Artificial Intelligence: Challenges and Opportunities

Marcelo Finger

Full Prefessor, Computer Science, IME-USP

Principal Investigator, USP-IBM-Fapesp C4AI -- Center for Artificial Intelligence

September 2023

Context

IME-USP

Artificial Intelligence is having a strong impact on society

Impacted Areas

Science and Business

The Culprits

- ChatGPT – OpenAI / Facebook
- Bard – Google
- LLaMA – Meta/Facebook

- Transformers

IME-USP

GPT 3.5
Chat GPT
GPT4

IME-USP

The latest hype is impressive

GPT-4 has 170 trillion parameters

Cost of hardware for trainig is U$ 350 millions

Microsoft has already investedi U$ 3 billions, promised U$10 bi

Performance seems impressive!

However ...

IME-USP

Several questions are being raised

- Unknown/unpredictable behavior
- Need for “Prompt Engineering”
- Ethical issues, regulatory inexperience
- Generation of Deepfakes and Fakenews

Where have all those problems come from?

Very Brief History of Neural Nets

The birth of AI

- Dartmouth Workshop **1956** (AI has a birthdate!)
- Excitement and wonder with the first computer programs

The Initial Hype

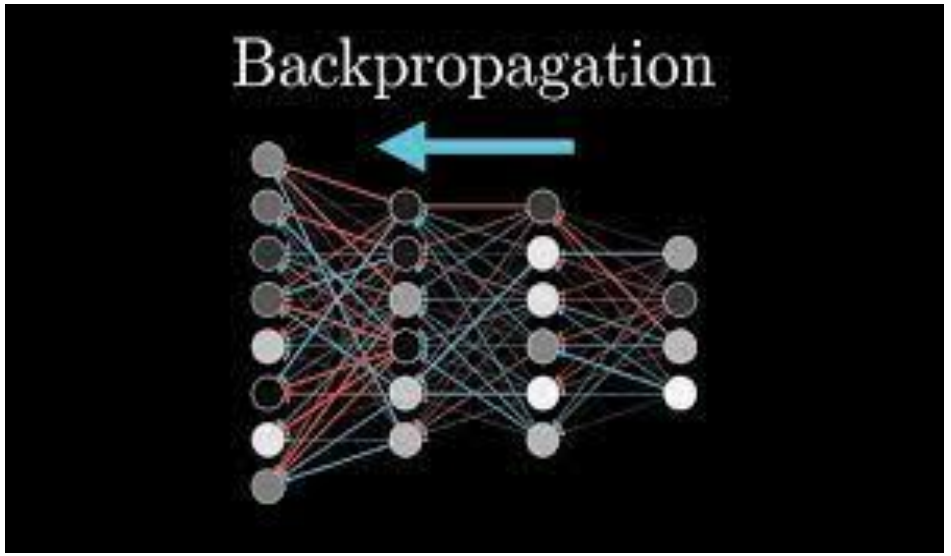
- 1957: Perceptron by Frank Rosenblatt
- Coverage in the New York Times and The New Yorker

The First Winter

- AI is plagued by a cycle Hype-Winter-Hype
- Hype = Interest + $$$
- Winter = little $$$
- Symbolic AI, Probabilistic AI, Classificatory AI, Generative AI

The rebirth of Neural Nets...

In **1986**, Hinton popularizes the **backpropagation algorithm**: training multilayer neural networks



IME-USP

Backpropagation requires much more memory and processing power than what was available in the 80s and 90s

… that then die again

New Winter

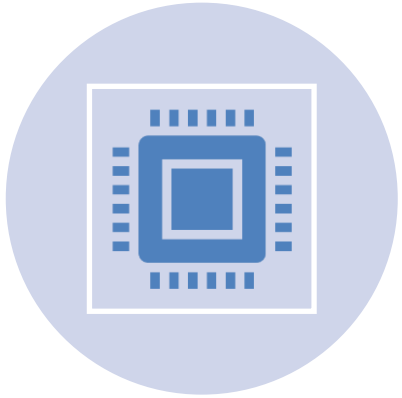
Japanese 5th Generation project fails: official termination of the project in 1995, after spending more than ¥50 billion

Again, expectations about Artificial Intelligence lead to disappointment

And times goes by

MICROCOMPUTERS SPREAD

AS WELL AS COMPUTER GAMES

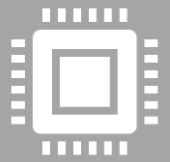


AND THE DEMAND FOR VIDEO CARDS (GPUS)

IME-USP

The Birth of Deep Learning

Hardware technology evolution

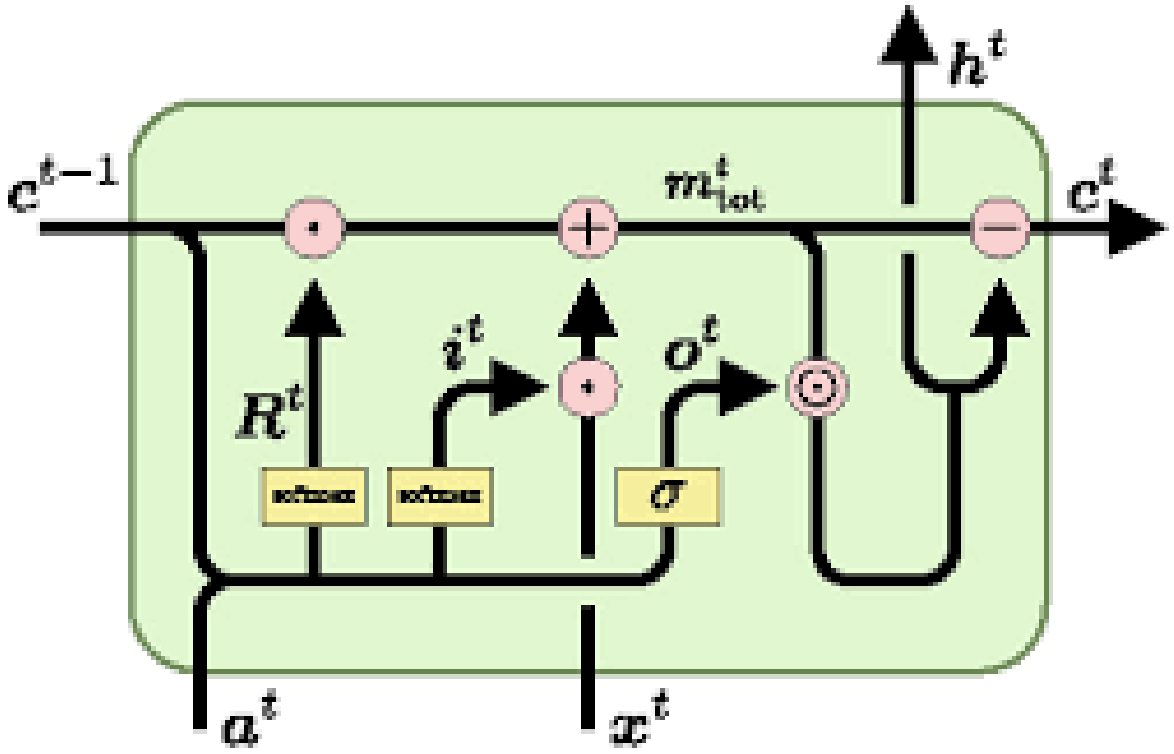


GPUs begin to provide the computational capacity for training neural networks

The Internet now makes data available for training: the birth of Big Data

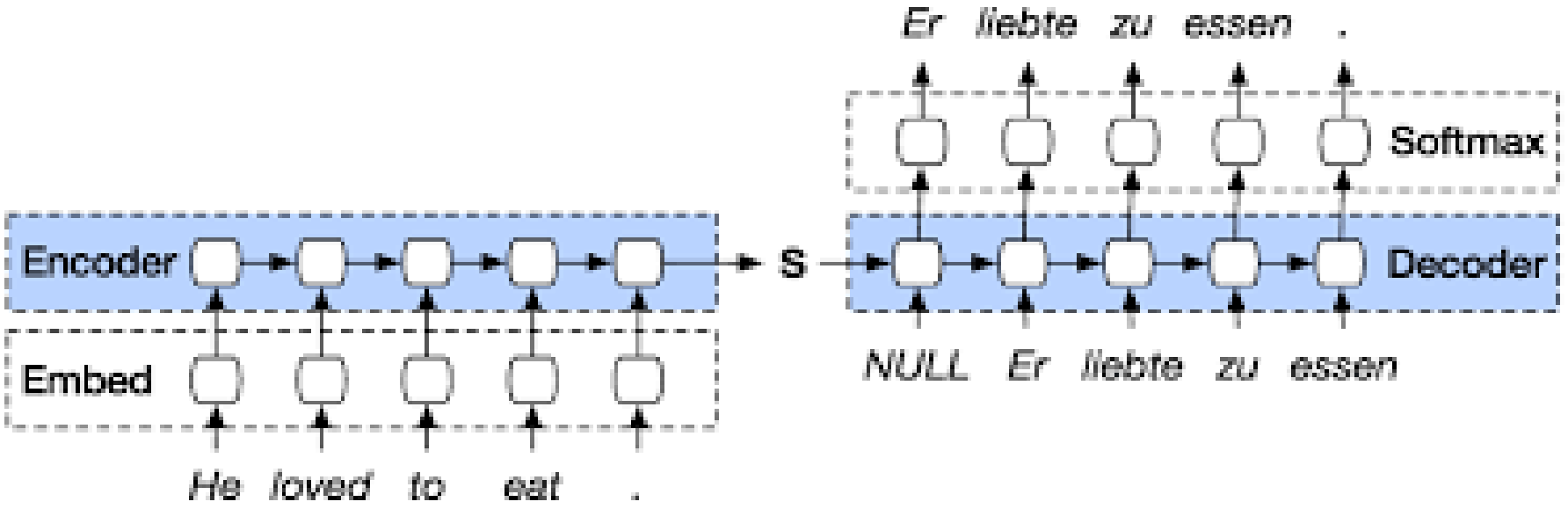
New Neural Architectures

- Recurrent neural networks
- LSTM (Word Processing)
- Convolutional networks (images and video)



IME-USP

Advances in Translation



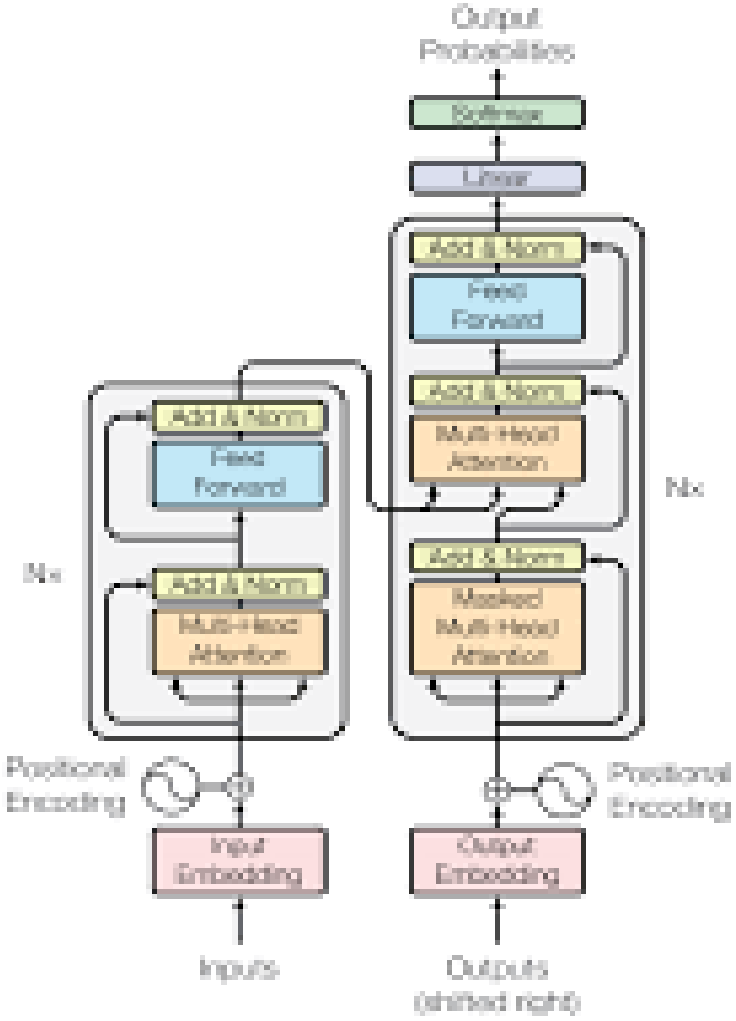
- Seq2seq Model (2014)

Other advances

- Seq2seq with **neural atention** (input/output correlation)
- Free Software for Neural Nets: TensorFlow/Google (2015), PyTorch/Facebook (2016)
- Explosion in neural models

Transformers

- 2017 (pre-history: < 2017)
- Attention, Encoder, Decoder without recurrence
- Machine learning ABOVE expectations



IME-USP

Several questions are being raised

- Unknown/unpredictable behavior
- Need for “Prompt Engineering”
- Ethical issues, regulatory inexperience
- Generation of Deepfakes and Fakenews

Only the BigTechs (OpenAI, Microsoft, Google, Meta, Amazon, Anthropic, Inflection) **are capable of AI development?**

Local Development of Artificial intelligence

How to tackle problems with AI?

What it does

How it does it

What I wish it would do

- Make sense of data
- Predict events
- Classify situations
- Dynamic adjustment
- Detect exceptional states
- Automate processes

Etc..

Is it risk or oportunity?

- Is ethics being considered?

- Is there an applicable regulation?

IME-USP

What is AI for

Data Classification

Ex. Diagnostic assistant, outlier detection

Estimation

Ex. Demand prediction (Uber)

Event forecasting

Ex: film recommendation, asthma attack

IME-USP

Generative AI (GPT and its competitors)

Improper uses

- Chatbots não são oráculos!
- ChatGPT, Bard are not oracles!
- They generate false information and hallucinate
- Their performance should be rigorously verified
- Interactions that start in the wrong way are hard to correct
- So **unreliable for decision making**

Proper Uses

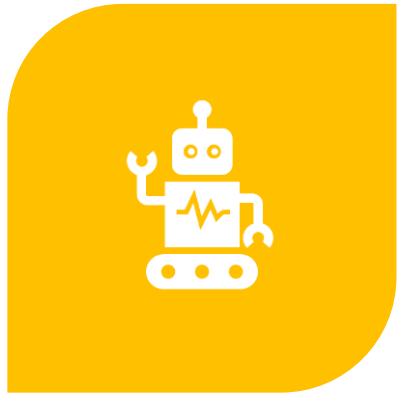
- text, email, letter, memo, etc, generation.
- Infomation extraction
- Sumarization
- Regulation, etc.

IME-USP

Pre-Requisites For AI Development

ETHICAL PROFESSIONALS

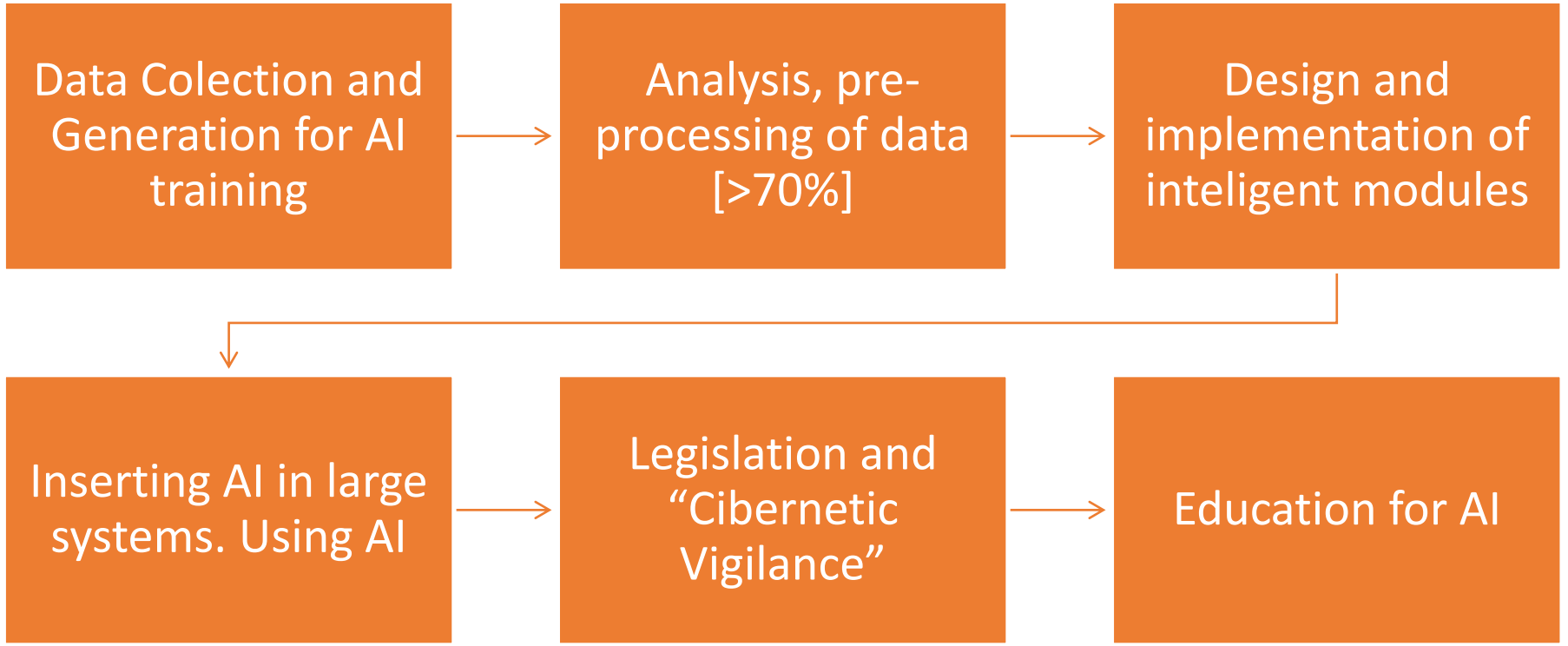
DATA



ALGORITHMS

IME-USP

AI and Future Jobs



What we do will be the future

IME-USP

Sitting on a treasure

Not only the BigTechs may develop AI

AI is not exclusive for english speakers!

IME-USP

Data is an Investment

- Data require colection, cleanig, storage
- Processing and Training
- Culture creation in which “data is part of the routine”
- All this requires $$$

Only those who see value in its use will enter the world of AI

IME-USP

Methodology for Artificial Intelligence in Practice

IME-USP

How to develop AI with one's own data???

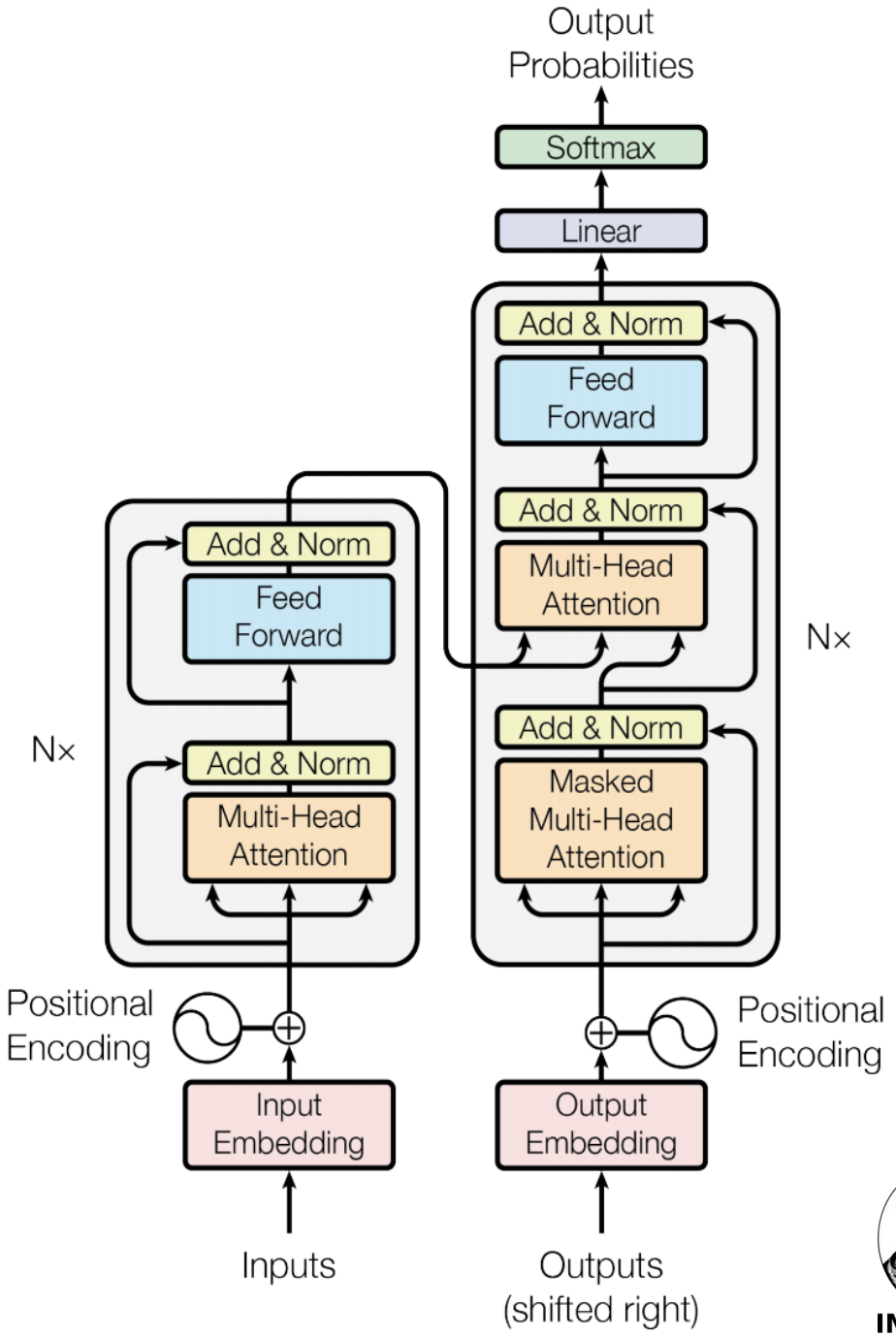
IME-USP

Algorithms for Serious AI

Transformers [2017], GPT – only the second part

The power lies on the **data**

*How to take advantadge of all that **power?***



IME-USP

AI Employment Methodology

What for do I need data?

How top colect?

There are no “generic data”

Each domain has its own perks

How to get return on investment?

IME-USP

AI Employment Methodology

What for do I need data?

How top colect?

There are no “generic data”

Each domain has its own perks

How to get return on investment?

Where do HUMANS fit in?

IME-USP

A Few Ongoing Projects

IME-USP

AI based projects in progress

Spira – AI for respiratory insuifficiency detection bia audio analysis

Cement – AI for Property Predictions; AI for demand forecasting

Carolina – language resources for Portuguese. AI for natural language processing and Large Language Models

Brazilian Indigenous languages – AI for studying, translating and preserving indigenous languages

Literacy – AI for fluency analysis in children's reading

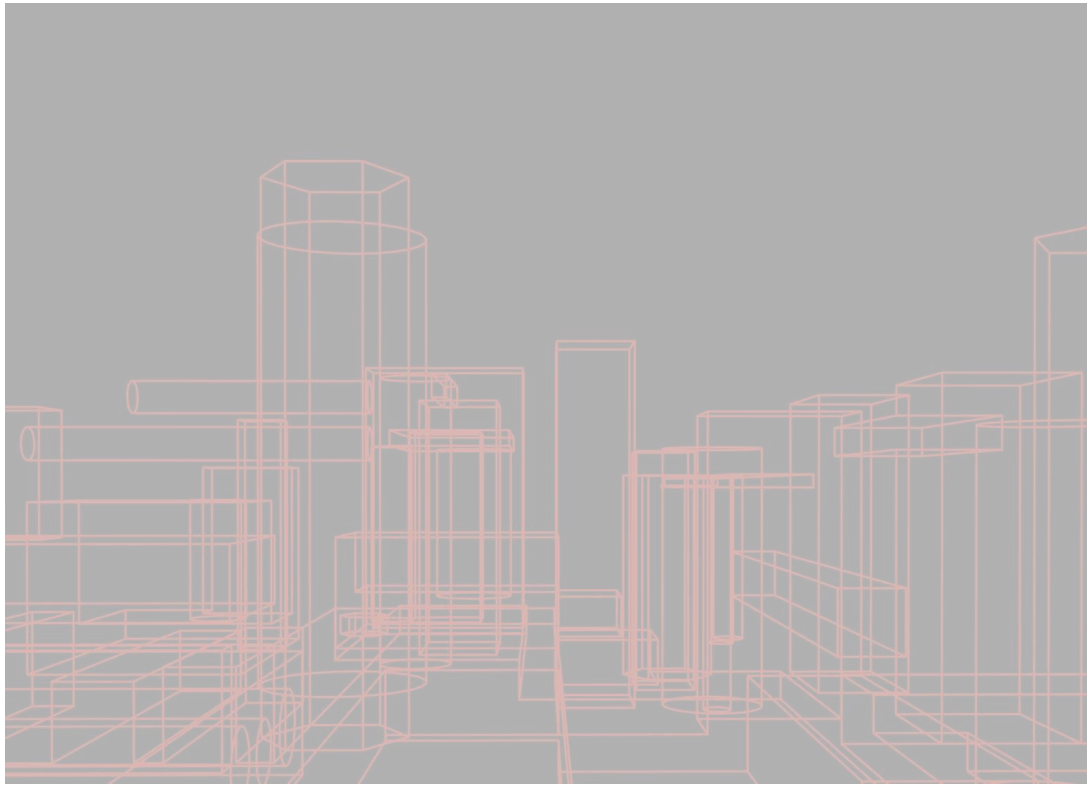
IME-USP

Conclusions

LLMs – are just another possibility for the applications of Artificial Intelligence

We cannot fail to mention the discussions around **ETHICS and the effects on society**

The path to/with AI is just beginning



obrigado

Contact:
mfinger@ime. usp.br