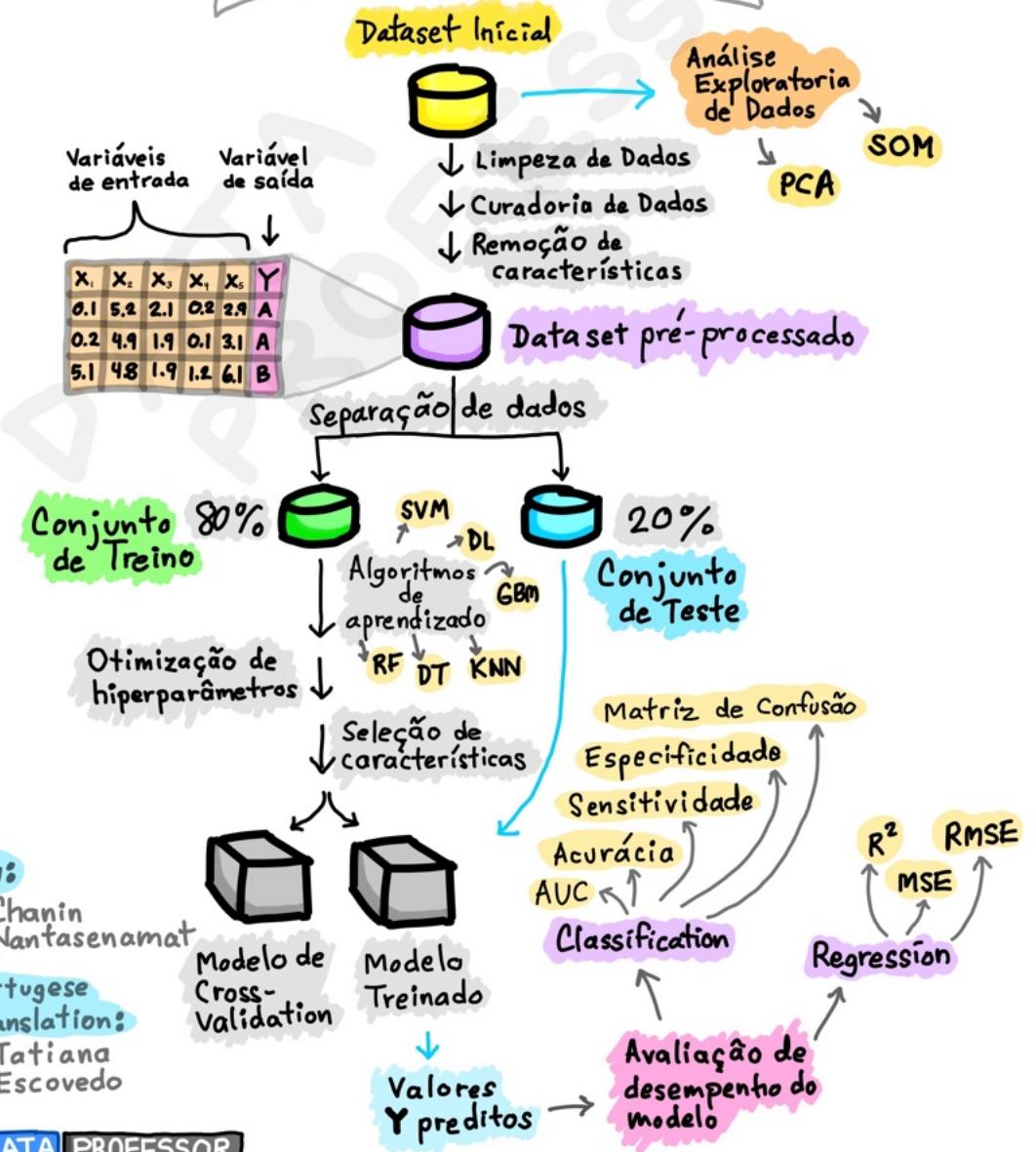
NLP

is a subfield of AI that uses machine learning to enable computers to understand and communicate with human language.

Large language models

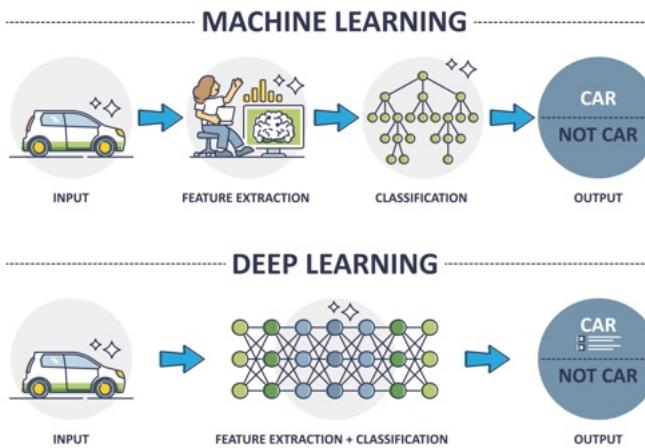
is a subset of foundation models focused on written text.

Fonte da Imagem: [Admscentre](#). Veja também: [History of AI](#).



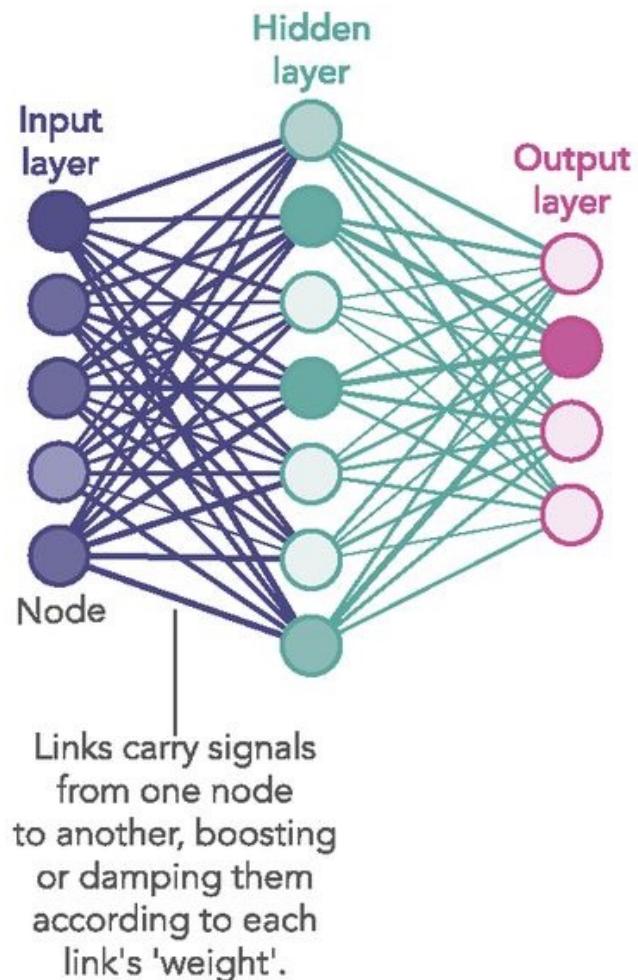
Pipeline Geral de ML

- Boa parte do tempo gasto no tratamento de dados
 - Feature Extraction
 - Feature Engineering
- Processo bastante iterativo (voltar para etapa anterior e corrigir algo)
- Fonte da imagem à esquerda: [Data Professor @GitHub](#)

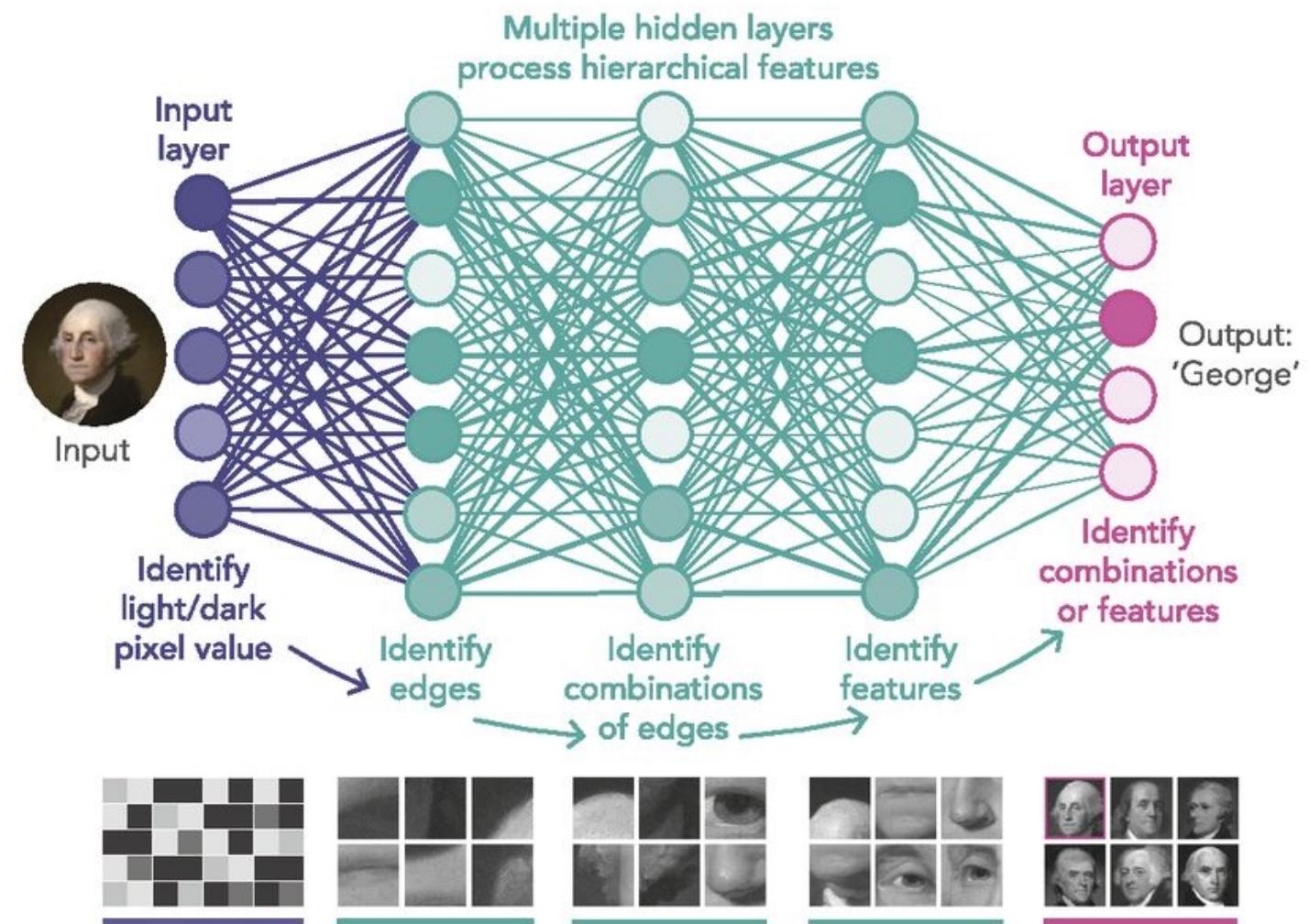


- Fonte da imagem acima: [AIT Goehner GmbH](#)

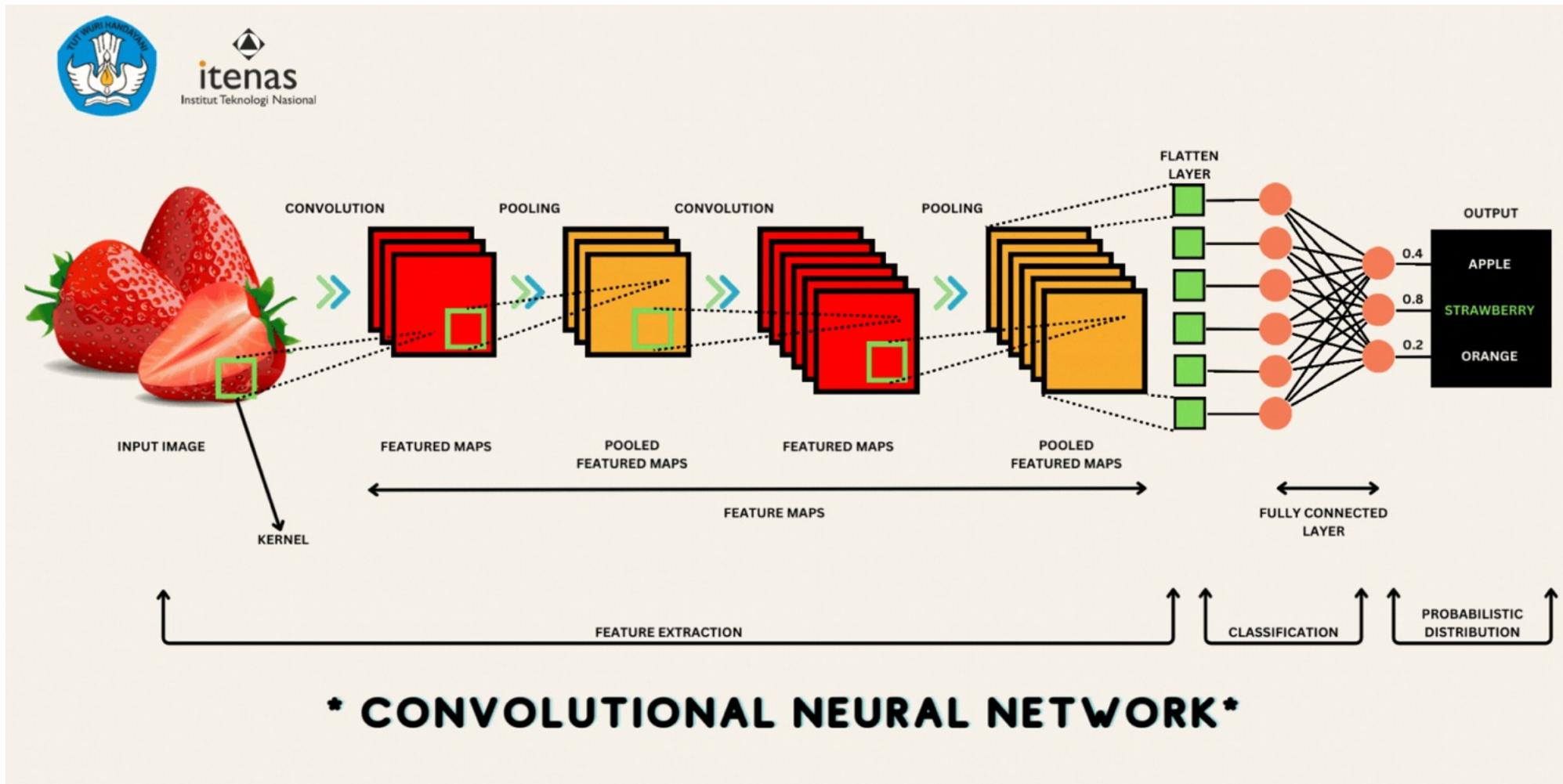
1980S-ERA NEURAL NETWORK



DEEP LEARNING NEURAL NETWORK



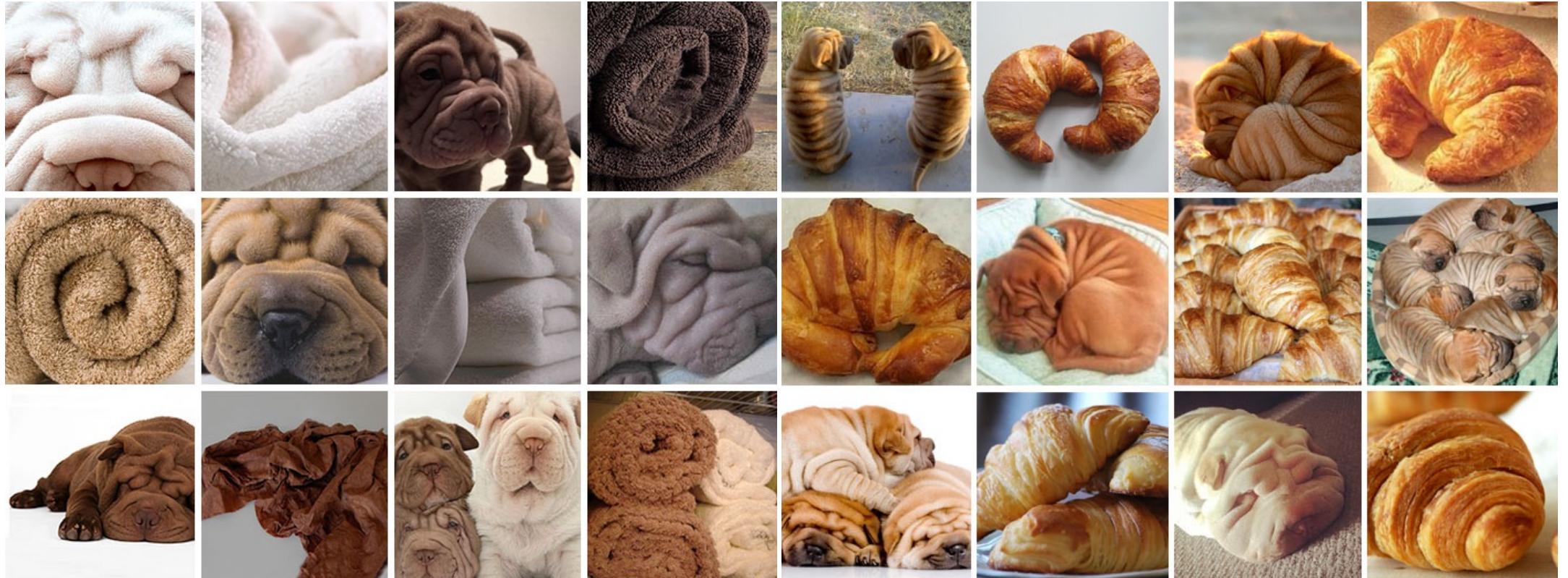
Fonte da Imagem: [Brian Wang @NextBigFuture](#)



* CONVOLUTIONAL NEURAL NETWORK *

Fonte da Imagem: [Amit Kumar](#).

A vida de um modelo de ML é difícil



Fonte das imagens: [Bored Panda](#)

Dúvidas e Discussão
