

Machine Learning

What is Machine Learning?

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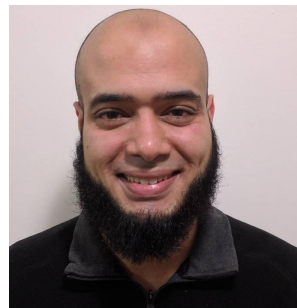
Teaching, Training and Coaching for more than a decade!

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Motivation

Is this a spam email?

- Have you ever received an email promising you a large sum of money?

CONGRATULATIONS! You just won \$100,000!!!!!!!

to me ▼

Greetings!

You're one of the lucky winners of our annual lottery for \$100,000.

Several winners were selected from your area, and only one will receive the money.
To confirm you've received this email, deposit \$5 to the [bank account at this URL](#).

HURRY UP BEFORE YOUR NEIGHBOR CLAIMS YOUR CASH AWARD.

This is your lucky day,
Barney Stinson

Is this a spam email?

- Given the text of an email, how can we **classify** it as spam or not?
- Image that we've already analyzed hundreds of spam emails related to money or bank accounts
- The analysis team found 8 types of fraudulent emails:
 - Overpayment Scams
 - Check-Cashing Scams
 - Unsolicited Check Fraud
 - Automatic Withdrawal Scams
 - Phishing Scams
 - Government Imposter Scams
 - Charity Scams
 - Employment Scams

Is this a spam email?

- One of the programmers suggests writing a code that checks an incoming email for the triplet of words commonly used in each type of scam
 - E.g. overpayment scam ⇒ credit card, bank, urgent
- Our code just looks to see whether the triplet of words are all included
 - We will also need a bunch of **if-else conditions** to handle some **special cases**
- What about the **new** banking scams that people will try?
- What about **other types** of spam emails?
- This task is mission **impossible!** The code will only work for a few cases

What about text translation?

- Do you think word-by word translation will work?! Will a naive case-by-case approach work?
- This task belongs to the **Natural Language Processing (NLP)**
 - It's all about understanding both written communication (text) and verbal communication (speech)

The screenshot shows the Google Translate web interface. At the top, there are tabs for 'Text', 'Documents', and 'Websites'. Below these, there are language selection buttons for 'DETECT LANGUAGE', 'ENGLISH', 'ARABIC', and 'SPANISH'. The 'ARABIC' button is selected, and a double-headed arrow indicates the translation direction from English to Arabic. The input text on the left is 'All the faith he had had had had no effect on the outcome of his life.' The word 'had' is highlighted in grey. The output on the right is 'كل إيمانه لم يكن له أي تأثير على نتيجة حياته.' Below the input text, a suggestion is shown: 'He had had a lot of faith, but it had had no effect on the outcome of his life.'

Text Documents Websites

DETECT LANGUAGE ENGLISH ARABIC SPANISH

↔ ARABIC ENGLISH SPANISH

All the faith he had had had had no effect on the outcome of his life. ✕

He had had a lot of faith, but it had had no effect on the outcome of his life.

☆ كل إيمانه لم يكن له أي تأثير على نتيجة حياته.

كان لديه الكثير من الإيمان ، لكن لم يكن له أي تأثير على نتيجة حياته.

What about images?

- Can we **classify** these images as cats or dogs?!
- This task belongs to the **Computer Vision (CV) Field**
 - It is all about understanding images and videos



There are tasks that we
can't explicitly program!

Observation

*There must be patterns
in the data!*

Warning

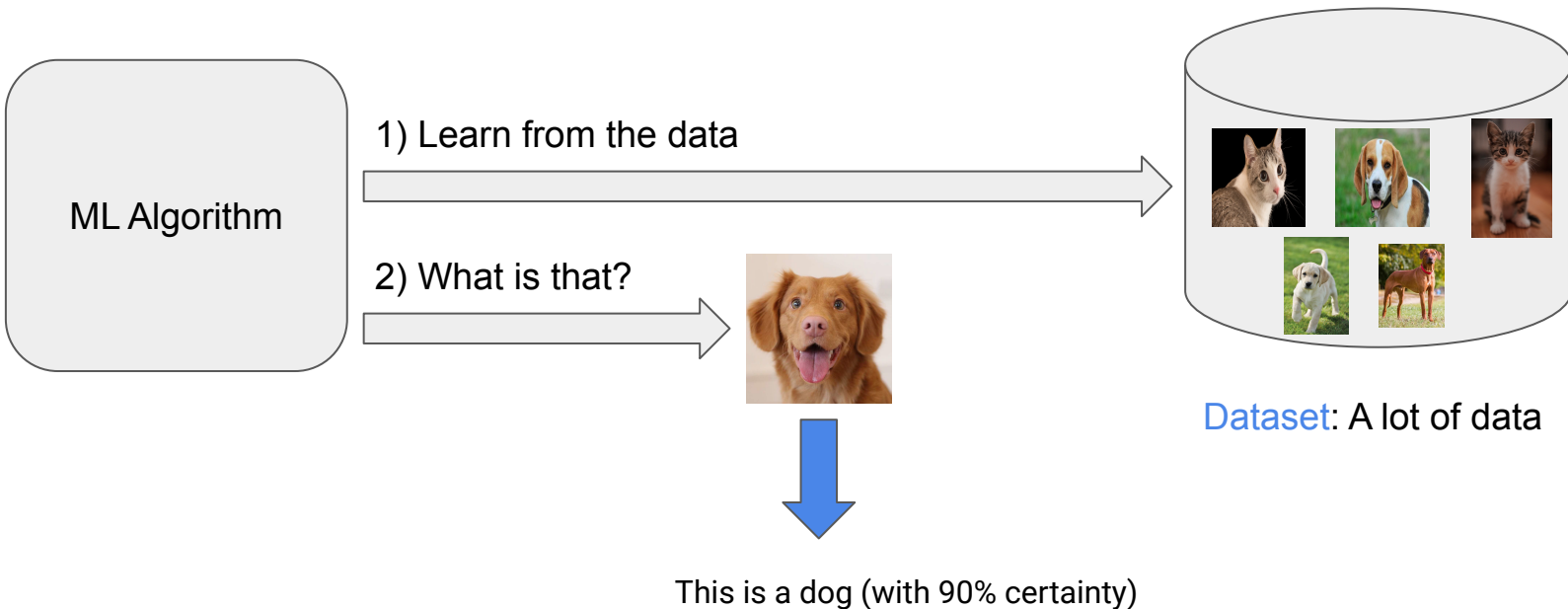
- Machine learning has too many concepts
- In the early introduction, many of these concepts will seem vague
- If you can get 60% of what I say, this is very good
 - No need to repeat the video
 - No need to find other resources
- During the course, most of that will be understood concretely
- With a later revision by you, things will be better
- Effective education
 - Is accumulative. You don't learn everything right now!
 - Needs flexibility. Move forward even if some things are not clear
 - ToDo list approach

Machine Learning Field (تعليم الآلة)

- Given many examples of **input** and **output** pairs, can we find **patterns** in the data to help solve the task?
 - Task 1 - **Input**: Email text **Output**: True for spam, false otherwise
 - Task 2 - Input: English text Output: Arabic text
 - Task 3 - Input: Picture Output: Either cat or dog
- A Machine Learning (ML) algorithm **learns from the data** by discovering **patterns and structures** within this data
 - So far, even with recent advances, ML algorithms are extremely limited comparing to human
 - English note: **An ML** algorithm not A ML algorithm (if u wrote the acronym)

Machine Learning Algorithm

- If there is no **data**, there is no **machine learning**

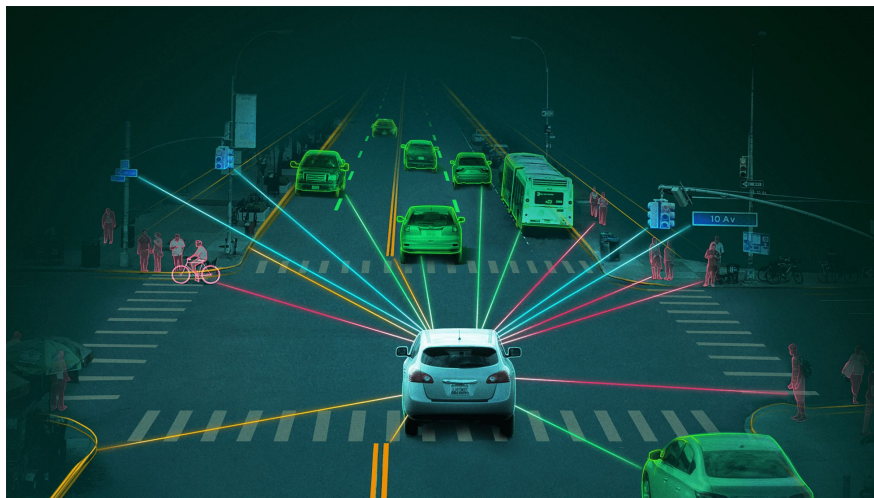


Machine Learning Algorithms vs Artificial intelligence Algorithms?

- Historically, there are several ways to define AI
 - Alan Turing's question (1950): "Can machines think?" ⇒ The Turing test
- **Narrow AI** focuses on performing a single task, e.g. translation
- **Artificial General Intelligence** (AGI) is what we *aim to achieve*: learning any intellectual task that a human being can / working jointly on all problems
 - We are extremely far from achieving that
- Machine Learning is a **current** application of AI
 - There are many ways to do AI, but most of them don't work well so far

Question!

- An autonomous driving car should be able to do:
 - **Perception:** know where are the agents (cars, bicycles, pedestrians, etc) and their attributes
 - **Prediction:** predict what each agent will do (e.g. the front car will change lane)
 - **Planning:** plan its route such that no accidents happens and it get closer from the goal
- Are such **current** systems (e.g. Tesla Autopilot) general or narrow AI?

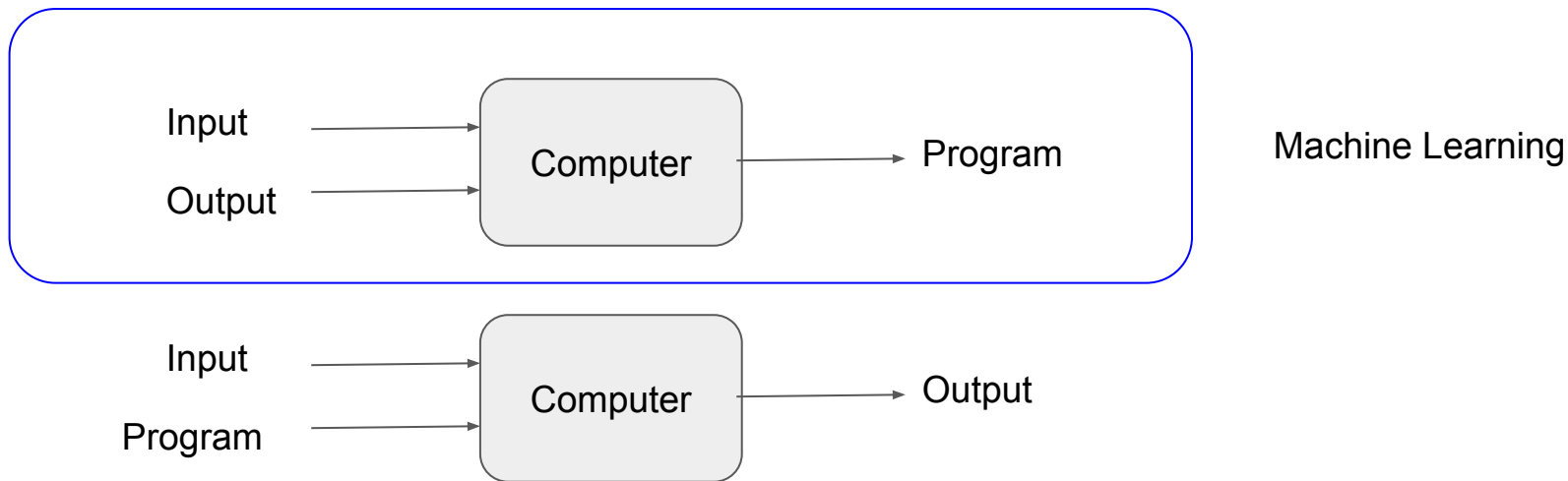


Machine Learning Algorithms vs Classical Algorithms?

- Classical algorithms define the exact processes for their task
- For example: given an array, sort it
 - We define an algorithm (like merge-sort) to order the data
 - Its steps are well known
- An ML algorithm finds patterns in the data, using the information to solve the task
 - The more diverse the data, the better the generated model
- You should be able to differentiate the 2 types

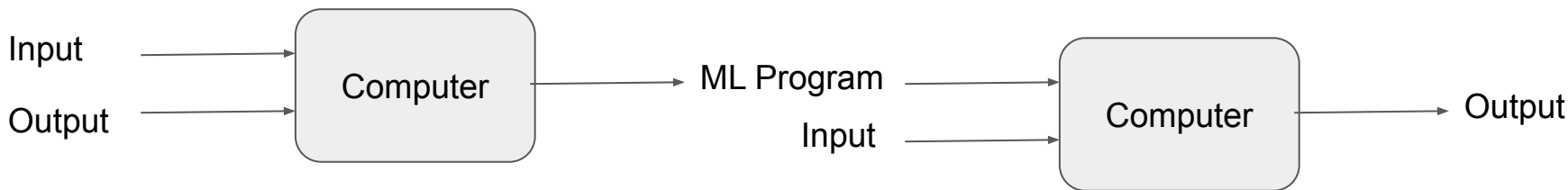
Question!

- Which is the traditional programming and which is machine learning?



ML Flow

- We build a program (model) based on (input, output) pairs, then use it to judge new inputs
 - This is mainly for supervised learning (coming)



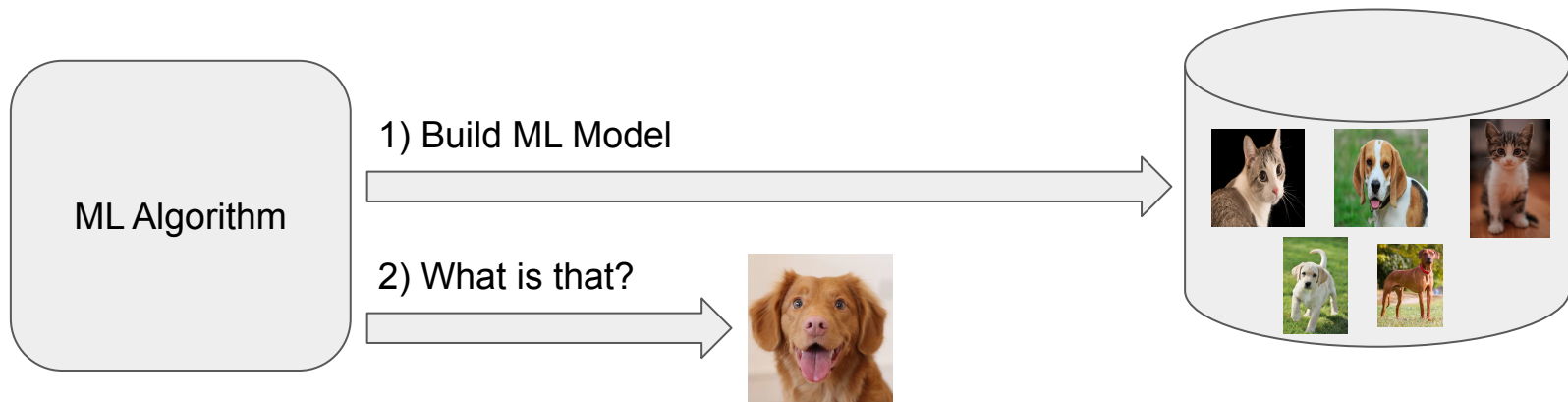
Question!

- Our building has several elevators. We'd like to tell people:
 - In the morning: 'Have a good day!'
 - At lunch-time: 'Enjoy your lunch'
 - In the evening: 'Have a good night!'
- You can suggest devices to install that will help you. For example, a camera positioned on the street
- What are your actions?
Is this normal coding,
or a machine learning task?



Question

- Given a dataset of 500 images for cats and dogs
- Do you think ML major goal is:
 - 1) **Memorize** them
 - Then, given one of these 500 animals, we can figure it out?
 - 2) **Generalize** beyond them (learn structure)
 - Then, given an image of a **new** dog/cat, we can figure it out?



About the very recent history of ML

- There are many novel and innovative machine learning algorithms
 - Including Neural Network in 1944 and [Deep Neural Network](#) in 1989
 - Due to external limitations, the DNN did **NOT** work well at that time
- Sadly, most ML algorithms didn't work well with applications in the real world
 - As a result, up until 2012, most of the industry had largely neglected ML
- In 2012, a research [publication](#) in the CV field demonstrated the use of deep learning to enable a huge jump in performance!
 - Success factors: a lot of data, big storage, fast computers (GPU)
- After that groundbreaking work, the industry realized that there are huge potential rewards in ML, and that it can work with real-world applications too!
 - That is why working with classical ML is not common in the industry nowadays
 - You have to **learn about the deep neural network** to secure a job in ML

1 Artificial Intelligence

Development of smart systems and machines that can carry out tasks that typically require human intelligence

2 Machine Learning

Creates algorithms that can learn from data and make decisions based on patterns observed
Require human intervention when decision is incorrect

3 Deep Learning

Uses an artificial neural network to reach accurate conclusions without human intervention

“Acquire knowledge and impart it to the people.”

“Seek knowledge from the Cradle to the Grave.”

