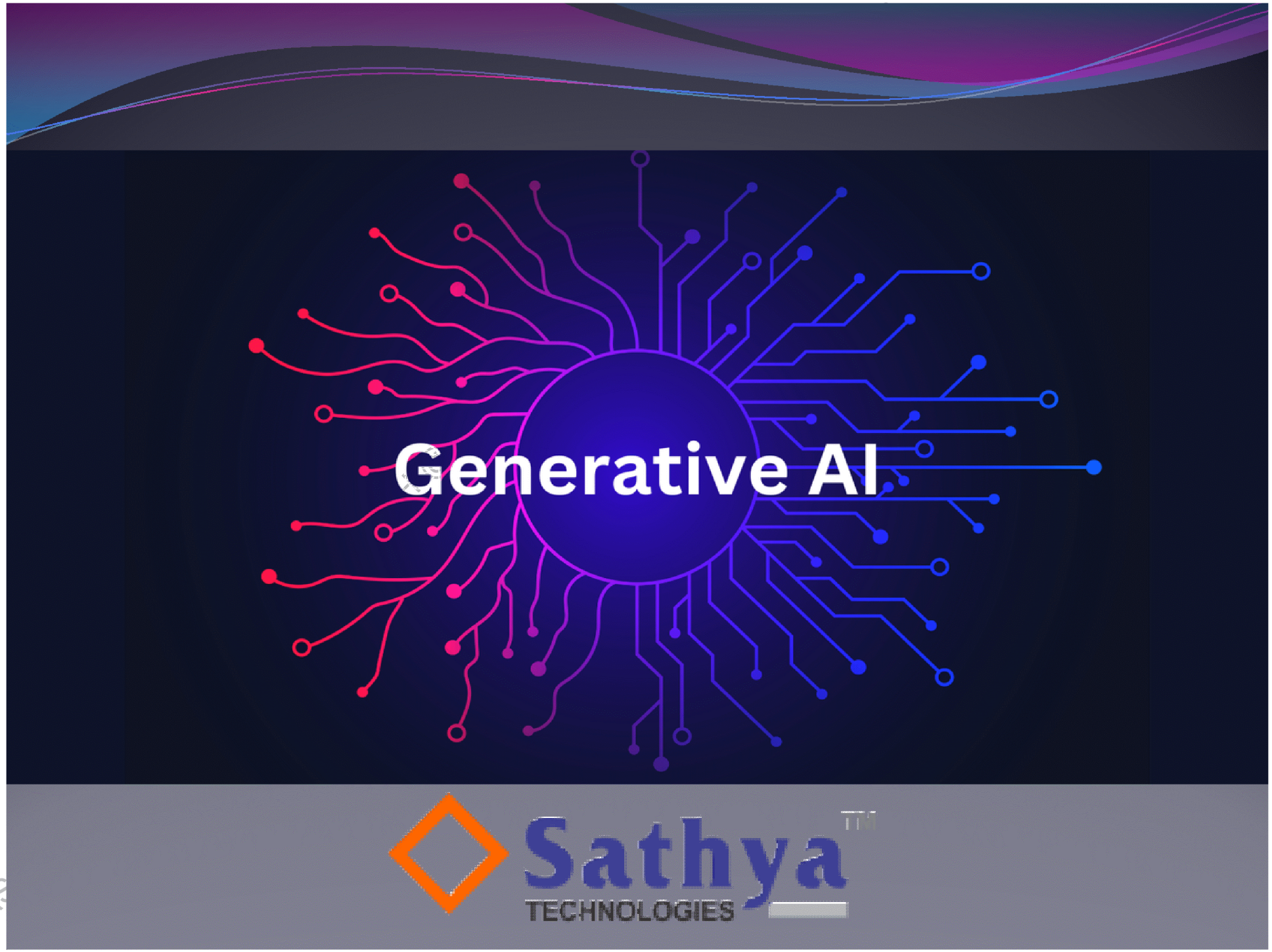
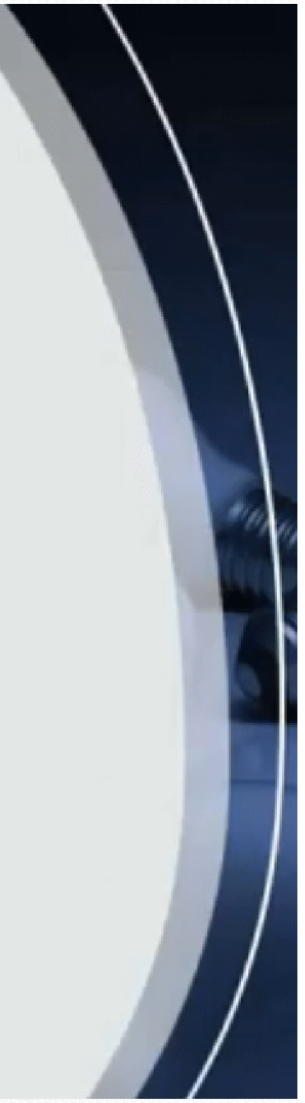

Generative AI
Sathya
TECHNOLOGIES

VALUE OF GEN AI

The real power of AI is in augmenting human intelligence, not replacing it."

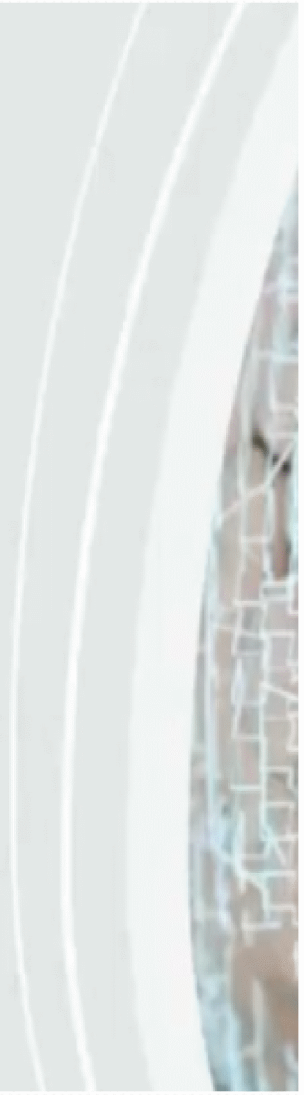
Ginni Rometty

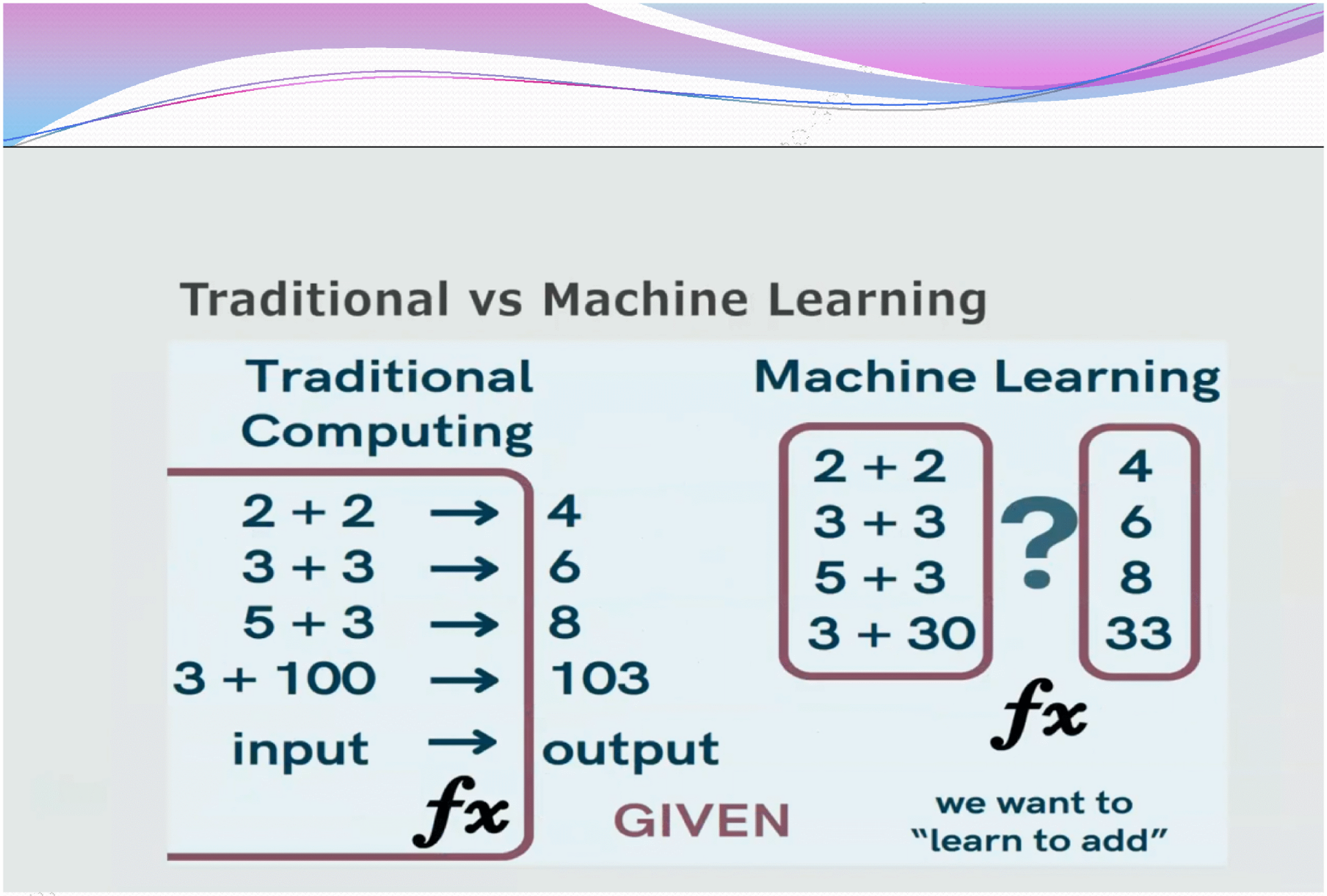
- Former CEO of IBM

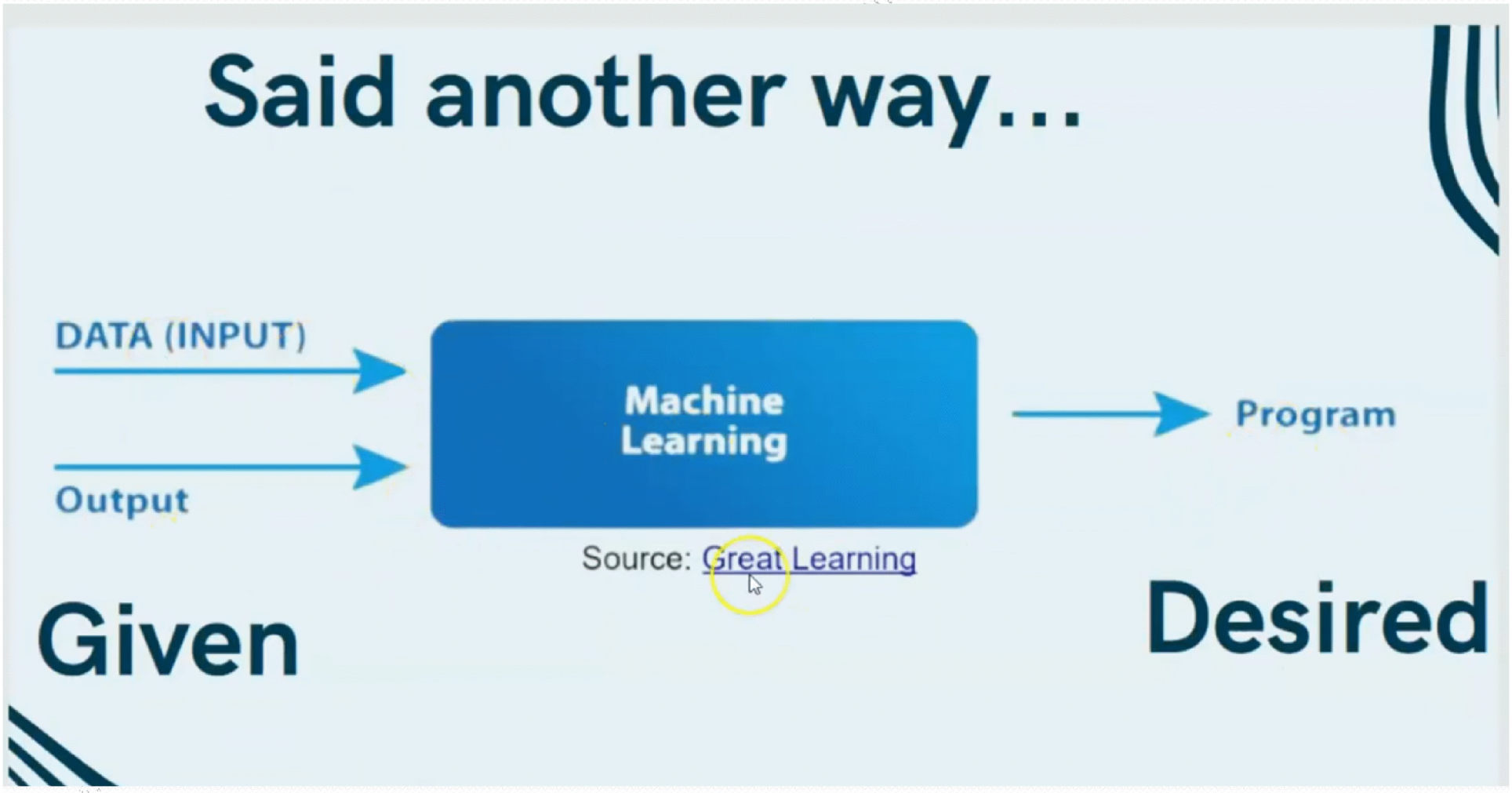


WHY ALL THE HYPE

- Replacing the old model of AI
- Closer to Human Functioning
- Synthesis of Human Intelligence




Traditional vs Machine Learning
Traditional Computing
2 + 2 → 4
3 + 3 → 6
5 + 3 → 8
3 + 100 → 103
input → output
fx
GIVEN
Machine Learning
2 + 2
3 + 3
5 + 3
3 + 30
?
4
6
8
33
fx
we want to "learn to add"


Said another way...
DATA (INPUT)
Output
Machine Learning
Program
Source: Great Learning
Given
Desired

Said another way

We want to learn patterns with minimal or no human intervention...

(explicit programming)

Introduction to Generative AI

- - Definition: Generative AI refers to artificial intelligence that can create new content, including text, images, music, and even code.

- - Significance: Enhances creativity, automates tasks, and expands human capabilities.

- - Examples: ChatGPT, DALL·E, DeepDream, GANs (Generative Adversarial Networks).

Applications of Generative AI

- - Text Generation: Chatbots, content writing, and summarization.
- - Image Generation: AI-generated art, photo enhancement, and deepfake creation.
- - Music & Audio: AI-composed music, voice synthesis, and speech enhancement.
- - Coding: AI-assisted coding tools like GitHub Copilot.

Applications of Generative AI

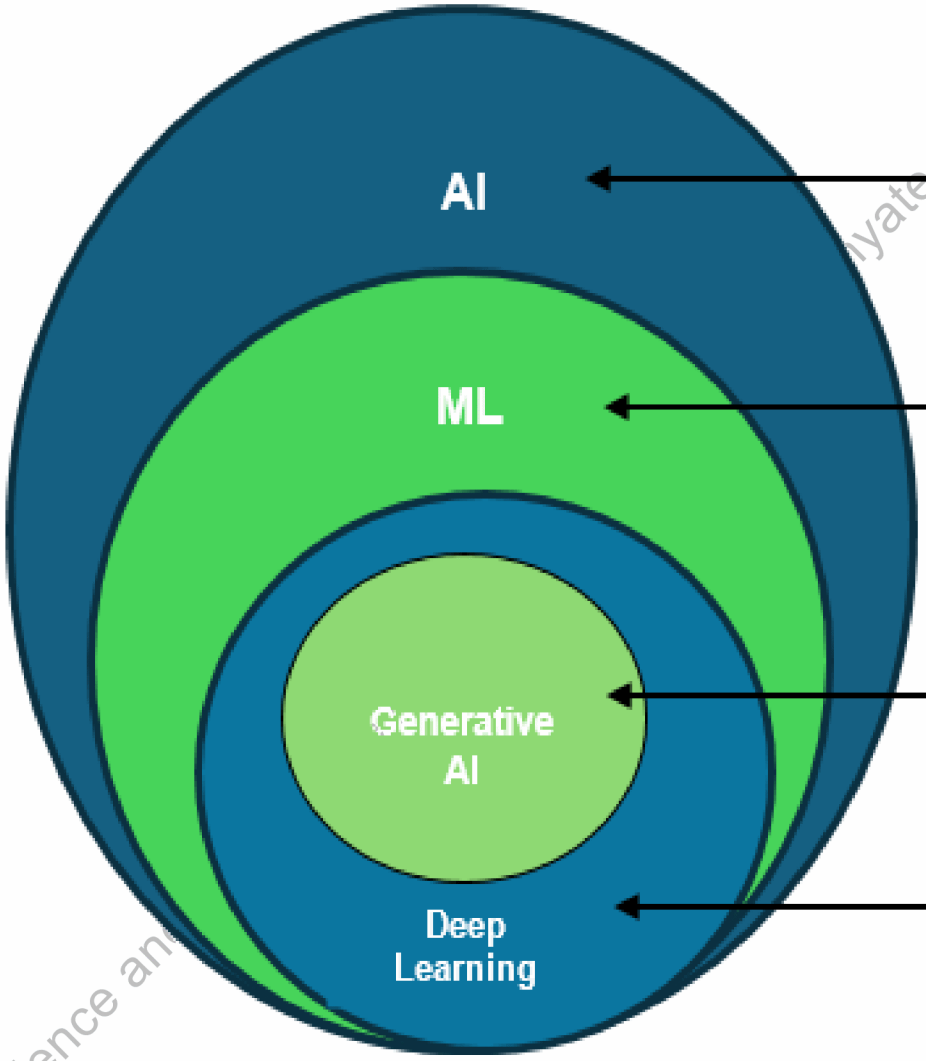
- **Art and Design** – Creating photorealistic art in specific styles.
- **Content Generation** – Generating text for articles, blogs, storytelling, etc.
- **Music Composition** – Crafting new music compositions with specific styles or tones.
- **Data Augmentation** – Generating synthetic data to improve machine learning models.
- **Anomaly Detection** – Identifying unusual patterns in data for **cybersecurity** or fraud detection.
- **Virtual Reality** – Generating realistic environments and characters.
- **Code Generation** – Writing, understanding, and debugging of any code.

Audience

- **Machine Learning Enthusiasts** – Those who are interested in understanding and applying cutting-edge machine learning techniques.
- **Data Scientists** – Professionals looking to expand their skills in generative modeling and its applications.
- **Students/Researchers** – Those studying **computer science**, data science, or related fields and want to explore advanced topics in AI.
- **Developers** – Individuals interested in implementing generative AI models in projects or applications.
- **Artists** – Those who are interested in using AI for artistic purposes, such as generating images, music, or other creative content.

Benefits of Generative AI

- - Enhances creativity and productivity.
- - Automates repetitive tasks.
- - Enables personalized content creation.
- - Advances fields like medicine, design, and education.



It enables machine to mimic human intelligence.

A Subset of AI that empowers machine to learn autonomously. It learns from the datasets and generate predictions depending on the scenario.

Learns patterns from existing training data and produces new and unique output.

Subset of ML that enables the operation of multi-layer neural network possible.

CORE FOUNDATIONS

Artificial Intelligence

The ability to learn and reason similar to humans (in some way)

Machine Learning

The ability to learn without human intervention (rules-based instructions)

Deep Learning

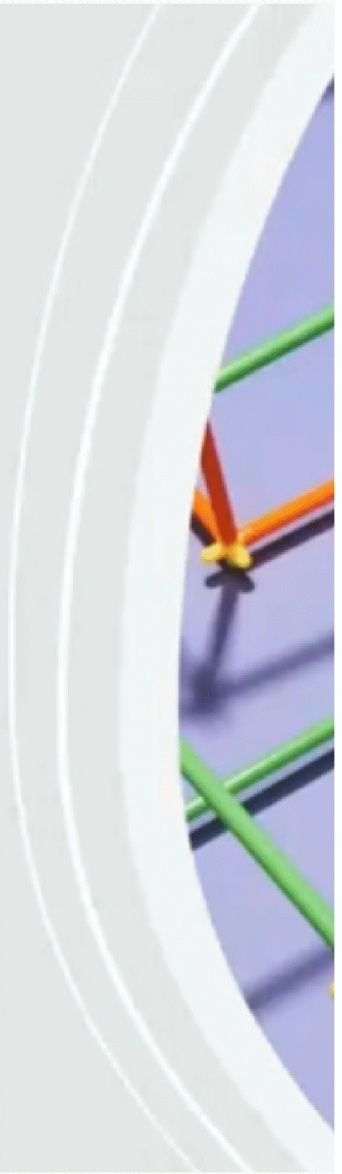
Subset of ML focused on creating neural networks (inspired by brain) to adapt/learn on large amounts of data.

GENERATIVE MODELS

Generative models are a class of Machine Learning

Models that generate new data samples...

that resemble the distribution of a training set.



How Generative AI Works

- - Machine Learning Models: Uses neural networks to understand patterns and generate outputs.
- - Training Data: AI models are trained on vast datasets to learn style, structure, and context.
- - Algorithms Used:
- - GANs (Generative Adversarial Networks)
- - Variational Autoencoders (VAEs)
- - Transformer Models (e.g., GPT, BERT, T5)

Challenges and Ethical Concerns

- - Bias and fairness in AI-generated content.
- - Misinformation and deepfakes.
- - Copyright and intellectual property issues.
- - Data privacy concerns.

TYPES OF GENERATIVE MODELS

Variational Autoencoders (VAEs)

AutoRegressive Models (AR)

Generative Adversarial Networks (GANs)

Large Language Models (LLMs/Transformers) AND MANY MORE

Types of Models

- **Generative Adversarial Networks (GANs)**
  - Two neural networks: Generator vs. Discriminator
  - Generator creates fake data
  - Discriminator detects real vs. fake
- **Variational Autoencoders (VAEs)**
  - Encode data into latent space
  - Decode to generate new data
- **Transformer-based Models**
  - Excel at sequential data (e.g., text)
  - Example: GPT for text generation

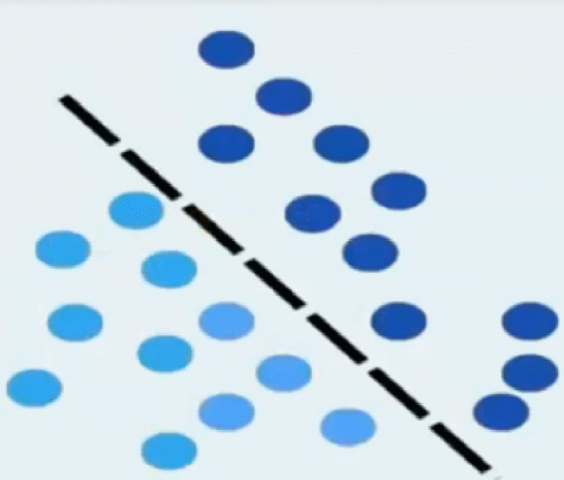
Example Generative Models

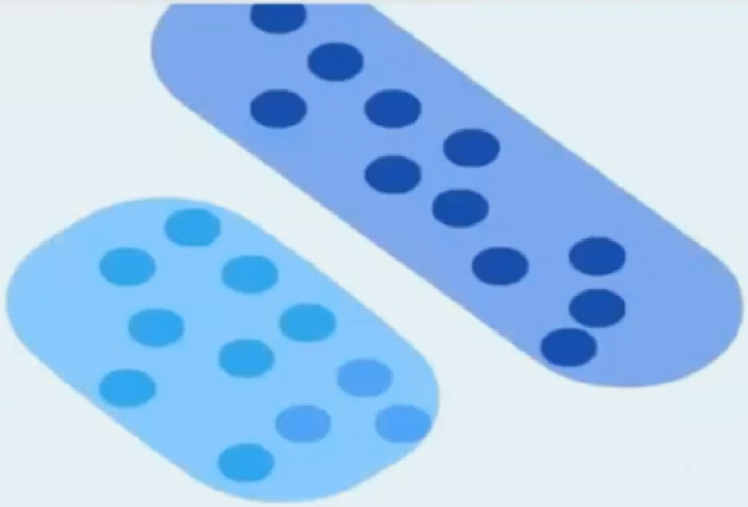
- GPT – GENERATIVE PRETRAINED TRANSFORMER
- BERT – BIDIRECTIONAL ENCODER REPRESENTATIONS FROM TRANSFORMERS.
- LLAMA –1,2 - LARGE LANGUAGE MODEL META AI.

Difference Between Traditional AI and Generative AI

Traditional AI	Generative AI
AI is used to create intelligent systems that can perform those tasks which generally require human intelligence.	It generates new text, audio, video, or any other type of content by learning patterns from existing training data.
The purpose of AI algorithms or models are to mimic human intelligence across wide range of applications.	The purpose of generative AI algorithms or models is to generate new data having similar characteristics as data from the original dataset.

DISCRIMINATIVE VS GENERATIVE





Discriminative

Modeling the **conditional probability** of the labels given input data

Used to **make predictions**

Used to **classify new data**

Generative

Aim to model **joint probability distribution** of input data + labels

Learn underlying data and **generate new data**

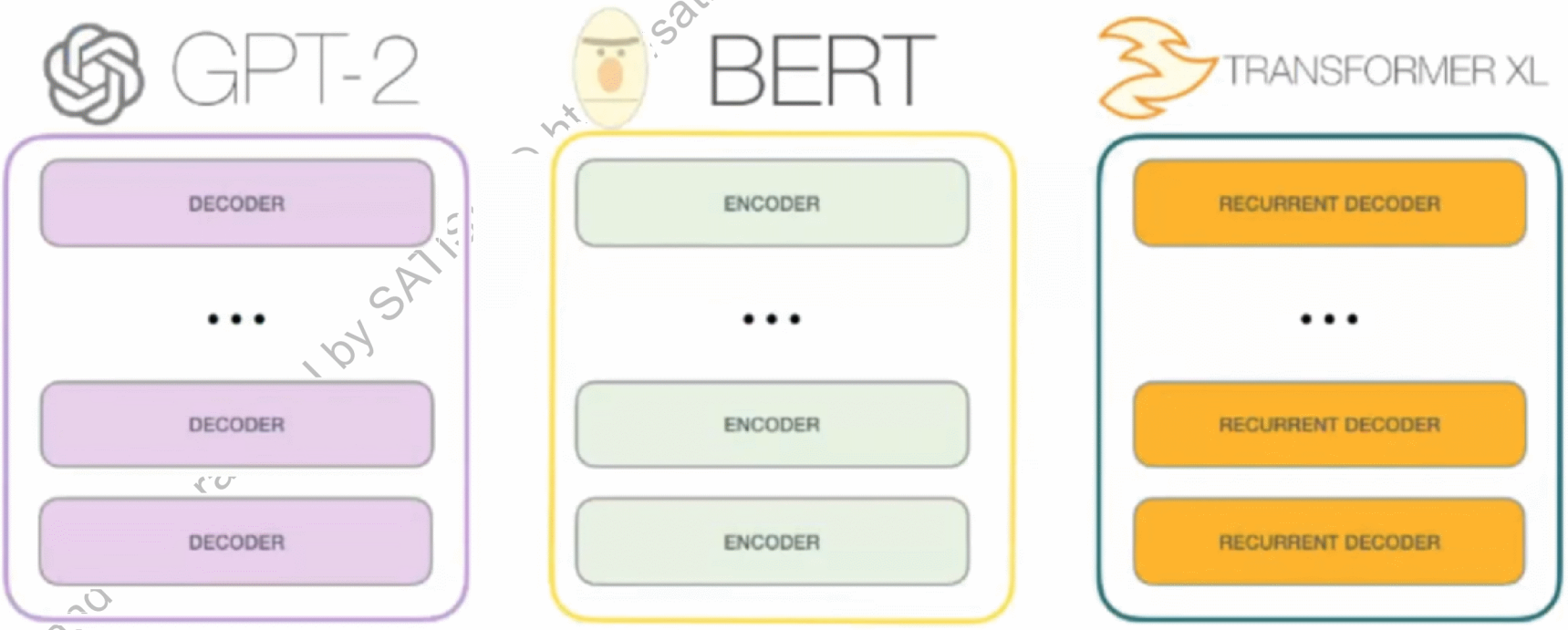
APPLICATIONS

Generative AI Examples	Discriminative AI Examples
- Image generation (e.g., GANs)	- Image classification (e.g., CNNs)
- Text generation (e.g., language models)	- Sentiment analysis (e.g., logistic regression)
- Music composition	- Object detection
- Video synthesis	- Fraud detection
- Synthetic data generation for training	- Face recognition

USE CASES

Generative AI Use Cases	Discriminative AI Use Cases
- Creative applications (art generation)	- Classification tasks (spam detection)
- Data augmentation	- Predictive analytics
- Synthetic data generation	- Medical diagnosis
- Anomaly detection	- Natural language processing (NLP)
- Drug discovery	- Speech recognition

THE FIRST HALL MARK LARGE LANGUAGE MODELS. (DIFFERENT TRANSFORMERS)



What is BERT

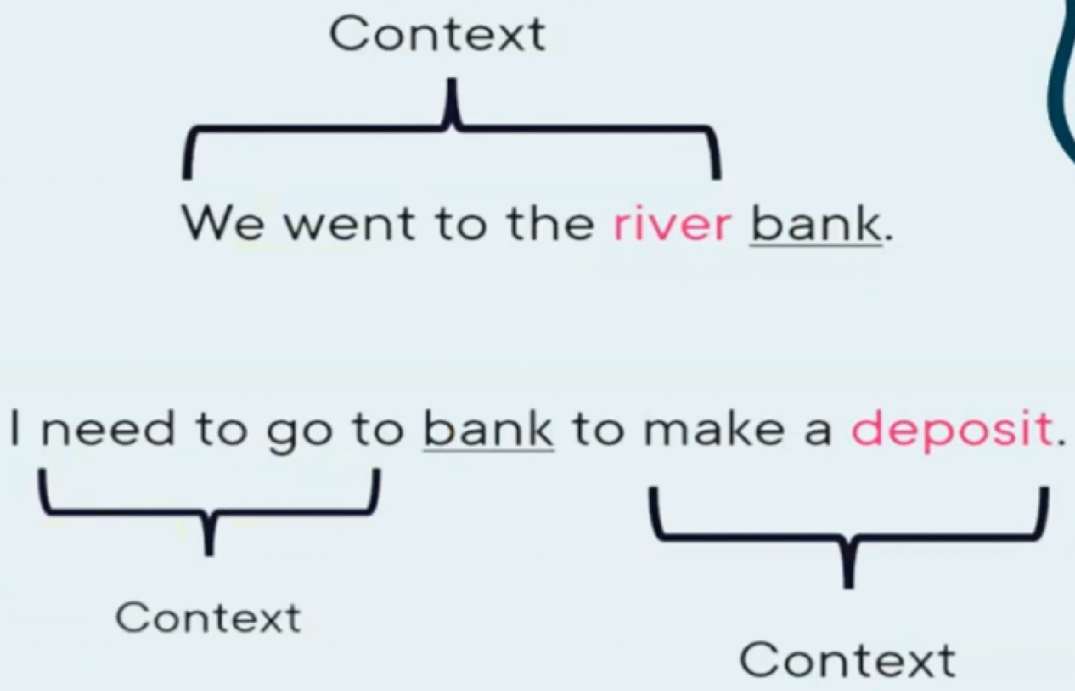
Released by Google (2018)

Bidirectional context

Masked Language Model

Pre-trained on text data

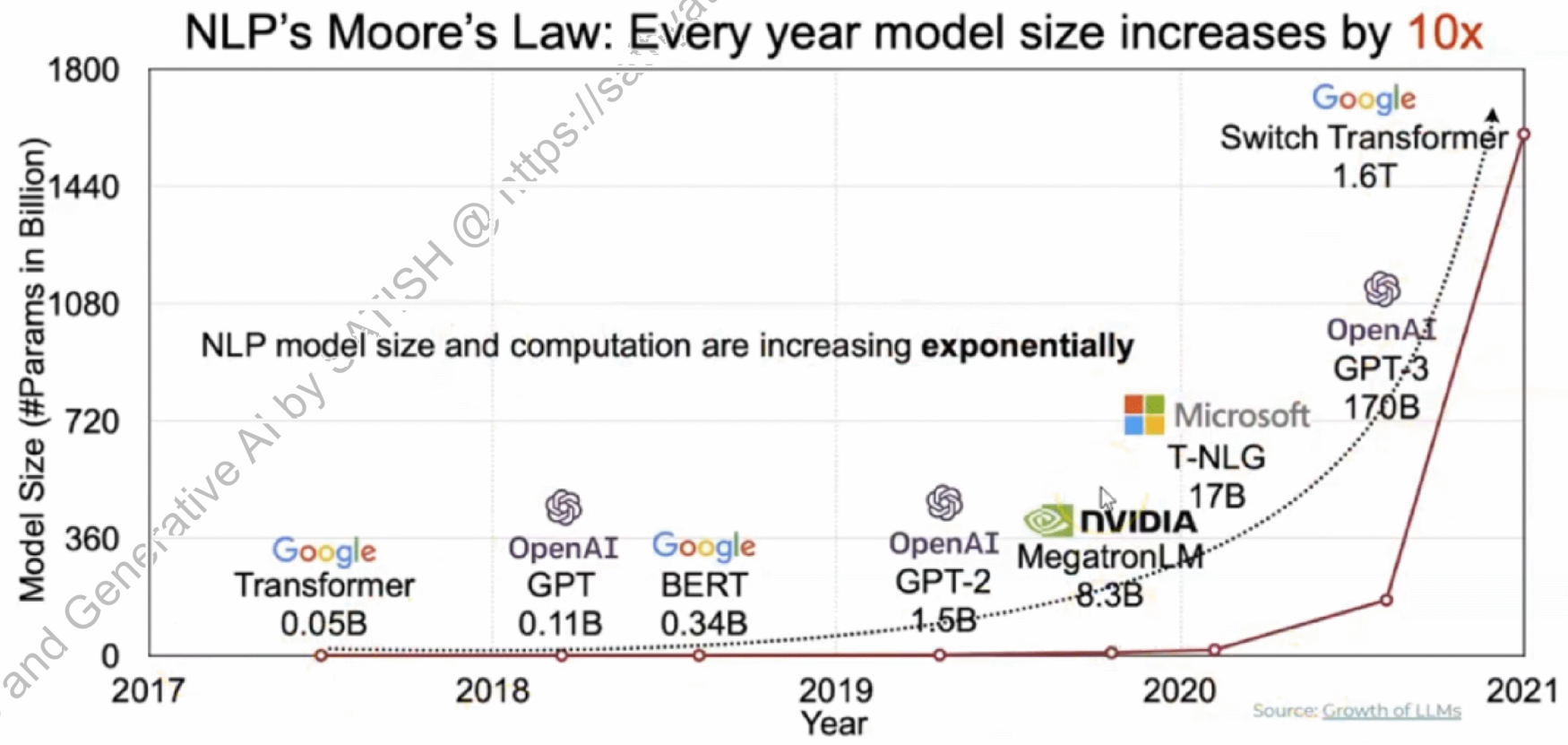
Transformer encoder blocks



GPT-2 VS BERT

Aspect	GPT-2	BERT
Architecture	Transformer-based with **unidirectional attention**	Transformer-based with **bidirectional attention**
Training Objective	**Autoregressive** language modeling	**Masked language model** prediction
Context Understanding	**Sequential context** generation	**Bidirectional context** understanding
Fine-tuning	Minimal task-specific parameters	Extensive task-specific parameters
Output	Generates coherent text	Outputs contextualized embeddings

Growth of LLMS



Generative AI Roadmap

- **Stage 1: Fundamentals (Beginner)**
- Focus: Basic programming, math, and AI/ML foundations
- ☑ **Learn Programming**
- Python (essential)
- Libraries: NumPy, Pandas, Matplotlib
- ☑ **Learn Math for AI**
- Linear Algebra (vectors, matrices)
- Calculus (derivatives, gradients)
- Probability & Statistics (distributions, Bayes' theorem)
- ☑ **Learn ML Basics**
- Supervised vs Unsupervised Learning
- Algorithms: Linear Regression, KNN, Decision Trees
- Tools: Scikit-learn, Jupyter Notebook

Generative AI Roadmap

- **Stage 2: Deep Learning (Intermediate)**
- Focus: Neural networks and the architecture that powers GenAI
- ✅ **Neural Networks**
- Feedforward NN, Backpropagation
- Activation functions (ReLU, Sigmoid)
- Loss functions (MSE, Cross-Entropy)
- ✅ **Tools & Frameworks**
- TensorFlow / PyTorch (pick one to master)
- Keras for quick prototyping
- ✅ **Core Concepts**
- CNNs (images)
- RNNs, LSTMs (sequences, text)
- Attention Mechanism

Generative AI Roadmap

- **Stage 3: Generative Models (Advanced ML)**
- Focus: Understanding how AI "generates" content
- ✅ **Learn Key Generative Models**
- **Autoencoders**
- **Variational Autoencoders (VAEs)**
- **Generative Adversarial Networks (GANs)**
  - DCGAN, StyleGAN, CycleGAN
- **Transformer Models**
  - BERT (Encoder)
  - GPT (Decoder)
- ✅ **Learn Tokenization**
- Word embeddings (Word2Vec, GloVe)
- Byte Pair Encoding (BPE)
- Tokenizers (HuggingFace's tokenizers library)

Generative AI Roadmap

- **Stage 4: Build with Generative AI**
- Focus: Applying skills to real-world creative tasks
- ☑ **Text Generation**
- Build chatbots using GPT-2/GPT-3
- Fine-tune GPT models with Hugging Face
- ☑ **Image Generation**
- Use **DALL·E**, **Stable Diffusion**, or **MidJourney**
- Train a StyleGAN on custom images
- ☑ **Audio/Music**
- TTS (Text to Speech): Tacotron, WaveNet
- Music Generation: OpenAI MuseNet, Jukebox
- ☑ **Tools & Platforms**
- **Hugging Face Transformers**
- **OpenAI API**
- **LangChain** (for agents and tool use)

Generative AI Roadmap

- **Stage 5: Specialized Applications & Research**
- Focus: Pushing boundaries, exploring niches
- ☑ **Use Cases**
- AI Art & Animation
- AI Code Assistants (e.g., Codex, Code Llama)
- Game Asset Generation
- Synthetic Data Generation
- Medical Imaging Synthesis
- ☑ **Research Directions**
- Alignment & Bias in Generative Models
- Prompt Engineering
- Multimodal AI (text + image + audio)
- Diffusion Models

Conclusion

- - Generative AI is transforming industries and human creativity.
- - Responsible use and regulation are key to harnessing its potential.
- - Continuous improvements in AI technology will lead to more innovative applications.

- **Thank You!**