



Human-Centered Data & AI



Vinicius Caridá, Ph.D.

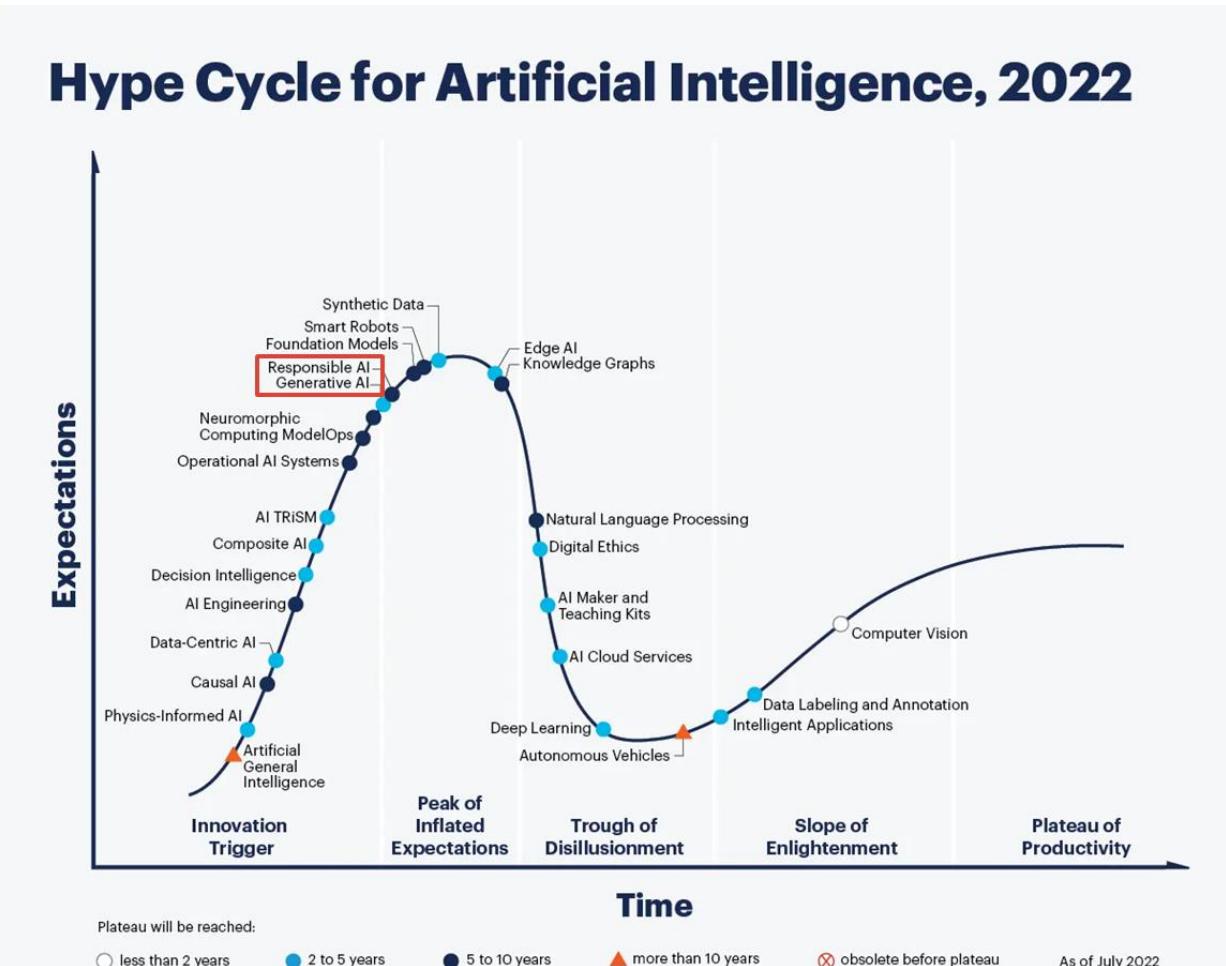
- Head of Digital Customer Service Platforms, PCP, WFM, Data and AI
- MBA Professor - FIAP



“

AI Generativa

AI Generativa



gartner.com

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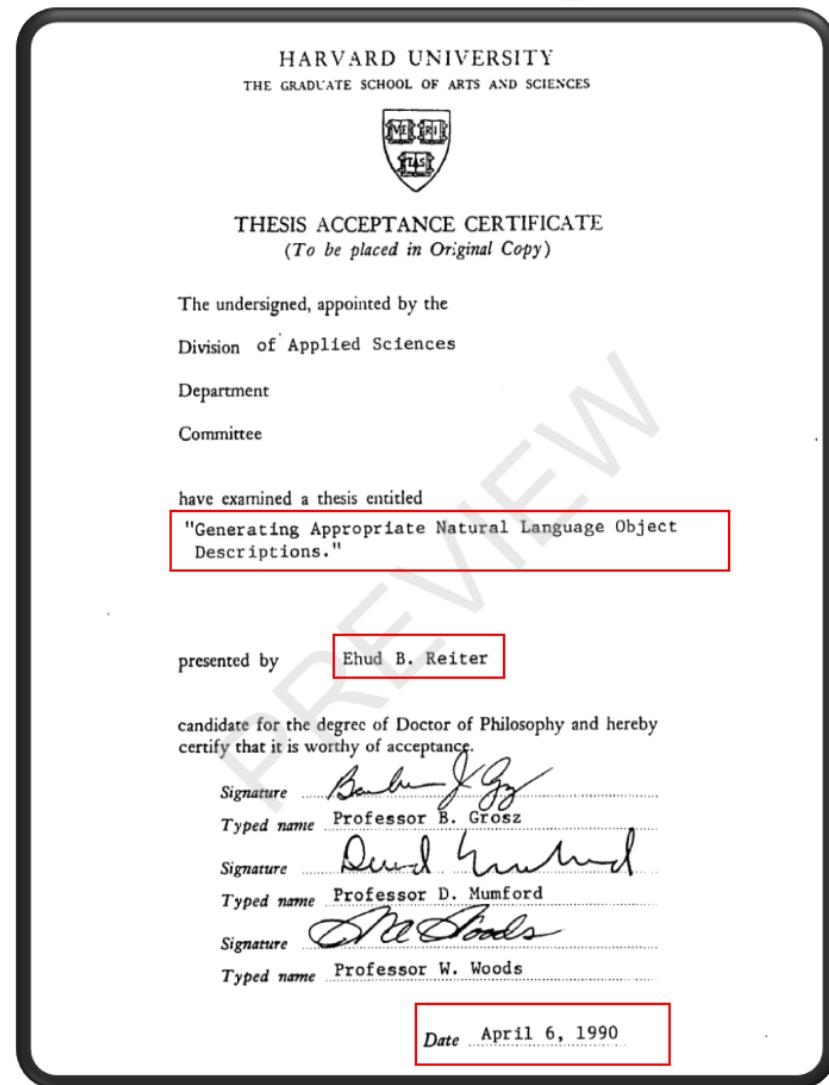
AI Generativa

Artificial Intelligence

Machine Learning

Deep Learning

Generative AI



[https://www.proquest.com/openview/a17fb9188f537c2ab3df4091453547ba/1?pq-](https://www.proquest.com/openview/a17fb9188f537c2ab3df4091453547ba/1?pq-origsite=gscholar&cbl=18750&diss=y)

Como representar contexto/significado das palavras

Você sabe qual o significado da palavra **tezgüino**?



Como representar contexto/significado das palavras

Observe a palavra **tezgüino** em diferentes contextos:



Como representar contexto/significado das palavras

Observe a palavra **tezgüino** em diferentes contextos:

- Uma garrafa de **tezgüino** está sobre a mesa.



Como representar contexto/significado das palavras

Observe a palavra **tezgüino** em diferentes contextos:

- Uma garrafa de **tezgüino** está sobre a mesa.
- Todo mundo gosta de beber **tezgüino**.



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- **Tezgüino** é feito de milho.



Como representar contexto/significado das palavras

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Consegue entender o que é **tezgüino**?



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- **Tezgüino** é feito de milho.

Com o contexto, conseguimos identificar do que se refere a palavra **tezgüino**.

Tezgüino:= é uma bebida alcoólica feita a base de milho.



Como representar contexto/significado das palavras

Como o cérebro faz isso?



Como representar contexto/significado das palavras

Quais outras palavras se “*encaixam*” nos slots das perguntas 1 até 4?

1. Uma garrafa de _____ está sobre a mesa.



Como representar contexto/significado das palavras

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Como representar contexto/significado das palavras

Inserindo contexto de forma manual...

1. Uma garrafa de _____ está sobre a mesa.
2. Todo mundo gosta de beber _____.
3. Você pode ficar bêbado com _____.
4. _____ é feito de milho.

	(1)	(2)	(3)	(4)	← contextos
tezgüino	1	1	1	1	
som	0	0	0	0	
suco de laranja	1	1	0	0	
vinho	1	1	1	0	



Como representar contexto/significado das palavras

Inserindo contexto de forma manual...

1. Uma garrafa de _____ está sobre a mesa.
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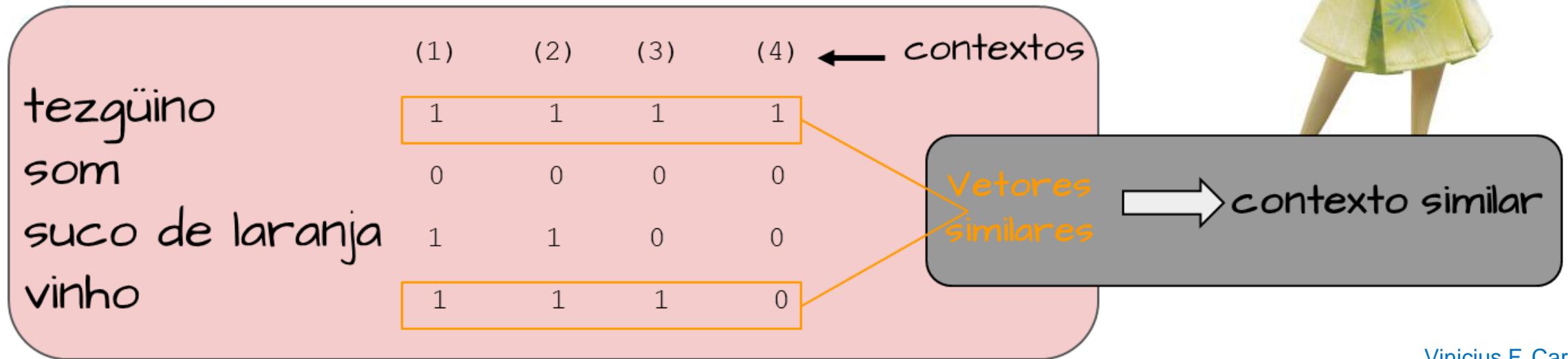
Vetores similares



Como representar contexto/significado das palavras

Inserindo contexto de forma manual...

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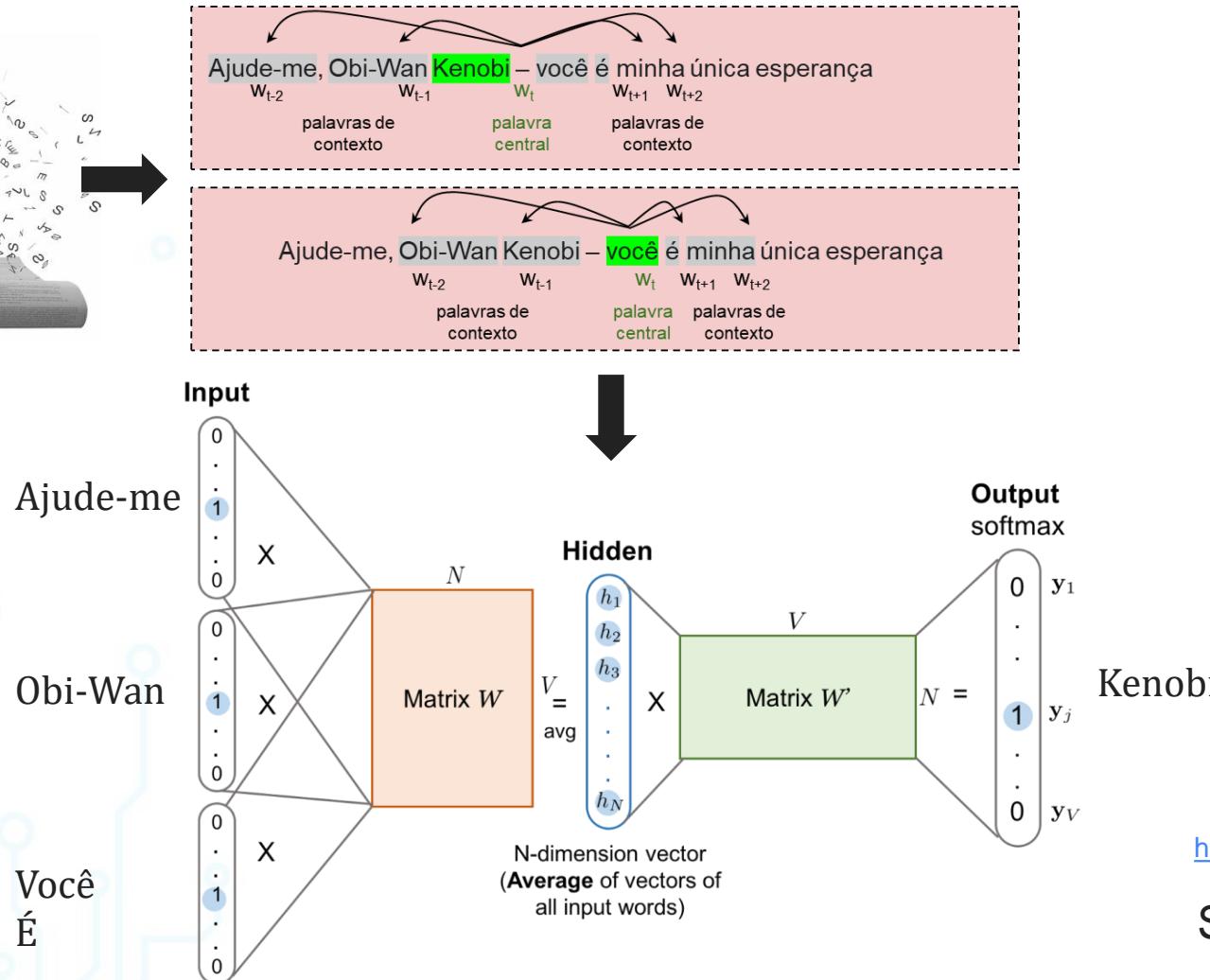
Processamento de Linguagem Natural

Natural Language Processing (NLP)



Processamento de Linguagem Natural

Natural Language Processing (NLP)

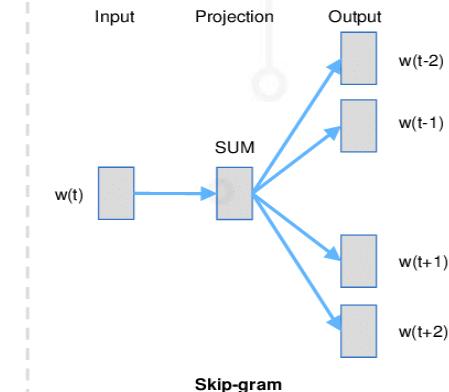
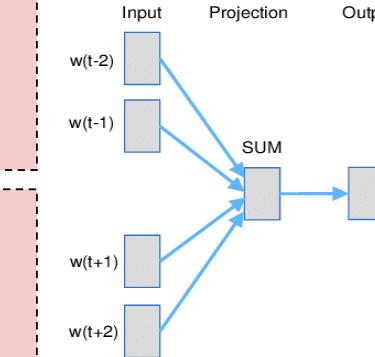
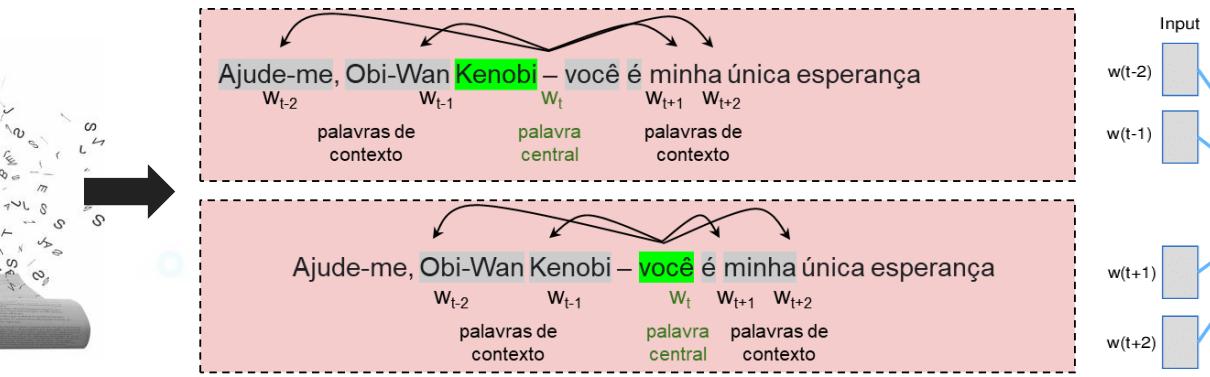


MultiLayer Perceptron MLP
<https://dl.acm.org/doi/10.5555/1639537.1639542>

Self Supervised Learning (SSL)
<https://arxiv.org/abs/2110.09327>

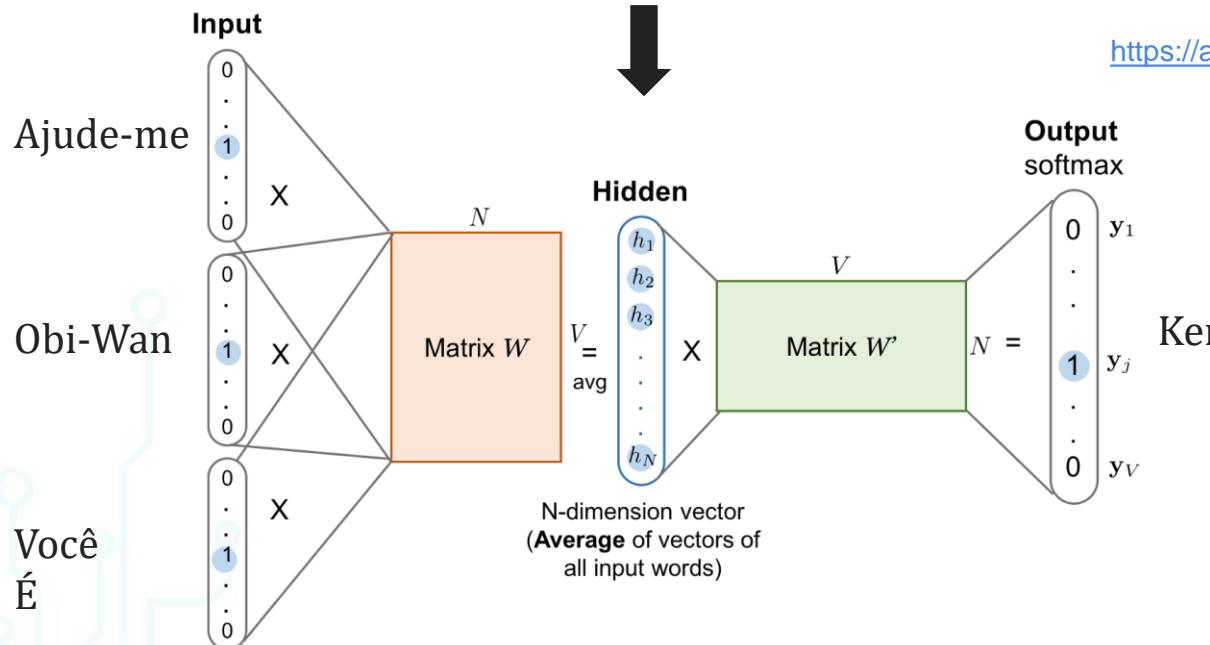
Processamento de Linguagem Natural

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<https://arxiv.org/abs/1301.3781>

<https://arxiv.org/pdf/1310.4546.pdf>



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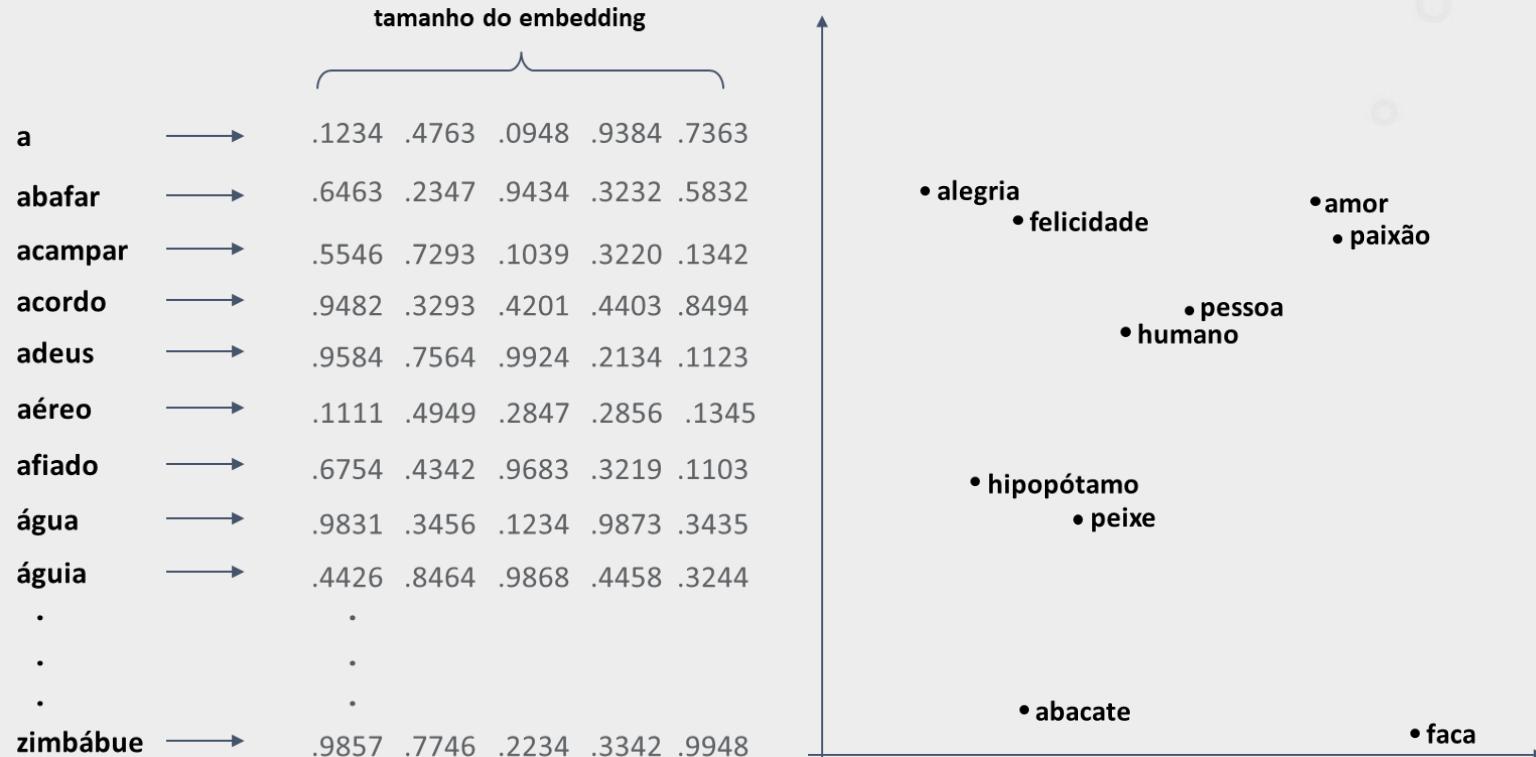
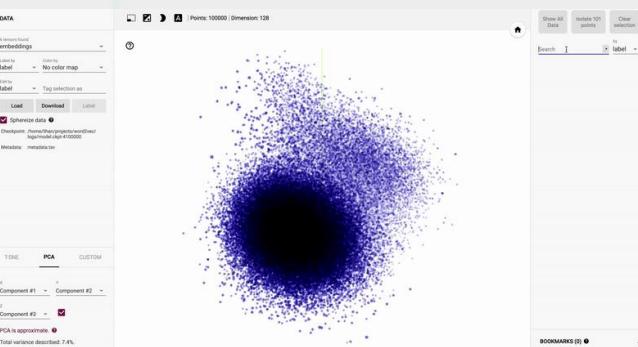
Processamento de Linguagem Natural

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Word Embedding

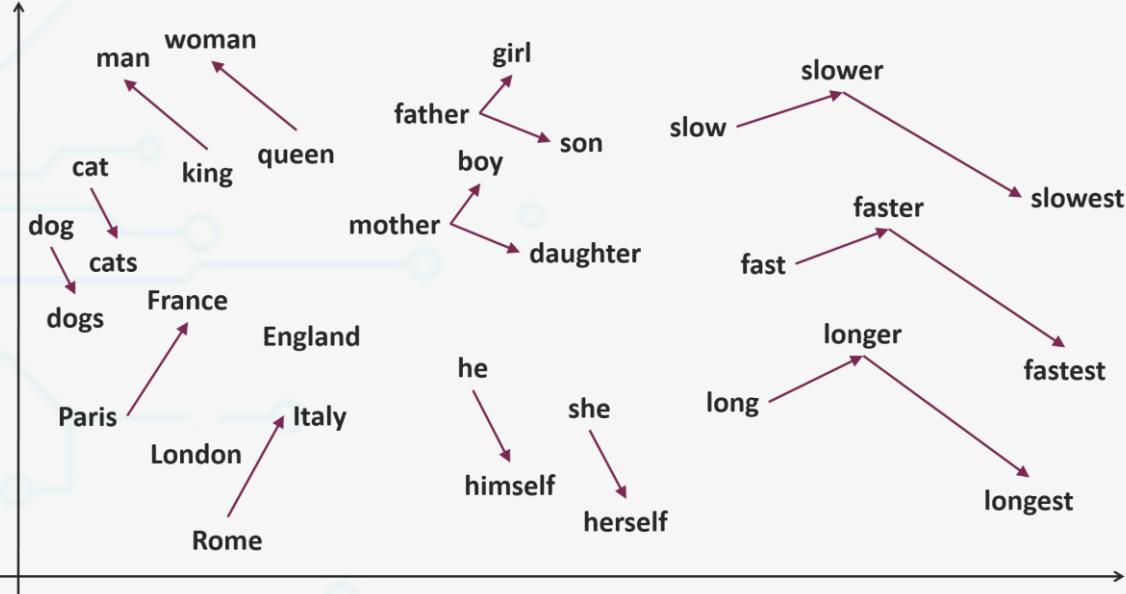
Representação densa

Palavras com significado similar
próximas (semântica)



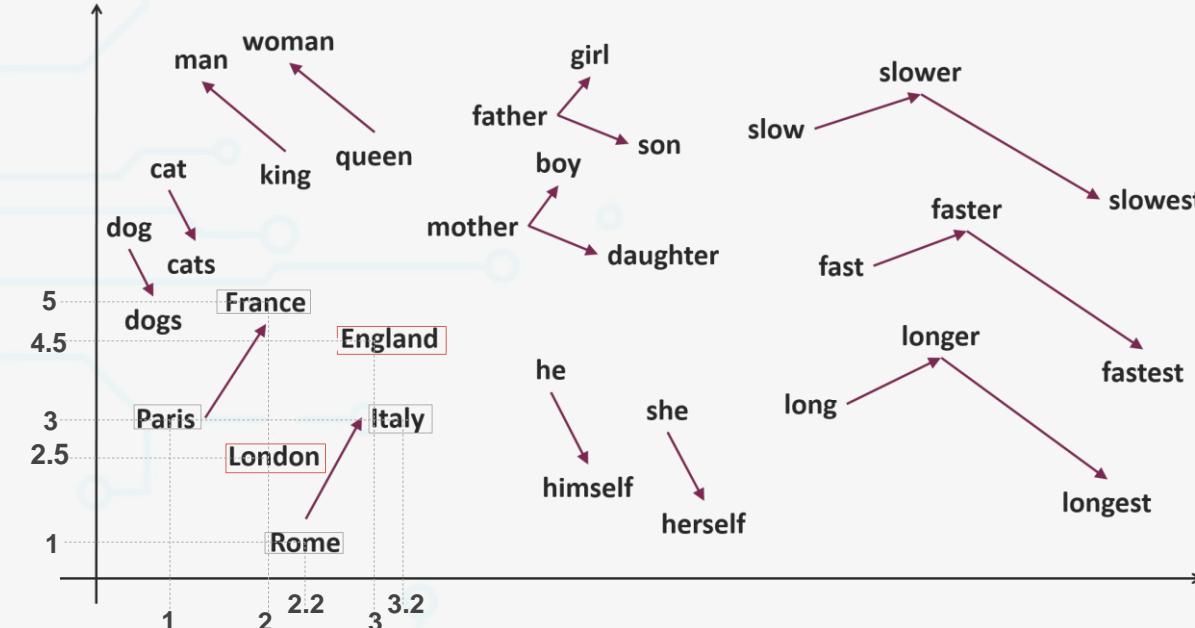
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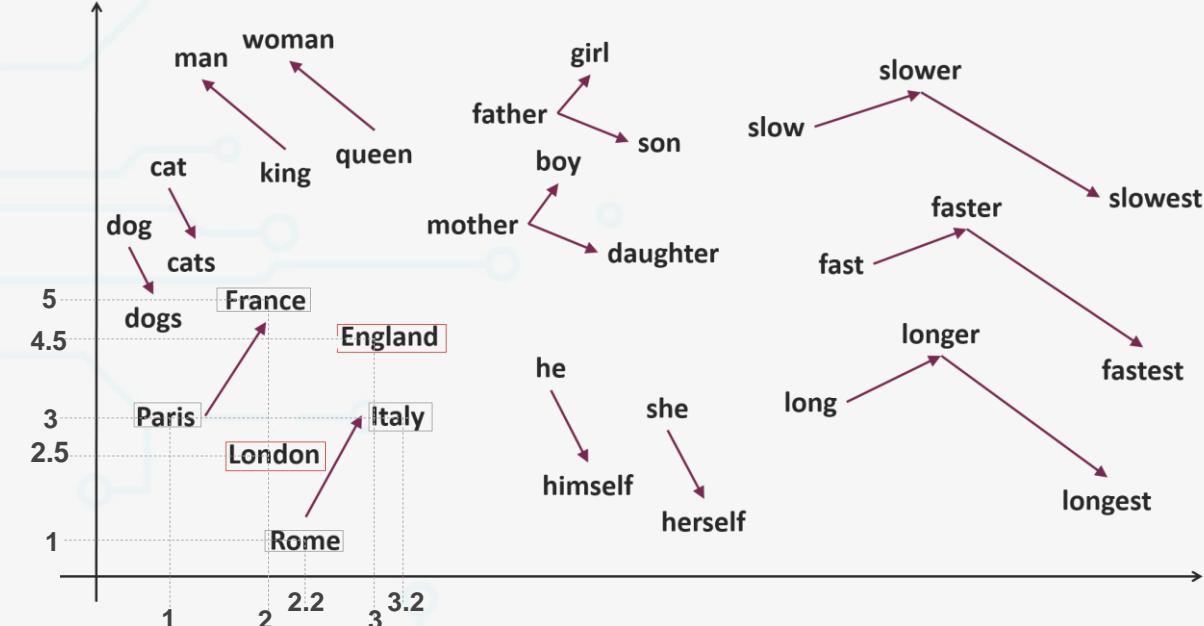


- Paris [1, 3]
- France [2, 5]
- London [2, 2.5]
- England [3, 4.5]
- Rome [2.2, 1]
- Italy [3.2, 3]

Processamento de Linguagem Natural

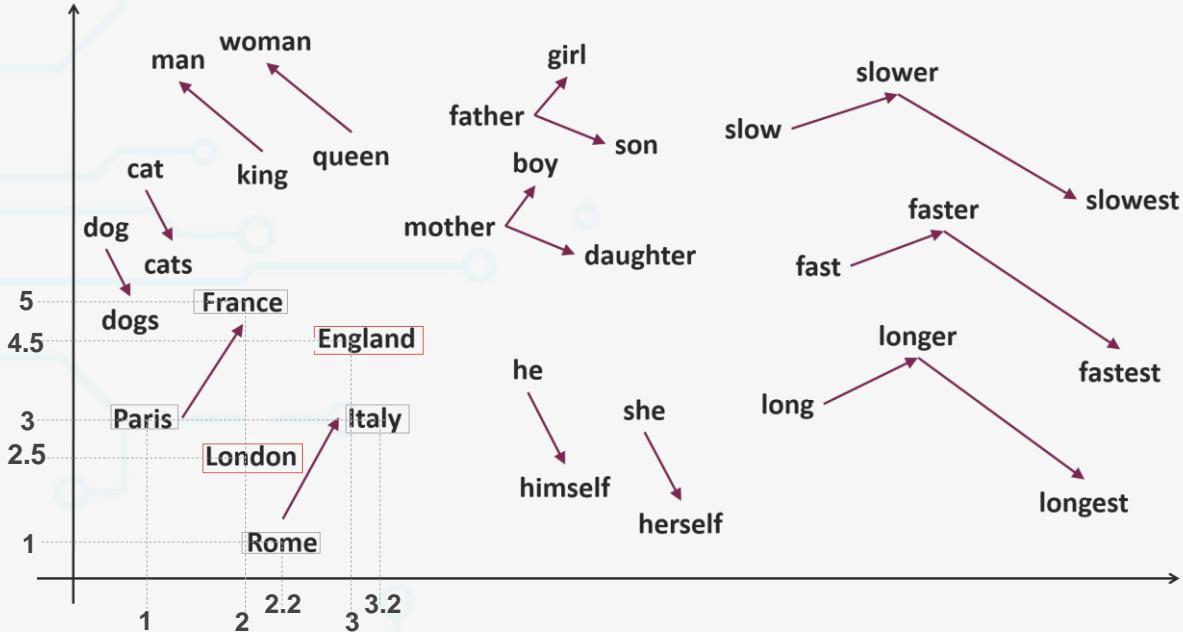
Natural Language Processing (NLP)

Qual a capital da Inglaterra?



Processamento de Linguagem Natural

Natural Language Processing (NLP)

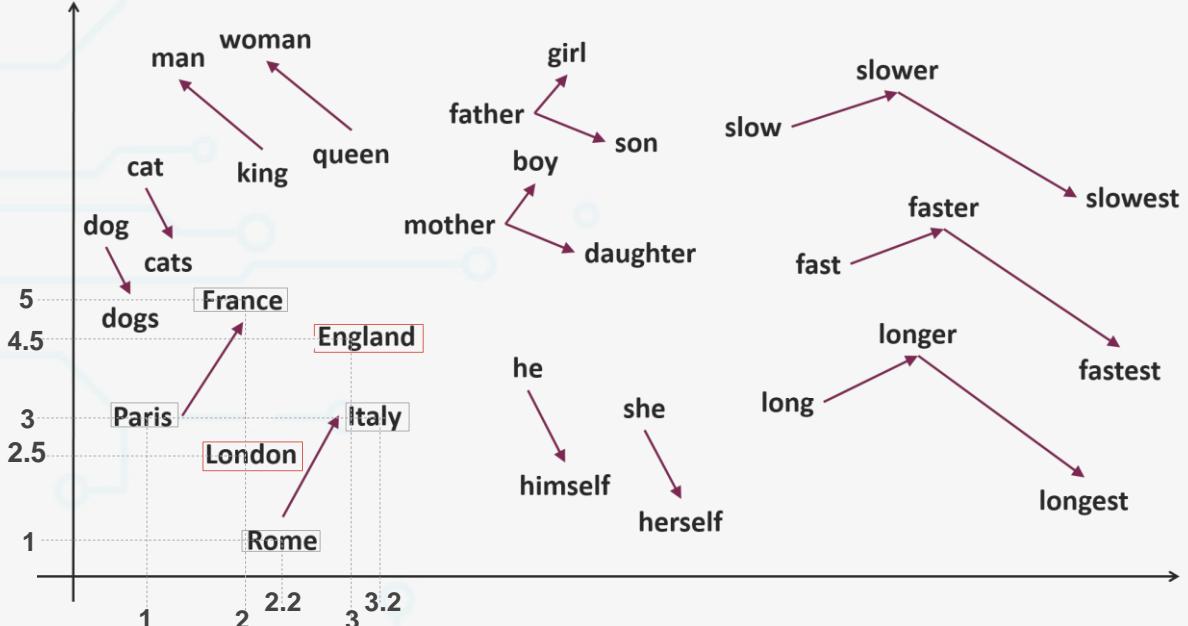


Qual a capital da Inglaterra?

Paris – France + England = ?

Processamento de Linguagem Natural

Natural Language Processing (NLP)



Qual a capital da Inglaterra?

Paris – France + England = ?

Paris [1, 3]

France [2, 5]

=

Result. [-1, -2]

+

England [3, 4.5]

=

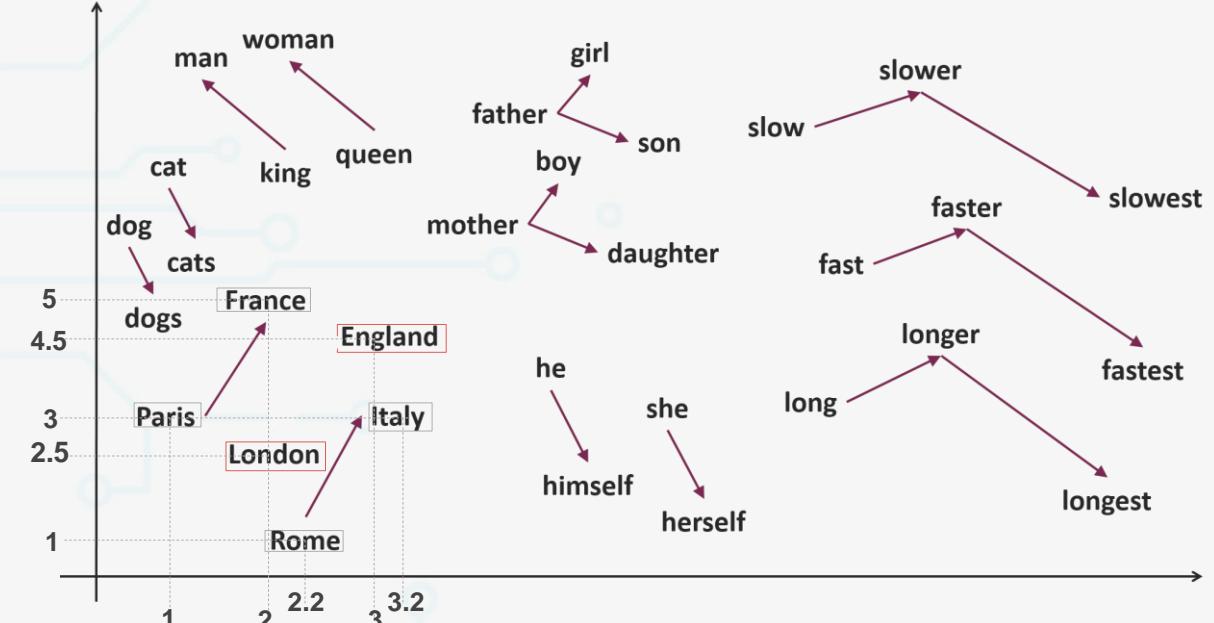
Result. [2, 2.5]

==

London [2, 2.5]

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Qual a capital da Inglaterra?

Paris – France + England = ?

Paris [1, 3]

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=

Result. [-1, -2]

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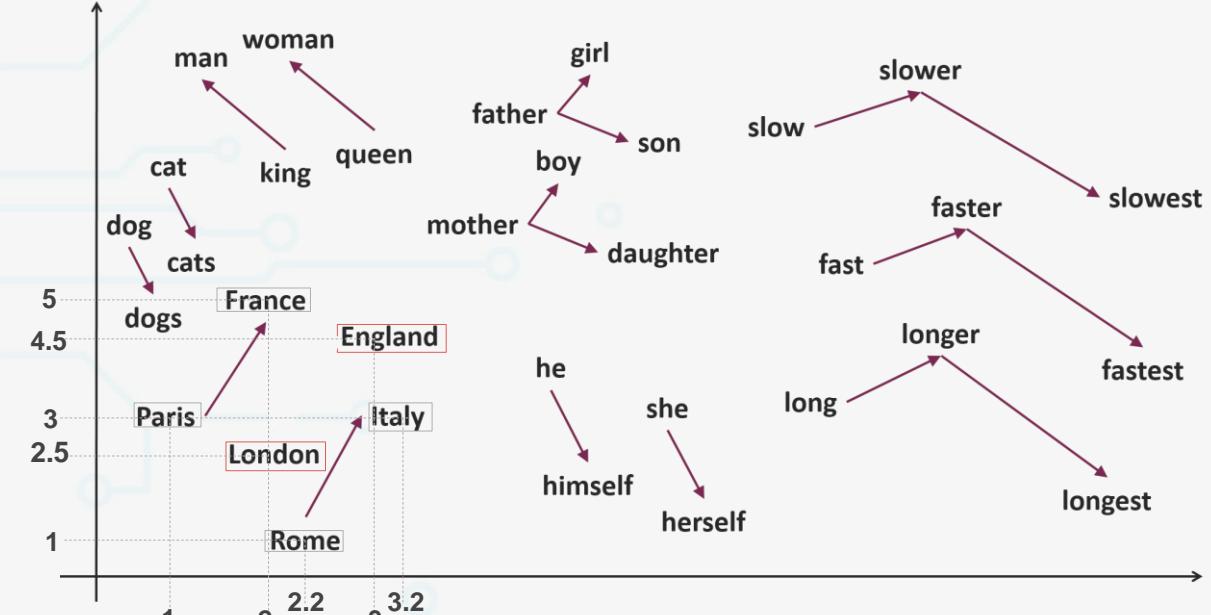
==

London [2, 2.5]

Paris – France + England = London

Processamento de Linguagem Natural

Natural Language Processing (NLP)



Qual a capital da Inglaterra?

$$\begin{aligned}
 \text{Paris} - \text{France} + \text{England} &= ? \\
 \text{Paris} &[1, 3] \\
 \text{France} &[2, 5] \\
 &= \\
 &\text{Result. } [-1, -2] \\
 &+ \\
 \text{England} &[3, 4.5] \\
 &= \\
 &\text{Result. } [2, 2.5] \\
 &== \\
 &\text{London } [2, 2.5]
 \end{aligned}$$

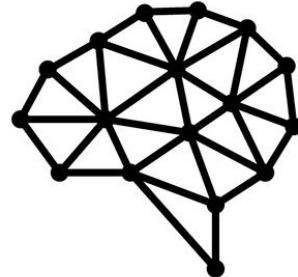
Paris – France + England = London

$$\begin{aligned}
 \text{Rome} - \text{Italy} + \text{England} &= ? \\
 \text{Rome} &[2.2, 1] \\
 \text{Italy} &[3.2, 3] \\
 &= \\
 &\text{Result. } [-1, -2] \\
 &+ \\
 \text{England} &[3, 4.5] \\
 &= \\
 &\text{Result. } [2, 2.5] \\
 &== \\
 &\text{London } [2, 2.5]
 \end{aligned}$$

Rome – Italy + England = London

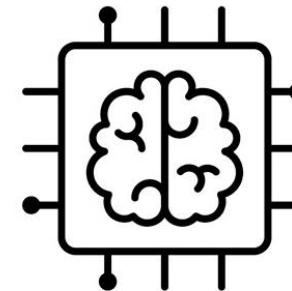
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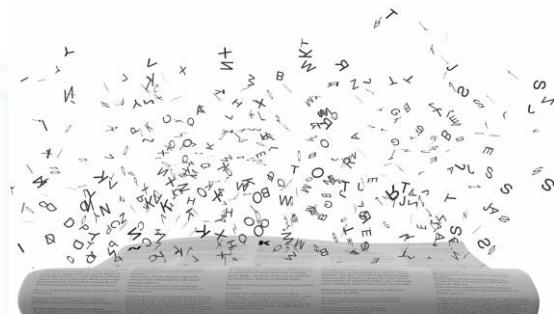


Representação
do Texto

Semi Supervisionado



Modelo de Machine Learning
Treinado para uma tarefa de NLP



Auto supervisionado (SSL)

Examples

Good price! Quality not bad! I'm happy I bought it.

Bad quality! I'm sad! I bought it I will return it.

Price not good. Quality bad! I'm not happy I bought it.

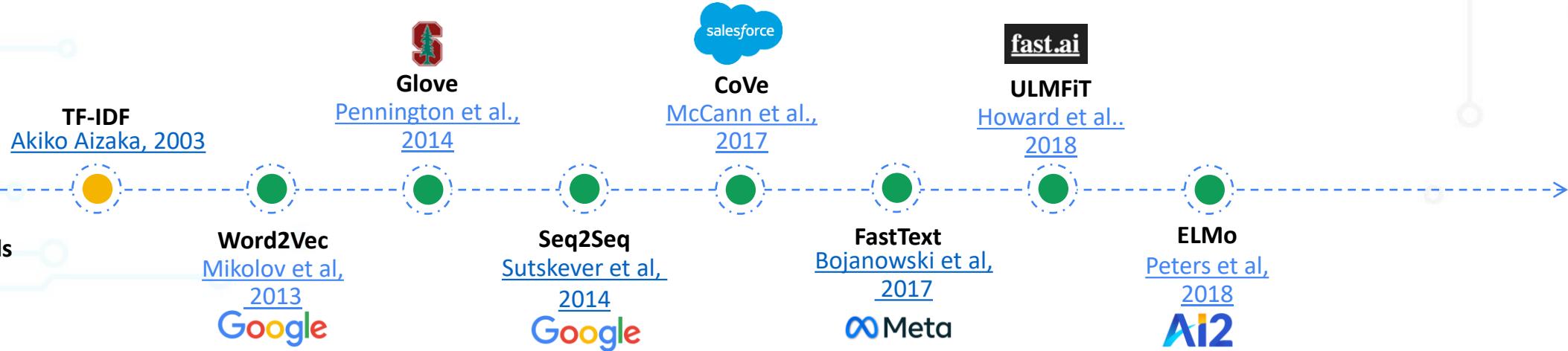
Labels



Supervisionado

Processamento de Linguagem Natural

Natural Language Processing (NLP)



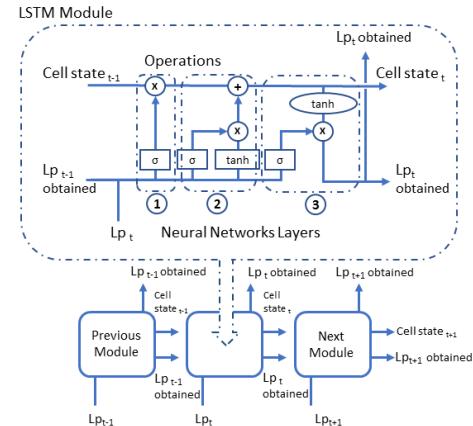
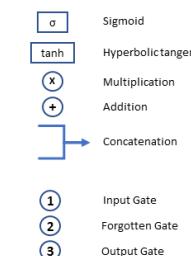
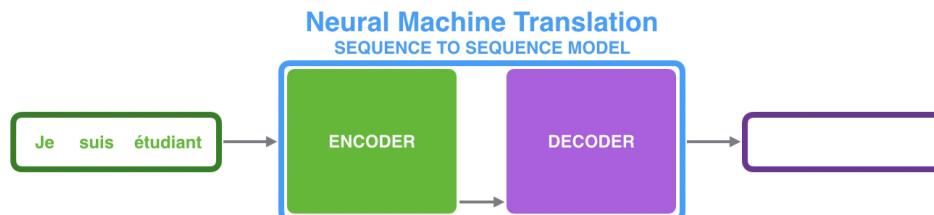
[<ca', 'car', 'arr', 'rro', 'ro>]

carro

carroça

sent₁: **banco da praça**

sent₂: app do banco

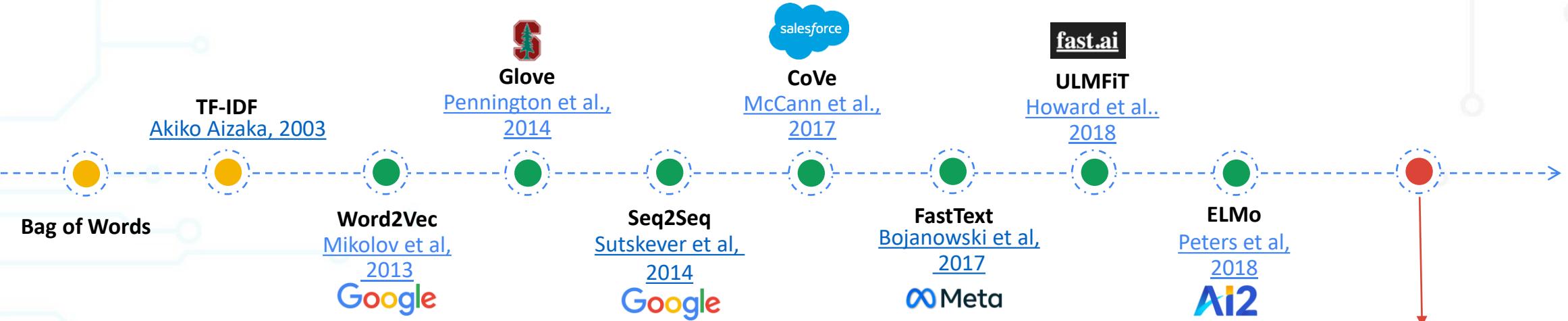


Long Short-Term Memory Networks (LSTM)

<https://arxiv.org/pdf/1909.09586.pdf>

Processamento de Linguagem Natural

Natural Language Processing (NLP)



Attention Is All You Need

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<https://arxiv.org/abs/1706.03762>

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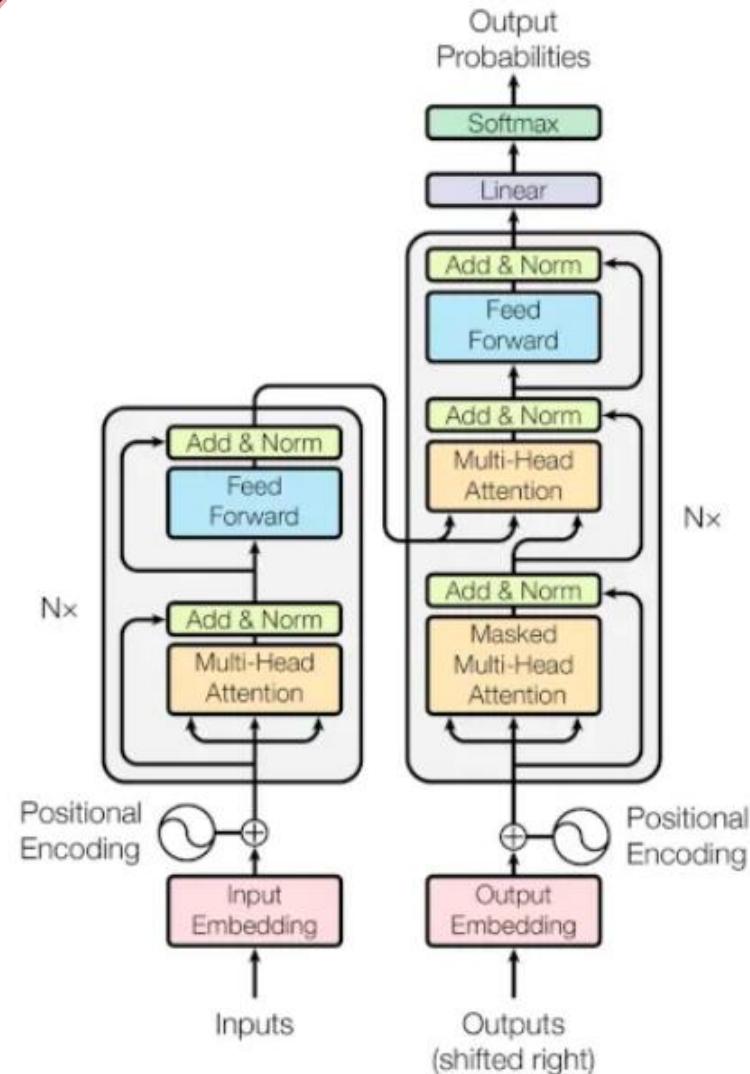
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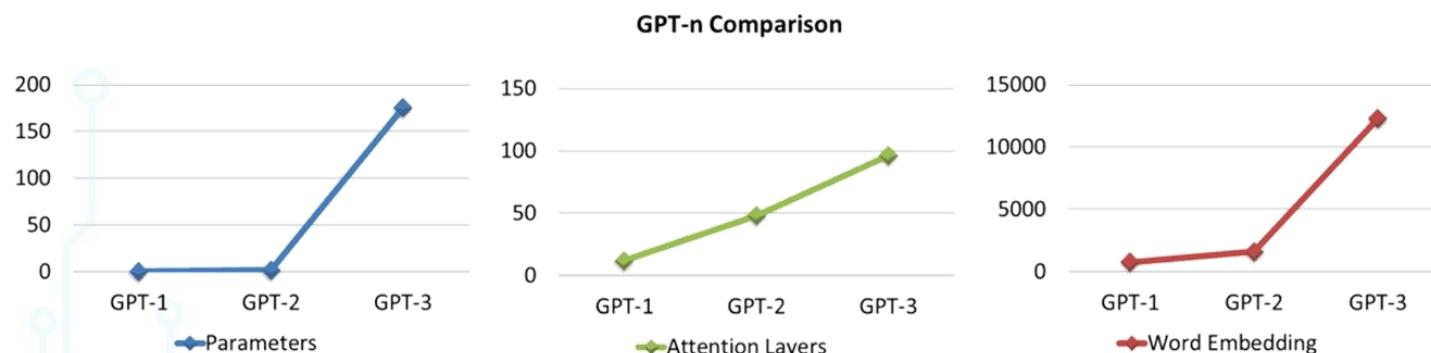
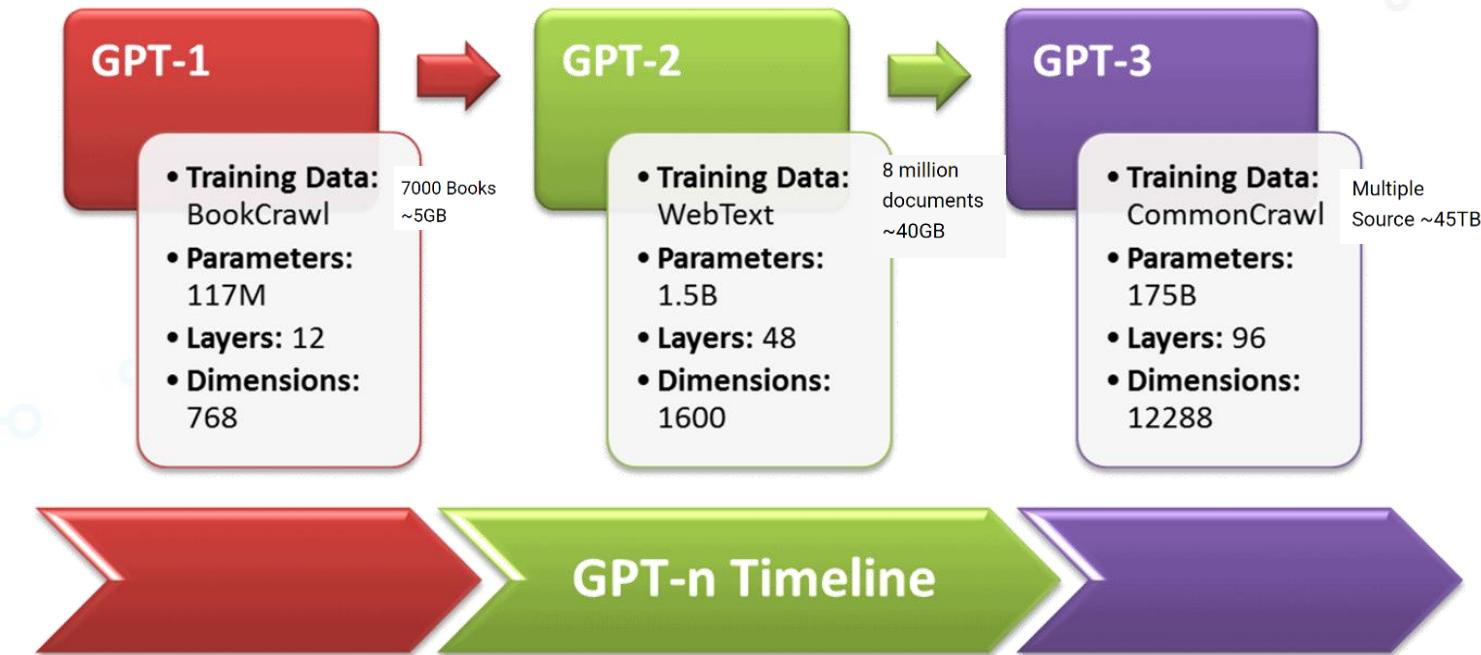
Abstract

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 41.9 after

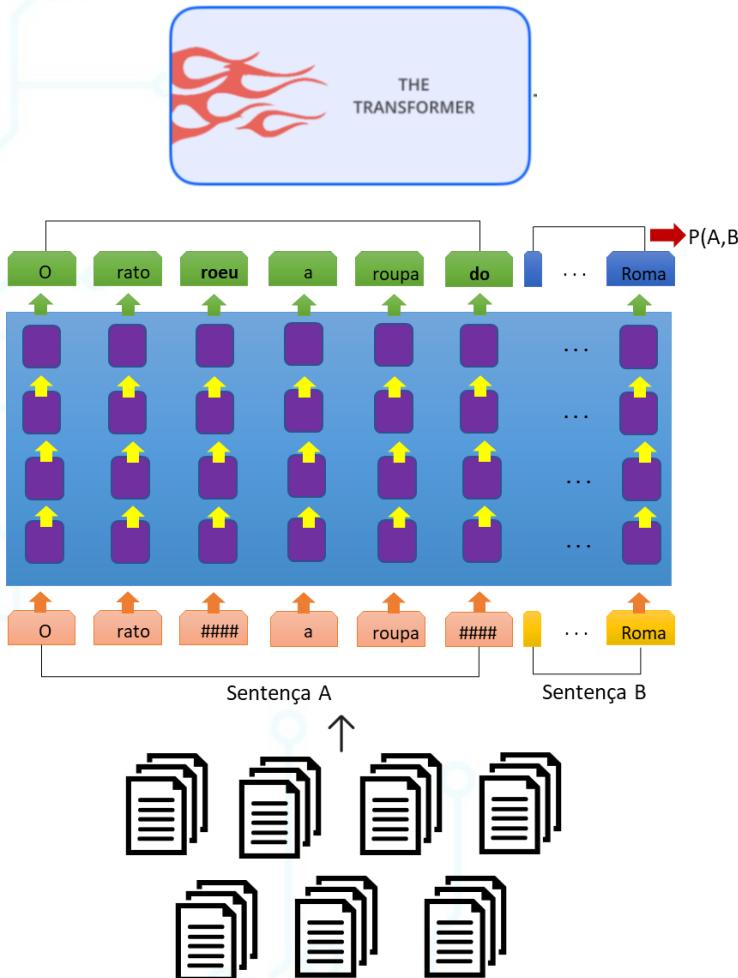
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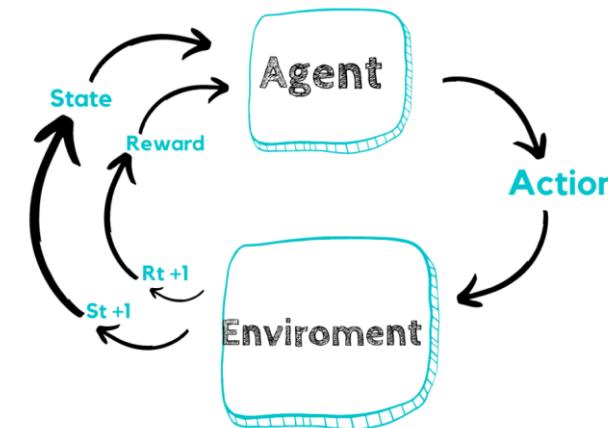
Família GPT



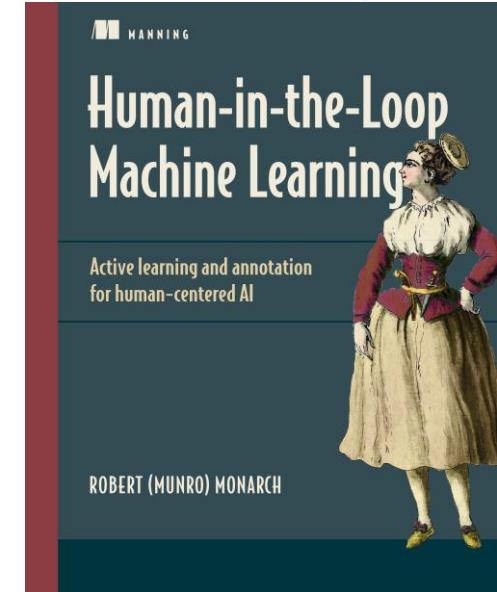
ChatGPT



+



Reinforcement Learning



Reinforcement Learning from Human Feedback (RLHF)

Quanto Custa os Modelos GPTs

LLM Training Costs on MosaicML Cloud

Model	Billions of Tokens (Compute-optimal)	Days to Train on MosaicML Cloud	Approx. Cost on MosaicML Cloud
GPT-1.3B	26B	0.14	\$2,000
GPT-2.7B	54B	0.48	\$6,000
GPT-6.7B	134B	2.32	\$30,000
GPT-13B	260B	7.43	\$100,000
GPT-30B *	610B	35.98	\$450,000
GPT-70B **	1400B	176.55	\$2,500,000

[original GPT-3](#), which had more parameters (175 billion params) but was trained on less data (300 billion tokens).

<https://www.mosaicml.com/blog/gpt-3-quality-for-500k#:~:text=The%20bottom%20line%3A%20it%20costs,10x%20less%20than%20people%20think.>

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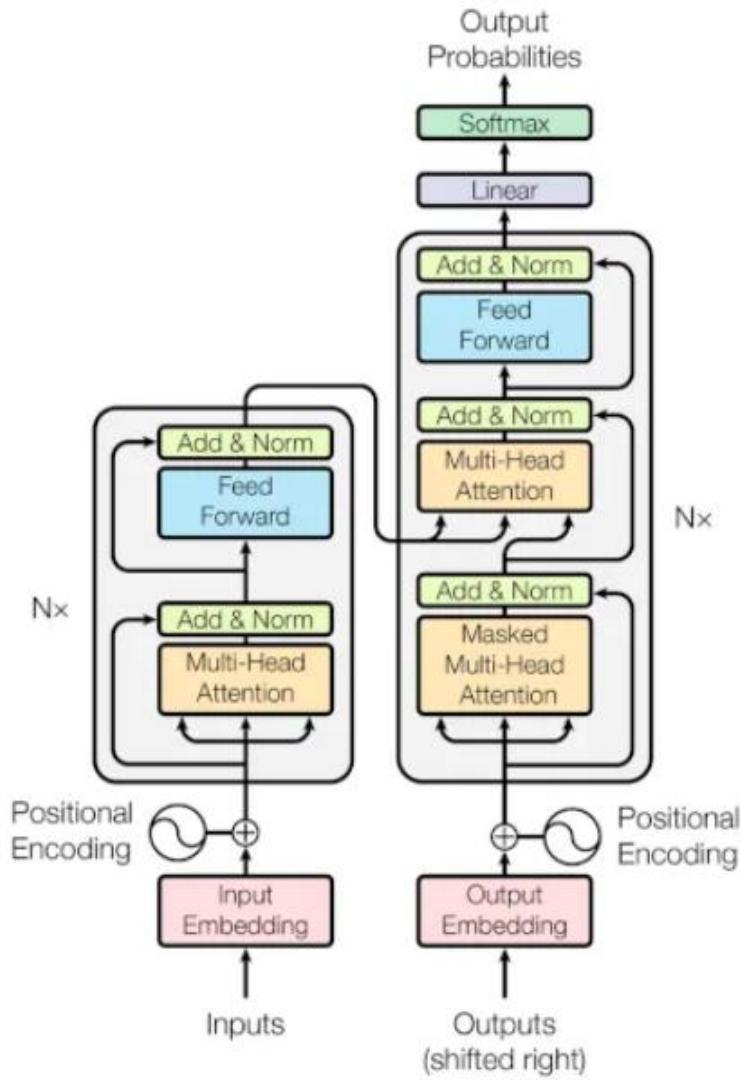
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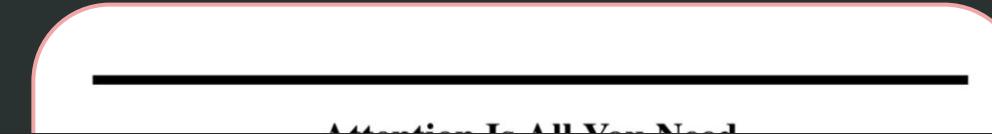
Illia Polosukhin* ‡
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Abstract

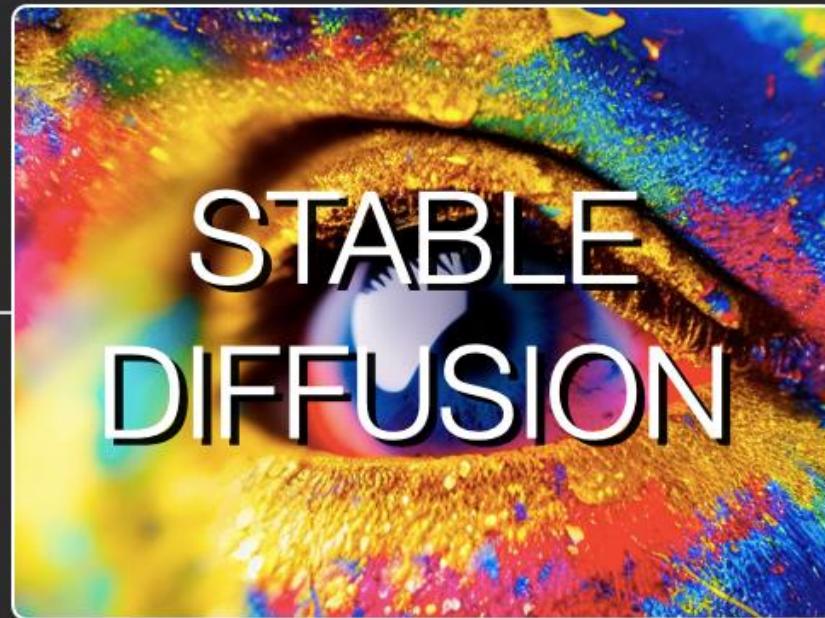
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<https://arxiv.org/abs/1706.03762>





Pirate
ship



<https://arxiv.org/abs/1706.03762>

Inputs

Outputs
(shifted right)

Stable Diffusion

- NÃO É UM MODELO! É um sistema composto por várias redes neurais.
- Permite a geração de imagens condicionada a um texto.
- Foi o primeiro a ser disponibilizado de forma totalmente open-source e com requisitos computacionais relativamente baixos, pois realiza a maioria das operações no espaço latente.

Stable Diffusion

Espaço latente



Meu amigo secreto é uma pessoa alta, com olhos castanhos, cabelo longo, usa óculos...

Stable Diffusion

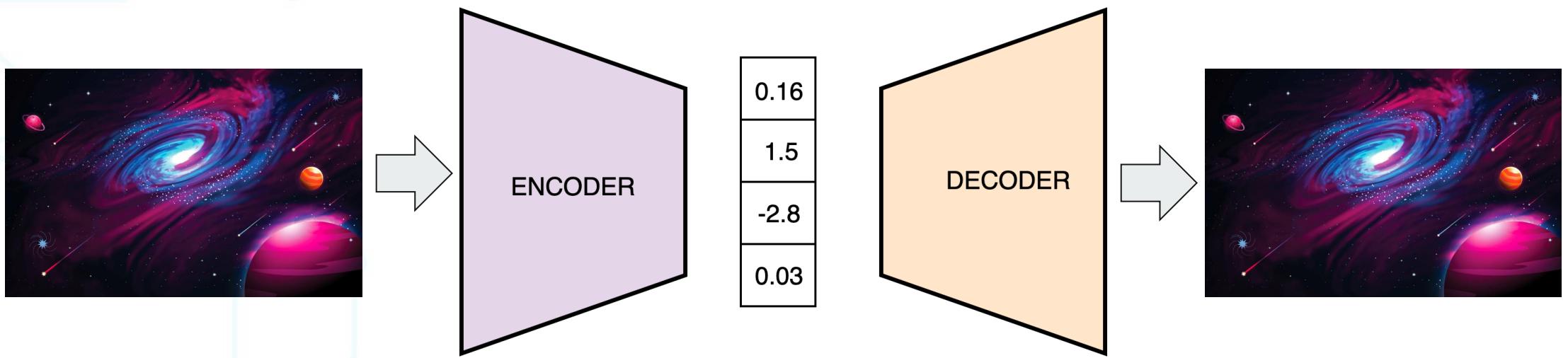
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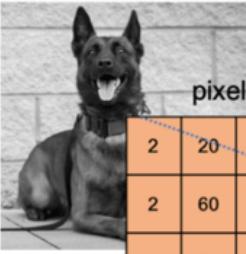
Stable Diffusion

Espaço latente



Stable Diffusion

original image



pixelized image

2	20	4	20	4	1
2	60	56	7	10	2
4	50	80	45	7	5
12	24	67	8	10	7
11	67	42	34	3	13
6	12	22	45	43	32

filter to detect vertical edges

1	0	-1
1	0	-1
1	0	-1

convolved output

-132	58	119	64
-185	74	176	46
..
..

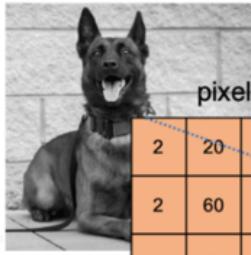
“max” pooling

74	176
..	..

Final representation of image that detects edges

Stable Diffusion

original image



pixelized image

2	20	4	20	4	1
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4	50	80	45	7	5
12	24	67	8	10	7
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convolved output

-132	58	119	64
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..
..

"max" pooling

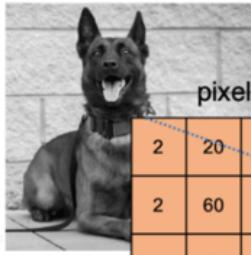
74	176
..	..

Final representation of image that detects edges



Stable Diffusion

original image



pixelized image

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11	67	42	34	3	13
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filter to detect vertical edges

1	0	-1
1	0	-1
1	0	-1

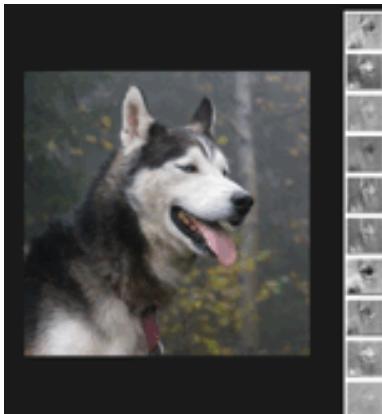
convolved output

-132	58	119	64
-185	74	176	46
..
74	176

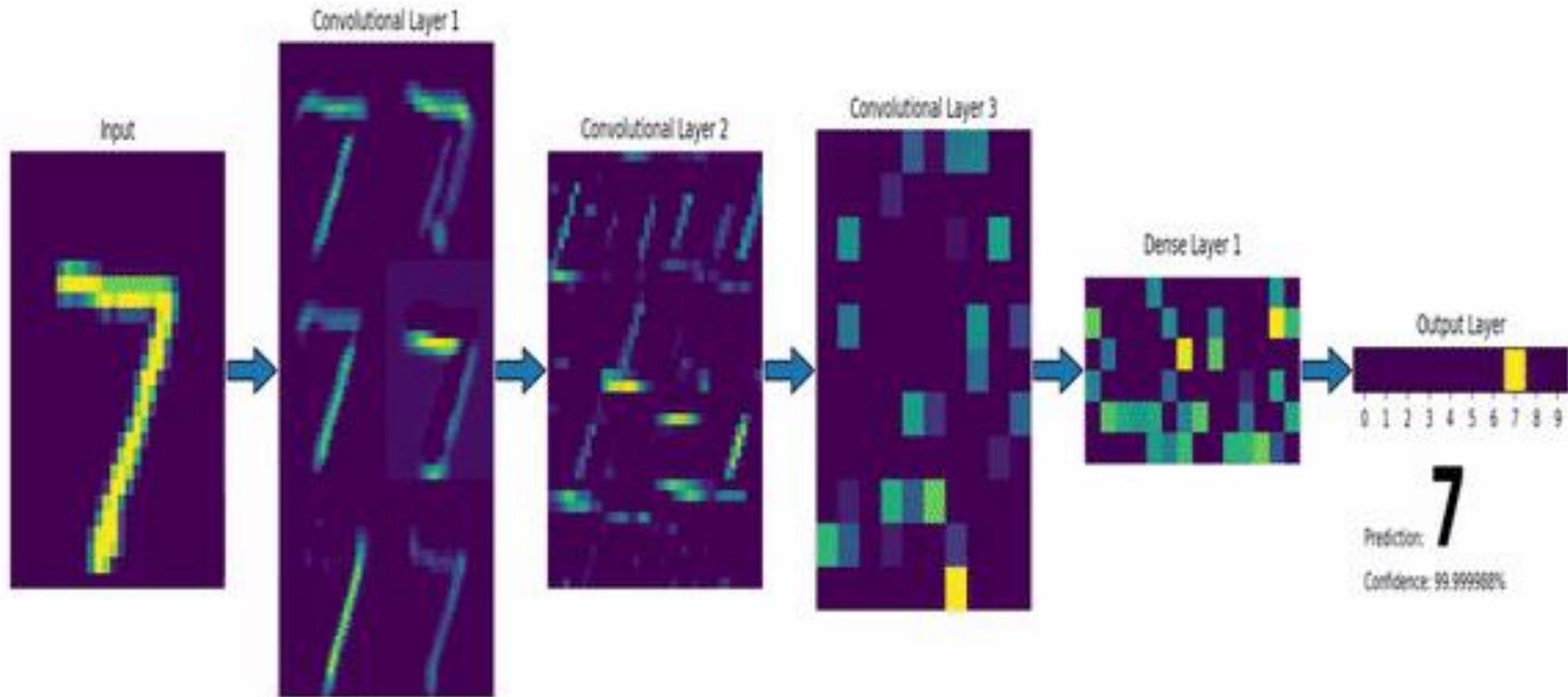
"max" pooling

74	176
..	..

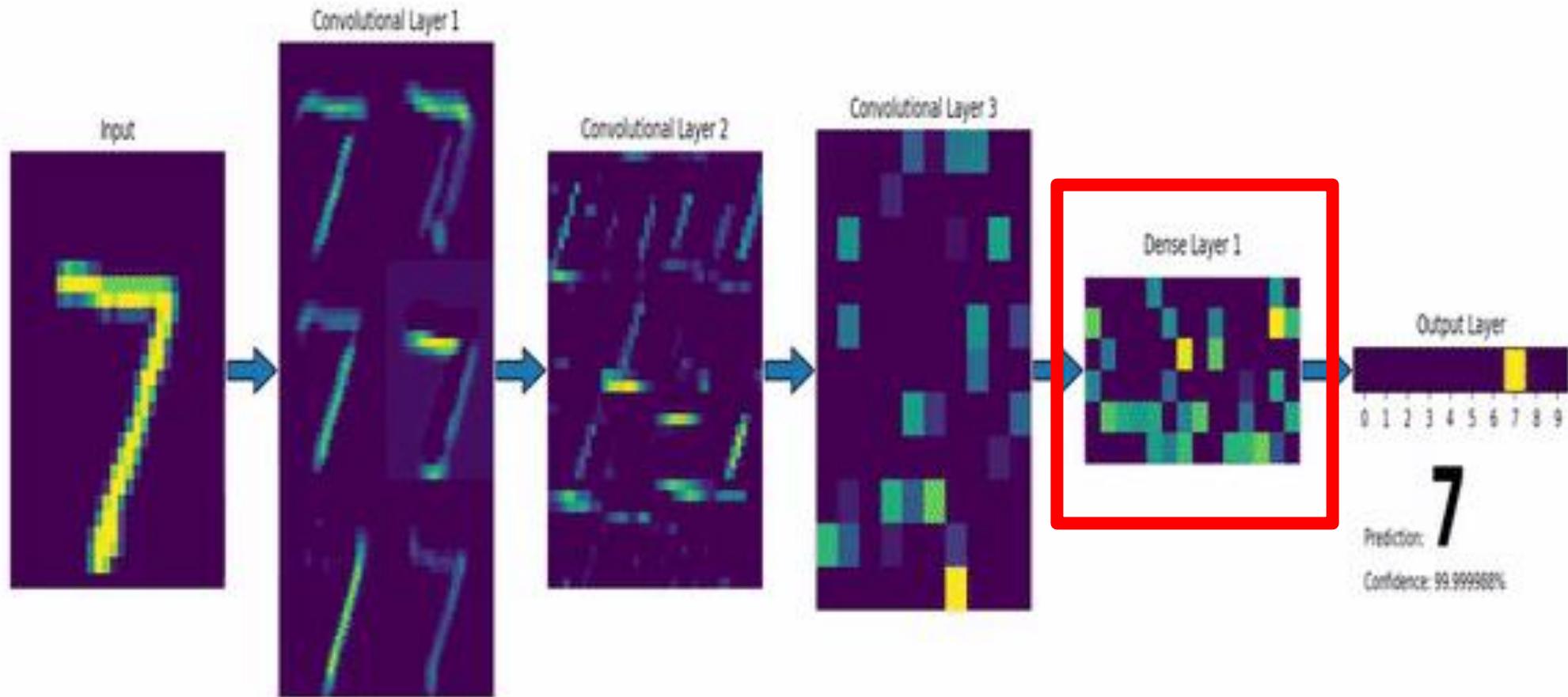
Final representation of image that detects edges



Stable Diffusion

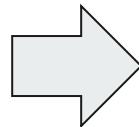


Stable Diffusion



Stable Diffusion

Carregando uma imagem na GPU

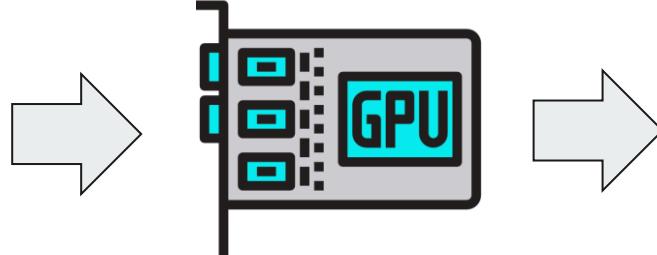
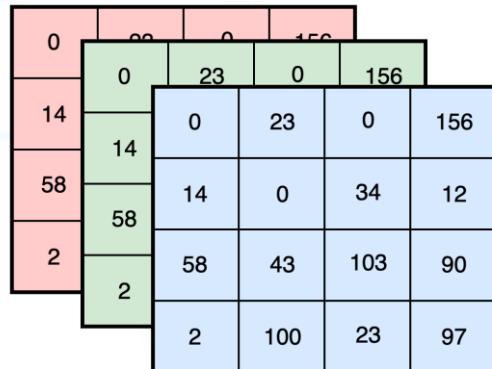


0	0	0	156
14	0	23	156
58	14	0	156
2	58	34	12
	2	14	90
		58	103
		2	97
		100	23

0-255 = 8 bits (int8)

Stable Diffusion

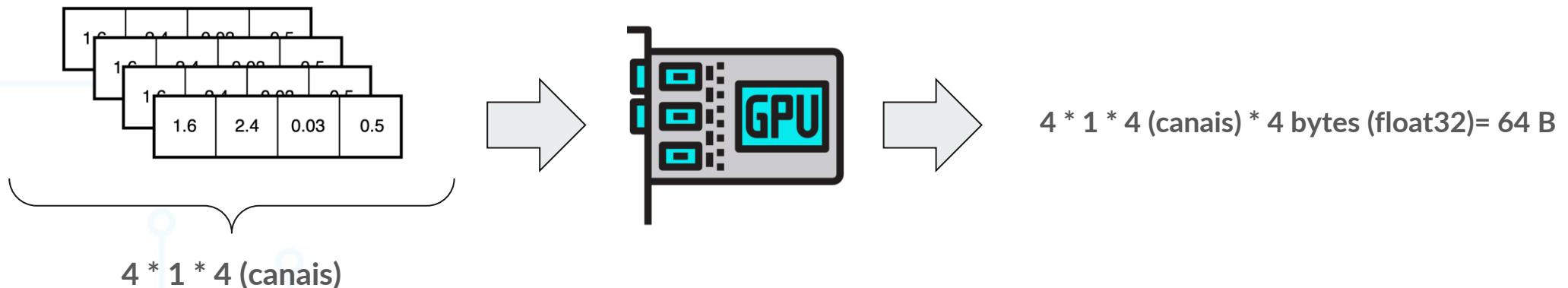
Carregando uma imagem na GPU



$640 * 640 * 3 (\text{RGB}) * 1 \text{ byte} = 1,22 \text{ MB}$

Stable Diffusion

Carregando uma imagem na GPU



Stable Diffusion



Modelos de difusão

São modelos probabilísticos criados para aprender uma distribuição $p(x)$ através da remoção gradual de ruído de uma variável normalmente distribuída, o que corresponde a aprender o processo inverso de uma cadeia de Markov fixa de tamanho T.

Modelos de difusão

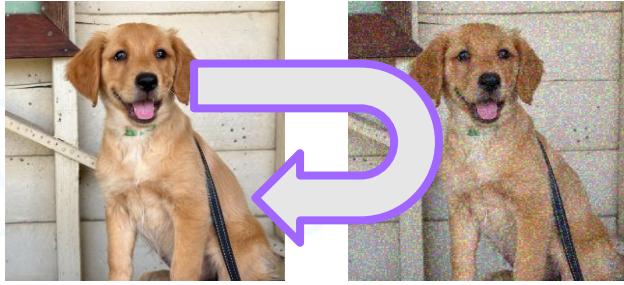
Diffusion model



Adds noise and learns how to work backwards to the original image.

Modelos de difusão

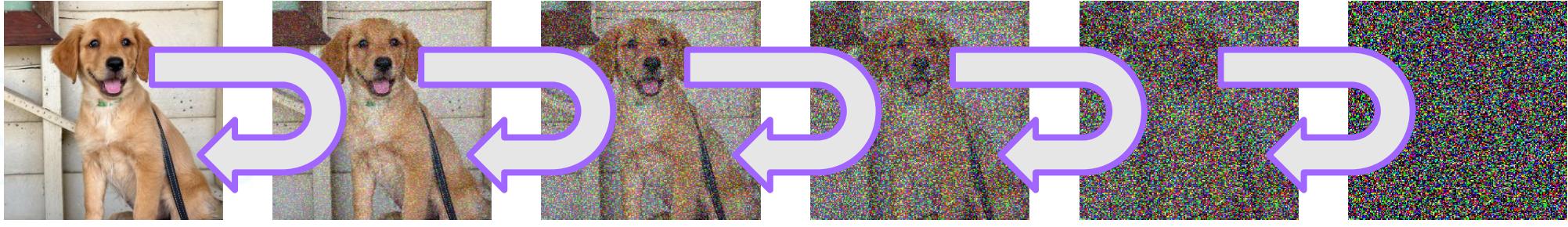
Diffusion model



Adds noise and learns how to work backwards to the original image.

Modelos de difusão

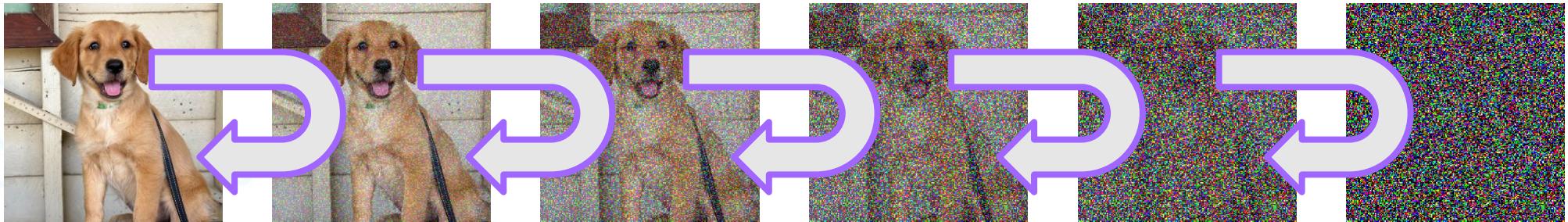
Diffusion model



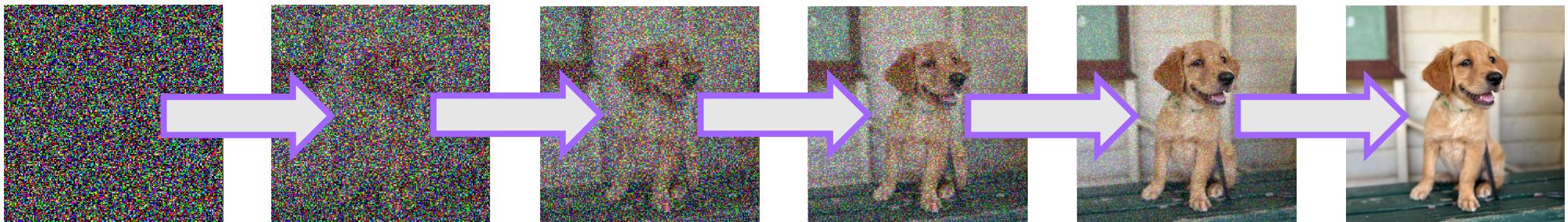
Adds noise and learns how to work backwards to the original image.

Modelos de difusão

Diffusion model

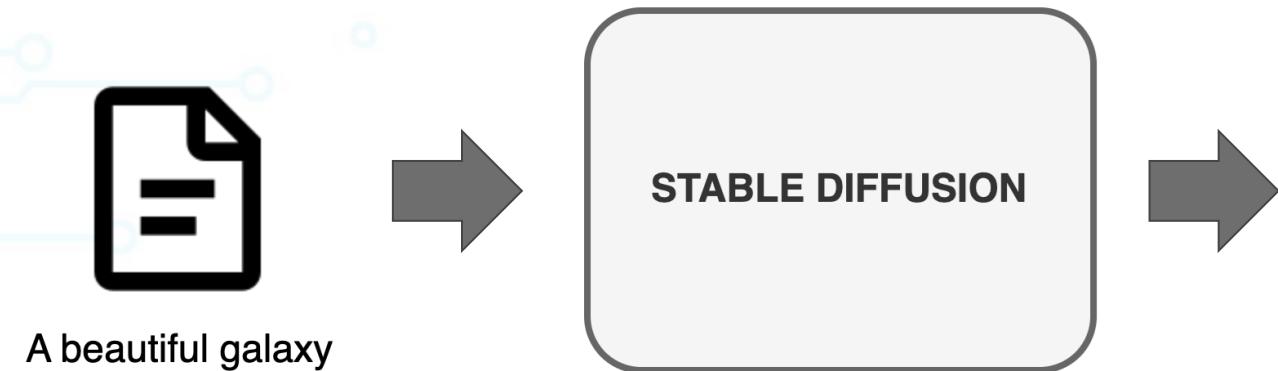


Adds noise and learns how to work backwards to the original image.

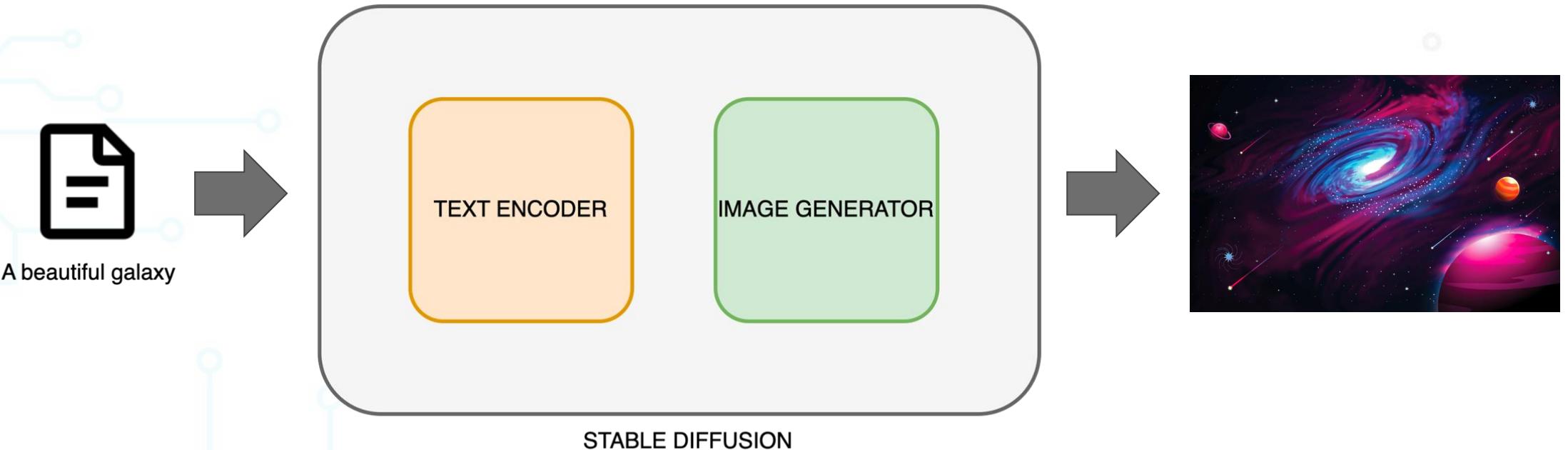


Trained model works from random noise to generated an image.

Stable Diffusion



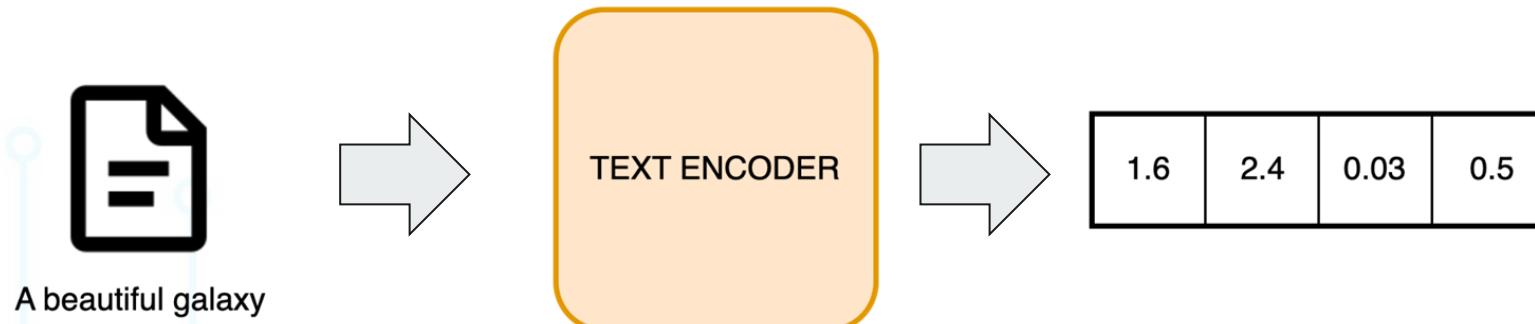
Stable Diffusion



Stable Diffusion

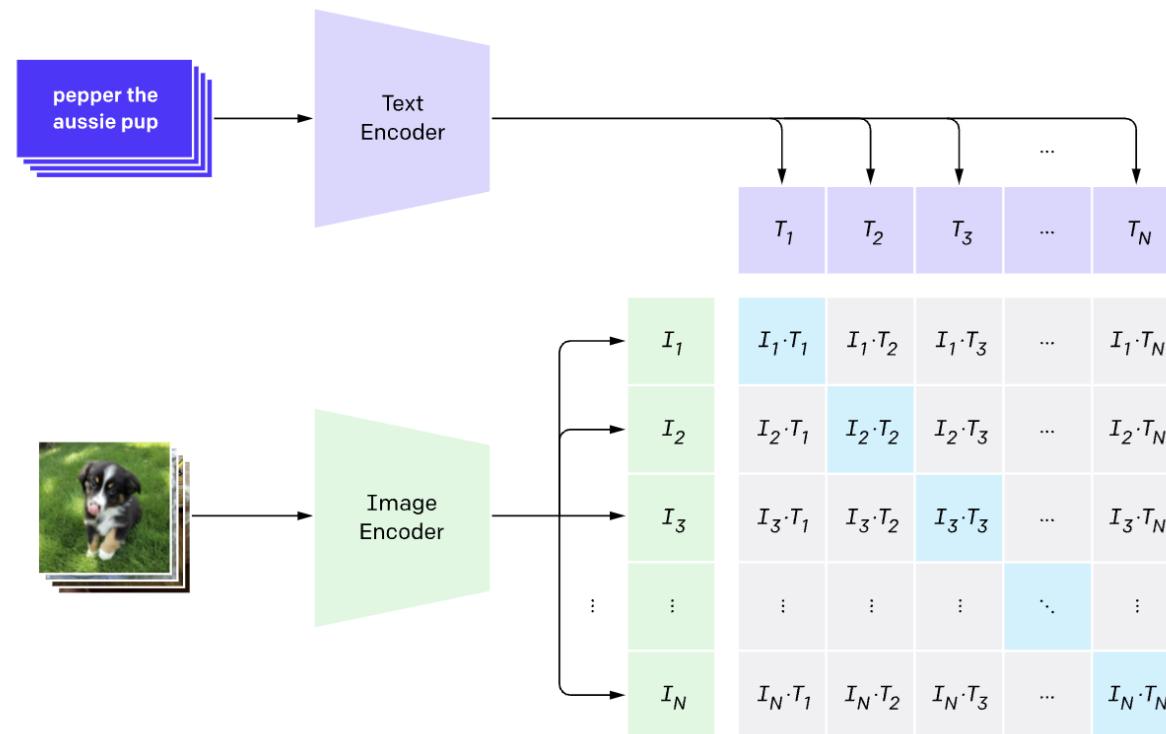
Text Encoder - CLIP

- Modelo treinado com o objetivo de gerar o mesmo embedding para uma imagem e sua descrição.
- Modelo possui um encoder de imagem e um encoder de texto que podem ser usados.
- No Stable Diffusion é usado o encoder de texto.



Stable Diffusion

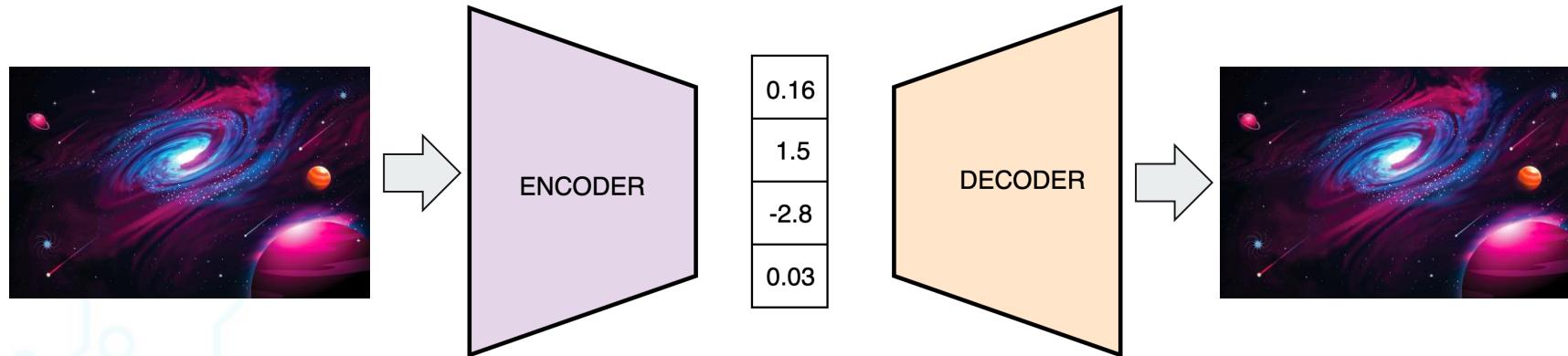
Text Encoder - CLIP



Stable Diffusion

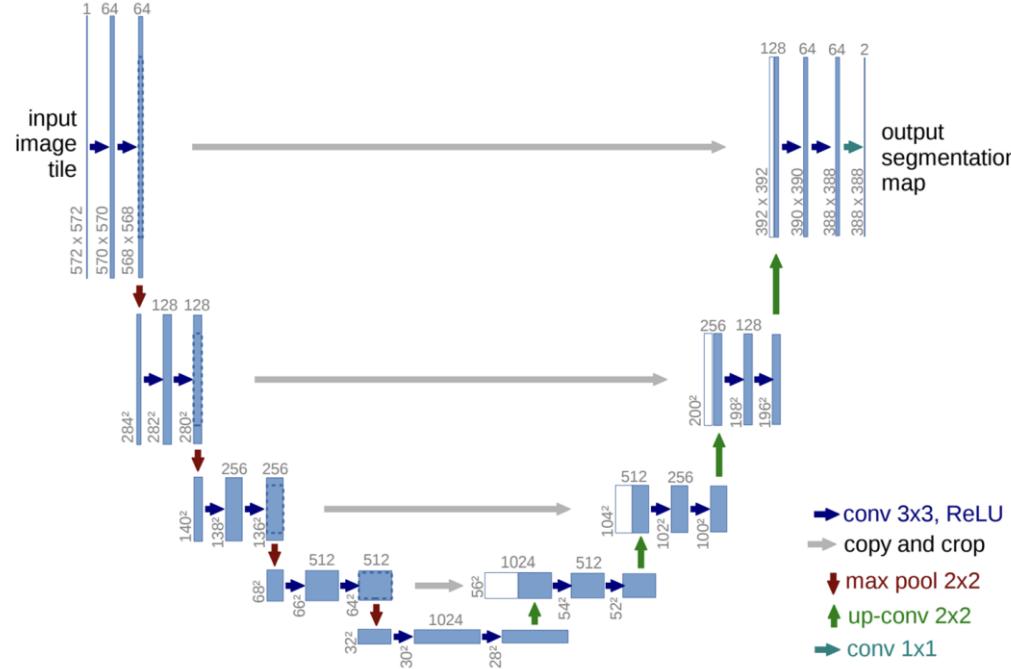
Autoencoder - VAE

- Transforma a imagem em um tensor de (4, 64, 64) que é usado no processo de *denoising*.
- No treinamento usamos o encoder e o decoder.
- Na predição usamos somente o decoder.



Stable Diffusion

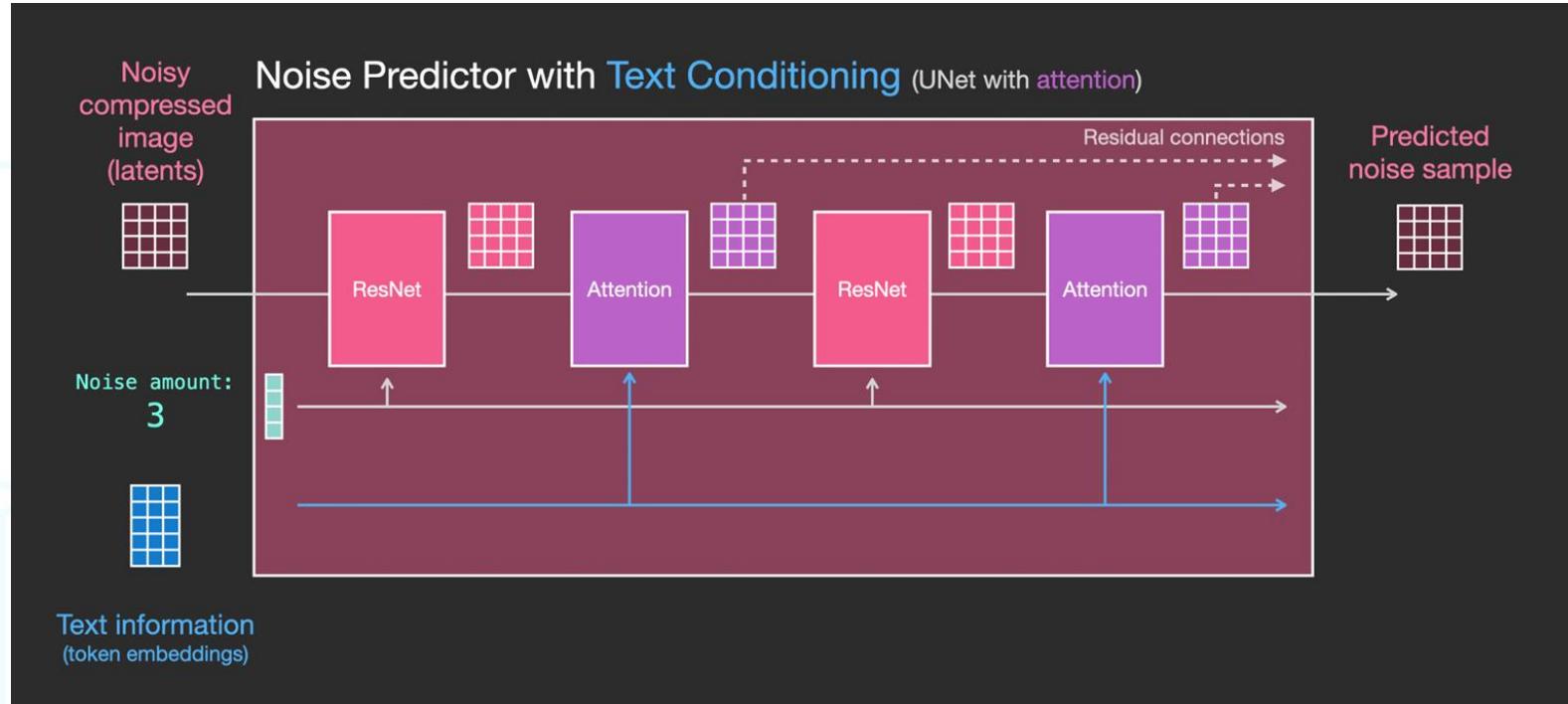
Predictor de ruído - UNet Condicionada



Olaf Ronneberger, Philipp Fischer, and Thomas Brox. [U-Net: Convolutional Networks for Biomedical Image Segmentation](#)

Stable Diffusion

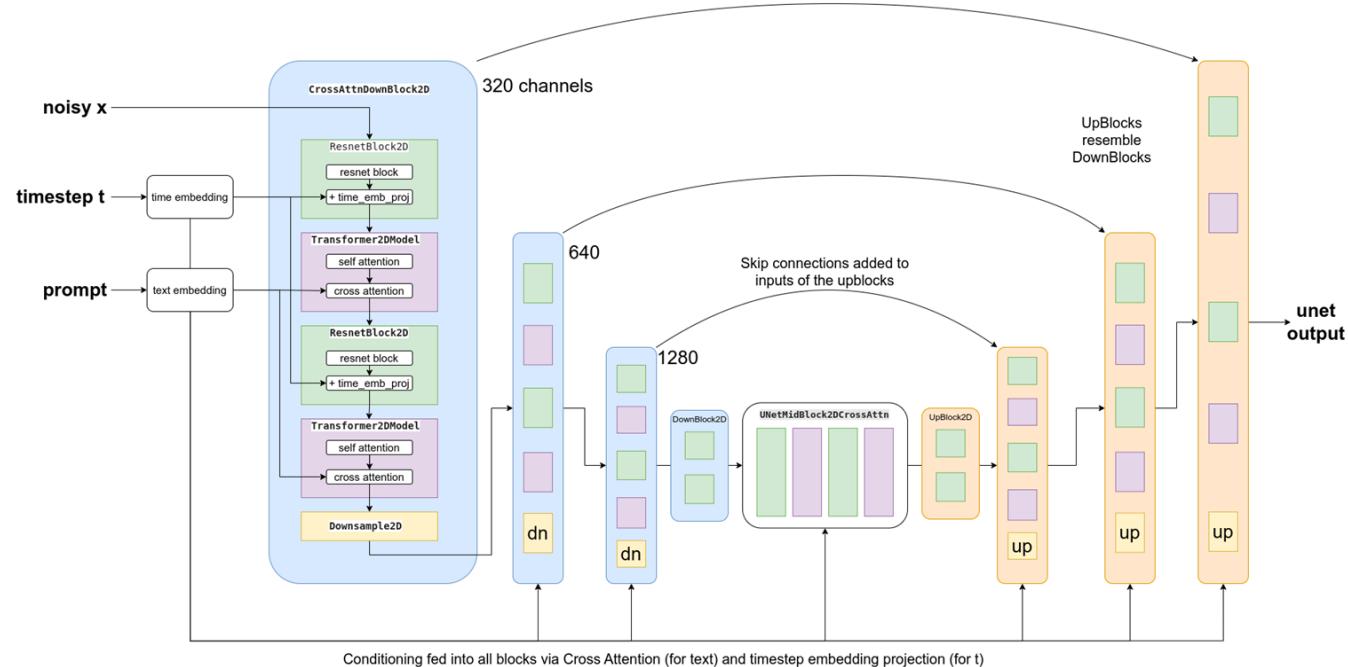
Predictor de ruído - UNet Condicionada



[The Illustrated Stable Diffusion](#)

Stable Diffusion

Predictor de ruído - UNet Condicionada

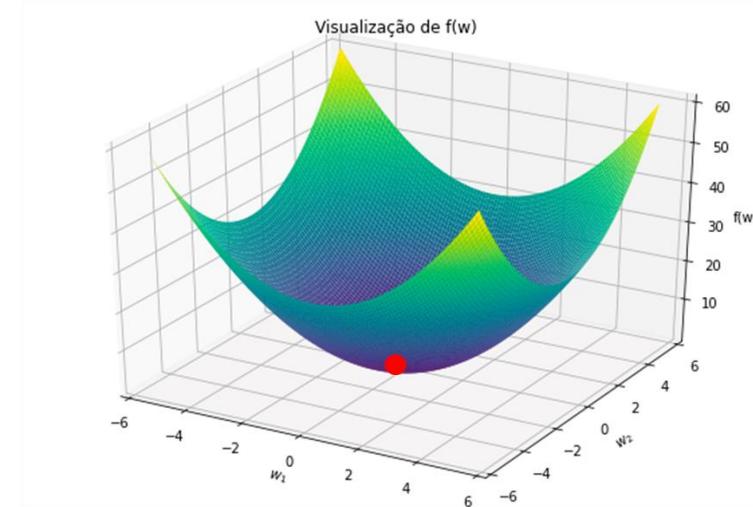
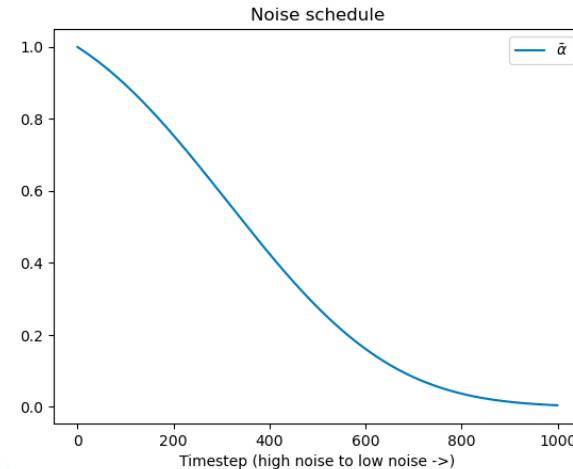


[Hugging Face diffusion models class](#)

Stable Diffusion

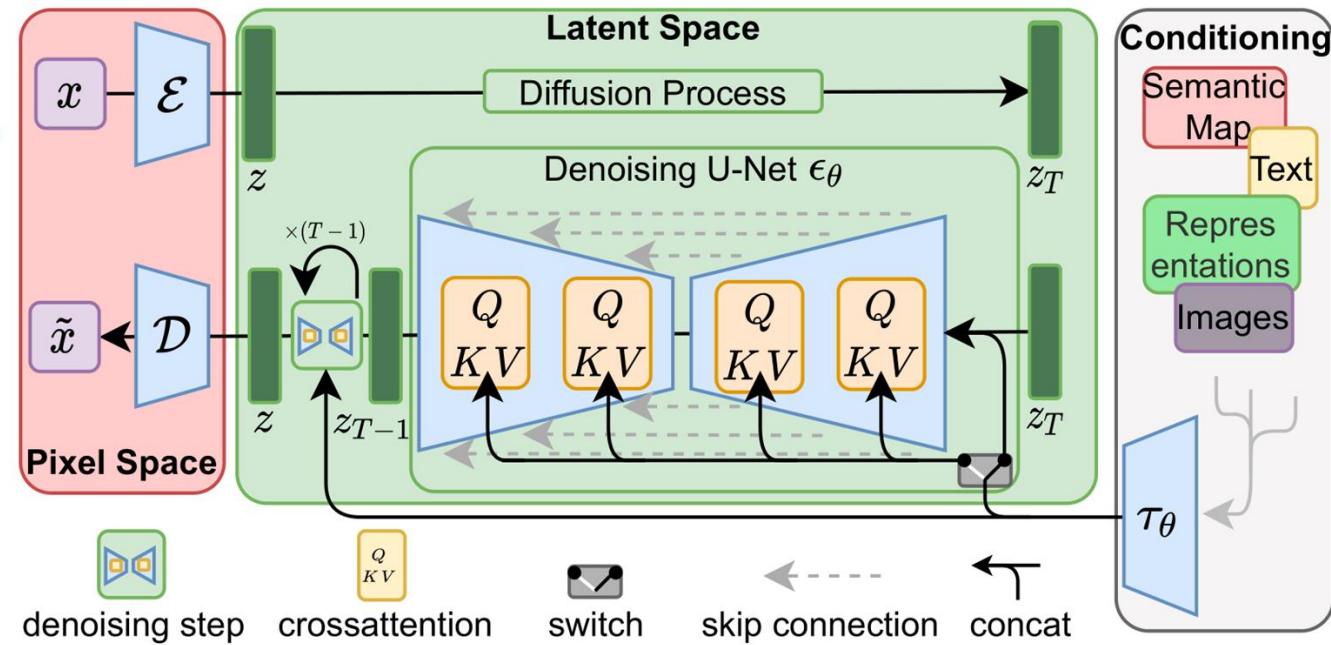
Scheduler

- Determina o quanto aplicar de ruído na imagem durante o treinamento, para a UNet ver diferentes quantidades de ruído e ser mais robusta.
- Determina o quanto remover de ruído (suavizar a remoção) durante a inferência.



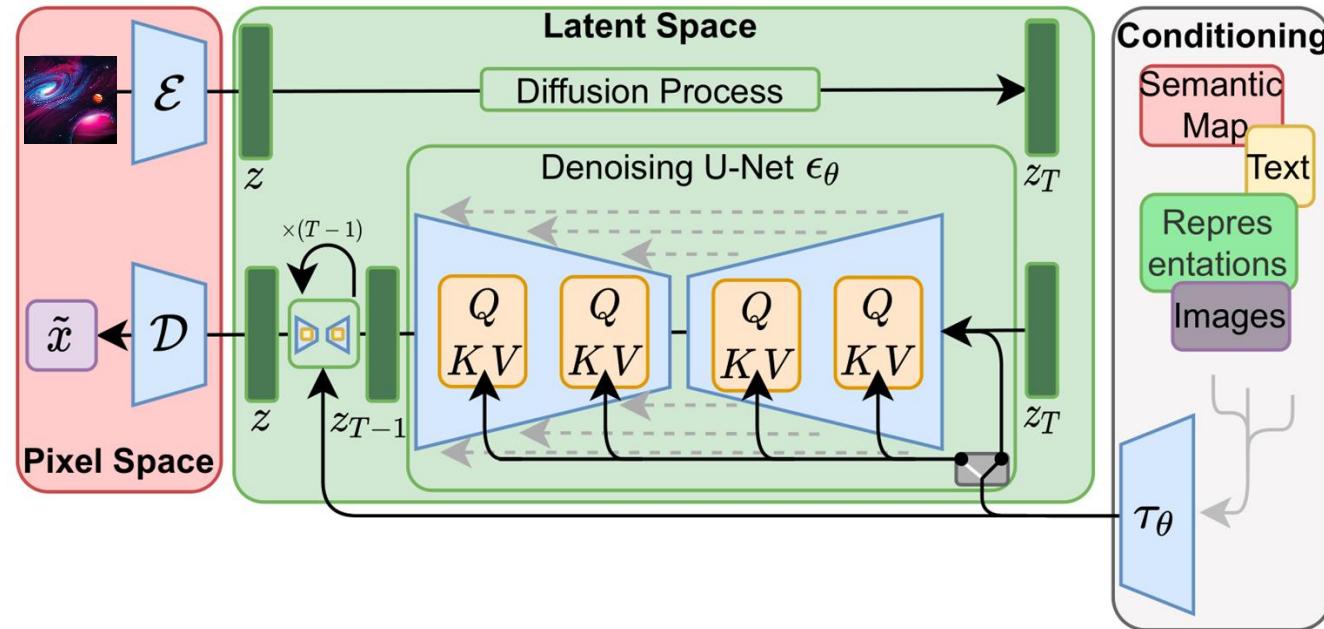
Stable Diffusion

Treinamento



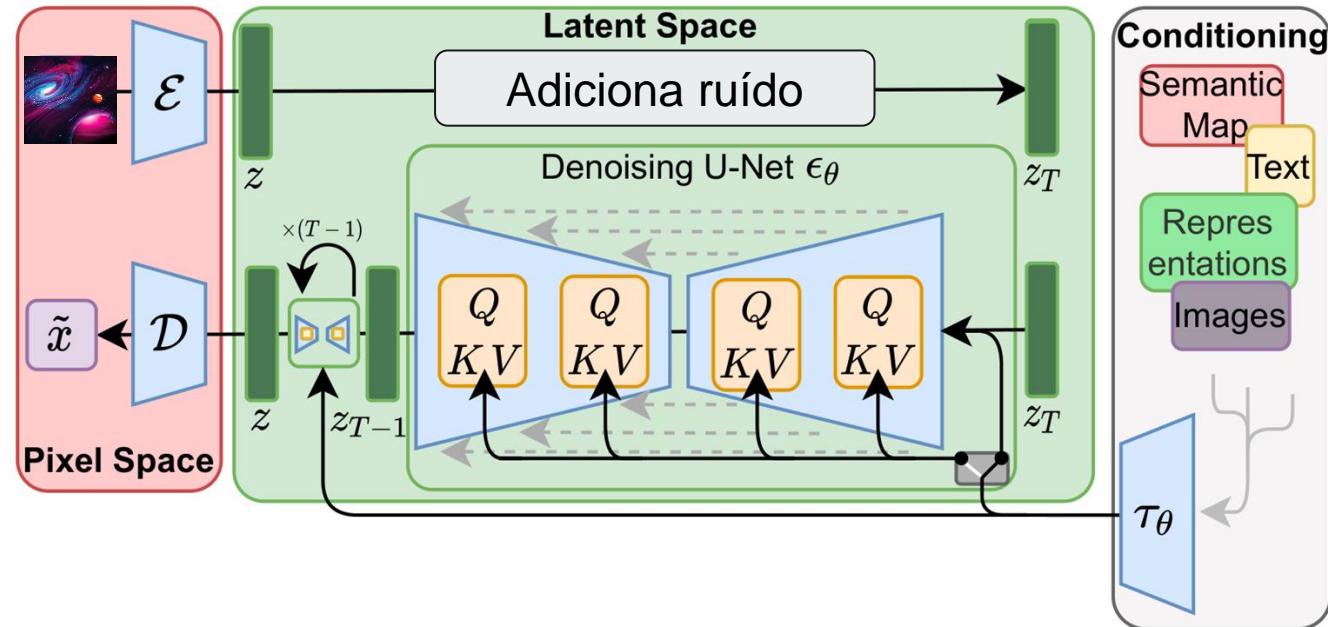
Stable Diffusion

Treinamento



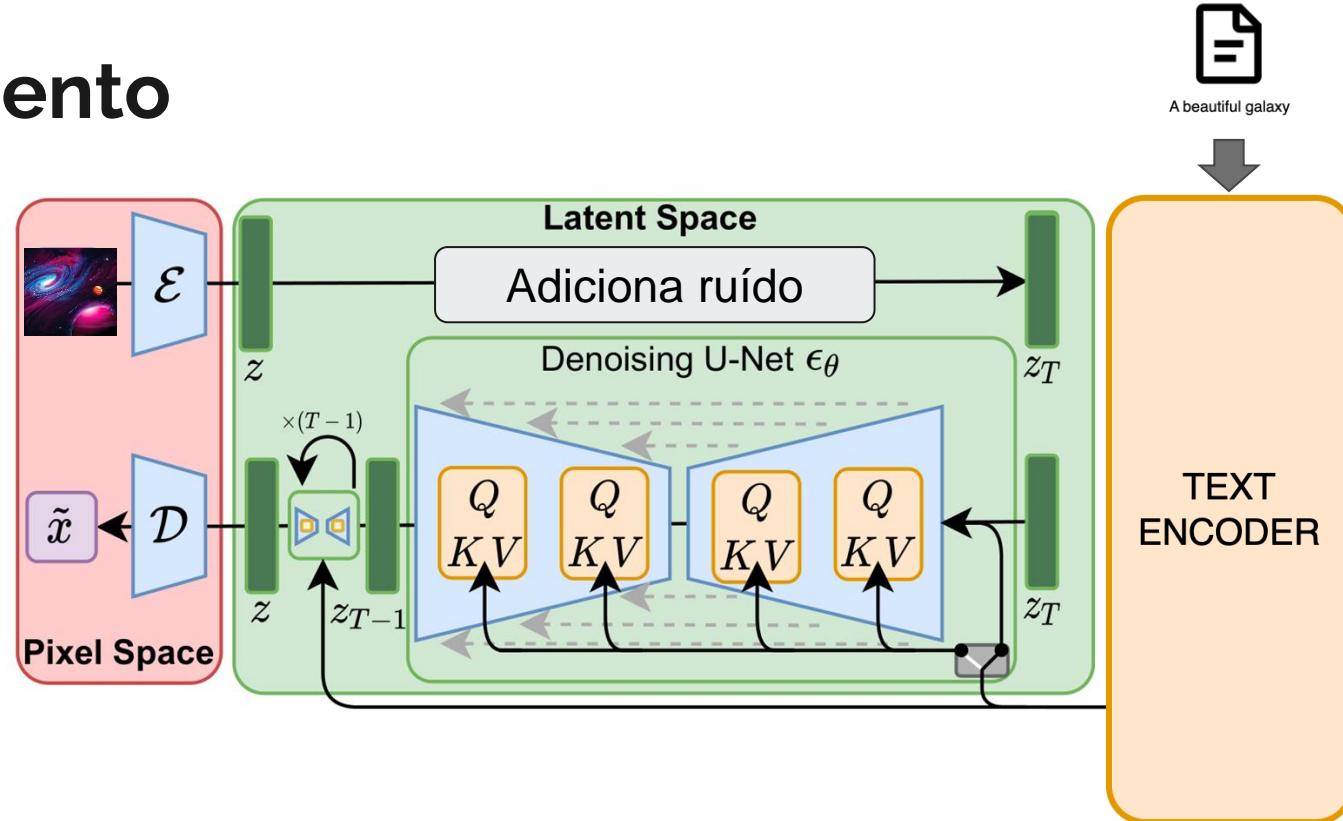
Stable Diffusion

Treinamento



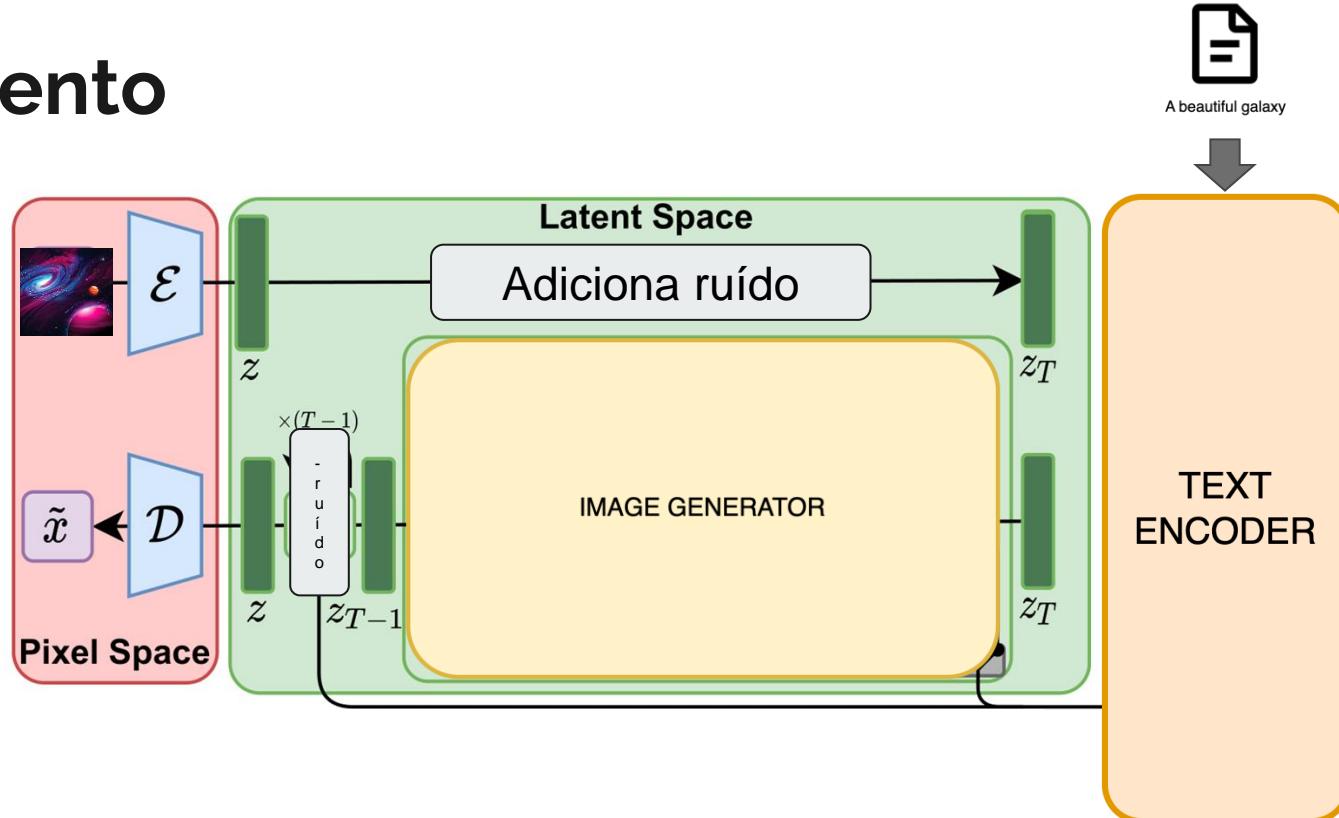
Stable Diffusion

Treinamento



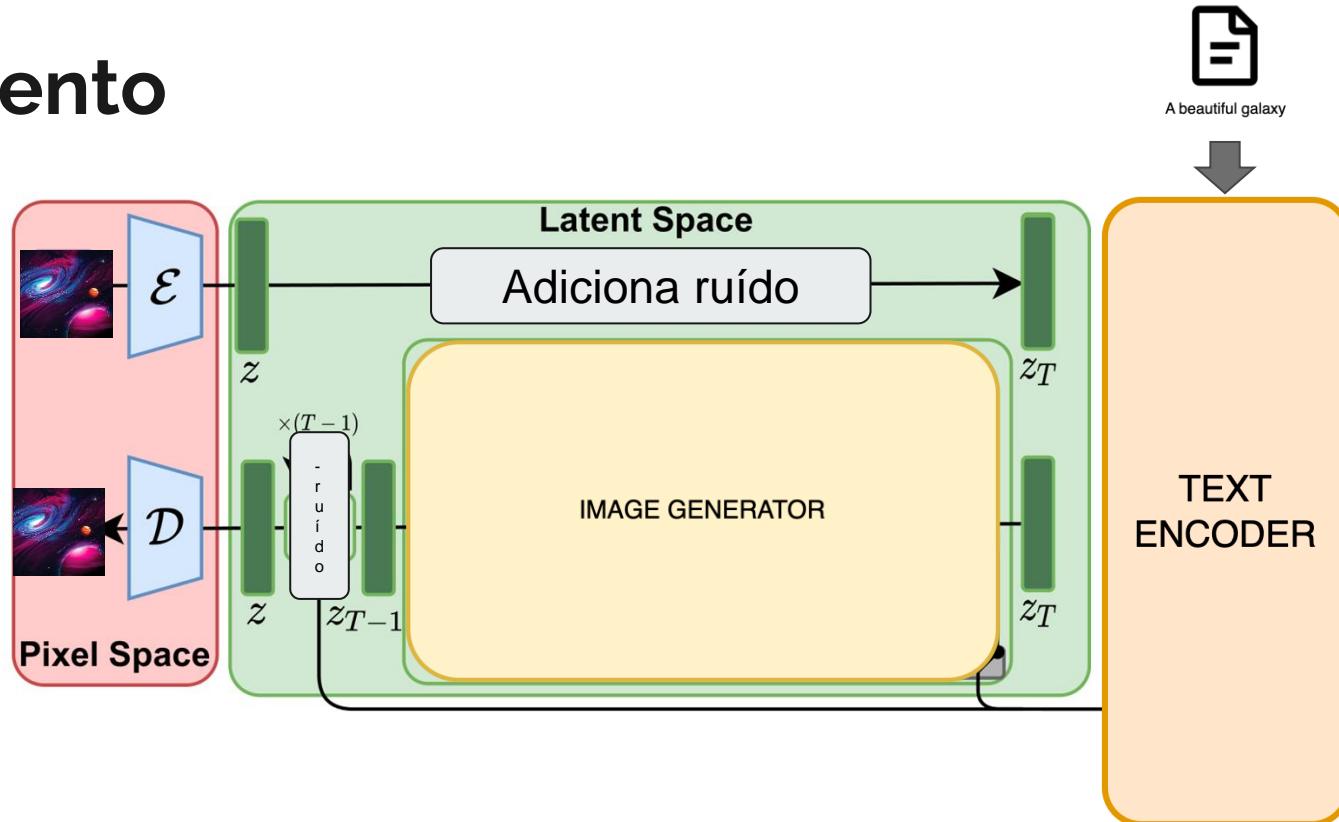
Stable Diffusion

Treinamento



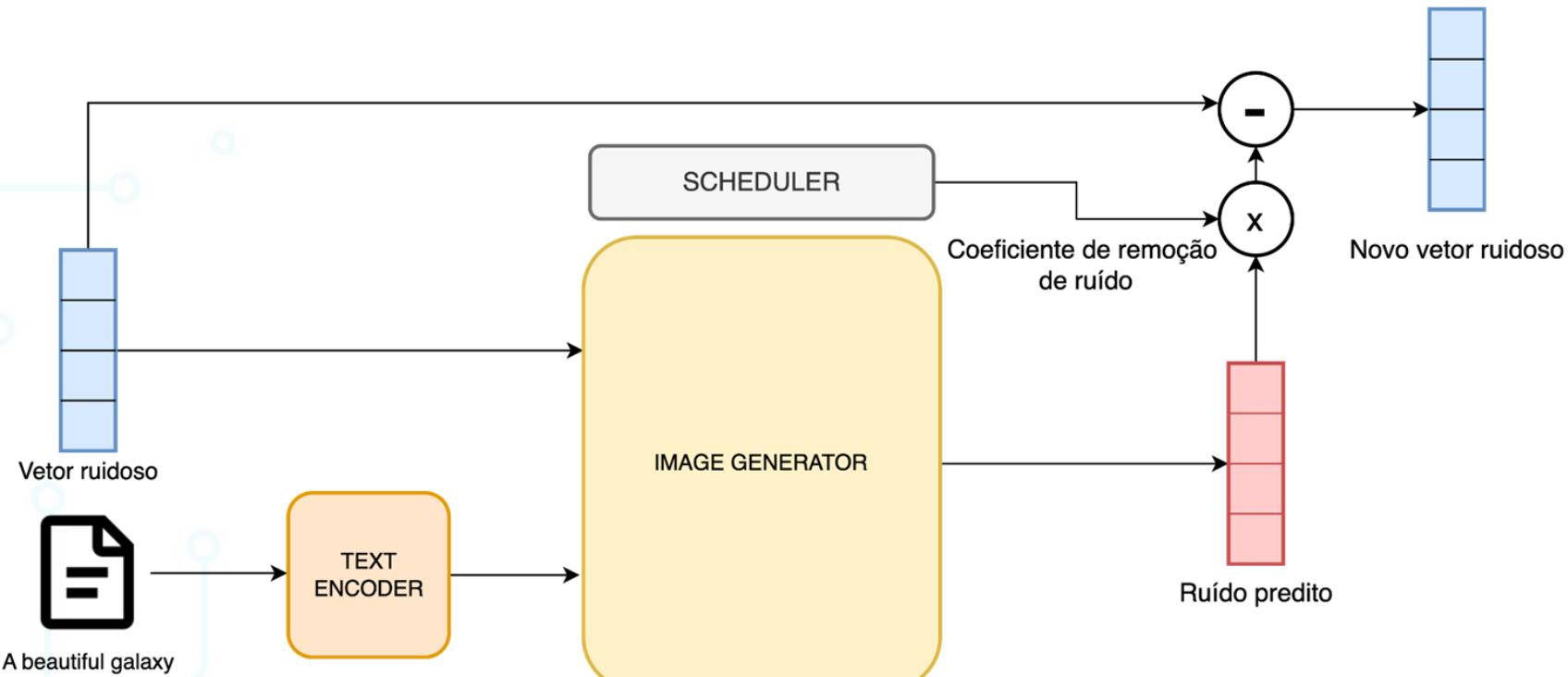
Stable Diffusion

Treinamento



Stable Diffusion

Inferência



Stable Diffusion

Referências

- [The Illustrated Stable Diffusion](#)
- [Hugging Face Diffusion course](#)
- [CLIP](#)
- [Deep Learning Foundations to Stable Diffusion from FastAi](#)
- [Finetuning Stable Diffusion with Keras](#)

Textual Inversion



A beautiful galaxy

STABLE DIFFUSION



Textual Inversion

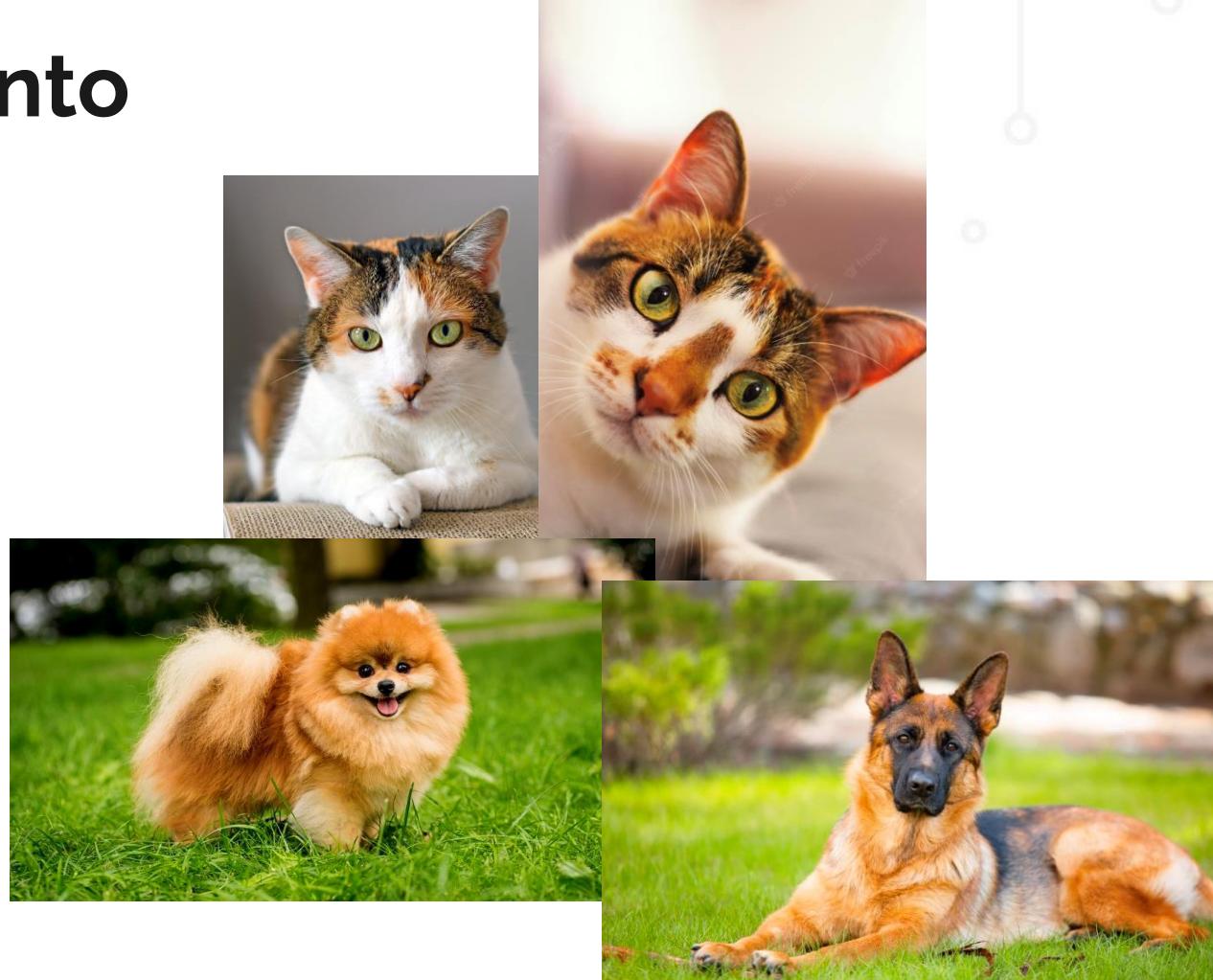
Dados fora do treinamento



Textual Inversion

Dados fora do treinamento

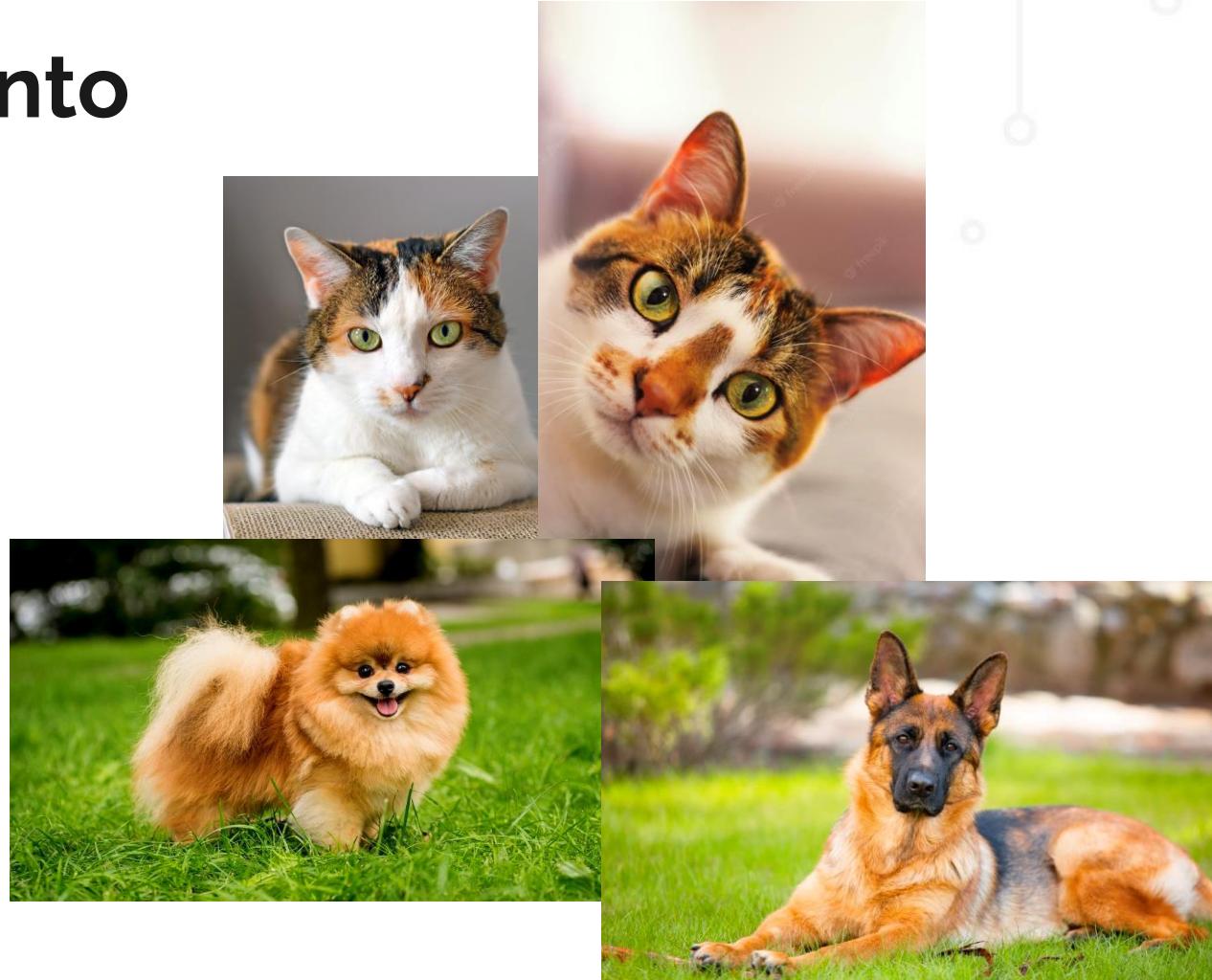
- Um gato em uma praça 



Textual Inversion

Dados fora do treinamento

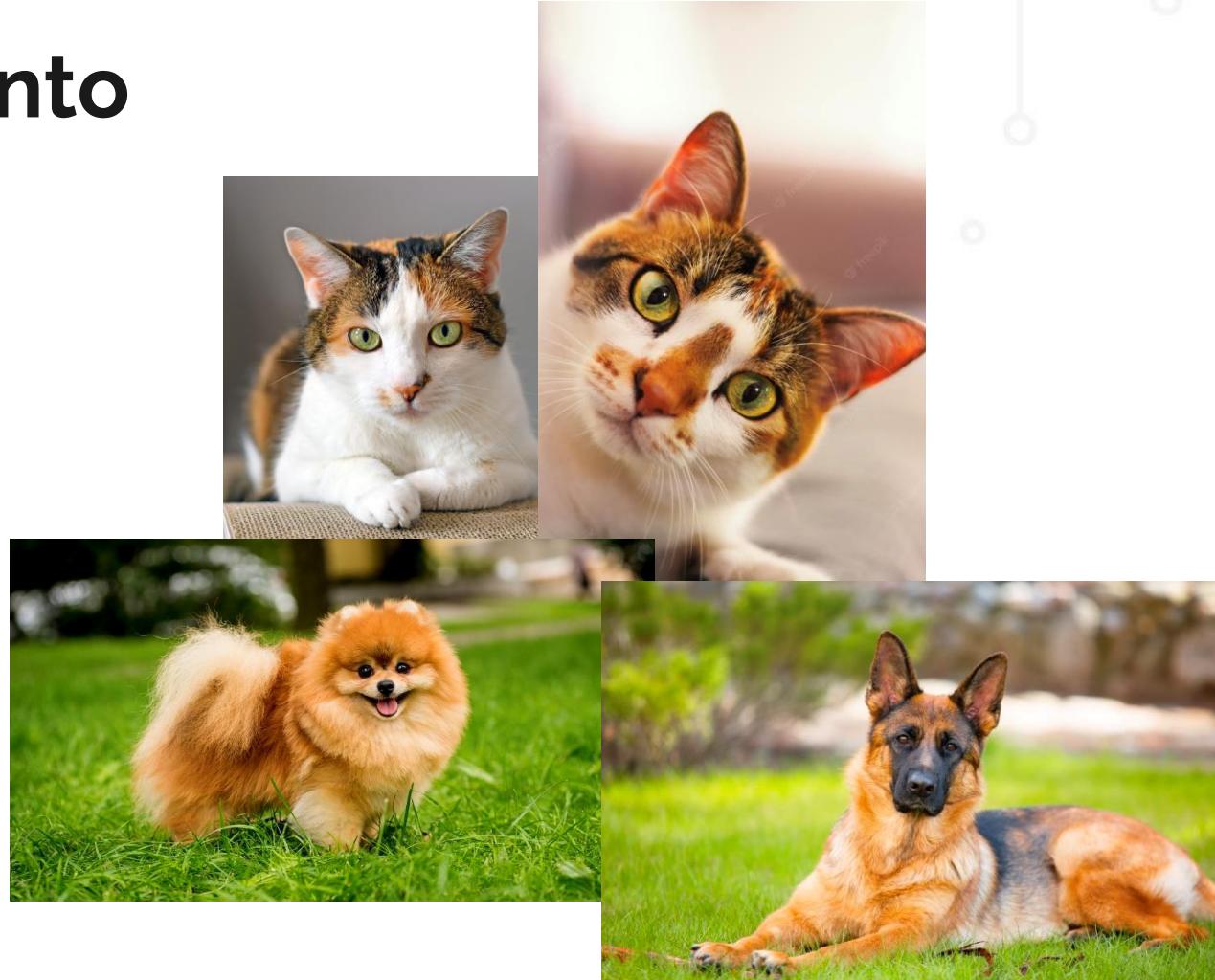
- Um gato em uma praça 
- Um cachorro na grama 



Textual Inversion

Dados fora do treinamento

- Um gato em uma praça 
- Um cachorro na grama 
- Um coelho no mato 



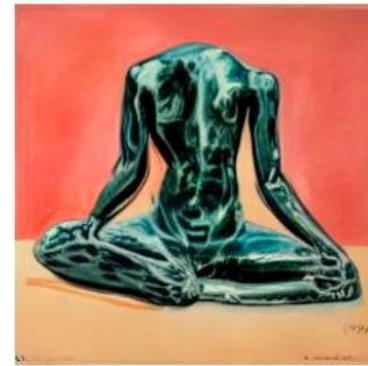
Textual Inversion

A inversão textual é uma técnica para capturar novos conceitos a partir de imagens de exemplo, que no geral é limitado. Os conceitos aprendidos podem ser usados para controlar melhor as imagens geradas a partir de pipelines de texto para imagem. De maneira simplista, o objetivo é aprender um novo token no espaço de embeddings do text encoder, os quais são usados para geração de imagem personalizada.

Textual Inversion



Input samples $\xrightarrow{\text{invert}}$ “ S_* ”



“An oil painting of S_* ”

“App icon of S_* ”

“Elmo sitting in the same pose as S_* ”

“Crochet S_* ”



Input samples $\xrightarrow{\text{invert}}$ “ S_* ”



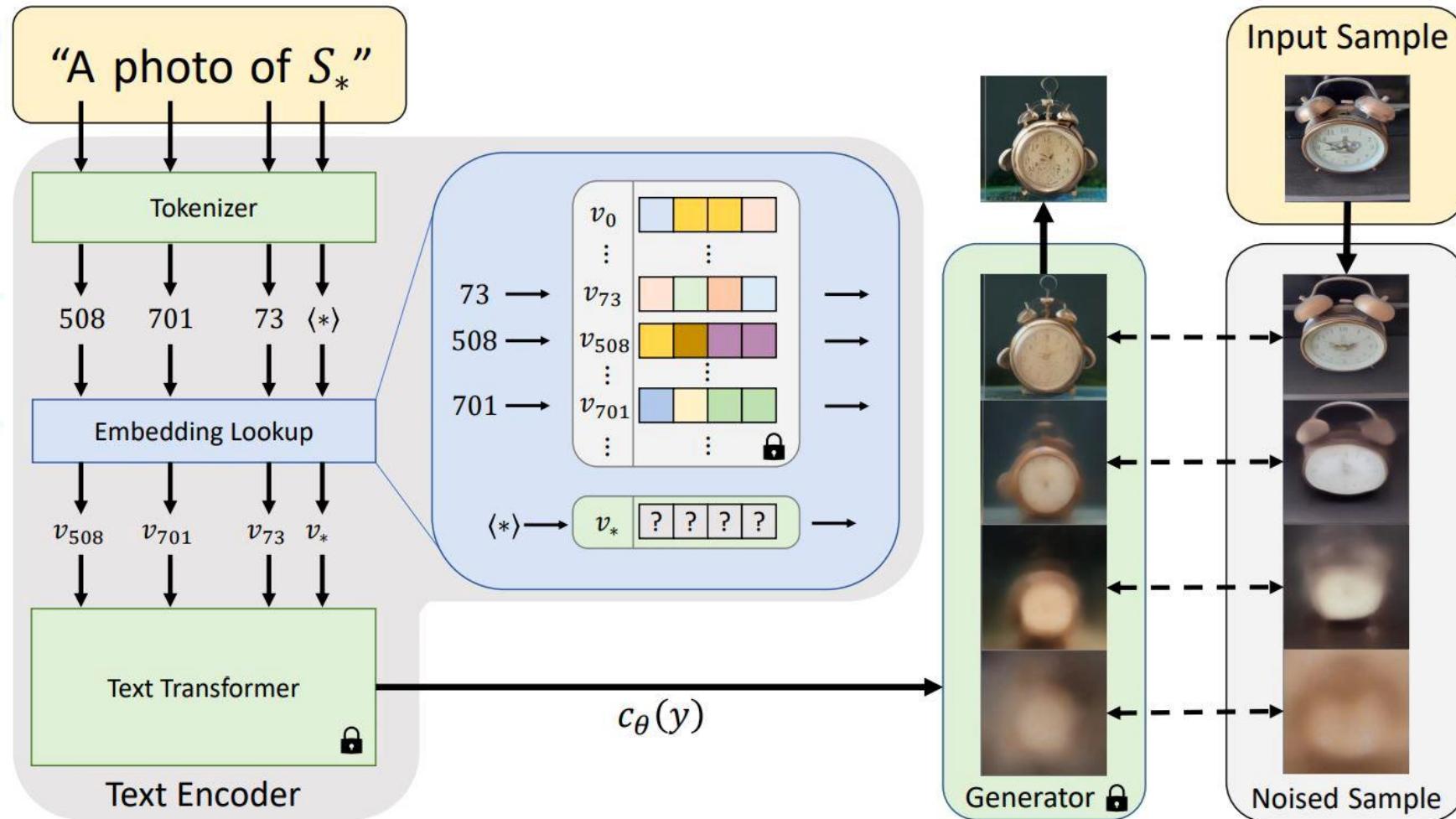
“Painting of two S_* fishing on a boat”

“A S_* backpack”

“Banksy art of S_* ”

“A S_* themed lunchbox”

Textual Inversion



Textual Inversion

carbon

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element periodic table symbol diamond atom structure wallpaper graphite pure chemistry di >

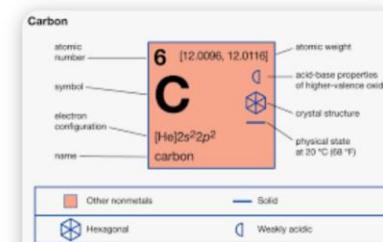
 

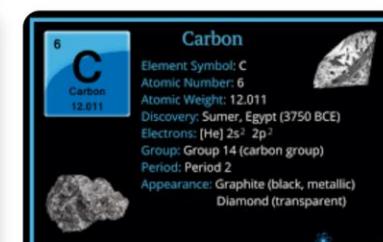
Carbon

atomic number	6 [12.0006, 12.0116]	atomic weight
symbol	C	acid-base properties of higher-valence oxides
electron configuration	[He]2s ² 2p ²	crystal structure
name	carbon	physical state at 20 °C (68 °F)

Other nonmetals Solid Hexagonal Weakly acidic

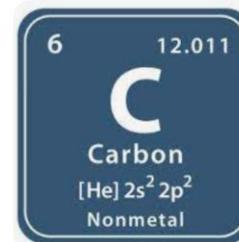
Encyclopedia Britannica, Inc.





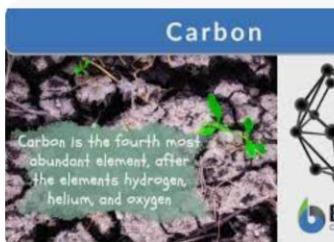




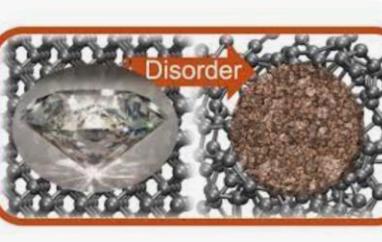












Textual Inversion

Search bar: c6 carbon

Filter buttons: All, News, Images (selected), Videos, Shopping, More, Tools, Saved, SafeSearch

Image suggestions: zo6, forged, bank, bank cartão de, cartões, credito c6, anuidade grátis, carbon mastercard, banco c6, sem anu



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C6 Carbon vale a pena? Veja os ...



[C6 Blog do C6 Bank](#)
Como funciona o C6 Carbon? | Blog ...



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C6 Carbon: o que é ...



[Senhor Viagens](#)
Conheça o cartão C6 Carbon...



[Passageiro de Primeira](#)
anuidade do cartão C6 Carbon ...



[YouTube](#)
C6 Carbon: 25.000 de limite



[Melhores Destinos](#)
C6 Carbon Mastercard Black tarif



[Foregon](#)
Cartão de Crédito C6 Bank Carbon



[C6 Bank - C6 Carbon n...](#)
C6 Bank - C6 Carbon n...



[Facebook](#)
C6 Bank: Numa galáx...



[Conta-Corrente](#)
C6 Bank agora disponibiliza o upgrade

Stable Diffusion



Textual Inversion

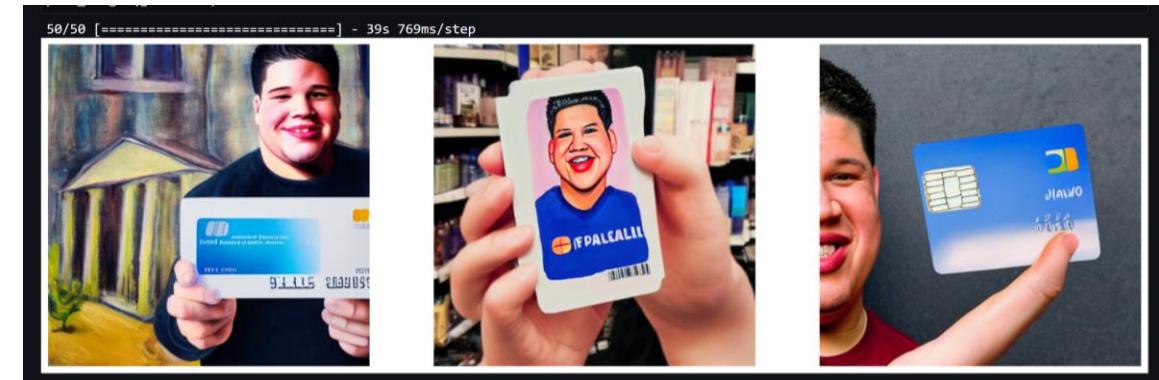
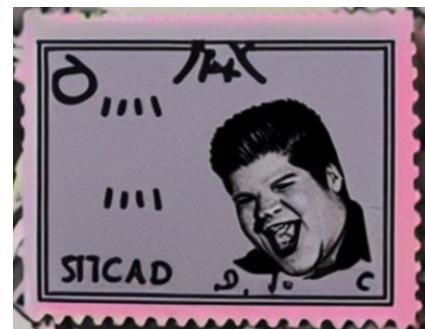


willlino

Textual Inversion

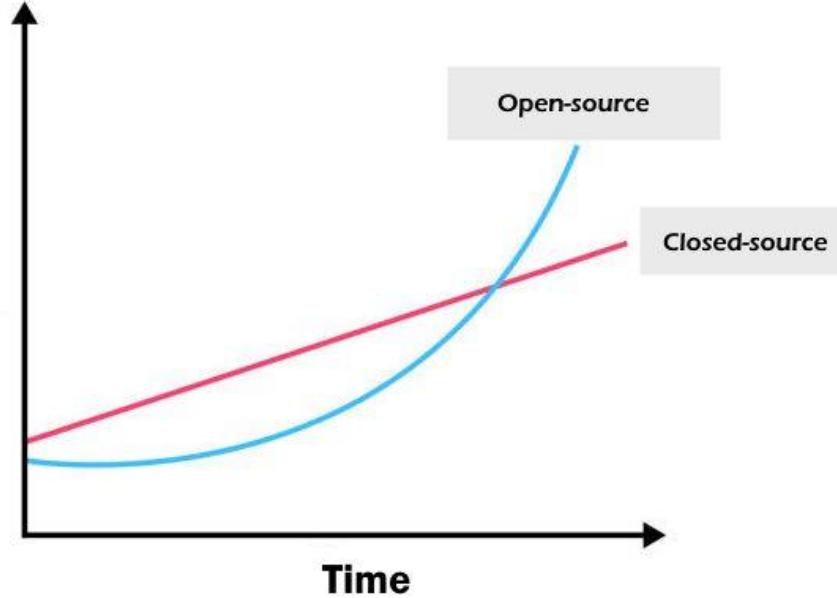


willlino



Open Source

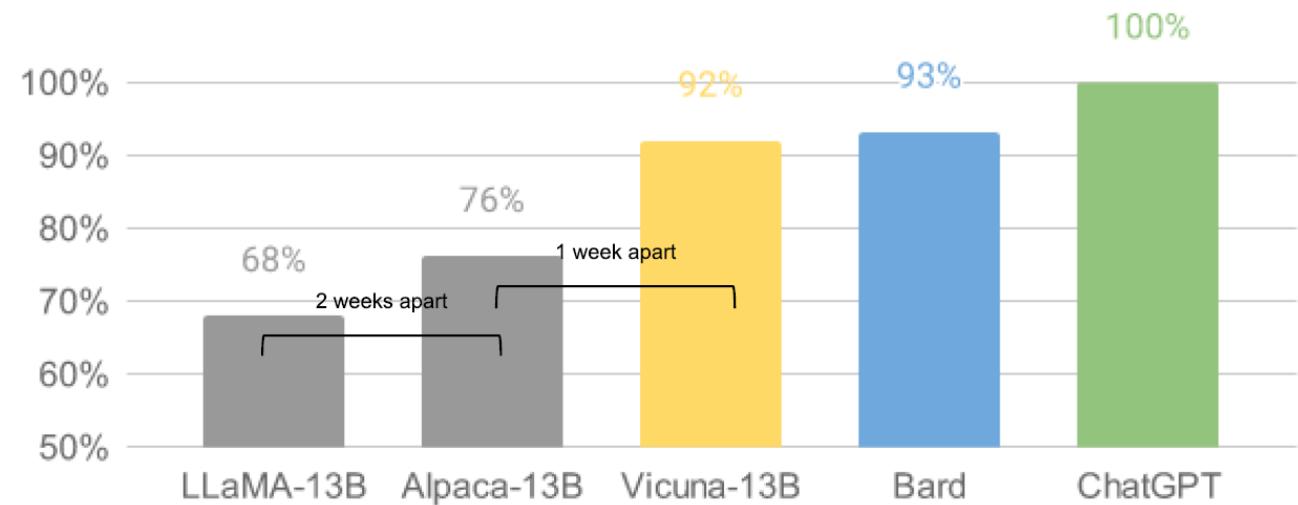
Capabilities of machine learning models



Google "We Have No Moat, And Neither Does OpenAI"

Leaked Internal Google Document Claims Open Source AI Will Outcompete Google and OpenAI

<https://www.semianalysis.com/p/google-we-have-no-moat-and-neither>



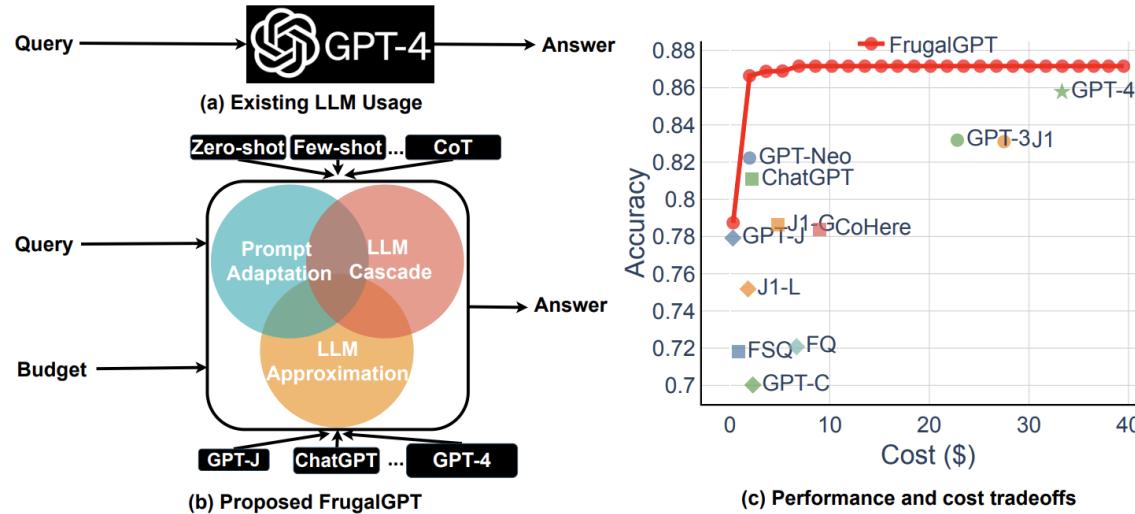
*GPT-4 grades LLM outputs. Source: <https://vicuna.lmsys.org/>

AI Generativa

FrugalGPT: How to Use Large Language Models While Reducing Cost and Improving Performance

Lingjiao Chen, Matei Zaharia, James Zou

Stanford University



<https://arxiv.org/pdf/2305.05176.pdf>



Pedro Gengo
@Predogl



Cabrita: A portuguese finetuned
instruction LLaMA



VinteDois-Diffusion



Piero Esposito
@piesposi_to



Vinicius Caridá
@vfcarida
Vinicius F. Caridá



<https://huggingface.co/22h>



<https://github.com/22-hours>

AI Generativa

Bloomberg the Company & Its Products ▾ | Bloomberg Terminal Demo Request |  Bloomberg Anywhere Remote Login | Bloomberg Customer Support

Bloomberg US

• Live Now Markets Economics Industries Technology Politics Wealth Pursuits Opinion Businessweek Equality

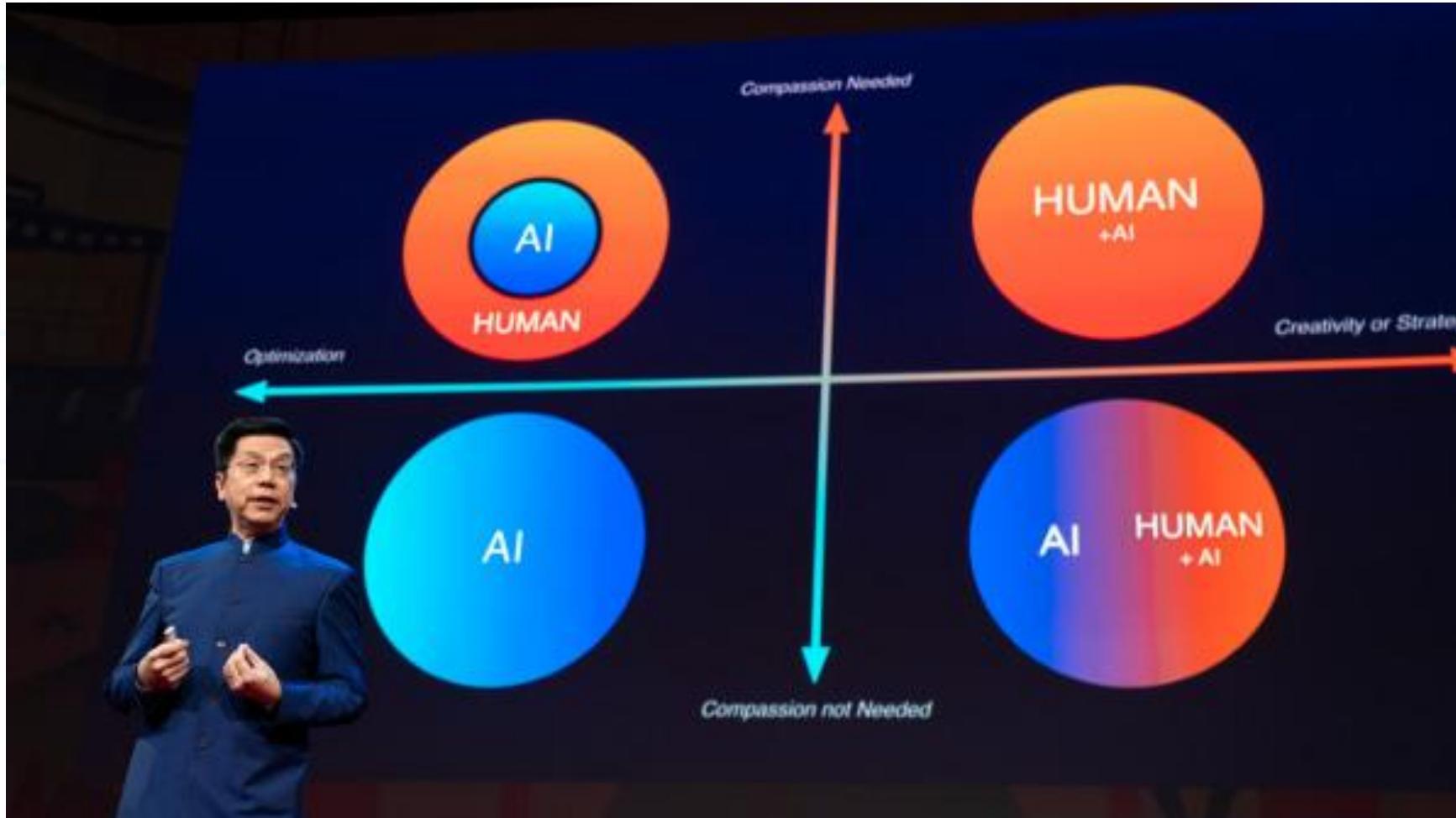
Work Shift Technology & Skills

Generative AI Boosts Worker Productivity 14% in First Real-World Study

<https://www.bloomberg.com/news/articles/2023-04-24/generative-ai-boosts-worker-productivity-14-new-study-finds#xj4y7vzkg>



AI Generativa



<https://www.youtube.com/watch?v=ajGgd9Ld-Wc>

AI Generativa

1886



Lei da Bandeira Vermelha (Red Flag Law), promulgada na Inglaterra em 1878. Este decreto obrigava que todo o automóvel fosse precedido de uma pessoa acenando uma bandeira vermelha, ou carregando uma lanterna à noite, para avisar os transeuntes sobre a aproximação da terrível máquina. Além disso, a velocidade não podia superar 6,4 km/h

1896



Quando a Volvo inventou o cinto de segurança de três pontos, em 1959, ela ofereceu a patente, de graça, a todos os seus concorrentes. De acordo com a empresa, a invenção era tão significativa que tinha mais valor como ferramenta gratuita para salvar vidas do que como algo para se obter lucro.



começou a ser utilizado de série nos veículos Mercedes Benz em 1984

AI Generativa



The screenshot shows the DeepLearning.AI website. At the top, there's a navigation bar with links: Courses, The Batch, Blog, Events, Resources, Company, and a red "Get AI News" button. Below the navigation is a large banner for a "SHORT COURSE" titled "ChatGPT Prompt Engineering for Developers". The banner features a colorful geometric graphic of interlocking shapes in yellow, blue, and pink. A "Learn for Free" button is visible. At the bottom left, it says "IN COLLABORATION WITH" and shows the OpenAI logo.

<https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/>

The screenshot shows the MIT website for the "Introduction to Deep Learning" course. The page has a dark background with a colorful abstract graphic of buildings. The MIT logo is in the top left. The main title "Introduction to Deep Learning" is in large white text. Below it, a subtitle reads "MIT's introductory program on deep learning methods with applications in language, and more!". A video player window shows two people speaking. A blue button at the bottom right says "2023 Edition is HERE!" and "Subscribe for updates".

<http://introtodeeplearning.com/>

Thanks !



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<https://linktr.ee/vfcarida>