

How ChatGPT Works and Why You Should Care

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What is ChatGPT?

ChatGPT is a conversational chatbot with:

- an encyclopedic knowledge base
- a non-human reasoning capacity
- the ability to follow instructions

It was created by OpenAI, which is partly funded by Microsoft.

Try it: <https://chat.openai.com>



DS

Can I substitute margarine for yogurt in a recipe?



Margarine and yogurt are two very different ingredients, so they are not interchangeable in most recipes. Margarine is a butter substitute, while yogurt is a dairy product that adds a creamy texture and tangy flavor to recipes. Substituting margarine for yogurt can significantly alter the flavor, texture, and moisture content of a recipe, and is not recommended.

If you are looking for a substitute for yogurt in a recipe, it's best to choose an ingredient that has a similar flavor and texture. Some options include sour cream, buttermilk, silken tofu, or a non-dairy yogurt alternative.



Lisa's house is 3 blocks north and four blocks east of my house. A block is 500 feet long. What is the distance from my house to Lisa's house? Explain your reasoning.

(page 1 of 2)



We can use the Pythagorean theorem to find the distance between the two houses.

First, we can find the length of the hypotenuse of a right triangle with legs of 3 blocks and 4 blocks. The hypotenuse represents the straight-line distance between the two houses.

Using the Pythagorean theorem, we have:

$$c^2 = a^2 + b^2$$

where c is the length of the hypotenuse, and a and b are the lengths of the legs.

Substituting in the values we have:

$$c^2 = 3^2 + 4^2$$

$$c^2 = 9 + 16$$

$$c^2 = 25$$

Taking the square root of both sides gives us:

$$c = \sqrt{25}$$

$$c = 5$$

So the distance from my house to Lisa's house is 5 blocks.

Since each block is 500 feet long, we can find the distance in feet by multiplying 5 blocks by 500 feet per block:

$$5 \text{ blocks} \times 500 \text{ feet per block} = 2500 \text{ feet}$$

Therefore, the distance from my house to Lisa's house is 2500 feet.



Compose a short poem about FDU CS Hub



In the land of coding and tech,
FDU's CS Hub stands erect,
A place for minds to come and connect,
And build great things without neglect.

With a community that's strong and bright,
FDU's CS Hub shines like a light,
Offering resources to make things right,
And help budding coders take flight.



Write a Python function to make all the vowels in a string be uppercase.


(page 1 of 4)



Here's a Python function that makes all the vowels in a string uppercase:



python


 Copy code

```
def uppercase_vowels(string):  
    vowels = ['a', 'e', 'i', 'o', 'u']  
    result = ''  
    for char in string:  
        if char.lower() in vowels:  
            result += char.upper()  
        else:  
            result += char  
    return result
```


This function takes a string as input and iterates over each character in the string. If the character is a vowel (either uppercase or lowercase), it is replaced with its uppercase version using the `upper()` string method. Otherwise, the character is left unchanged. The resulting string is returned.

To use this function, you can call it with a string argument:

python

 Copy code

```
string = "hello world"  
result = uppercase_vowels(string)  
print(result) # "hElLo wOrld"
```

This will output the input string with all vowels capitalized.

It's not necessary to convert char to lowercase for this code to work. Can you write a simpler version?

(page 3 of 4)



Yes, you are correct that it's not necessary to convert the character to lowercase in this case, since we are only looking for vowels and not distinguishing between uppercase and lowercase letters.



Here is a simplified version of the function that doesn't require converting the characters to lowercase:

python

Copy code

```
def uppercase_vowels(string):  
    vowels = "aeiouAEIOU"  
    result = ""  
    for char in string:  
        if char in vowels:  
            result += char.upper()  
        else:  
            result += char  
    return result
```



Yes, you are correct. In fact, if we only want to capitalize lowercase vowels in the input string, we can further simplify the function and just use the string "aeiou" as the vowels string, like this:



python

Copy code

```
def uppercase_vowels(string):  
    vowels = "aeiou"  
    result = ""  
    for char in string:  
        if char in vowels:  
            result += char.upper()  
        else:  
            result += char  
    return result
```

This version works in the same way as the previous one, but it only looks for lowercase vowels in the input string and capitalizes them. All other characters are left unchanged.

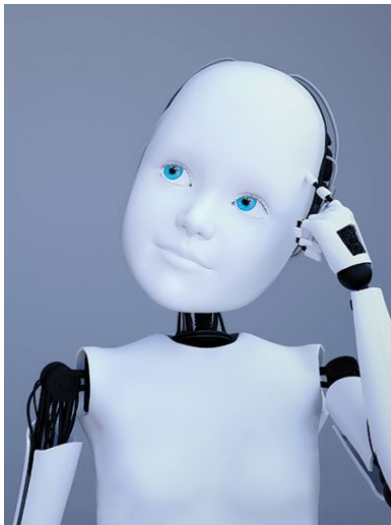
Implications for Industry

- Replace conventional web search: instead of getting a list of links, you just get the answer you wanted, in clear English.
 - Microsoft already has Bing connected to ChatGPT.
 - Google is trying something similar with Bard.
- Many writing tasks can be partially automated.
 - BuzzFeed will use ChatGPT to generate quizzes and personalize content.
- People are using ChatGPT to help with programming tasks.
 - Should professional programmers be worried about their jobs?

Implications for Education

- Students have begun using ChatGPT to write their essays.
- Teachers are using ChatGPT to compose problem sets or lesson plans.
- Some school systems have banned ChatGPT.
- Huge potential for customized tutoring for each child.
 - “Give me some fraction addition problems.”
 - “Drill me on state capitals of Nigeria.”
 - “Explain completing the square to me.”

But How Does It Work?



ChatGPT is a Large Language Model (LLM)

LLM's are huge neural networks (billions of weights) trained on massive amounts of text, e.g.,

- all of Wikipedia, plus
- a massive collection of books, plus
- a large chunk of Reddit

All the big AI companies are developing LLM's:

- Google: BERT, T5, LaMDA, PaLM
- OpenAI: GPT, GPT-2, GPT-3, GPT-3.5, ChatGPT
- Facebook/Meta: RoBERTa, LLaMa
- Amazon: AlexaTM 20B
- Baidu: PCL-BAIDU Wenxin (Ernie 3.0)

Training: Try to Predict the Next Word

Since he was out of milk, on the way home from work John →

stopped
dropped
bought
...

Since he was out of milk, on the way home from work John dropped →

by
into
off
...

Generation: Predict the Next Word, and Iterate

Where do eagles live? → **Eagles**

Where do eagles live? Eagles → **are**

Where do eagles live? Eagles are → **found**

Where do eagles live? Eagles are found → **on**

Where do eagles live? Eagles are found on → **every**

Where do eagles live? Eagles are found on every → **continent**

Where do eagles live? Eagles are found on every continent → **except**

Where do eagles live? Eagles are found on every continent except → **Antarctica**

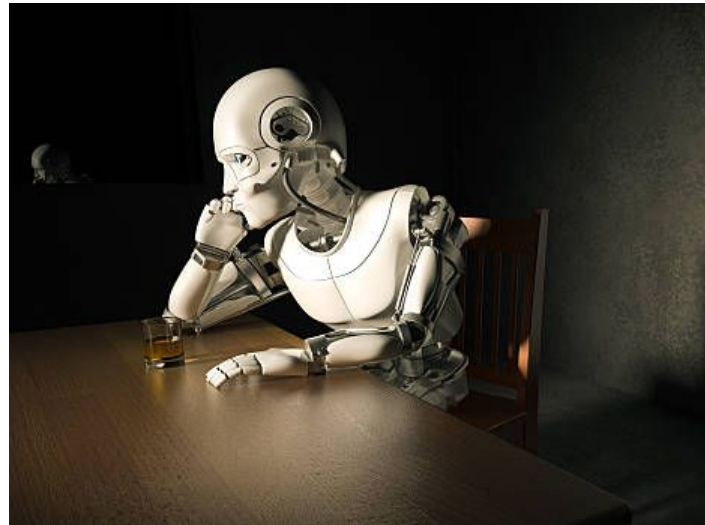
Why This Is Remarkable

- Earlier, smaller language models could make only simple statistical predictions about which words follow other words.
- They could not interpret the meaning of the text.
- But when LLMs got large enough, a new phenomenon suddenly appeared.
- Now these models seemed to “understand” the text. They exhibit some general reasoning abilities, can follow directions contained in the text, and can even write computer code.
- **This is a major, historic scientific breakthrough. And you are there!**

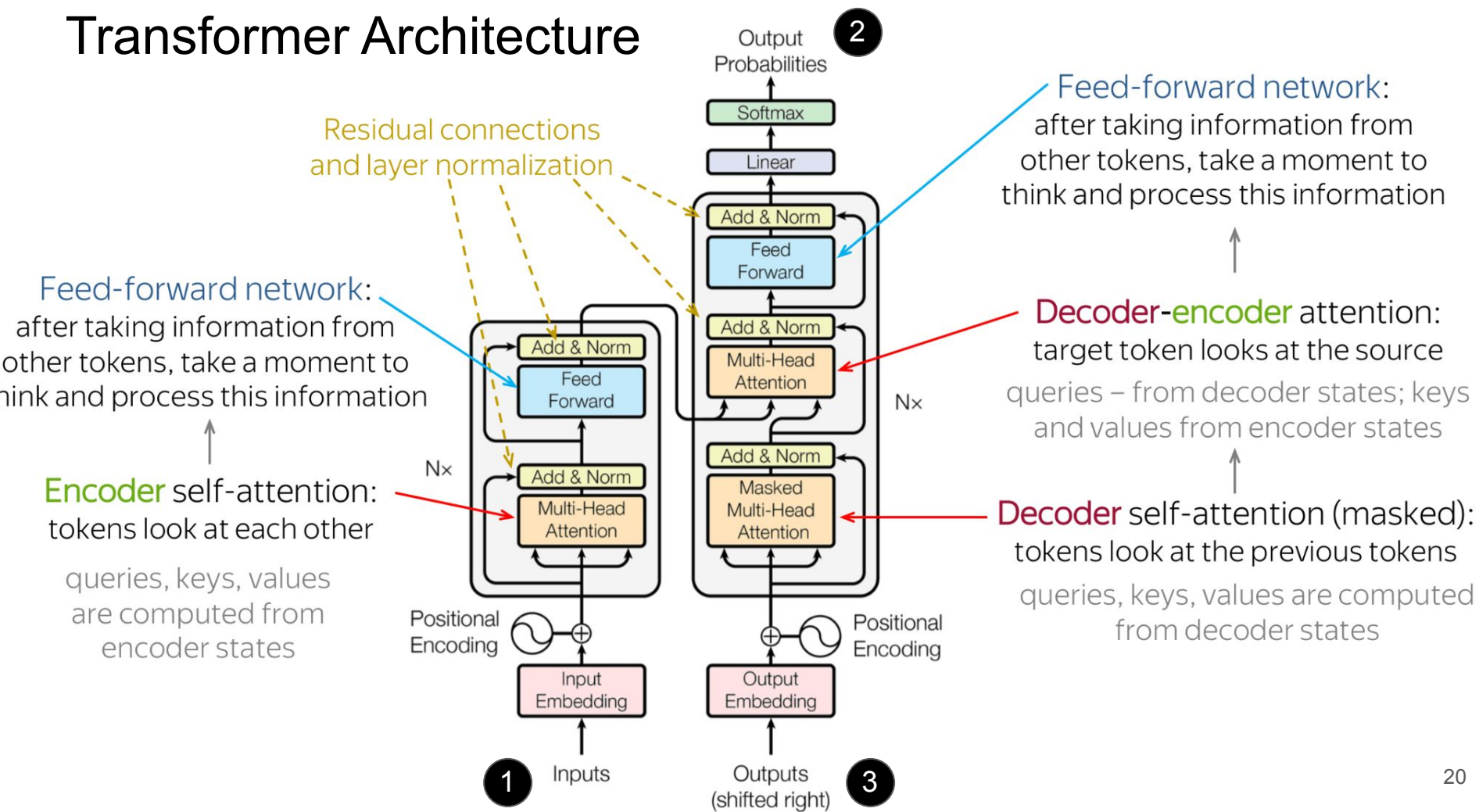
But How Does It Really Work?



We Don't Fully Understand It Yet



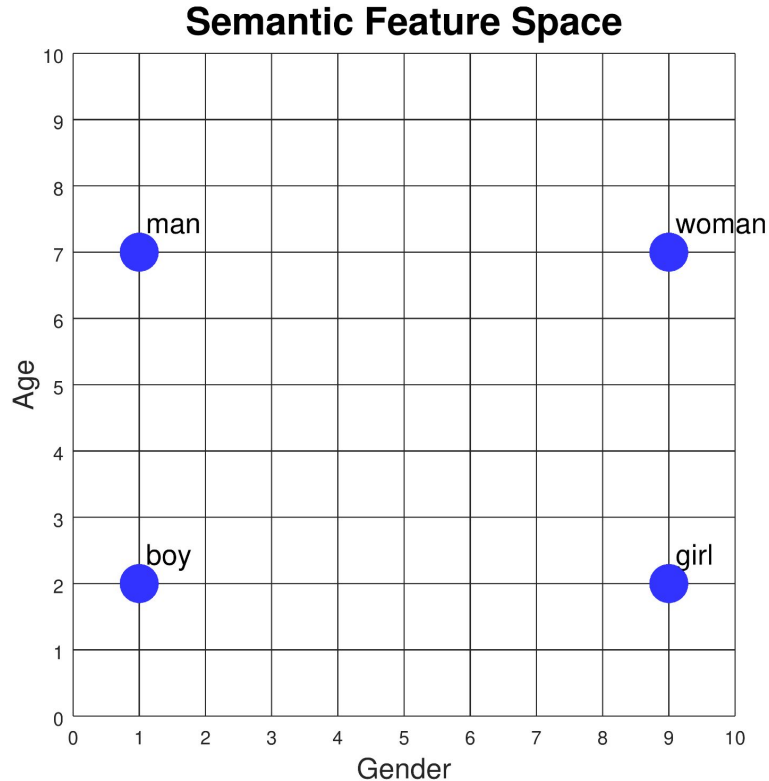
Transformer Architecture



Two Key Ideas to Share With Your Students

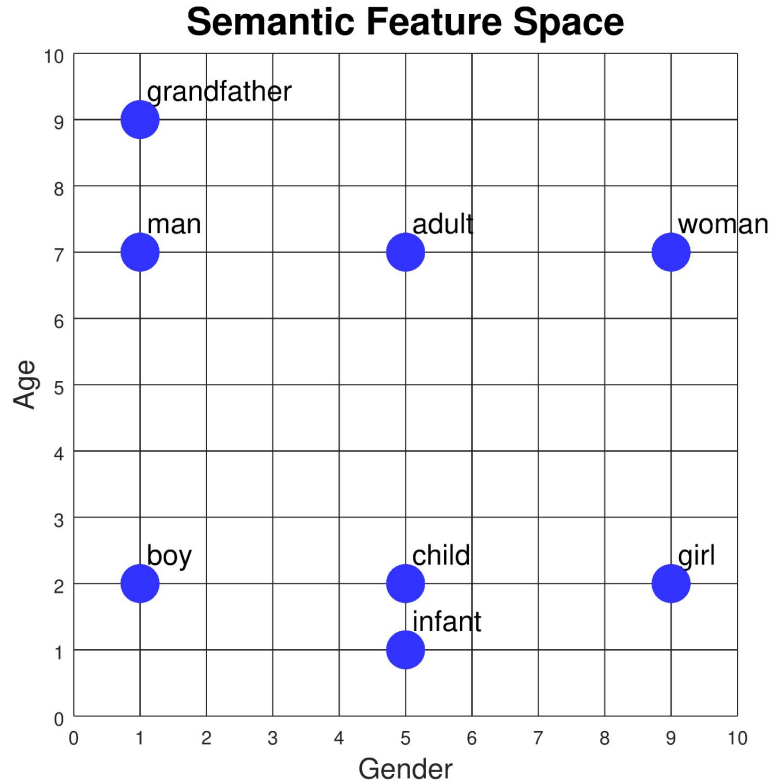
1. **Embeddings**: encoding meaning as collections of numbers.
2. **Self-attention**: enriching meaning based on context.

Word Embeddings



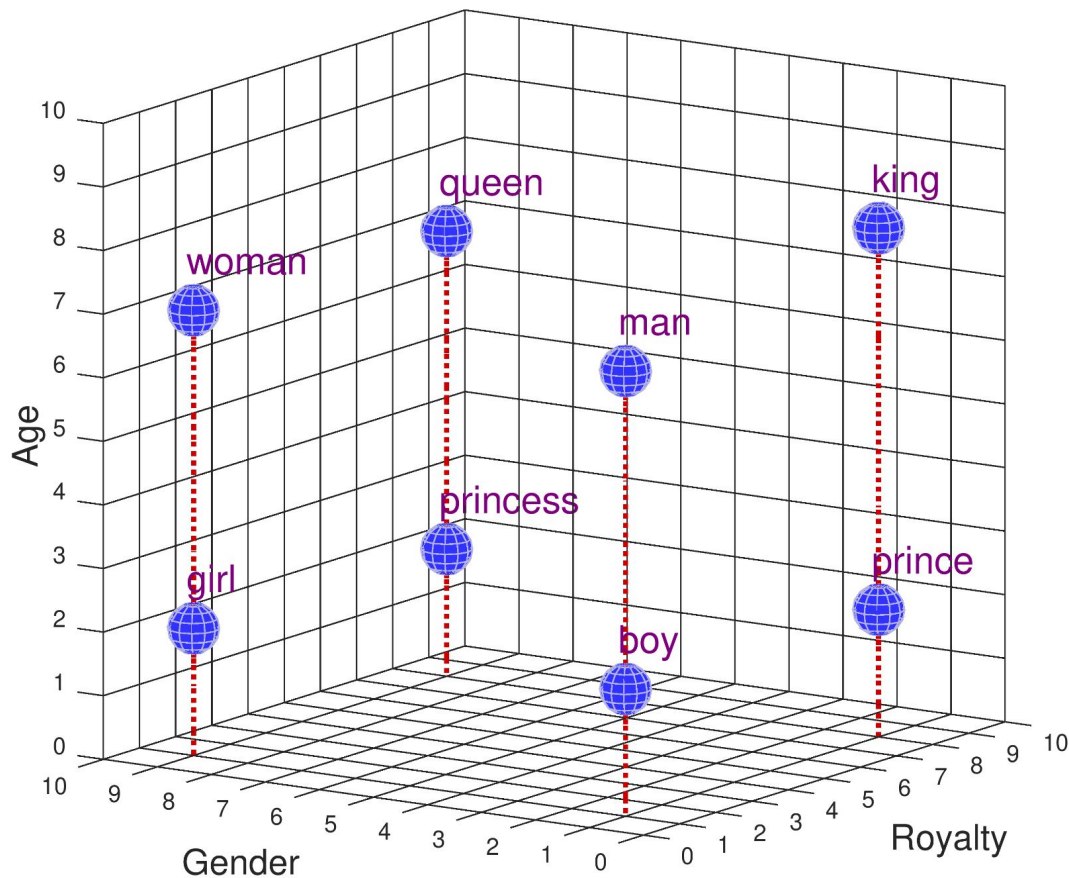
| Word Coordinates | | |
|------------------|--------|-----|
| | Gender | Age |
| man | [1, | 7] |
| woman | [9, | 7] |
| boy | [1, | 2] |
| girl | [9, | 2] |

Word Embeddings



| Word Coordinates | | |
|------------------|--------|-----|
| | Gender | Age |
| grandfather | [1, | 9] |
| man | [1, | 7] |
| adult | [5, | 7] |
| woman | [9, | 7] |
| boy | [1, | 2] |
| child | [5, | 2] |
| girl | [9, | 2] |
| infant | [5, | 1] |

3D Semantic Feature Space



| Word Coordinates | | | |
|------------------|--------|-----|---------|
| | Gender | Age | Royalty |
| man | [1, | 7, | 1] |
| woman | [9, | 7, | 1] |
| boy | [1, | 2, | 1] |
| girl | [9, | 2, | 1] |
| king | [1, | 8, | 8] |
| queen | [9, | 7, | 8] |
| prince | [1, | 2, | 8] |
| princess | [9, | 2, | 8] |

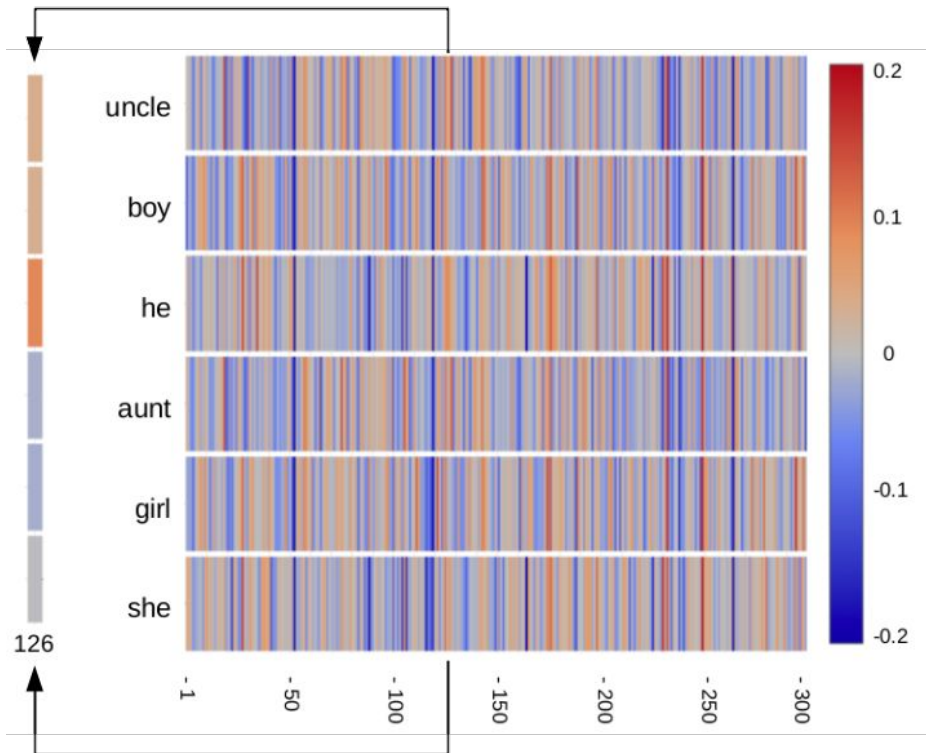
But how can we encode
“pickles”, “happiness”, or
“casually”?

300 Dimensional Feature Space

Let the computer create the feature space for us.

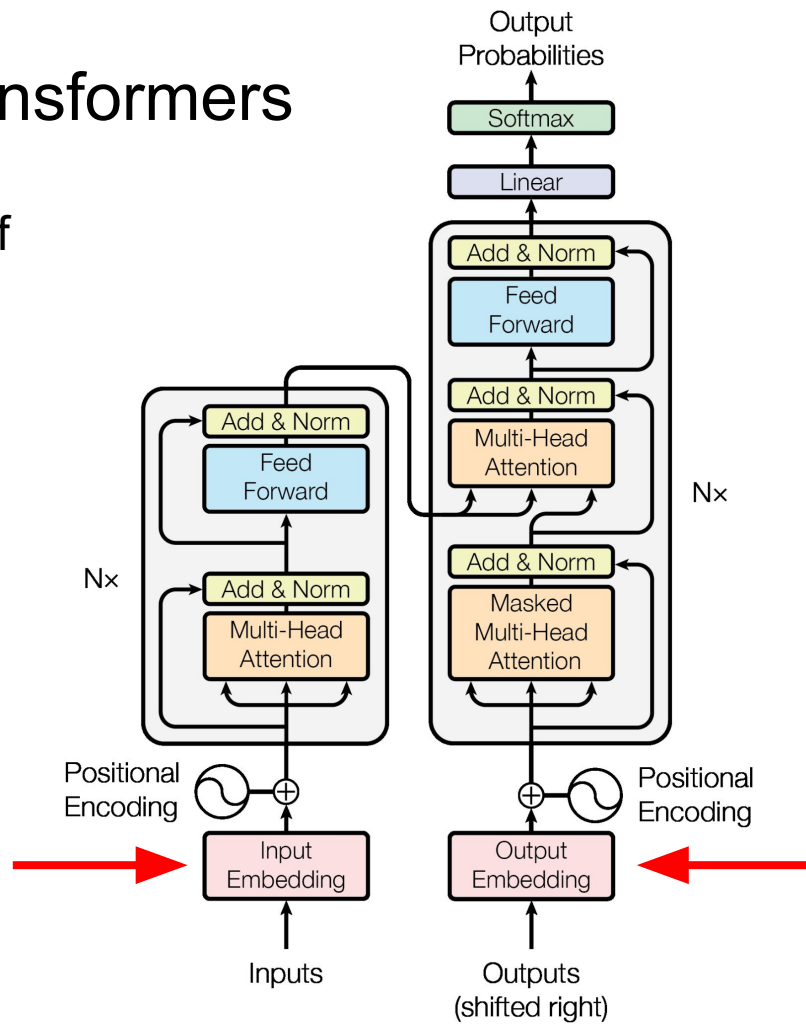
Use machine learning.

Element 126 appears to encode gender information.



Word Embeddings and Transformers

Word embeddings are the first layer of meaning in a transformer network.



Self-Attention

Level 1 Embeddings

house cat,
alive, chasing
something

...

rodent, alive,
being chased

its (mouse),
possesses
a nest

Attention
head 1:
word
senses

Attention
head 1:
word
senses

Attention
head 2:
references

Attention
head 3:
rhyming

Attention
head 4:
numbers

Level 0 Embeddings

The

cat

chased

the

mouse

to

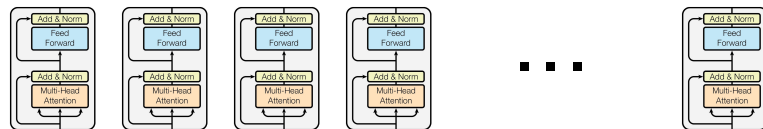
its

nest

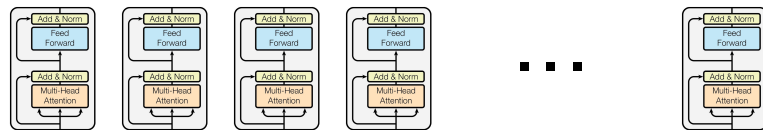
house cat, big cat, cat species,
plush cat, cartoon cat, cool cat

Many Layers of Self-Attention Yields “Intelligence”

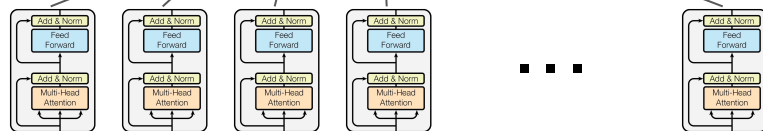
Layer 96



Layer 2



Layer 1



Embeddings

Embeddings

GPT-3 has 96 layers of self-attention, with 16 attention heads at each layer.

Every word is recoded and recombined with the other words 1536 times.

The model has 175 billion parameters (weights).

16 different attention heads in each layer

Conclusions

- Large language models are a **significant milestone** in AI.
- Transformers can do “reasoning”, but it’s not yet human-like.
- We are just beginning to figure out how attention heads do what they do.
- These models are being deployed in products today, and the world is changing, rapidly, in ways we can’t anticipate. Hold on, it’s going to be a...

WILD RIDE