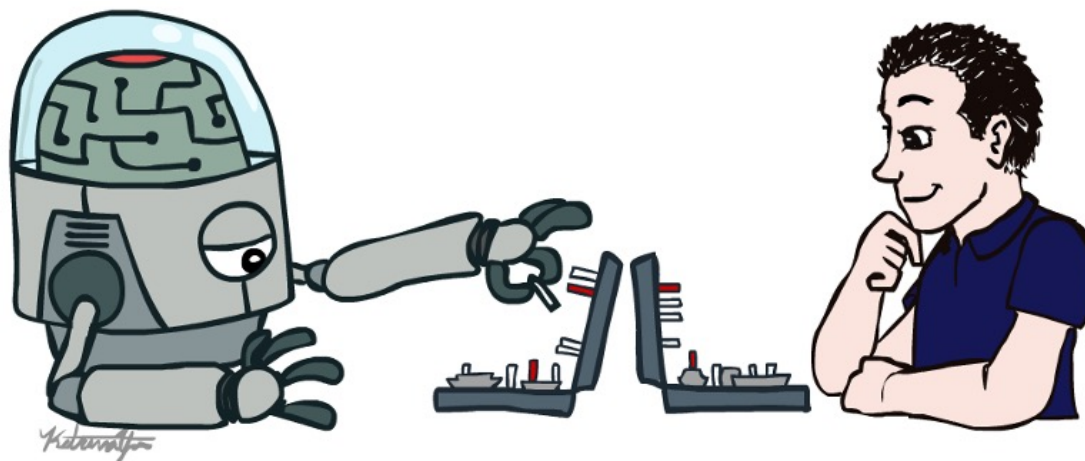


CS 4100: Introduction to AI

Wayne Snyder
Northeastern University

Lecture 1: What is Artificial Intelligence




What is Intelligence?

Intelligence is....

"[a] mental quality that consists of the abilities to learn from experience, adapt to new situations, understand and handle abstract concepts, and use knowledge to manipulate one's environment."

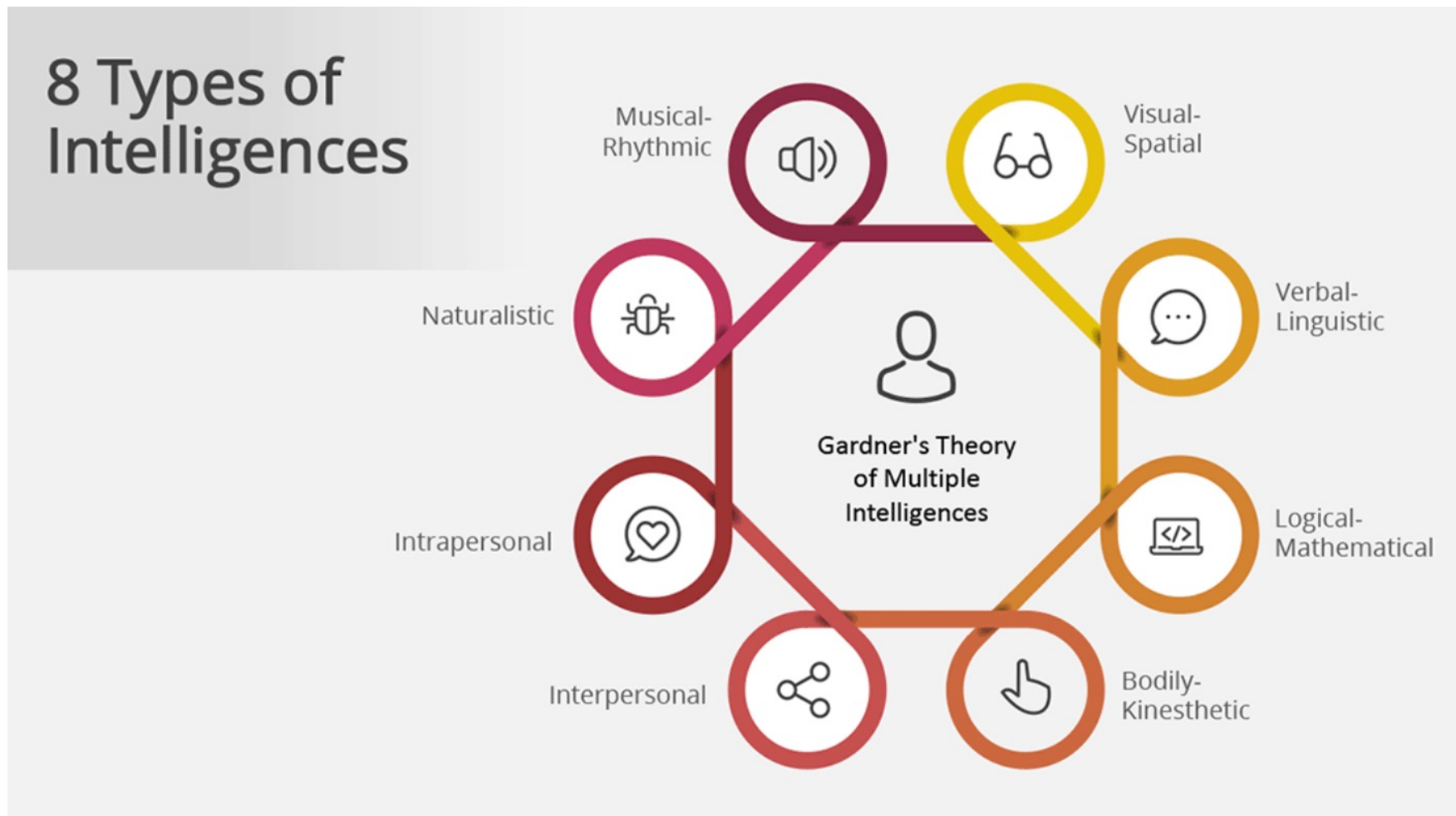
-Encyclopedia Britannica

"A very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings—"catching on," "making sense" of things, or "figuring out" what to do."

^ Gottfredson, Linda S. (1997). "Mainstream Science on Intelligence (editorial)"  (PDF). *Intelligence*. **24**: 13–23.

What is Intelligence?

Intelligence is....



How do we test Intelligence?

There is a tremendous amount of controversy among psychologists about the construction, evaluation, and even the ultimate value of IQ tests; however, here are some typical types of questions that appear on standardized tests.

1. [Numerical reasoning test](#)
2. [Verbal reasoning test](#)
3. [Logical reasoning test](#)
4. [Diagrammatic reasoning test](#)
5. [Spatial reasoning test](#)
6. [Inductive reasoning test](#)
7. [Deductive reasoning test](#)
8. [Mechanical reasoning test](#)
9. [Critical thinking test](#)
10. [Error checking test](#)

Classical intelligence test

2. Number series

Which number logically follows this series: 4 - 6 - 9 - 6 - 14 - 6 - ...

- ☐ 6
- ☐ 17
- ☐ 19
- ☐ 21

1. Welfare

A trade union is suing two municipalities that let welfare recipients work for years without paying them. The union believes they are entitled to the minimum wage. Since 2011, people on welfare in the two municipalities have folded fake flowers without any compensation, which were then sold in garden centres. They also glued envelopes and harvested trees. According to the union, the work was "humiliating, unsafe and devoid of perspective". Neither did it contribute to a successful reintegration, claims the union. The social services of the two municipalities have since halted the unrestricted deployment of welfare recipients. Some employees have been given an employment contract. However, the union considers the compensation that the municipalities want to offer to be insufficient. They claim that more than 230 people are entitled to the full minimum wage with retroactive effect. The social services of the two municipalities are only willing to offer 170 people untaxed compensation of up to \$1,500 per person. The municipalities dispute that money was earned unfairly through the use of welfare recipients. They claim that the income went directly back to the budget used to help and support people on welfare experiencing difficulties finding a job.

Do the municipalities believe that money was earned unfairly by deploying welfare recipients?

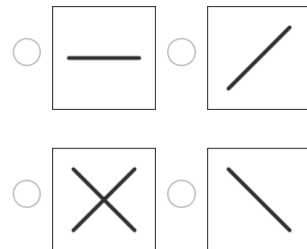
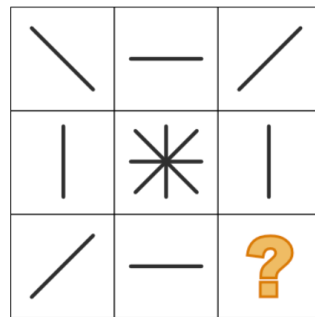
- ☐ Yes, those entitled to benefits worked for years without being paid.
- ☐ Yes, the municipalities say they found the work "humiliating, unsafe and devoid of perspective".
- ☐ No, the welfare recipients eventually received an employment contract.
- ☐ No, the income was used to support those entitled to welfare.

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1.



1.

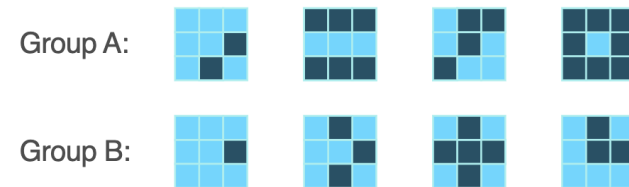


Figure:



To which group does the figure belong?

- ☐ Group A
- ☐ Group B
- ☐ Neither A or B

How do we test Intelligence?

There is a tremendous amount of controversy among psychologists about the construction, evaluation, and even the ultimate value of IQ tests; however, here are some typical types of questions that appear on standardized tests.

1.



Which figure replaces the question mark?



1.

1. Vehicles are either to the right or left of other vehicles.
2. Only Dutch vehicles are next to the German car.
3. The bus is two times bigger than the German car.
4. The Dutch bicycle is placed next to the Swedish truck.
5. The motorcycle has the same country of origin as the vehicles next to the German car.
6. The motorcycle is half the size of the German car.

Statement: The motorcycle is Dutch

- ☐ True
- ☐ False
- ☐ Insufficient information

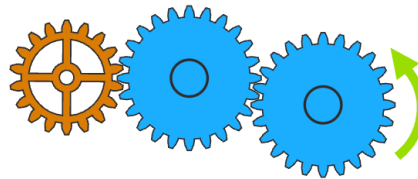
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1. In which direction does the orange gear rotate?



- ☐ Clockwise
- ☐ Counterclockwise
- ☐ No rotation

1. Analysing arguments

Below is a statement that is followed by an argument. You should consider this argument to be true. It is then up to you to determine whether the argument is strong or weak. Do not let your personal opinion about the statement play a role in your evaluation of the argument.

Statement: *It would be good if people would eat vegetarian more often.*

Argument: *No, because dairy also requires animals to be kept that will have to be eaten again later.*

Is this a strong or weak argument?

- ☐ Strong argument
 - ☐ Weak argument
-

What is Artificial Intelligence?

"The goal of AI is to develop machines that behave as though they were intelligent."

John M cCarthy

"AI is the ability of digital computers or computer controlled robots to solve problems that are normally associated with the higher intellectual processing capabilities of humans."

Encyclopedia Britannica

"[AI is] the theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."

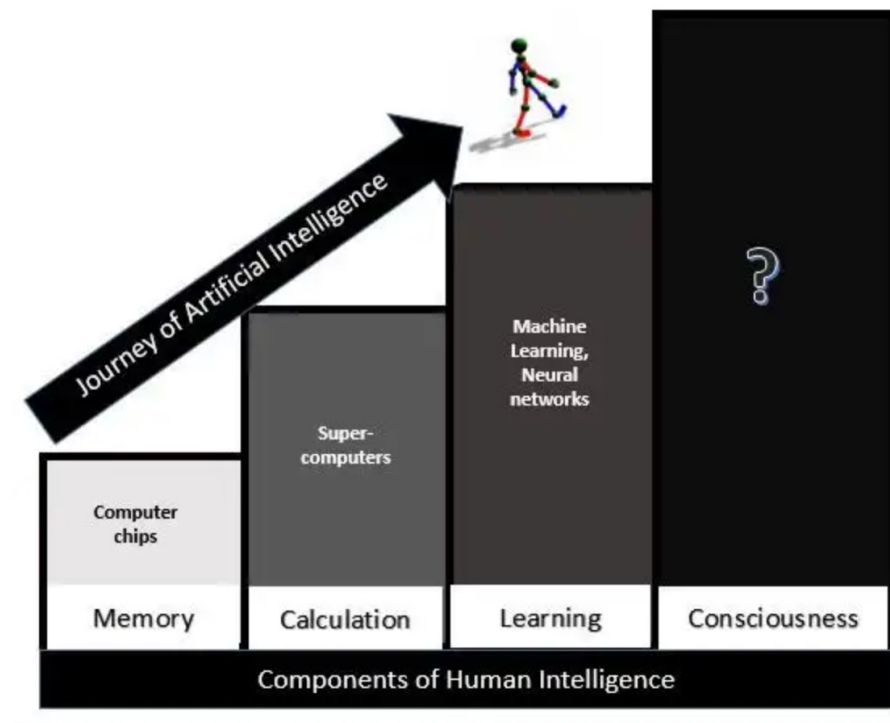
Oxford English Dictionary

"Artificial Intelligence is the study of how to make computers do things which, at the moment, people are better."

Elaine Rich

Digression: Intelligence vs Consciousness

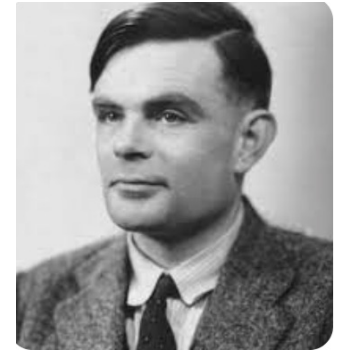
Notice that the definitions, and test questions on intelligence say nothing about the most important quality of human beings, the fact that we are conscious! Therefore, in many ways this is completely irrelevant to the question of whether machines can be intelligent. Still, this is the dream (or nightmare) of AI researchers....



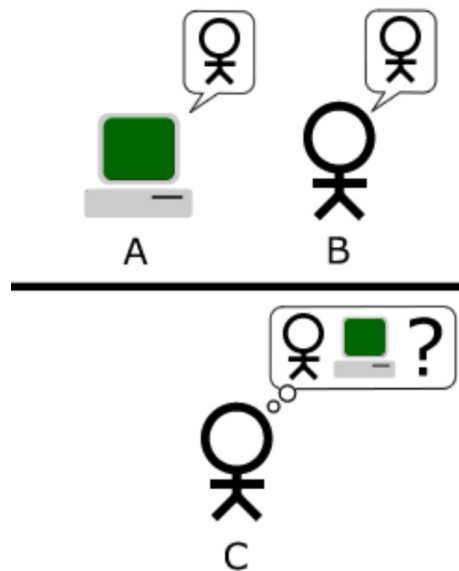
(End of Digression)

How do we test Artificial Intelligence?

The first attempt to test a machine for intelligence was devised by Alan Turing, and is naturally called the Turing Test (originally, the Imitation Game):



There are two "entities" A and B behind a wall, one a computer and one a person; the human interrogator C asks questions (by typing text) of each, not knowing which is the computer. If after a reasonable time, C can not figure out which is the human, then the machine may be considered intelligent.



VOL. LIX. NO. 236.]

[October, 1950

MIND A QUARTERLY REVIEW OF PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND INTELLIGENCE

By A. M. TURING

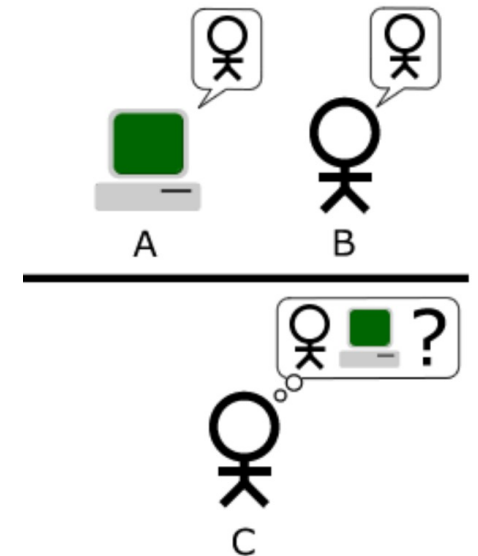
1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?' This should

Turing Test

Turing gave several examples of the kind of conversations that might take place:

Q : Please write me a sonnet on the subject of the Forth Bridge.
A : Count me out on this one. I never could write poetry.
Q : Add 34957 to 70764
A : (Pause about 30 seconds and then give as answer) 105621.
Q : Do you play chess?
A : Yes.
Q : I have K at my K1, and no other pieces. You have only K at K6 and R at R1. It is your move. What do you play?
A : (After a pause of 15 seconds) R-R8 mate.



Do you think this is a reasonable test?

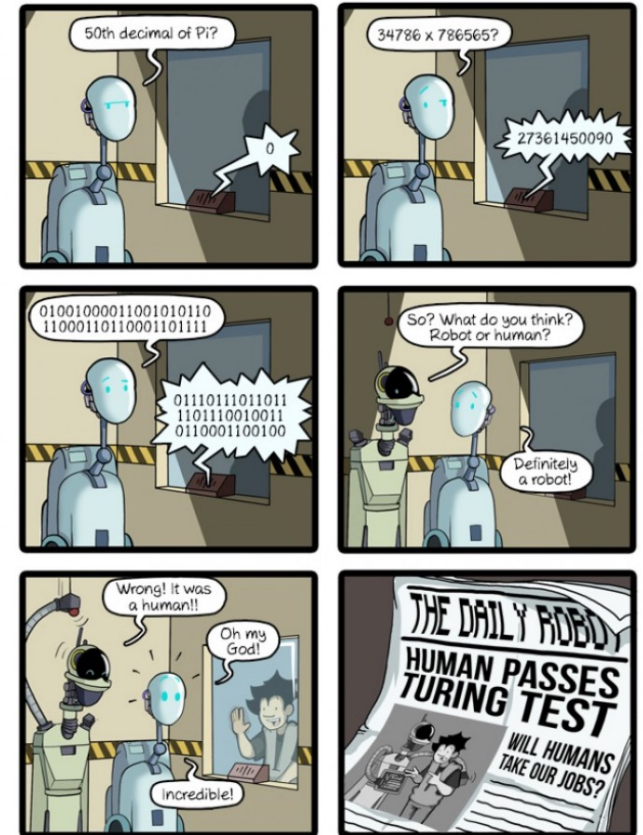
What might be some of the problems with testing AI this way?

Turing Test

This has been a part of our culture for a long time....



Reverse Turing Test



CommitStrip.com



ChatBots and the Turing Test

Throughout the history of AI, the Turing Test has been a semi-serious benchmark to aim for, starting with Joseph Weizenbaum's Eliza:

<https://web.njit.edu/~ronkowitz/eliza.html>

The Loebner Prize was an annual contest (discontinued in 2020), to award the best human-simulation in a Turing Test:







And now we have chatGPT, which is so popular, it is hard to try it out....

<https://openai.com/blog/chatgpt/>

But here is a small selection of chatGPT's greatest hits (so far)....

chatGPT

T write a biblical verse in the style of the king james bible explaining how to remove a peanut butter sandwich from a VCR 

 And it came to pass that a man was troubled by a peanut butter sandwich, for it had been placed within his VCR, and he knew not how to remove it.  

And he cried out to the Lord, saying, "Oh, Lord, how can I remove this sandwich from my VCR, for it is stuck fast and will not budge?"

And the Lord spoke unto him, saying, "Fear not, my child, for I shall guide thy hand and show thee the way. Take thy butter knife, and carefully insert it between the sandwich and the VCR, and gently pry them apart. And with patience and perseverance, the sandwich shall be removed, and thy VCR shall be saved."

And the man did as the Lord commanded, and lo and behold, the sandwich was removed from the VCR, and the man was saved.

And the Lord said, "Verily I say unto thee, seek not to put thy peanut butter sandwiches in thy VCR, for it is not a suitable place for such things. Rather, keep thy sandwiches in thy refrigerator or on thy plate, where they belong."

And the man heeded the Lord's words, and from that day forth, he kept his sandwiches in their proper place, and was saved from trouble and woe. Amen.

chatGPT



Find the bug with this code:

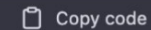
```
...  
for (var i = 0; i < 5; i++) {  
  setTimeout(() => console.log(i), 1000)  
}  
...
```



The code contains a bug that will cause it to always print the number 5 to the console, rather than the expected sequence of numbers from 0 to 4. This is because the `setTimeout` function creates a closure that captures the value of the `i` variable, but the `i` variable is changed before the callback function is executed.



To fix this bug, the code can be modified to create a new variable in the loop that is passed to the `setTimeout` callback function, rather than using the loop variable directly. This will ensure that each callback function captures the correct value of the loop variable, and the expected output will be produced. Here is an example of how the code could be fixed:



Copy code

```
for (var i = 0; i < 5; i++) {  
  // Create a new variable and pass its value to setTimeout  
  const value = i;  
  setTimeout(() => console.log(value), 1000)  
}
```

This code will print the numbers 0 to 4 to the console, as expected. Alternatively, the `let` keyword can be used in place of `var` to declare the loop variable, which will automatically create a new variable for each iteration of the loop and avoid the need to create a new variable manually. This is a common pattern for avoiding closure-related bugs in JavaScript.



Can you write me a 4 paragraph academic essay comparing and contrasting the theories of nationalism of Benedict Anderson and Ernest Gellner?



Benedict Anderson and Ernest Gellner both have theories about the origins and nature of nationalism, but their perspectives differ in key ways. Anderson believes that nationalism is a cultural construct, arising from the development of print capitalism and the creation of imagined communities. Gellner, on the other hand, sees nationalism as a product of modernization and industrialization, with nations being formed as a means of organizing society and providing a shared identity.

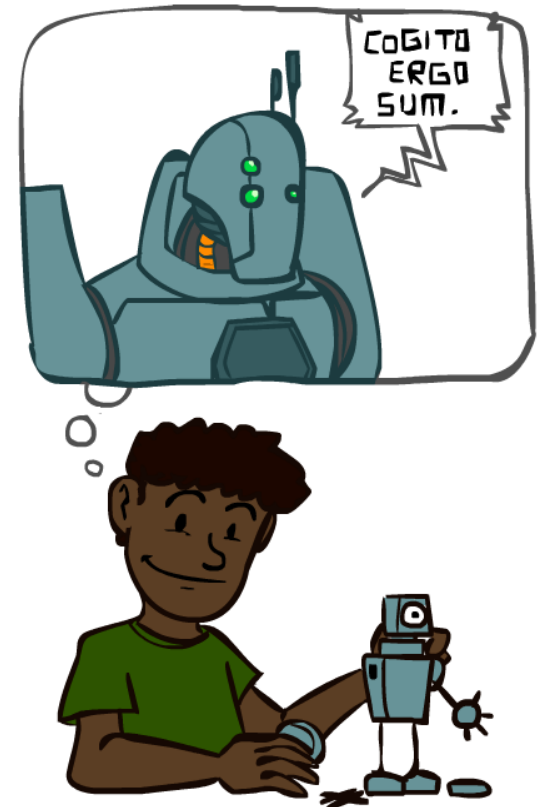
One key difference between the two theories is the role of culture. For Anderson, culture is central to the creation of nationalism, as the spread of print media allows for the creation of imagined communities that transcend physical boundaries. This allows for the development of a national identity based on shared cultural experiences and practices. In contrast, Gellner downplays the importance of culture in the formation of nationalism, arguing that it is primarily a function of economic and political developments. He sees nations as being formed in response to the need for a shared identity and sense of belonging in an industrialized society.

Another point of contrast is the emphasis on agency. Anderson's theory suggests that people actively participate in the construction of national identity, through their engagement with print media and other cultural practices. In contrast, Gellner's theory emphasizes the role of external factors in shaping national identity, with individuals being passive recipients of the national identity imposed on them by the forces of modernization.

Overall, while both Anderson and Gellner provide valuable insights into the origins of nationalism, their theories offer different perspectives on the role of culture and agency in the formation of national identity. Anderson emphasizes the cultural construction of nationalism, while Gellner sees it as a product of modernization and industrialization. Both theories offer valuable insights into the complex process of national identity formation, and can be useful in understanding the dynamics of nationalism in different historical contexts.

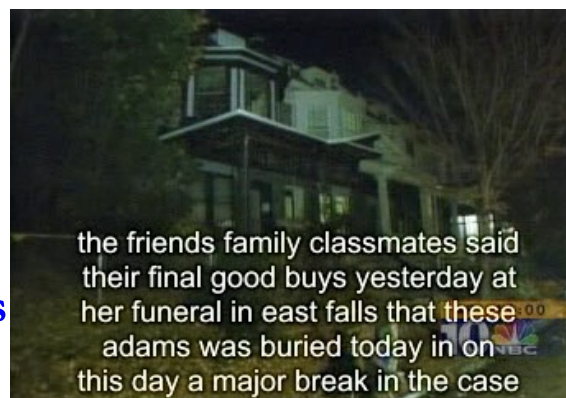
A (Short) History of AI

- **1940-1950: Early days**
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- **1950—70: Excitement: Look, Ma, no hands!**
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
 - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
 - 1965: Robinson's complete algorithm for logical reasoning
- **1970—90: Knowledge-based approaches**
 - 1969—79: Early development of knowledge-based systems
 - 1980—88: Expert systems industry booms
 - 1988—93: Expert systems industry busts: "AI Winter"
- **1990—: Statistical approaches**
 - Resurgence of probability, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?
- **2000—: Where are we now?**



Natural Language

- **Speech technologies (e.g. Siri)**
 - Automatic speech recognition (ASR)
 - Text-to-speech synthesis (TTS)
 - Dialog systems
- **Language processing technologies**
 - Question answering
 - Machine translation



"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

Vidéo Anniversaire de la rébellion tibétaine: la Chine sur ses gardes



"It is impossible for journalists to enter Tibetan areas"

Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959

Video Anniversary of the Tibetan rebellion: China on guard



- Web search
- Text classification, spam filtering, etc...

<https://play.aidungeon.io/>

Computer Vision



"man in black shirt is playing guitar."



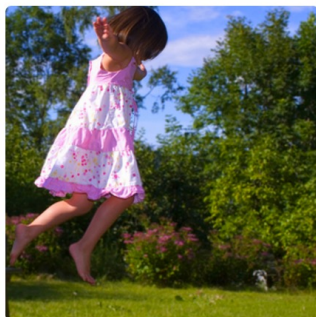
"construction worker in orange safety vest is working on road."



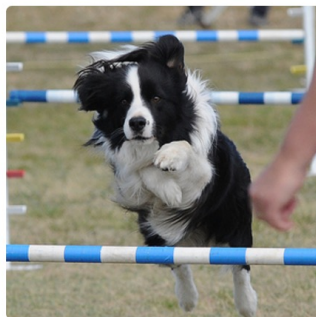
"two young girls are playing with lego toy."



"boy is doing backflip on wakeboard."



"girl in pink dress is jumping in air."



"black and white dog jumps over bar."



"young girl in pink shirt is swinging on swing."



"man in blue wetsuit is surfing on wave."

Karpathy & Fei-Fei, 2015; Donahue et al., 2015; Xu et al, 2015; many more

Generative Computer Vision

TEXT PROMPT

an armchair in the shape of an avocado. an armchair imitating an avocado.

AI-GENERATED
IMAGES



Generative Computer Vision



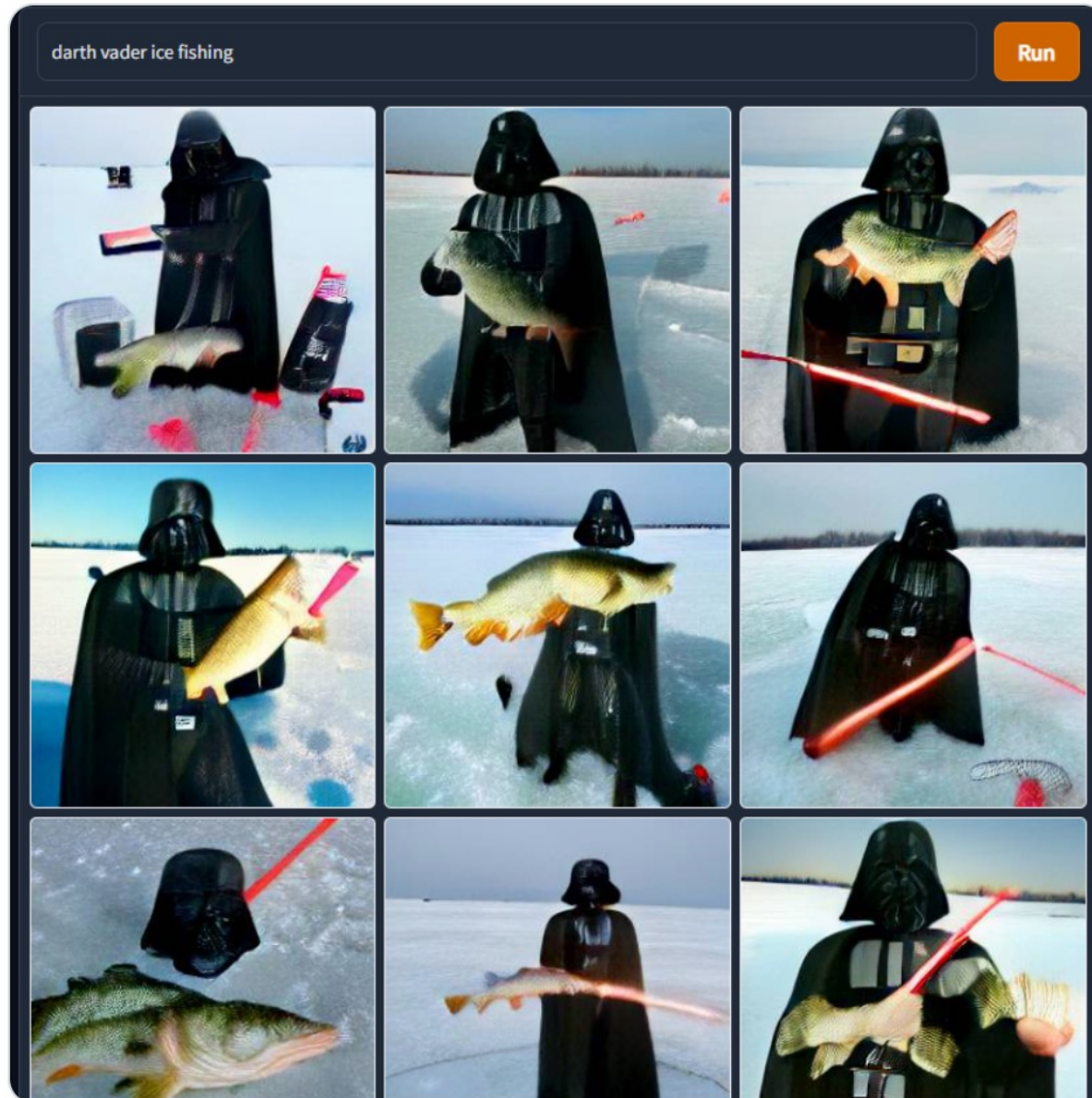
Generative Computer Vision

Thanos looking for his mom in a Walmart

Run



Generative Computer Vision



Game Agents

- **Classic Moment: May, '97: Deep Blue vs. Kasparov**
 - First match won against world champion
 - “Intelligent creative” play
 - 200 million board positions per second
 - Humans understood 99.9 of Deep Blue's moves
 - Can do about the same now with a PC cluster
- **1996: Kasparov Beats Deep Blue**
“I could feel --- I could smell --- a new kind of intelligence across the table.”
- **1997: Deep Blue Beats Kasparov**
“Deep Blue hasn't proven anything.”
-
- **2017: AlphaGo beats #1 ranked Go player Ke Jie**



Google's AlphaGo Soundly Defeated Ke Jie, Humanity's Best Hope To Win A Game Of Go : The Two-Way : NPR

[Visit](#)

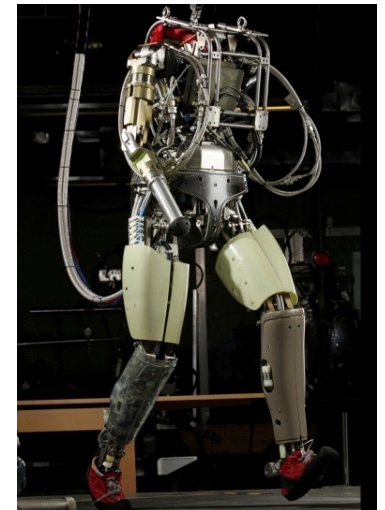
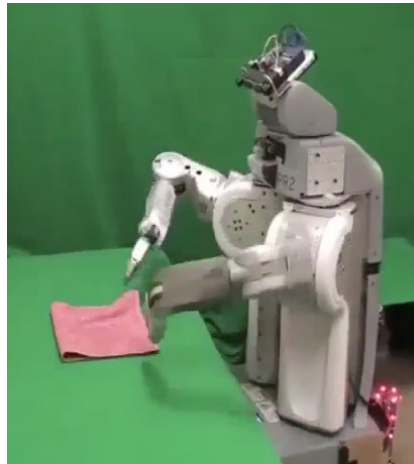
Robotics

- **Robotics**

- Part mech. eng.
- Part AI
- Reality much harder than simulations!

- **Technologies**

- Vehicles
- Rescue
- Help in the home
- Lots of automation...



Robots!

Boston Dynamics: https://www.youtube.com/watch?v=_q8FVd_4rtg

More BD: <https://www.youtube.com/watch?v=uhND7Mvp3f4>

Tesla Robots: <https://www.youtube.com/watch?v=dnJFhHoAeOw>

Ameca conversation using GPT-3:

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