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of Economics
& Management
Universidade de Lisboa

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ARTIFICIAL INTELLIGENCE AND MANAGEMENT

Index

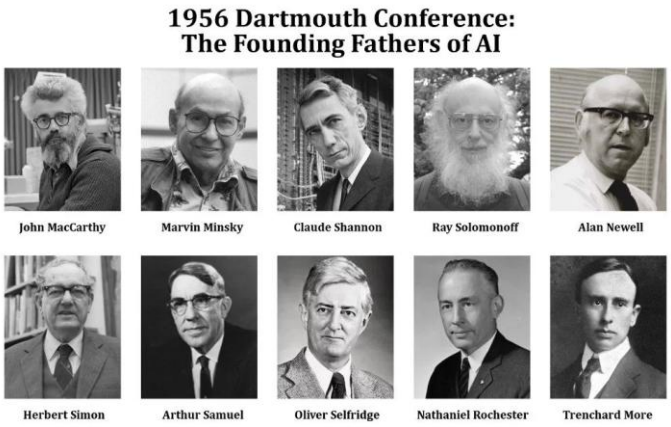
- Concepts
- AI and Management: research
- AI and Management: Use Cases

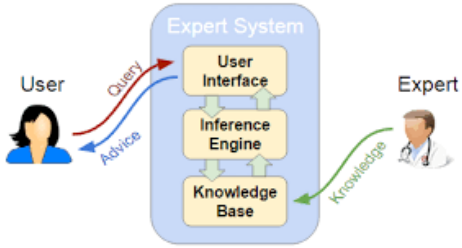
WHAT IS A.I.?

WHAT IS A.I.?

Artificial Intelligence(AI)

- Artificial intelligence refers to the development of computer-based solutions that can perform tasks which mimic human intelligence.





Symbolic AI

Euristic Search

Winter 1

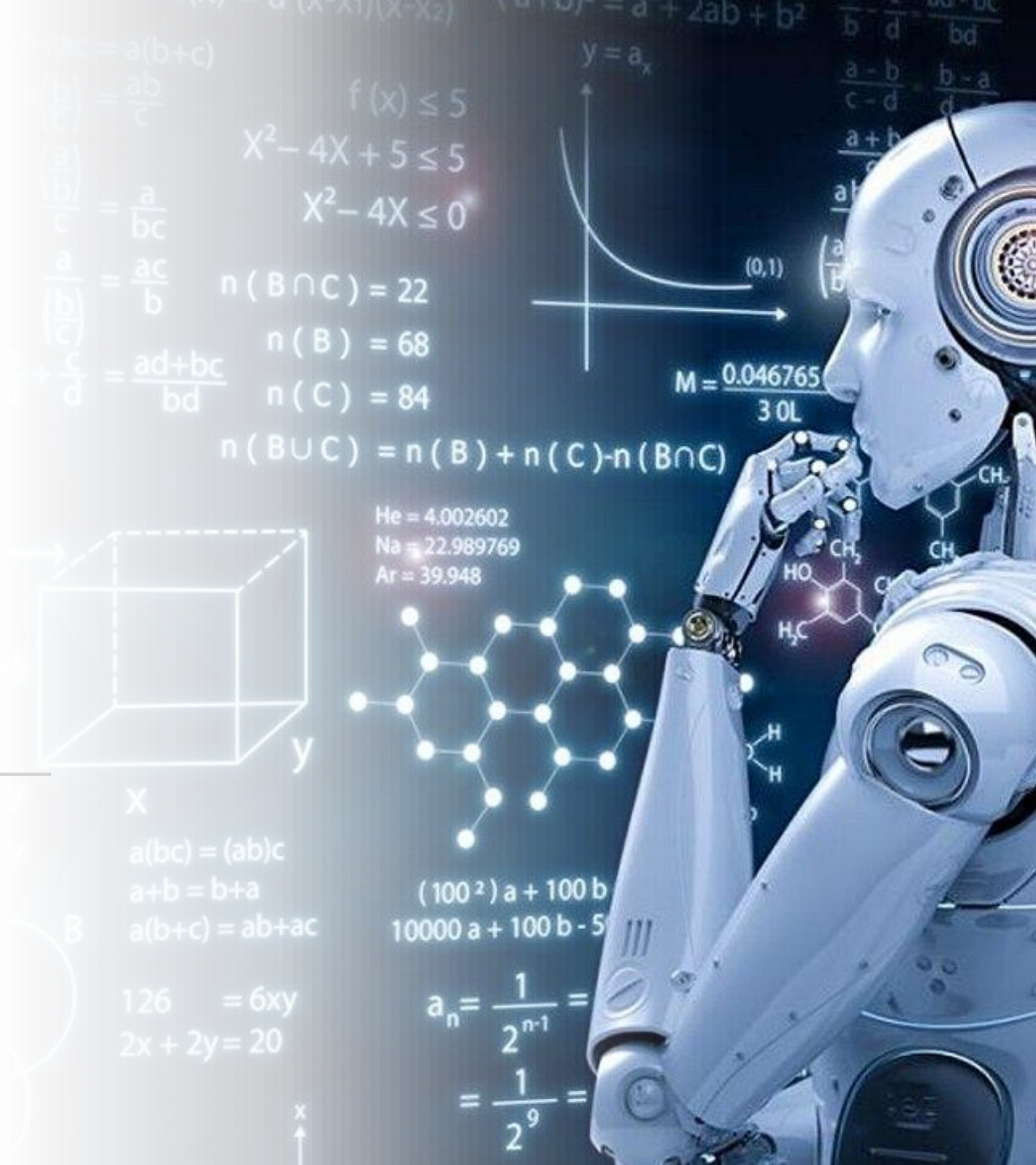
Expert Systems

Knowledge Engineering

Winter 2

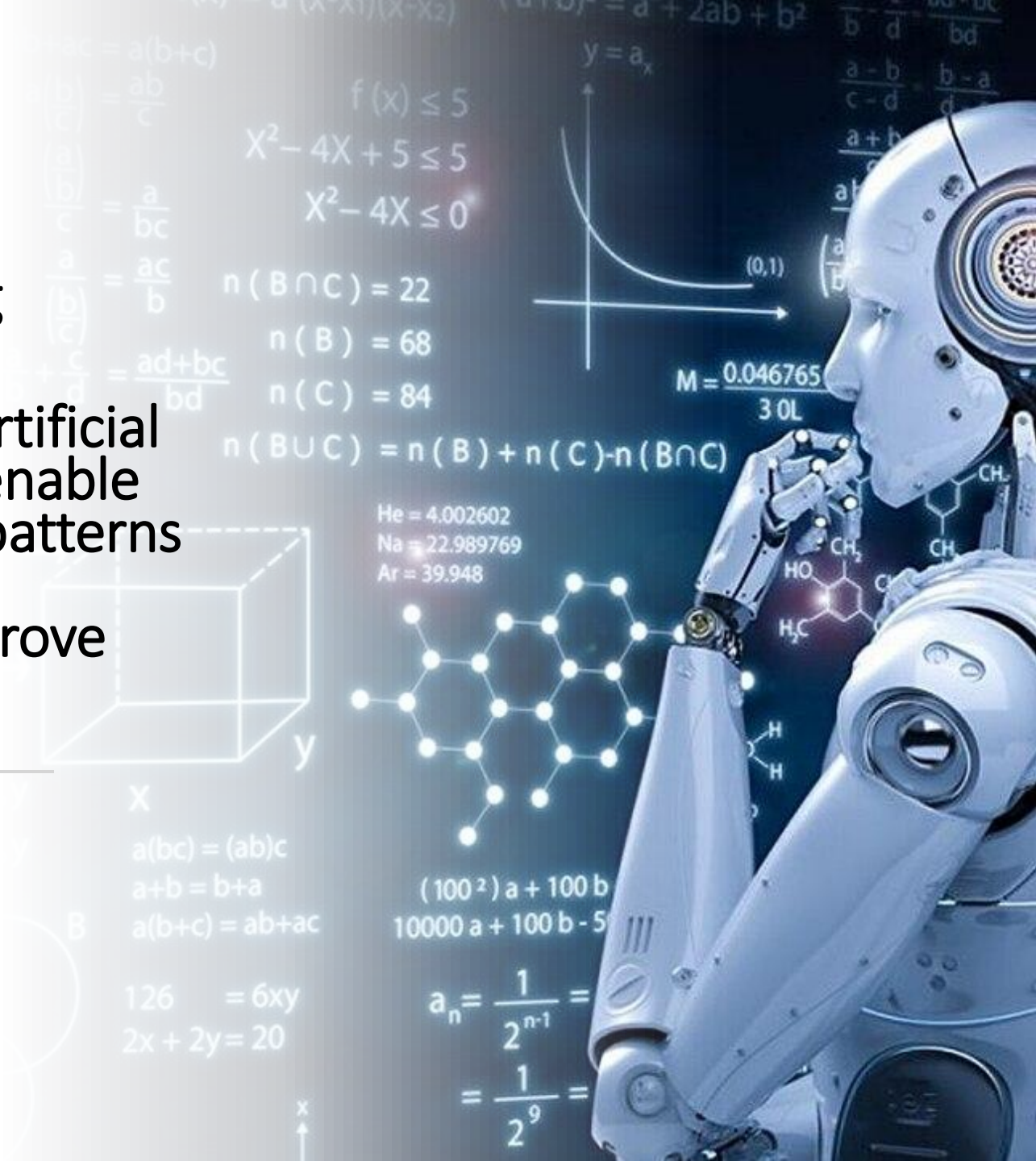
1950 1960 1970 1980 1990 2000 2010 2020

What is Machine Learning?

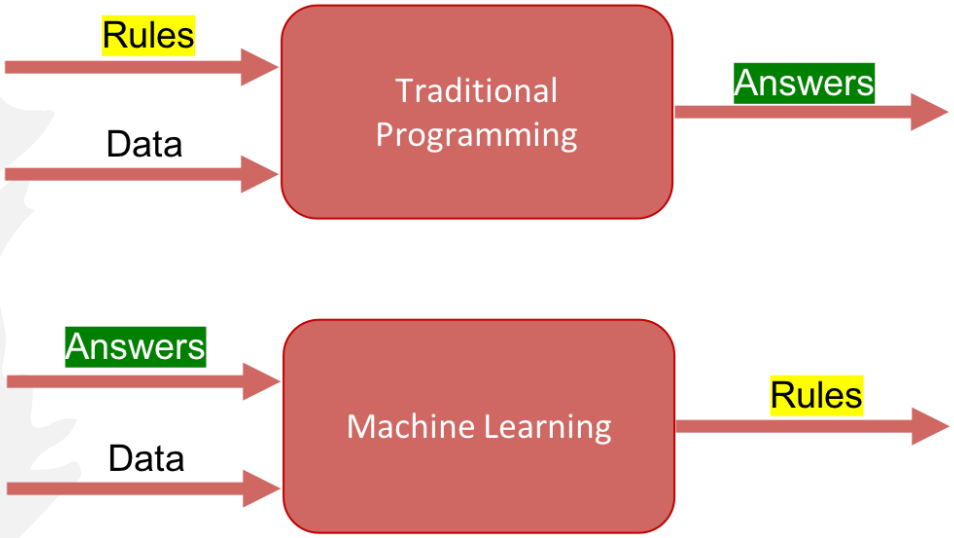


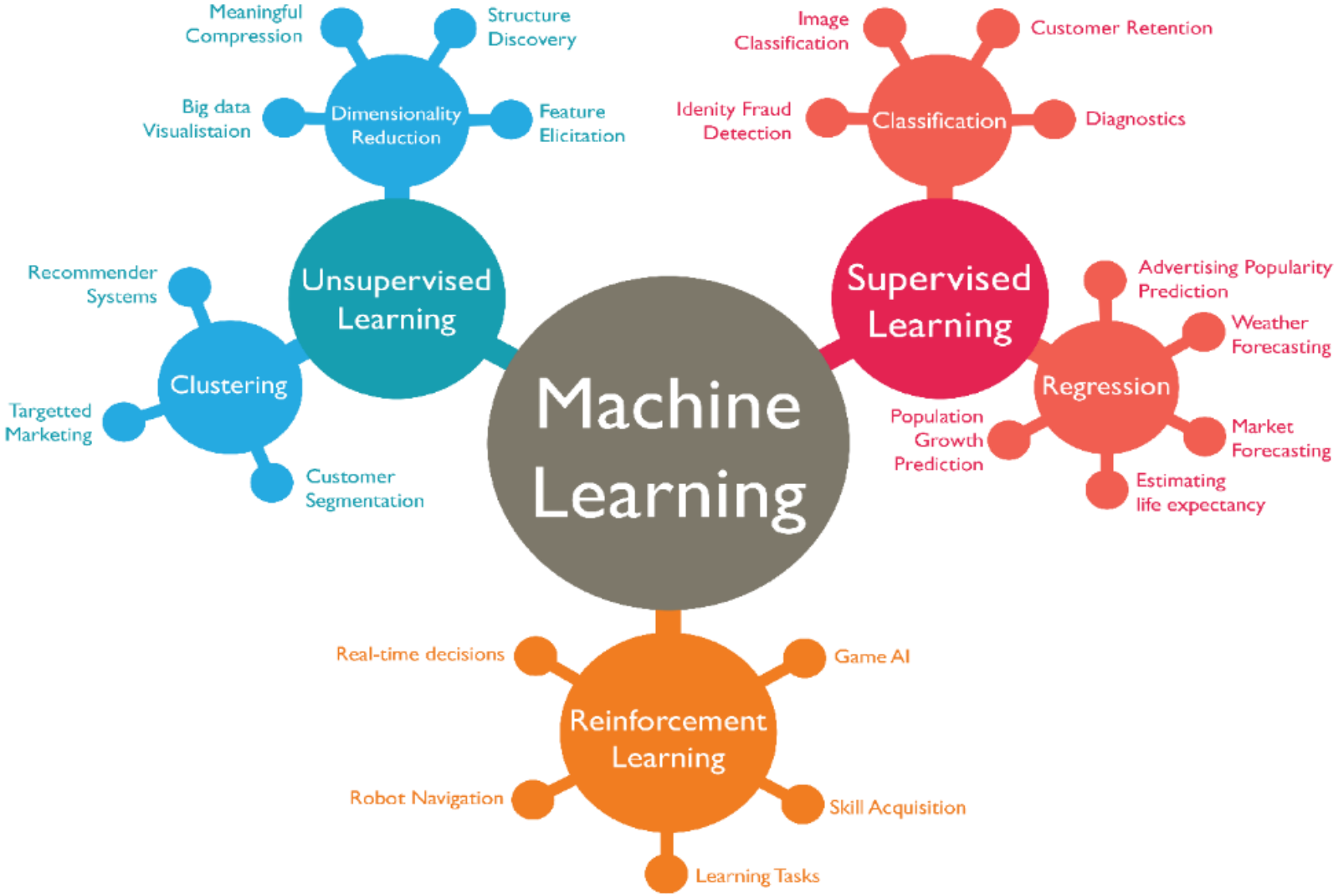
Machine Learning

is as a subset of artificial intelligence that enable systems to learn patterns from data and subsequently improve from experience



Tradicional programming vs. Machine Learning

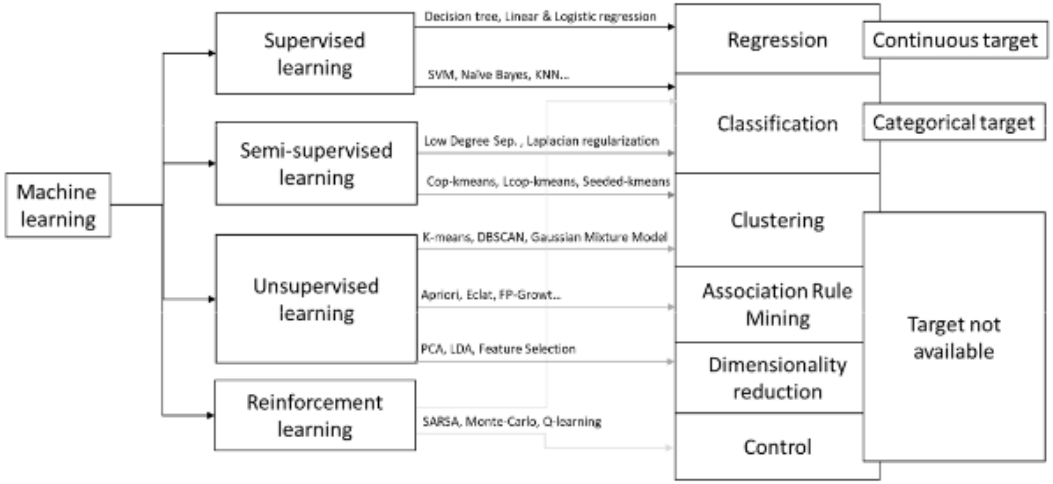



Machine Learning
Unsupervised Learning
Dimensionality Reduction
Meaningful Compression
Structure Discovery
Big data Visualistaion
Feature Elicitation
Clustering
Recommender Systems
Targetted Marketing
Customer Segmentation
Supervised Learning
Classification
Image Classification
Customer Retention
Idenity Fraud Detection
Diagnostics
Regression
Advertising Popularity Prediction
Weather Forecasting
Population Growth Prediction
Market Forecasting
Estimating life expectancy
Reinforcement Learning
Real-time decisions
Game AI
Robot Navigation
Skill Acquisition
Learning Tasks

- Machine Learning Algorithms

I. INTRODUCTION

Prediction has been one of the main objectives of pursuit science is or at least creating models that may help understand reality and further help prediction. [12] In recent years statistics, energy price, and alternative investment (or cost of opportunity) on bitcoins prices. The second purpose is to identify the algorithm with better predicting power. To do it, we use several machine learning algorithms.

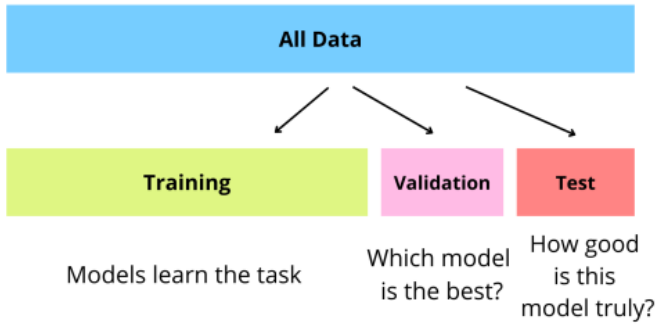


- Aparicio, Romao & Costa (2022)

Example of supervised Model

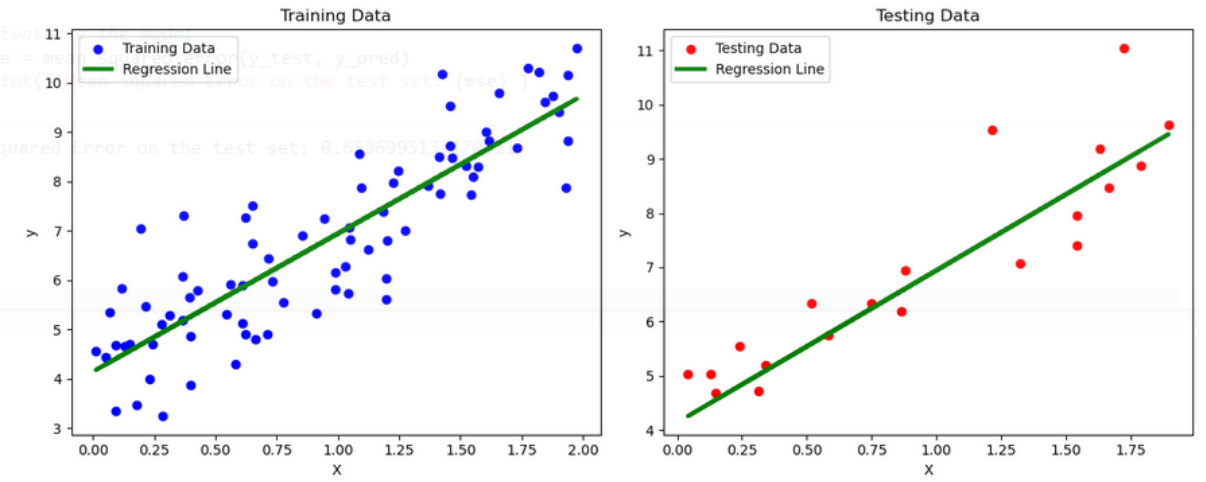
```python
# Import necessary libraries
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error


# Generate synthetic data
np.random.seed(42)  # For reproducibility
X = 2 * np.random.rand(100, 1)
y = 4 + 3 * X + np.random.randn(100, 1)

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Train a linear regression model
model = LinearRegression()
model.fit(X_train, y_train)

# Make predictions on the test set
y_pred = model.predict(X_test)

# Evaluate the model
mse = mean_squared_error(y_test, y_pred)
print(f'Mean Squared Error on the test set: {mse}')

```

```
Mean Squared Error on the test set: 0.6536995137170021
```



Example of supervised Model

```python
import matplotlib.pyplot as plt
# Plot the regression line for the training data
plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
plt.scatter(X_train, y_train, color='blue', label='Training Data')
plt.plot(X_train, model.predict(X_train), color='green', linewidth=3, label='Regression Line')
plt.xlabel('X')
plt.ylabel('y')
plt.title('Training Data')
plt.legend()

# Plot the regression line for the testing data
plt.subplot(1, 2, 2)
plt.scatter(X_test, y_test, color='red', label='Testing Data')
plt.plot(X_test, y_pred, color='green', linewidth=3, label='Regression Line')
plt.xlabel('X')
plt.ylabel('y')
plt.title('Testing Data')
plt.legend()

plt.tight_layout()
plt.show()
```



	Prediction	Inference
Goal	Robust model using all predictors to accurately predict the outcome variable (Y) with high accuracy and low error.	Estimate the relationship between an outcome variable and predictor variable(s), while accounting for confounding factors.
Question Answered	How can I accurately predict new data points?	What do the relationships between the variables signify?
Example	Predicting house prices based on features like size, location, and number of bedrooms using regression models.	Inferring the impact of education level on income while controlling for factors such as experience and occupation using linear regression analysis.

Inference

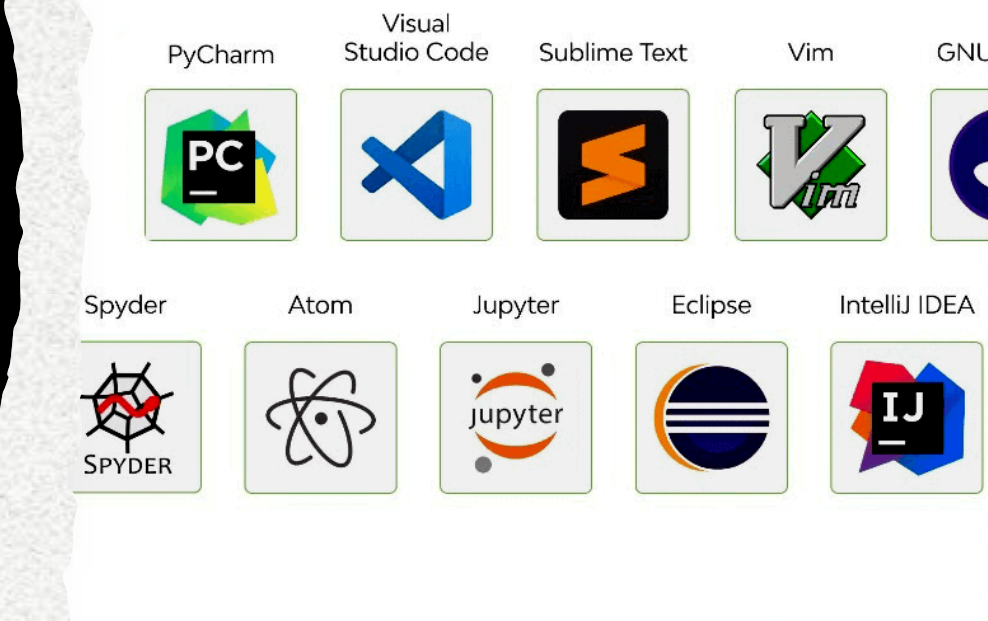
- Given a dataset, the purpose is to infer how the output is generated as a function of the data.
- Use the model to learn about the data generation process.
- Understand the way the independent variables X affect the target variable Y.
- Ex: find out what the effect of passenger gender, class and age, has on surviving the Titanic Disaster
- Model interpretability is a necessity for inference

Prediction

- Use the model to predict the outcomes for new data points.
- When performing predictions over data, the purpose is estimating f in y=f(x)
- The purpose is not understanding the exact form of the estimated function, as far as it can perform predictions quite accurately.
- To be able to predict what the responses are going to be to future input variables.
- Ex: predict prices of oil

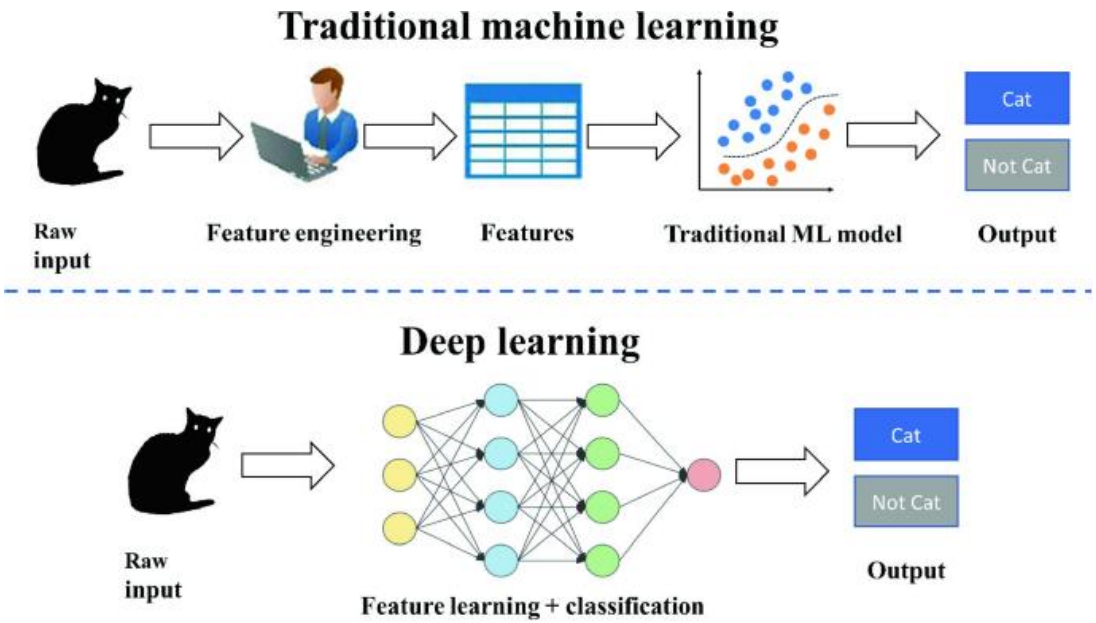
Machine Learning

- **Supervised Learning:**
  - Classification
  - Regression
- **Unsupervised Learning**
  - Clustering
  - Dimensional Reduction
- Reinforcement Learning



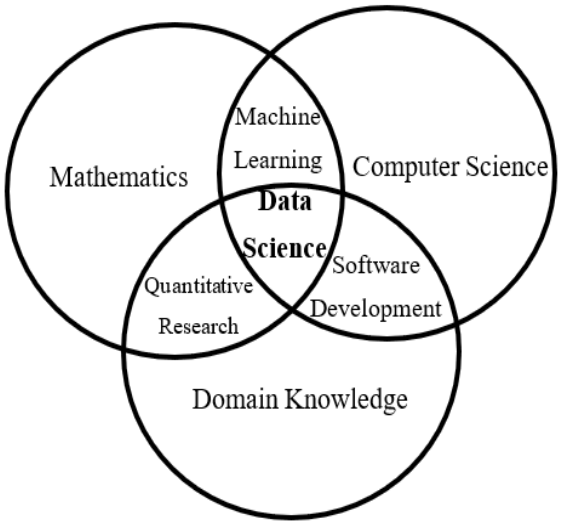
Deep learning

- is a subfield of machine learning
- focuses on the development and application of artificial neural networks, particularly deep neural networks.
    - composed of layers of interconnected nodes (artificial neurons) that can learn and make decisions.
- The term "deep" refers to the use of multiple layers in the neural network.



Data Science

- includes techniques developed in some traditional fields like artificial intelligence, statistics or machine learning.



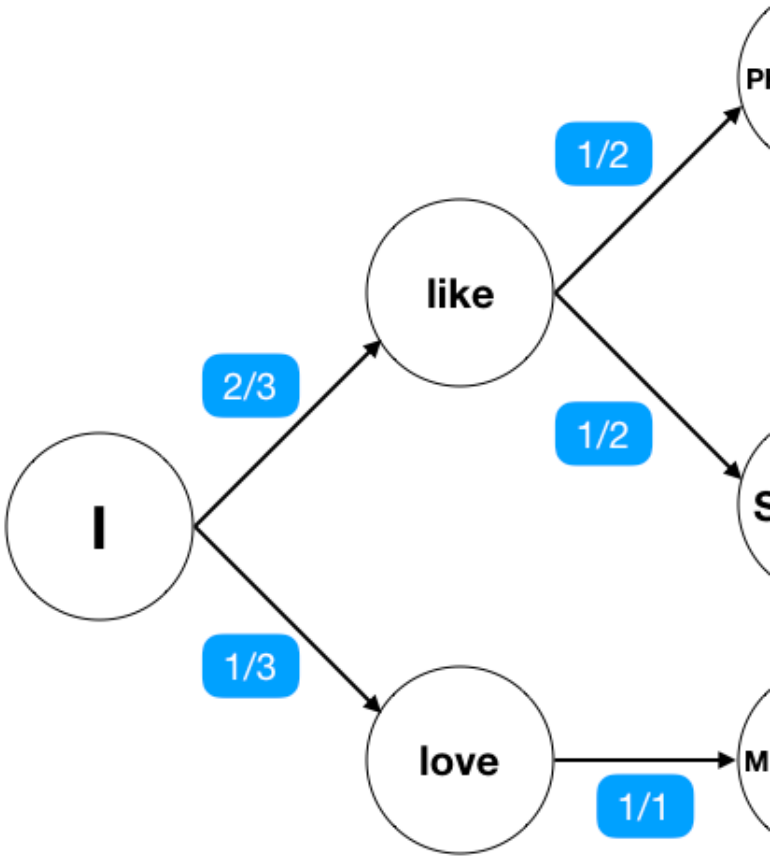
Aparicio et al. (2019).

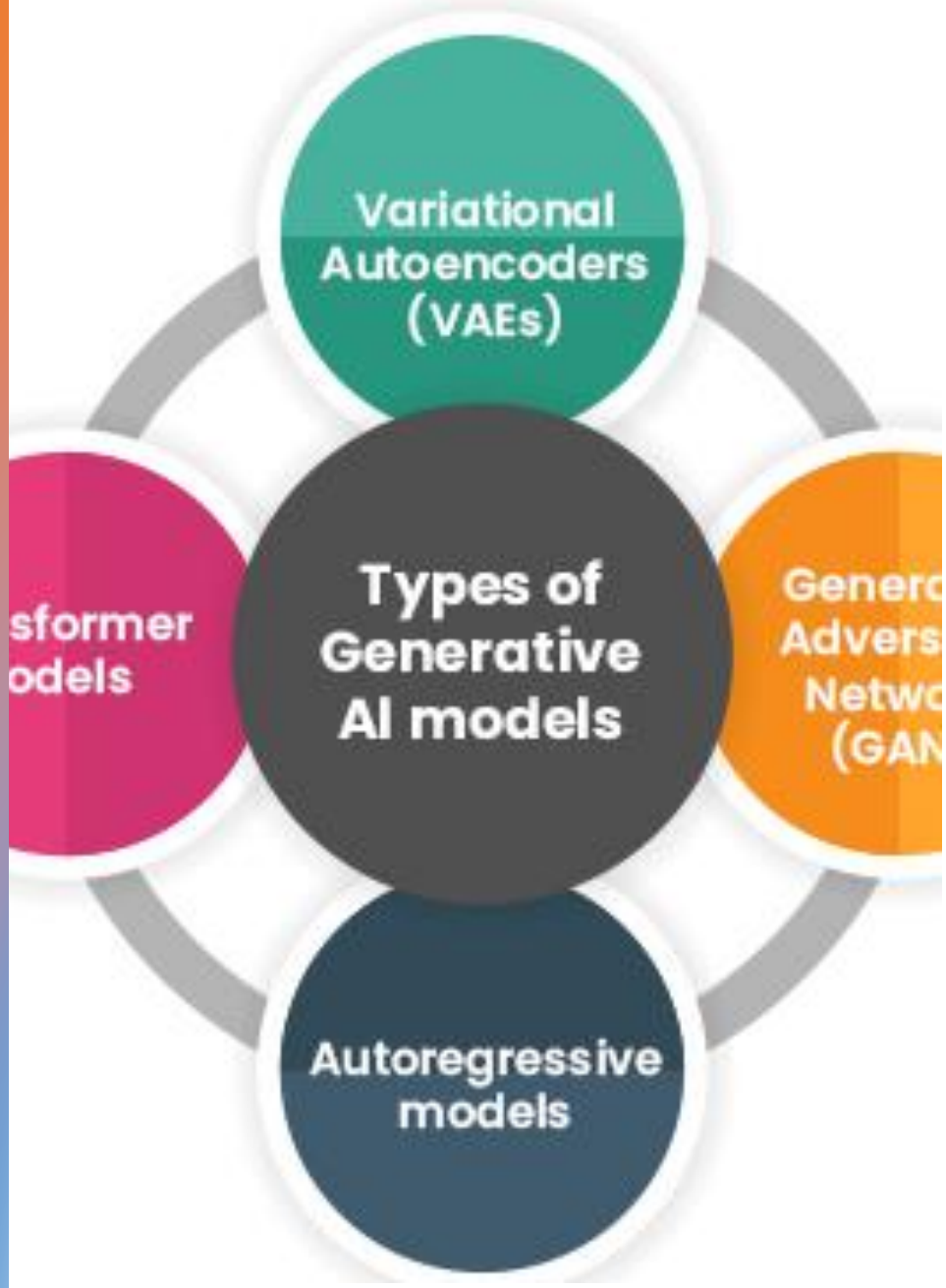
Generative AI

- Class of AI algorithms and models that are designed to generate new, original content.
- Gen AI learn the underlying patterns and structures in the data and can generate novel outputs.
- *Instead of being trained on specific examples and then making predictions or classifications*
- These models are particularly good at creating content that resembles or is similar to the data they were trained on.

Generative AI

- Guessing next word
- Markov Chain
- Training model



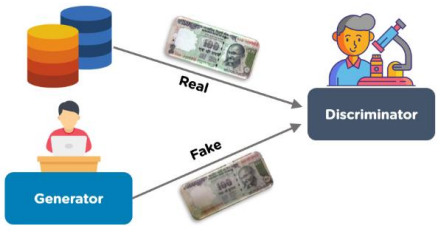


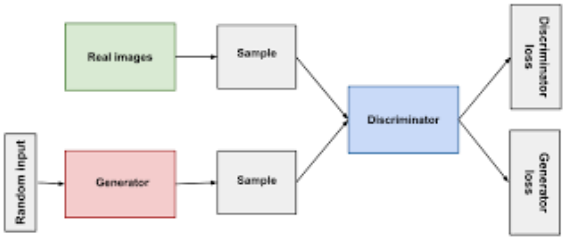
Types of generative AI models

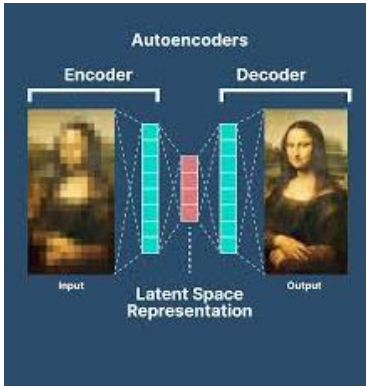
- Generative Adversarial Networks (GANs)
- Variational Autoencoders (VAEs)
- Autoregressive Models
- Recurrent Neural Networks (RNNs)
- Transformer-based Models
- Reinforcement Learning for Generative Tasks
- Generative AI for Data Privacy, Security and Governance.

Types of generative AI models

- Generative Adversarial Networks (GANs):
  - a generator and a discriminator are trained simultaneously through adversarial training.
- Variational Autoencoders (VAEs):
  - learn a probabilistic mapping from the observed data to a latent space.
  - Good to generate new samples from the learned latent space.
- Autoregressive Models:
  - the probability distribution of the next value in a sequence depends on the previous values.



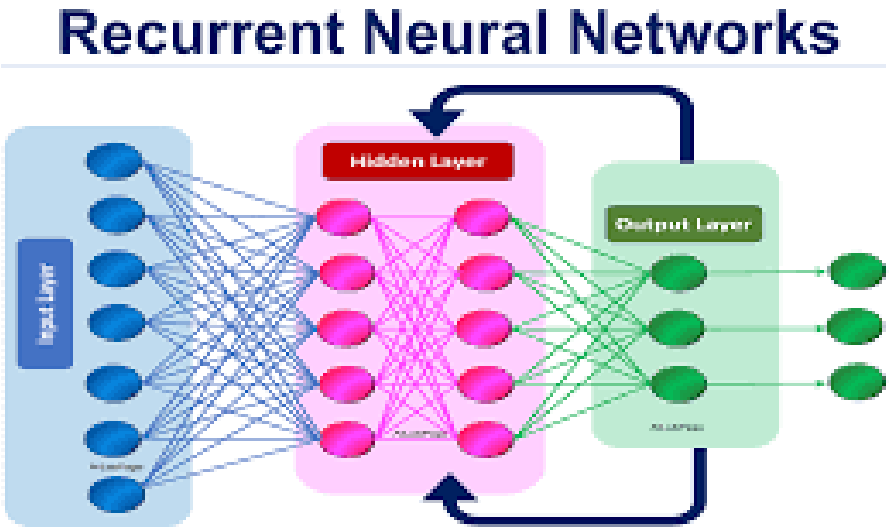




$$y_t = c + \sum_{i=1}^{p} a_{t-i} y_{y-i} + e_t$$

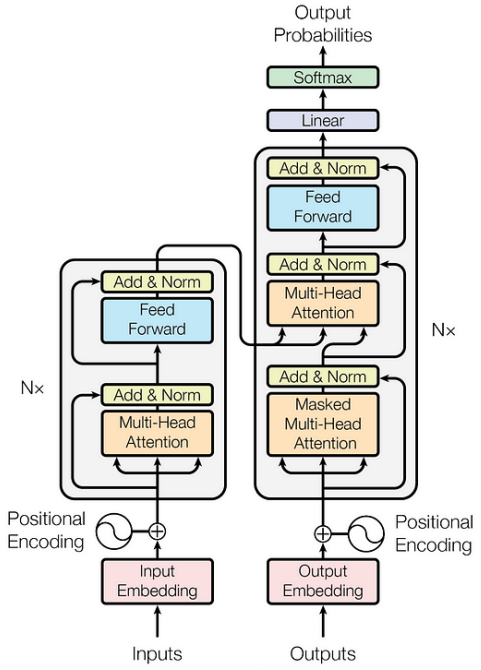
Types of generative AI models

- Recurrent Neural Networks (RNNs):
  - RNNs are commonly used for sequence tasks, including some generative tasks, they are not exclusively generative models.
  - Variants like LSTM and GRU are popular choices.
- Transformer-based Models:
  - Transformers, especially large language models.
- Reinforcement Learning for Generative Tasks:
  - can be used in conjunction with generative models, and this combination is powerful in scenarios where the generative model needs to produce sequences or structures guided by a reward signal.



BERT

Encoder

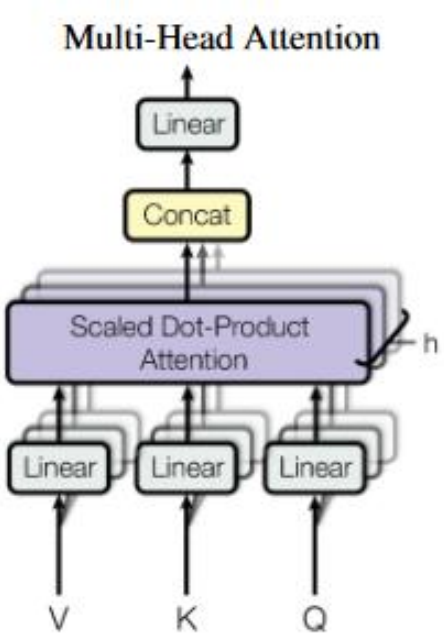


GPT

Decoder

Transformer

- Deep learning architecture based on the multi-head attention mechanism



Attention Is All You Need

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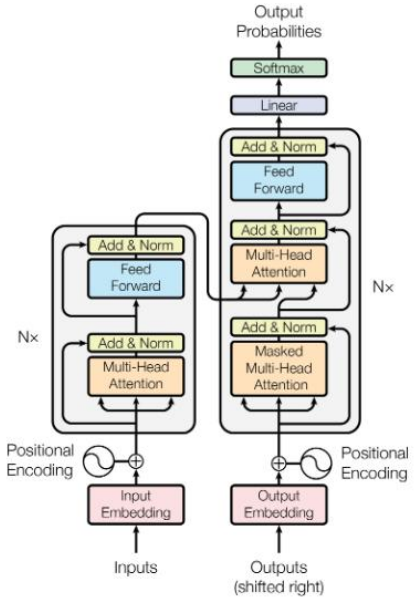
Abstract

The dominant sequence transduction models are based on complex recurrent or convolutional neural networks that include an encoder and a decoder. The best performing models also connect the encoder and decoder through an attention mechanism. We propose a new simple network architecture, the Transformer, based solely on attention mechanisms, dispensing with recurrence and convolutions entirely. Experiments on two machine translation tasks show these models to be superior in quality while being more parallelizable and requiring significantly less time to train. Our model achieves 28.4 BLEU on the WMT 2014 English-to-German translation task, improving over the existing best results, including ensembles, by over 2 BLEU. On the WMT 2014 English-to-French translation task, our model establishes a new single-model state-of-the-art BLEU score of 41.0 after training for 3.5 days on eight GPUs, a small fraction of the training costs of the best models from the literature.

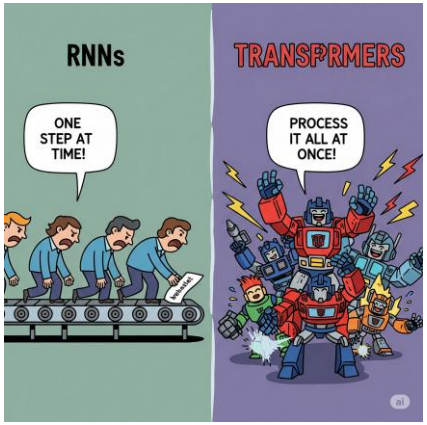
1 Introduction

Recurrent neural networks, long short-term memory [12] and gated recurrent [7] neural networks in particular, have been firmly established as state of the art approaches in sequence modeling and transduction problems such as language modeling and machine translation [29, 2, 5]. Numerous efforts have since continued to push the boundaries of recurrent language models and encoder-decoder architectures [31, 21, 13].



Vaswani, et al. (2017)

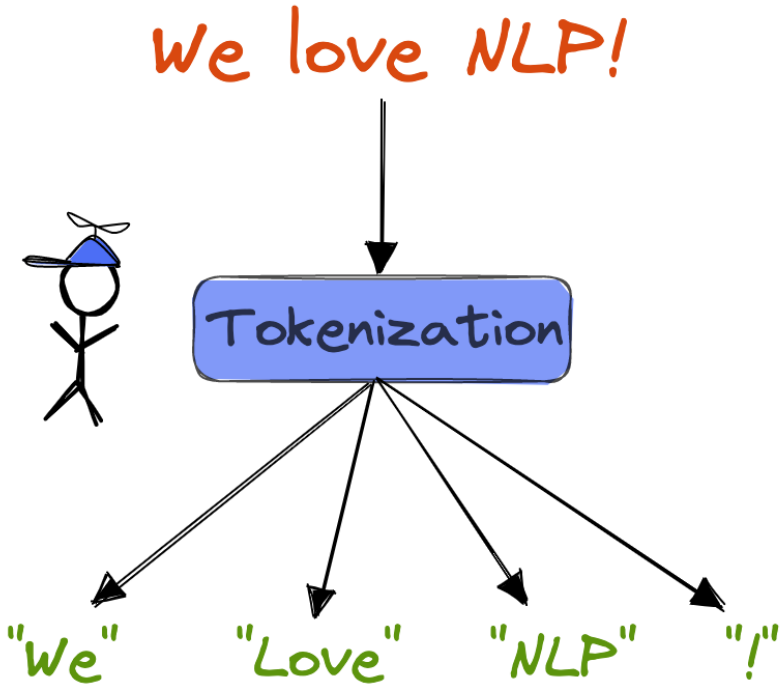
Concepts

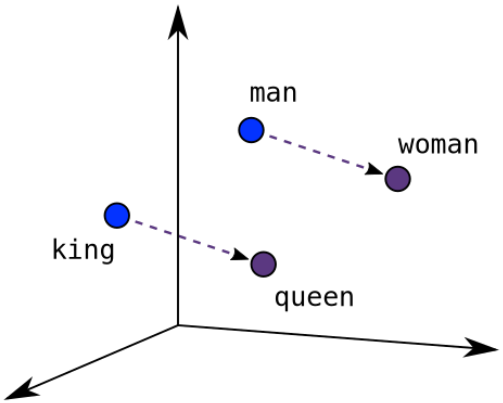


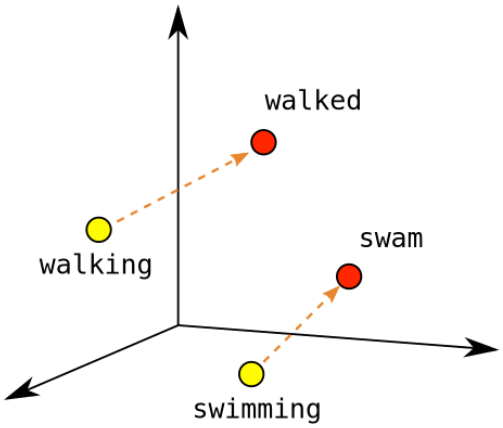
- Token - A piece of text (usually a word)
- Embedding - Translation of a word into numbers
- Attention - Mechanism that links related words
- Encoder - The part that "reads and understands"
- Decoder - The part that "writes the response"

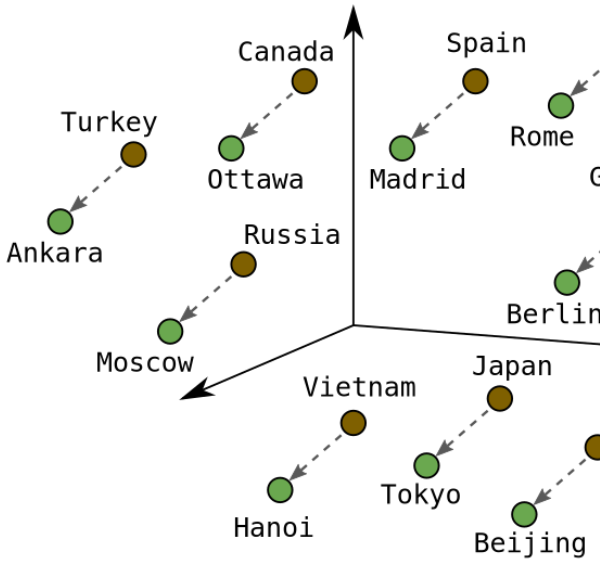
What is a "token"?

- When you write a sentence, the computer doesn't understand words directly.
- So the text is broken into pieces called tokens.
- The sentence "The cat sleeps" can be split into: ["The", "cat", "sleeps"]









Male-Female

Country-Capital

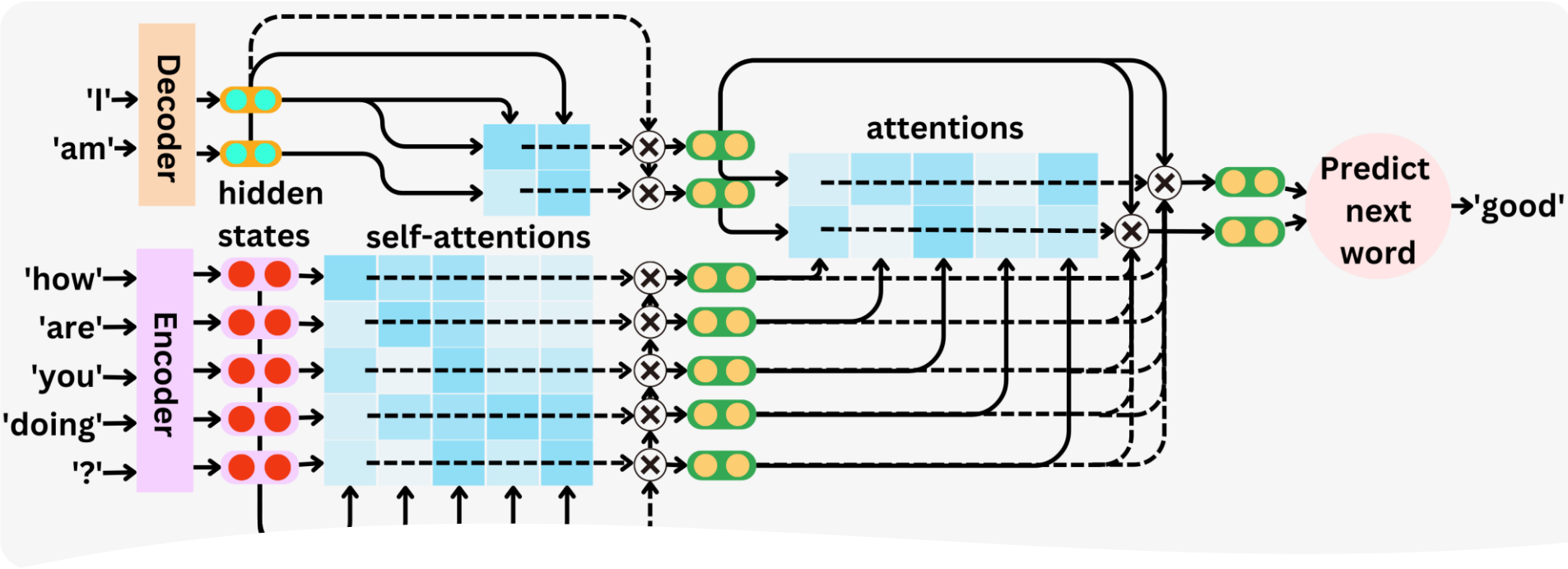
What is an "embedding" ?

- Computers only understand numbers.
- An embedding is a way of converting each token into a list of numbers (a vector), so that words with similar meanings end up represented by similar numbers.
- For example:
  - "king" → [0.2, 0.9, 0.1, ...]
  - "queen" → [0.2, 0.8, 0.1, ...] (similar!)
  - "car" → [0.9, 0.1, 0.7, ...] (very different)

Vextorization vs. Embeding

- Vectorization:
  - Process/action of turning data into vectors.
  - Often produces sparse, high-dimensional,
  - Sometimes meaningless representations (e.g., TF-IDF).
- Embedding:
  - Resulting semantic vector.
  - Dense, low-dimensional representation
  - Captures the context and relationship between data points (e.g., Word2Vec).

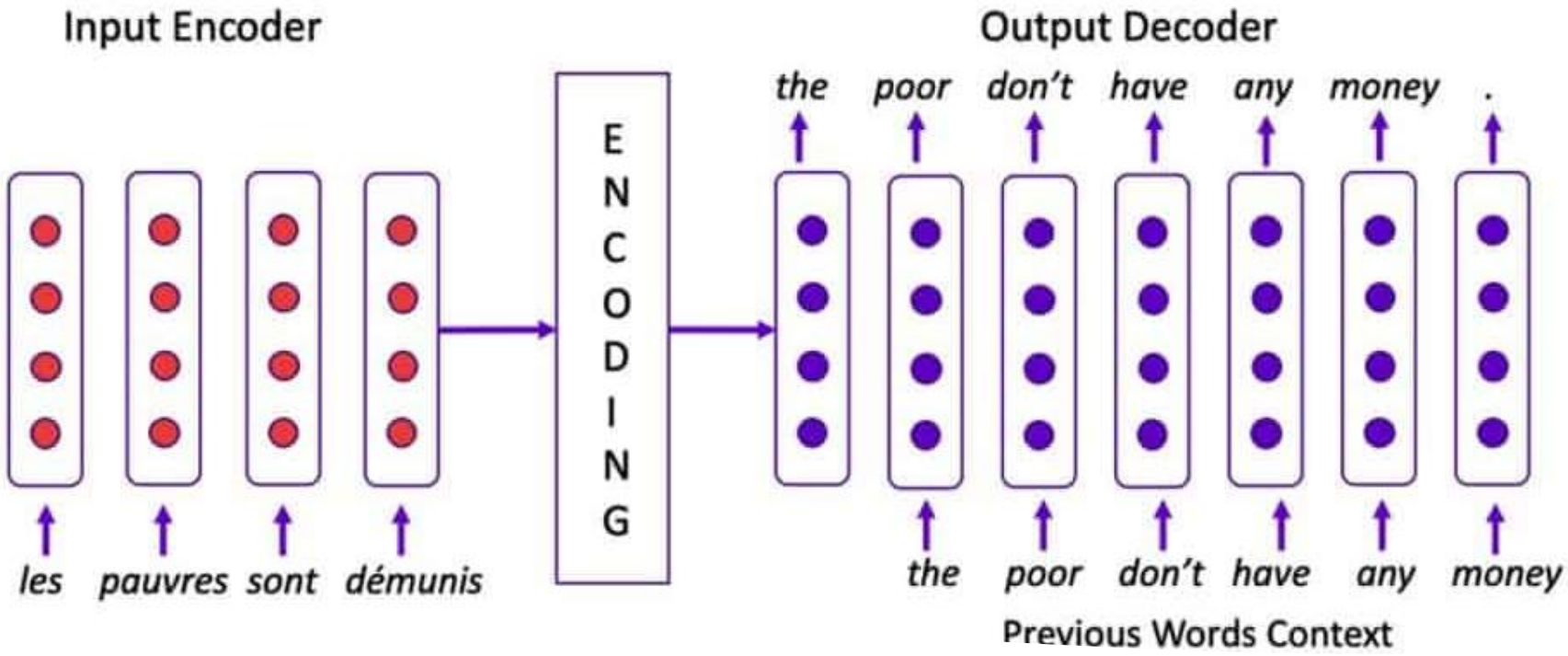
Self-attention mechanism



The Attention Mechanism

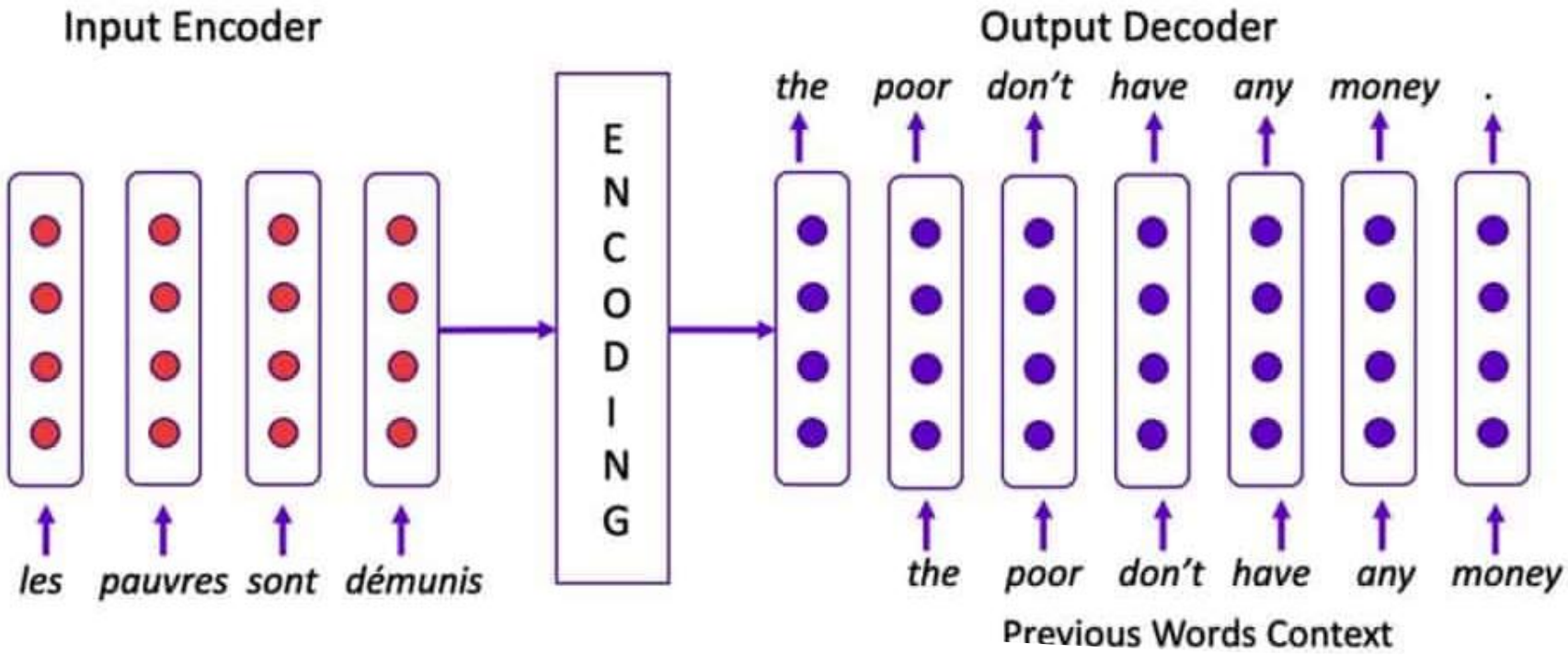
- "Andrew went to the market but he forgot his wallet."
  - When you reach the word "he", your brain automatically links it to "Andrew".
  - figuring out which words relate to which other words.

- The transformer does exactly that:
  - for each word, it calculates how important every other word is for understanding its meaning.



What is the "Encoder"?

- The encoder is the part of the transformer that reads and understands the input text.
- Think of it as a very attentive reader:
  - it reads the whole sentence,
  - understands the relationships between words,
  - and builds a rich representation of the overall meaning.
- e.g. : in a translation system, the encoder reads the sentence in Portuguese and "*deeply understands*" it.



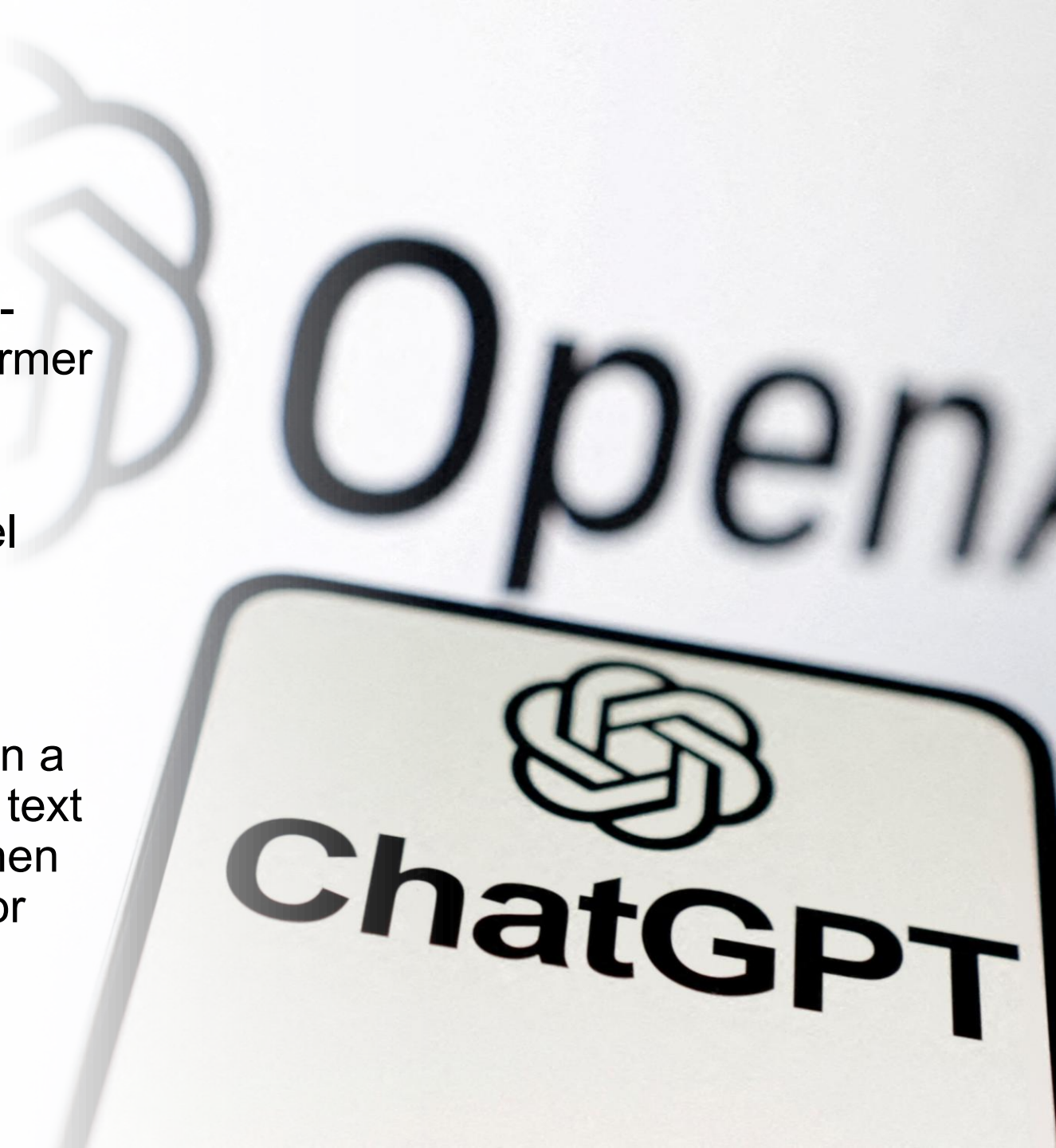
What is the "Decoder"?

- the part that generates the output text, based on what the encoder understood.
- writer
  - it takes the encoder's understanding
  - and produces the response, word by word.

- e.g. : the decoder takes the understanding of the Portuguese sentence and writes the English translation.

GPT

- Generative Pre-trained Transformer
- Is a type of autoregressive language model that uses a transformer architecture.
- Is pre-trained on a large corpus of text data and can then be fine-tuned for specific tasks.



Google Gemini

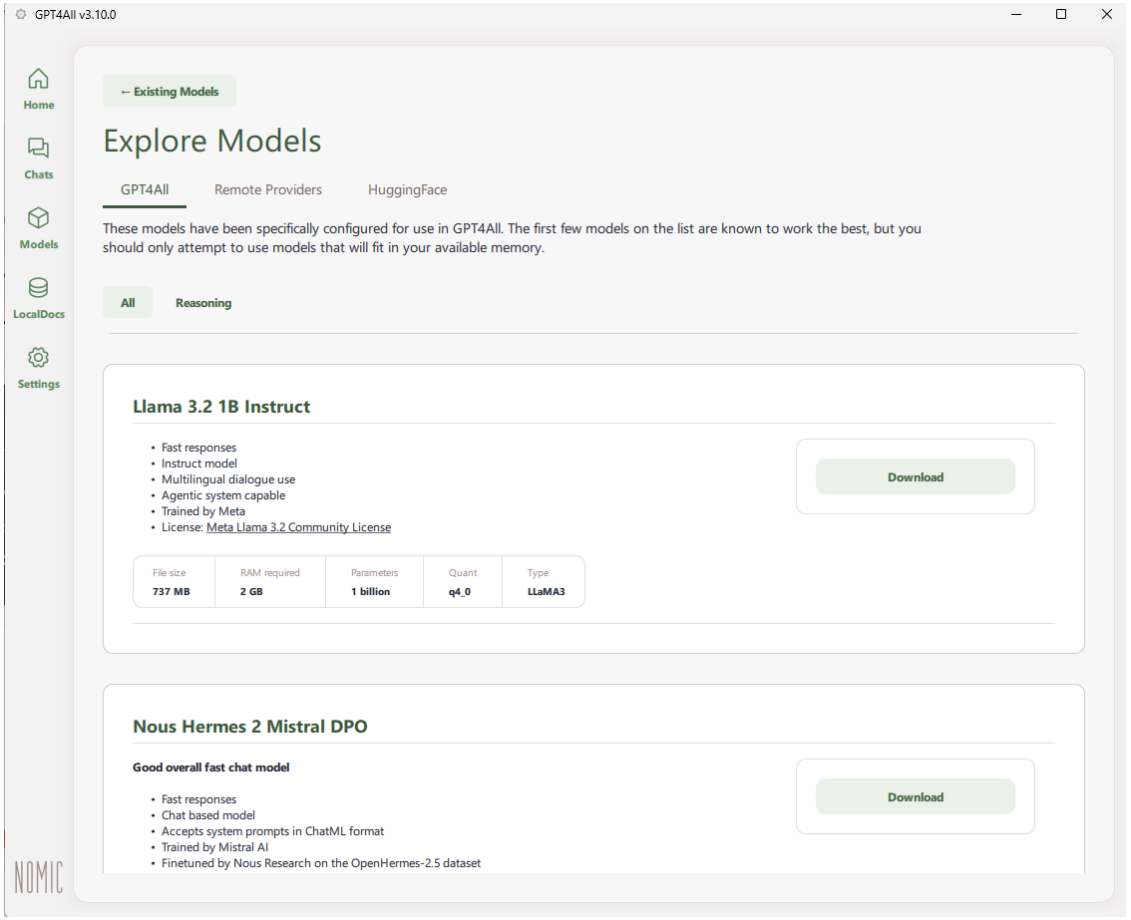
Bard is a conversational AI chatbot powered by a combination of generative AI techniques, including:

- **Transformer-based models:**
  - Google's Pathways Language Model (PaLM) is used to generate text that is fluent, coherent, and grammatically correct.
- **Autoregressive models**
  - to predict the next word in a sequence, which helps to ensure that its responses are natural and engaging.
- **Reinforcement learning:**
  - it is rewarded for generating responses that are informative, comprehensive, and relevant to the user's query.

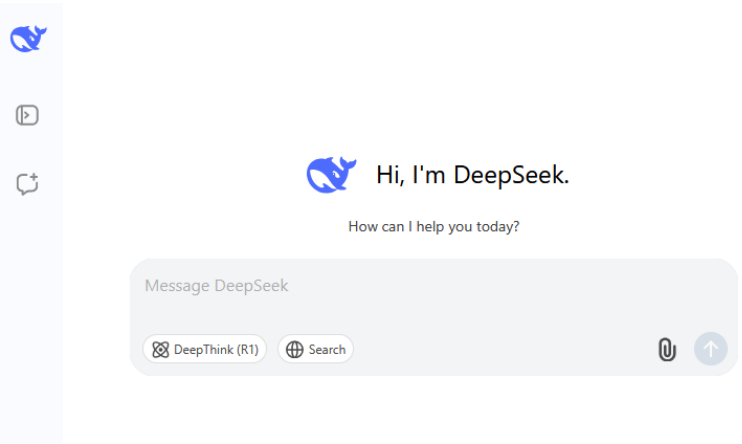
Feature	LaMDA	PaLM	Gemini
Release Date	2021	2022	December 2023
Focus	Conversational AI	General-purpose	Multimodal
Strengths	Realistic dialogue	Large & diverse dataset	Understanding & processing various data formats
Successor	Gemini/ PaLM	Gemini	N/A

Your Own LLM locally

gpt4all



- Founded by Liang Wenfeng
- Headquarters: Hangzhou, Zhejiang, China




deepseek

DeepSeek-V3 Technical Report

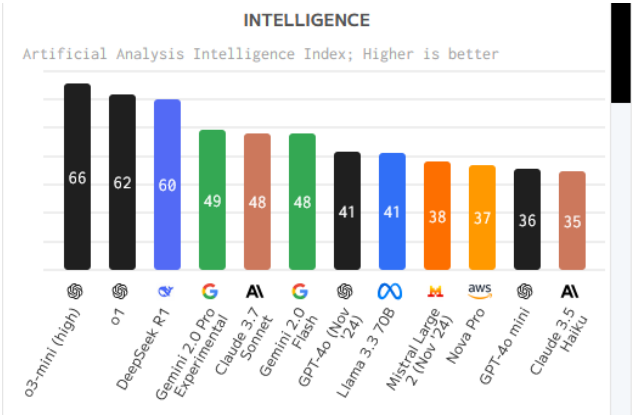
DeepSeek-AI
research@deepseek.com

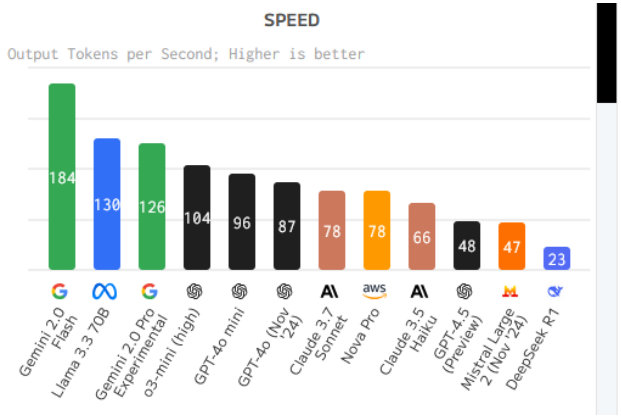
Abstract

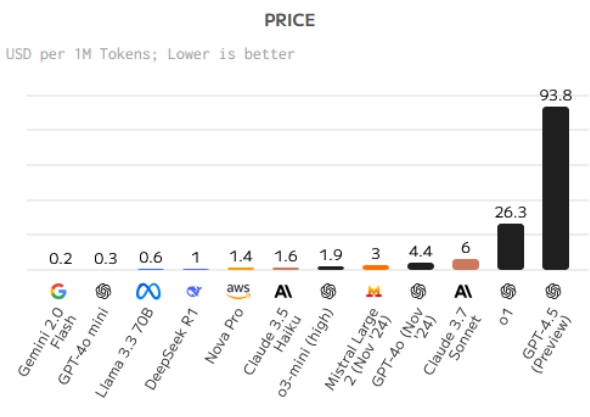
We present DeepSeek-V3, a strong Mixture-of-Experts (MoE) language model with 671B total parameters with 37B activated for each token. To achieve efficient inference and cost-effective training, DeepSeek-V3 adopts Multi-head Latent Attention (MLA) and DeepSeekMoE architectures, which were thoroughly validated in DeepSeek-V2. Furthermore, DeepSeek-V3 pioneers an auxiliary-loss-free strategy for load balancing and sets a multi-token prediction training objective for stronger performance. We pre-train DeepSeek-V3 on 14.8 trillion diverse and high-quality tokens, followed by Supervised Fine-Tuning and Reinforcement Learning stages to fully harness its capabilities. Comprehensive evaluations reveal that DeepSeek-V3 outperforms other open-source models and achieves performance comparable to leading closed-source models. Despite its excellent performance, DeepSeek-V3 requires only 2.788M H800 GPU hours for its full training. In addition, its training process is remarkably stable. Throughout the entire training process, we did not experience any irrecoverable loss spikes or perform any rollbacks. The model checkpoints are available at https://github.com/deepseek-ai/DeepSeek-V3.

- Liu, A., Feng, B., Xue, B., Wang, B., Wu, B., Lu, C., ... & Piao, Y. (2024). Deepseek-v3 technical report. *arXiv preprint arXiv:2412.19437*.

Comparing Models







- https://artificialanalysis.ai/

Some issues…

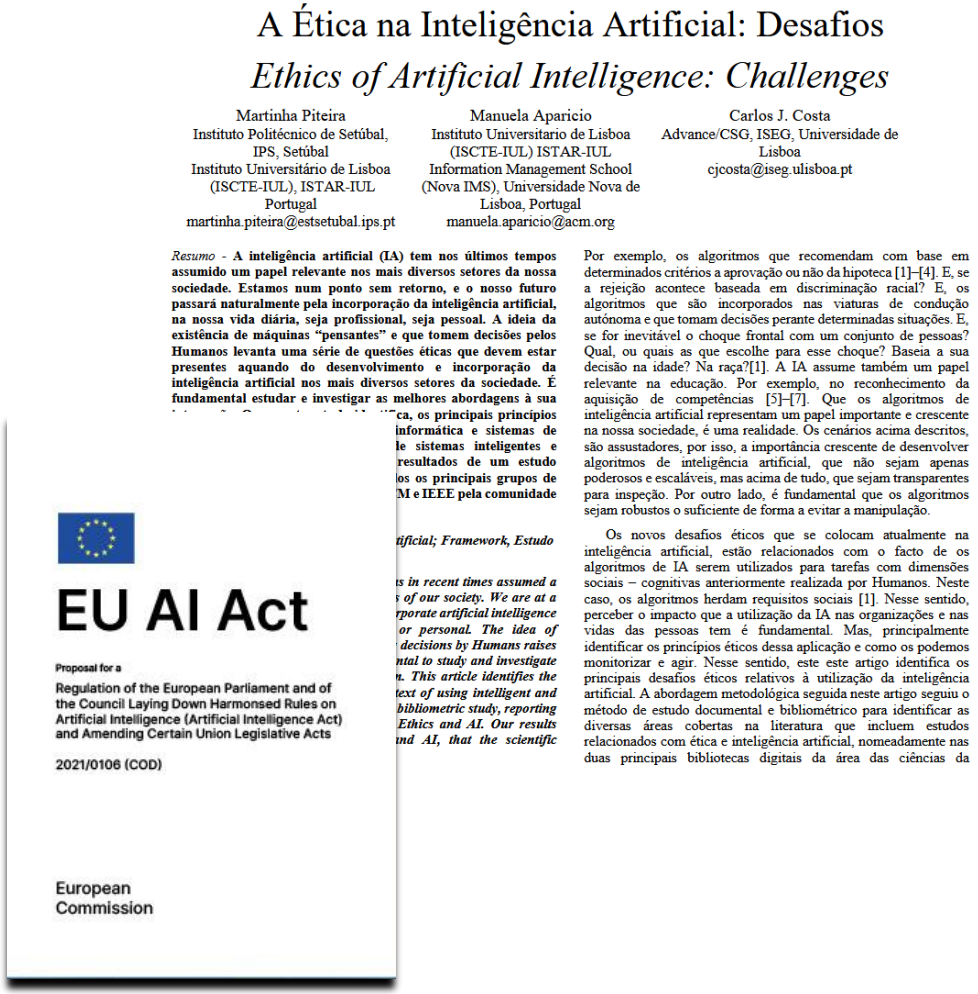
- Hidden costs
- Ethical Control vs. Political Censorship
- Corporations or government are stealing data?
- Bad practices

WAIM Workshop on Artificial Intelligence and Management

- Ai and Ethics
- Robotic Process Automation
- Digital Transformation and AI
- Social and Economic Impact of AI
- AI Users
- AI and Finances
- AI and Communication
- AI Democratization

Ai and Ethics

- ACM and IEEE have discussed proposals
- Robotics
- Privacy
- Responsibility
- Transparency
- AI Act
- REGULATION (EU) 2024/1689 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 June 2024



A Ética na Inteligência Artificial: Desafios

Ethics of Artificial Intelligence: Challenges

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Resumo - **A inteligência artificial (IA) tem nos últimos tempos assumido um papel relevante nos mais diversos setores da nossa sociedade. Estamos num ponto sem retorno, e o nosso futuro passará naturalmente pela incorporação da inteligência artificial, na nossa vida diária, seja profissional, seja pessoal. A ideia da existência de máquinas "pensantes" e que tomem decisões pelos Humanos levanta uma série de questões éticas que devem estar presentes aquando do desenvolvimento e incorporação da inteligência artificial nos mais diversos setores da sociedade. É fundamental estudar e investigar as melhores abordagens à sua**

Por exemplo, os algoritmos que recomendam com base em determinados critérios a aprovação ou não da hipoteca [1]–[4]. E, se a rejeição acontece baseada em discriminação racial? E, os algoritmos que são incorporados nas viaturas de condução autónoma e que tomam decisões perante determinadas situações. E, se for inevitável o choque frontal com um conjunto de pessoas? Qual, ou quais as que escolhe para esse choque? Baseia a sua decisão na idade? Na raça?[1]. A IA assume também um papel relevante na educação. Por exemplo, no reconhecimento da aquisição de competências [5]–[7]. Que os algoritmos de inteligência artificial representam um papel importante e crescente na nossa sociedade, é uma realidade. Os cenários acima descritos, são assustadores, por isso, a importância crescente de desenvolver algoritmos de inteligência artificial, que não sejam apenas poderosos e escaláveis, mas acima de tudo, que sejam transparentes para inspeção. Por outro lado, é fundamental que os algoritmos sejam robustos o suficiente de forma a evitar a manipulação.

Os novos desafios éticos que se colocam atualmente na inteligência artificial, estão relacionados com o facto de os algoritmos de IA serem utilizados para tarefas com dimensões sociais – cognitivas anteriormente realizada por Humanos. Neste caso, os algoritmos herdam requisitos sociais [1]. Nesse sentido, perceber o impacto que a utilização da IA nas organizações e nas vidas das pessoas tem é fundamental. Mas, principalmente identificar os princípios éticos dessa aplicação e como os podemos monitorizar e agir. Nesse sentido, este este artigo identifica os principais desafios éticos relativos à utilização da inteligência artificial. A abordagem metodológica seguida neste artigo seguiu o método de estudo documental e bibliométrico para identificar as diversas áreas cobertas na literatura que incluem estudos relacionados com ética e inteligência artificial, nomeadamente nas duas principais bibliotecas digitais da área das ciências da

EU AI Act

Proposal for a

Regulation of the European Parliament and of the Council Laying Down Harmonsed Rules on Artificial Intelligence (Artificial Intelligence Act) and Amending Certain Union Legislative Acts

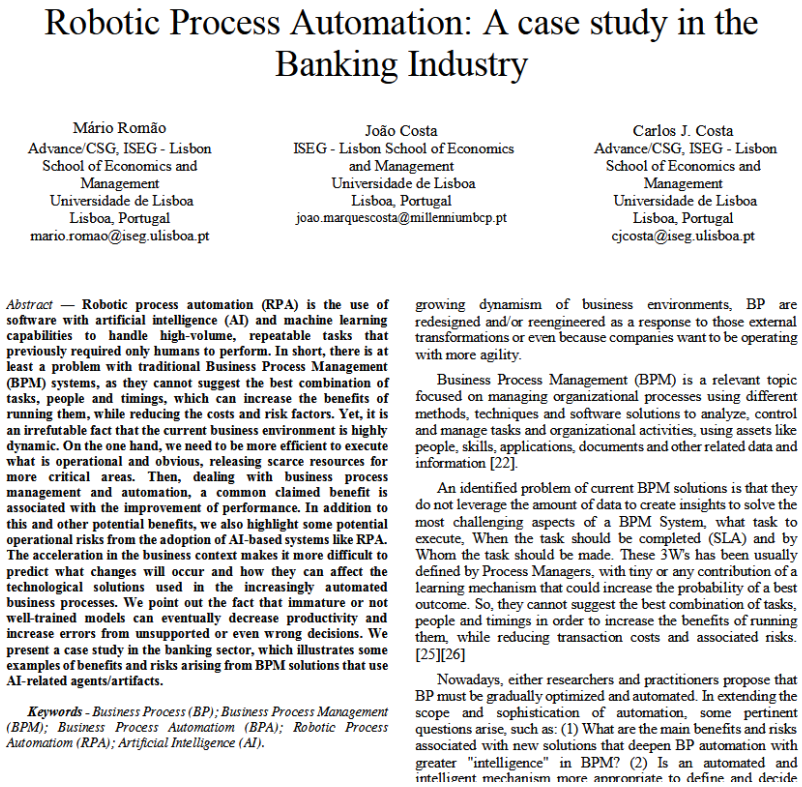
2021/0106 (COD)

European Commission

- Piteira, M., Aparicio, M., & Costa, C. J. (2019, June). Ethics of artificial intelligence: Challenges. In 2019 14th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.
- Veiga, M., & Costa, C. J. (2024). Ethics and Artificial Intelligence Adoption. *arXiv preprint arXiv:2412.00330*.

Robotic Process Automation

- RPA is not AI
- RPA may be integrated with AI
- AI may help redesign processes



Robotic Process Automation: A case study in the Banking Industry

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Abstract — **Robotic process automation (RPA) is the use of software with artificial intelligence (AI) and machine learning capabilities to handle high-volume, repeatable tasks that previously required only humans to perform. In short, there is at least a problem with traditional Business Process Management (BPM) systems, as they cannot suggest the best combination of tasks, people and timings, which can increase the benefits of running them, while reducing the costs and risk factors. Yet, it is an irrefutable fact that the current business environment is highly dynamic. On the one hand, we need to be more efficient to execute what is operational and obvious, releasing scarce resources for more critical areas. Then, dealing with business process management and automation, a common claimed benefit is associated with the improvement of performance. In addition to this and other potential benefits, we also highlight some potential operational risks from the adoption of AI-based systems like RPA. The acceleration in the business context makes it more difficult to predict what changes will occur and how they can affect the technological solutions used in the increasingly automated business processes. We point out the fact that immature or not well-trained models can eventually decrease productivity and increase errors from unsupported or even wrong decisions. We present a case study in the banking sector, which illustrates some examples of benefits and risks arising from BPM solutions that use AI-related agents/artifacts.**

Keywords *- Business Process (BP); Business Process Management (BPM); Business Process Automatiom (BPA); Robotic Process Automatiom (RPA); Artificial Intelligence (AI).*

growing dynamism of business environments, BP are redesigned and/or reengineered as a response to those external transformations or even because companies want to be operating with more agility.

Business Process Management (BPM) is a relevant topic focused on managing organizational processes using different methods, techniques and software solutions to analyze, control and manage tasks and organizational activities, using assets like people, skills, applications, documents and other related data and information [22].

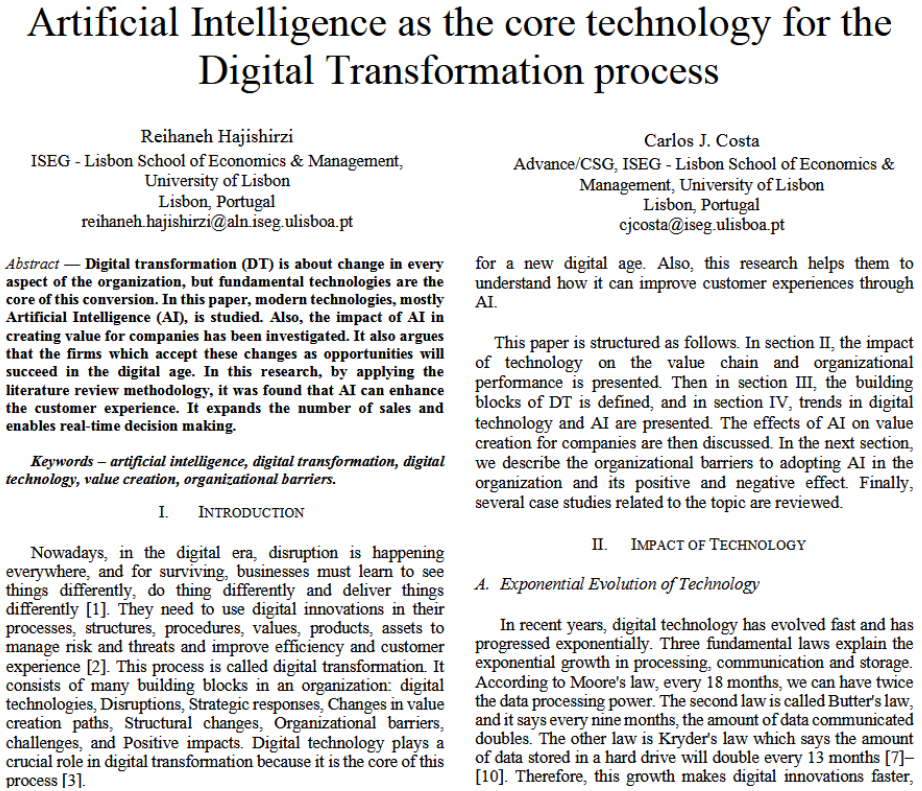
An identified problem of current BPM solutions is that they do not leverage the amount of data to create insights to solve the most challenging aspects of a BPM System, what task to execute, When the task should be completed (SLA) and by Whom the task should be made. These 3Ws has been usually defined by Process Managers, with tiny or any contribution of a learning mechanism that could increase the probability of a best outcome. So, they cannot suggest the best combination of tasks, people and timings in order to increase the benefits of running them, while reducing transaction costs and associated risks. [25][26]

Nowadays, either researchers and practitioners propose that BP must be gradually optimized and automated. In extending the scope and sophistication of automation, some pertinent questions arise, such as: (1) What are the main benefits and risks associated with new solutions that deepen BP automation with greater "intelligence" in BPM? (2) Is an automated and intelligent mechanism more appropriate to define and decide

- Romao, M., Costa, J., & Costa, C. J. (2019, June). Robotic process automation: A case study in the banking industry. In *2019 14th Iberian Conference on information systems and technologies (CISTI)* (pp. 1-6). IEEE.
- Ortiz, F. C. M., & Costa, C. J. (2020, June). RPA in Finance: supporting portfolio management: Applying a software robot in a portfolio optimization problem. In 2020 15th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Digital Transformation and AI

- Machine learning
- Deep learning
- NLP
- Improve competitive advantage
- Improve Organization



Artificial Intelligence as the core technology for the Digital Transformation process

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Abstract — **Digital transformation (DT) is about change in every aspect of the organization, but fundamental technologies are the core of this conversion. In this paper, modern technologies, mostly Artificial Intelligence (AI), is studied. Also, the impact of AI in creating value for companies has been investigated. It also argues that the firms which accept these changes as opportunities will succeed in the digital age. In this research, by applying the literature review methodology, it was found that AI can enhance the customer experience. It expands the number of sales and enables real-time decision making.**

Keywords – artificial intelligence, digital transformation, digital technology, value creation, organizational barriers.

I. INTRODUCTION

Nowadays, in the digital era, disruption is happening everywhere, and for surviving, businesses must learn to see things differently, do thing differently and deliver things differently [1]. They need to use digital innovations in their processes, structures, procedures, values, products, assets to manage risk and threats and improve efficiency and customer experience [2]. This process is called digital transformation. It consists of many building blocks in an organization: digital technologies, Disruptions, Strategic responses, Changes in value creation paths, Structural changes, Organizational barriers, challenges, and Positive impacts. Digital technology plays a crucial role in digital transformation because it is the core of this process [3].

for a new digital age. Also, this research helps them to understand how it can improve customer experiences through AI.

This paper is structured as follows. In section II, the impact of technology on the value chain and organizational performance is presented. Then in section III, the building blocks of DT is defined, and in section IV, trends in digital technology and AI are presented. The effects of AI on value creation for companies are then discussed. In the next section, we describe the organizational barriers to adopting AI in the organization and its positive and negative effect. Finally, several case studies related to the topic are reviewed.

II. IMPACT OF TECHNOLOGY

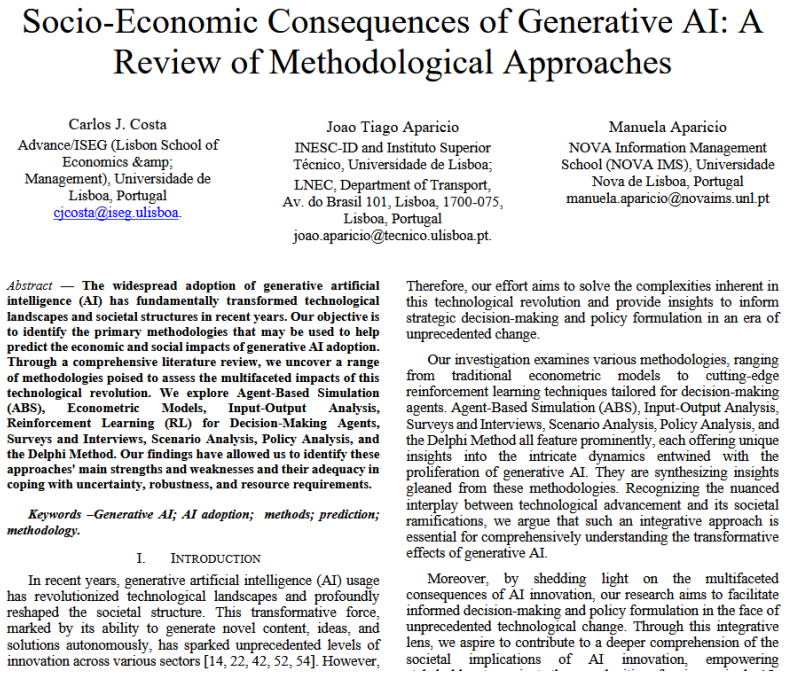
A. Exponential Evolution of Technology

In recent years, digital technology has evolved fast and has progressed exponentially. Three fundamental laws explain the exponential growth in processing, communication and storage. According to Moore's law, every 18 months, we can have twice the data processing power. The second law is called Butter's law, and it says every nine months, the amount of data communicated doubles. The other law is Kryder's law which says the amount of data stored in a hard drive will double every 13 months [7]–[10]. Therefore, this growth makes digital innovations faster,

- Hajishirzi, R., & Costa, C. J. (2021, June). Artificial Intelligence as the core technology for the Digital Transformation process. In *2021 16th Iberian Conference on Information Systems and Technologies (CISTI)* (pp. 1-6). IEEE..

Social and Economic Impact of AI

- Increase Unemployment?
- Increase Employment?
- Several techniques may be used to help predicting and deciding



Socio-Economic Consequences of Generative AI: A Review of Methodological Approaches

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Abstract — **The widespread adoption of generative artificial intelligence (AI) has fundamentally transformed technological landscapes and societal structures in recent years. Our objective is to identify the primary methodologies that may be used to help predict the economic and social impacts of generative AI adoption. Through a comprehensive literature review, we uncover a range of methodologies poised to assess the multifaceted impacts of this technological revolution. We explore Agent-Based Simulation (ABS), Econometric Models, Input-Output Analysis, Reinforcement Learning (RL) for Decision-Making Agents, Surveys and Interviews, Scenario Analysis, Policy Analysis, and the Delphi Method. Our findings have allowed us to identify these approaches' main strengths and weaknesses and their adequacy in coping with uncertainty, robustness, and resource requirements.**

Keywords –Generative AI; AI adoption; methods; prediction; methodology.

I. INTRODUCTION

In recent years, generative artificial intelligence (AI) usage has revolutionized technological landscapes and profoundly reshaped the societal structure. This transformative force, marked by its ability to generate novel content, ideas, and solutions autonomously, has sparked unprecedented levels of innovation across various sectors [14, 22, 42, 52, 54]. However, Therefore, our effort aims to solve the complexities inherent in this technological revolution and provide insights to inform strategic decision-making and policy formulation in an era of unprecedented change.

Our investigation examines various methodologies, ranging from traditional econometric models to cutting-edge reinforcement learning techniques tailored for decision-making agents. Agent-Based Simulation (ABS), Input-Output Analysis, Surveys and Interviews, Scenario Analysis, Policy Analysis, and the Delphi Method all feature prominently, each offering unique insights into the intricate dynamics entwined with the proliferation of generative AI. They are synthesizing insights gleaned from these methodologies. Recognizing the nuanced interplay between technological advancement and its societal ramifications, we argue that such an integrative approach is essential for comprehensively understanding the transformative effects of generative AI.

Moreover, by shedding light on the multifaceted consequences of AI innovation, our research aims to facilitate informed decision-making and policy formulation in the face of unprecedented technological change. Through this integrative lens, we aspire to contribute to a deeper comprehension of the societal implications of AI innovation, empowering

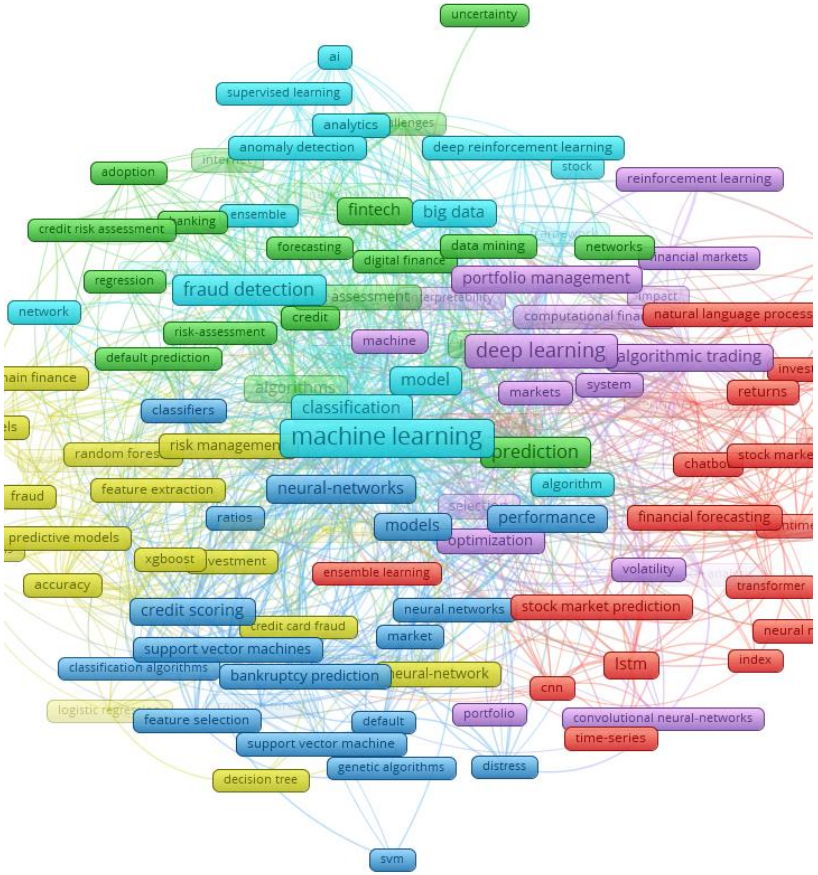
- Costa, C. J., Aparicio, J. T., & Aparicio, M. (2024). Socio-Economic Consequences of Generative AI: A Review of Methodological Approaches. *arXiv preprint arXiv:2411.09313*.

- Type of Users: Architype
  - Not all the users are equal
  - Some reacted
  - Come adopted
  - Some are champion
  - Com are addicted
  - Some will be successful
  - Some will loose

- Costa, C.J. (2026). AI User Archetype Model. In: Rocha, A., García Peñalvo, F., Costa, C.J., Gonçalves, R. (eds) Proceedings of 20th Iberian Conference on Information Systems and Technologies (CISTI 2025). CISTI 2025. Lecture Notes in Networks and Systems, vol 1719. Springer, Cham. https://doi.org/10.1007/978-3-032-10728-2_8

AI and Finance

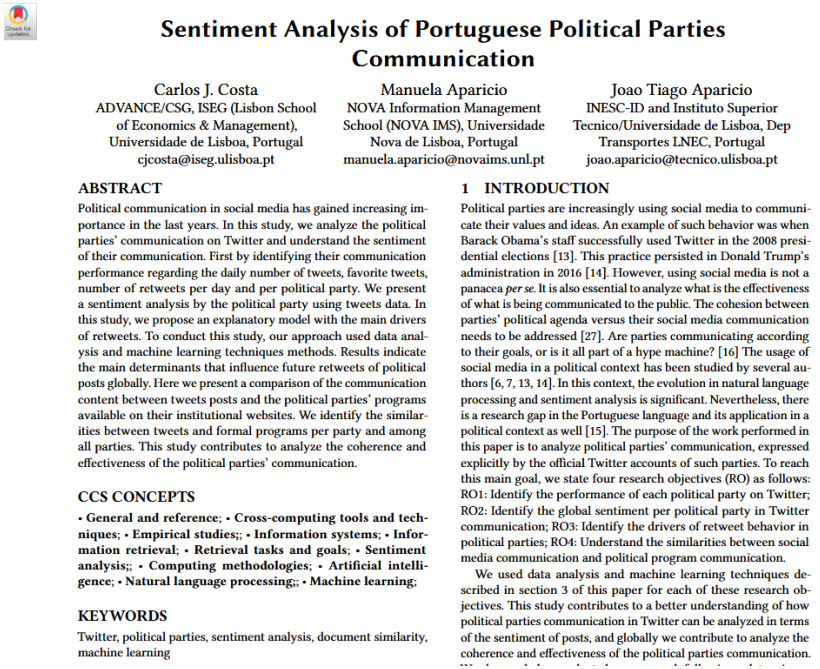
- Widespread use:
  - Fraud Detection and Risk Management:
  - Credit Scoring and Financial Inclusion
  - Investment & Portfolio Management
  - Customer Service
  - Algorithmic Trading
  - Regulatory Compliance & Automation
- challenges:
  - Data Quality and Bias
  - Regulatory Compliance
  - Integration with Legacy Systems
- Ethical and Privacy Concerns



Aparicio, J.T., Costa, C.J. (2026). Artificial Intelligence in Finance: Opportunities, Challenges, and Future Directions. In: Rocha, A., García Peñalvo, F., Costa, C.J., Gonçalves, R. (eds) Proceedings of 20th Iberian Conference on Information Systems and Technologies (CISTI 2025). CISTI 2025. Lecture Notes in Networks and Systems, vol 1719. Springer, Cham. https://doi.org/10.1007/978-3-032-10728-2_10

AI and Communication

- What make messages more effective?
- Small messages
- Negative Sentiment



Sentiment Analysis of Portuguese Political Parties Communication

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ABSTRACT

Political communication in social media has gained increasing importance in the last years. In this study, we analyze the political parties' communication on Twitter and understand the sentiment of their communication. First by identifying their communication performance regarding the daily number of tweets, favorite tweets, number of retweets per day and per political party. We present a sentiment analysis by the political party using tweets data. In this study, we propose an explanatory model with the main drivers of retweets. To conduct this study, our approach used data analysis and machine learning techniques methods. Results indicate the main determinants that influence future retweets of political posts globally. Here we present a comparison of the communication content between tweets posts and the political parties' programs available on their institutional websites. We identify the similarities between tweets and formal programs per party and among all parties. This study contributes to analyze the coherence and effectiveness of the political parties' communication.

CCS CONCEPTS

• **General and reference**; • **Cross-computing tools and techniques**; • **Empirical studies;**; • **Information systems**; • **Information retrieval**; • **Retrieval tasks and goals**; • **Sentiment analysis;**; • **Computing methodologies**; • **Artificial intelligence**; • **Natural language processing;**; • **Machine learning**;

KEYWORDS

Twitter, political parties, sentiment analysis, document similarity, machine learning

1 INTRODUCTION

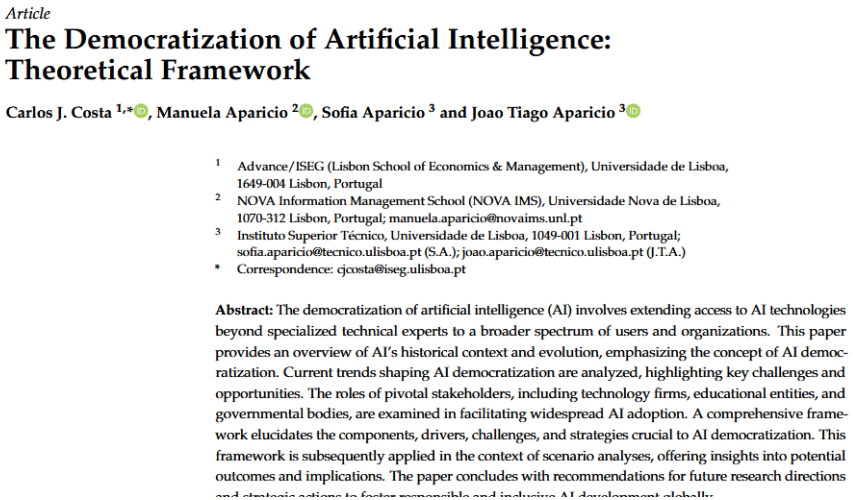
Political parties are increasingly using social media to communicate their values and ideas. An example of such behavior was when Barack Obama's staff successfully used Twitter in the 2008 presidential elections [13]. This practice persisted in Donald Trump's administration in 2016 [14]. However, using social media is not a panacea *per se*. It is also essential to analyze what is the effectiveness of what is being communicated to the public. The cohesion between parties' political agenda versus their social media communication needs to be addressed [27]. Are parties communicating according to their goals, or is it all part of a hype machine? [16] The usage of social media in a political context has been studied by several authors [6, 7, 13, 14]. In this context, the evolution in natural language processing and sentiment analysis is significant. Nevertheless, there is a research gap in the Portuguese language and its application in a political context as well [15]. The purpose of the work performed in this paper is to analyze political parties' communication, expressed explicitly by the official Twitter accounts of such parties. To reach this main goal, we state four research objectives (RO) as follows: RO1: Identify the performance of each political party on Twitter; RO2: Identify the global sentiment per political party in Twitter communication; RO3: Identify the drivers of retweet behavior in political parties; RO4: Understand the similarities between social media communication and political program communication.

We used data analysis and machine learning techniques described in section 3 of this paper for each of these research objectives. This study contributes to a better understanding of how political parties communication in Twitter can be analyzed in terms of the sentiment of posts, and globally we contribute to analyze the coherence and effectiveness of the political parties communication.

- Aparicio, J. T., de Sequeira, J. S., & Costa, C. J. (2021, June). Emotion analysis of Portuguese political parties communication over the COVID-19 pandemic. In *2021 16th Iberian Conference on Information Systems and Technologies (CISTI)* (pp. 1-6). IEEE
- Costa, C., Aparicio, M., & Aparicio, J. (2021, October). Sentiment analysis of Portuguese political parties communication. In *Proceedings of the 39th ACM international conference on design of communication* (pp. 63-69), ACM

AI Democratization

- Access to all
- Distributed models
- Centralized models
- Personal models



Article

The Democratization of Artificial Intelligence: Theoretical Framework

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Abstract: The democratization of artificial intelligence (AI) involves extending access to AI technologies beyond specialized technical experts to a broader spectrum of users and organizations. This paper provides an overview of AI's historical context and evolution, emphasizing the concept of AI democratization. Current trends shaping AI democratization are analyzed, highlighting key challenges and opportunities. The roles of pivotal stakeholders, including technology firms, educational entities, and governmental bodies, are examined in facilitating widespread AI adoption. A comprehensive framework elucidates the components, drivers, challenges, and strategies crucial to AI democratization. This framework is subsequently applied in the context of scenario analyses, offering insights into potential outcomes and implications. The paper concludes with recommendations for future research directions

- Costa, C. J., Aparicio, M., Aparicio, S., & Aparicio, J. T. (2024). The Democratization of Artificial Intelligence: Theoretical Framework. *Applied Sciences*, *14*(18), 8236. https://doi.org/10.3390/app14188236

Bibliography

Aparicio, J.T., Costa, C.J. (2026). Artificial Intelligence in Finance: Opportunities, Challenges, and Future Directions. In: Rocha, A., García Peñalvo, F., Costa, C.J., Gonçalves, R. (eds) Proceedings of 20th Iberian Conference on Information Systems and Technologies (CISTI 2025). CISTI 2025. Lecture Notes in Networks and Systems, vol 1719. Springer, Cham. https://doi.org/10.1007/978-3-032-10728-2_10

Aparicio, S., Aparicio, J. T., & Costa, C. J. (2019,). Data Science and AI: trends analysis. In 2019 14th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Aparicio, J. T., de Sequeira, J. S., & Costa, C. J. (2021). Emotion analysis of portuguese political parties communication over the covid-19 pandemic. In 2021 16th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Aparicio, J. T., Romao, M., & Costa, C. J. (2022). Predicting Bitcoin prices: The effect of interest rate, search on the internet, and energy prices. In 2022 17th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-5). IEEE.

Arriaga, A., & Costa, C. J. (2023, May). Modeling and Predicting Daily COVID-19 (SARS-CoV-2) Mortality in Portugal: The Impact of the Daily Cases, Vaccination, and Daily Temperatures. In Proceedings of International Conference on Information Technology and Applications: ICITA 2022 (pp. 275-285). Singapore: Springer Nature Singapore.

Costa, C.J. (2026). AI User Archetype Model. In: Rocha, A., García Peñalvo, F., Costa, C.J., Gonçalves, R. (eds) Proceedings of 20th Iberian Conference on Information Systems and Technologies (CISTI 2025). CISTI 2025. Lecture Notes in Networks and Systems, vol 1719. Springer, Cham. https://doi.org/10.1007/978-3-032-10728-2_8

Costa, C. J., & Aparicio, J. T. (2020). POST-DS: A methodology to boost data science. In 2020 15th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Costa, C. J., & Aparicio, M. (2023). Applications of Data Science and Artificial Intelligence. Appl. Sci, 13, 9015.

Costa, C., Aparicio, M., & Aparicio, J. (2021). Sentiment analysis of portuguese political parties communication. In Proceedings of the 39th ACM International Conference on Design of Communication (pp. 63-69).

Costa, C. J., Aparicio, J. T., & Aparicio, M. (2024). Socio-Economic Consequences of Generative AI: A Review of Methodological Approaches. *arXiv preprint arXiv:2411.09313*

Costa, C. J., Aparicio, M., Aparicio, S., & Aparicio, J. T. (2024). The Democratization of Artificial Intelligence: Theoretical Framework. *Applied Sciences*, *14*(18), 8236. https://doi.org/10.3390/app14188236

Custódio, J. P. G., Costa, C. J., & Carvalho, J. P. (2020). Success prediction of leads–A machine learning approach. In 2020 15th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Hajishirzi, R., & Costa, C. J. (2021). Artificial Intelligence as the core technology for the Digital Transformation process. In 2021 16th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Ortiz, F. C. M., & Costa, C. J. (2020, June). RPA in Finance: supporting portfolio management: Applying a software robot in a portfolio optimization problem. In 2020 15th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Piteira, M., Aparicio, M., & Costa, C. J. (2019, June). Ethics of artificial intelligence: Challenges. In 2019 14th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Samadani, S., & Costa, C. J. (2021). Forecasting real estate prices in Portugal: A data science approach. In 2021 16th Iberian Conference on Information Systems and Technologies (CISTI) (pp. 1-6). IEEE.

Vaswani, A.; Shazeer, N.; Parmar, N. Uszkoreit, J.; Jones, L.; Gomez, A; Kaiser, Ł; Polosukhin, I (2017). "Attention is All you Need" Advances in Neural Information Processing Systems. Curran Associates, Inc. 30.

Veiga, M., & Costa, C. J. (2024). Ethics and Artificial Intelligence Adoption. *arXiv preprint arXiv:2412.00330*.