# Large Language Models

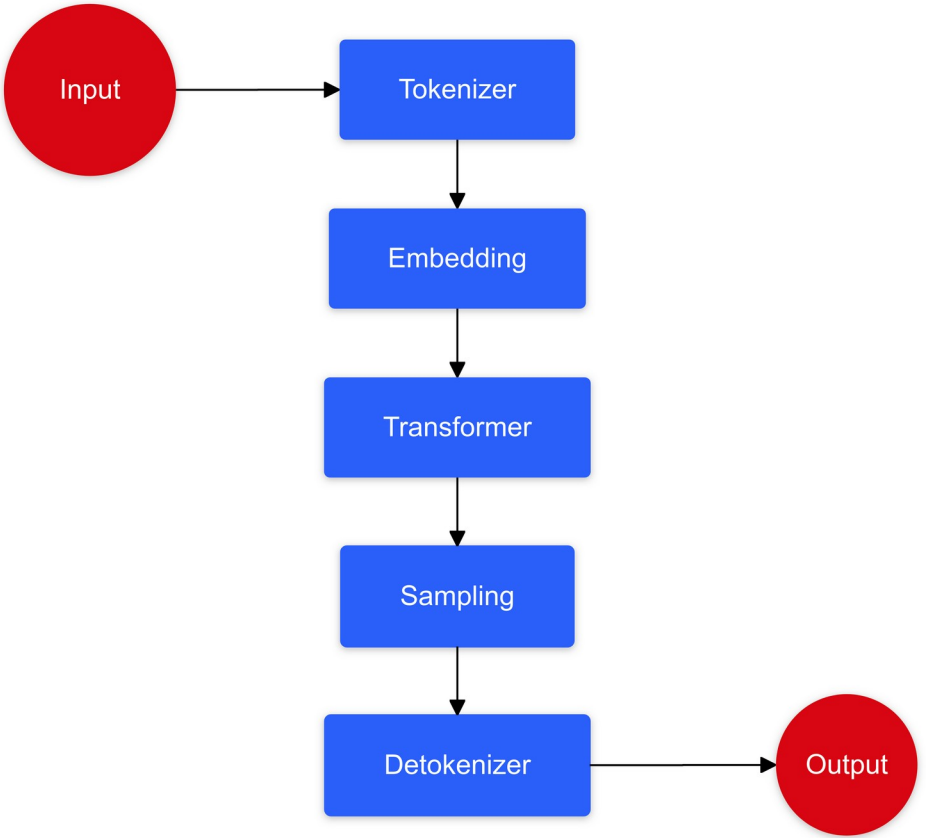
Fundamentos e aplicações

# Github

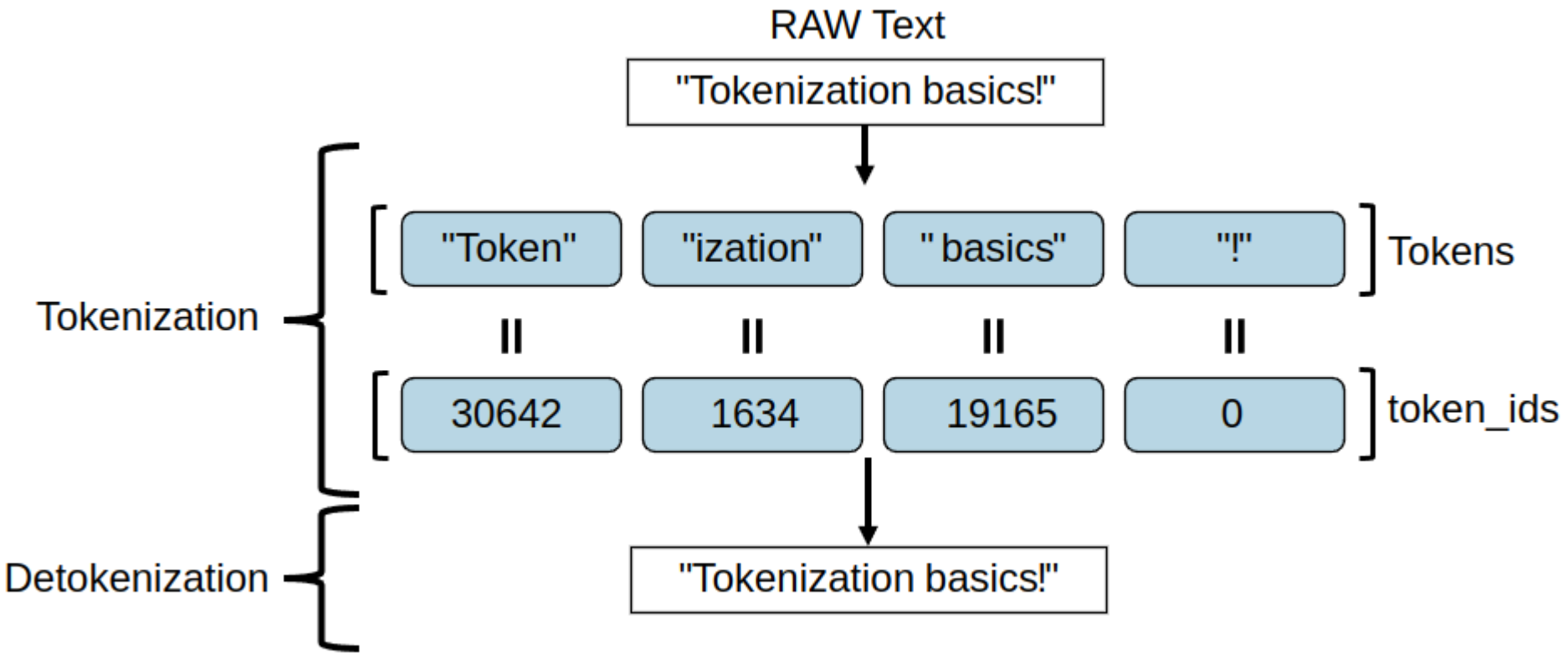
https://github.com/mucciaccia/eri-es-llm

Os códigos em Python utilizados durante a oficina estão disponíveis no link do Github acima.

# Partes de uma LLM



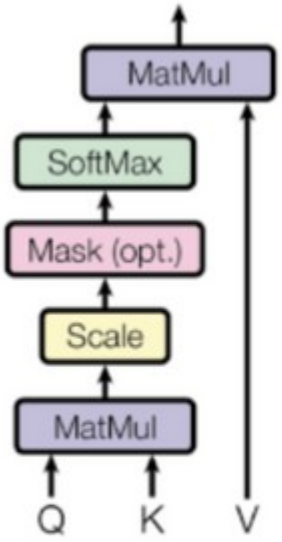
# Tokenizer


RAW Text
"Tokenization basics!"
Tokenization
"Token"
"ization"
" basics"
"!"
Tokens
30642
1634
19165
0
token_ids
Detokenization
"Tokenization basics!"

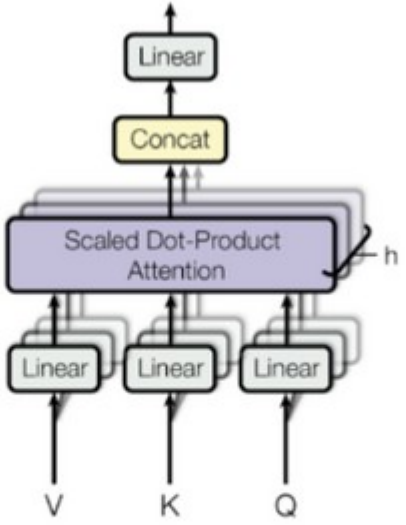
# Embedding

| Token String | Token ID | Embedded Token Vector |
|---|---|---|
| '<s>' | 0 | [ 0.1150, -0.1438, 0.0555, ... ] |
| '<pad>' | 1 | [ 0.1149, -0.1438, 0.0547, ... ] |
| '</s>' | 2 | [ 0.0010, -0.0922, 0.1025, ... ] |
| '<unk>' | 3 | [ 0.1149, -0.1439, 0.0548, ... ] |
| '.' | 4 | [-0.0651, -0.0622, -0.0002, ... ] |
| ' the' | 5 | [-0.0340, 0.0068, -0.0844, ... ] |
| ',' | 6 | [ 0.0483, -0.0214, -0.0927, ... ] |
| ' to' | 7 | [-0.0439, 0.0201, 0.0189, ... ] |
| ' and' | 8 | [ 0.0523, -0.0208, -0.0254, ... ] |
| ' of' | 9 | [-0.0732, 0.0070, -0.0286, ... ] |
| ' a' | 10 | [-0.0194, 0.0302, -0.0838, ... ] |
| | | ... |

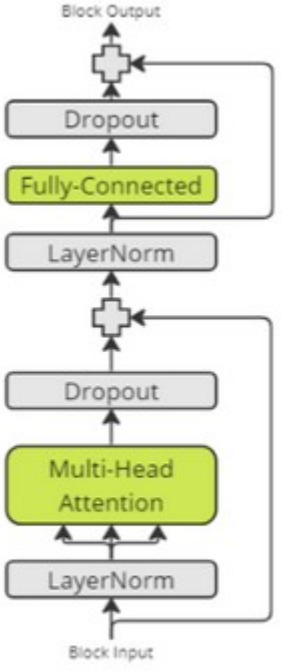
# Transformer




Scale Causal Attention




Multi-Head Attention




Transformer Block

# Sampling


S = The boy went to the ___
1.0
0.8
0.6
0.4
0.2
0.0
P(W|S)
park
store
grocery
beach
restaurant
...
....
Next token [W]

# Tipos das saídas

- Input: String
- Tokenizer: Vetor de inteiros (Nx1)
- Embedding: Matriz de pontos flutuantes (NxM)
- Transformer: Vetor de probabilidades (Tx1)
- Sampling: Inteiro (1x1)
- Detokenizer: String

# NLP Tasks

- Sentiment Analysis
- Sumarization
- Question answering
- Translation
- Grammar check
- Text completion

# Curiosidade

- Prêmios Nobel de 2024 de física e química foram dados a pesquisadores de inteligência artificial

# THE NOBEL PRIZE IN PHYSICS 2024

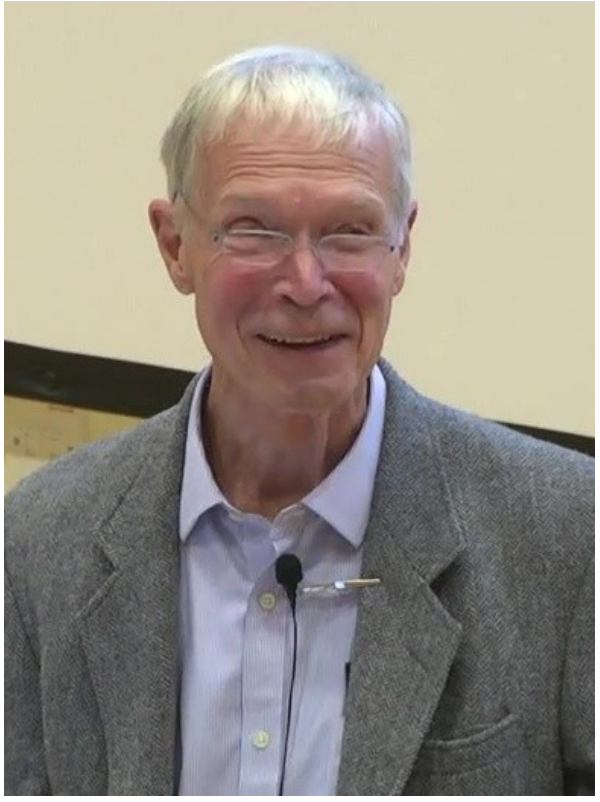
Illustrations: Niklas Elmehed

## John J. Hopfield  Geoffrey E. Hinton

"for foundational discoveries and inventions
that enable machine learning
with artificial neural networks"

THE ROYAL SWEDISH ACADEMY OF SCIENCES

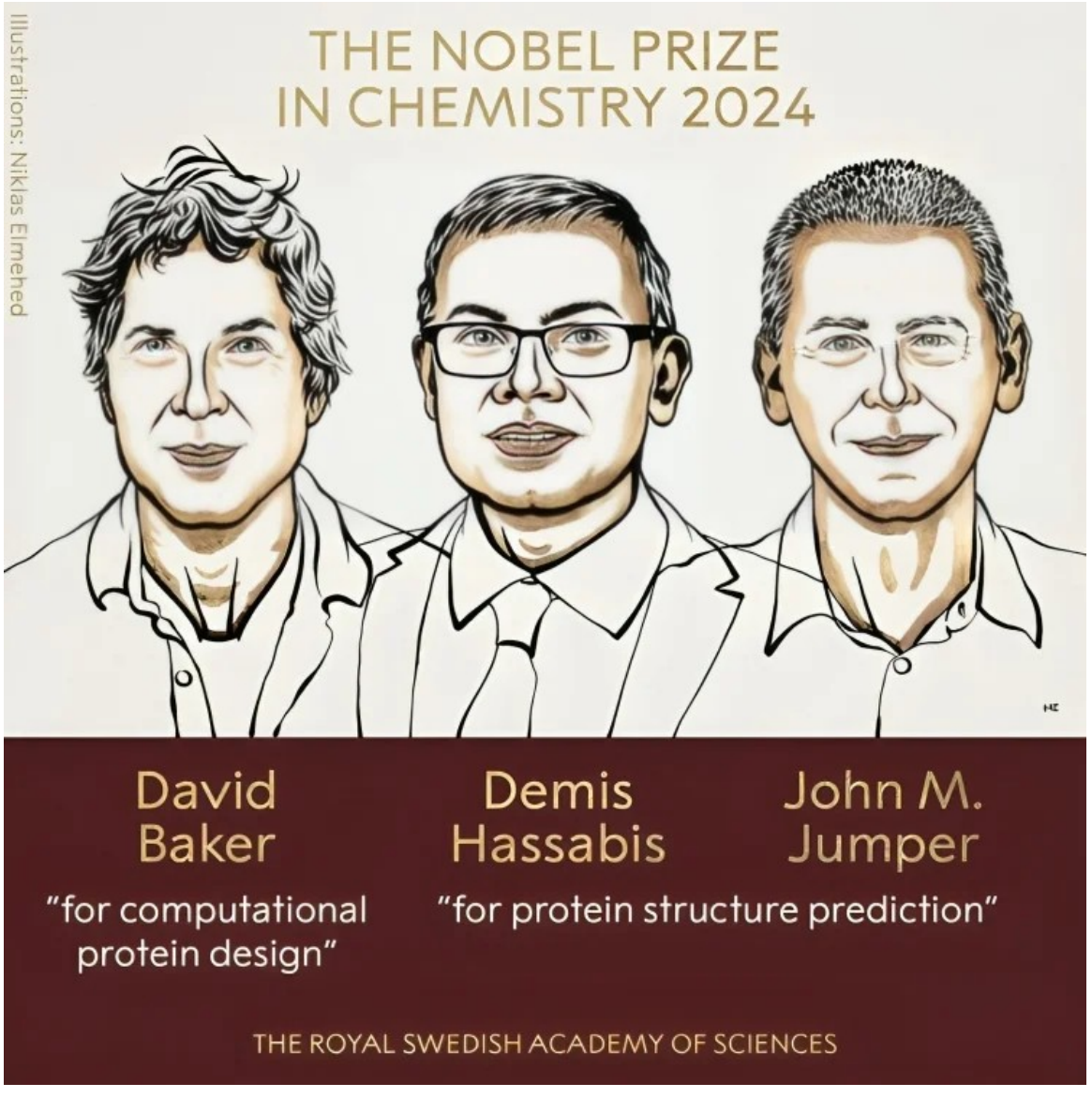
# John Hopfield



- Ph.D. em Física
- Hopfield Network (1982)
- Energy Minimization Approach

# Geoffrey Hinton

- Ph.D. em Inteligência Artificial
- Backpropagation (1986)
- Deep Learning
- Dropout (2012)


THE NOBEL PRIZE
IN CHEMISTRY 2024
Illustrations: Niklas Elmehed
David Baker
"for computational protein design"
Demis Hassabis
John M. Jumper
"for protein structure prediction"
THE ROYAL SWEDISH ACADEMY OF SCIENCES

# David Baker

- Ph.D. em Bioquímica
- Diretor do Institute for Protein Design
- Rosetta Software (1990)

# Demis Hassabis

- PhD em neurociência cognitiva
- DeepMind (2010)
- AlphaGo (2016)
- AlphaZero (2017)
- AlphaFold (2020)

# John Jumper

- Ph.D. em Física e Biologia Computacional
- AlphaFold 1 (2018)
- AlphaFold 2 (2020)

# Fim