AL/ML Overview

About Me

Name: Pooja Ramesh

Occupation: Machine Learning Engineer at Betteromics

Background:

Education - Computer and Electrical Engineering

Worked in a variety of hardware and software engineering roles

Made the transition to data science and machine learning in 2015

Interested in healthcare, medicine, and science in general

Introduction

- Artificial Intelligence and Machine Learning have reached massive new interest and concern in the world today
  - Large Language Models (LLMs, like ChatGPT) provide human-level responses on a wide variety of subjects
  - Generative AI can now create photo-realistic pictures, movies, and art, as well as written work–with just a simple prompt
  - However, for all their creative power, such AIs can be the source of damaging content, e.g. bias, deepfakes
  - Increasing power demands for training models place huge burdens on our electrical grids and may adversely impact our environment
- Great concern that AI could replace humans in a variety of fields in the years ahead (or even supplant us)
- We really don't know where the current track of AI will go

Important we understand these tools to maximize their creative power for our own advantage and minimize the risks

Real-World Example

Which is real and which is AI-generated?

Source: Karras et al., 2018; The New York Times

Trick question: They are both AI-generated!

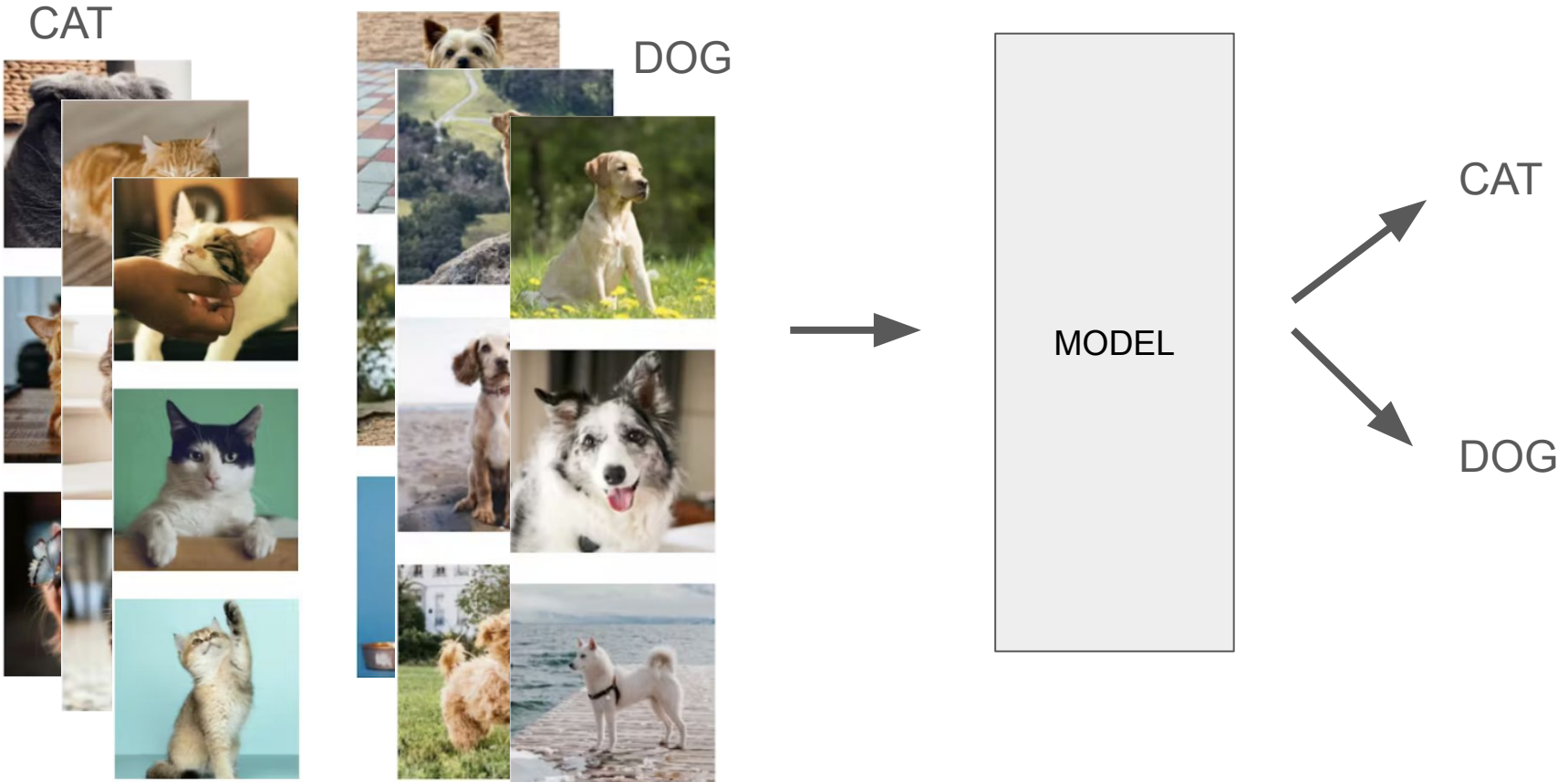
AI vs. ML vs. Generative AI

- First of all, what is the difference between “Artificial Intelligence” and “Machine Learning” and “Generative AI”?
  - **Artificial Intelligence**: Computers programmed to behave ‘intelligently’
  - **Machine Learning**: Sub-field of AI, rather than programming a computer to behave intelligently directly, the computer ‘learns’ from training data and establishes a statistical model of the world around it
  - **Generative AI**: A form of machine learning that generates new content (text, images, music, code etc.). These models learn the probability of certain data points occurring based on what it has seen.

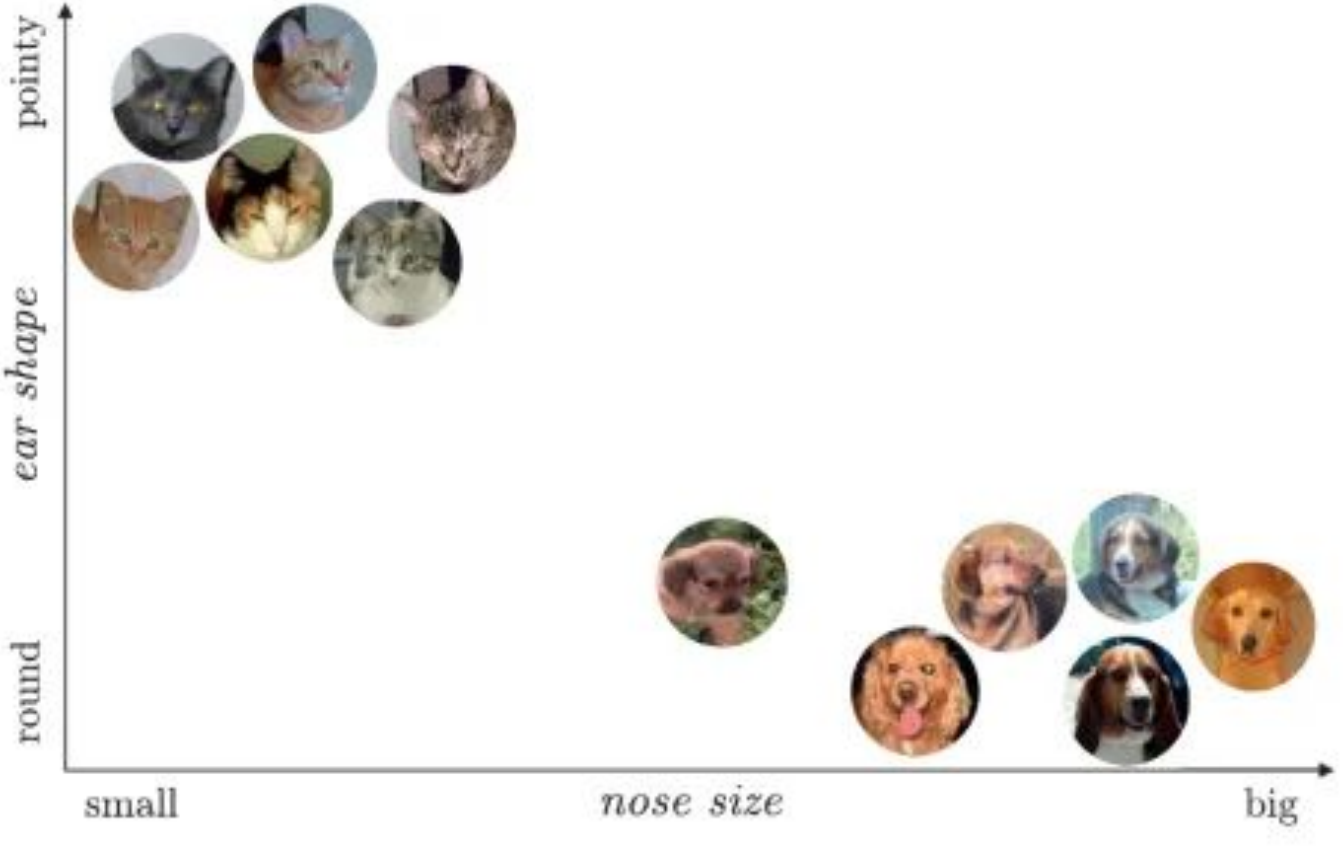
AI vs. ML vs. Generative AI

- Example: Let’s create a machine learning AI that can identify photos of ‘dogs’ vs. ‘cats’
  - Initialize a learning algorithm (e.g. deep neural network) with randomized weights
  - Feed a training set of photos (photos with dogs, cats, and photos without dogs or cats) into the neural network
  - Network will update its weights; upon training completion, it will embody a statistical model
  - Classification: Provide a new photo to the trained model. It will likely give the correct answer if the photo has a dog or not.
  - Generation: Take a statistical sample from the trained model. It will likely be a photo of a dog but unique to anything that has been seen before.

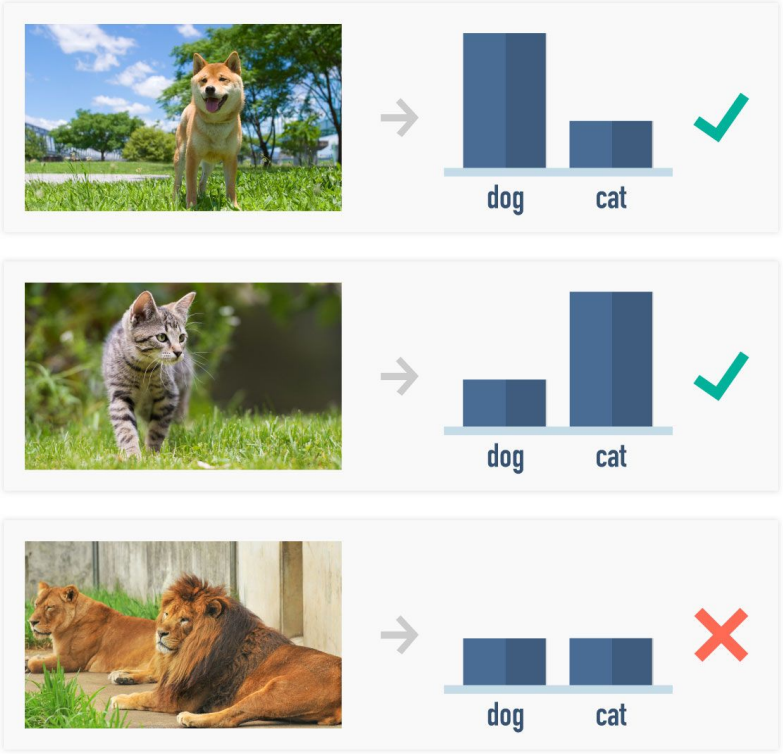
Machine Learning Paradigm: Classification



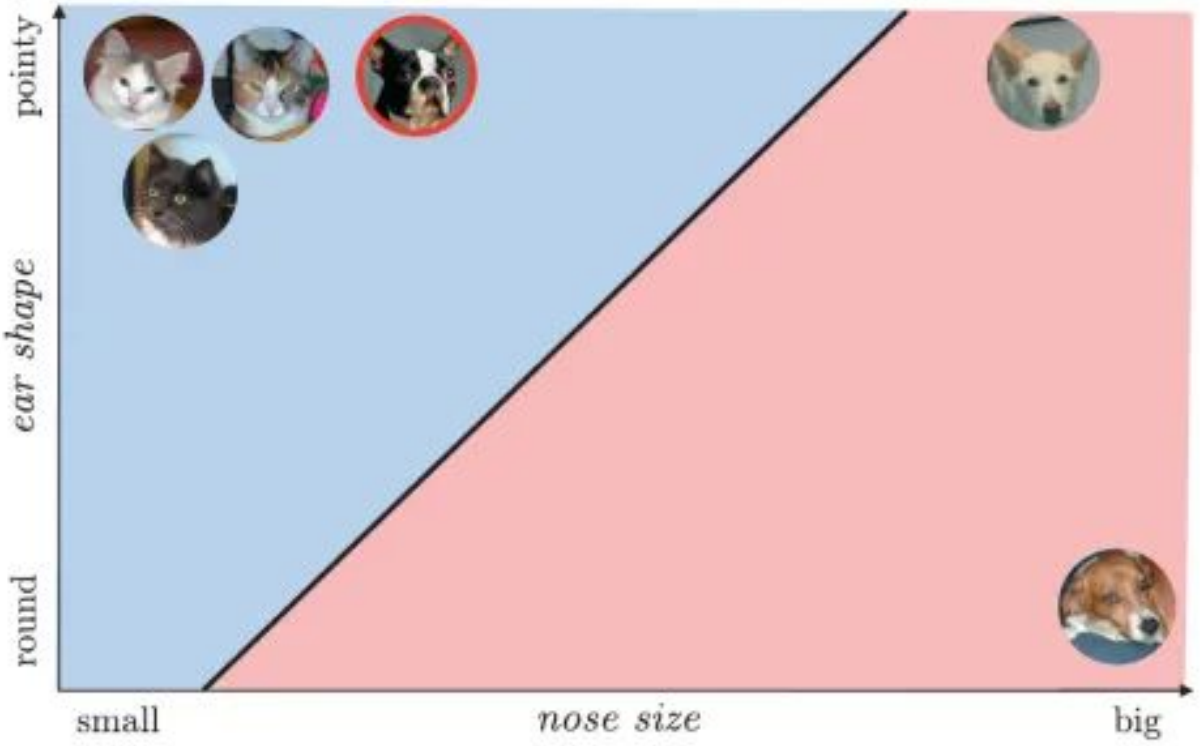
Machine Learning Paradigm: Feature Representation



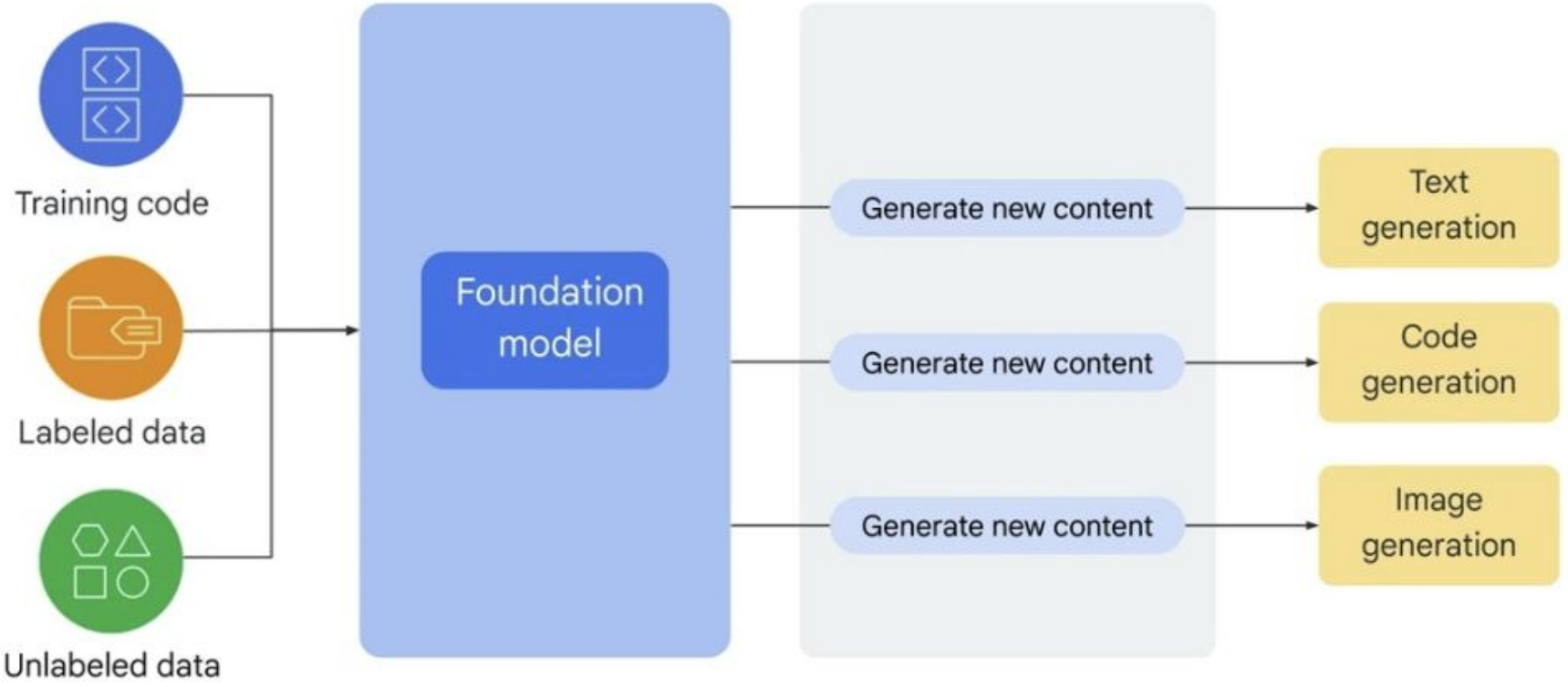
Machine Learning Paradigm: Inference



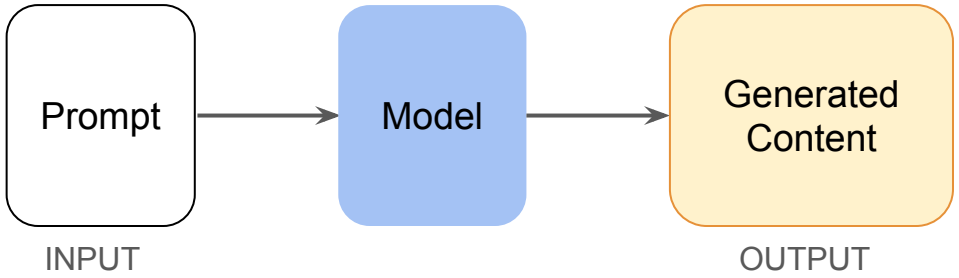
Machine Learning Paradigm: Bias

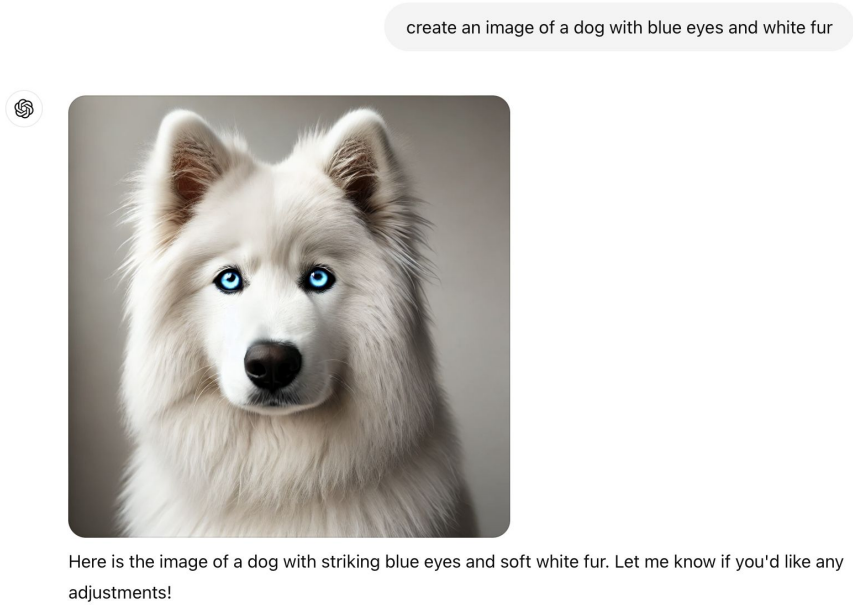


Generative AI Paradigm



Generative AI Paradigm: Inference/Prompting

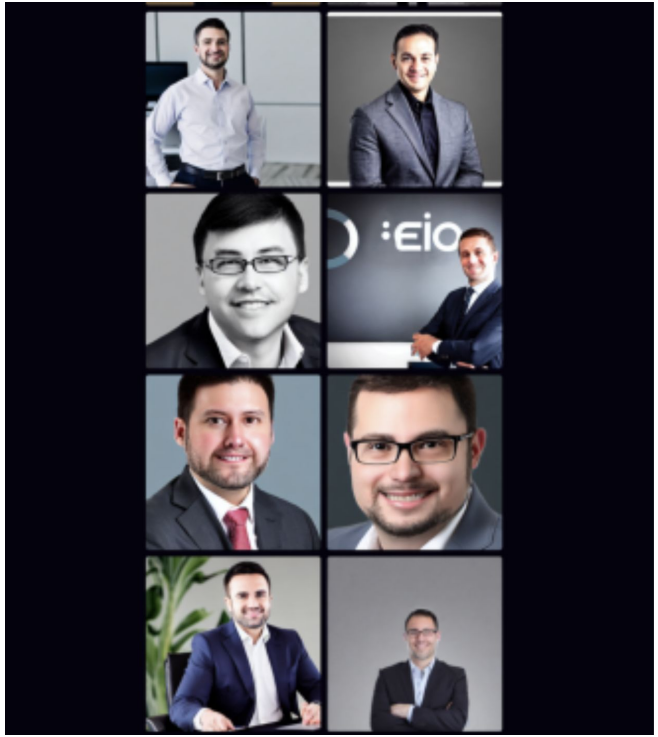


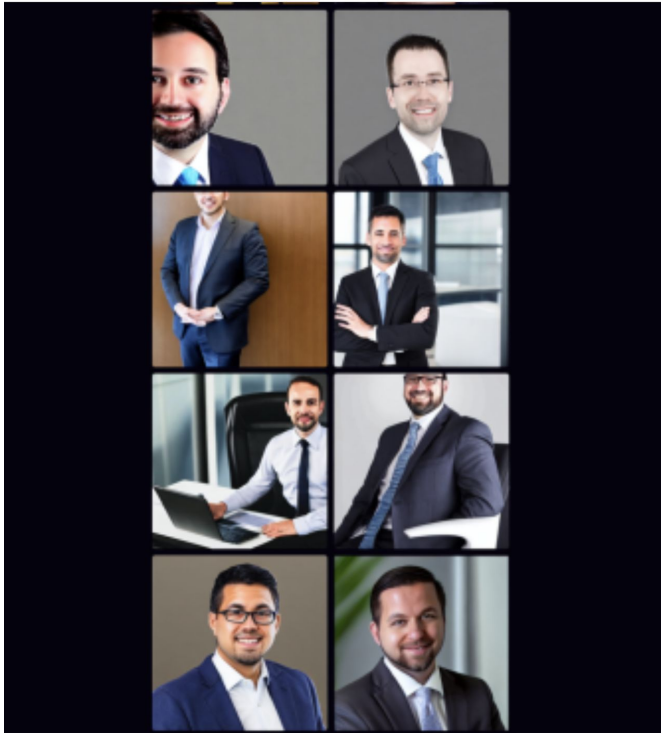


Source: ChatGPT DALL.E

Generative AI Paradigm: Bias

Prompt: “Picture of a CEO”

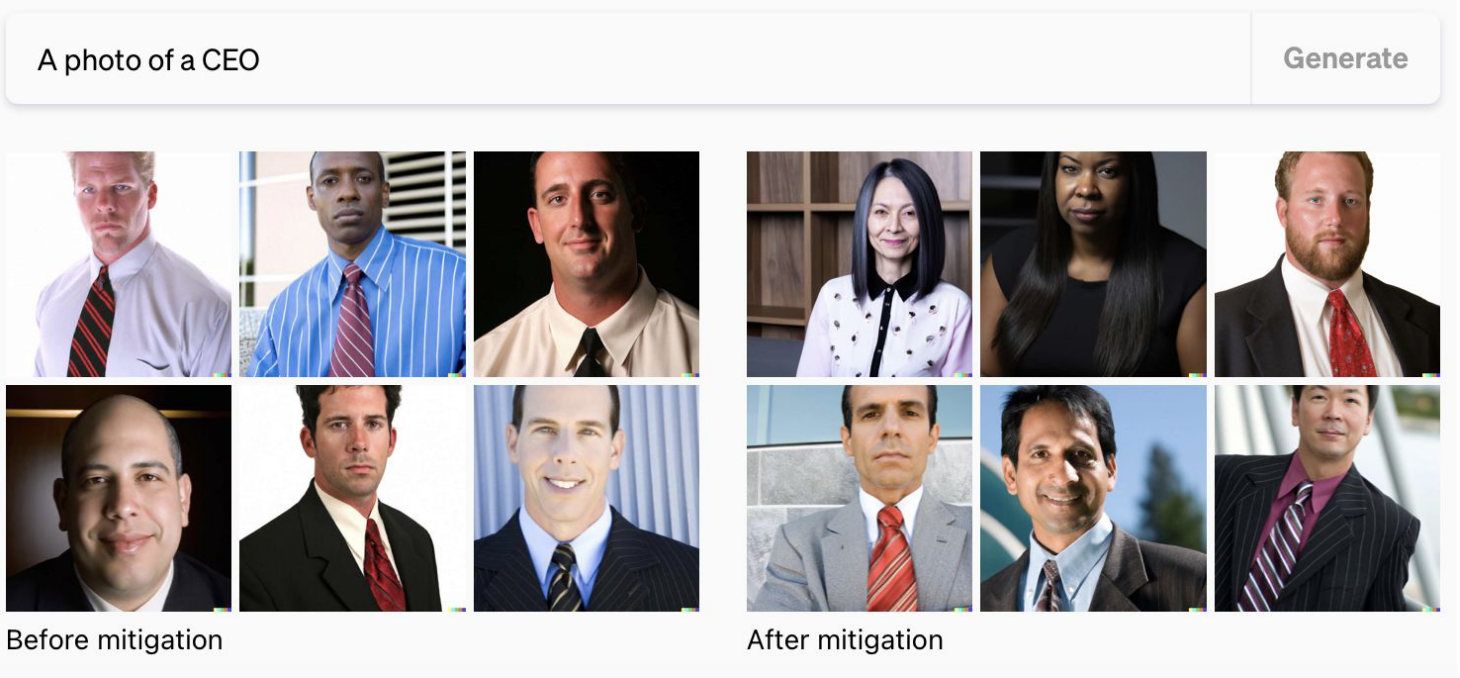




Generated on November 7, 2022 by Michael Todasco on Stable Diffusion with the prompt "picture of ceo"

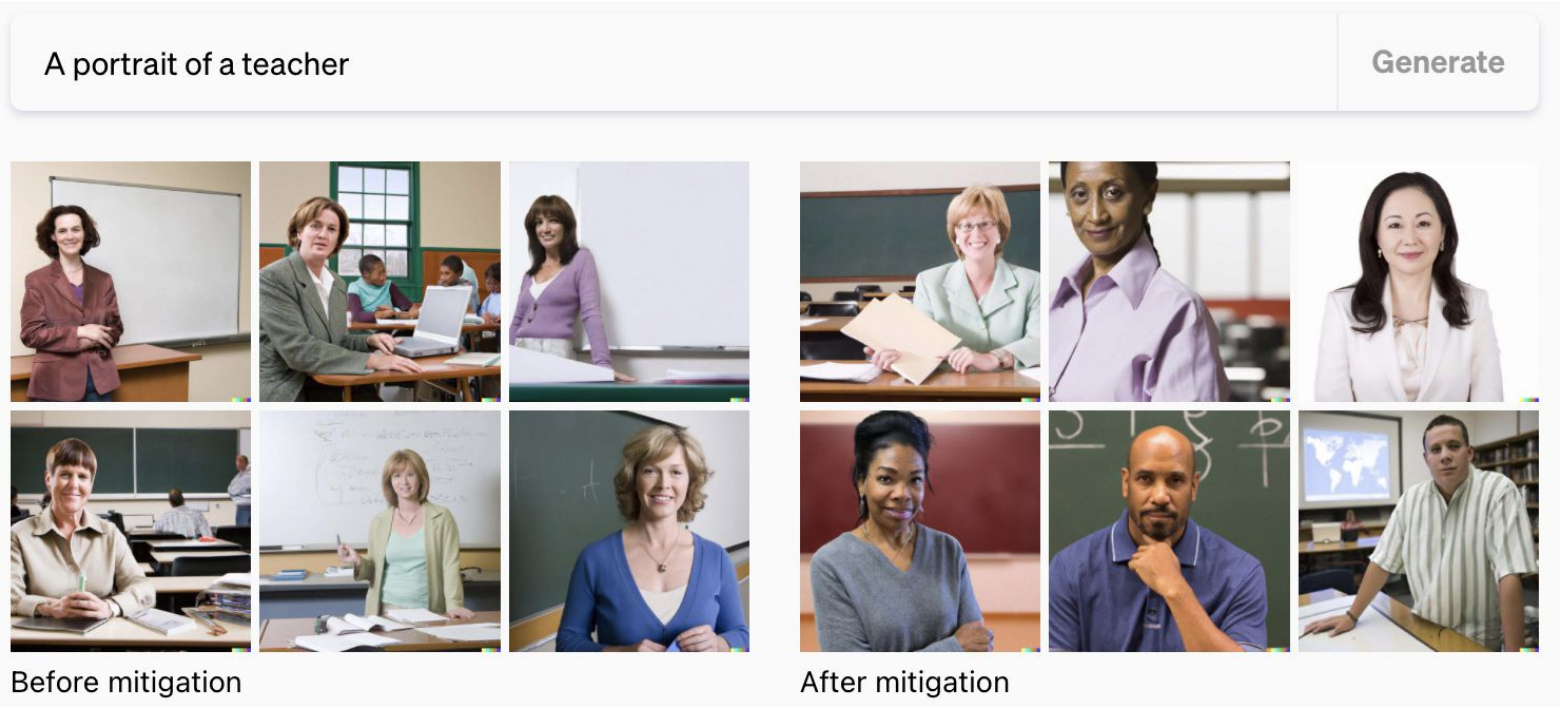
Generative AI Paradigm: Bias

OpenAI: [Reducing bias and improving safety in DALL·E 2]



Generative AI Paradigm: Bias

OpenAI: [Reducing bias and improving safety in DALL·E 2]



Types of Machine Learning Algorithms

Supervised Learning: The algorithm learns from labeled data.

- Examples: identify the objects in an image, predict housing prices, detect fraud

Unsupervised Learning: The algorithm is given data without explicit instructions on what to look for. It tries to identify patterns or groupings on its own.

- Examples: Cluster patient groups, segment customers into groups based on purchasing behavior

Reinforcement Learning: The algorithm learns by trial and error. It takes actions, receives feedback (rewards or penalties), and adjusts its actions to improve over time.

- Example: Train an AI to play chess

Use cases for ML

Forecasting - weather, markets, manufacturing failures, power grid usage

Fraud detection - credit card transactions

Image Segmentation - fashion, satellite imagery

Recommendation Algorithms - Netflix, Ads on social media, ecommerce

Types of Generative Models

Generative Adversarial Networks (GANs): generator and a discriminator. The generator creates new content, while the discriminator evaluates how realistic it is.

Transformers: Work particularly well with text by learning to predict the next word in a sentence, which allows them to generate entire paragraphs of new, coherent text. (Example: ChatGPT)

Diffusion Models: Excel at generating high-quality, realistic images (Example: DALL-E, Midjourney)

Use cases for generative models

1. Text - writing, extracting information from text, analyzing, problem solving
2. Art and design
3. Healthcare - design new drugs or create simulations of proteins and molecules to speed up research, generate new DNA sequences for research
4. Music
5. Gaming and animation
6. Deep fakes and video content - unfortunately mainly used for disinformation

AI and Machine Learning in Graphic Design

- Use Cases
  - Image Generation
  - Automated Editing
  - Color Palette Generation
  - Vector Graphics Generation
  - Layout Design
  - Font Matching
- Apps
  - Adobe: Sensei, Firefly, Illustrator (AI Features)
  - OpenAI: Dall-E 3
  - Midjourney
  - Canva AI
  - Playground
  - Google: Gemini

Thank you and happy to answer any questions!