Data Schools

Module 1:
Introduction to Machine Learning

Overview

Agenda Topics

1. Overview: What is Machine learning
   - *Building Classification Model – Lab Exercises*
2. Recommender Systems
   - *Building a Recommender Engine – Lab Exercises*
3. **From ML to Deep Learning**
   - **The Rise of Gen AI – Discussion Topic**

Learning Objectives

Upon successful completion of this topic, you will be able to:

- Define machine learning
- Describe the categories of machine learning
- Decide when to leverage Machine learning
- Build a simple classifier model
- Discuss approaches to ML application development
- Differentiate between the ML approaches and motivations
- Build a simple recommender engine
- Good insight to Deep Learning & Gen AI

The Rise of Generative AI: Exploring Innovations, Applications, and Ethical Considerations

Understanding AI's impact on various industries

Agenda Items

Understanding Generative AI

Generative AI Vs. Traditional AI

Introduction to Large Language Models (LLMs)

Real-Life Applications of Generative AI

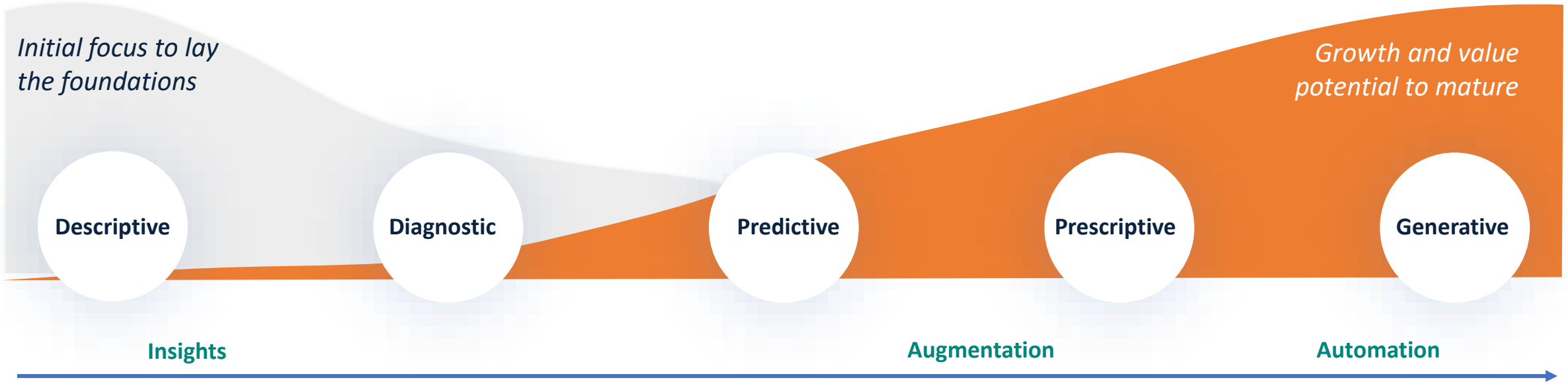
Limitations and Ethical Considerations

Understanding Generative AI

Introduction to Machine Learning

What is Gen AI?

Generative AI is the latest evolution in analytics and machine learning.



Analytics

Finding answers and gaining insights for problems that we know

Data science

Establish solutions of questions that are not yet discovered

Machine learning

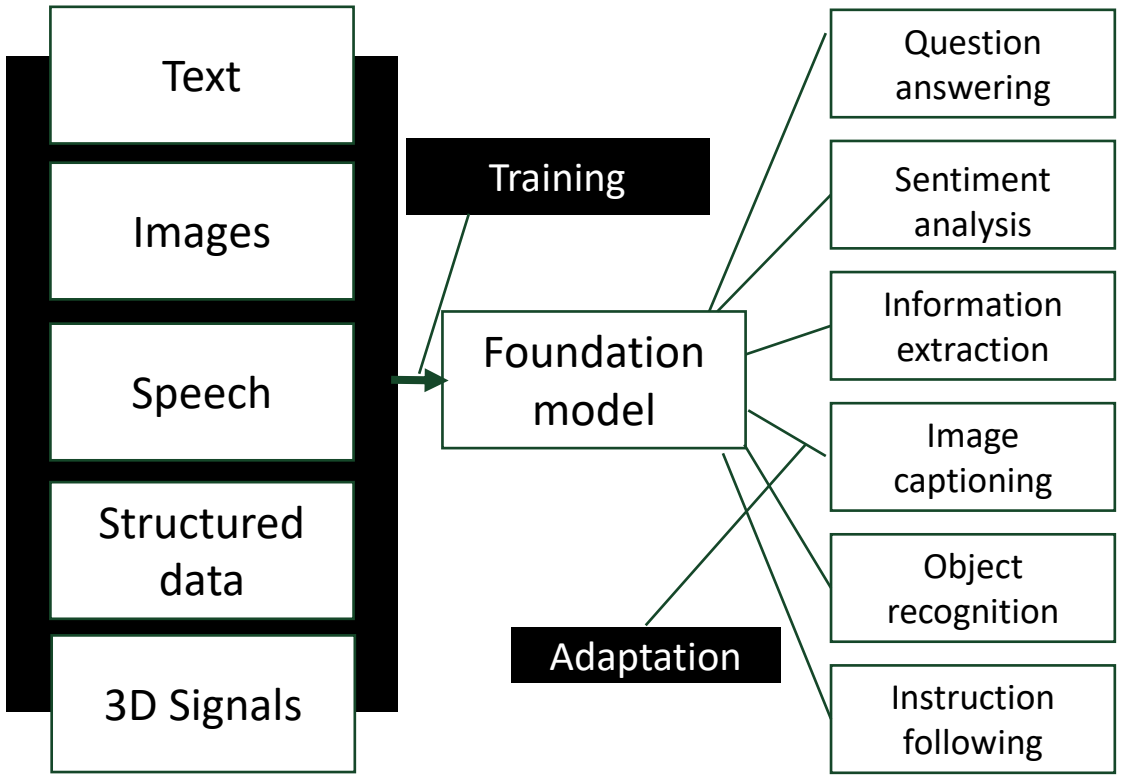
Develop software (i.e., trained models) that can access data, make inferences, and improve

LLM's and gen AI

Utilize large 'pre-trained' models to analyze data and generate new content

What is Gen AI?

Foundation models are the underlying disruptive force of ChatGPT-like gen AI.



The generative nature

A single large model could be used to write convincing essays, create charts and websites, generate computer code, and more.

Self-supervised learning

LLMs can learn from unlabeled data, this opens doors to training on almost unlimited amounts of data.

Multi-modal learning

Multi-modal learning allows multiple forms of data like images, sound, text, and speech that mimic human-level multi-sensory learning experiences.

Fine-tune with little data

A revolutionary feature of LLMs is their capacity for few-shot and zero-shot learning to perform tasks that were not included in their training examples.

Chain-of-thought prompting

The model can generate a series of intermediate steps before giving the final answer, allowing the model to solve multi-step problems.

Key Components and Technologies

Neural Networks

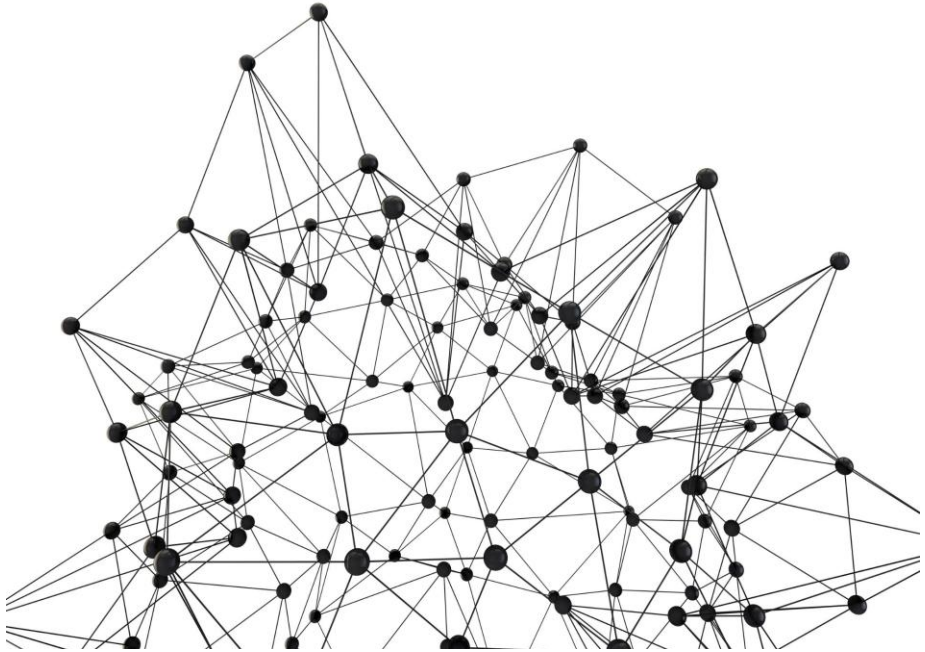
Neural networks are foundational to generative AI, mimicking the human brain's structure to process information and learn from data.

Deep Learning

Deep learning is a subset of machine learning that utilizes multi-layered neural networks to model complex patterns in large datasets.

Generative Models

Generative models like GANs and VAEs are crucial for creating new content and data by learning from existing data distributions.



Generative AI Vs. Traditional AI

Generative AI Vs. Traditional AI

Traditional AI	Features	Generative AI
Analyzes data, performs specific tasks	**Focus**	Creates new data (text, images, music)
Explicit rules and algorithms	**Learning Approach**	Data-driven learning (neural networks)
Solutions of Classifications	**Output**	Entirely new content
Master chef following a recipe	**Analogy**	Innovative chef creating new dishes
Accuracy, efficiency, reasoning	**Buset suited for**	Creativity, content generation, exploring possibilities

Introduction to Large Language Models (LLMs)

What is Chat GTP?

Chat: natural language system

G: Generatively – Designed to model the creation of text

P: Pretrained – Trained on lots of naturally occurring data

T: Transformer – A kind of neural network architecture

Chat GPT is just one example of a

Large Language Model (LLM)

What is a Large Language Model (LLM)?

- **Large:** The model parameters are BIG!
  - BILLIONS or TRILLIONS OF PARAMETERS!!!!!

- **Language Model:** predicting language (e.g., words)

The best city in the US to visit is

Dallas

Atlanta

…

Ok, let's try being a **language model**

Predicting the Next Word is Knowledge

The best city in the US to vistit is

Dallas

Atlanta

...

Predicting the next word allows you to:

- Answer questions
- Tell stories
- Accomplish tasks

Generative AI

How do we model the next ~~word~~ token?

Modeling Tokens not Words

- **Tokens** represent **words, word parts**, and **special characters**

  "The smallest tokenizer!" ->
  Tokens: ["The", "small", "est", "token", "izer", "!"]

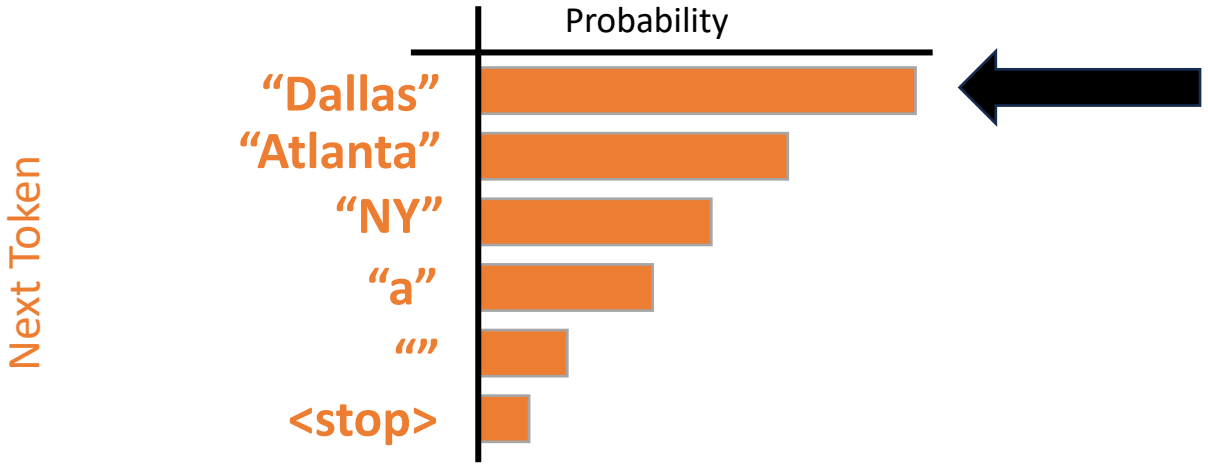
- Constructed based on **frequency of char. sequences**
- Allows for **new words, misspelling**, and **numbers**
- **Vocabulary Sizes:** Llama-2: 32K -> Llama-3: 128K tokens

Causal Language Modeling

The best city in the US to visit is _____

Model: Pr(“Dallas” | “The best city in the US to visit is”)

Next Token **Context (ordered tokens)**



- Conditioned on the **context**
- Model probability of the **next token**
  - **Sample** or **pick most likely**

Causal Language Modeling

The best city in the US to visit is _____

Model: Pr("Dallas" | "The best city in the US to visit is")

Next Token **Context (ordered tokens)**

- Conditioned on the **context**
- Model probability of the **next token**
  - **Sample** or **pick most likely**

How do we go from **predicting a single token to writing an essay**?

One token at a time!

Auto Regressive Decoding

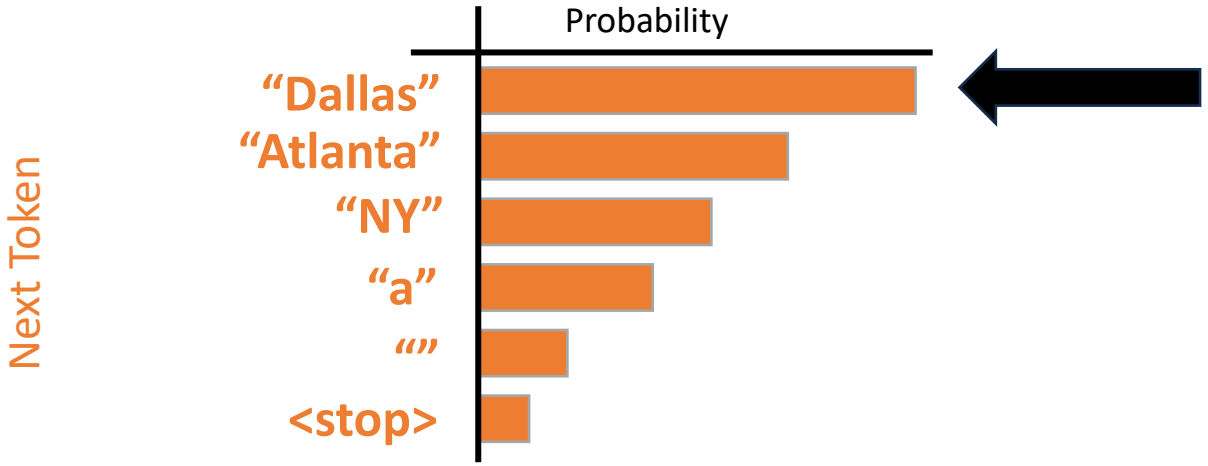
1. Compute the probability over the next token
2. Select the next token
   - Most likely next token (temperature 0)
   - Sample over the top few most likely tokens
3. Append the selected token to the context
4. Repeat until the <stop> token is reached.

Auto Regressive Decoding

- Sample **one token at a time** and add to the context

Model: Pr(“Dallas” | “The best city in the US to visit is”)

Next Token **Context (ordered tokens)**



Decode one word:

The best city in the US to visit is

Dallas

Auto Regressive Decoding

- Sample **one token at a time** and **add to the context**

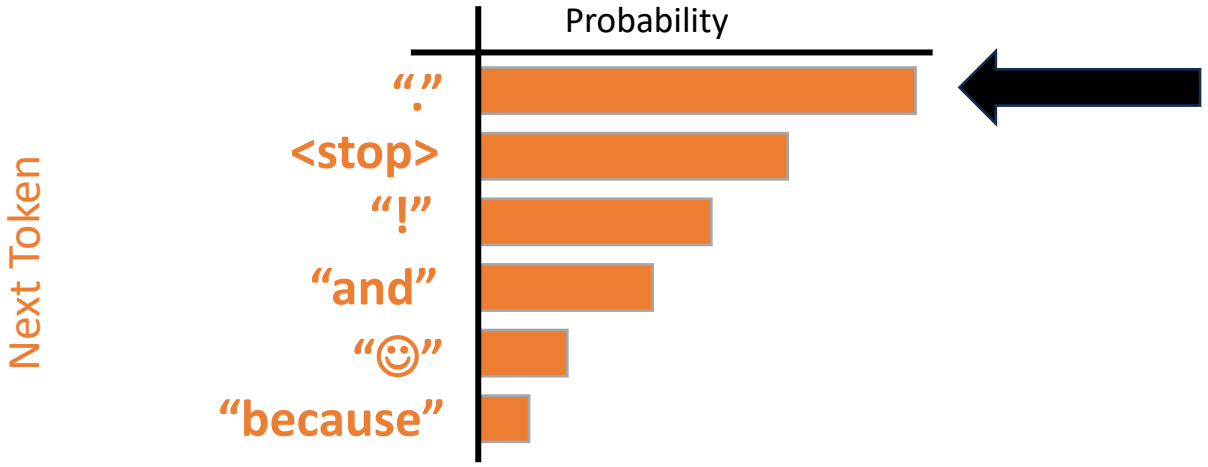
Auto Regressive Decoding

- Sample **one token at a time** and **add to the context**

Model: Pr(| "The best city in the US to visit is Dallas")

Next Token

Context (ordered tokens)



Decode one word:

The best city in the US to visit is **Dallas.**

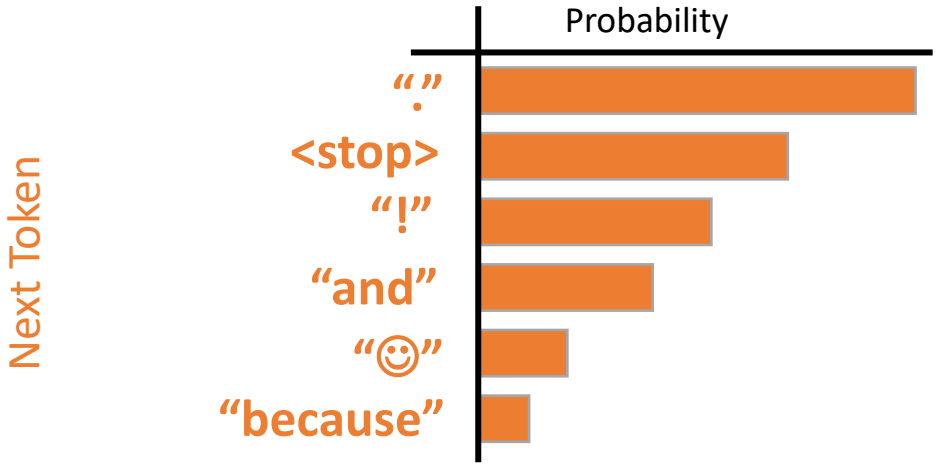
Auto Regressive Decoding

- Sample **one token at a time** and **add to the context**

Model: Pr(| "The best city in the US to visit is Dallas")

Next Token

Context (ordered tokens)



Sample according to probabilities

Decode one word:

The best city in the US to visit is

Dallas <stop>

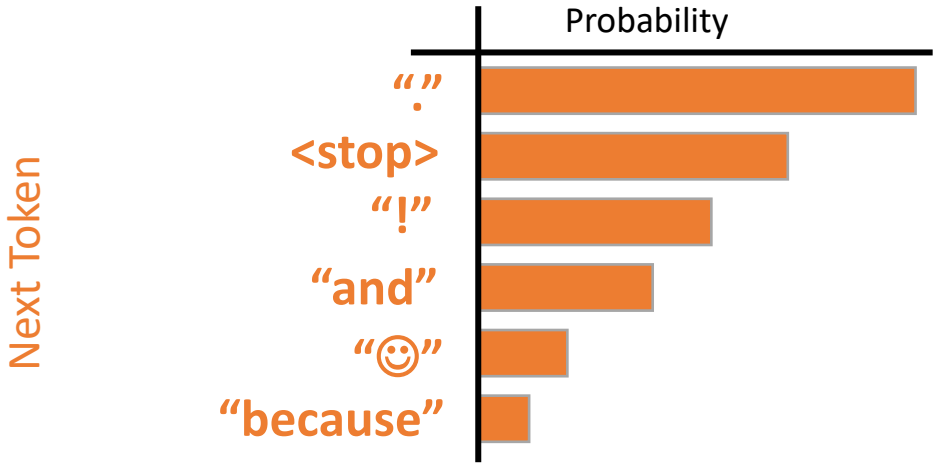
Auto Regressive Decoding

- Sample **one token at a time** and **add to the context**

Model: Pr(“.” | “The best city in the US to visit is Dallas”)

Next Token

Context (ordered tokens)



Sample according to probabilities

Decode one word:

The best city in the US to visit is

Dallas .

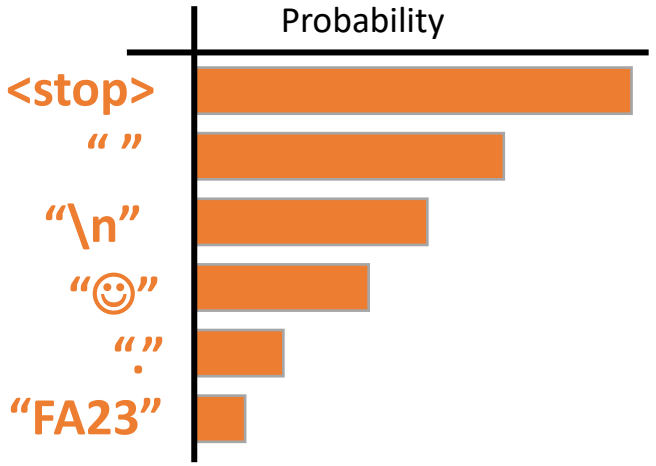
Auto Regressive Decoding

- Sample **one token at a time** and **add to the context**

Model: Pr(<stop> | "The best city in the US to visit is Dallas.")

Next Token

Context (ordered tokens)



Sample according to probabilities

Decode one word:

The best city in the US to visit is

Dallas. <stop>

Stop decoding

Limitations and Ethical Considerations

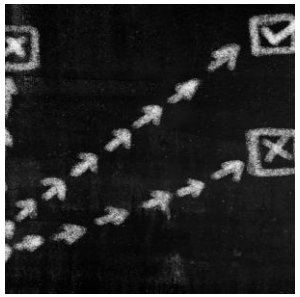
Issues of Hallucinations and Inaccuracies

Understanding Hallucinations

Hallucinations in AI models refer to the generation of content that is incorrect or misleading, which can confuse users.

Impact on Users

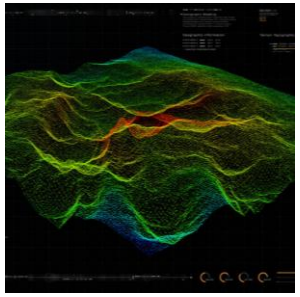
Users must recognize the potential inaccuracies in AI-generated content to make informed decisions and assessments.



Importance of Verification

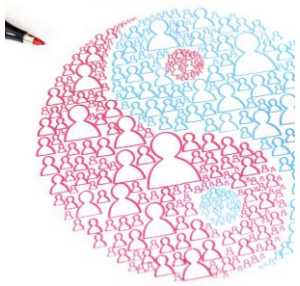
It is essential to verify AI-generated information against reliable sources to mitigate the risks of misinformation.

Bias in AI Models



Impact of Bias

Bias in training data significantly influences the outputs of generative AI models, leading to skewed results.



Importance of Diversity

Ensuring diversity in training datasets is crucial to mitigate bias and promote fairness in AI applications.

Mitigating Inequalities

Addressing bias in AI models is essential to avoid perpetuating social inequalities and ensure equitable outcomes.

Ethical Implications and Responsible Use

Copyright Concerns

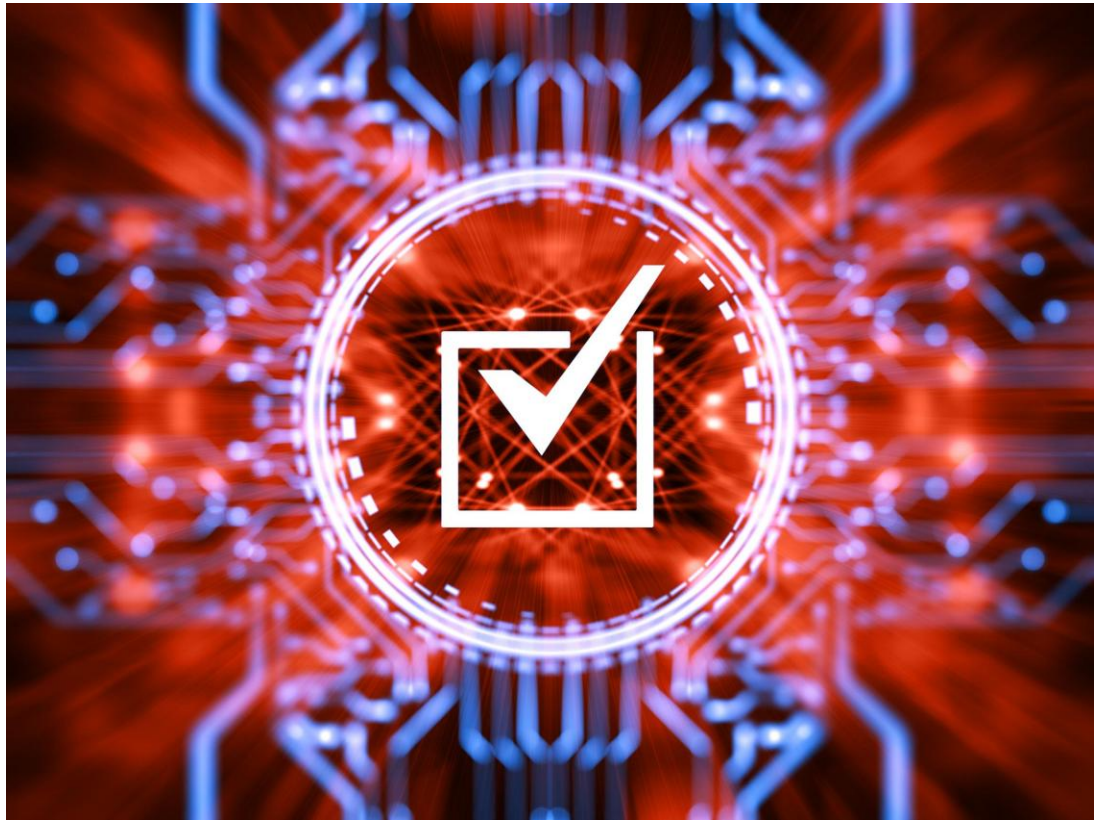
Generative AI raises significant copyright questions regarding ownership of the content produced and its implications for creators.

Misinformation Risks

The potential for generative AI to spread misinformation necessitates careful scrutiny and awareness to protect the public.

Establishing Guidelines

Promoting responsible use of generative AI involves establishing guidelines that mitigate risks and encourage ethical practices.



Prompt 101:

Elements of a Prompt

A prompt basically consists of the following elements:

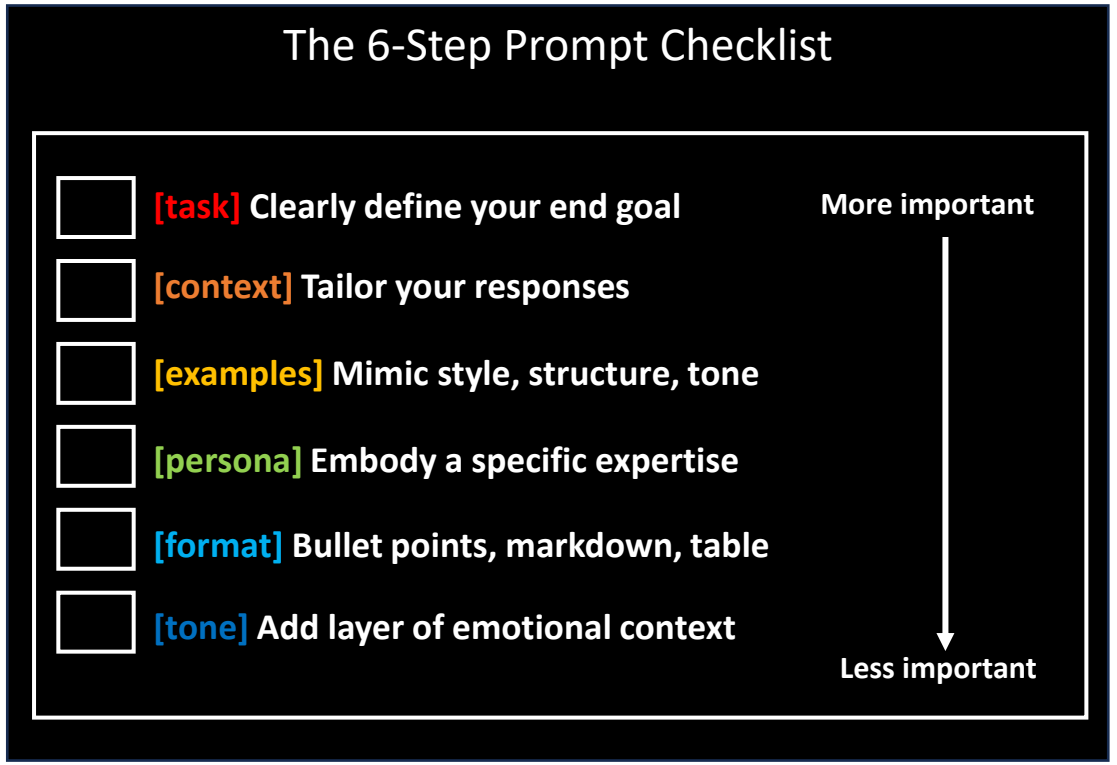
i. **Instructions** — a specific task or instruction you want the model to perform.

ii. **Context** — external information or additional context that can steer the model to give better responses.

iii. **Input Data** — question that you are asking to LLM and seeking for a response.

iv. **Output format** — a type or a format of the response you want to get answered with. For example: you are generating a difference table, then you must write, “generate the answer in a tabular format”.

How to design an effective??



Exercise: Hands-On Activity 2: Prompt Like a Pro

Objective:
Learn how to write better prompts for AI tools like ChatGPT by experimenting with structure, tone, and specificity.

Step 1: Start with a Basic Prompt

Example:

> "Write a birthday message for my friend."

Try it in ChatGPT and observe the result.

Step 2: Refine the Prompt Iteratively

Add layers like:

- Role: "Act as a poet" or "Pretend you are a stand-up comedian"
- Instruction: "Make it humorous and short"
- Examples: "Here's a message I liked before: 'Hope your day is as awesome as you are!'"

Example refined prompt:

> *"You are a creative poet. Write a short, funny birthday message for my 30-year-old friend who loves science fiction and hates cake."*

Run the prompt again and compare results.

Step 3: Try These Challenge Styles

1. Creative:
   "Write a breakup letter from a cat to its owner."
2. Professional:
   "Summarize this article in 3 bullet points like a news anchor."
3. Conversational:
   "Explain what quantum computing is like I'm 10 years old."

Discussion Prompts

- What changed between the first and final output?
- What did adding a "role" or "tone" do?
- How did examples help?
- Who got the most unexpected or entertaining response?

Exercise: Hands-On Activity 3: “AI Art Jam”

Objective:
Experience how generative AI can transform creative ideas into images, and explore how prompt wording influences output.

Website: https://www.craiyon.com

No account or login needed — just type a prompt and go!

Step 1: Brainstorm a Fun Prompt

Try combining unusual themes or styles:

- “A robot making jollof rice on the moon”
- “A giraffe wearing sunglasses at a jazz concert”
- “Traditional African village in a cyberpunk future”

Step 2: Generate the Image

- Type your prompt into Craiyon
- Wait ~1 minute for results
- Review all 9 generated images

Step 3: Pick Your Favorite

- Select the image you like most
- (Optional: Screenshot or take a picture)

Step 4: Share & Showcase

- Briefly present:
  - Your prompt
  - The image
  - What surprised or amused you

Discussion Prompts

- How did changing the prompt wording affect results?
- What kinds of details improved image quality?
- What limitations did you notice?

Conclusion

Growth of Generative AI

Generative AI is rapidly evolving, showcasing immense potential across various sectors, including healthcare, art, and technology.

Limitations of Generative AI

Despite its advancements, generative AI has limitations, including biases in data, creativity constraints, and reliability issues.

Ethical Implications

As we adopt generative AI innovations, it is vital to consider ethical implications such as privacy, consent, and accountability.