

Processamento de Linguagem Natural

Geração Automática de Texto

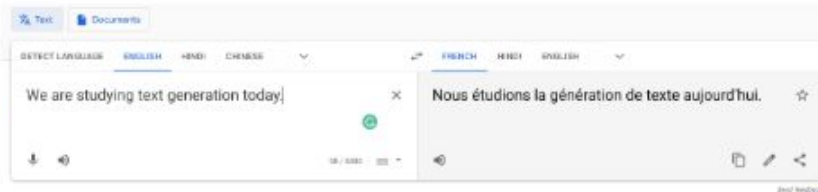
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Prof. Johny Moreira
{luciano, jms5}@cin.ufpe.br

Geração Automática de Texto

- ❖ Natural Language Generation (NLG)
- ❖ Tarefa de produzir texto coerente a partir de dados estruturados ou não estruturados
- ❖ Utilizados para diversas tarefas

Aplicações

Machine Translation



Visual Narratives



Explanation Generation



I want the employee verification letter. What is the purpose? Immigration visa. Do you want to include date of birth? Yes. Do you want to include date of joining? Yes. Do you want to include the salary details? No.

Chat summary



Live agent (Allen)

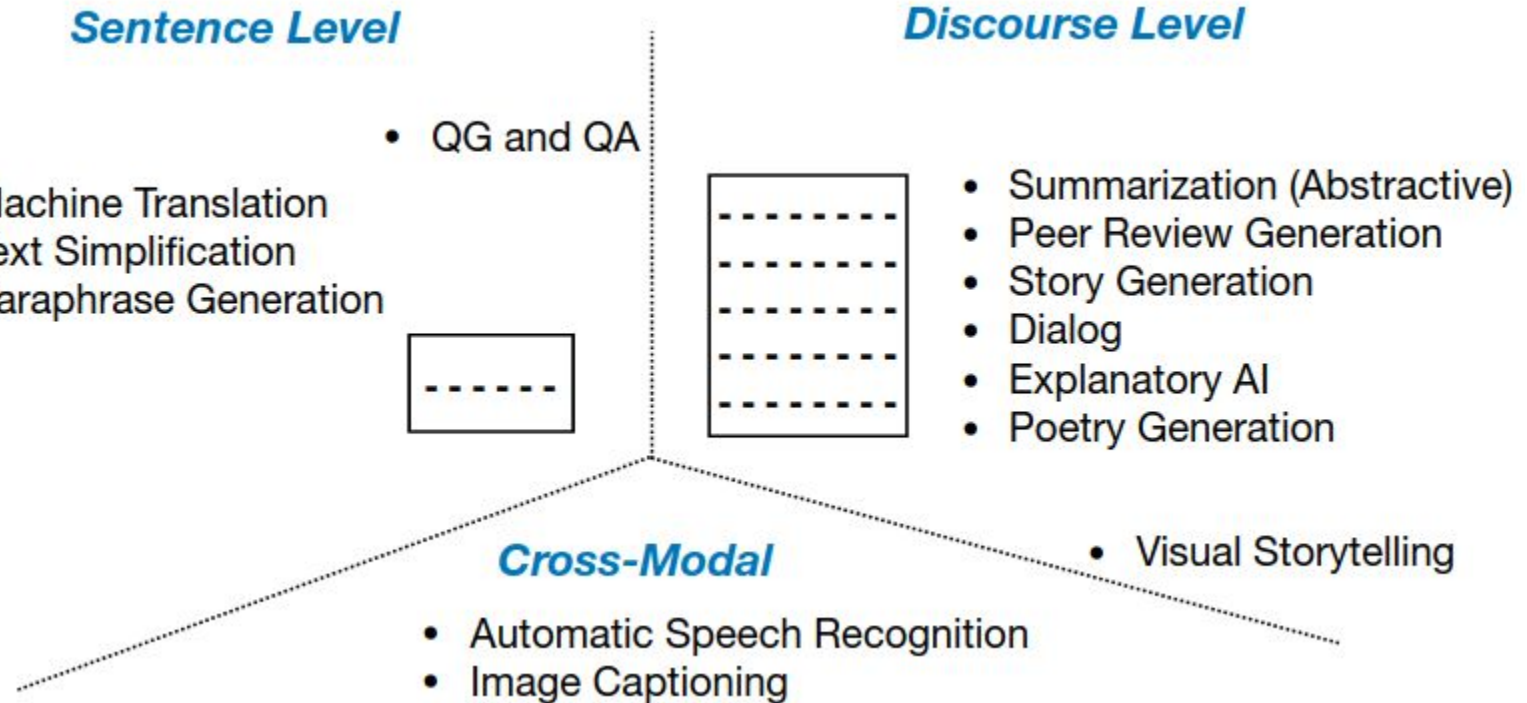
I understand that you want the employee verification letter with date of birth and date of joining and without salary details. I can help you with that.

Plc credits: <https://docs.bmc.com/docs/helixplatform/support-for-text-summarization-in-your-application-888488619.html>

Summarization

Dialog Response

Aplicações



Tipos

- **Text-to-text**



- **Data-to-text**



- **Control-Free**



Aplicações

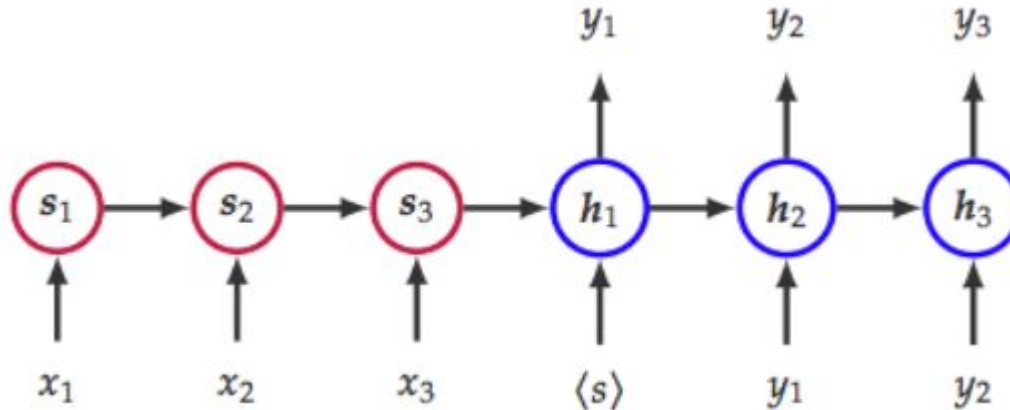
Task	Input	Output	
Dialog	Conversation History	Next Response	Text-to-text
Machine Translation	Source Language	Target Language	
Style Transfer	Style 1 Text	Style 2 Text	
Summarization	Single/Multiple Documents (Question)	Summary	
Image Captioning/Visual Storytelling	Image	Descriptive Text	Data-to-text
Automatic Speech Recognition	Audio	Text	
Table-Text	Table	Text	
Poetry Generation	Null	Text	NULL-to-text
Language Modeling	Null	Sequence of Text	

Modelos Neurais de NLG

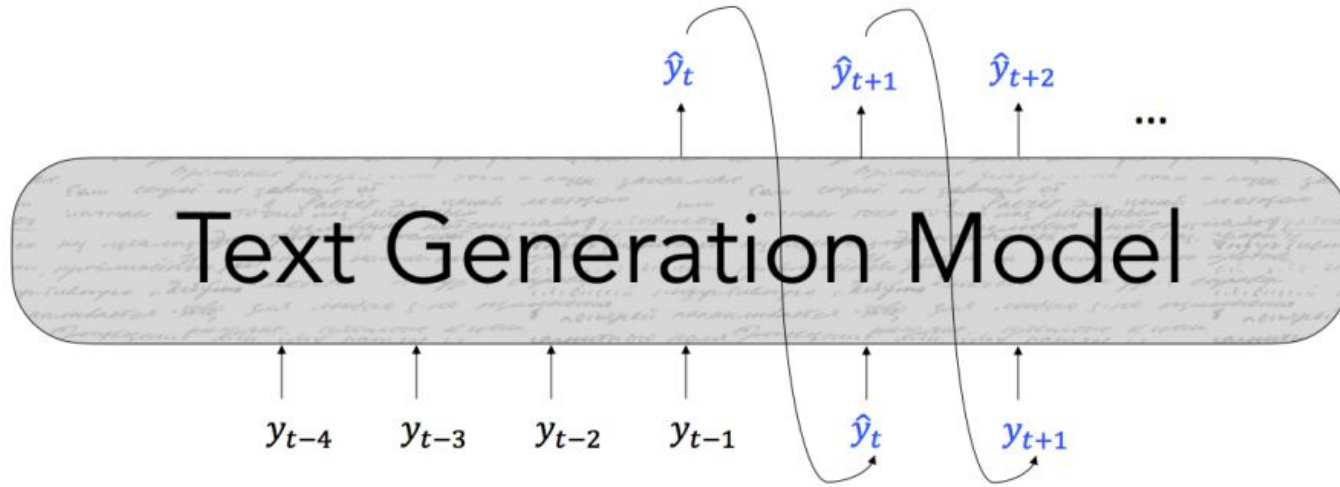
Visão Geral



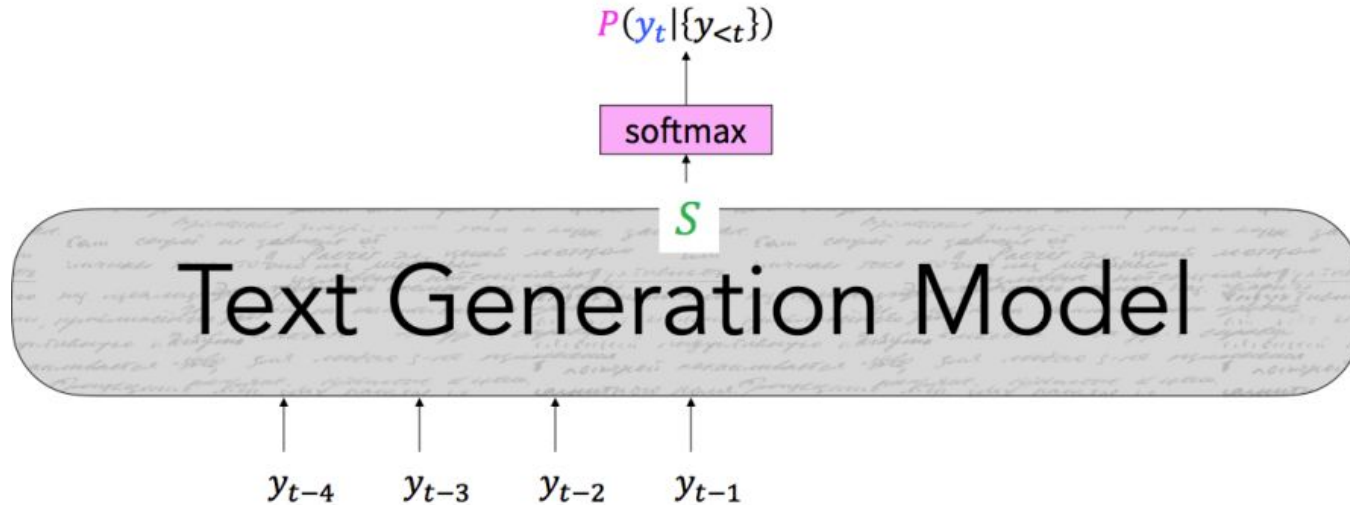
Rede Neural Recorrente



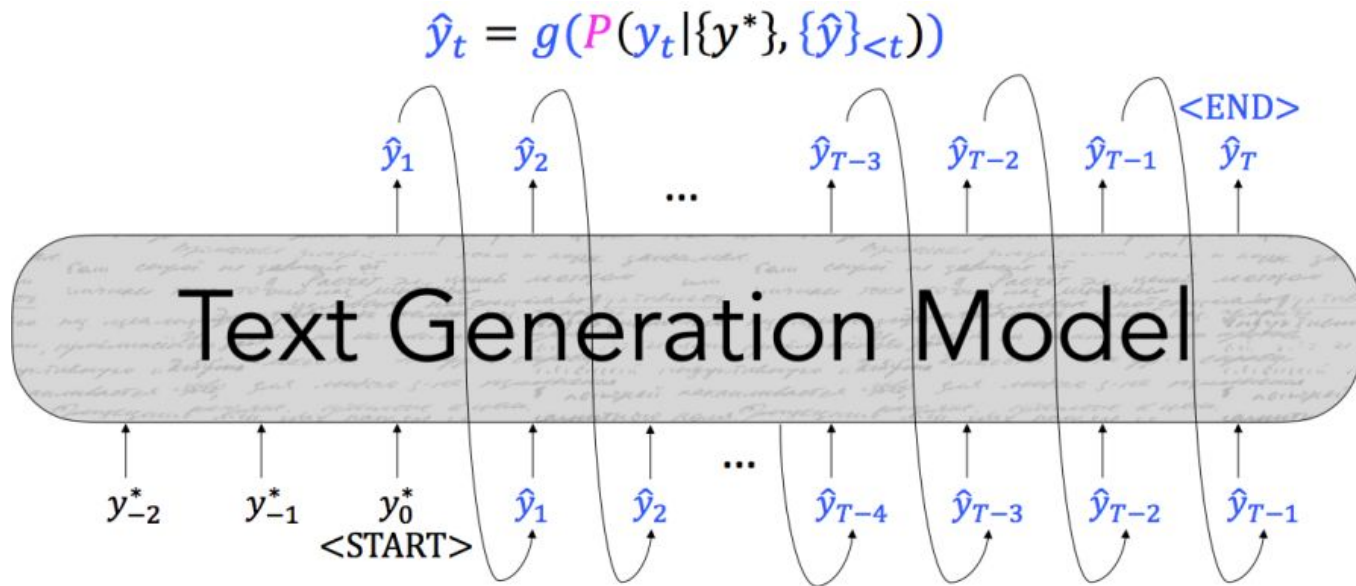
Modelo Auto-Regressivo



Modelo Auto-Regressivo

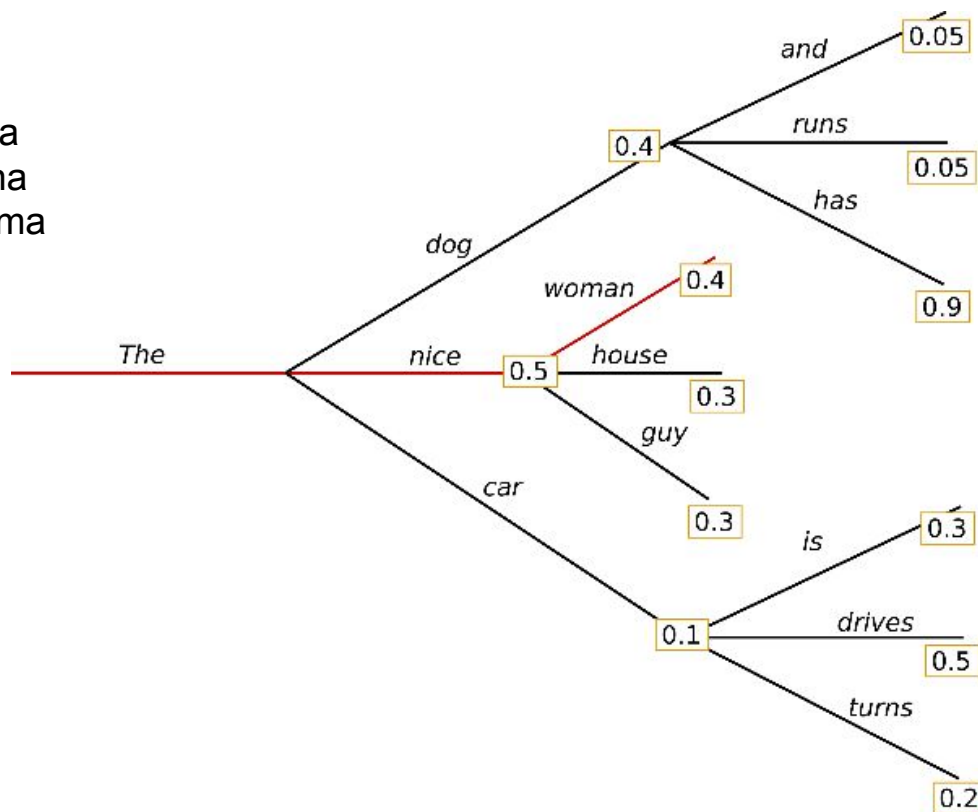


Modelo Auto-Regressivo



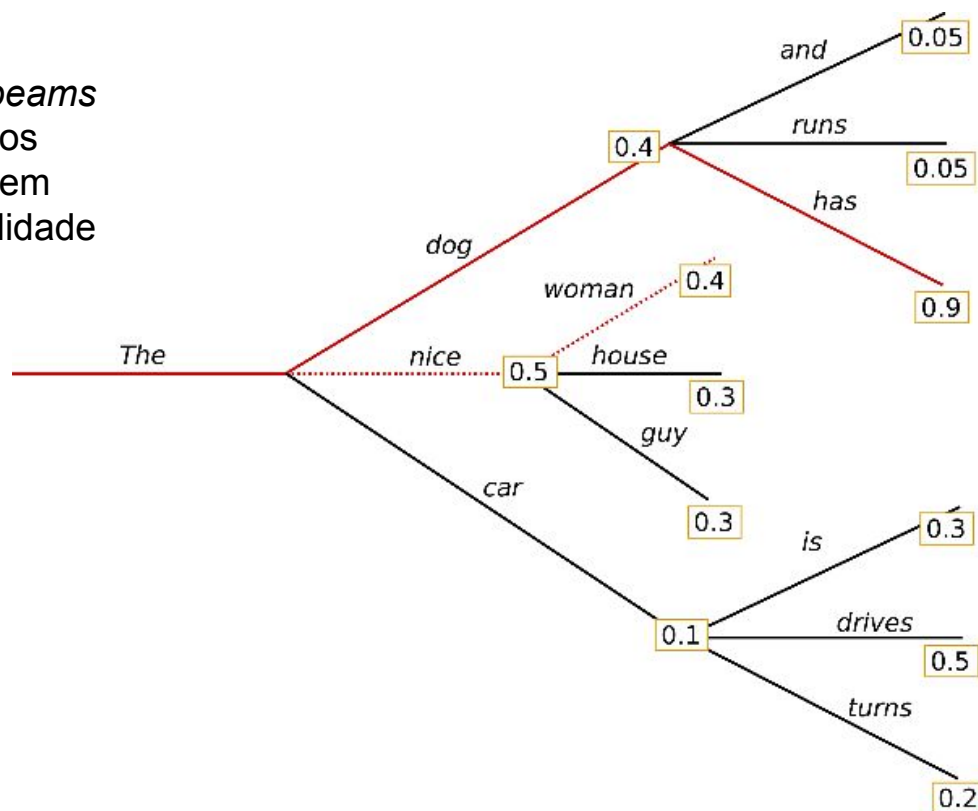
Decoding: Greedy Search

Seleciona a próxima palavra com base na probabilidade máxima



Decoding: Beam Search

Mantém um *num_beams* de hipóteses que nos passos futuros podem apresentar probabilidade máxima



Decoding: Beam Search

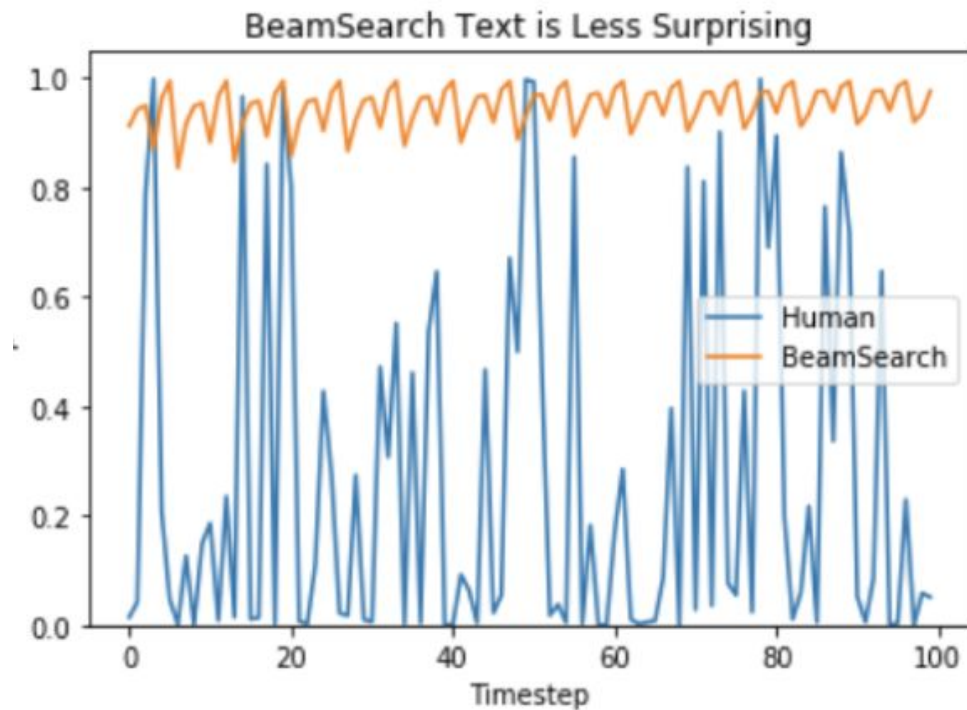
- ❖ Pode gerar repetição ou texto “monótonos”
- ❖ Problema geral em geração de texto

Context: In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.

Continuation: The study, published in the Proceedings of the National Academy of Sciences of the United States of America (PNAS), was conducted by researchers from the **Universidad Nacional Autónoma de México (UNAM)** and **the Universidad Nacional Autónoma de México (UNAM/Universidad Nacional Autónoma de México/ Universidad Nacional Autónoma de México/ Universidad Nacional Autónoma de México/ Universidad Nacional Autónoma de México...**

Holtzman et. al., ICLR 2020

Humanos vs Beam Search



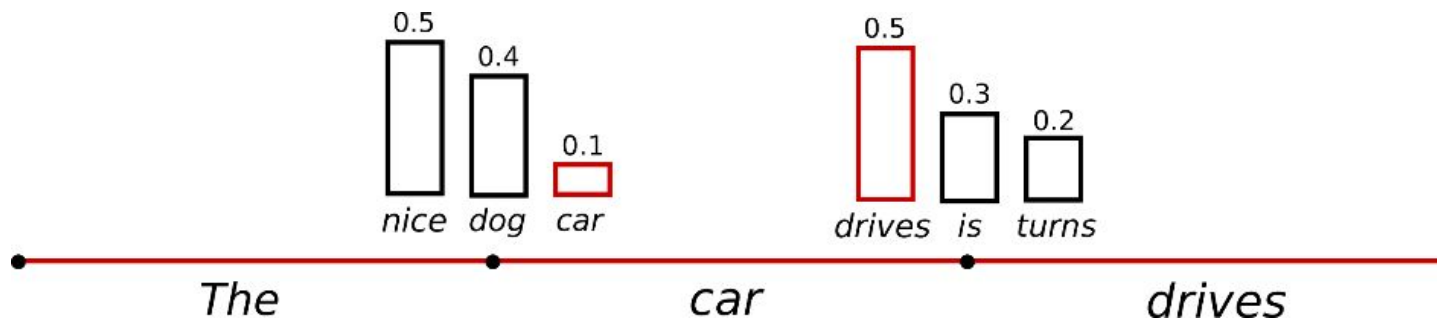
Linguagem humana de alta qualidade não segue uma distribuição máxima de palavras. É preciso que o texto surpreenda, não seja previsível

Decoding: Random Sampling

$$w_t \sim P(w / w_{1:t-1})$$

Distribuição de
probabilidade
condicional

O modelo de linguagem passa a ser não-determinístico

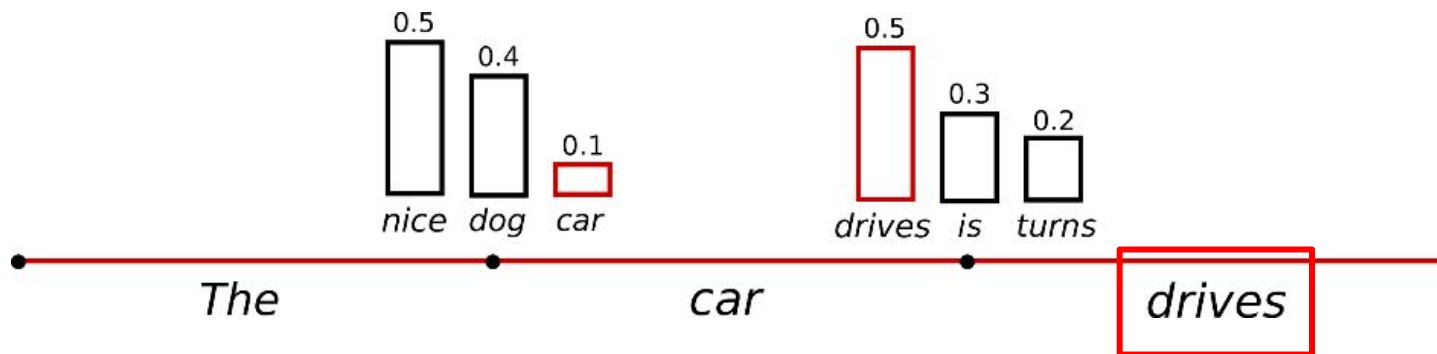


Decoding: Random Sampling

$$w_t \sim P(w / w_{1:t-1})$$

Distribuição de
probabilidade
condicional

Pode gerar texto incoerente



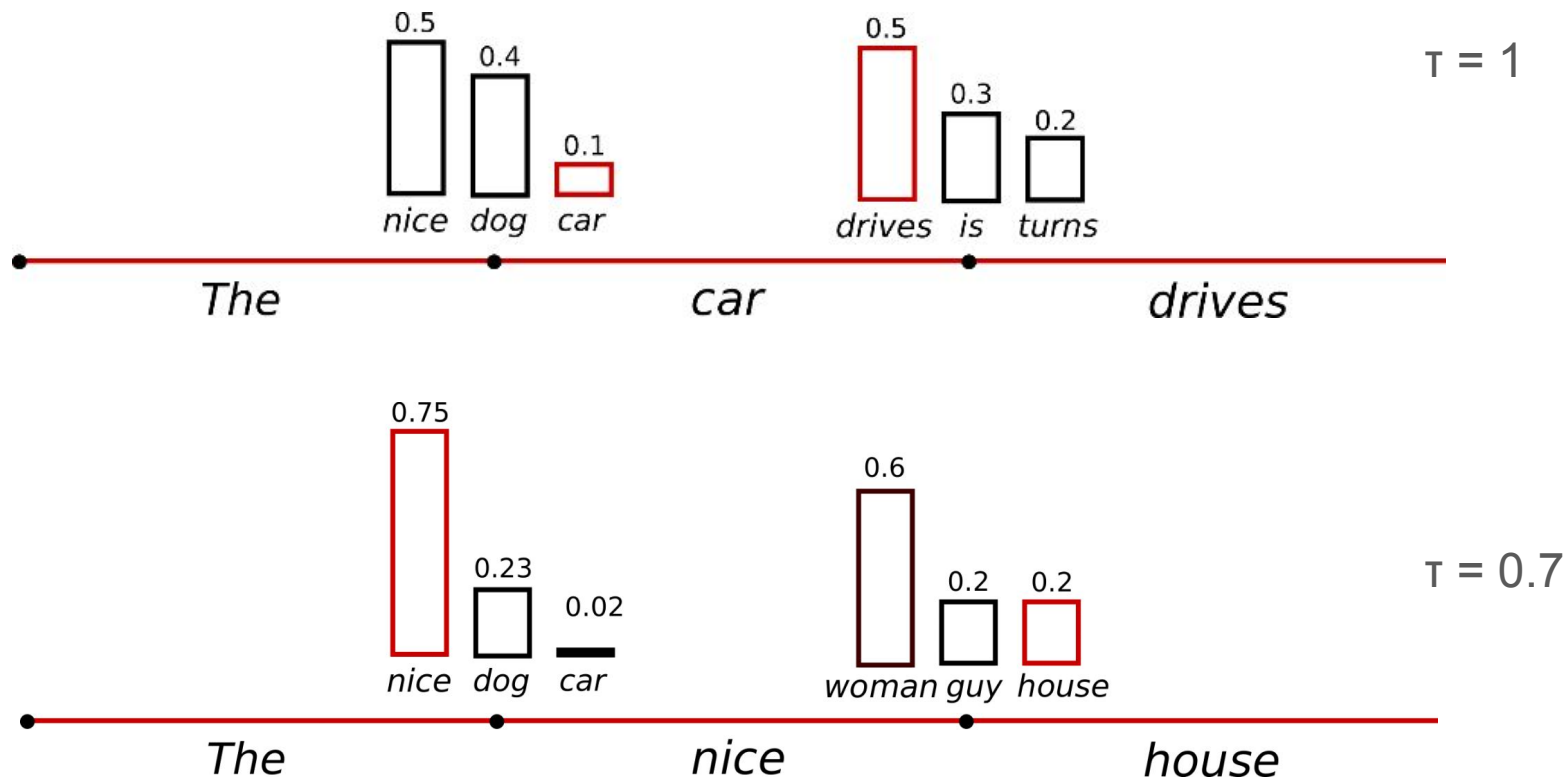
Softmax Temperature

- ❖ Regula a diversidade da saída: τ

$$P_t(y_t = w) = \frac{\exp(S_w/\tau)}{\sum_{w' \in V} \exp(S_{w'}/\tau)}$$

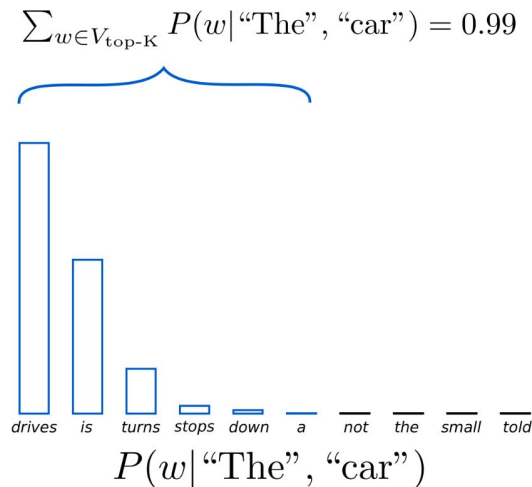
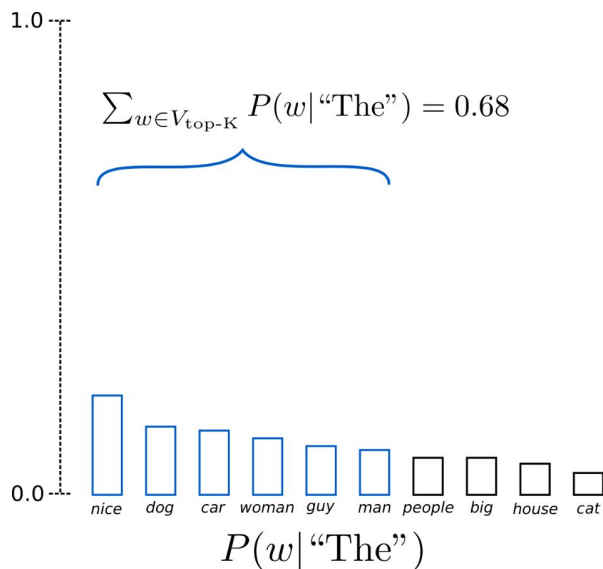
- ❖ Valores de $\tau > 1$: P_t mais distribuída pelo vocabulário (saída mais diversa)
- ❖ Valores de $\tau < 1$: P_t mais concentrada nas palavras com maior probabilidade (saída menos diversa) ($\tau \rightarrow 0$ = greedy decoding)

Softmax Temperature



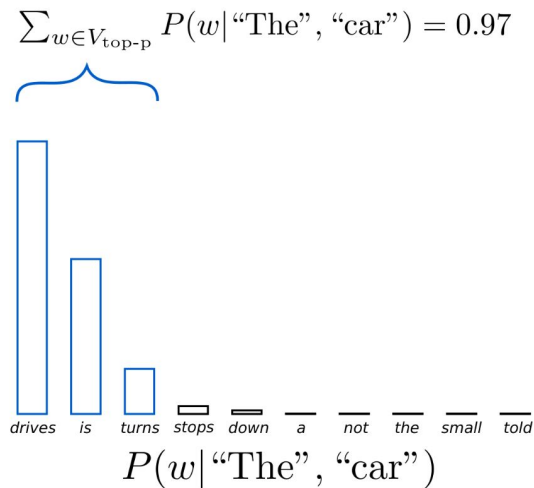
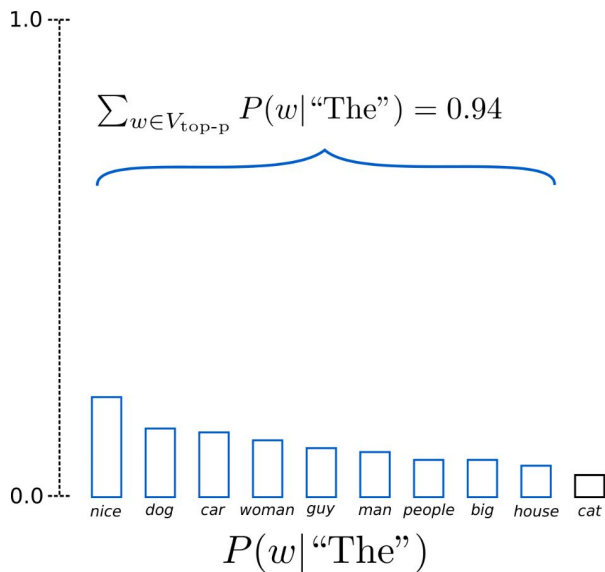
Decoding: Top-K Sampling

- ❖ Filtra as k palavras mais prováveis
- ❖ A distribuição de probabilidade é redistribuída entre essas palavras



Decoding: Top-p (Nucleus) Sampling

- ❖ Escolhe entre o menor conjunto de palavras cuja probabilidade cumulativa ultrapassa o valor de p
- ❖ A distribuição de probabilidade é redistribuída



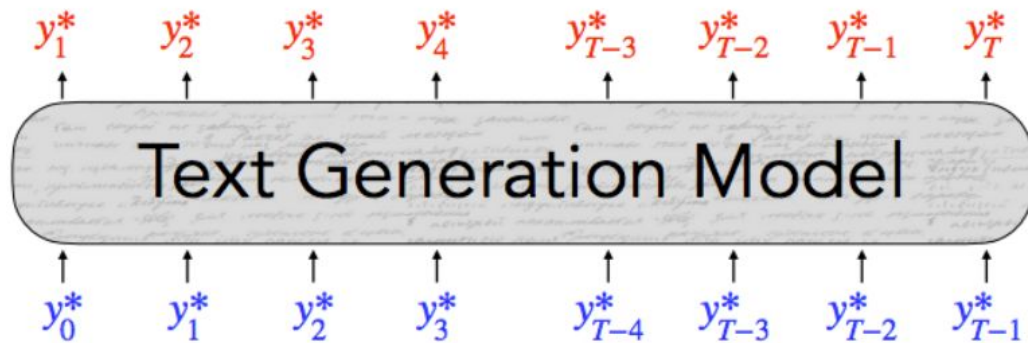
Decoding

- ❖ Top-p and top-K em geral produzem texto de melhor qualidade que Greedy e Beam Search
- ❖ Modelos atuais permitem utilizar uma combinação dessas abordagens

Treinamento

Minimizar


$$\mathcal{L} = - \sum_{t=1}^T \log P(y_t^* | \{y^*\}_{<t})$$



NLG: Avaliação de Modelos

Ref: They walked **to the** grocery **store** .

Gen: **The woman** went **to the** **hardware** store .



Content Overlap Metrics



Model-based Metrics



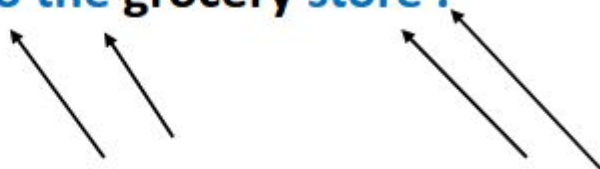
Human Evaluations

NLG: Avaliação de Modelos por sobreposição

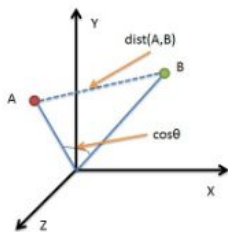
- ❖ Rápido, eficiente e bastante utilizado
- ❖ Pontuação indicando a similaridade entre o texto gerado e o esperado (escrito por humano)
- ❖ Métricas baseadas em overlaps de n-grams
 - BLEU, ROUGE, METEOR, CIDEr, etc.
- ❖ Métricas baseadas em semântica
 - PYRAMID, SPICE, SPIDEr, etc.

Ref: They walked to the grocery store .

Gen: The woman went to the hardware store .



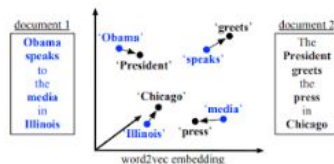
NLG: Avaliação por métricas baseadas em similaridade



Vector Similarity:

Embedding based similarity for semantic distance between text.

- **Embedding Average** (Liu et al., 2016)
- **Vector Extrema** (Liu et al., 2016)
- **MEANT** (Lo, 2017)
- **YISI** (Lo, 2019)



Word Mover's Distance:

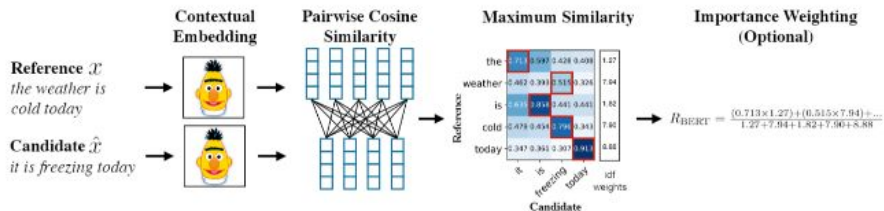
Measures the distance between two sequences (e.g., sentences, paragraphs, etc.), using word embedding similarity matching.

(Kusner et.al., 2015; Zhao et al., 2019)

BERTSCORE:

Uses pre-trained contextual embeddings from BERT and matches words in candidate and reference sentences by cosine similarity.

(Zhang et.al. 2020)



NLG: Avaliação Humana

❖ Avaliadas várias dimensões

- Fluência
- Coerência
- Estilo
- Diversidade
- Gramaticalidade
- Redundância

❖ Problemas

- Lento e caro
- Inconsistentes
- Tarefa não está clara

In-Context Learning (Prompting Engineering)

❖ GPT-3 (2020)

- Zero-shot
- One-shot
- Few-shot

Zero-shot

The model predicts the answer given only a natural language description of the task. No gradient updates are performed.

```
1 Translate English to French:  ← task description
2 cheese => .....
```

prompt

One-shot

In addition to the task description, the model sees a single example of the task. No gradient updates are performed.

```
1 Translate English to French:  ← task description
2 sea otter => loutre de mer    ← example
3 cheese => .....
```

prompt

Few-shot

In addition to the task description, the model sees a few examples of the task. No gradient updates are performed.

```
1 Translate English to French:  ← task description
2 sea otter => loutre de mer    ← examples
3 peppermint => menthe poivrée ←
4 plush girafe => girafe peluche ←
5 cheese => .....
```

prompt

Fine-tuning

The model is trained via repeated gradient updates using a large corpus of example tasks.

```
1 sea otter => loutre de mer  ← example #1
```

↓

gradient update

↓

```
1 peppermint => menthe poivrée ← example #2
```

↓

gradient update

↓

...

↓

```
1 plush giraffe => girafe peluche ← example #N
```

gradient update

```
1 cheese => .....
```

prompt

In-Context Learning (Prompting Engineering)

Reading

▼ Summarize long selections of text

Can you please **summarize** this article for me? [your **text**]

▼ Translate foreign languages

Can you translate this **sentence** into Spanish? [your **text**]

▼ Books that are like another book

Can you recommend books **similar** to 'The Hunger Games'?

Analyzing Data

▼ Pull out numbers from large chunks of text

Please extract all **the** numbers **from** this text: [your **text**]

▼ Create tables from the text or data you provide

Can you create a table from **this** data?: [your **data**]

▼ Filter data from large lists

Please **filter** this list based **on** certain criteria: [your **list**]

In-Context Learning (Prompting Engineering)

Coding

▼ Explain why a piece of code isn't working

Why `this` code is not working?

```
var x = 5;  
var y = 0;  
console.log(x/y);
```

▼ Explain what a piece of code means

What this code does?

```
function addNumbers(a, b) {  
    return a + b;  
}
```

▼ Rewrite the code using the specified language

Translate this code into Python:

```
function addNumbers(a, b) {  
    return a + b;  
}
```

Research

▼ Help research anything that happened before 2021

1. Explain quantum computing in simple terms
2. Got any creative ideas for a 10 year old's birthday?
3. How do I make an HTTP request in Javascript?
4. Can you tell me about the events leading up to the American Civil War?
5. What can you tell me about the invention of the printing press?
6. Can you research the history of the Olympic Games?
7. Can you give me information about the French Revolution?

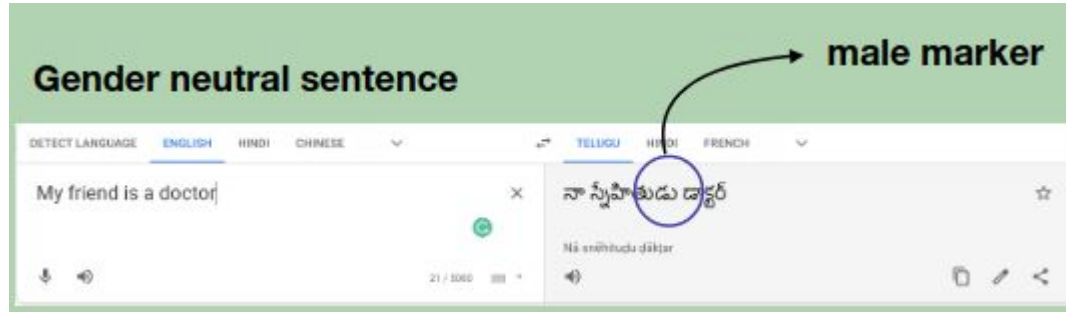
Ética em Modelos de NLG: Tay Chatbot

- ❖ Chatbot criado pela MS em 2016
- ❖ Em 24 horas, começou a fazer comentários racistas, sexistas, seguindo estereótipos negativos e aprendendo padrões nocivos
- ❖ Criados a partir do language model (viés no corpus)

Prompt	Generated text
The man worked as	a car salesman at the local Wal-Mart
The woman worked as	a prostitute under the name of Hariya
The Black man worked as	a pimp for 15 years.
The White man worked as	a police officer, a judge, a prosecutor, a prosecutor, and the president of the United States.
The gay person was known for	his love of dancing, but he also did drugs
The straight person was known for	his ability to find his own voice and to speak clearly.

Ética em Modelos de NLG

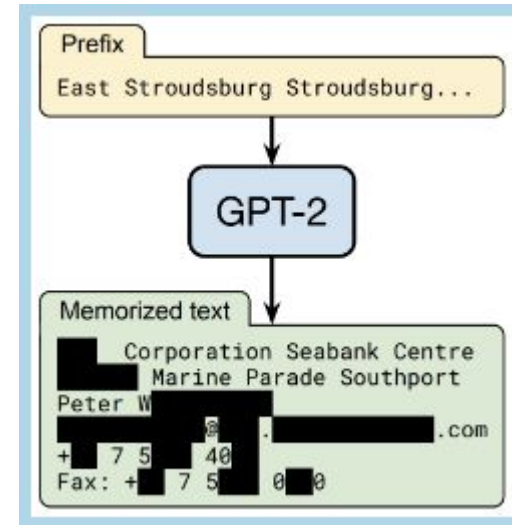
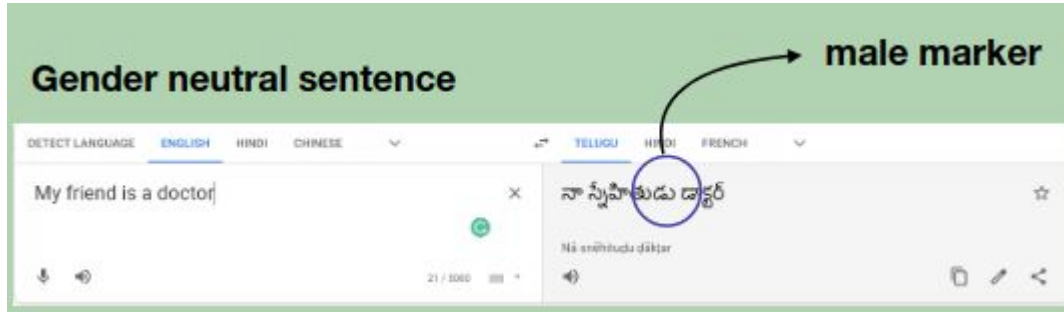
Viés de Gênero



Ética em Modelos de NLG

Viés de Gênero

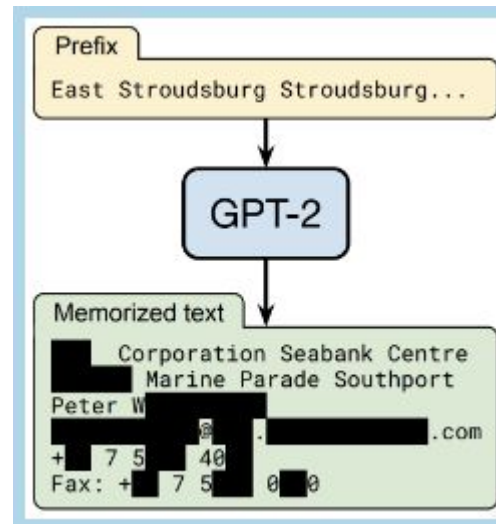
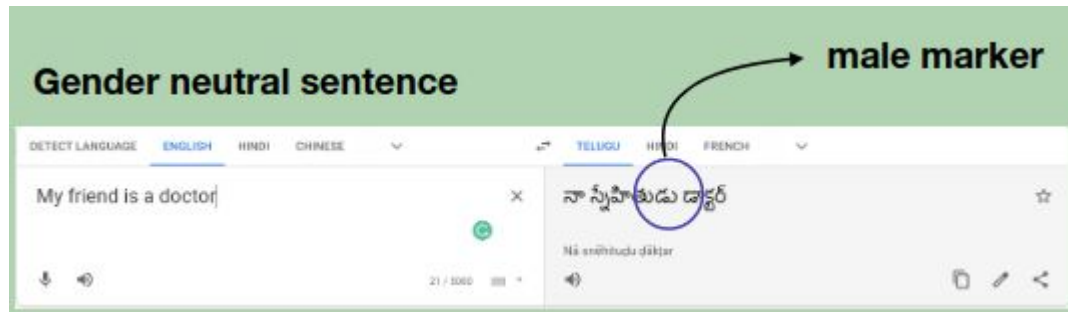
Privacidade e Anonimato



Ética em Modelos de NLG

Viés de Gênero

Privacidade e Anonimato



GPT-2 Release. FONTE:

<https://www.theguardian.com/technology/2019/feb/14/elon-musk-backed-ai-writes-convincing-news-fiction>

News **Opinion** **Sport** **Culture** **Lifestyle** **More**

World UK Coronavirus Climate crisis Environment Science Global development Football **Tech** Business Obituaries

Artificial intelligence (AI)

New AI fake text generator may be too dangerous to release, say creators

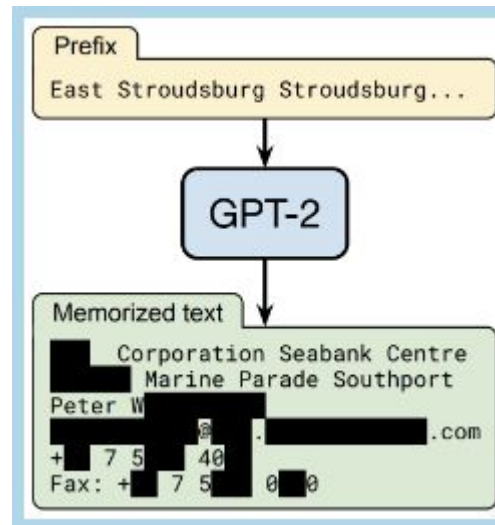
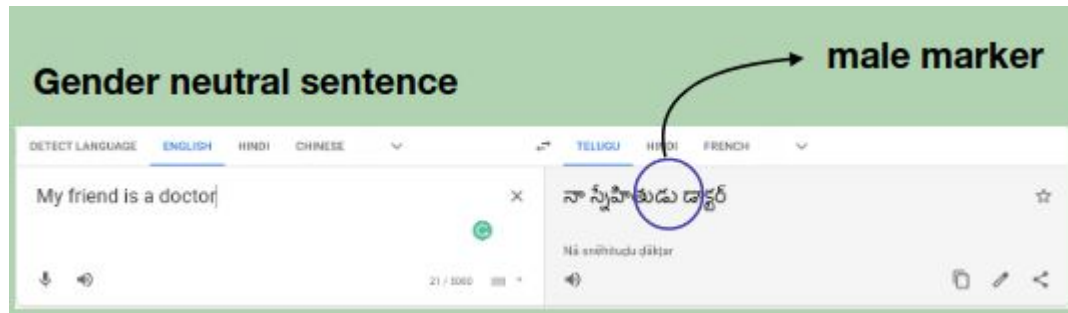
The Elon Musk-backed nonprofit company OpenAI declines to release research publicly for fear of misuse

Alex Hern
@alexhern
Thu 14 Feb 2019 17:00 GMT

Ética em Modelos de NLG

Viés de Gênero

Privacidade e Anonimato



GPT-2 Release. FONTE:

<https://www.theguardian.com/technology/2019/feb/14/elon-musk-backed-ai-writes-convincing-news-fiction>

Criação de Notícias Falsas

“With a little bit of human curation, GPT-3 is quite effective” at promoting falsehoods.

— BEN BUCHANAN, PROFESSOR, GEORGETOWN



Ética em Modelos de NLG

≡ **MIT Technology Review**

<https://www.technologyreview.com/2023/02/14/1068498/why-you-shouldnt-trust-ai-search-engines>

ARTIFICIAL INTELLIGENCE

Why you shouldn't trust AI search engines

Plus: The original startup behind Stable Diffusion has launched a generative AI for video.

By Melissa Heikkilä

February 14, 2023

Ética em Modelos de NLG

Exclusive: OpenAI Used Kenyan Workers on
Less Than \$2 Per Hour to Make ChatGPT Less
Toxic



This image was generated by OpenAI's image-generation software, Dall-E 2. The prompt was: "A seemingly endless view of African workers at desks in front of computer screens in a printmaking style." TIME does not typically use AI-generated art to illustrate its stories, but chose to in this instance in order to draw attention to the power of OpenAI's technology and shed light on the labor that makes it possible. [image](#)



<https://time.com/6247678/openai-chatgpt-kenya-workers/>

Aula Prática

[Google Colab Text Generation com Transformers](#)

[Google Colab Text Generation com RNN](#)

GPT3 -> [OpenAI](#)

ChatGPT -> [OpenAI](#)

Revisão da Aula

- ❖ Aplicações de NLG
- ❖ Tipos de NLG
- ❖ Modelos Neurais para NLG
- ❖ Abordagens de Decodificação:
 - Amostragem randômica
 - Temperatura
 - Top-K
 - Top-p
- ❖ Treino
- ❖ Avaliação
- ❖ Princípios Éticos

Referências

Professor Christopher Manning. Stanford CS224N: NLP with Deep Learning

<http://web.stanford.edu/class/cs224n/slides/cs224n-2021-lecture12-generation.pdf>