INTRODUCTION TO LLM

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Agenda

- Introduction and History of LLM
- Neural Networks and LLM (RNN, LSTMs, Transformers)
- Deep Dive – Architecture of LLM models
- Live Demo on LLM using transformer
- Types of LLM models
- Use cases
- Live Demo – Basic usage of GPT 2
- Challenges
- Quiz
- Q/A

What are Large Language Models?

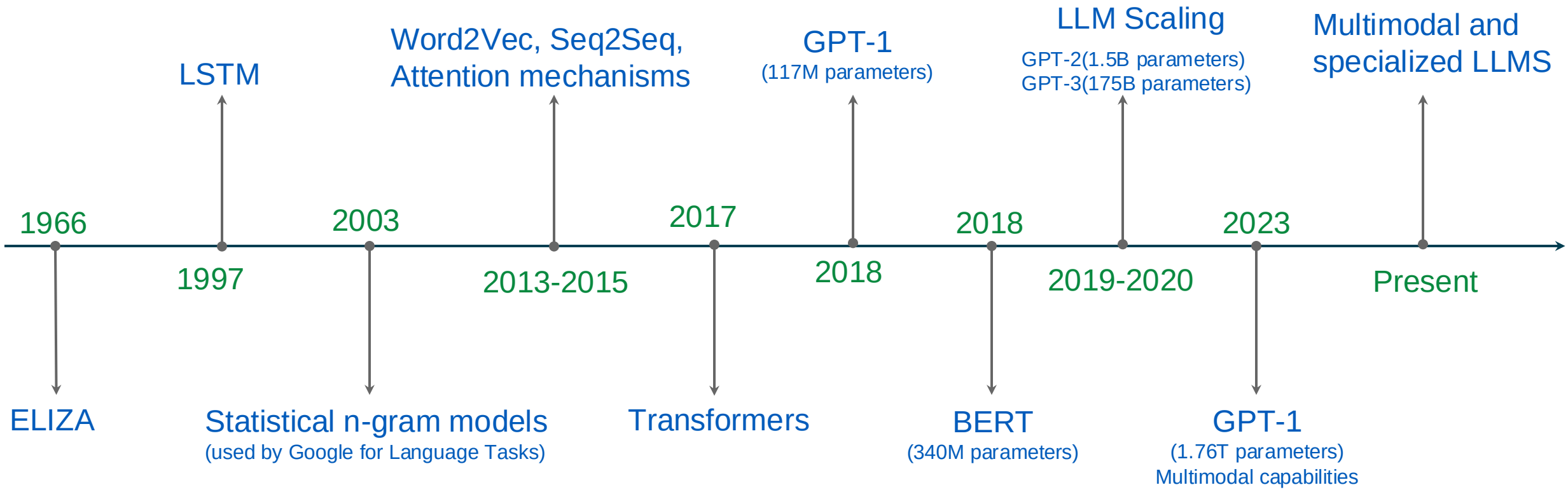
Definition: Type of Artificial Intelligence that uses deep learning techniques to process, understand and generate human language.

Foundation: Built using deep learning and neural networks

Training: Utilizes vast amounts of text datasets from internet, books, blogs, etc.

Utility: Ability to perform diverse set of language tasks like chatbots, text summarization, translation and more.

History of LLMs



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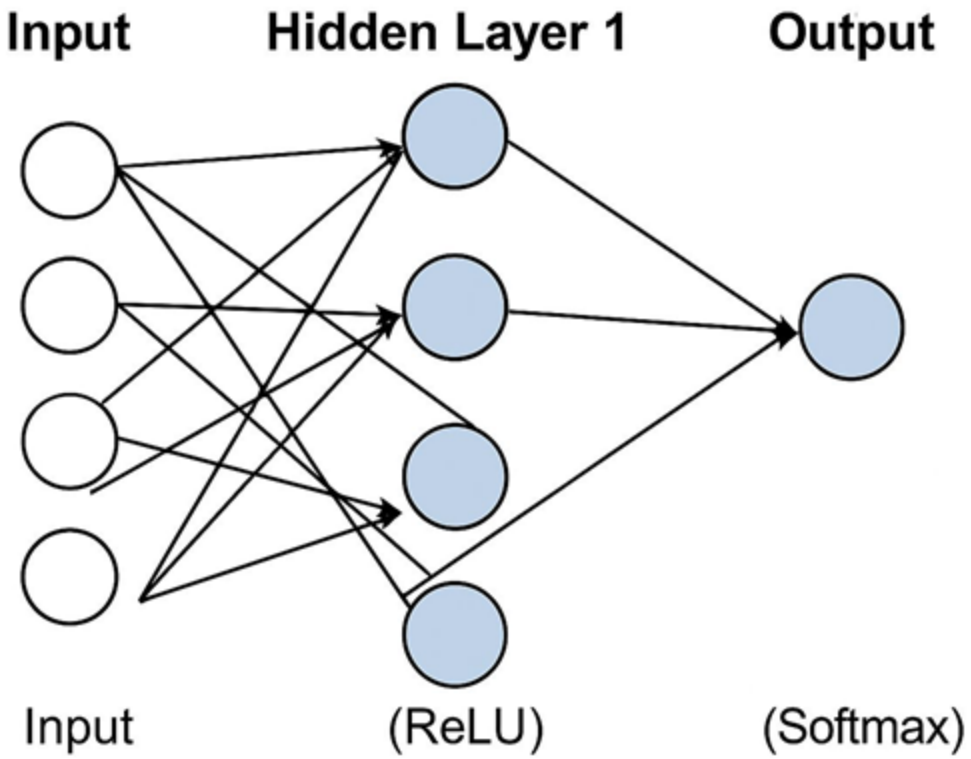
Neural Networks and LLM

Introduction to Neural Networks

Definition: System of connected nodes (neurons) inspired by the human brain

Commonly used in vision, speech and language tasks

Utility: Ability to perform diverse set of language tasks like chatbots, text summarization, translation and more.



From Traditional Neural Networks to LLMS

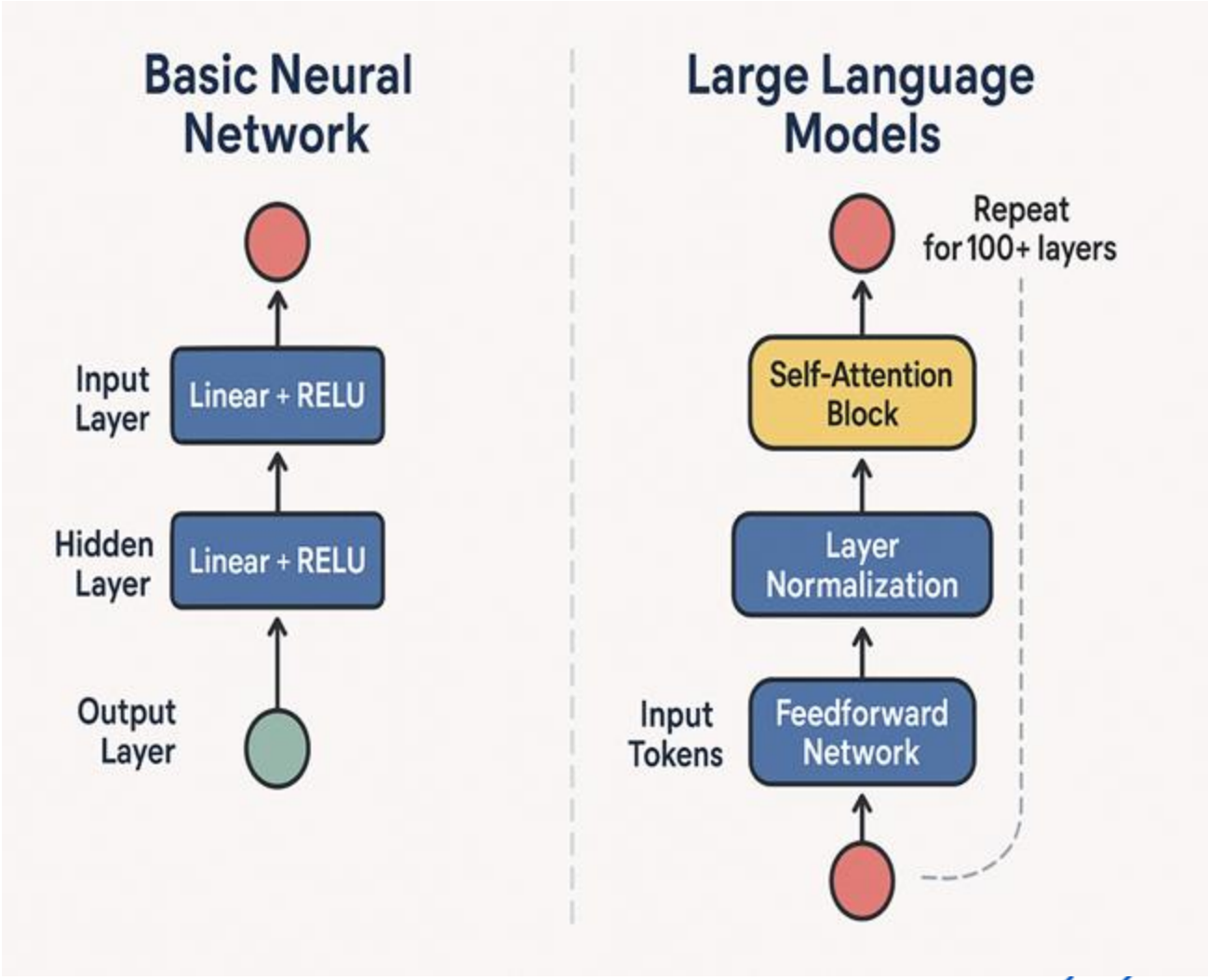
Issue → Traditional NNs work with fixed-size inputs → Not ideal for sequences

Solution : Use sequence-aware models

RNNs → capture previous state

LSTMs → handle longer dependencies

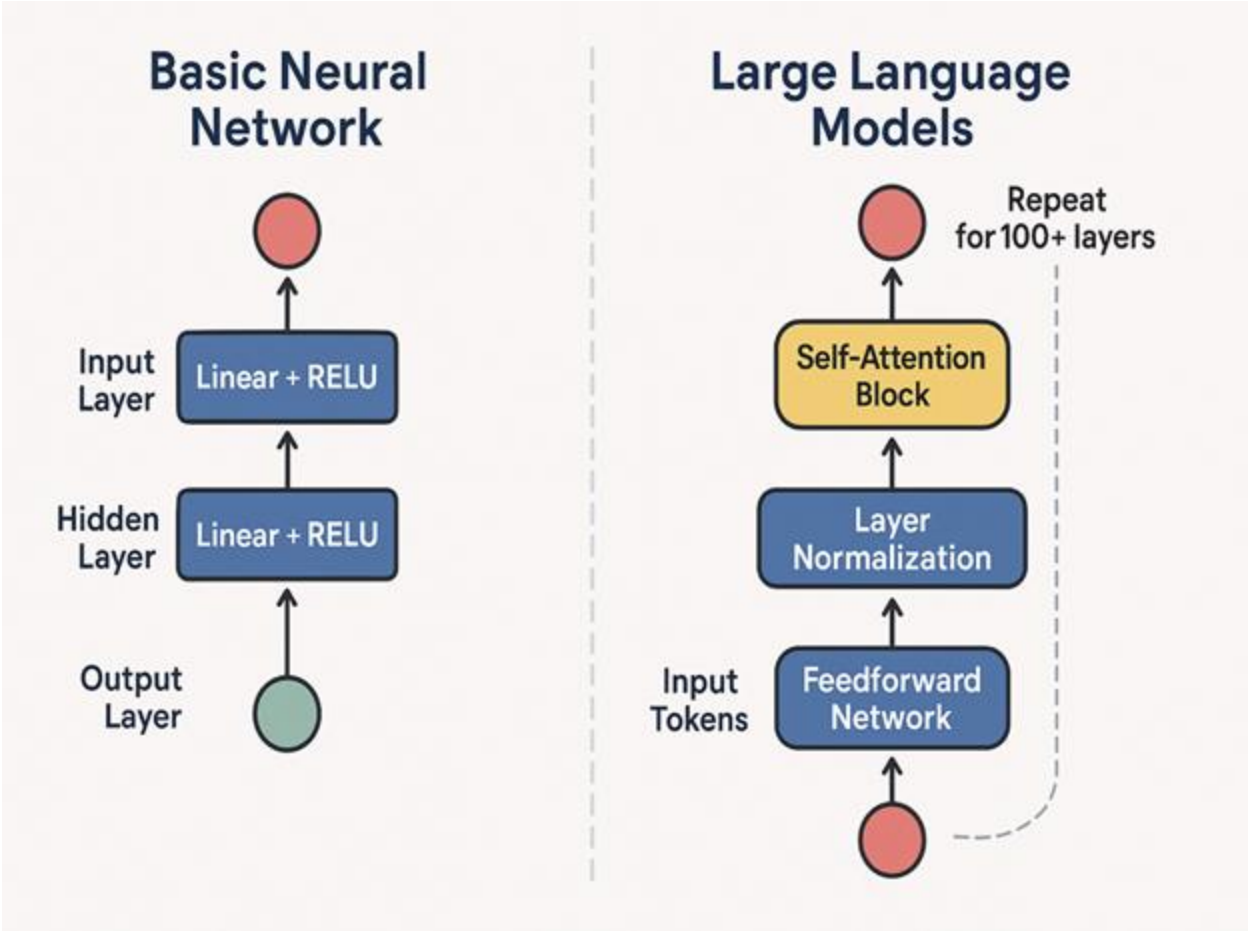
Transformers → attend to all positions



From Traditional Neural Networks to LLMS

Large Language Models are Deep Neural Networks

LLMs (like GPT, BERT) are deep neural networks with 100s of layers



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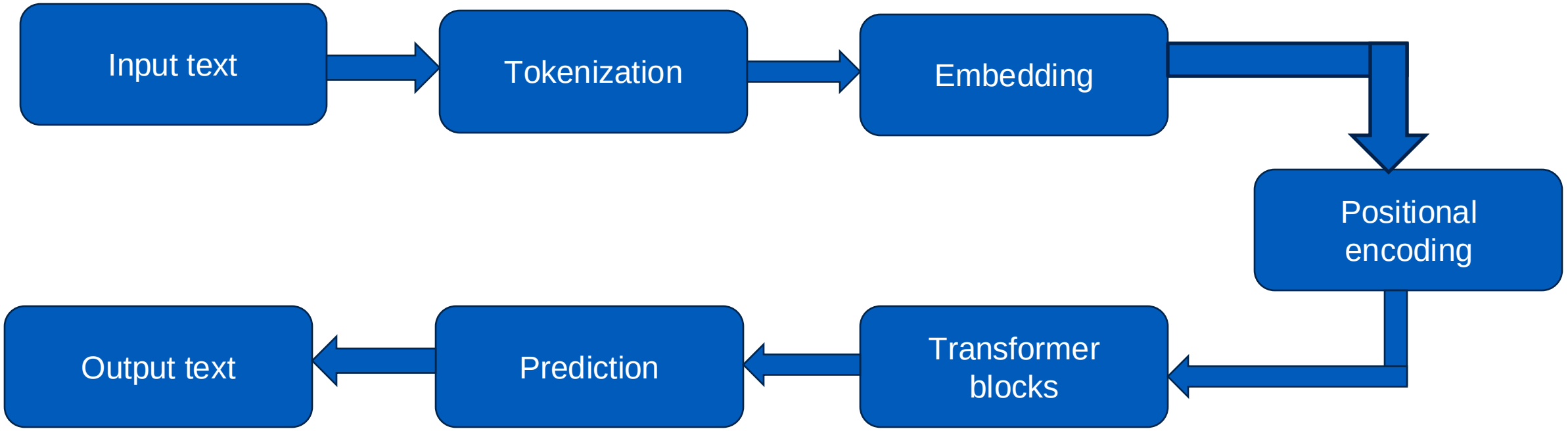
WORKING OF LLMS

Pipeline


Input text
Tokenization
Embedding
Positional encoding
Transformer blocks
Prediction
Output text

Tokenization

Converts text into numerical tokens
(words, sub-words, or characters)

```
from transformers import GPT2Tokenizer
tokenizer = GPT2Tokenizer.from_pretrained("gpt2")
tokenizer.tokenize("unwatched cats")
```

✓ 0.1s

```
['un', 'w', 'atched', 'Ġcats']
```

Examples using GPT-2 tokenizer and BERT

"unwatched" → "un", "watch", "ed" (sub-word)

"cats" → "cat", "s"

```
from transformers import BertTokenizer
tokenizer = BertTokenizer.from_pretrained("bert-base-uncased")
tokens = tokenizer.tokenize("unwatched cats")
print(tokens)
```

✓ 0.1s

```
['un', '##watch', '##ed', 'cats']
```

Tokenization

GPT-2's tokenizer treats spaces as meaningful and sometimes splits words in unusual ways at the byte level.

```
from transformers import GPT2Tokenizer
tokenizer = GPT2Tokenizer.from_pretrained("gpt2")
tokenizer.tokenize("unwatched cats")
```

✓ 0.1s

```
['un', 'w', 'atched', 'Ġcats']
```

In BERT's tokenizer, ## indicates token is a sub-word

```
from transformers import BertTokenizer
tokenizer = BertTokenizer.from_pretrained("bert-base-uncased")
tokens = tokenizer.tokenize("unwatched cats")
print(tokens)
```

✓ 0.1s

```
['un', '##watch', '##ed', 'cats']
```

Embedding

Converts token IDs (e.g., 210 → "the") into dense vectors

These vectors capture semantic meaning (e.g., "king" and "queen" are clos

```
from transformers import GPT2Tokenizer, GPT2Model
tokenizer = GPT2Tokenizer.from_pretrained("gpt2")
model = GPT2Model.from_pretrained("gpt2")

inputs = tokenizer("I love pizza", return_tensors="pt")
outputs = model(**inputs)
print(outputs.last_hidden_state.shape)
```

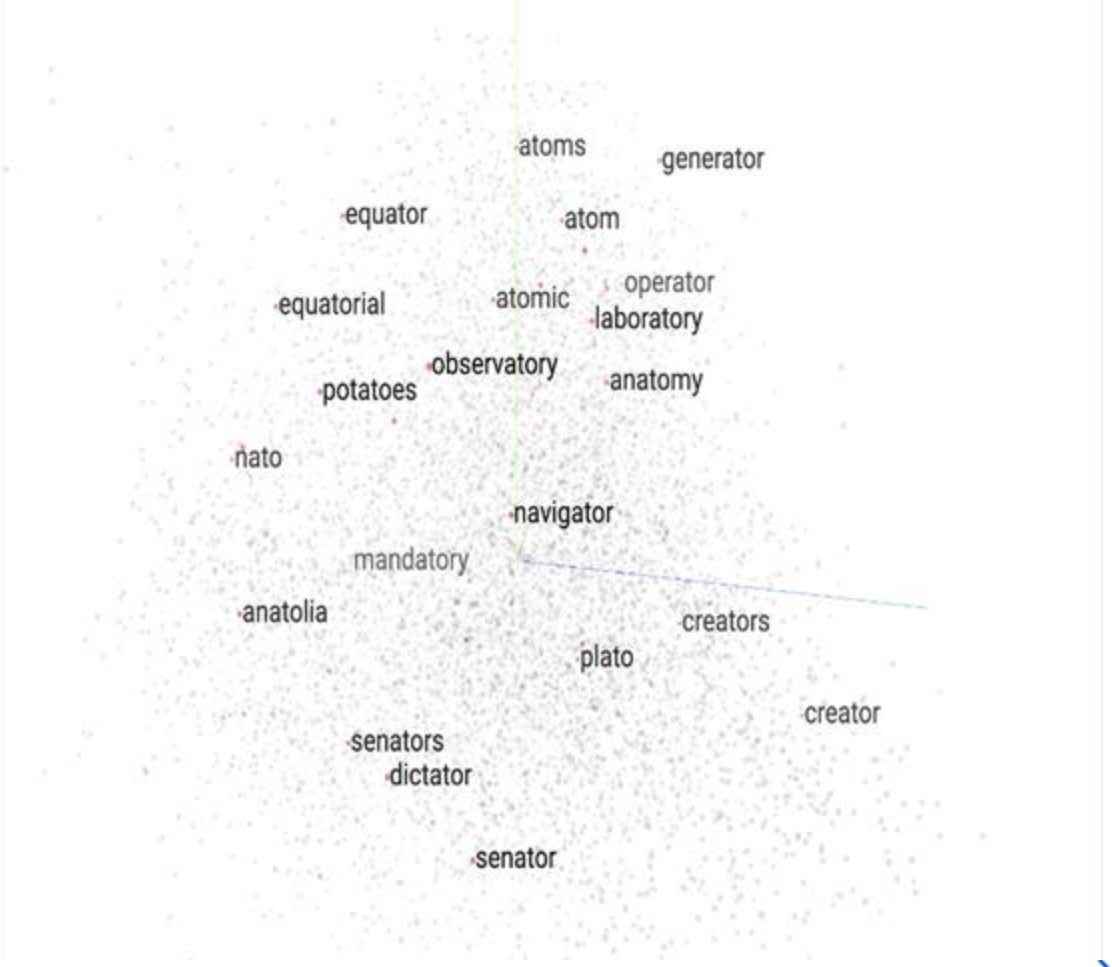
✓ 0.8s

```
torch.Size([1, 3, 768])
```

Embedding

Perform the following tasks

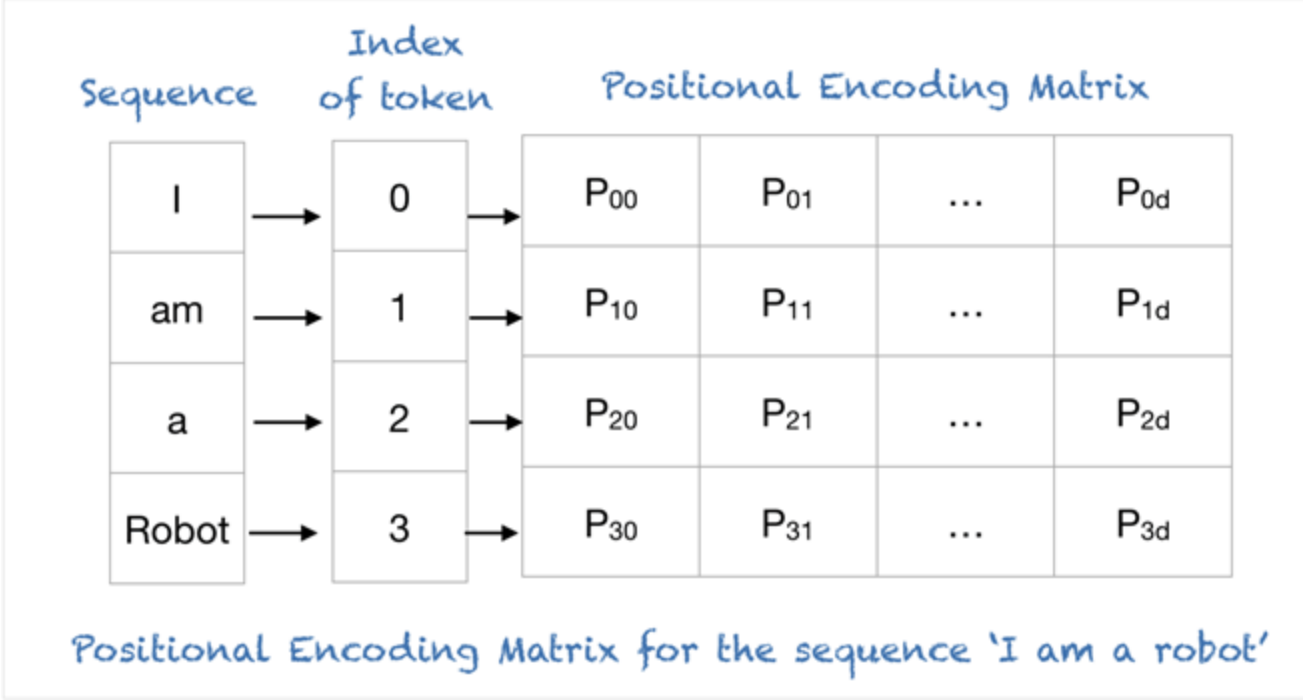
- ✓ Open the Embedding Projector tool at https://projector.tensorflow.org/
- ✓ In the right panel, enter the word **atom** in the **Search** field.
- ✓ Then click the word **atom** from the results below (under **4 matches**).



Positional Encoding

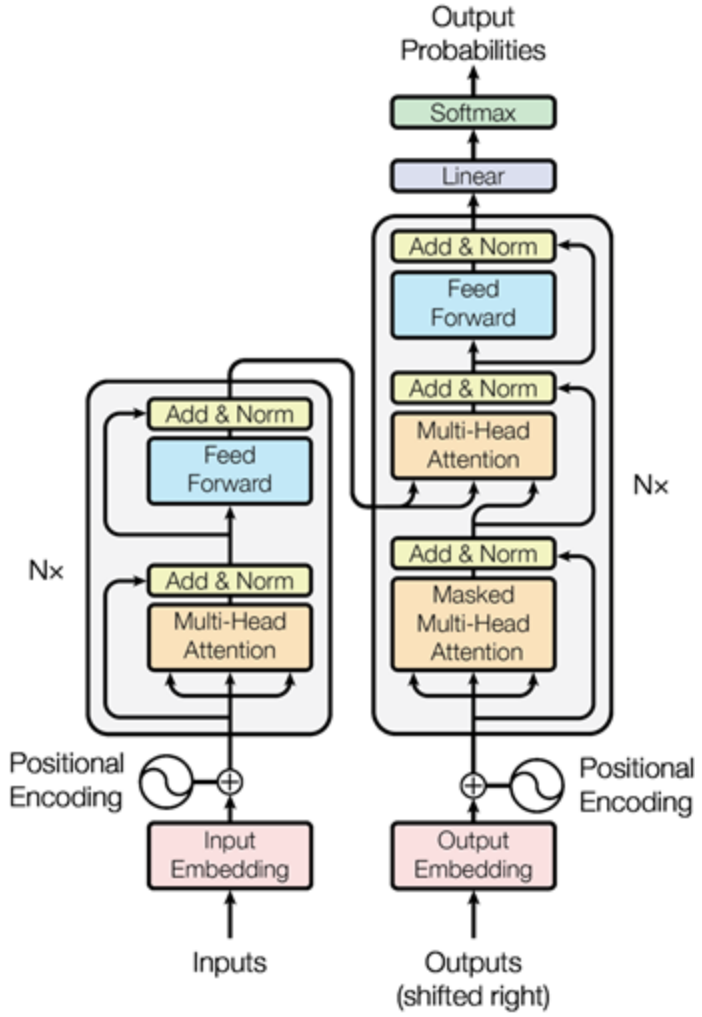
Why Do We Need Position?

- ✓ Transformers Are Orderless
- ✓ Self-attention has no built-in order
- ✓ Example "Cats eat fish" ≠ "Fish eat cats"



Architecture of LLM

- Based on Transformer architecture
  - Key component:
    - Embedding layer
- Self-attention mechanism
- Feed-forward neural networks
  - Encoder-decoder or decoder only designs
  - Billions of parameters



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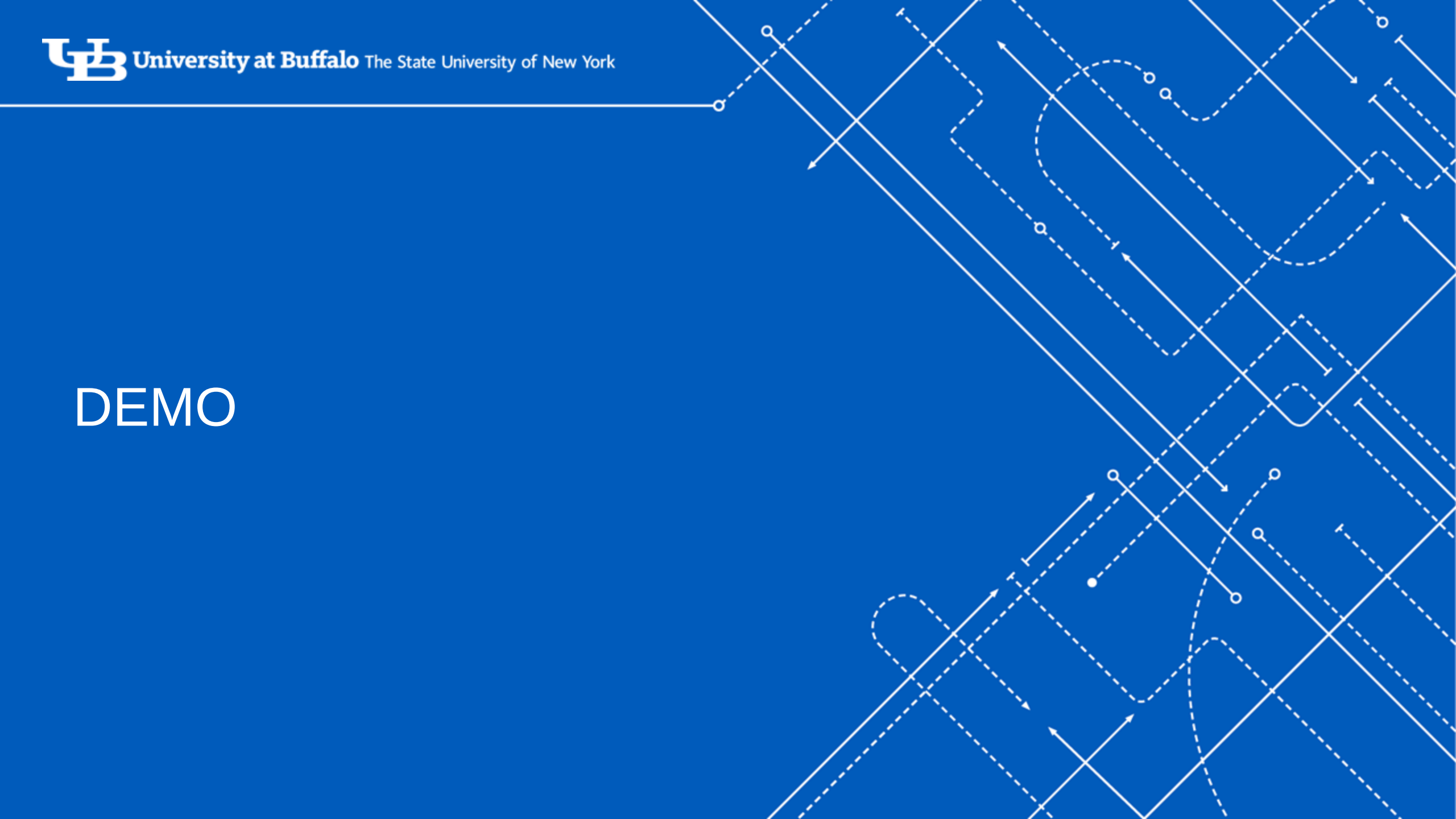
DEMO



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TYPES OF LLM

Types of LLMs

Language Representation Models
(GPT, BERT, RoBERTa)

Zero-Shot Models
(GPT-3)

Multimodal Models
(DALL-E2)

Fine-Tuned Models
(Medical chatbots)

Selfie Time!!!!!

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USECASES

USECASES

AI Assistants

Semantic Search with embeddings

Text summarization

Sentiment analysis

Procurement management

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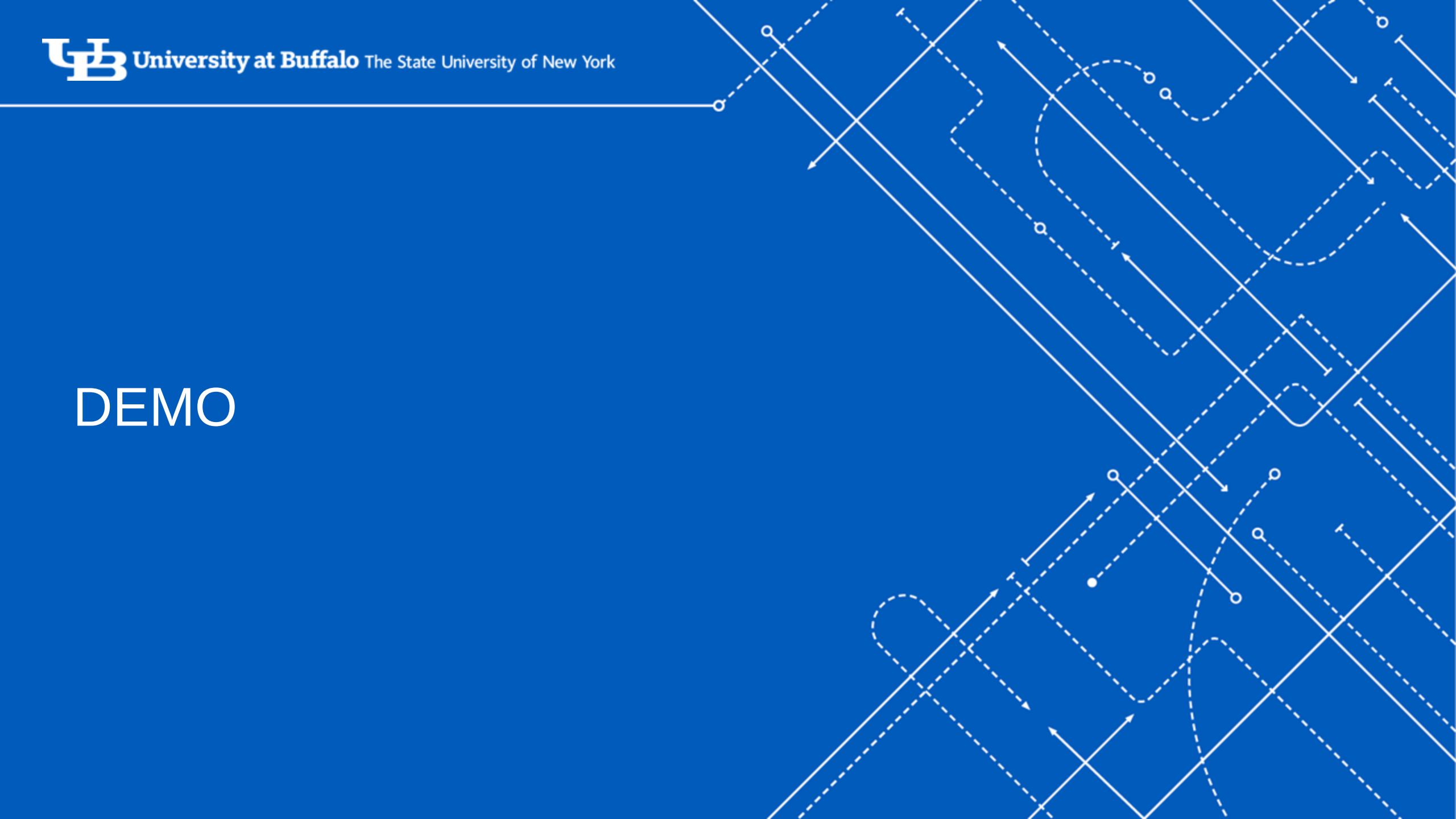
DEMO

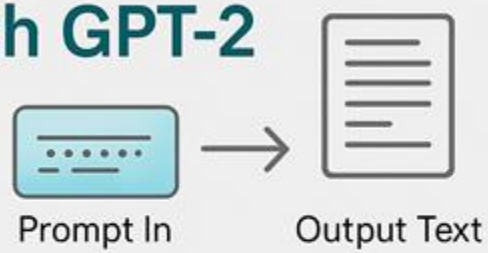


Prompt Engineering

Prompt Engineering with GPT-2

What is Prompt Engineering?

Crafting effective input prompts to guide the language model's output



Why It Matters in GPT-2?

GPT-2 is not instruction-tuned.

Output depends heavily on prompt phrasing

No fine-tuning = Smart prompting is essential

Techniques:

Instructional Prompt: "Write a poem about summer."

Few-Shot Learning: Provide 1-2 examples in the prompt

Challenges:

- Requires prompt trial & error.
- Sensitive to slight wording changes
- Harder than with GPT-3+ models

Use Cases:

- Text completion
- Story generation
- Summarization
- Q&A
- Code synthesis

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CHALLENGES OF LLM

CHALLENGES

Hallucination → Making up facts

Bias → Reflecting societal stereotypes in training data

Compute costs → Training huge models requires massive hardware and energy

Ethics → Risk of misuse in misinformation, impersonation, etc.

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QUIZ

References

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Q & A