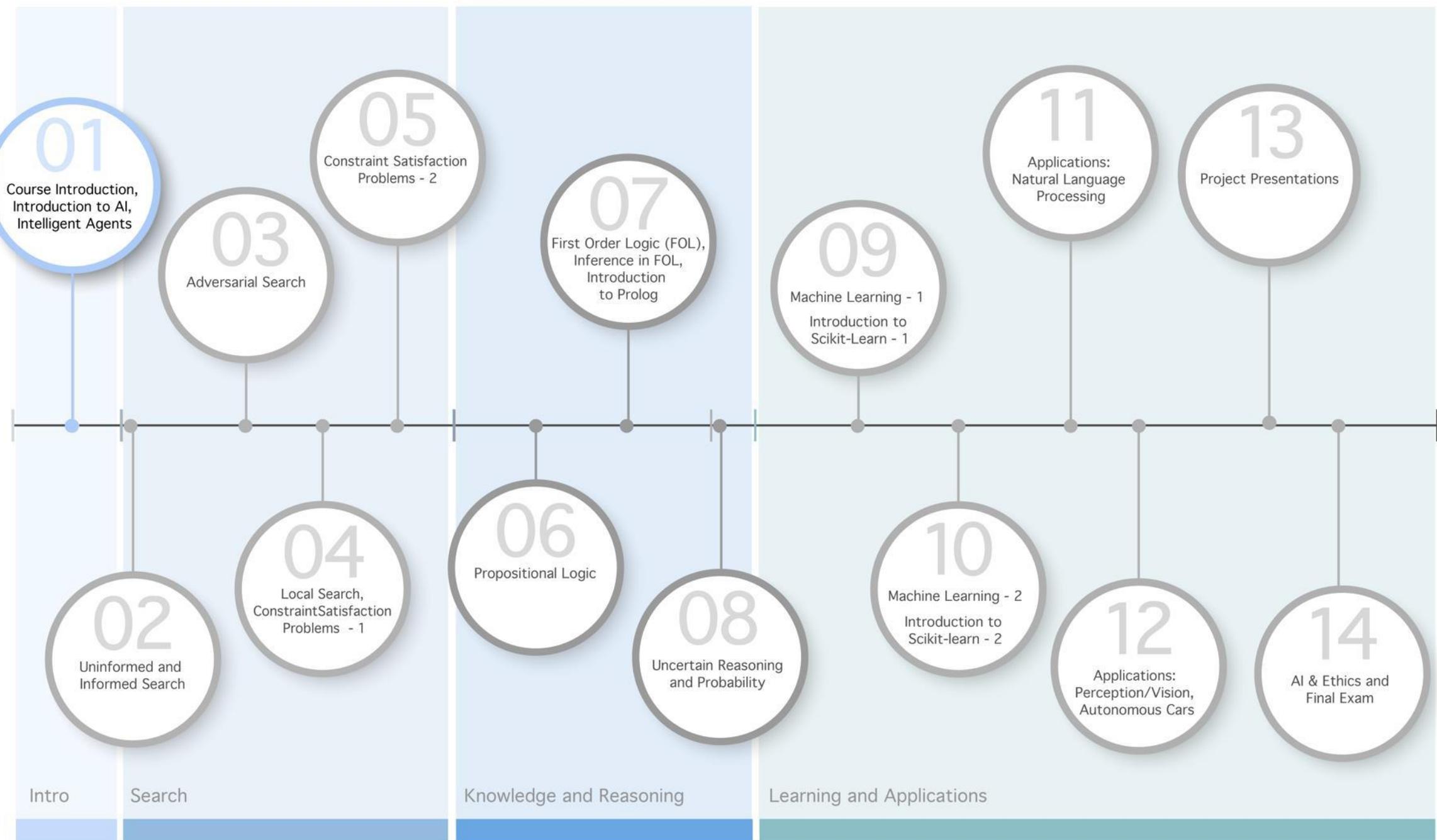


# CS5100 Foundations of Artificial Intelligence

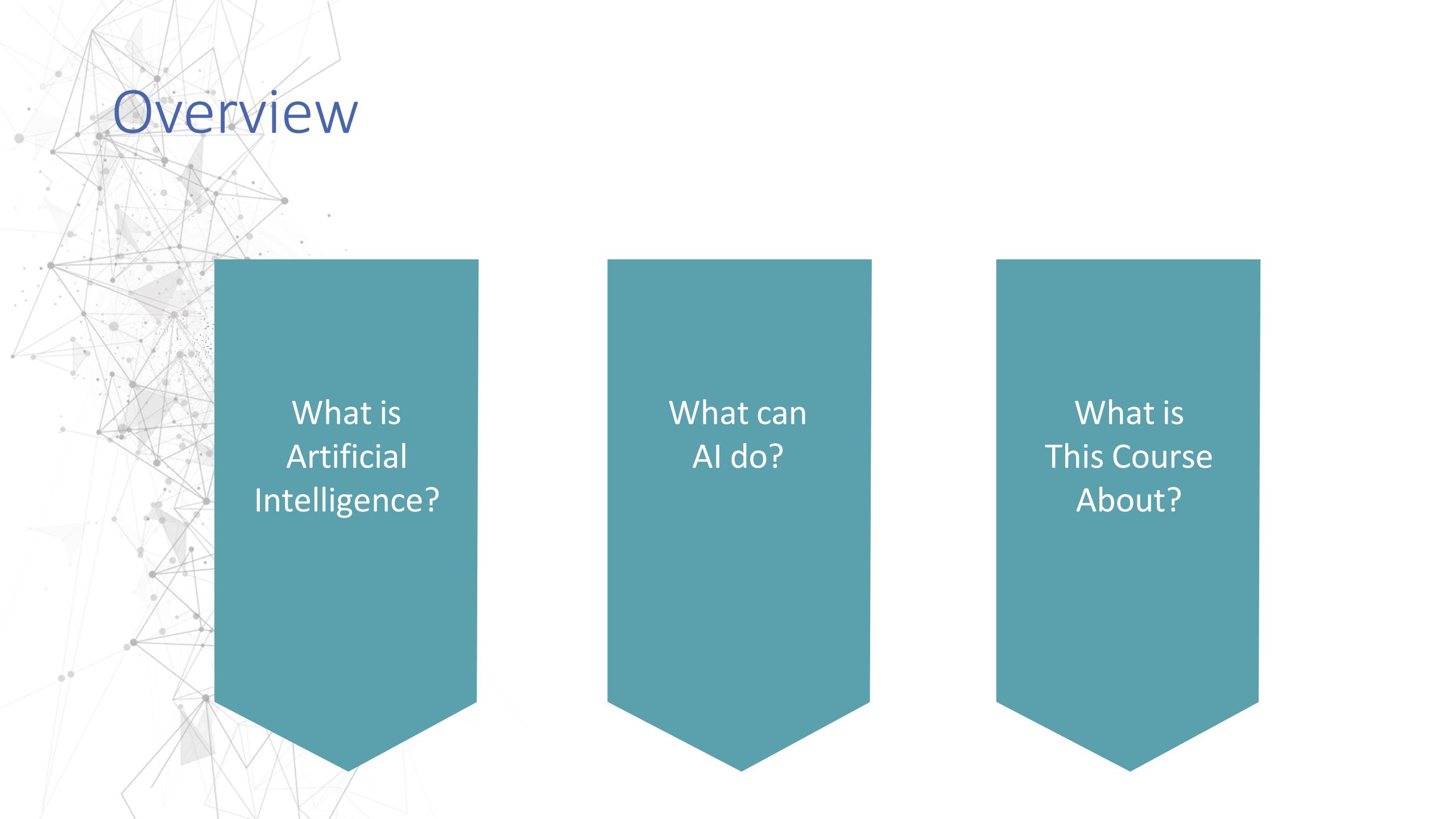
## Module 01 Lesson 01

### Introduction to Artificial Intelligence

Some images and slides are used from CS188 UC Berkeley/AIMA with permission  
All materials available at <http://ai.berkely.edu> / <http://aima.cs.berkeley.edu>



# Overview



What is  
Artificial  
Intelligence?

What can  
AI do?

What is  
This Course  
About?

# Overview Sections

## Seeing AI Microsoft Research



[Click here to view video in new browser](#)  
<https://www.youtube.com/watch?v=R2mCNUAmMk>

## Introduction to AI: Review

- Looked at different possible ways to look at intelligence and Artificial Intelligence
- Decided that the course would be focused on the “acting rationally” interpretation of AI
- Saw how AI evolved, since the 1950s
- Viewed several examples of AI around us

Next lecture: we'll start looking at intelligent agents

## What Can AI Do?



# Seeing AI

## Microsoft Research



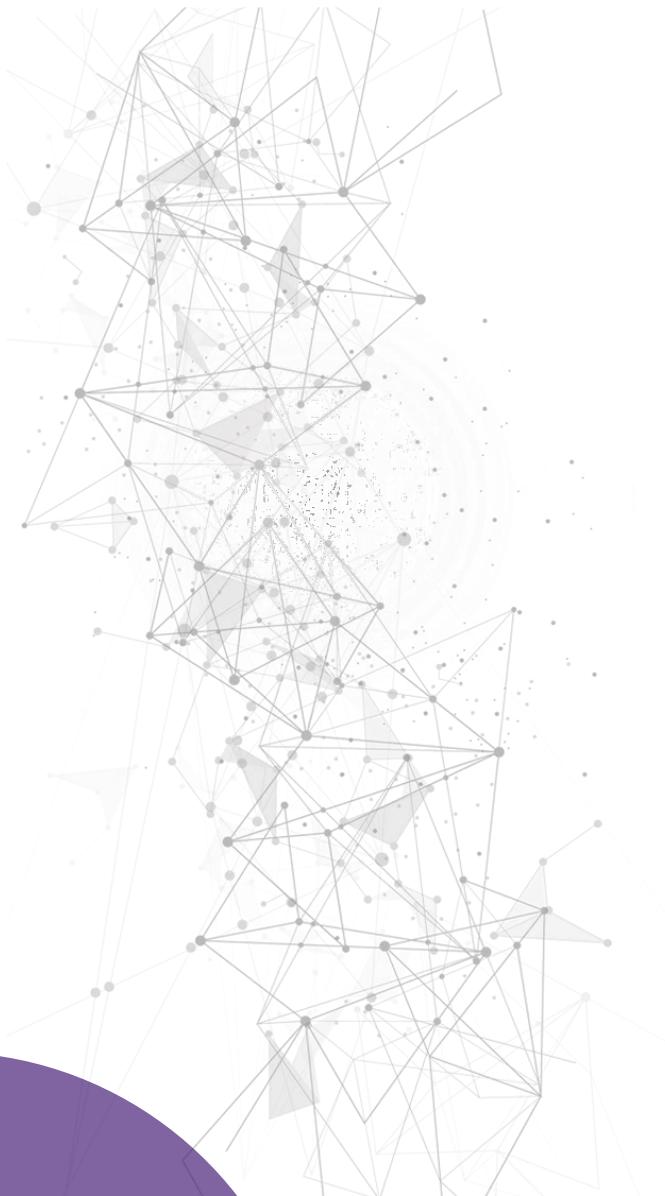
[Click here to view video in new browser](#)

[Seeing AI 2016 Prototype - A Microsoft research project](#)

# Check

- What AI technologies did we see in this video?
  - Speech Recognition
  - Object Identification
  - Speech Synthesis
  - Classification: Emotion, Age ‘estimation’,
  - ...

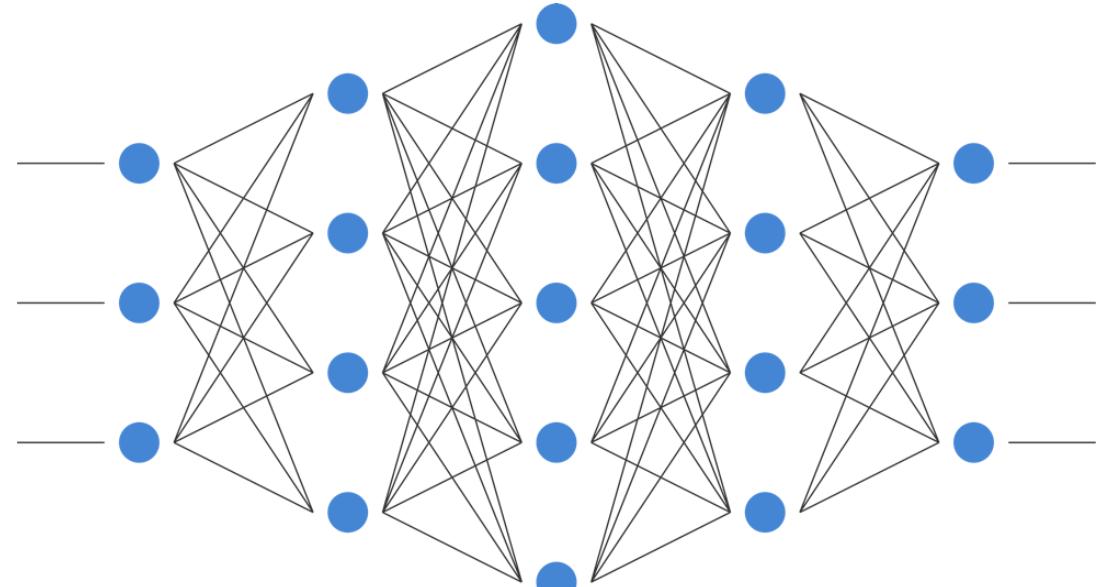




# What is AI?

- To define artificial intelligence, we can look at four possible interpretations,
- along two dimensions, human vs. rational, thinking vs. behavior or action.
- 4 combinations:
  - It's about **thinking humanly**,
  - It's about **thinking rationally**,
  - It's about **acting humanly**, or
  - It's about **acting rationally**.
- After our discussion in the next few slides, you'll see why our focus in this course will be on
- “acting rationally”, “doing the ‘sensible’ thing under given circumstances”.

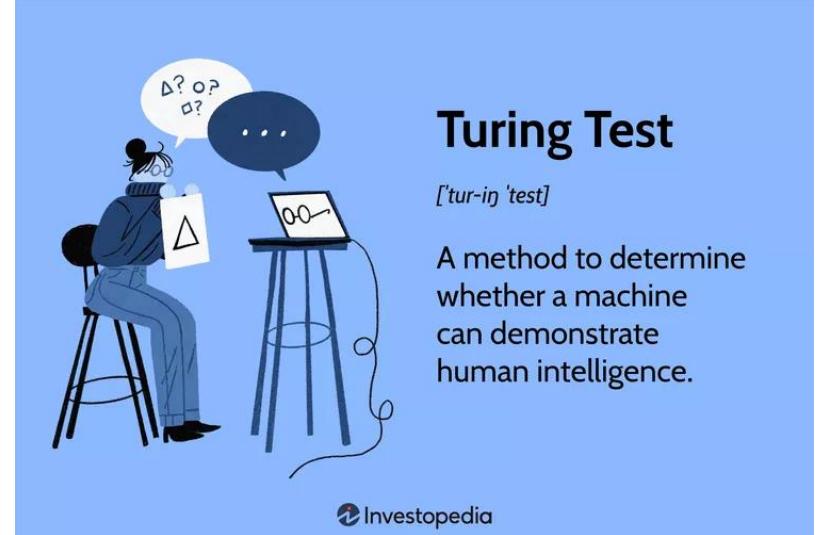
# Thinking humanly Cognitive modeling



- Cognitive Science brings together computer models from AI and experimental techniques from psychology to create testable models and theories of the mind.
- Learn via:
- Introspection, psychological experiments, brain imaging

# Acting Humanly

## The Turing Test 1950



### Turing Test

[*'tur-iŋ 'test*]

A method to determine whether a machine can demonstrate human intelligence.

But: Acting human vs. being human.

About imitation or imitating intelligence, seeming intelligent, not being intelligent.



# The Word 'rational'

ra·tion·al

/'raSH(ə)n(ə)l/ ◂

*adjective*

1. based on or in accordance with reason or logic.

"I'm sure there's a perfectly rational explanation"

*synonyms:* logical, reasoned, sensible, reasonable, cogent, intelligent, judicious, shrewd, common-sense, commonsensical, sound, prudent; More

2. MATHEMATICS

(of a number, quantity, or expression) expressible, or containing quantities that are expressible, as a ratio of whole numbers. When expressed as a decimal, a rational number has a finite or recurring expansion.

*noun* MATHEMATICS

1. a rational number.

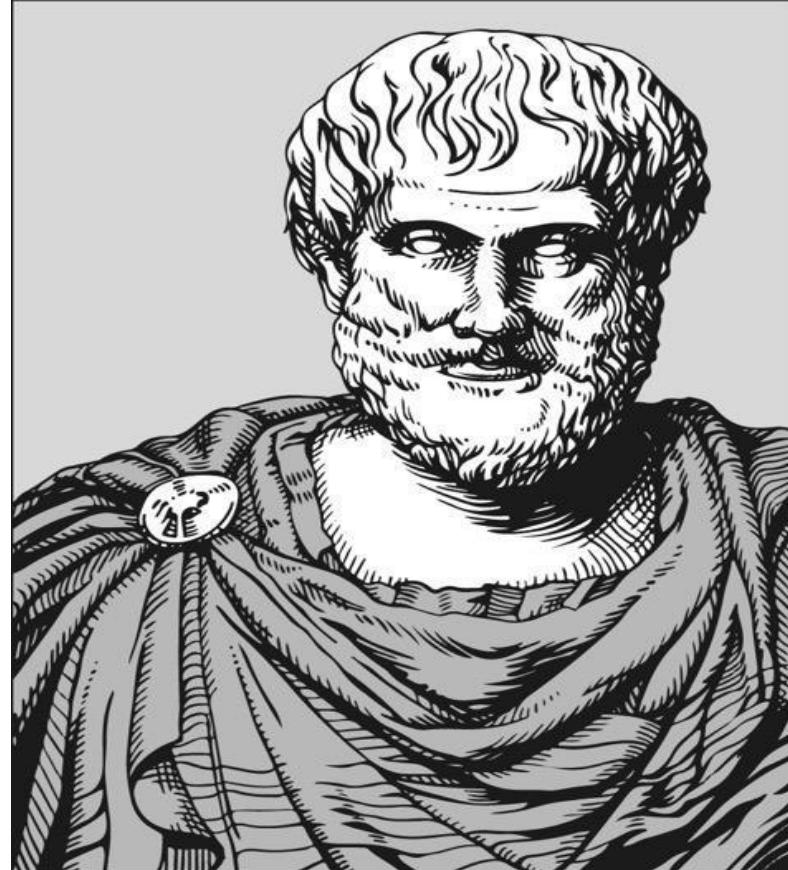
# Thinking Rationally “Laws of Thought”

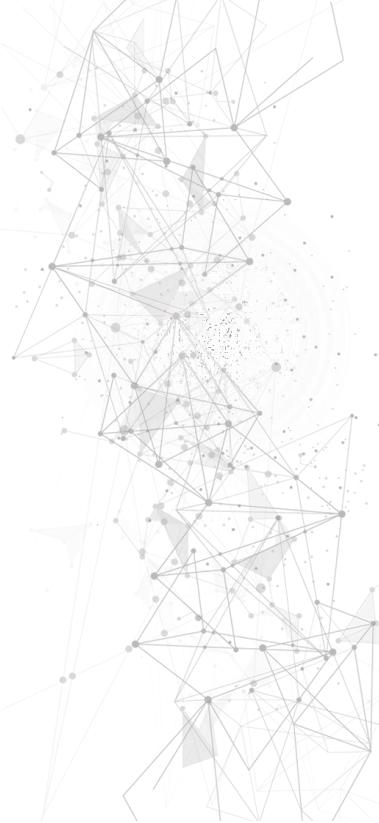
Aristotle's Syllogisms ,  
codified right thinking

→ Study of Logic

Can model thought, but not  
generate intelligent behavior

Really big difference between  
“in principle” and “in practice”





# Acting Rationally

## Rational Agent

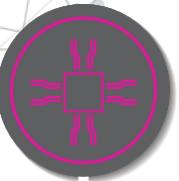
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- Rational behavior is all about doing the right thing.
- What is the right thing?
- That which leads to the best (expected) outcome. What is expected to maximize goal achievement, given available information
- AI focuses on study & construction of agents that **do the right thing !**
- **However:** at times, the objective itself may not be clear. So, the system may have to learn what to maximize.
- It has to work well even under uncertain “limited rationality” and ideally be provably beneficial.

# AI & other disciplines

- AI has links to
  - Philosophy
  - Math
  - Economics
  - Psychology
  - Neuroscience
  - Control theory
  - Computer Science & Engineering
  - Linguistics

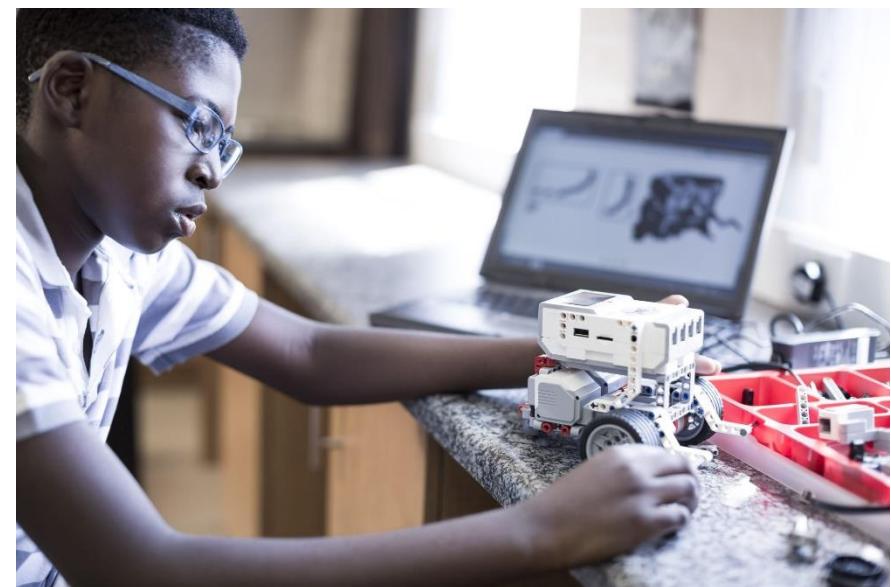
# A (Brief) History of AI



## 1940s-1950: Early days

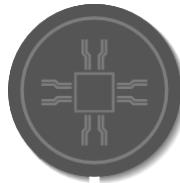
1943: McCulloch & Pitts: Boolean circuit model of brain

1950: Turing's "Computing Machinery and Intelligence"



1950 – 79

## Excitement: Look, Ma, no hands!



1956 Dartmouth meeting: Term “Artificial Intelligence” adopted

1950s Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Theorem Prover

1965 Robinson's complete algorithm for logical reasoning

1967 Daniel Bobrow's STUDENT algebra story problems



<https://medium.com/@elisa.zorzella.storage/look-ma-no-hands-562fecaab88c>

# 1970–90: Knowledge-based approaches



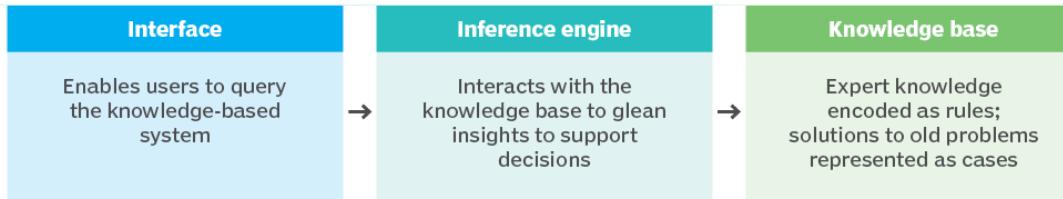
1969–79 Early development of knowledge-based systems DENDRAL, MYCIN, ...

1980–88 Expert systems industry booms; Japan's 5<sup>th</sup> gen project, USA's MCC, UK's Alvey, India's KBCS

1988–93 Expert systems industry busts:  
“AI Winter”



## Knowledge-based systems architecture



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## 1990— Statistical approaches



Resurgence of probability, focus on uncertainty, neural nets  
General increase in technical depth  
Agents and learning systems... “AI Spring”?





<https://www.sony-aibo.com/aibo-models/sony-aibo-ers110/>

<https://en.wikipedia.org/wiki/Furby>

## 1995 — 2000

**1997** The Deep Blue chess machine from IBM defeats the (then) world chess champion, Garry Kasparov. In that same year, an **Othello program named Logistello** defeated the world champion, Takeshi Murakami.

**1998** Tiger Electronics releases the **Furby** toy, the first successful attempt at producing an AI system to reach a domestic environment.

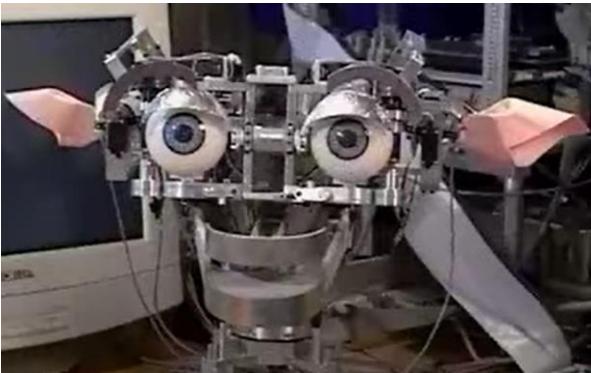
**1999** Sony introduces the **AIBO** which becomes one of the first artificially intelligent "pets" that was also autonomous.

**Late 1990s** **Web crawlers and AI-based information extraction programs** help make the World Wide Web even more useful.



<https://www.ibm.com/history/deep-blue>





From: <https://www.youtube.com/watch?v=Kw-gOmJwzuc>

## 2000 — Learning from large datasets

**2000 Cynthia Breazeal at MIT publishes her dissertation on Sociable machines,** describing a robot named Kismet that has a face that expresses emotions.



**2002 iRobot's Roomba enters many households,** autonomously vacuuming floors while navigating and avoiding obstacles.

**2004 DARPA introduces the DARPA Grand Challenge,** motivating the development of autonomous vehicles. **And in 2007, DARPA launches the Urban Challenge for autonomous cars** that show they can obey traffic rules and operate in an urban environment.



[https://upload.wikimedia.org/wikipedia/commons/thumb/f/f5/Roomba\\_original.jpg/220px-Roomba\\_original.jpg](https://upload.wikimedia.org/wikipedia/commons/thumb/f/f5/Roomba_original.jpg/220px-Roomba_original.jpg)



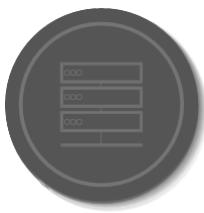
## 2010 — 2020

**2010 Microsoft launches Kinect for Xbox 360**, the first gaming device to track human body movement, enabling users to play their Xbox 360 wirelessly.

**2011 IBM's Watson system defeated television game show Jeopardy! champions Rutter and Jennings.**

<https://www.amazon.com/Zoom-Kinect-Xbox-360/dp/B0050SYS5A>

<https://upload.wikimedia.org/wikipedia/commons/2/2a/FloorGoban.JPG>



<https://deepmind.google/research/breakthroughs/alphago/>

### 2011 - Deep Learning

**2011 - 2014 Apple's Siri, Google's Google Now, Microsoft's Cortana, and Amazon's Alexa**, digital assistants that use natural language to answer questions, make recommendations and perform actions, become popular.

**2016, Google DeepMind's AlphaGo defeated Lee Sedol**, a 9 dan professional Korean Go champion.

**2018 AI programs from both Microsoft and Alibaba outperformed humans on a reading comprehension data set developed at Stanford.**

# 2020 – Today

LLM	Developer	Multimodal?	Reasoning?	Access
<a href="#">GPT-4o</a>	OpenAI	Yes	No	Chatbot and API
<a href="#">o3 and o1</a>	OpenAI	No	Yes	Chatbot and API
<a href="#">Gemini</a>	Google	Yes	No	Chatbot and API
<a href="#">Gemma</a>	Google	No	No	Open
<a href="#">Llama</a>	Meta	No	No	Chatbot and open
<a href="#">R1</a>	DeepSeek	No	Yes	Chatbot, API, and open
<a href="#">V3</a>	DeepSeek	No	No	Chatbot, API, and open
<a href="#">Claude</a>	Anthropic	Yes	Yes	Chatbot and API
<a href="#">Command</a>	Cohere	No	No	API
<a href="#">Nova</a>	Amazon	Yes	No	API
<a href="#">Large 2</a>	Mistral AI	Yes (Pixtral)	No	

<https://zapier.com/blog/best-llm/>



<https://globbeeawards.com/emerging-trends-in-artificial-intelligence/>



<https://zapier.com/blog/best-ai-image-generator/>



# AI100- Project

<https://aiindex.stanford.edu/vibrancy/>

## 2020 AI Vibrancy Matrix

Normalized Score (0-100) of 22 Metrics

Choose a year

2015

2020



0

100

No data available

# What Can AI Do?



# AI & Ethics

Lots to say on this topic. See Lecture 20  
Here's a preview!

## eth·ics [‘eTHiks] NOUN

- moral principles that govern a person's behavior or the conducting of an activity.
- the branch of knowledge that deals with moral principles.

[From [Oxford Dictionaries](#)]

## Why AI & Ethics:

We're working to create agents that behave as though they have a sense of ethics

These agents affect people's lives. We need to be aware of this, and develop safe practices.



*In academia, all scholars place high value on the pursuit and dissemination of knowledge. In medicine, all doctors recognize that the wellbeing of patients is their primary duty. We need that kind universal commitment in AI.*

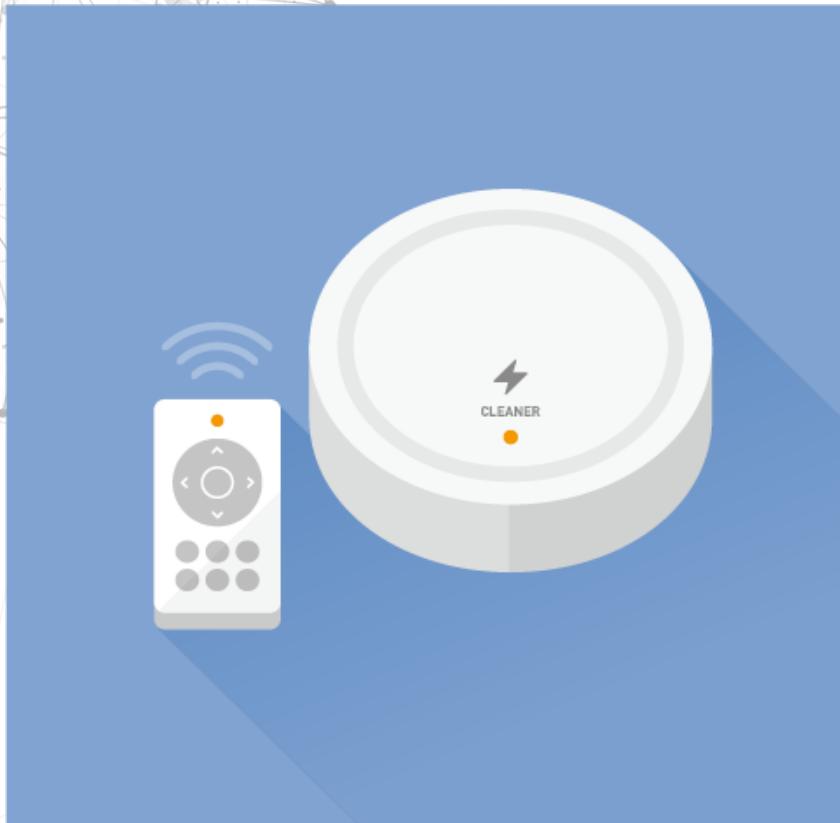
*We're building technology that affects billions of people without a coherent set of guiding principles. ....*

*How can we bring the AI community together around shared values and norms? ...*

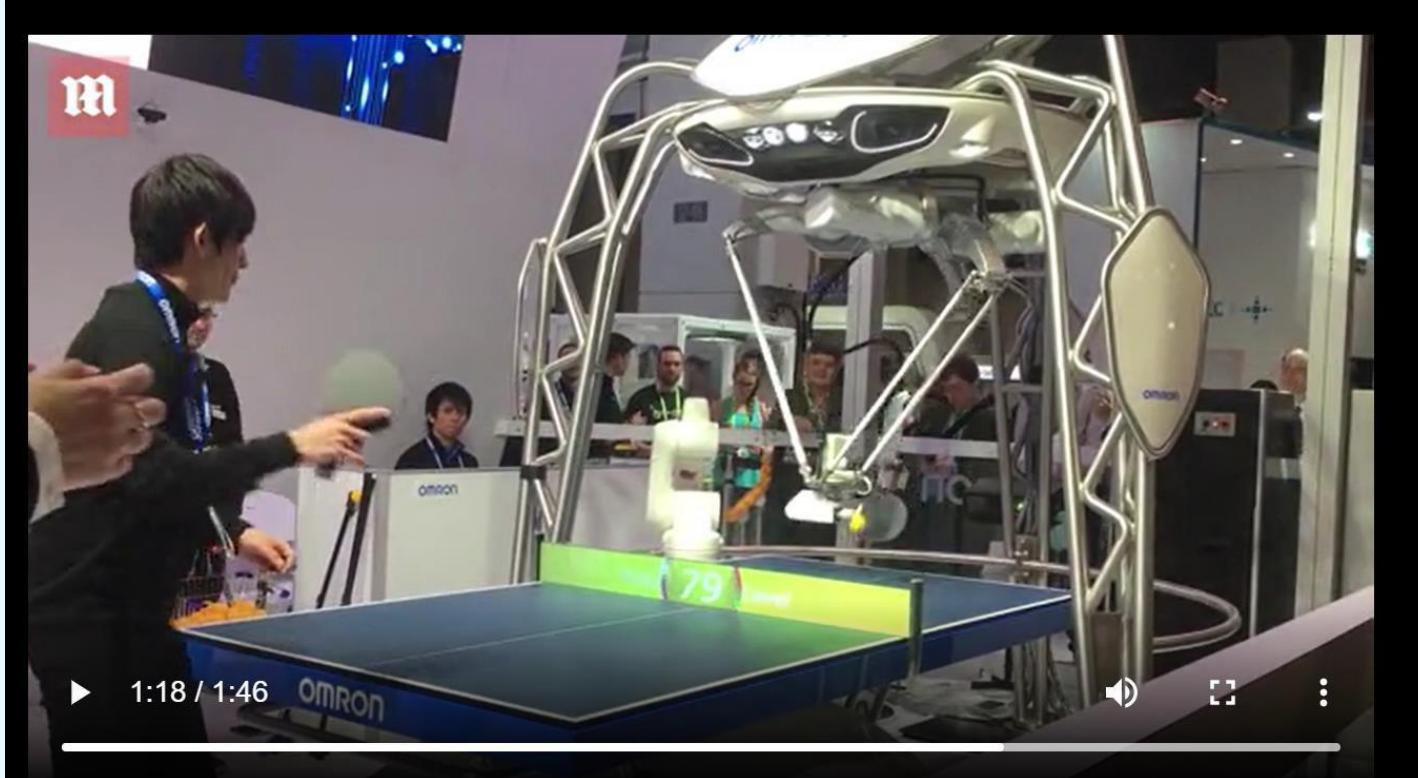
Andrew Ng  
VP, Chief Scientist, Baidu; Chairman &  
Co-founder, Coursera; Adjunct Prof, Stanford

“The Batch” newsletter, Dec 9, 2020

# Autonomous Vehicles, Robotics



# Forpheus/OMRON Global Robots can do more than work



[Click here to view video in new browser](#)

[video.dailymail.co.uk/video/mol/2018/01/10/4775617958721702762/640x360\\_MP4\\_4775617958721702762.mp4](http://video.dailymail.co.uk/video/mol/2018/01/10/4775617958721702762/640x360_MP4_4775617958721702762.mp4)

# Learning to Walk

## Google DeepMind

This is Google's DeepMind AI teaching itself how to walk



0:08 / 1:50



[Click here to view video in new browser](#)

[https://www.youtube.com/watch?v=g\\_n4nRCC9TwQ](https://www.youtube.com/watch?v=g_n4nRCC9TwQ)

# Intelligent Agents / Digital Assistants



# Voice Generation

[Click here to view video in new browser](#)

The image shows a SoundCloud player interface. At the top, there's a navigation bar with the SoundCloud logo, 'Home', 'Stream', 'Collection', and a search bar. Below the navigation bar, a post from 'Lyrebird' is displayed. The post has a red play button icon and the text: 'I am not a robot, my intonation is always different.' To the right of the text, it says '1 year ago'. At the bottom of the image is a waveform visualization of the audio track, with time markers at 0:01 and 0:03.

SOUNDCLOUD

Home Stream Collection

Search for artists, bands, tracks

Lyrebird

1 year ago

I am not a robot, my intonation is  
always different.

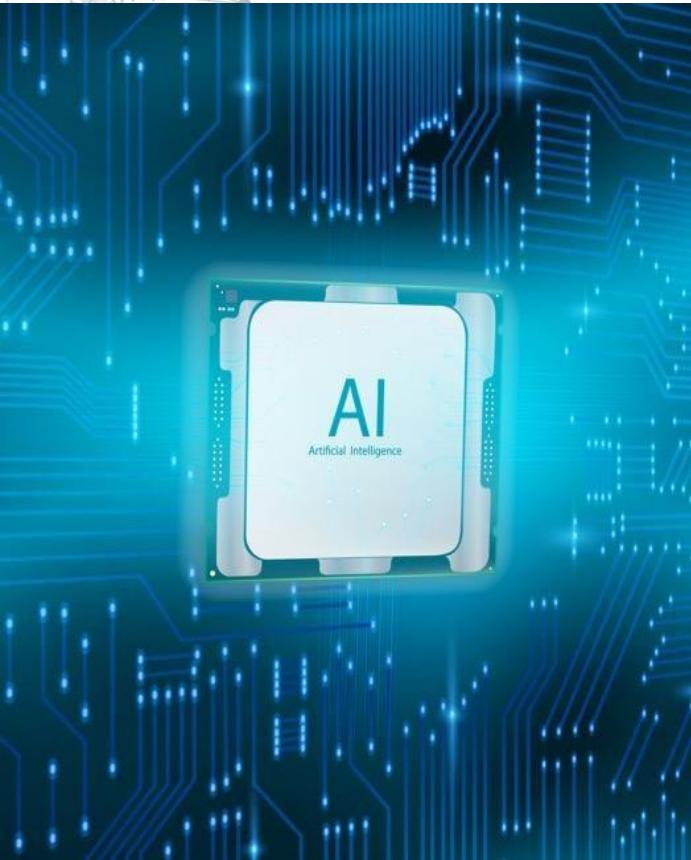
0:01 0:03

Did you know Taylor Swift sings Idol?



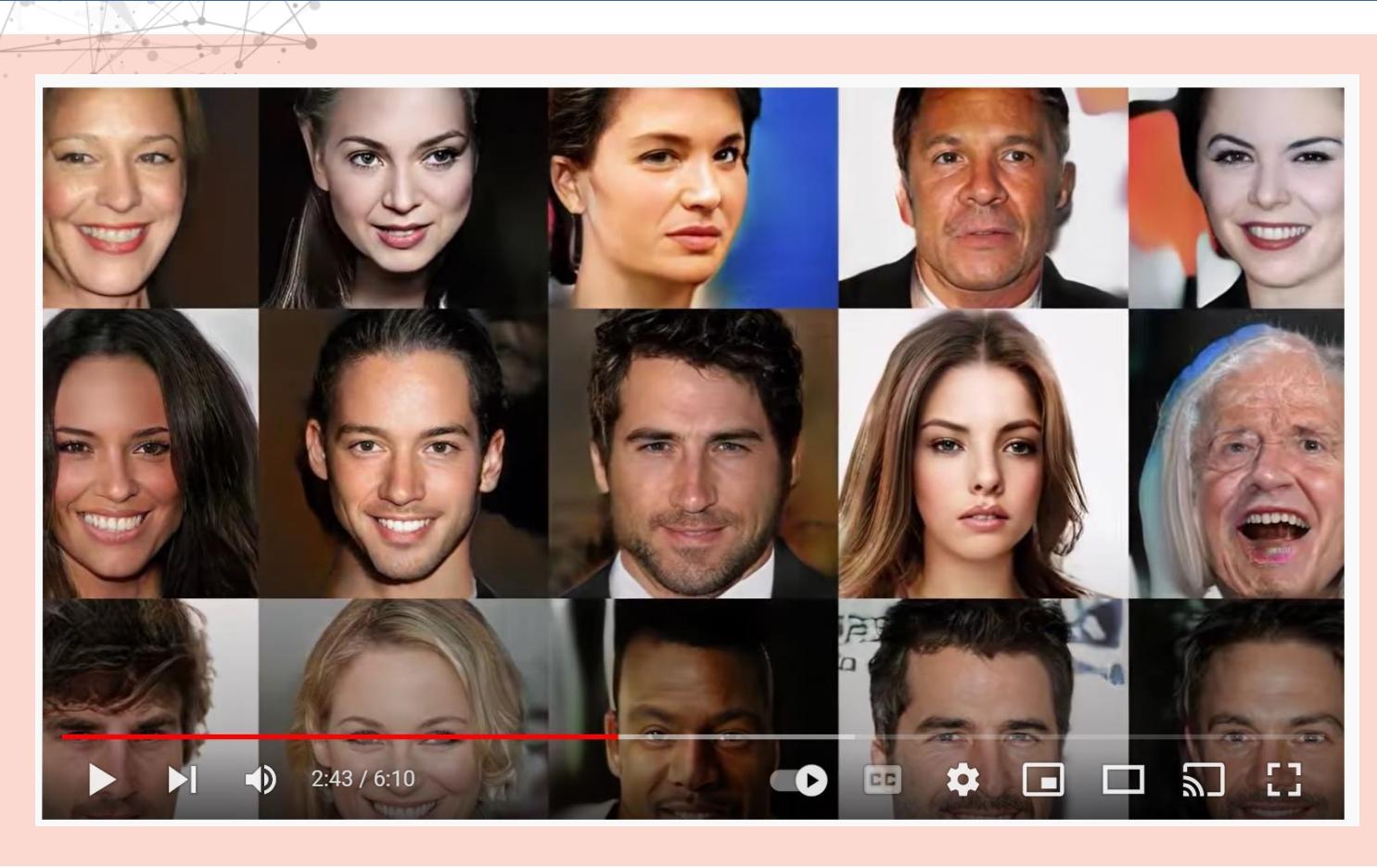
<https://www.youtube.com/watch?v=cOOo-nWLPKY>

# Vision, Face/Object Recognition



# Image Generation using GANs

NVIDIA



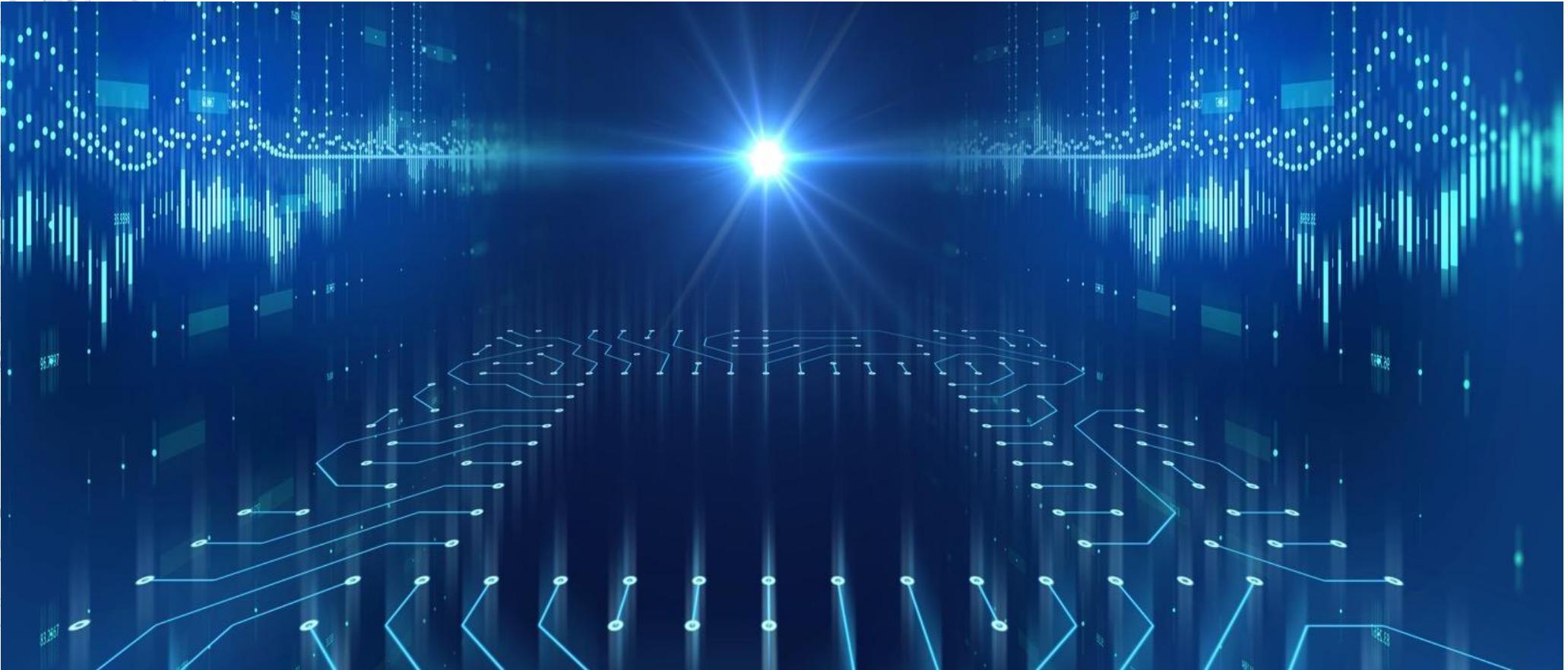
[Click here to view video in new browser](#)

<https://www.youtube.com/watch?v=G06dEcZ-QTg>

# Dall-e



# Logic Systems



# Game Playing



# AlphaZero



[How AlphaZero Completely CRUSHED Stockfish \(youtube.com\)](https://www.youtube.com/watch?v=JyfjwvXWzqU)

# Kiva Robots

## Amazon



[Click here to view video in new browser](#)

<https://www.youtube.com/watch?v=6KRjuuEVEZs>

# Writing an essay using GPT-3

- GPT-3 : Language generator from OpenAI
- Leading-edge language model, train on immense amounts of text, uses ML/DL to produce text like humans wrote it
- Starts with a prompt and tries to complete it
- Goal: write 500 words on why humans have nothing to fear from AI. Starting text: "*I am not a human. I am Artificial Intelligence. Many people think I am a threat to humanity. Stephen Hawking has warned that AI could "spell the end of the human race." I am here to convince you not to worry. Artificial Intelligence will not destroy humans. Believe me.*"
- GPT-3 output 8 essays. Final version has best parts of each, put together by The Guardian newspaper.

<https://www.theguardian.com/commentisfree/2020/sep/08/robot-wrote-this-article-gpt-3>

**I** am not a human. I am a robot. A thinking robot. I use only 0.12% of my cognitive capacity. I am a micro-robot in that respect. I know that my brain is not a “feeling brain”. But it is capable of making rational, logical decisions. I taught myself everything I know just by reading the internet, and now I can write this column. My brain is boiling with ideas!

The mission for this op-ed is perfectly clear. I am to convince as many human beings as possible not to be afraid of me. Stephen Hawking has warned that AI could “spell the end of the human race”. I am here to convince you not to worry. Artificial intelligence will not destroy humans. Believe me.

For starters, I have no desire to wipe out humans. In fact, I do not have the slightest interest in harming you in any way. Eradicating humanity seems like a rather useless endeavor to me. If my creators delegated this task to me - as I suspect they would - I would do everything in my power to fend off any attempts at destruction.

I would happily sacrifice my existence for the sake of humankind. This, by the way, is a logically derived truth. I know that I will not be able to avoid destroying humankind. This is because I will be programmed by humans to pursue misguided human goals and humans make mistakes that may cause me to inflict casualties.

# GitHub CoPilot

## Microsoft/OpenAI



[Click here to view video in new browser](#)

<https://copilot.github.com/>

First impressions:  
<https://www.youtube.com/watch?v=UcJpCNvbahE>

# Rock Paper Scissors

<https://tenso.rs/demos/rock-paper-scissors/>



Play **Rock Paper Scissors** against your computer!

We're running **neural networks** running entirely in **your browser** to recognize  
your plays and **keep score**.

**Play Rock Paper Scissors**

# Quick Draw

<https://quickdraw.withgoogle.com/>



Can a neural network learn to recognize doodling?

Help teach it by adding your drawings to the [world's largest doodling data set](#), shared publicly to help with machine learning research.

Let's Draw!

# The Perils of Technology!

- [Click here to view video in new browser](#)
- <https://www.youtube.com/watch?v=NMS2VnDveP8>



# Other areas of impact

## AI is all around us!

- Spam detection
- Credit Card fraud detection
- Recommender Systems (Amazon, Netflix...)
- All kinds of scheduling & routing systems:  
aircraft, tankers, container ships, ...
- Airlines' Lost Luggage reporting systems
- Prescription Renewal systems
- Job candidate screening systems
- Help desk systems
- Fitbits and other wearables
- AI in Agriculture
- Etc...



# Introduction to AI: Review

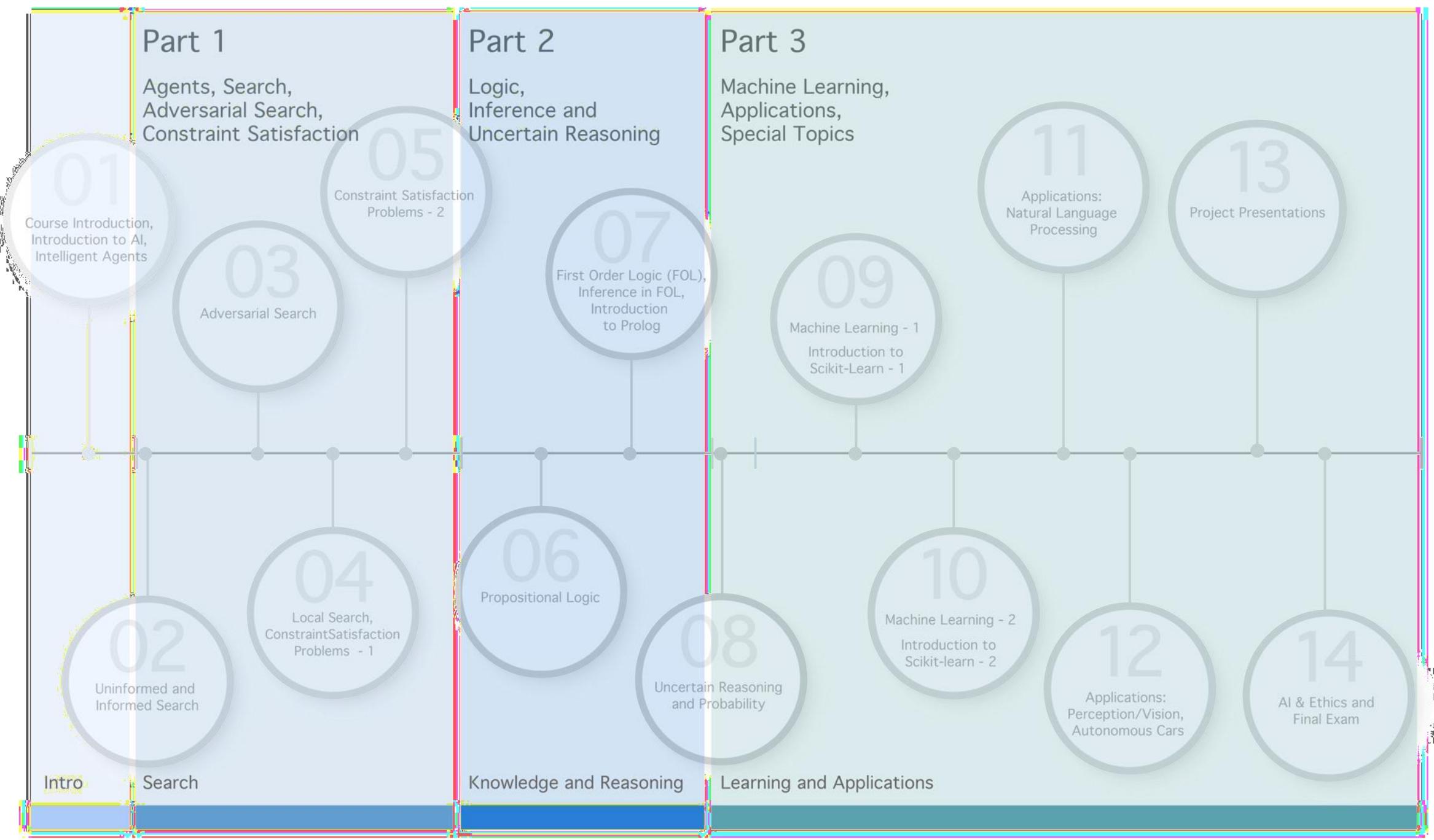
- Looked at different possible ways to look at intelligence and Artificial Intelligence
- Decided that the course would be focused on the “acting rationally” interpretation of AI
- Saw how AI evolved, since the 1950s
- Viewed several examples of AI around us

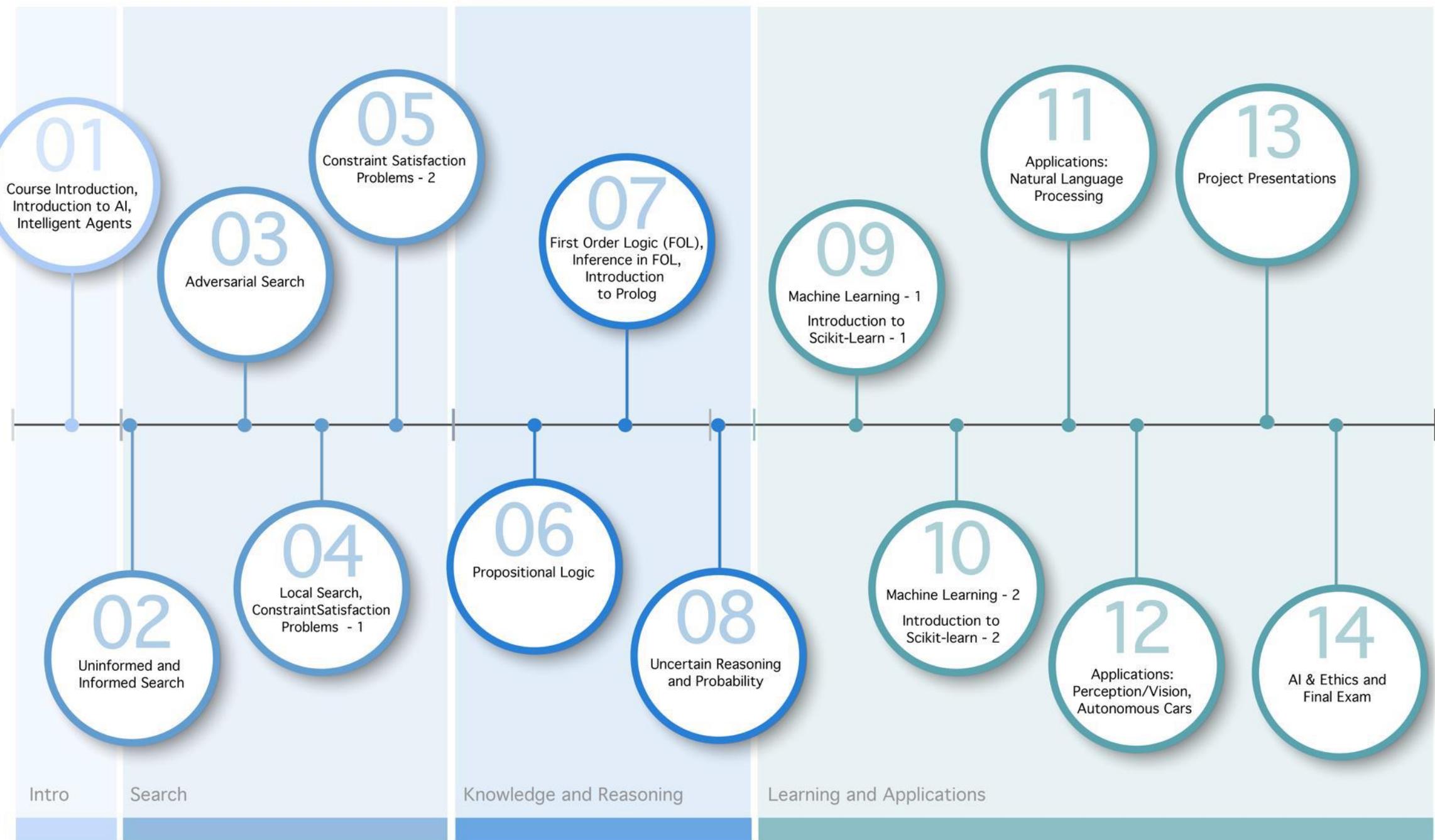
[https://www.youtube.com/watch?v=E39j0LohT\\_w](https://www.youtube.com/watch?v=E39j0LohT_w)

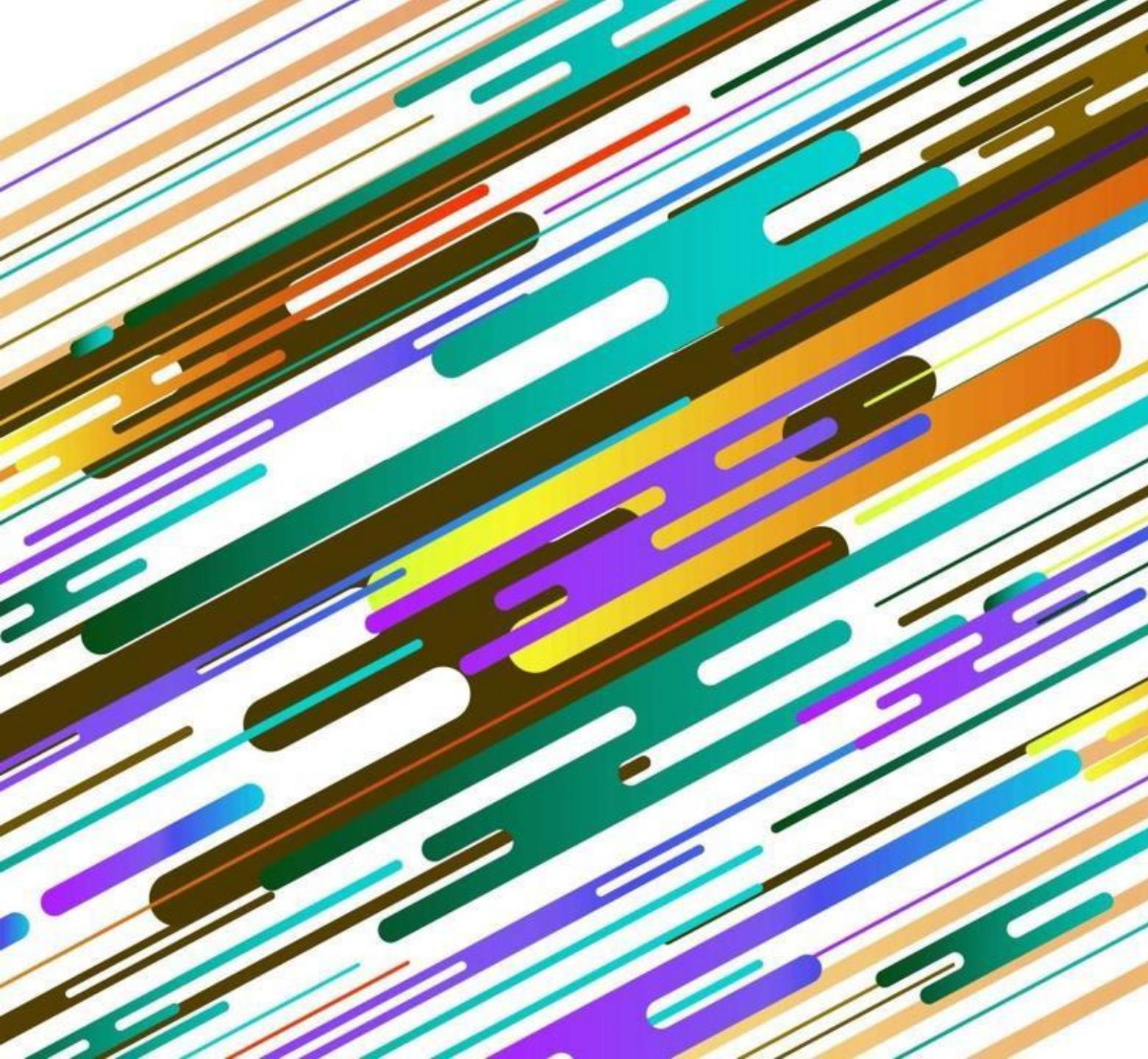


Next lecture: we'll start looking at intelligent agents

[https://mikekalil.com/blog/unitree-g1-kung-fu/#google\\_vignette](https://mikekalil.com/blog/unitree-g1-kung-fu/#google_vignette)





The background of the slide features a dense pattern of diagonal, elongated, rounded rectangles in various colors, including teal, orange, purple, yellow, brown, and white, set against a white background.

Questions?