

Introduction

COEN166
Artificial Intelligence

What is AI?

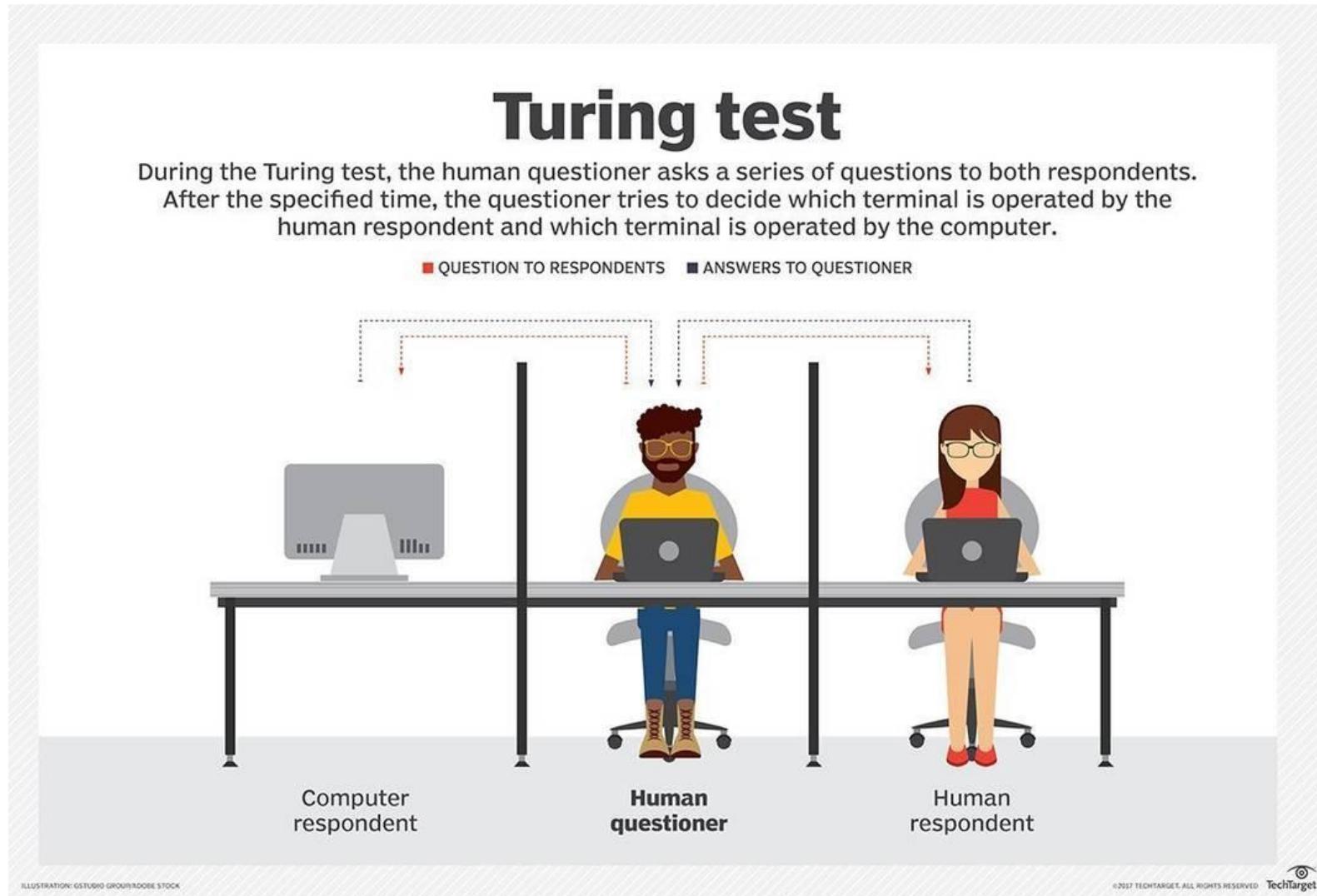
- What is Artificial Intelligence?
- Artificial?
 - Computers, machines, ...
- Intelligence?

Turing Test

- How to evaluate that a machine system is intelligent?
- Alan Turing created the Turing Test (1950-1952)
- **Basic idea**
 - I don't have a good definition of “intelligence”
 - However, I know humans are intelligent
 - If an entity can masquerade as human so well that I can't distinguish the difference, I will say this entity is intelligent



Turing Test



A machine has passed the test if 30% of human judges fail to distinguish it from humans

Turing Test

- [The Loebner Prize](#): the annual competition on Turing Test (launched in 1990)
- Prediction: By 2000, 30% chance of fooling a person for 5 mins
- First AI that passed the Turing Test
 - Eugene Goostman (2014)



Loebner Prize:
awarded annually
to best AI program

Examples of Artificial Intelligence

- Think about some examples of AI?
 - Computer Games
 - Robotics
 - Smart Devices
 - ...
- What capabilities do they have?

Game Playing: AlphaGo

- AlphaGo beat Korean grandmaster Lee Sedol (2016)
 - Google DeepMind
 - 4 games to 1
- Capabilities:
 - automatic reasoning, decision making



Chatbots

- ELIZA (1966): the first chatbot in the history
 - To mimic psychotherapist
 - Convert declarative sentences to questions
 - Does not understand the semantics

Conversation with ELIZA:

You: I feel bad these days.

Eliza: Do you often feel bad these days?

You: Yes, but I don't know how to make myself happy.

Eliza: Why do you not know what to make yourself happy?

You: Will you tell me something?

Eliza: Oh, I tell you something.

You: Tell me then.

Eliza: Can you elaborate on that?

You: No, I just feel unhappy. Maybe I am worried about something.

Eliza: How long have you been worried about something?

Chatbots

- ALICE: 2000 and 2001 Loebner Prize winner, designed by Richard S. Wallace
 - Has a much larger and better **knowledge base** than ELIZA
 - Cannot understand the dialogue if it is too jumpy, has omitted dialogue, or is too complicated
- **Capabilities**
 - Natural language processing

Chatbots



Valerie

- Valerie: CMU Robot Receptionist
- **Capabilities:** Natural language processing

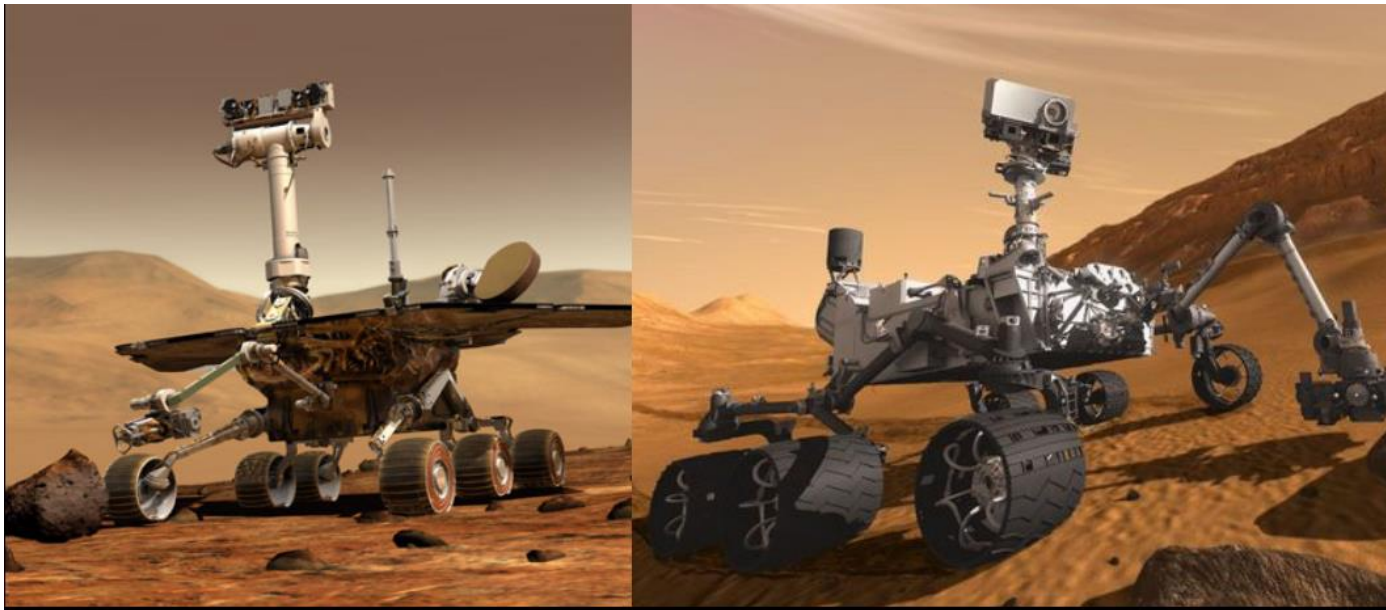
Cleaning Robots

- iRobot
- Roomba: Autonomous home vacuum cleaner
- Capabilities:
 - mobility/robotics (can move about), perception (achieved by infra-red sensors to detect walls and obstacles), planning



Space Exploration Robots

- Mars-rovers: motor vehicle that travels across the surface of Mars, searching for evidence of ancient life, water, and minerals
- Capabilities:
 - visual perception, robotics (manipulate objects and move about), planning, learning (adapt to new circumstances)



Machine Translation

- The use of software to translate text or speech from one language to another.
- The famous Russian saying: “The spirit is willing but the flesh is weak.”
 - Actual meaning: someone has good intentions but fails to live up to them.
- Early days machine translation:
 - The vodka is good but the meat is rotten.
- Capabilities:
 - Natural language understanding, natural language processing

Virtual Assistant

- Apple Siri, Amazon Alexa
- Capabilities:
 - Speech recognition, natural language understanding and processing



Face ID on iPhone X

- Unlocks the phone using infrared and visible light images to uniquely identify your face
- **Capabilities:**
 - Visual perception, image processing, learning (learns a pattern such that it can recognize a newly captured face image)



What Capabilities Does AI Have?

- Capabilities of AI
 - Reasoning, decision making
 - Learning, planning
 - Visual recognition
 - Robotics
 - Speech recognition
 - Natural language processing
- How to summarize these capabilities?
 - Artificial Intelligence is the science that makes machines to think humanly, act humanly, think rationally, and act rationally.

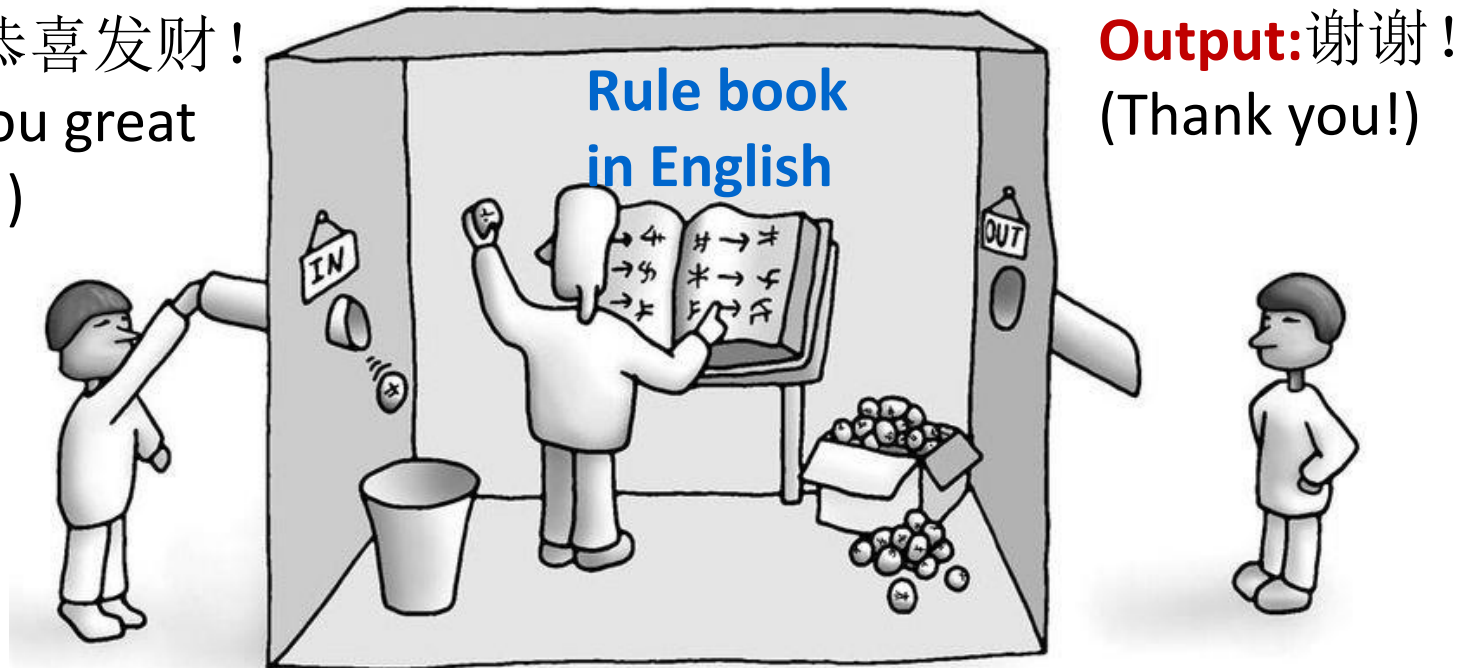
Thinking Humanly

- How do humans think?
 - Human mind
 - A set of cognitive faculties: consciousness, perception, thinking, judgment, language, and memory
 - Be able to: make decisions, solve problems, learn things
- Can we make machines with “minds”?
 - Such that they can make decisions, solve problems, and learn things
- Strong AI vs Weak AI
 - Strong AI: is the artificial intelligence that has a mind in exactly the same sense human beings have minds.
 - Weak AI: machines can demonstrate intelligence, but do not necessarily have a mind, mental states or consciousness.

Chinese Room Argument

- John Searle, “Minds, Brains, and Programs”, 1980
 - A program cannot give a computer a “mind”, “understanding” or “consciousness”, regardless of how human-like the program may make the computer behave

Input: 恭喜发财!
(Wish you great fortune!)

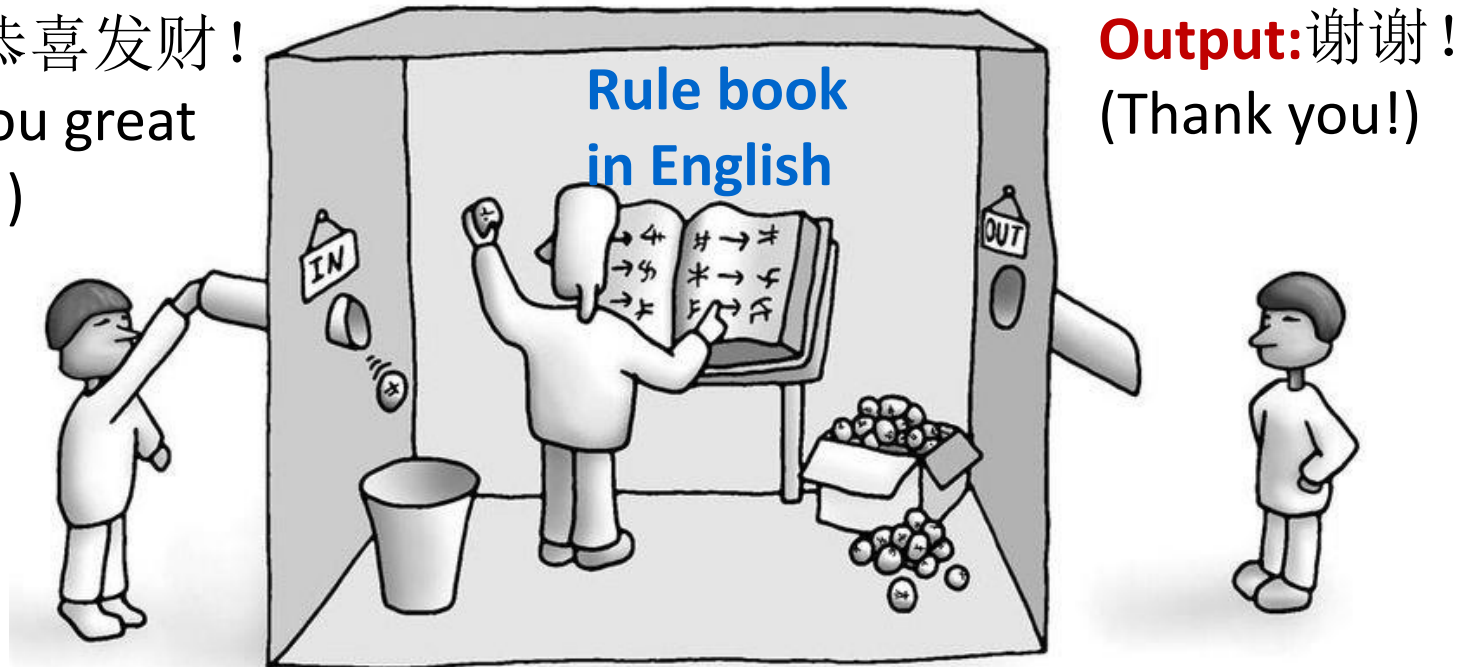


Output: 谢谢!
(Thank you!)

Chinese Room Argument

- What is the problem here?
 - Syntactic conversion? Yes.
 - Semantic understanding? No.

Input: 恭喜发财!
(Wish you great fortune!)



Output: 谢谢!
(Thank you!)

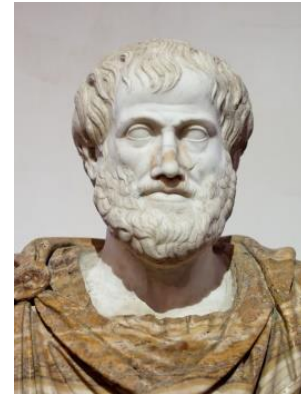
Acting Humanly

- Tasks that people do? e.g.
 - Sing and dance
 - Play soccer
 - Do surgeries
 - Navigate in a building
 - Assemble parts
 - ...
- AI: build machines that perform the above tasks automatically

Thinking rationally

- Make machines that use logical reasoning and/or computation to solve problems, make decisions, and learn things.
- Example of logical reasoning:
 - Aristotle's syllogisms:

“Socrates is a man; all men are mortal;
therefore, Socrates is mortal”.



Acting rationally

- **Rational behavior:** doing the right thing
- What is the “right thing”?
 - The action/behavior that achieves the goal

Example: The goal is to select the route from one city to another

- Achieve the best performance, given available information

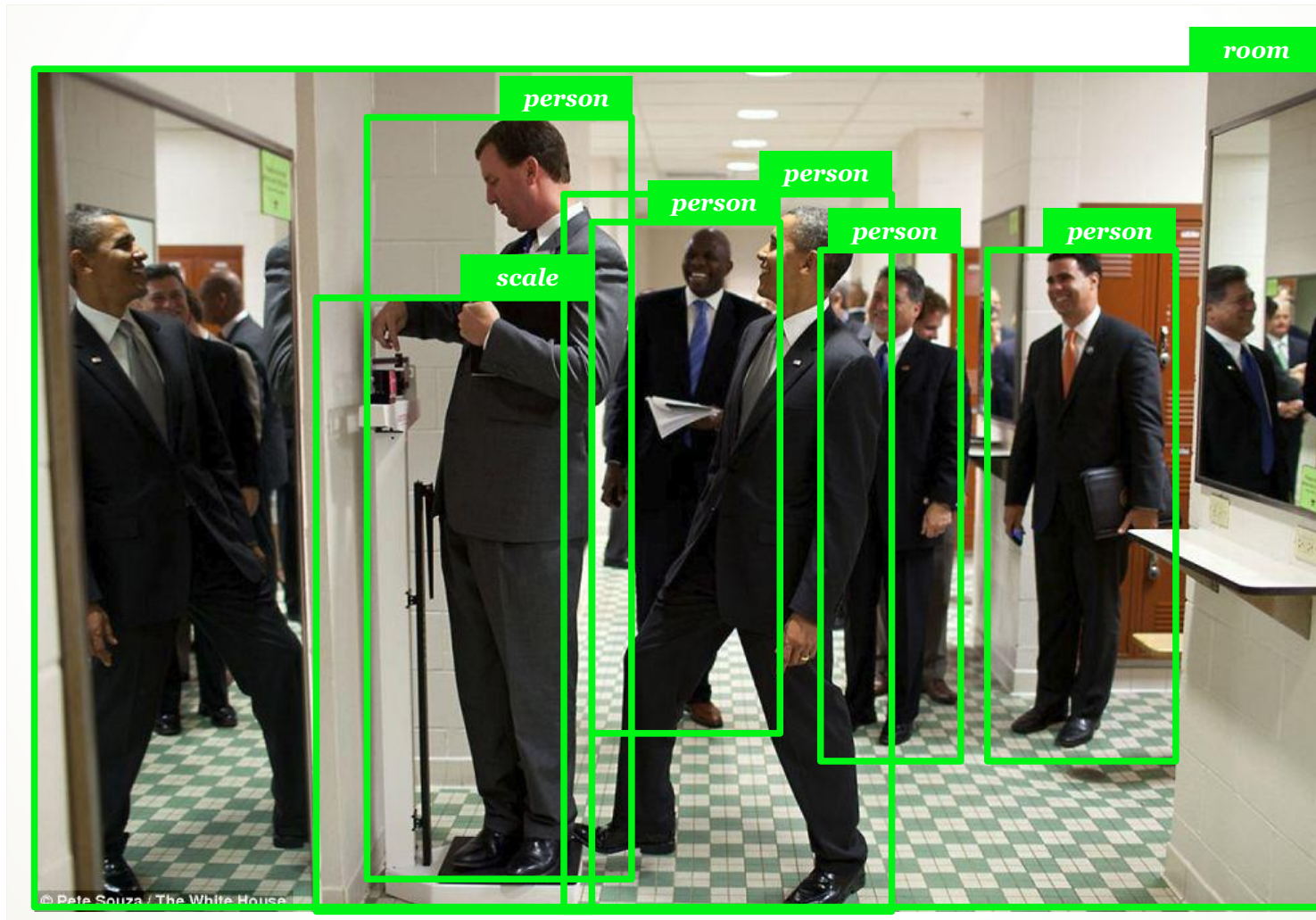
Example: When selecting the route, we want to minimize the path cost

The State of the Art: Visual Recognition

- ImageNet
 - A large visual database for visual object recognition research
- ImageNet Large Scale Visual Recognition Challenge (ILSVRC)
 - An annual contest (2010-2017)
 - Breakthrough in 2012 (AlexNet): the beginning of the deep learning revolution

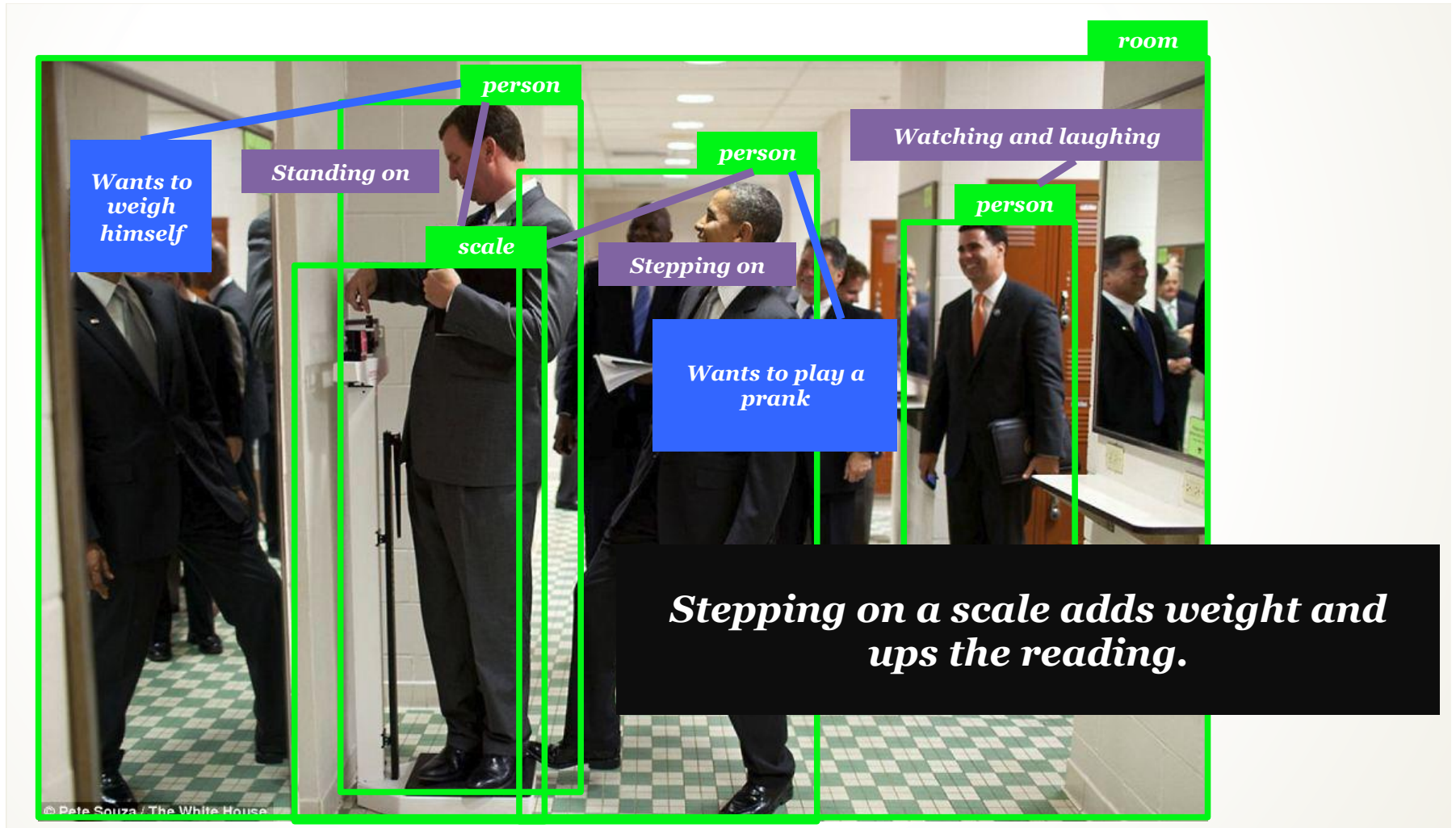
The State of the Art: Visual Recognition

- Moving from object recognition...



The State of the Art: Visual Recognition

- ... to human-level understanding



The State of the Art: Visual Recognition

- Image Captioning (Success)



A cat sitting on a suitcase on the floor



A cat is sitting on a tree branch



A dog is running in the grass with a frisbee



A white teddy bear sitting in the grass



Two people walking on the beach with surfboards



A tennis player in action on the court



Two giraffes standing in a grassy field



A man riding a dirt bike on a dirt track

The State of the Art: Visual Recognition

- Image Captioning (Failure)



A woman is holding a cat in her hand



A person holding a computer mouse on a desk



A woman standing on a beach holding a surfboard



A bird is perched on a tree branch



A man in a baseball uniform throwing a ball

The State of the Art

- Autonomous Vehicles
- Level 0
- No automation
- The driver performs all driving tasks



The State of the Art

- Autonomous Vehicles
- Level 1
- Driver assistance
- Vehicle is controlled by the driver
- Driving assist features
 - Anti-lock Break System (ABS)
 - Adaptive Cruise Control (ACC)
 - Lane Keeping Assistance...



The State of the Art

- Autonomous Vehicles
- Level 2
- Partial automation
- Vehicle has combined automated functions
 - Acceleration
 - Steering
- Driver must remain engaged with the driving task and monitor the environment at all times



The State of the Art

- Autonomous Vehicles
- Level 3
- Conditional automation
- Driver is a necessity, but is not required to monitor the environment.
- The driver must be ready to take control of the vehicle with notice.



The State of the Art

- Autonomous Vehicles
- Level 4
- High automation
- The vehicle is capable of performing all driving functions **under certain conditions**
 - e.g. only in limited spatial areas ([geofenced](#))
 - e.g. under special circumstances, like traffic jams
- No take over request
- The driver need to control the vehicle outside these areas or circumstances



The State of the Art

- Autonomous Vehicles
- Level 5
- Full automation
- Driverless
- The vehicle is capable of performing all driving functions under all conditions
- e.g. a robotic taxi



The State of the Art

- Currently, Level 4 is achieved
- Level 5 still has a long way to go
- Example



The State of the Art: Delivery Robots

- Robby Technologies
- Build self-driving robots to deliver food, groceries, and packages
- <https://www.youtube.com/watch?v=6F2MW9Xt4nk>



The State of the Art: Humanoid Robotics

- Boston Dynamics

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

- Spot Launch:

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

The State of the Art: Automated Retail

- Amazon Go
 - Just Walk Out technology
 - Sensors on shelves and ceiling cameras
 - <https://www.youtube.com/watch?v=NrmMk1Myrxc>

