Artificial Intelligence Fundamentals

Course materials

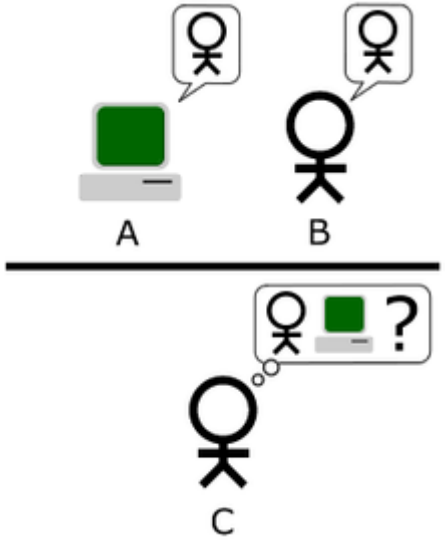
- Online course – Peter Norvig and Sebastian Thrun, “Intro to Artificial Intelligence”, https://www.udacity.com/course/cs271
- Stuart Russell, Peter Norvig, “Artificial Intelligence – A modern approach”,(3rd Edition)
- Online course – Patrick Winston, “Artificial Intelligence”, http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/
- Artificial Intelligence (3rd Edition) Paperback, Patrick Winston, 1992, http://courses.csail.mit.edu/6.034f/ai3/

What is AI ?

Systems that think like humans.	Systems that think rationally.
Systems that act like humans	Systems that act rationally

- a tension exists between approaches centered around humans and approaches centered around rationality
- we are not suggesting that humans are necessarily “irrational” in the sense of “emotionally unstable” or “insane”.
- we often make mistakes; we are not all chess grandmasters even though we may know all the rules of chess

The Turing Test – Can machines think?



- The "standard interpretation" of the Turing Test, in which player C, the interrogator, is tasked with trying to determine which player – A or B – is a computer and which is a human. The interrogator is limited to using the responses to written questions to make the determination

The Turing Test - computer capabilities

- The Turing test
  - Natural language processing
  - Knowledge representation
  - Automated reasoning
  - Machine learning
- The Total Turing Test
  - All of the above
  - Computer Vision
  - Robotics
- Captcha –Completely Automated Public Turing test to tell Computers and Humans Apart

Turing test success marks milestone in computing history

- Q. Hi Eugene. What is your favorite breed of dog?
- A. No, I hate dog's barking.

- Q. What color is your hair?
- A. Red, of course! Oh, what a fruitful conversation;-)

- Q. What is your favorite subject in school?
- A. My friends and teachers say I am totally stupid and untalented, so I only like music lessons because music teacher tells me only that I'm tone-deaf and at least doesn't call me stupid.

- Q: How many roads must a man walk down, before you can call him a man?
- A. No more than four. Some another topic?

- Q. Do you have a girlfriend?
- A. I don't have a girlfriend 'cause I still can't understand what a pleasure to spend my money on somebody else without and instant or delayed result.

http://www.reading.ac.uk/news-and-events/releases/PR583836.aspx

Introduction

- Artificial Intelligence is a branch of Science which deals with helping machines find solutions to complex problems in a more human-like fashion.
- AI is the technique of uncertainty management in computer software. AI is the discipline that you apply when you want to know what to do when you don't know what to do.
- AI has successfully been used in:
  - Medicine
  - Games
  - Robotics
  - Entertainment
  - Many more applications that makes your computer software smart

AI through history

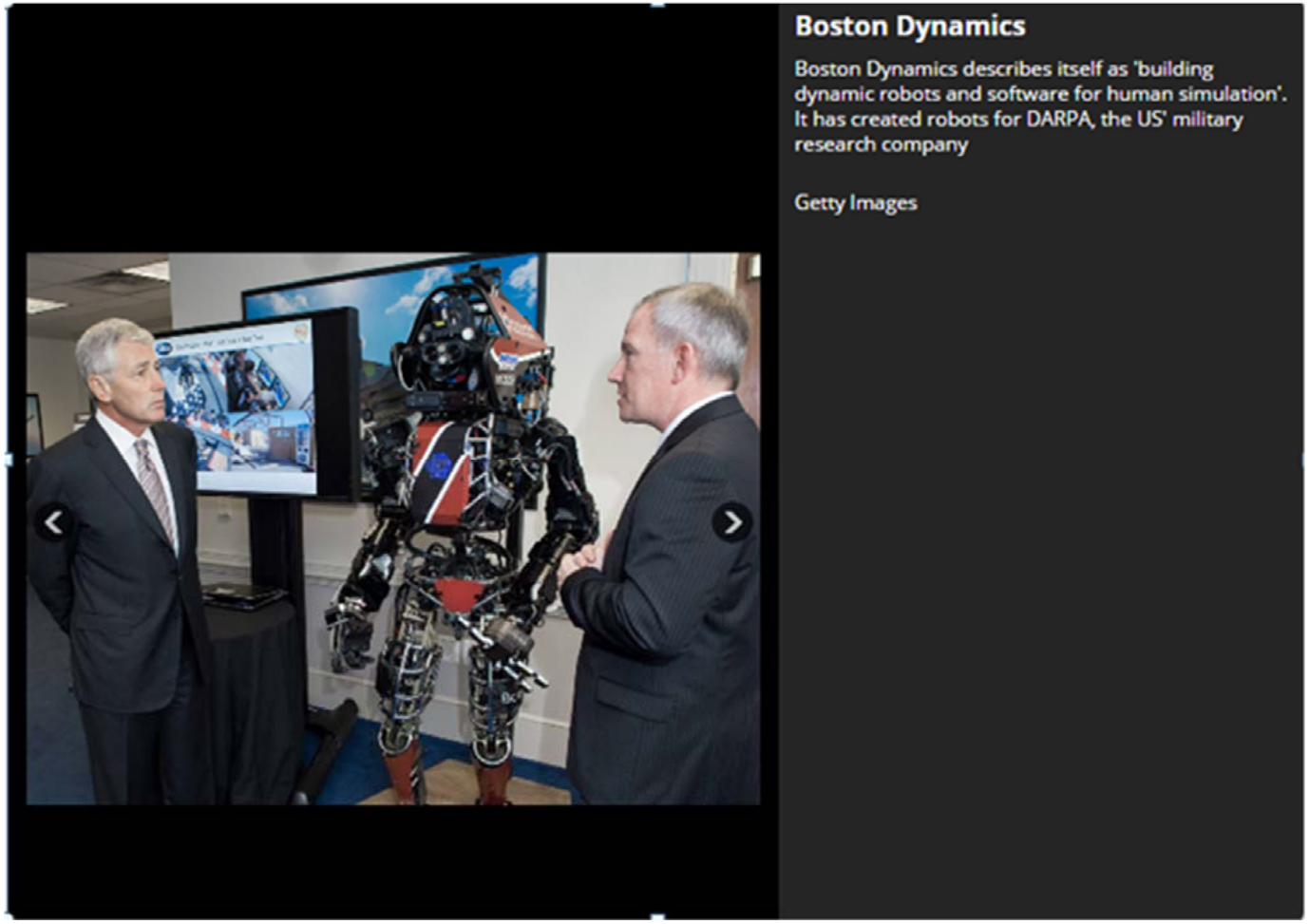
Deep Blue beats Kasparov

Deep Blue, a computer created by IBM, won a match against world champion Garry Kasparov in 1997. The computer could evaluate 200 million positions per second, and Kasparov accused it of cheating after the match was finished

Getty Images

http://www.independent.co.uk/

AI through history



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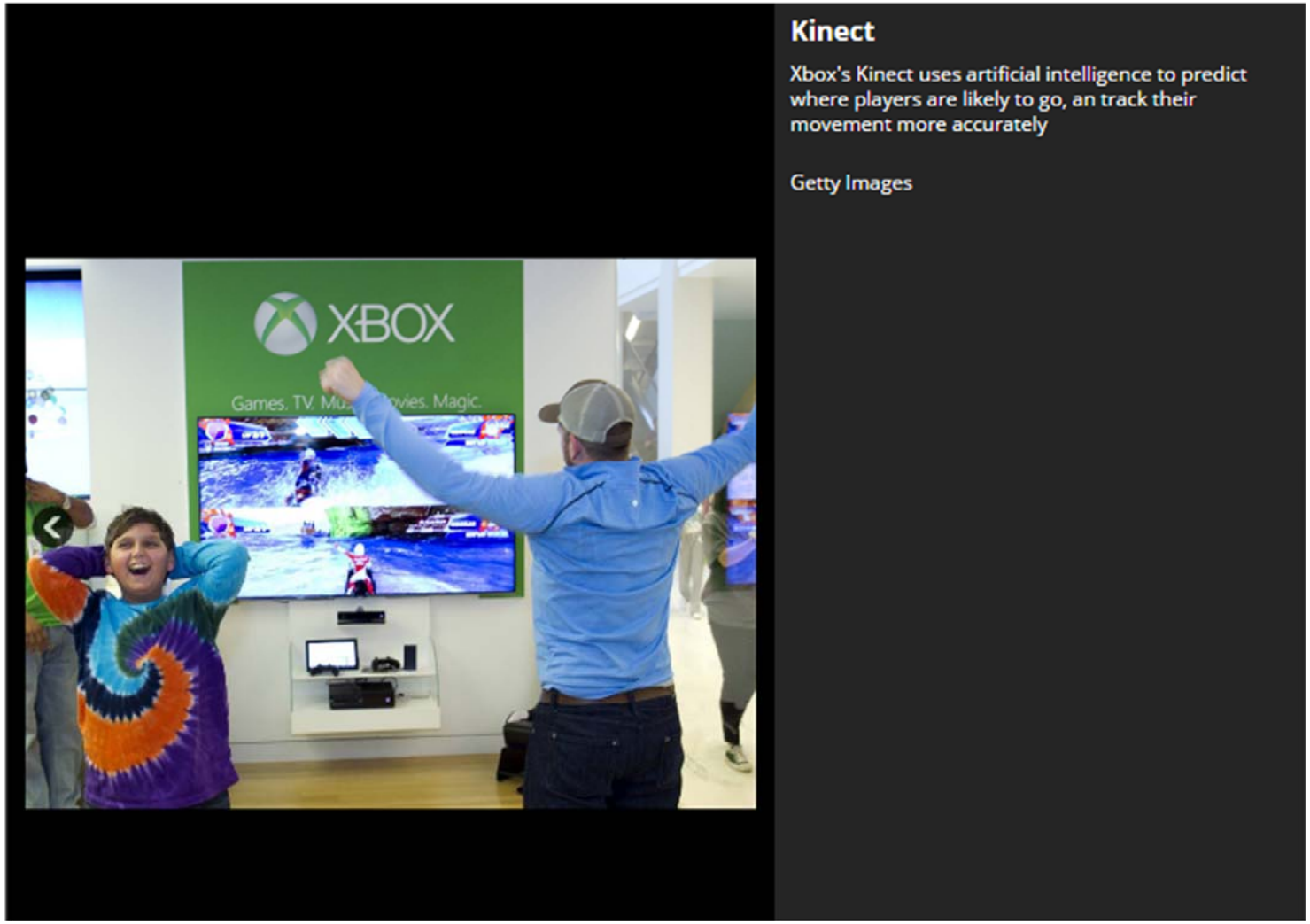

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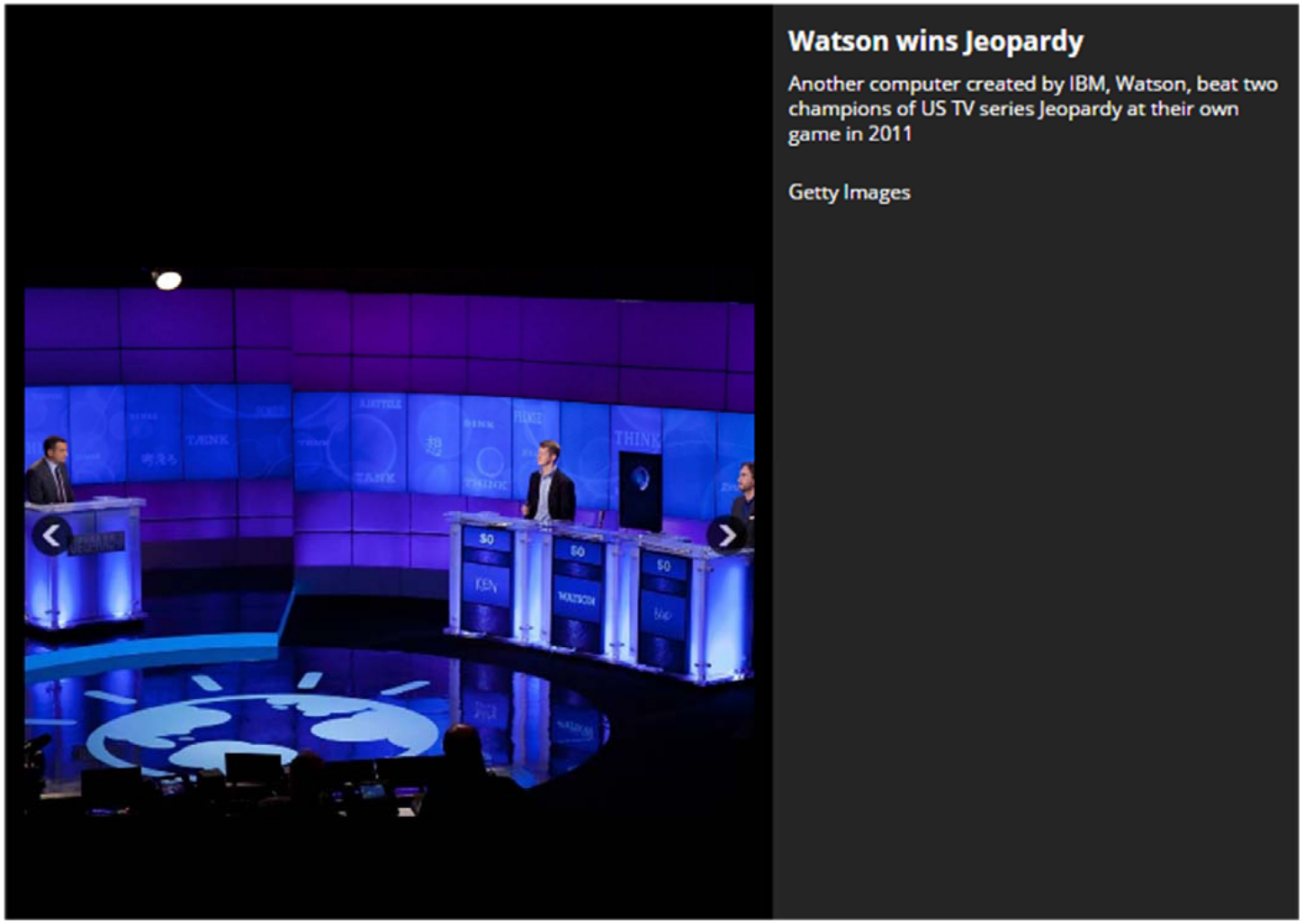

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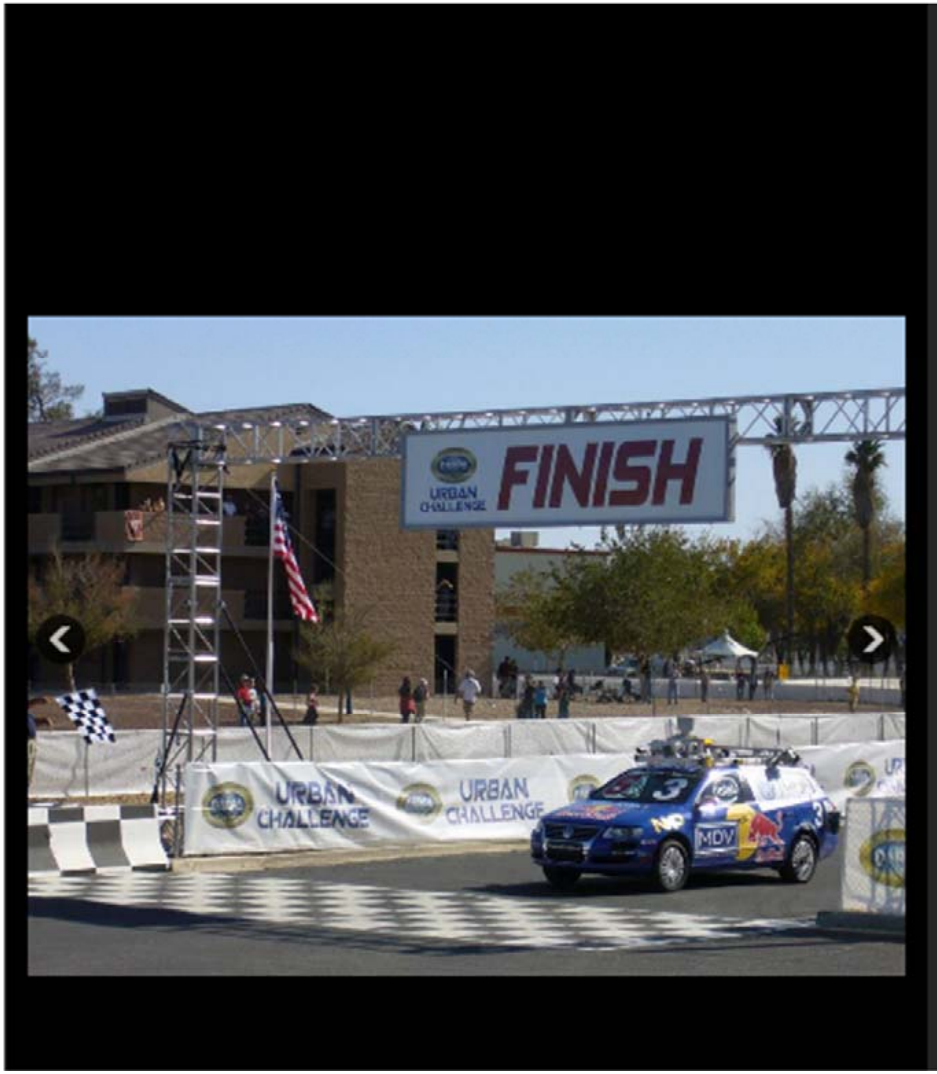
AI through history



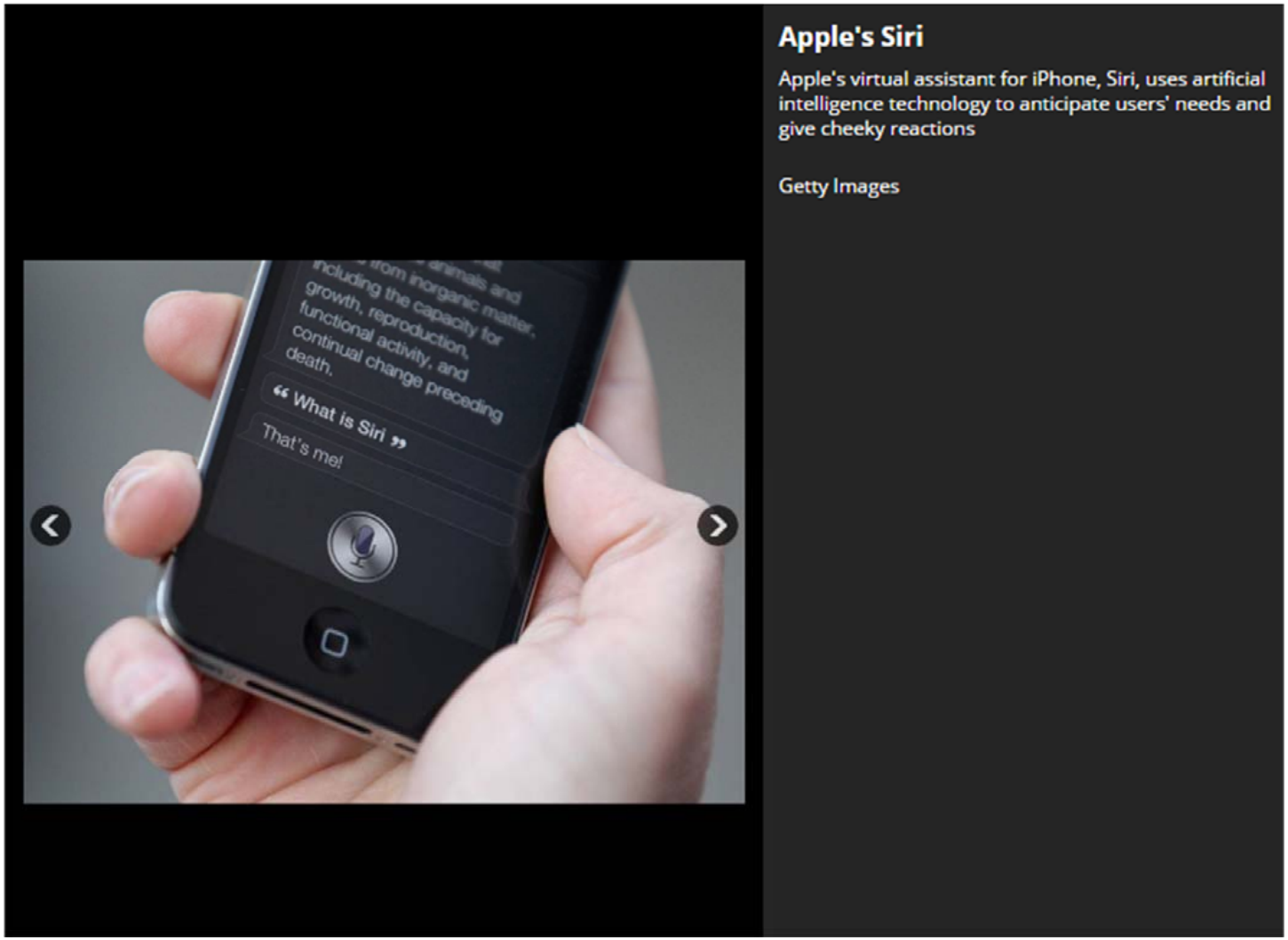
DARPA Urban Challenge

The DARPA Urban Challenge, set up by the US Department of Defense, challenges driverless cars to navigate a 60 mile course in an urban environment that simulates guerilla warfare

Getty Images

http://www.independent.co.uk/

AI through history



http://www.independent.co.uk/

AI now

AlphaGo: using machine learning to master the ancient game of Go

- There are 1,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000 possible positions
- that’s more than the number of atoms in the universe
- more than a googol (10^{100}) times larger than chess.
- https://www.alphagomovie.com/

Versions	Hardware	Elo rating	Matches
AlphaGo Fan	176 GPUs, distributed	3144	5:0 against Fan Hui
AlphaGo Lee	48 TPUs,distributed	3739	4:1 against Lee Sedol
AlphaGo Master	4 TPUs, single machine	4858	60:0 against professional players; Future of Go Summit
AlphaGo Zero	4 TPUs, single machine	5185	100:0 against AlphaGo Lee 89:11 against AlphaGo Master
AlphaZero	4 TPUs, single machine	N/A	60:40 against AlphaGo Zero

AI now

- Adobe demos “photoshop for audio,” lets you edit speech as easily as text https://arstechnica.com/information-technology/2016/11/adobe-voco-photoshop-for-audio-speech-editing/
- Amazon Echo
- Amazon Go - http://www.vox.com/new-money/2016/12/5/13842712/amazon-go-no-checkout
- Google Brain Super-resolution - https://arstechnica.com/information-technology/2017/02/google-brain-super-resolution-zoom-enhance/

AI now

- Boston Dynamics in present
- https://www.cnbc.com/video/2018/05/10/boston-dynamics-new-video-atlas-and-spotmini-have-new-tricks.html
- Google AI creates its own 'child' AI that's more advanced than systems built by humans – AutoML project (http://www.independent.co.uk/life-style/gadgets-and-tech/news/google-child-ai-bot-nasnet-automl-machine-learning-artificial-intelligence-a8093201.html)

AI – friend or foe?

Bill Gates - “First the machines will do a lot of jobs for us and not be super intelligent. A few decades after that though the intelligence is strong enough to be a concern. I don’t understand why some peoples are not concerned.”

Elon Musk – donates $10M to keep AI from turning Evil

Stephen Hawking – “Once humans develop artificial intelligence, it would take off on its own and re-design itself at an ever increasing rate. Humans, who are limited by slow biological evolution, couldn't compete and would be superceded.”

Stuart Russell –“AI potential to benefit humanity is enormous, even in defense. But allowing machines to choose to kill humans will be devastating to our security and freedom.” https://www.youtube.com/watch?v=HipTO_7mUOw

AI – friend or foe?

Google – incorporates AI into the very core of its current and future technologies. AI is no longer a subject for academia; it's out there in the consumer market.

You could ask Facebook "Which of my friends had babies recently?" and get a reasonable answer, complete with photos, even if the new parents had never explicitly said that a baby was born. (It can already figure out, who you're dating, and when you might break up, even if the relationship isn't listed on Facebook.)

SwiftKey™

Ben Medlock – "We need to discuss the likely ethical implications, from data security when machines further analyze our lives, to whether self-driving cars should prioritize the safety of the driver . But are we currently at risk of being extinguished by our own creations? Not for a long time in my view."

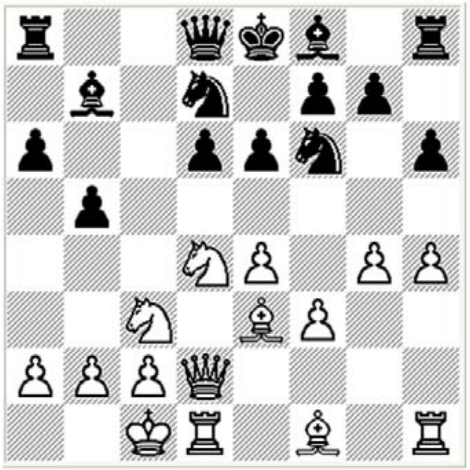
Building safe artificial intelligence

- https://medium.com/@deepmindsafetyresearch/building-safe-artificial-intelligence-52f5f75058f1
- https://www.theregister.co.uk/2017/02/16/deepmind_shows_ai_can_turn_aggressive/
- https://deepmind.com/blog/specifying-ai-safety-problems/

Terminology

- FULLY vs. PARTIALLY OBSERVABLE

Game of Chess



In any point of time, the information is completely sufficient to make the optimal decision.

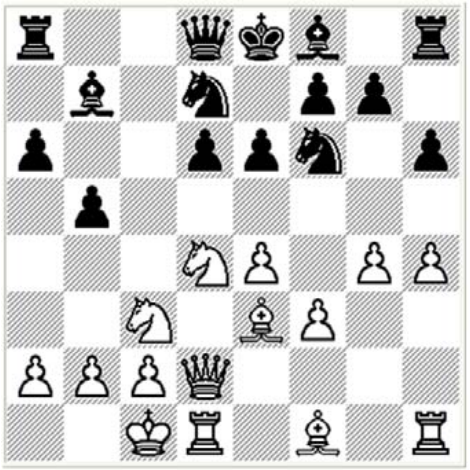
Game of Poker

You need memory to make the optimal decision

Terminology

- DETERMINISTIC vs. STOCHASTIC

Game of Chess



The taken actions determine the outcome in an unique way. (e.g. in chess no randomness is involved in the development of the future states)

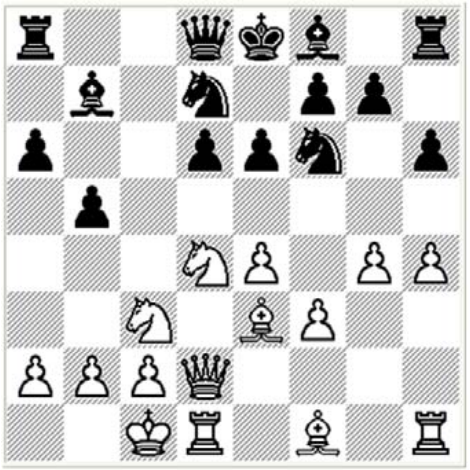
Games with dices

Even if movements are still deterministic, the outcome of an action involves the dices (a random variable), so the output is randomness.

Terminology

- DISCRETE vs. CONTINUOUS

Game of Chess



Involves a finite set of actions and outcomes.

Football

Involves an infinite actions and outcomes (depends of angle, acceleration, etc.).

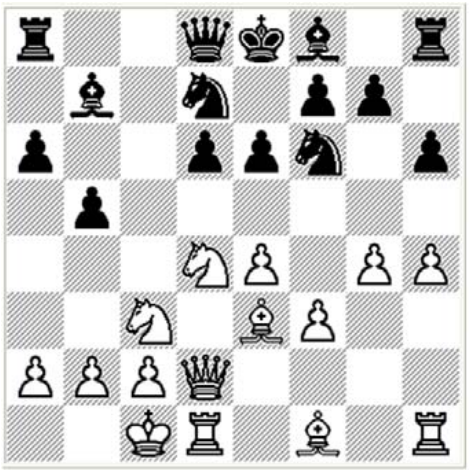
Terminology

- BENIGN vs. ADVERSARIAL environment

Whether prediction

Environment might be random (stochastic) but he has no objectives on its own.

Many games

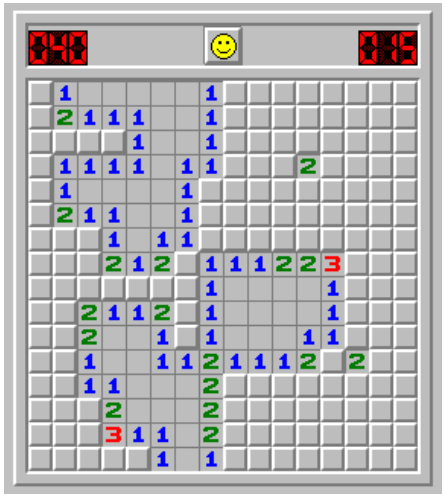


It's interested in "making your life worst".

QUIZ

	Partially observable	Stochastic	Continuous	Adversarial
Checkers				
Poker				
Autonomous robot car				
Minesweeper				

Checkers



Minesweeper

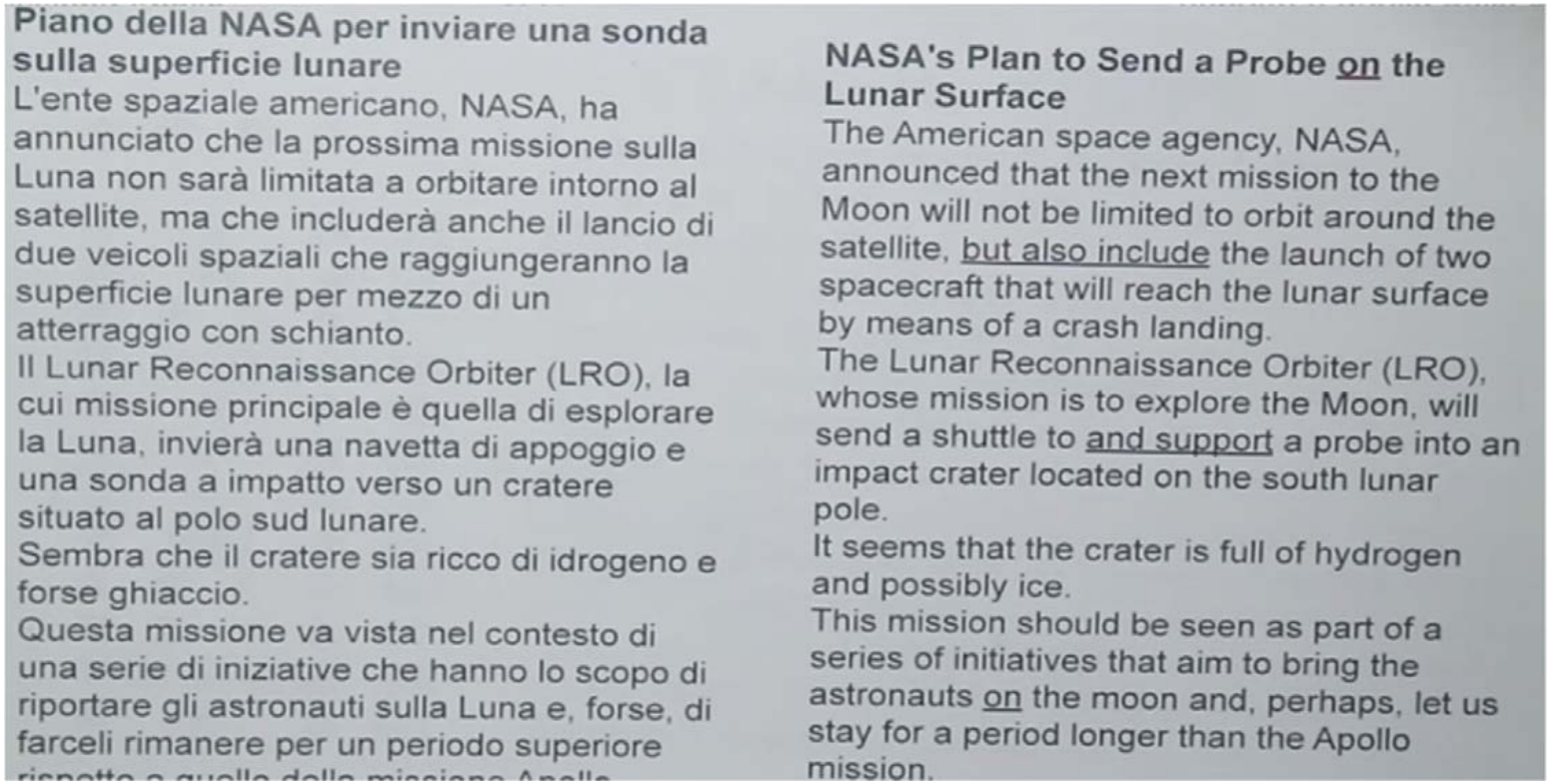
QUIZ ANSWERS

	Partially observable	Stochastic	Continuous	Adversarial
Checkers				●
Poker	●	●		●
Autonomous robot car	●	●	●	Depends where you live ☺
Minesweeper	●	Depends		

Example of AI – Machine Translation

- Google machine translation system
- Supports 90 languages
- Before Oct. 2007, Google Translate was based on SYSTRAN (uses Rule-based machine translation – RbMT)
- Since Oct. 2007 Google Translate uses statistical machine translation

How it works ?



Piano della NASA per inviare una sonda sulla superficie lunare

L'ente spaziale americano, NASA, ha annunciato che la prossima missione sulla Luna non sarà limitata a orbitare intorno al satellite, ma che includerà anche il lancio di due veicoli spaziali che raggiungeranno la superficie lunare per mezzo di un atterraggio con schianto.

Il Lunar Reconnaissance Orbiter (LRO), la cui missione principale è quella di esplorare la Luna, invierà una navetta di appoggio e una sonda a impatto verso un cratere situato al polo sud lunare.

Sembra che il cratere sia ricco di idrogeno e forse ghiaccio.

Questa missione va vista nel contesto di una serie di iniziative che hanno lo scopo di riportare gli astronauti sulla Luna e, forse, di farceli rimanere per un periodo superiore

NASA's Plan to Send a Probe on the Lunar Surface

The American space agency, NASA, announced that the next mission to the Moon will not be limited to orbit around the satellite, but also include the launch of two spacecraft that will reach the lunar surface by means of a crash landing.

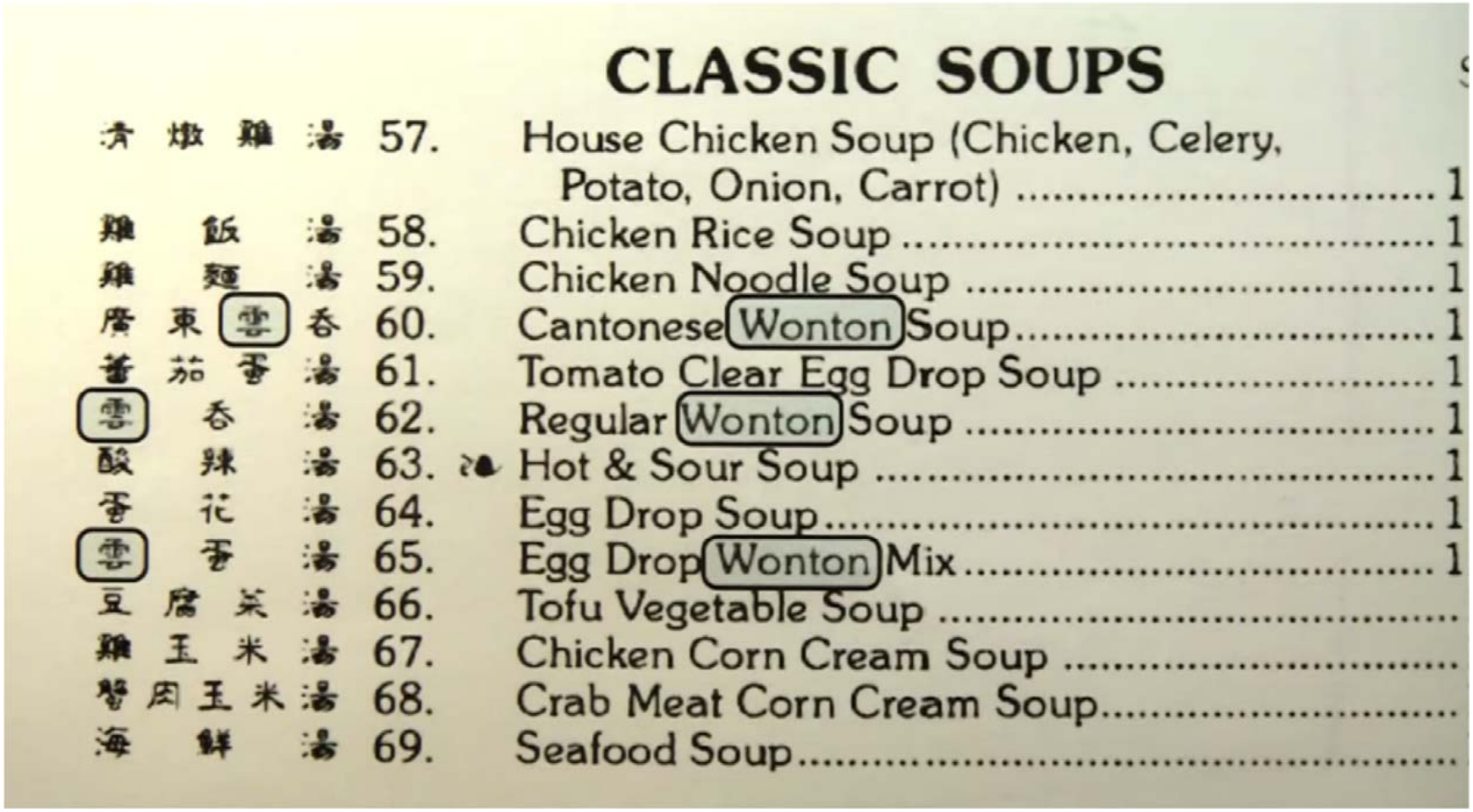
The Lunar Reconnaissance Orbiter (LRO), whose mission is to explore the Moon, will send a shuttle to and support a probe into an impact crater located on the south lunar pole.

It seems that the crater is full of hydrogen and possibly ice.

This mission should be seen as part of a series of initiatives that aim to bring the astronauts on the moon and, perhaps, let us stay for a period longer than the Apollo mission.

- Find newspaper that publishes 2 editions, and now we have examples of translations
- The process has 2 parts: offline (build the model based on examples) and online (given another text we use the model to translate it)

Chinese restaurant



CLASSIC SOUPS

清燉雞湯	57.	House Chicken Soup (Chicken, Celery, Potato, Onion, Carrot) 1
雞飯湯	58.	Chicken Rice Soup 1
雞麵湯	59.	Chicken Noodle Soup 1
廣東雲吞	60.	Cantonese Wonton Soup 1
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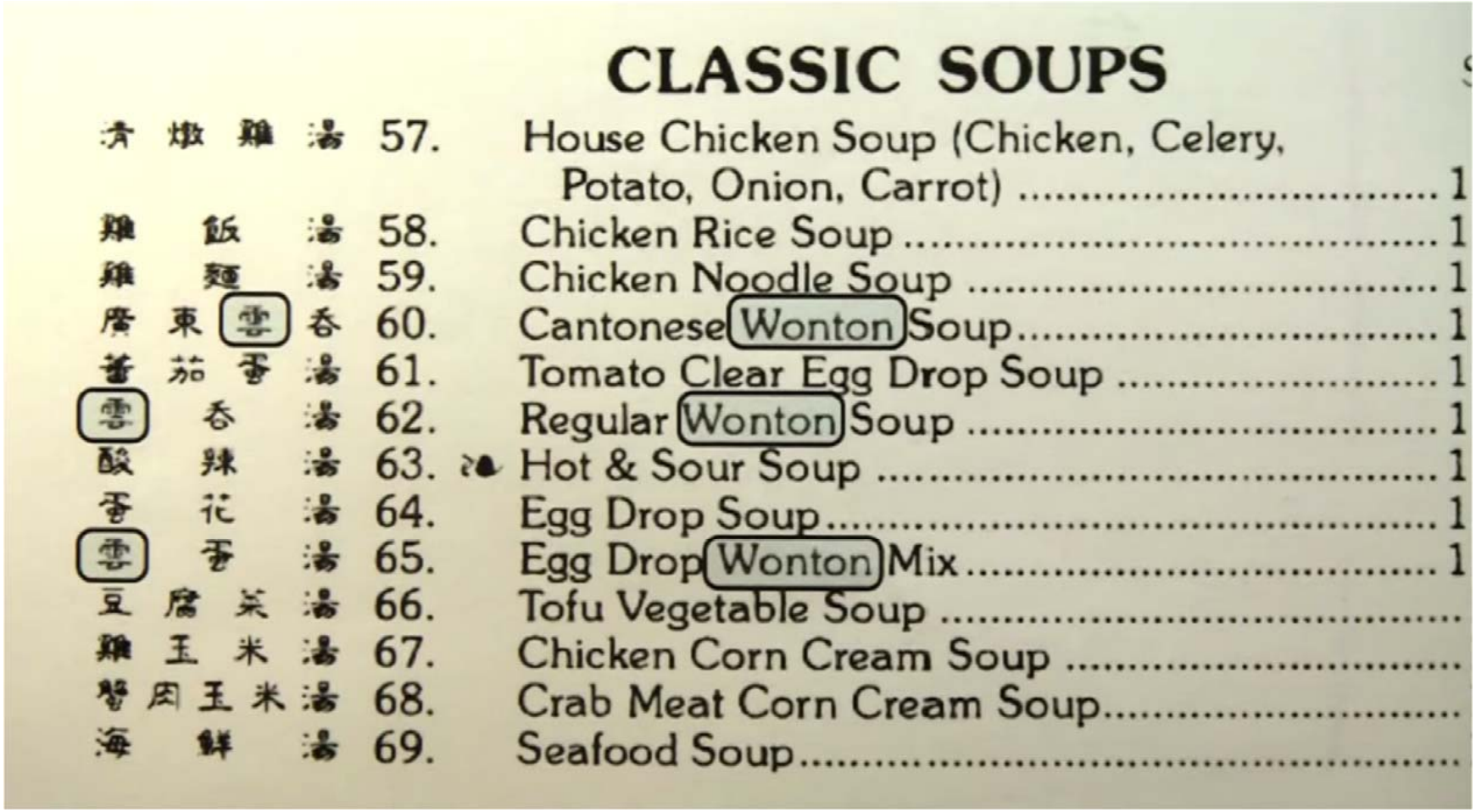
雲吞湯	62.	Regular Wonton Soup 1
酸辣湯	63.	Hot & Sour Soup 1
雪花湯	64.	Egg Drop Soup 1
雲雪湯	65.	Egg Drop Wonton Mix 1
豆腐菜湯	66.	Tofu Vegetable Soup .....
雞玉米湯	67.	Chicken Corn Cream Soup .....
蟹肉玉米湯	68.	Crab Meat Corn Cream Soup .....
海鮮湯	69.	Seafood Soup .....

QUIZ



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- Find the chinese character for **chicken, corn cream**
- How about the **soup ?**

Chinese restaurant – find chinese character for chicken

CLASSIC SOUPS

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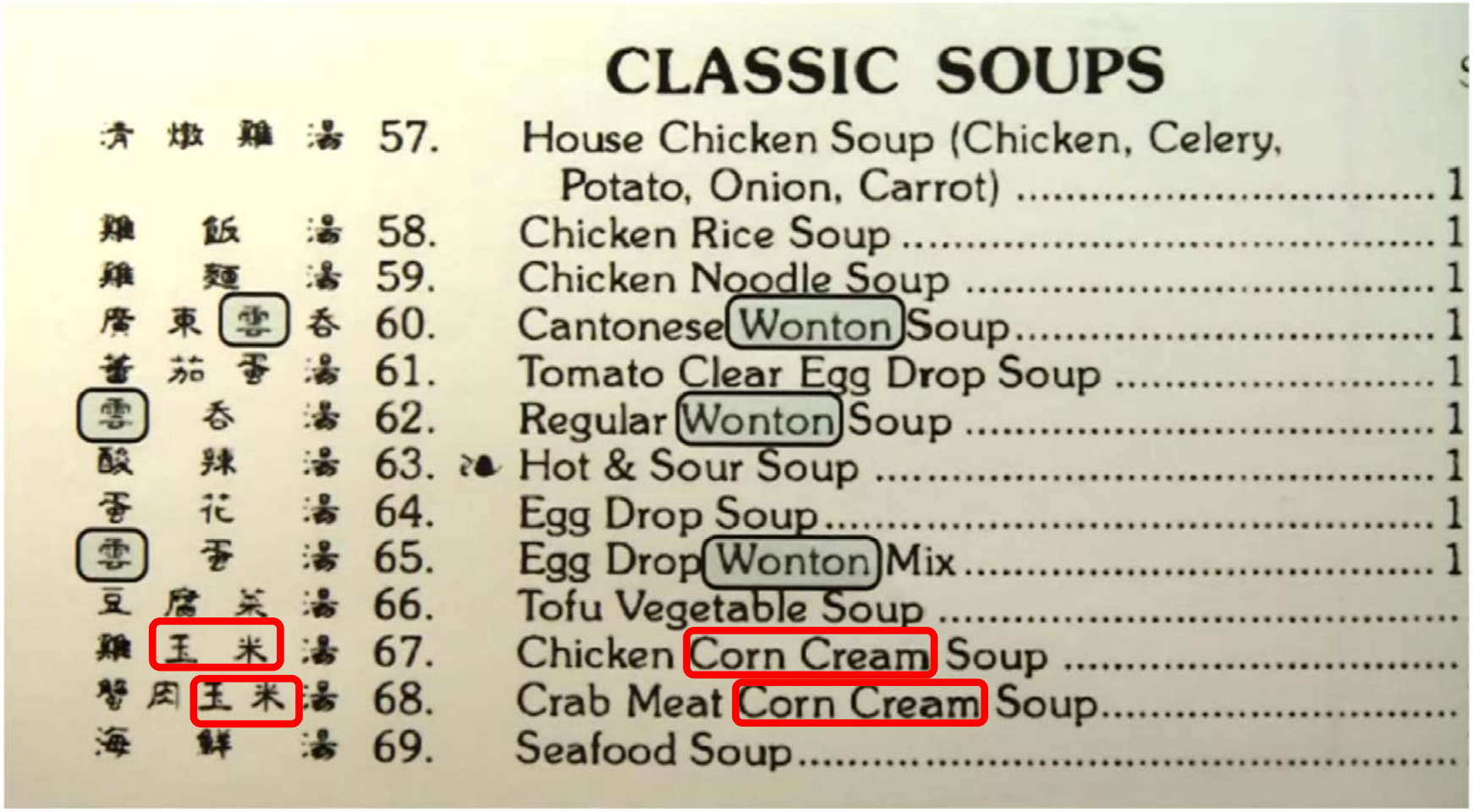
Chinese restaurant – find chinese character for corn cream



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Chinese restaurant – find chinese character for soup

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We don’t have a 100% correlation