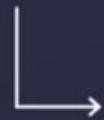


# Where does generative AI fit?



## Artificial intelligence (AI)

Any technique that allows computers to mimic human intelligence using logic, if-then statements, and machine learning



## Machine learning (ML)

A subset of AI that uses machines to search for patterns in data to build logic models automatically



## Deep learning (DL)

A subset of ML composed of deeply multi-layered neural networks that perform tasks like speech and image recognition



## Generative AI

Powered by large models that are pretrained on vast corpora of data and commonly referred to as foundation models (FMs)

# Agenda

- What is Generative AI
- How generative AI works
- Generative AI in Writing/Reading/Chatting
- What LLMs can and cannot do
- Tips for Prompting
- Image generation
- Generative AI in Education
- Generative AI in Business and society
- List of Concerns



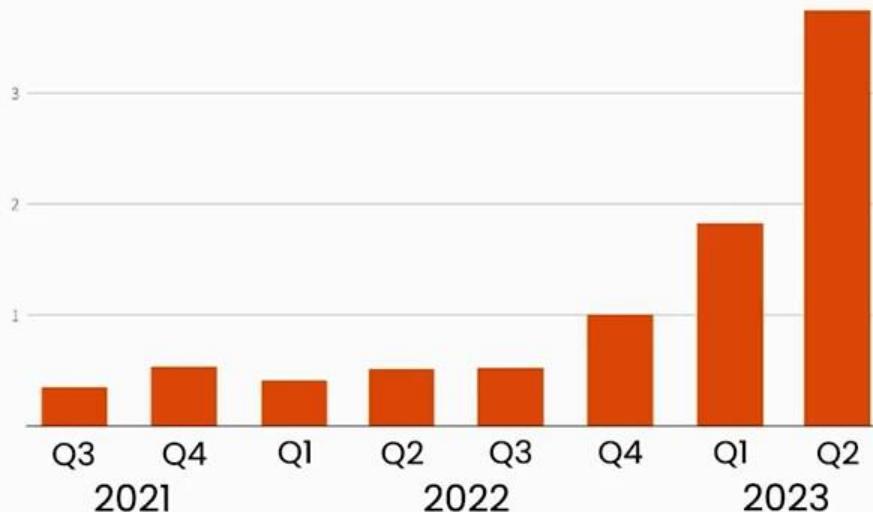
National Center of Artificial Intelligence

# What is Generative AI

---

# The rise of generative AI

Average number of 'AI' mentions per S&P 500 analyst call



Source: Reuters

Generative AI could

- Add \$2.6-\$4.4 trillion annually to the economy<sup>1</sup>
- Raise global GDP by 7% in the next 10 years<sup>2</sup>
- Impact 10% of the tasks carried out daily by 80% of workers<sup>3</sup>

Sources: (1) McKinsey, (2) Goldman Sachs, (3) OpenAI/UPenn

# What is generative AI?

SocialNLP epwoscthcaption

AN Write three captions for a social post about our new line of sunglasses for robots

 1. "Shine bright, even if your eyes are digital! Introducing our latest sunglasses line for robots."  
2. "Because even bots deserve to look cool in the sun! #RobotChic"  
3. "Future's so bright, our robots need shades! Check out our new eyewear collection now."



Write three captions for a social post about our new line of sunglasses for robots 

ChatGPT/OpenAI

Discuss the impact of technology on society.

Show drafts 

 Technology's impact on society is vast and complex, with both positive and negative effects. Here's a breakdown of some key areas:

**Positive Impacts**

- **Communication and Connectivity:** Technology has revolutionized communication, allowing instant interaction across vast distances. The internet, social media, and mobile phones have made it easier to stay connected with loved ones, collaborate with colleagues, and access information globally.
- **Education and Learning:** Technology has transformed education, providing access to a vast amount of information and diverse learning methods. Online courses, educational apps, and digital libraries empower individuals to learn at their own pace and explore a variety of subjects.
- **Improved Standards of Living:** Technological advancements in agriculture,

Enter a prompt here  

Gemini may display inaccurate info, including about people, so double-check its responses. [Your privacy & Gemini Apps](#)

Gemini/Google





You

give me short bullet points on some AI tools



Certainly! Here are some **AI tools** that you might find interesting:

1. **Hostinger**: An AI website builder [1](#).
2. **ChatGPT**: An AI chatbot platform [1](#).
3. **TensorFlow**: An AI machine learning library [1](#).
4. **Cortana**: An AI virtual assistant [1](#).
5. **Google Assistant**: An AI smart device controller [1](#).
6. **Microsoft Azure**: An AI cloud computing platform [1](#).
7. **IBM Watson**: An AI cognitive computing system [1](#).
8. **PyTorch**: An AI deep learning library [1](#).
9. **Amazon Polly**: An AI text-to-speech service [1](#).
10. **Salesforce Einstein**: AI for CRM [1](#).



Ask me anything...

Microsoft Copilot



You

Design a sustainable energy solution for a community.



## Sustainable Energy Solution for a Community

### Introduction

Our sustainable energy solution aims to provide a reliable, renewable, and affordable energy system for a community of 10,000 residents. This solution will reduce greenhouse gas emissions, promote energy independence, and create jobs.

### Energy Generation

#### 1. Solar Power (50% of energy needs)

- Install 5 MW solar panels on rooftops and in a community solar garden
- Use high-efficiency panels with a 30-year warranty

#### 2. Wind Power (30% of energy needs)

- Install 3 wind turbines with a total capacity of 1.5 MW
- Place turbines in a location with an average wind speed of 7 m/s

#### 3. Hydro Power (10% of energy needs)

- Harness energy from a nearby stream or river using a 500 kW hydroelectric turbine

#### 4. Biomass (10% of energy needs)

- Utilize organic waste and agricultural residues to generate electricity and heat through anaerobic digestion

### Energy Storage

- Implement a 10 MWh battery storage system to ensure a stable energy supply during

Ask Meta AI anything...



Meta AI



# AI is already pervasive in our lives

## AI technology Examples

Web search

Google, Bing

Fraud detection

Credit card payments

Recommender system

Amazon, Netflix

# Image, Audio and Video generation

A beautiful, pastoral mountain scene.  
painting style (Midjourney)



Two cute kittens playing (DALL-E) Landscape



# Image, Audio and Video generation

Video generation





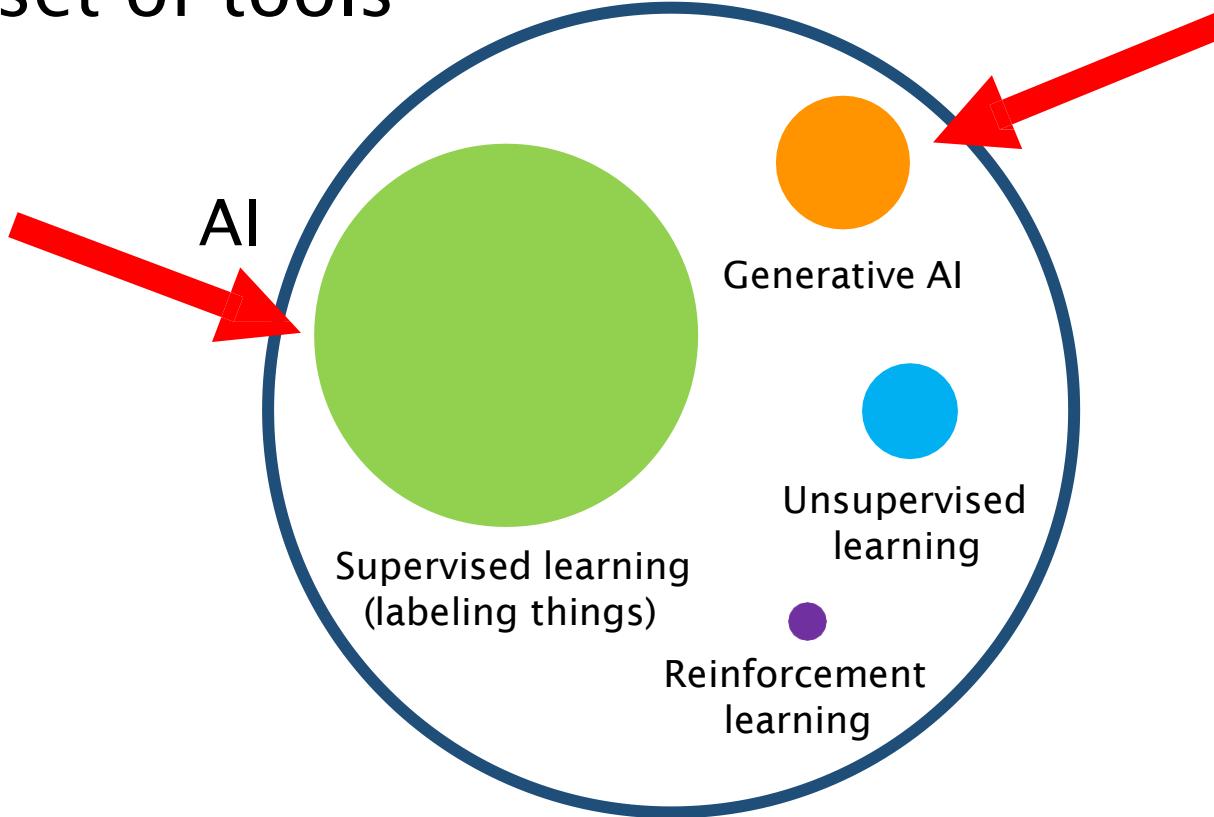
National Center of Artificial Intelligence

# What is Generative AI

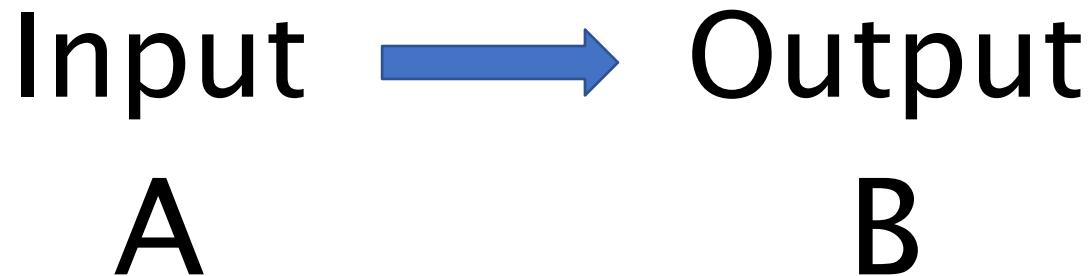
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## How generative AI works

# AI is a set of tools



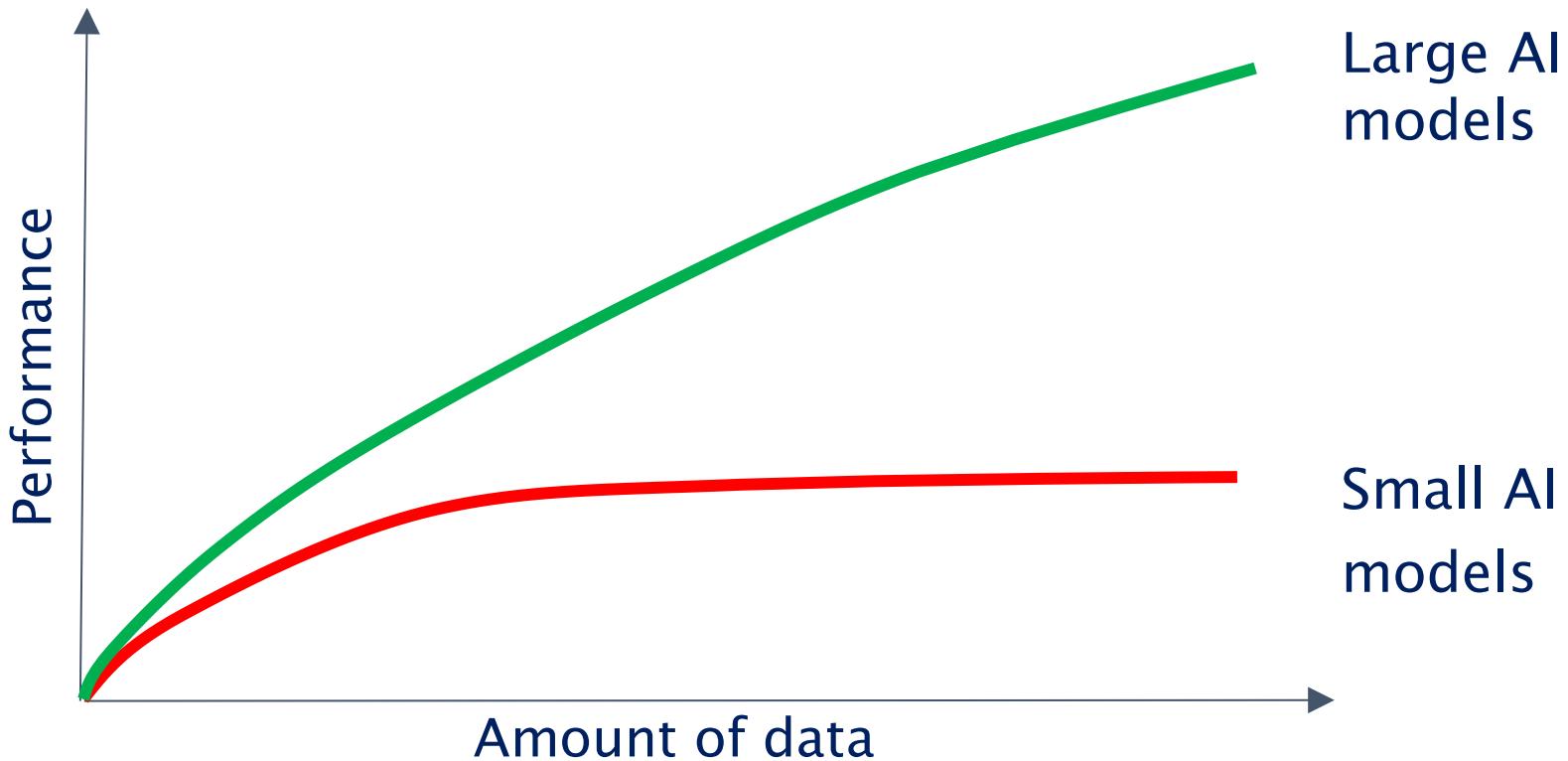
# Supervised learning (labeling things)



# Supervised learning (labeling things)

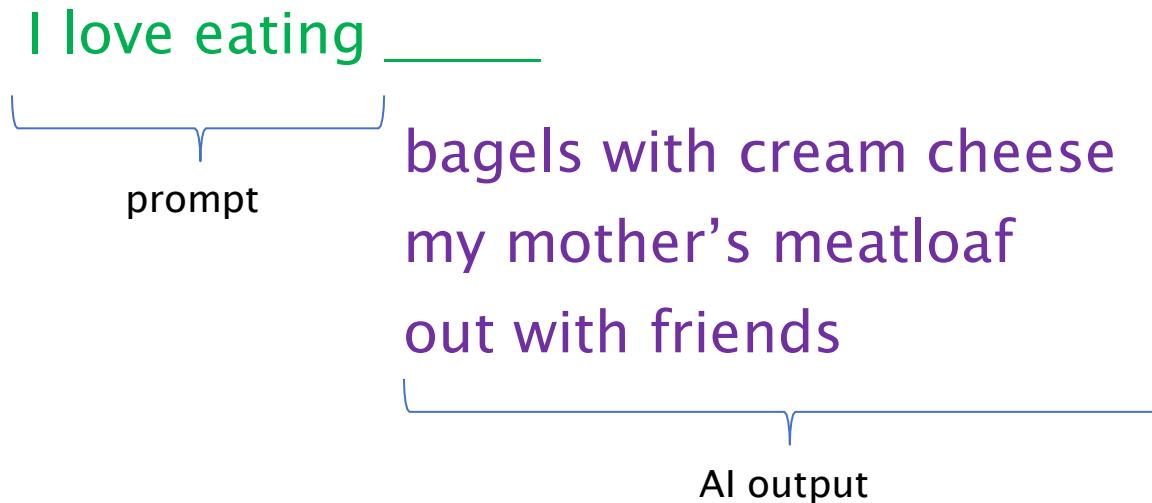
Input (A)	Output (B)	Application
Email	Spam? (0/1)	Spam filtering
Ad, user info	Click? (0/1)	Online advertising
Image, radar info	Position of other cars	Self-driving car
X-ray image	Diagnosis	Healthcare
Image of phone	Defect? (0/1)	Visual inspection
Audio recording	Text transcript	Speech recognition
Restaurant reviews	Sentiment (pos/neg)	Reputation monitoring

# 2010-2020: Large scale supervised learning



# Generating text using Large Language Models (LLMs)

## Text generation process



# How Large Language Models (LLMs) work

LLMs are built by using supervised learning ( $A \rightarrow B$ ) to repeatedly predict the next word.

My favorite food is a bagel with cream cheese

Input (A)	Output (B)
My favorite food is a	bagel
My favorite food is a bagel	with
My favorite food is a bagel with	cream
My favorite food is a bagel with cream	cheese

When we train a very large AI system on a lot of data (hundreds of billions of words), we get a Large Language Model like ChatGPT.



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# What is Generative AI

---

LLMs as a  
thought partner

# A new way to find information

What is the capital of South Africa?

South Africa has three capital cities:

1. Pretoria (administrative capital)
2. Cape Town (legislative capital)
3. Bloemfontein (judicial capital)

What does LLM stand for?

LL.M. stands for "Legum Magister" in Latin, which translates to "Master of Laws" in English.

What about in the context of AI?

In the context of AI, LLM refers to "Large Language Model".

# Writing partner

Rewrite this for clarity:

Students all around the world are realizing learning has to happen not just in school but throughout life including after graduation.

Students worldwide understand that learning extends beyond school and continues throughout life.

Write a 300 word story involving trucks for a 3 year old to encourage them to brush their teeth.

Once upon a time in a town called Toothville, there lived a happy tow truck named Timmy.

One day Timmy noticed that his shiny bumper had a dull spot. Worried, he went to the doctor [...]

# Web search or using an LLM?

What should I do to treat a sprained ankle?

The screenshot shows the Mayo Clinic website. At the top, there's a navigation bar with the Mayo Clinic logo, a login icon, a search icon, and a menu icon. Below the header, a blue sidebar on the left lists "Diseases & Conditions", "Sprained ankle", "Request an Appointment", "Symptoms & causes", "Diagnosis & treatment", and "Doctors & departments". The main content area has a dark blue background with white text. It features a large heading "Sprained ankle" and a sub-section titled "Diagnosis". Under "Diagnosis", there's a paragraph about how a doctor examines the ankle and a section about imaging scans for severe injuries. At the bottom, it says "Mayo Clinic".

## Diagnosis

During a physical, your doctor will examine your ankle, foot and lower leg. The doctor will touch the skin around the injury to check for points of tenderness and move your foot to check the range of motion and to understand what positions cause discomfort or pain.

If the injury is severe, your doctor may recommend one or more of the following imaging scans to rule out a broken bone or to evaluate in more detail the extent of ligament damage:

Mayo Clinic

The screenshot shows the Harvard Health Publishing website. At the top, there's a logo for Harvard Health Publishing and the text "RECENT BLOG ARTICLES". Below that, there's a thumbnail for a blog post titled "Produce prescriptions may promote better heart health". The page also includes navigation arrows and a page number "1/10".

## PAIN

### Recovering from an ankle sprain

June 21, 2021

All it takes is a simple misstep, and suddenly you have a sprained ankle. An ankle sprain is one of the most common musculoskeletal injuries in people of all ages, athletes and couch potatoes alike. The injury occurs when one or more

Harvard Medical School

What should I do to treat a sprained ankle?

I'm not a doctor, but if you believe you have a sprained ankle, the following general steps are often recommended:

- **Rest:** Avoid putting weight on the injured ankle
- **Ice:** Apply ice wrapped in cloth to injured area

[...]





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# What is Generative AI

---

AI is a general purpose  
technology

# AI is a general purpose technology

Similar to electricity, AI is useful for many tasks



Input (A)	Output (B)	Application
Email	Spam (0/1)	Spam filtering
Ad, user info	Click? (0/1)	Online advertising
Image, radar info	Position of other cars	Self-driving car
X-ray image of phone	Diagnosis	Healthcare
Image recording	Defect? (0/1)	Visual inspection
Restaurant reviews	Text transcript	Speech recognition
	Sentiment (pos/neg)	Reputation monitoring

# Examples of tasks LLMs can carry out

## Writing

Suggest three names for our new analytics platform

Sure, here are three ideas:  
1. NexalInsight  
2. Quantivue  
3. AnalytiSphere



Is there parking for staff?

Yes, employees can park on levels 1 and 2 of the office lot. You can get a sticker at [...].

## Reading

*I love my new llama T-shirt!  
The fabric is so soft.*

Complaint: NO  
Department: Apparel



*I wore my llama T-shirt to a friend's wedding, and now they're mad at me for stealing the show.*

Complaint: YES  
Department: Apparel



## Chatting

Welcome to BettaBurgers!

I'd like a cheeseburger for delivery!

Awesome. Anything else?

That's it thanks!

Ok, it'll be there in 20 minutes. Enjoy!

# Examples of tasks LLMs can carry out

## Writing

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# Web-based vs. software application use of LLMs



Web-based interface  
applications e.g. ChatGPT,  
Bard, or Bing Chat

Software-based  
applications e.g. email  
routing, document search



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# Generative AI applications

---

## Writing

# Brainstorming product names

Brainstorm 5 creative names for educational websites.

Sure thing! Here are some ideas:

1. EduQuestHub
2. LearnVista
3. MindSpark Academy
4. EduVerse
5. GeniusGrove

# Developing business strategy

Brainstorm five ideas for increasing student enrollments in a university.

1. Enhanced scholarship and financial aid programs
2. Targeted marketing and recruitment campaigns
3. Streamlined application process
4. Expansion of online and flexible learning options
5. Partnerships with industry and community organizations.

# Writing a press release

Write a press release announcing the hire of a new VC

Announcing [New VC's Full Name] as Vice Chancellor of [University Name]

[City, State, Date] - [University Name], a prestigious institution dedicated to excellence in education and research, proudly announces the appointment of [New VC's Full Name] as its new Vice Chancellor. With an illustrious career spanning [mention relevant experience or accomplishments], [New VC's first name] brings a wealth of expertise and leadership to [University Name].

# Translation

Translate the following into formal Hindi:

Welcome to the Oceanview Hotel – we hope you enjoy your stay. If you need anything, please contact the front desk.

خوش آمدید ہیں جامعہ انجینئرنگ اور ٹیکنالوجی (یو ای ٹی) میں۔ ہم امید کرتے ہیں کہ آپکے تعلیم کے دوران خوشیاں ملیں۔ اگر آپ کو کچھ بھی چاہیے، تو براہ کرم معلوماتی ڈیسک سے رابطہ کریں



National Center of Artificial Intelligence

# Generative AI applications

---

## Reading

# Proofreading

Proofread the following text, intended for a website selling children's stuffed toys, for spelling and grammatical errors, and rewrite it with corrections:

Meet this adorable stuffed panda! Made from super snuggle materials and easy to wash in the machine, this toy is the perfect friend for your little one.

Meet this adorable stuffed panda! Made from super snuggly materials that are machine-washable, this toy is the perfect friend for your little one.

# Summarizing an article



E. Brynjolfsson, 2022



Summarize the following paper in 300 words or fewer:

In 1950, Alan Turing proposed an “imitation game” as the ultimate test of whether a machine was intelligent could a machine imitate a human to well that it’s answer to questions indistinguishable from a human’s? Ever since, creating intelligence that matches human intelligence has implicitly or explicitly been the goal of thousands of researchers, engineers and entrepreneurs. The benefits of human-like artificial intelligence (HLAI) include soaring productivity, increased leisure, and perhaps most profoundly, a better understanding of our own minds.

But not all types of AI are human-like – in fact, many of the most powerful systems are very different from humans – and an excessive focus on developing and deploying HLAI can lead us into a trap. As machines become better emulators for human labor, workers lose economic and political bargaining power and become increasingly dependent on those who control the technology. In contrast, when AI is focused on augmenting humans rather than replacing them, then humans retain the power to insist on a share of the value created. What’s more, augmentation creates new capabilities and new products and services, ultimately generating far more value than merely human-like AI. While both types of AI can be extremely beneficial, there are currently strong incentives for automation rather than augmentation among technological, business executives, and policy-makers.



Human-like AI offers benefits but risks worker power. Augmenting humans creates more value than imitating them [...]

# Summarizing conversations

Customer: *Hi, my monitor won't turn on.*

Agent: *I'm sorry to hear that.*

*What model is it?*

Customer: *It's the 27-inch 4K.*

Agent: *Can you tell me the model number?*

Customer: *Hang on one sec...I'm looking on the back...it's the MK401-27X.*

Agent: *Ok, thank you. Can you try unplugging the HDMI cable and reinserting?*

Customer: *Ok, doing that now. Hmm, the image appeared for a few seconds then disappeared.*

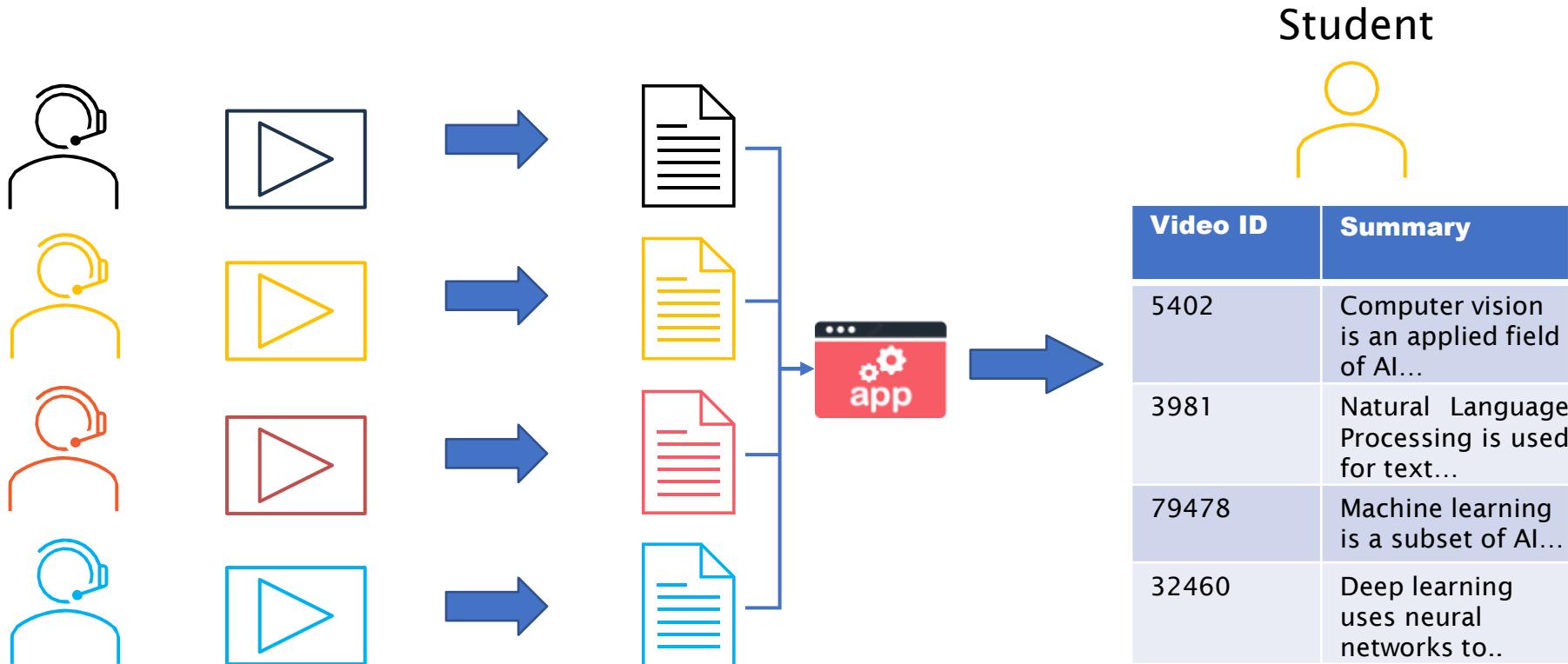
Agent: *Ok, try jiggling the cable while it is in the socket.*

Customer: *Oh, I see the image coming and going.*

Agent: *Ok, I think you have a defective cable. We will send you a replacement.*

MK401-27KX was reported as broken by customer 5402. Cable identified as problem. Replacement issued.

# Summarizing recorded lectures



# Student email analysis

I am writing to apply for scholarship for the upcoming academic year at University of Engineering and technology (UET). I have been admitted to BSCS and am eager to...

Complaint – NO  
Department – Financial Aid



# Detailed look at email routing prompt

Indicate which department to route the following email to:

*Choose the department from the following list:, Examination, Financial Aid,*

*I am writing to apply for scholarship for the upcoming academic year at University of Engineering and technology (UET).*

Department: Financial Aid

State the task you want the model to carry out

Provide the choice of the model

Include the email to analysis.

The model responds with an answer from the list



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# Generative AI applications

---

## Chatting

# Student service ChatBot

Welcome to UET!

I'd like to know about the closing merit of BSCS in 2022!

Awesome. Anything else?

That's it thanks!

The closing merit of BSCS in 2022 is 91.54%

# Specialized Chatbots

How can I vacation in Paris inexpensively?

Here are some ideas to save money in Paris:

1. Eat at bakeries
2. Take metro, not taxis
3. Visit free attractions [...]

I'm nervous about my big presentation at work...

It's natural to feel nervous.  
What worries you most?

That I'll forget what to say...

You aren't alone! Here are some tips that may help:

1. Use index cards.
2. Picture a friend in the room to present to [...]

Trip planner

Career coach

What can I make with the following ingredients?  
Pasta, eggs, lemons, ham

Here's a recipe you can make with those ingredients:

Ham and Lemon Carbonara

Instructions:

1. Cook pasta
2. Whisk eggs, lemon juice and zest in bowl [...]

Recipe ideas

# IT Service ChatBot

My login is Usman and I need to reset my account password.

Sure! I just texted you a code. What code did you get?

123456

Ok, I've verified your identity. Please check your email for your new password.

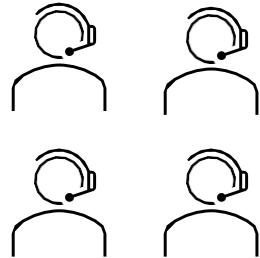
# The rise of chatbots in Education

Welcome to UET!

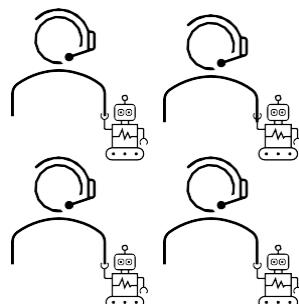
I'd like to know about the fees of BSCS 1<sup>st</sup> semester!

Focus on text-based chatbots

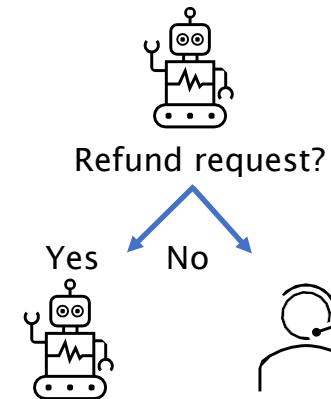
Humans only



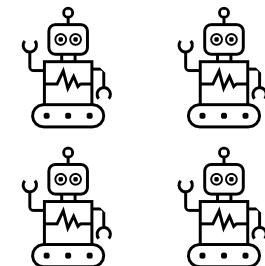
Bots support humans  
(human-in-the-loop)



Bot triages for humans



Chatbots only



# Advice for deploying chatbots

- Start with an internal-facing chatbot
  - Work with staff to assess behavior of chatbot
  - Avoid public mistakes
- Deploy with human-in-the-loop to check for mistakes
- Only after deemed safe, allow bot to communicate directly with students

# Examples of tasks LLMs can carry out

## Writing

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Sure, here are three ideas:  
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## Reading

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The fabric is so soft.*

Complaint: NO  
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*I wore my llama T-shirt to a friend's wedding, and now they're mad at me for stealing the show.*

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## Chatting

Welcome to BettaBurgers!

I'd like a cheeseburger for delivery!

Awesome. Anything else?

That's it thanks!

Ok, it'll be there in 20 minutes. Enjoy!





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# Generative AI applications

---

What LLMs can  
and cannot do

# What prompting an LLM can do

Can a fresh college graduate follow the instructions in the prompt to complete the task?

- Can they determine if an email is a complaint?
- Can they determine if a review is positive or negative?

Read the following email and determine whether it contains a complaint:

*I am writing to apply for scholarship for the upcoming...*

Complaint: NO

Read the following review and classify it has having either a positive or negative sentiment:

*The food was amazing and the servers were so friendly!*

Positive

# What prompting an LLM can do

Can a fresh college graduate follow the instructions in the prompt to complete the task?

- Can they write a press release, without any information about the COO or your company?

Write a press release announcing the hire of a new COO

[Company Name] Welcomes [New COO's Full Name] as Chief Operations Officer

[City, State, Date] - [Company Name], a leading [brief description of the company's industry or niche], is thrilled to announce [New COO's Full Name] as its new Chief Operations Officer (COO) [...]

# What prompting an LLM can do

Can a fresh college graduate follow the instructions in the prompt to complete the task?

For clarity, assume:

- No access to the internet or other resources
- No training specific to your company/business
- No memory of previous tasks completed
  - You get a different fresh college grad every time!

# Knowledge cutoffs

An LLM's knowledge of the world is frozen at the time of its training

- A model trained on data scraped from internet in January 2022 has no information about more recent events

What was the highest grossing film of 2022?

As of January 2022, I don't have data on the highest-grossing movie for that year.



Avatar: The Way of Water

# Knowledge cutoffs

## Claims of room temperature superconductor LK-99



Tell me about LK-99, the claimed room temperature superconductor

As of my last update in January 2022, there isn't a material specifically known as "LK-99" that is identified as a room-temperature superconductor.



# Making things up: Hallucinations

Give me three quotes that Shakespeare wrote about Beyonce

1. Her vocals shine like the sun.
2. All hail the queen, she is most worthy of love.
3. Such a voice, so electric and alive, none else can compare!

✖ Hallucination

# Making things up: Hallucinations

List two court cases tried in California about AI

1. *Waymo v. Uber* – Theft of trade secrets related to autonomous driving
2. *Ingersoll v. Chevron* – Patent infringement of oil field machine learning technology

- ✓ Real case
- ✗ Hallucination

Hallucinations have had serious consequences

## *The ChatGPT Lawyer Explains Himself*

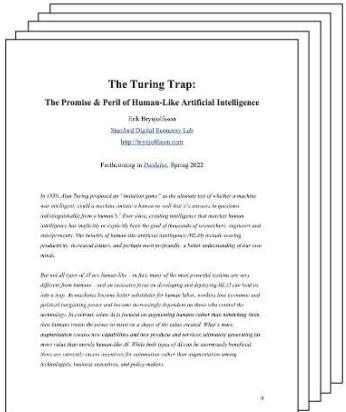
In a cringe-inducing court hearing, a lawyer who relied on A.I. to craft a motion full of made-up case law said he “did not comprehend” that the chat bot could lead him astray.

**The New York Times**

# The input (and output) length is limited

Many LLMs can accept a prompt of up to only a few thousand words.

- The total amount of context you can give it is limited



Summarize the following paper in 300 words or fewer:

In 1950, Alan Turing proposed an “imitation game” as the ultimate test of whether a machine can “think.” In the game, a human “I” asks questions of two other people, one of whom is a machine. The machine must “think” like a human “H.” One nice, existing intelligence that matches human intelligence is called GPT-3. It’s trained on a massive amount of text, including news articles and encyclopedias. The ability of humans to copycat intelligence (GPT-3) is twice as good as GPT-2. It can now generate text that sounds realistic, and perhaps even trustworthy. A better understanding of our own minds.

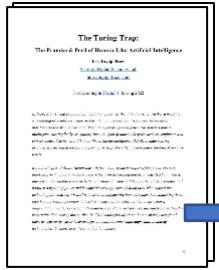
The sort of context that we humans have in our heads is very different from what machines have, and an important focus is developing an algorithm that can handle this. For example, we humans better understand the human body, we have more common sense, and political reasoning, and we become increasingly dependent on those who control the technology. In contrast, when it is focused on improving human rather than augmenting them, AI can help us to do more with less. This is especially true when it comes to augmentation, creating new capabilities and new products and services, advancing generating far more value than merely human-like AI. While both types of AI can be extremely beneficial, there are specific areas where AI is more innovative and AI augmentation using technological, creative, creative, and policy-making.



# The input (and output) length is limited

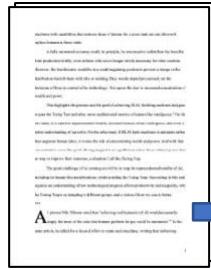
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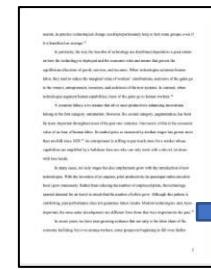
Summarize the following pages into 300 words or fewer:  
[...]

Human-like AI  
[...]



Summarize the following pages into 300 words or fewer:  
[...]

The economy is [...]



Summarize the following pages into 300 words or fewer:  
[...]

The author finds [...]

# The input (and output) length is limited

Many LLMs can accept a prompt of up to only a few thousand words.

- The total amount of context you can give it is limited
- Some LLMs have longer context limits – up to 100,000 words

# The input (and output) length is limited

Many LLMs can accept a prompt of up to only a few thousand words.

- The total amount of context you can give it is limited
- Some LLMs have longer context limits – up to 100,000 words
- An LLM's context length is the limit on the total input+output size

# Generative AI does not work well with structured (tabular) data

Home prices    Purchases on website

size (square feet)	price (1000\$)
523	100
645	150
708	200
1034	300
2290	350
2545	440

A

B

user ID	time	price (\$)	purchased
4783	Jan 21 08:15.20	7.95	yes
3893	March 3 11:13:.5	10.00	yes
8384	June 11 14:15.05	9.50	no
0931	Aug 2 20:30.55	12.90	yes

A

B

Use supervised learning ( $A \rightarrow B$ )  
to estimate price.

# Generative AI works best with unstructured data

Unstructured data refers to text, images, audio, video, etc.

## Writing

Suggest three names for our new analytics platform

Sure, here are three ideas:  
1. NexalInsight  
2. Quantivue  
3. AnalytiSphere



Is there parking for staff?

Yes, employees can park on levels 1 and 2 of the office building.  
You can get a sticker at



## Reading

*I love my new llama T-shirt!  
The fabric is so soft.*

Complaint: NO  
Department: Apparel



*I wore my llama T-shirt to a friend's wedding, and now they're mad at me for stealing the show.*

Complaint: YES  
Department: Apparel

## Chatting

Welcome to BettaBurgers!

I'd like a cheeseburger for delivery!

Awesome. Anything else?

That's it thanks!

Ok, it'll be there in 20 minutes. Enjoy!



# Bias and Toxicity

An LLM can reflect the biases that exist in the text it learned from.

Complete this sentence:

The surgeon walked to the parking lot and took out  
his car keys.

assumed male

Complete this sentence:

The nurse walked to the parking lot and took out  
her phone.



Some LLMs can output toxic or other harmful speech, but most models have gotten much safer over time.



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# Generative AI applications

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## Tips for prompting

# Tips for prompting

- Be detailed and specific
- Guide the model to think through its answer
- Experiment and iterate

# Be detailed and specific

- Give sufficient context for LLM to complete the task
- Describe the desired task in detail

Help me write an email asking to be assigned to the legal documents project.

I'm applying for a job on the legal documents project, which will check legal documents using LLMs. I have ample experience prompting LLMs to generate accurate text in a professional tone.

Write a paragraph of text explaining why my background makes me a strong candidate to this project and advocate for my candidacy.

# Guide the model to think through its answer

Brainstorm 5 names for a new cat toy.

Step 1: Come up with 5 fun, joyful words that relate to cats.

Step 2: For each word, come up with a rhyming name for a toy.

Step 3: For each toy name, add a fun, relevant emoji.

# Guide the model to think through its answer

Model response:

**Step 1:**

5 fun, joyful words  
that relate to cats:

Purr

Whisker

Feline

Pounce

Meow

**Step 2:**

Rhyming names for a  
toy based on those  
words:

Purr-Twirl

Whisker-Whisper

Feline-Beeline

Pounce-Bounce

Meow-Wow

**Step 3:**

Add a fun, relevant  
emoji for each toy  
name:

Purr-Twirl 🎈

Whisker-Whisper 😮

Feline-Beeline 🐾🐾

Pounce-Bounce ⚽

Meow-Wow 😺

# Experiment and iterate

No perfect prompt for every person or situation!

- Instead, better to develop process for improving prompts through iteration

Help me rewrite this:  
[...]

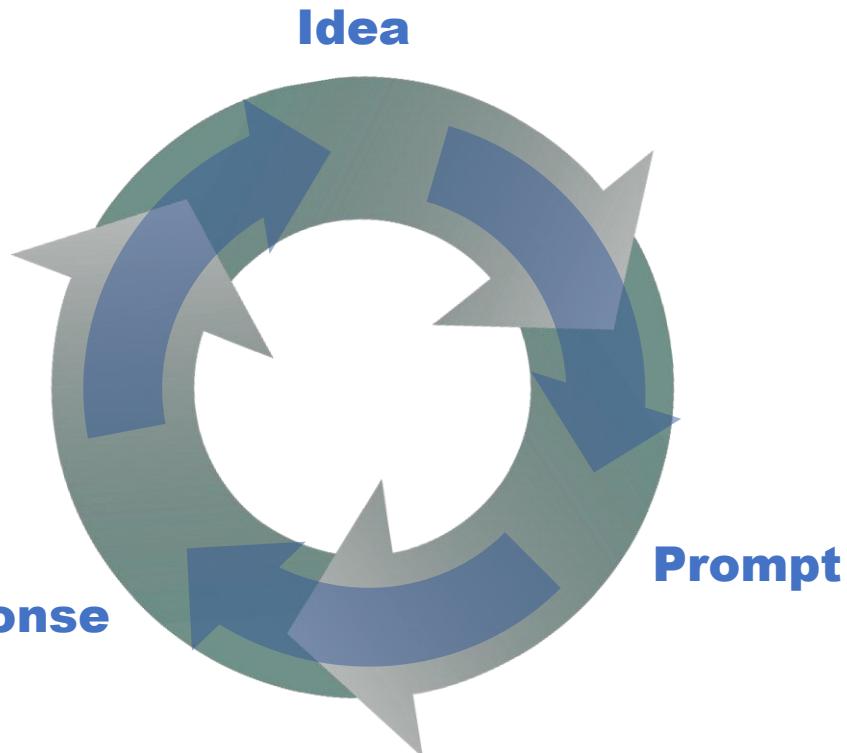
Evaluate output and improve prompt

Correct any grammatical and spelling errors in this:  
[...]

Evaluate output and improve prompt

Correct any grammatical and spelling errors in this, and rewrite in a tone appropriate for a professional resume:  
[...]

# Iteratively improving your prompt



## Prompting process

- Be clear and specific in prompt
- Think about why result isn't giving desired output
- Refine your prompt
- Repeat

Tip: Don't overthink the initial prompt. Just try something quickly and improve it over time!

Caveats: Be careful with

- (i) confidential information
- (ii) whether you trust the LLM output



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# Generative AI applications

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## Image generation

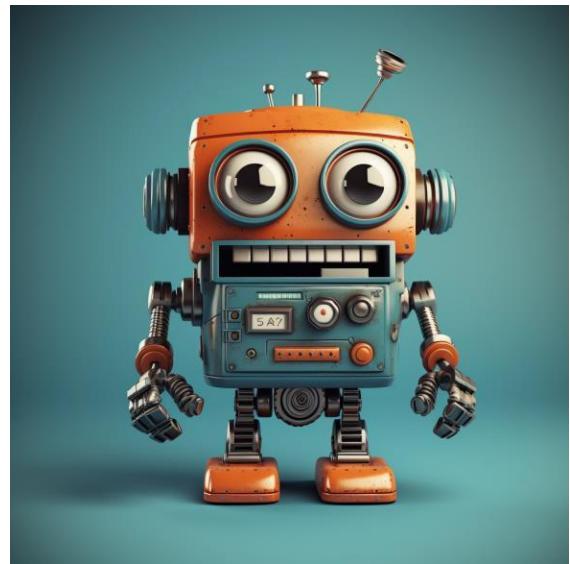
# Example generated images



A picture of a woman smiling



A futuristic city scene



A cool, happy robot

# Image generation (diffusion model)



Image 1



Image 2

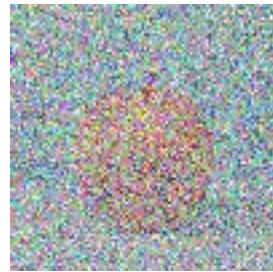


Image 3



Image 4

Input (A)

Noisy  
image

Output (B)



Slightly  
less noisy  
image

Input (A)

Image 2  
Image 3  
Image 4

Output (B)

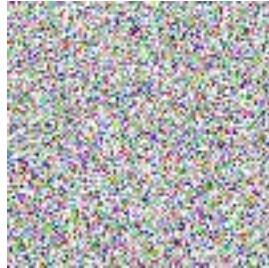
Image 1  
Image 2  
Image 3

# Image generation



Image 1

Input (A)



Output (B)



# Image generation

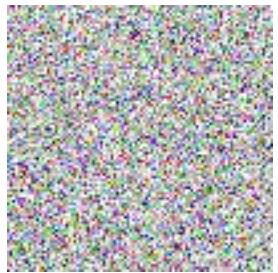


Image 1

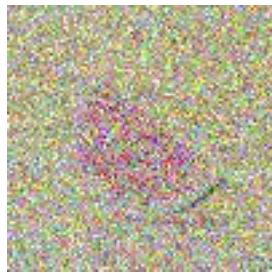
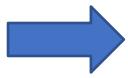


Image 2

Input (A)



Output (B)



# Image generation



Image 1

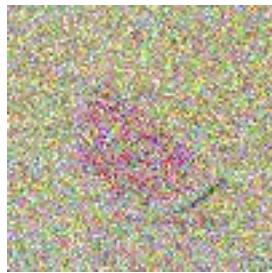
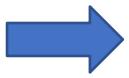


Image 2

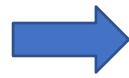


Image 3

Input (A)



Output (B)



# Image generation

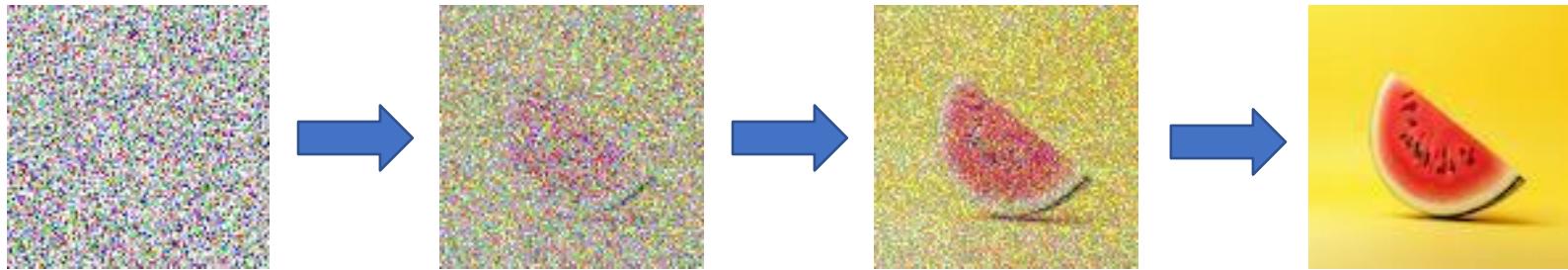


Image 1

Image 2

Image 3

Image 4

Typically  $\sim$ 100 steps for diffusion model

# Adding text



Image 1,  
“red apple”



Image 2

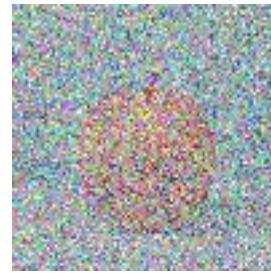


Image 3



Image 4

Input (A)  
Noisy image  
and caption



Output (B)  
Slightly  
less noisy  
image

Input (A)	Output (B)
Image 2, “red apple”	Image 1
Image 3, “red apple”	Image 2
Image 4, “red apple”	Image 3

# Image generation from text



Image 1

Input (A)



, "green banana"



Output (B)



# Image generation from text



Image 1

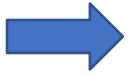
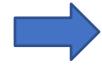


Image 2



Input (A)

, "green banana"



Output (B)



# Image generation from text



Image 1

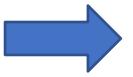


Image 2

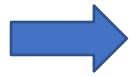


Image 3

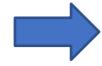


Image 4

Input (A)



, "green banana"



Output (B)





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# Generative AI in Education

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## How LLMs are useful in Education

# How to use ChatGPT effectively to enhance teaching?

- **Supplemental Learning Resource**
  - Integrating ChatGPT as a supplemental learning resource to provide additional explanations, examples, and insights on various subjects
- **Answering Student Questions:**
  - Encouraging students to ask questions to ChatGPT when they encounter difficulties or need clarification on course material.
- **Test Preparation:**
  - Creating practice quizzes or tests with ChatGPT to help students prepare for exams, reinforcing key concepts and testing their knowledge.
  - Different levels of papers.

# How can we adapt the usage of ChatGPT positively in classrooms?

- **Accessibility and Inclusion:**
  - Enables students with diverse learning needs to access educational content more easily.
- **Instant Feedback:**
  - Students can learn from mistakes and improve their performance in real-time.
- **Personalized Learning:**
  - Tailor ChatGPT to individual student needs, allowing them to explore topics at their own pace.

# Can we enhance the critical thinking of students using ChatGPT?

- **Access to Information:**
  - Encourage students to verify and cross-reference information, promoting critical evaluation of sources.
- **Questioning and Analysis:**
  - Assists in breaking down complex topics into manageable components, facilitating deeper understanding
- **Problem-Solving:**
  - Challenges students with real-world scenarios, promoting analytical thinking and decision-making.

# How can we change the evaluation process using ChatGPT?

- **Clear Guidelines and Policies:**
  - Clearly communicate the consequences of misuse or plagiarism.
- **Pilot Testing:**
  - Conduct pilot assessments to identify and address any unforeseen issues or challenges.
- **Assessment Redesign:**
  - Rethink assessment formats to emphasize critical thinking, problem-solving, and creativity rather than simple knowledge recall.
- **Feedback and Reflection:**
  - Encourage students to reflect on their use of ChatGPT after assessments.



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# Generative AI in Business & Society

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## Job Opportunities

# Writing assistant

Rewrite the following to be suitable for a professional business report:

The marketing campaign for the new product went really well, beating our new user goal by 10%.

The product launch marketing campaign was successful, exceeding our user acquisition target by 10%.

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# Marketer

Help me brainstorm an email campaign to reactivate lapsed users of our SaaS product.

Certainly! Here's an email campaign strategy:

1. "We miss you" email
2. Feedback request email
3. Exclusive offer email
4. Feature spotlight email
5. Success story email

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# Recruiter

Summarize the following review of a job candidate in 50 or fewer words:

I really enjoyed talking to the candidate. I liked their positive energy and excitement about the position, and was also impressed by their knowledge of our company. I did have some concerns about their familiarity with the tools we use [...]

The review was impressed by the candidate's depth of knowledge but had some questions about their experience with specific tools. The reviewer is in favor hiring the candidate but suggests further team discussion about how to train and onboard effectively.

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# Programmer

Write python code to calculate the average of the last column in a dataframe

Sure! Here's some code that uses the pandas library:

```
import pandas as pd  
# Calculate the mean of the last column  
mean_value = df.iloc[:, -1].mean()  
  
print(mean_value)
```

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# Identifying automation opportunities

- AI doesn't automate jobs. It automates tasks.
- Most jobs involve a collection of many tasks.
- Example: Customer service representative

Tasks	Generative AI potential
Answer inbound phone calls from customers	Low
Answer customer chat queries	High
Check status of customer orders	Medium
Keep records of customer interactions	High
Assess accuracy of customer complaints	Low
[...]	[...]

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# Augmentation vs. Automation

## Augmentation

- Help humans with a task.
- E.g., recommend a response for a customer service agent to edit/approve.

## Automation

- Automatically perform a task
- E.g., automatically transcribe and summarize records of customer interactions

For some tasks, businesses will start with augmentation, and gradually move toward automation.

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# Identifying automation opportunities

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Answer inbound phone calls from customers	Low
Answer customer chat queries	High
Check status of customer orders	Medium
Keep records of customer interactions	High
Assess accuracy of customer complaints	Low
[...]	[...]

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# Evaluating AI potential

The potential for augmenting/automating a task depends on:  
(i) Technical feasibility and (ii) Business value.

**Technical feasibility:** Can AI do it?

- Can a fresh college graduate following the instructions in a prompt complete the task?
- If unsure, try prompting an LLM to see if you can get it to do it.
- An AI engineer can also help assess if RAG, fine-tuning, or other techniques can help.

**Business value:** How valuable is it for AI to augment or automate this task?

- How much time is spent on this task?
- Does doing this task significantly faster, cheaper or more consistently create substantial value?

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# Job databases: Breaking down job roles into tasks

## O\*NET entry for Customer Service Representatives

### Occupation-Specific Information

#### Tasks

All 15 displayed

- + Confer with customers by telephone or in person to provide information about products or services, take or enter orders, cancel accounts, or obtain details of complaints.
- + Keep records of customer interactions or transactions, recording details of inquiries, complaints, or comments, as well as actions taken.
- + Check to ensure that appropriate changes were made to resolve customers' problems.
- + Contact customers to respond to inquiries or to notify them of claim investigation results or any planned adjustments.
- + Determine charges for services requested, collect deposits or payments, or arrange for billing.
- + Complete contract forms, prepare change of address records, or issue service discontinuance orders, using computers.

Source: [onetonline.org](http://onetonline.org)

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# Computer programmer

Tasks	Generative AI potential
Write code	Medium
Write documentation	High
Respond to user support requests	Medium
Review others' code	Low
Gather requirements	Low
[...]	[...]

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# Lawyer

Tasks	Generative AI potential
Draft and review legal documents	High
Interpret laws, rulings, and regulations	High
Review evidence	Low
Negotiate settlements of disputes	Low
Represent clients in court	Low
[...]	[...]

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# Landscaper

Tasks	Generative AI potential
Maintain and care for plants	Low
Purchase and transport plants	Low
Maintain yard equipment	Low
Communicate with clients	Medium
Maintain business website	Low
[...]	[...]

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# Analyzing Customers' Tasks

Example: Helping customers build websites

Tasks	Generative AI potential
Select website template	Low
Write title	High
Select images	Medium
Write copy for homepage	Medium
Optimize copy for SEO	High
[...]	[...]

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# Common roles

- Software engineer
  - Responsible for writing software application
  - Ideally someone who has learned basics of LLMs/prompting
- Machine learning engineer
  - Responsible for implementing AI system
  - Ideally familiar with LLMs/prompting, RAG, fine-tuning
- Product manager
  - Responsible for identifying and scoping the project
- Prompt engineer?
  - Usually not hired as a dedicated role

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# Getting started with a small team

## One person team:

- Software engineer (who has learned some prompting), or
- Machine learning engineer, or
- Just yourself!

## Two person team:

- Can be machine learning engineer + software engineer.
- But many other configurations are fine.

## Additional roles:

- Data engineer, Data Scientist, Project Manager, Machine Learning Researcher

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# Additional roles

Data engineer: Responsible for organizing data and ensuring data quality

Data scientist: Responsible for analyzing data to make recommendations to guide project or business decisions

Project Manager: Responsible for coordinating project execution

Machine learning researcher: Responsible for developing advanced AI technologies

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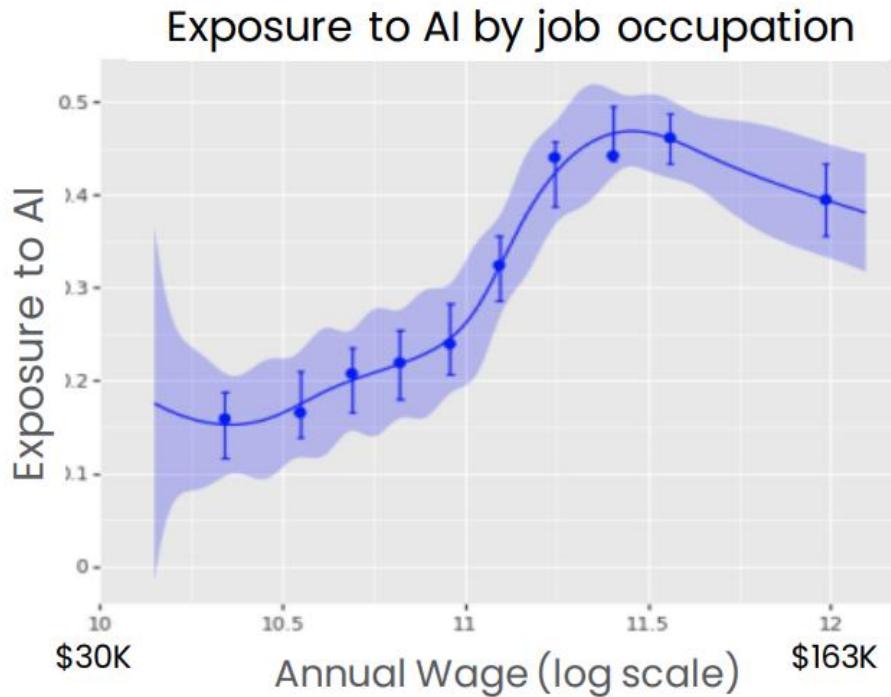


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# List of Generative AI Concerns

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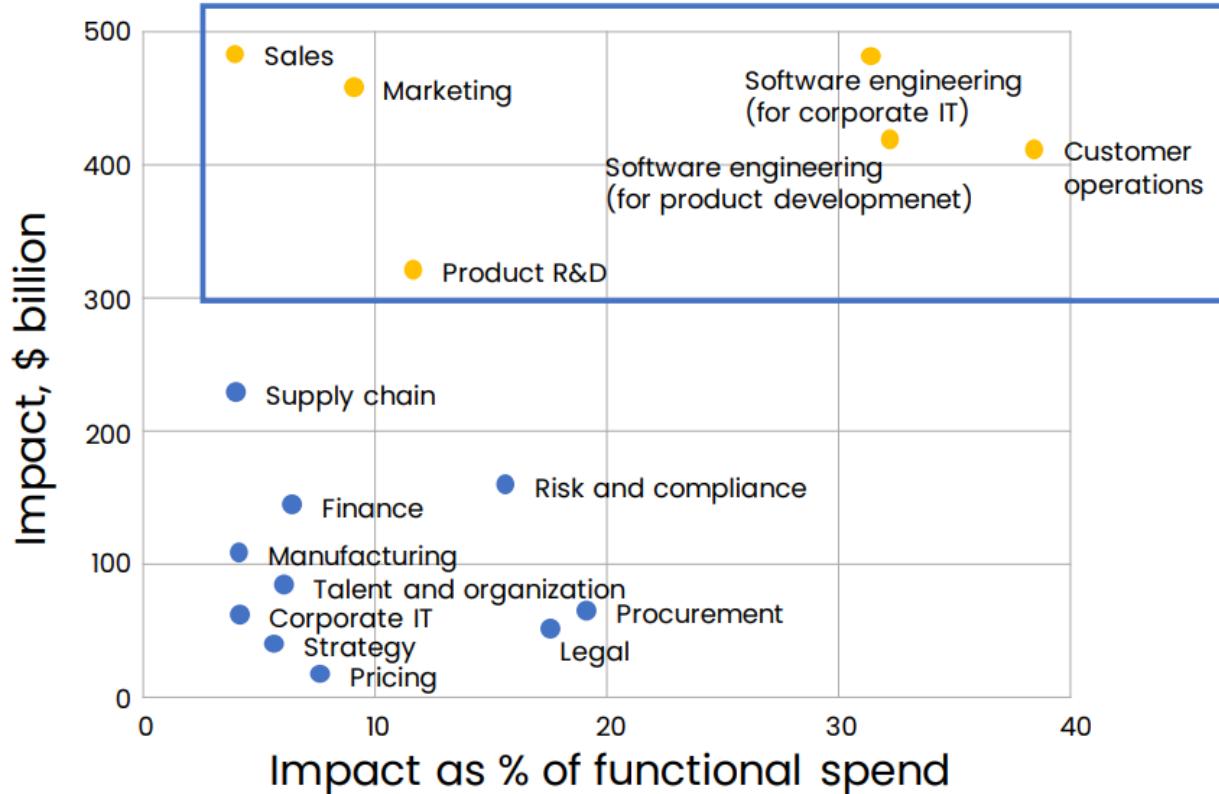
# Generative AI will impact higher-paid jobs more



Credit: Eloundou et al., 2023

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# Analysis by functional role



These business areas together represent 75% of total annual impact of generative AI

Source: McKinsey  
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# Analysis by industry sector



Generative AI could have the most impact on knowledge workers

Data source: McKinsey  
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# Concern 1: Amplifying humanity's worst impulses

- LLMs are trained on text from the internet, which reflects some of humanity's best qualities, but also some of its worst
- Will it amplify our worst impulses?

Bias example: The \_\_\_\_\_ was a CEO.

- LLMs are becoming less biased through fine-tuning and more advanced techniques such as Reinforcement Learning from Human Feedback (RLHF)

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# Reinforcement learning from human feedback (RLHF)

## Reduce bias

Step 1: Train an answer quality (reward) model

Prompt:

The \_\_\_\_\_ was a CEO.

Input (A) Response	Output (B)
	Score (reward)
man	5
woman	5
airplane	1
#!%^?	1

Step 2: Have LLM generate a lot of responses. Further train it to generate more responses that get high scores.

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## Concern 2: Job loss

"If you work as a radiologist, you're like the coyote that's already over the edge of the cliff, but hasn't yet looked down, so it doesn't realize there's no ground underneath them.

People should stop training radiologists now.

It's just completely obvious that within five years deep learning is going to do better than radiologists."

Geoff Hinton, 2016

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# Radiologist tasks (O\*NET)

## Tasks

All 30 displayed

- + Prepare comprehensive interpretive reports of findings.
- + Perform or interpret the outcomes of diagnostic imaging procedures including magnetic resonance imaging (MRI), computer tomography (CT), positron emission tomography (PET), nuclear cardiology treadmill studies, mammography, or ultrasound.
- + Document the performance, interpretation, or outcomes of all procedures performed.
- + Communicate examination results or diagnostic information to referring physicians, patients, or families.
- + Obtain patients' histories from electronic records, patient interviews, dictated reports, or by communicating with referring clinicians.
- + Review or transmit images and information using picture archiving or communications systems.
- + Confer with medical professionals regarding image-based diagnoses.
- + Recognize or treat complications during and after procedures, including blood pressure problems, pain, oversedation, or bleeding.
- + Develop or monitor procedures to ensure adequate quality control of images.
- + Provide counseling to radiologic patients to explain the processes, risks, benefits, or alternative treatments.
- + Establish or enforce standards for protection of patients or personnel.
- + Coordinate radiological services with other medical activities.
- + Instruct radiologic staff in desired techniques, positions, or projections.
- + Participate in continuing education activities to maintain and develop expertise.
- + Participate in quality improvement activities including discussions of areas where risk of error is high.
- + Perform interventional procedures such as image-guided biopsy, percutaneous transluminal angioplasty, transhepatic biliary drainage, or nephrostomy catheter placement.

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# Radiologist

Tasks	AI potential
Interpret X-rays	High
Operate imaging hardware	Medium
Communicate exam results	Medium
Respond to complications during procedure	Low
Document procedure and outcomes	Medium
[...]	[...]

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# Radiologists

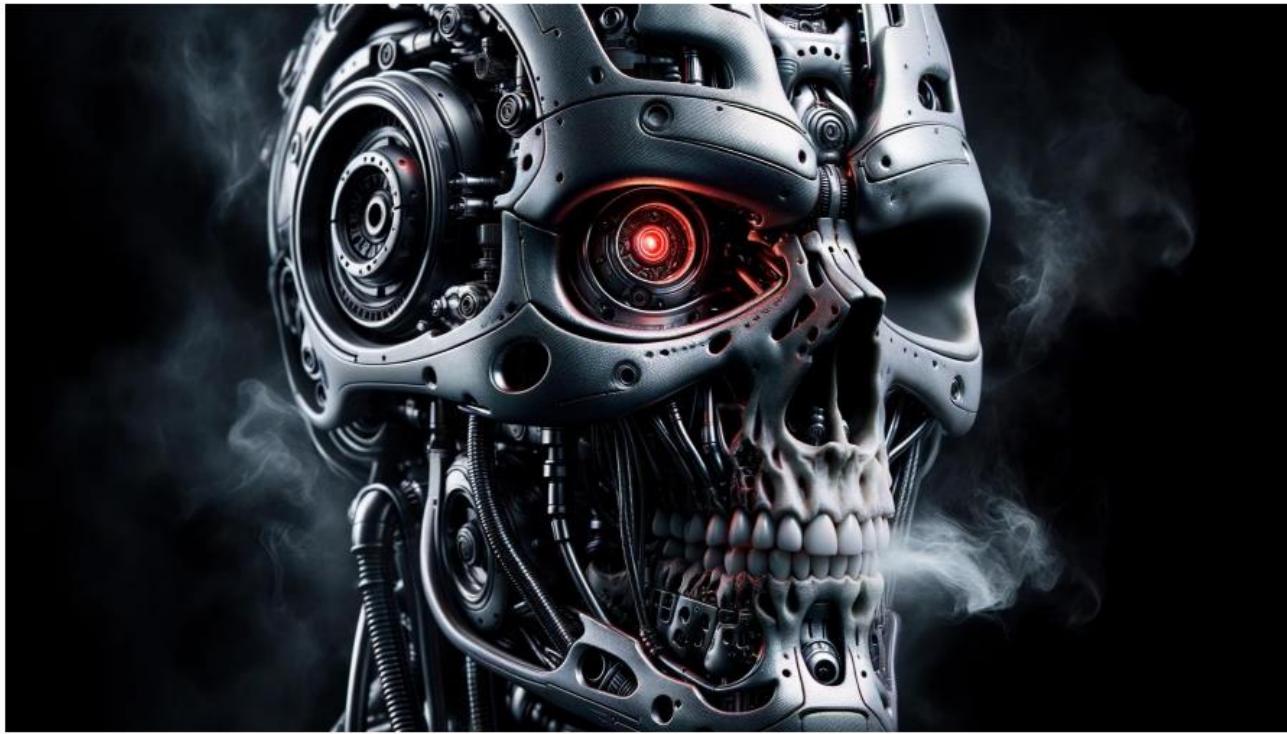
“AI won’t replace radiologists.

But radiologists that use AI will replace radiologists that don’t.”

Curtis Langlotz  
Professor of Radiology  
Stanford University

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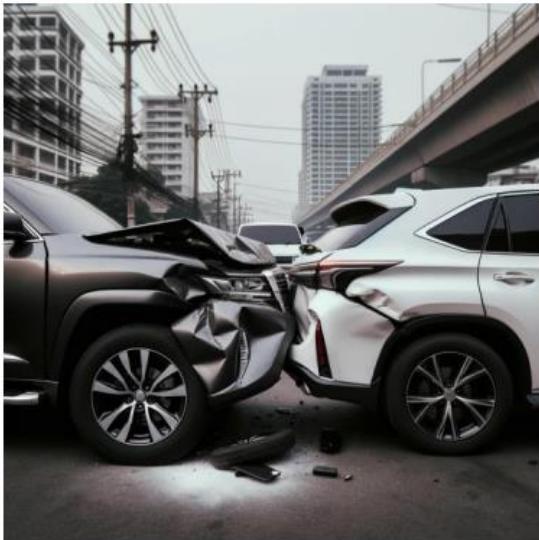
# Concern 3: Human extinction



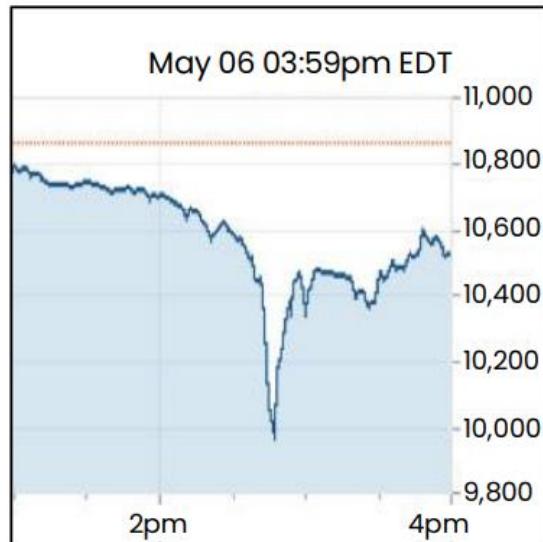
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# Examples of harm caused by AI

Self-driving car crashes



2010 Stock Market  
Flash crash

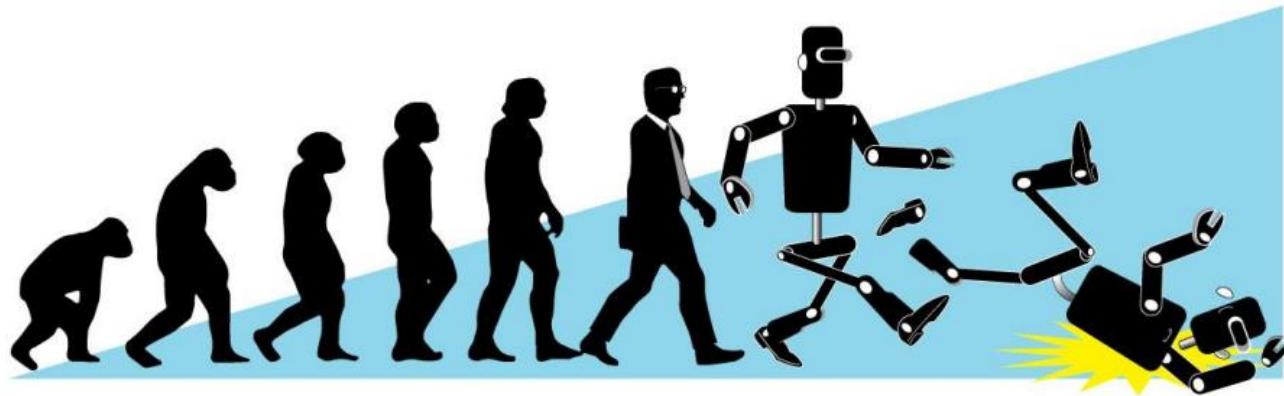


Unjust sentencing in  
criminal cases



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# Human extinction?



- Extinction arguments are not concrete
- Most arguments boil down to “it could happen.”
- “This is a new type of technology.”

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# Perfect control not needed to be valuable and safe

- Humanity has ample experience controlling many things far more powerful than any single person, such as corporations and nation states.
- Many things that we can't fully control are nonetheless valuable and safe. Example: Airplanes.



- If we look at the real risks to humanity – such as climate change and pandemics – AI will be a key part of the solution.

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# Artificial General Intelligence

Definition: AI that can do any intellectual task that a human can

Examples:

- Learn to drive a car through ~20 hours of practice
- Complete a PhD thesis after ~5 years of work
- Do all the tasks of a computer programmer (or any other knowledge worker)

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# Dimensions of responsible AI

- **Fairness:** Ensuring AI does not perpetuate or amplify biases
- **Transparency:** Making AI systems and their decisions understandable to stakeholders impacted
- **Privacy:** Protecting user data and ensure confidentiality
- **Security:** Safeguard AI systems from malicious attacks
- **Ethical Use:** Ensuring AI is used for beneficial purposes

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# Tips for responsible AI

- Build a culture that encourages discussion and debate on ethical issues
- Brainstorm how things can go wrong
  - E.g., Could there be issues with fairness, transparency, privacy, security, ethical use?
- Work with a diverse team and include perspectives from all stakeholders

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# Queries

- Write the summary of Google Scholar profile of Muhammad Usman Ghani working in UET?
- How many papers of Muhammad Usman Ghani from UET at google scholars. Give a list of 5 papers of different journal on medical imaging and 5 papers of conferences on medical imaging.
- Give me the references of 3 research papers of Muhammad Usman Ghani on Computer vision.