

CMPS 460 – Spring 2022

MACHINE LEARNING

Tamer Elsayed

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1.a

Welcome to Machine Learning



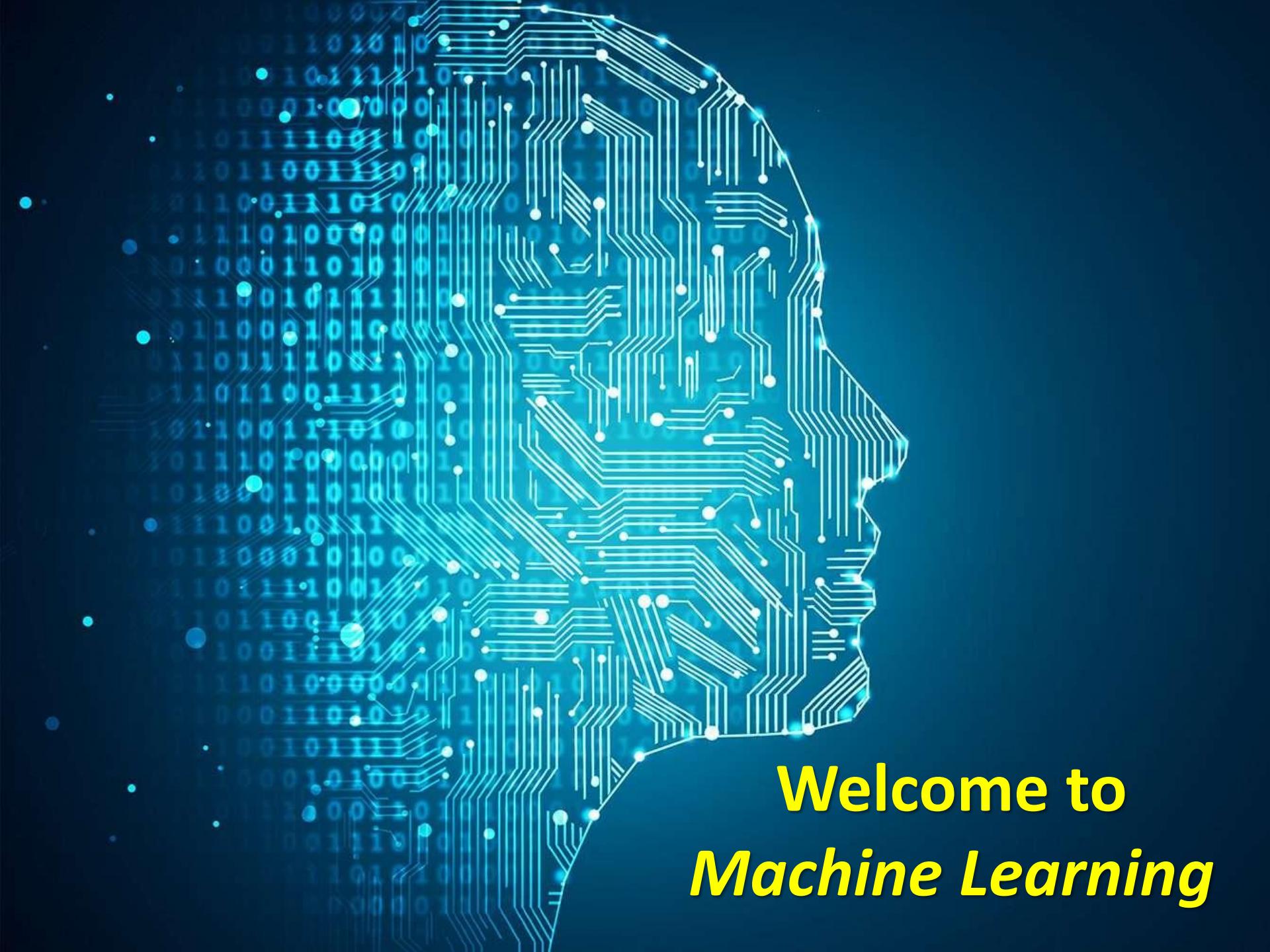
Chapter 1

اللهم تعلّمنا ما ينفعنا
وأنفعنا بما علمنا
ورزقنا

*O' Allah, let us learn what would benefit us,
benefit us from what we learned,
and increase us in knowledge*

هُنَّ سَالِكُونَ طَرِيقًا يُلْتَهِسُ فِيهِ الْعَلَمَا
سَهْلٌ اللَّهُ لَهُ بِهِ طَرِيقًا إِلَى الْجَنَّةِ

*Whoever follows a path to seek knowledge
therein, Allah will make easy for him a path to
Paradise.*



Welcome to
Machine Learning



What is Machine Learning?

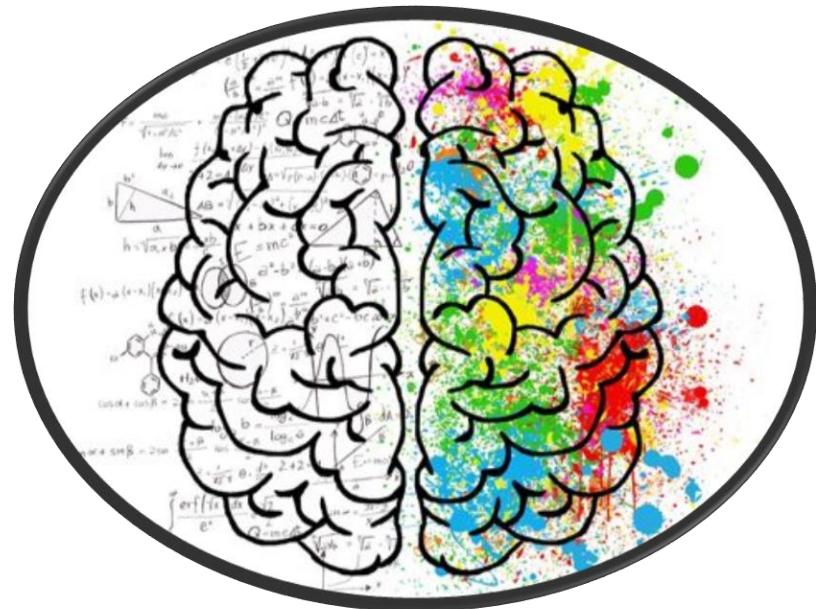
What is Machine Learning?

Machine Learning is about
predicting the ***future*** based on the ***past***.

Machine Learning is about
predicting the ***unseen*** based on the ***already-seen***.

A growing and fast moving field

- Broad applicability
 - Daily life: finance, entertainment, natural language processing, information retrieval, computer vision, robotics, healthcare, medicine, biology, etc.
 - Close connection between theory and practice.
- Open field, lots of room for new work (e.g., deep learning)!
- Fear of AI/ML
 - Understand what's in the black box

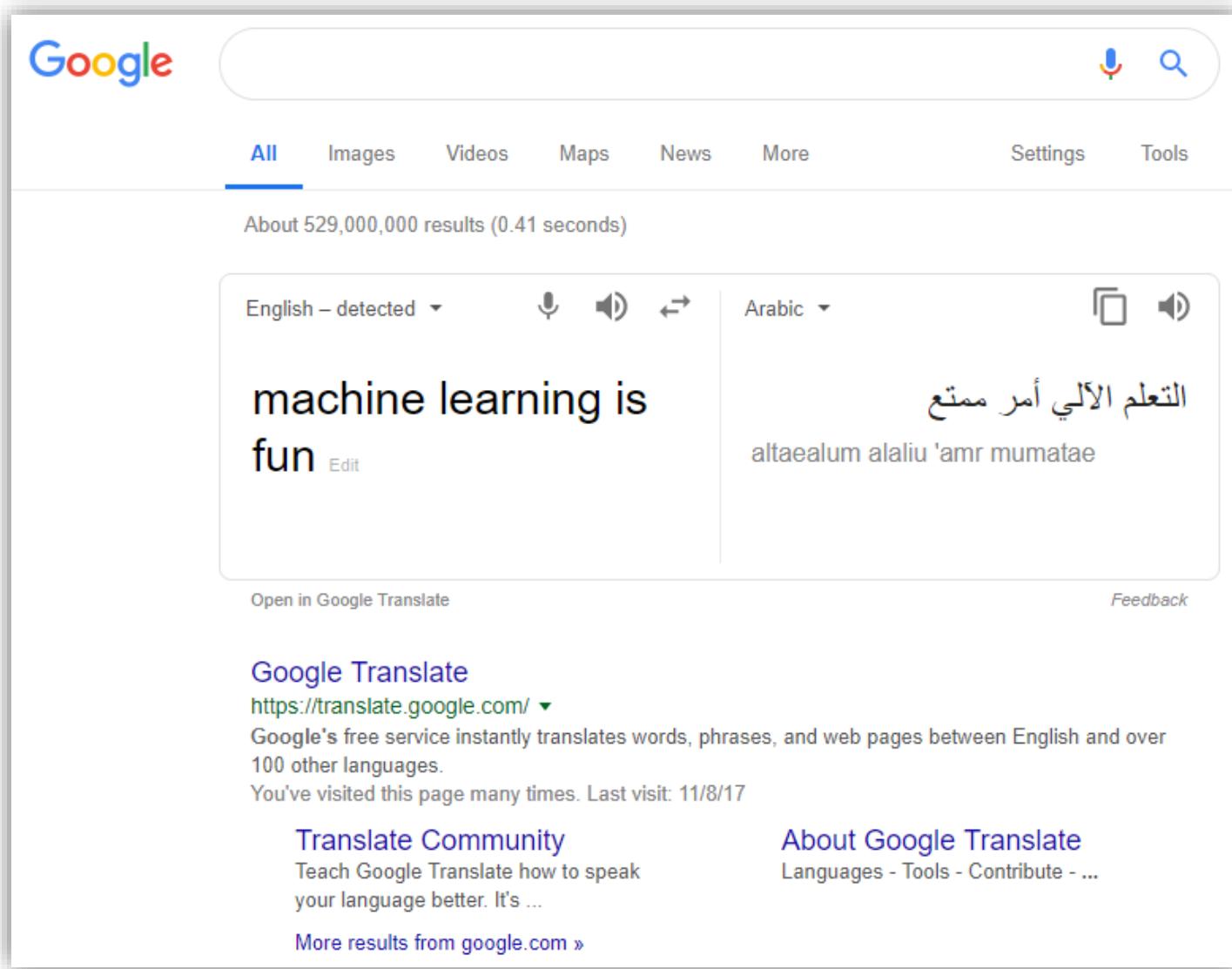


What can ML do?

Assist you at home ...



Translate ...



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machine learning is fun Edit

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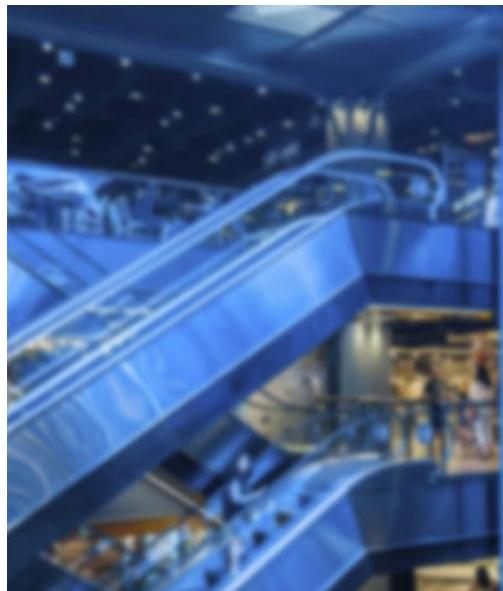
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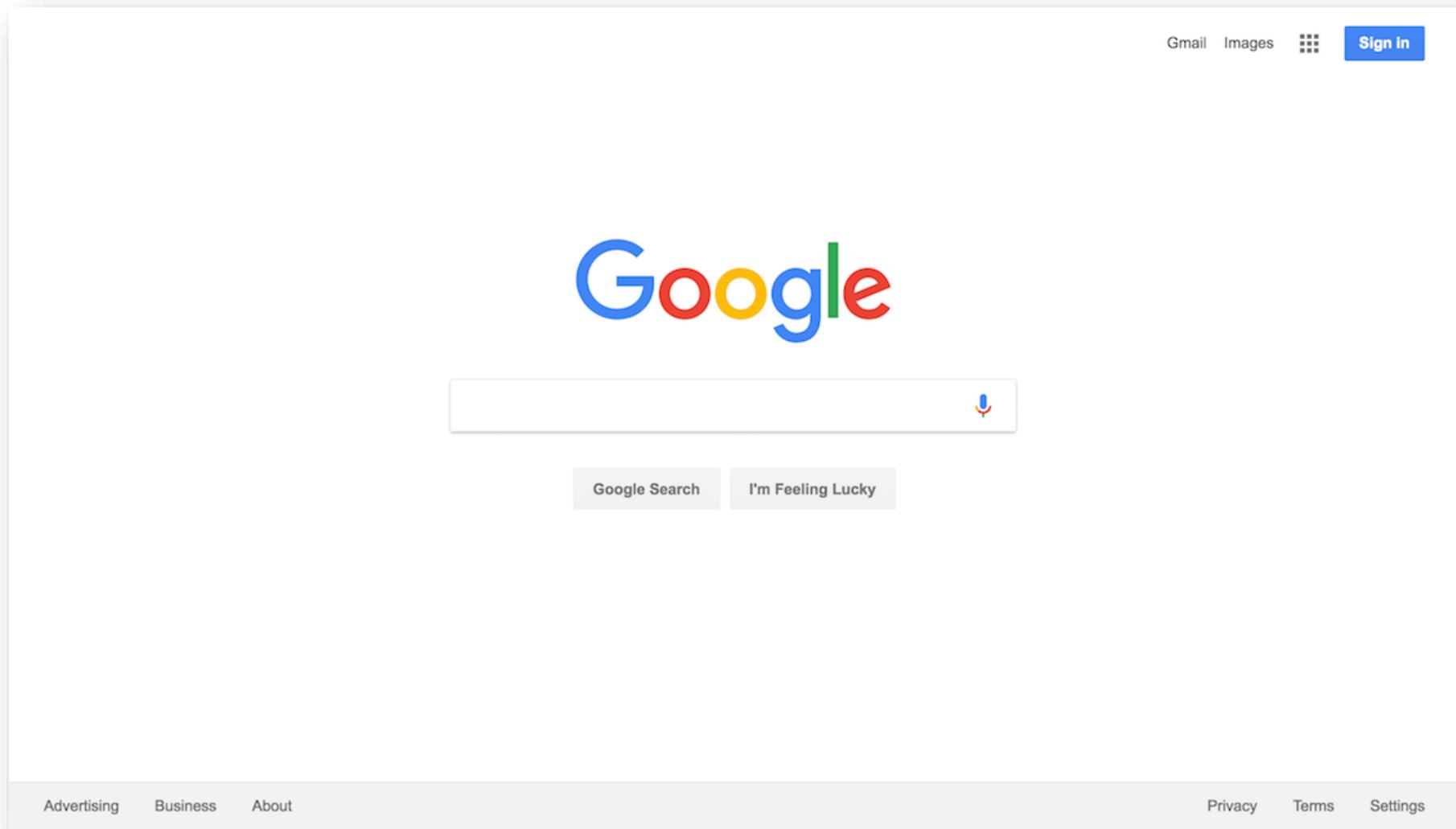
Estimate the price of your ride ...



Monitor unusual behavior ...



Find good search results ...

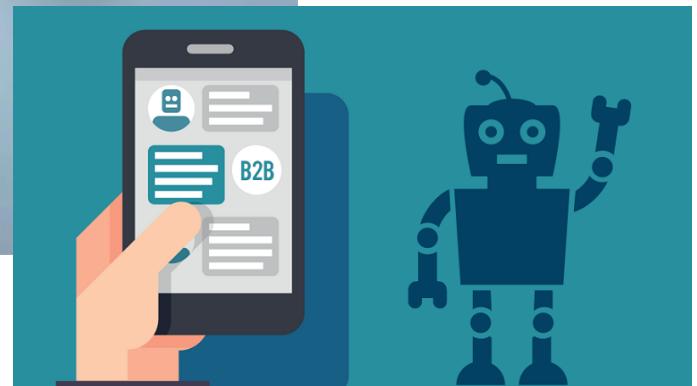
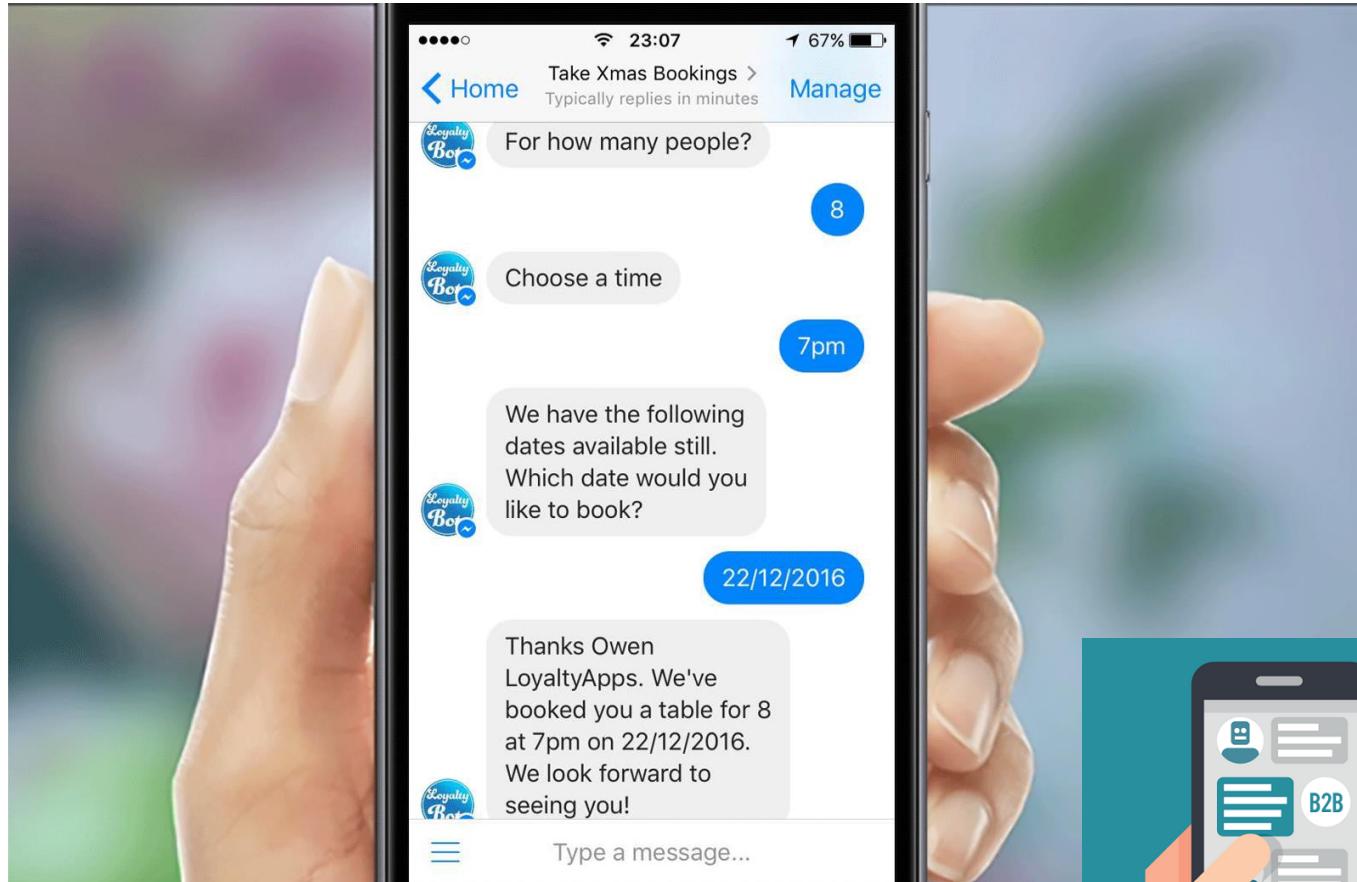


The image shows the Google search homepage. At the top right, there are links for "Gmail", "Images", and a grid icon. A blue "Sign In" button is also visible. The central feature is the large, colorful "Google" logo. Below it is a search bar with a microphone icon on the right. Under the search bar are two buttons: "Google Search" and "I'm Feeling Lucky". At the bottom of the page, there is a navigation bar with links for "Advertising", "Business", "About", "Privacy", "Terms", and "Settings".

Predict stock prices ...



Chat with you ...



Discover fraud ...



Recommend good stuff ...

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Teach robots how to cook ...



Drive your car ...



**“Intelligent” machines can even be
“smarter” than humans!**

Beat the best GO player ...

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NATURE | ARTICLE

日本語要約

Mastering the game of Go with deep neural networks and tree search

David Silver, Aja Huang, Chris J. Maddison, Arthur Guez, Laurent Sifre, George van den Driessche, Julian Schrittwieser, Ioannis Antonoglou, Veda Panneershelvam, Marc Lanctot, Sander Dieleman, Dominik Grewe, John Nham, Nal Kalchbrenner, Ilya Sutskever, Timothy Lillicrap, Madeleine Leach, Koray Kavukcuoglu, Thore Graepel & Demis Hassabis

Affiliations | Contributions | Corresponding authors

Nature 529, 484–489 (28 January 2016) | doi:10.1038/nature16961
 Received 11 November 2015 | Accepted 05 January 2016 | Published online 27 January 2016

PDF Citation Reprints Rights & permissions Article metrics



Beat the Jeopardy Champion ...



IBM Watson Question Answering system beats Jeopardy champion Ken Jennings at Quiz bowl!

What is your favorite ML application?



INTRODUCTIONS



Instructor

- Tamer Elsayed
 - telsayed@qu.edu.qa
 - **Office:** Eng. Annex Bldg. (end of corridor G), room 209
 - **Phone:** 4403 4296
- Research interests:
 - Information Retrieval
 - Big Data Analytics

University of Alexandria, Egypt

- 1992-1997: B.Sc. (CS), 1998 – 2001: M.Sc.



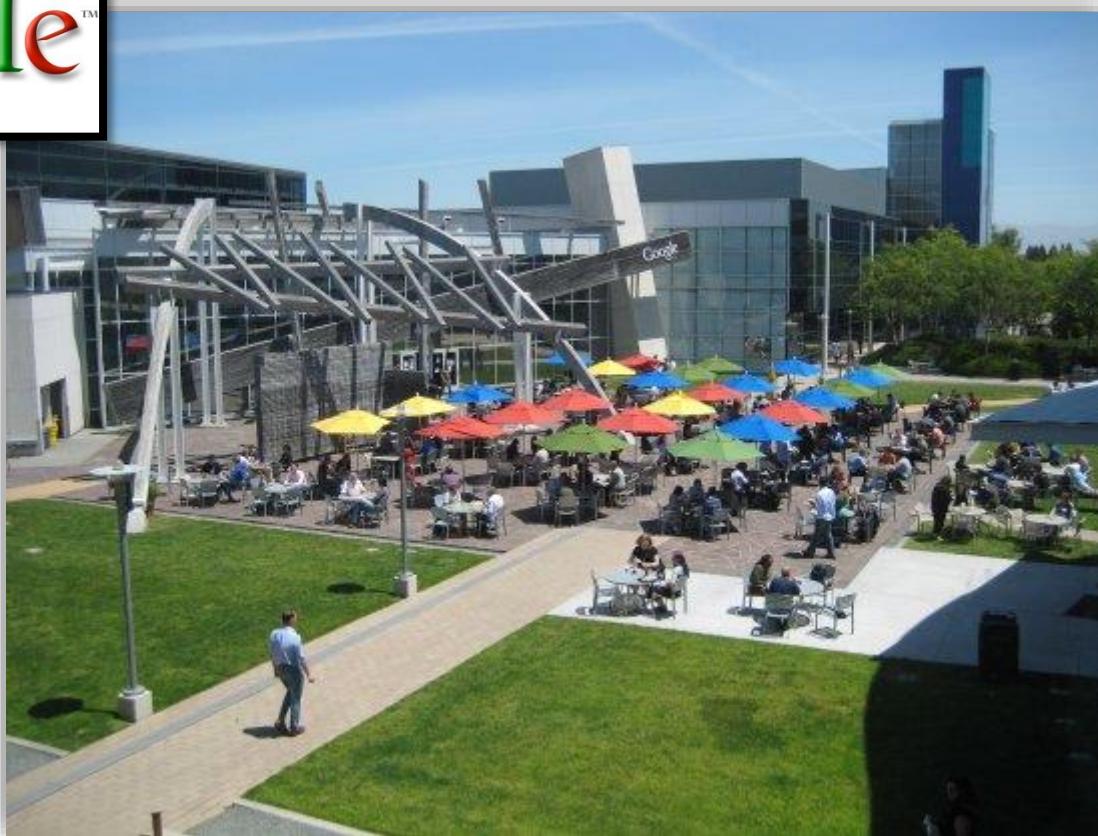
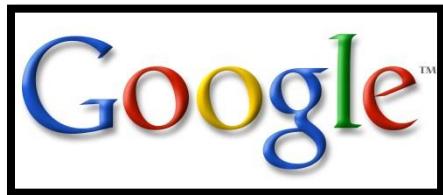
University of Maryland, USA

- 2002-2009: Ph.D., 2009-2010: PostDoc



Google, USA

- 2007: Software Engineer Intern



KAUST, Saudi Arabia

- 2010-2011: PostDoc



Microsoft, Egypt

- 2011-2012: Researcher



Qatar University, Qatar

- 2012 – 2018: Assistant Professor
- 2018 – current: Associate Professor



Teaching Style

- I like interaction in class
- I like to ask questions
- I like to be asked questions
- I like to know (and memorize) your names ☺
- I like to give practical assignments and projects
- I like to learn ...

What is your favorite ML application?





What's Learning?

What's Learning?

Simply, it's the ability to use *previous data* to perform *future actions*.

Analogy with human learning?

Ex. 1: Learning in a course ...



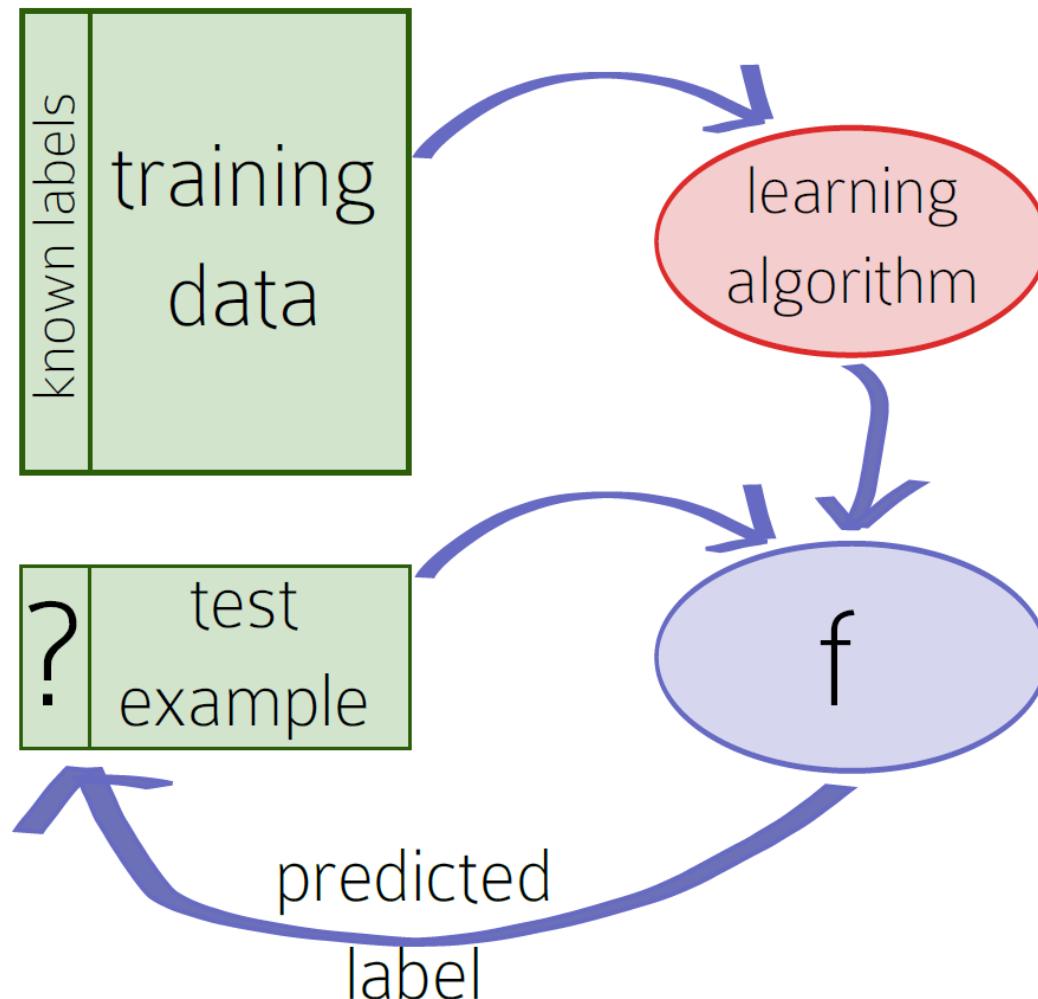
- You expect to “learn” a subject in a specific course.
- What’s a common way to judge how well you do ☺?
 - You did well at learning, if you do well on the exam.

Ex. 1: Learning in a course ...

- What makes a reasonable exam?
 - If it has chemistry questions, it's not representative of your learning.
 - If it only has questions that I asked you before in lectures, that's a bad test of your learning.
 - Especially if open-notes.
- Best?
 - You study and understand examples, then answer “new” but “related” questions.
 - Test your ability to “**generalize**”.

Supervised Learning (in 1 slide!)

Predicting the future based on the past.



Ex. 2: Classification Tasks

- How would you write a program to distinguish a picture of me from a picture of someone else?
- *Provide example pictures of me and pictures of other people and let a classifier learn to distinguish the two.*

Ex. 2: Classification Tasks

- How would you write a program to distinguish cancerous cells from normal cells?
- *Provide examples of cancerous and normal cells and let a classifier learn to distinguish the two.*

Let's try it out!

Your task

- Learn a classifier (to distinguish class A from class B) from examples
- Then predict class on new examples using what you've learned



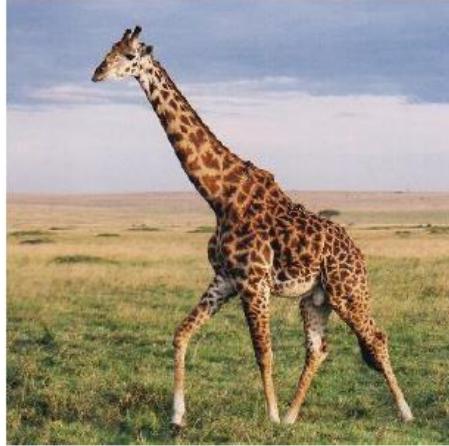
Examples of Class A



CLASS
A

Examples of Class B

Class B



How about these?

Bird or not?

Flying or not?



Background in focus or not?



*Learning
Algorithms/Models*

Different Hypotheses?

- Different learning algorithms/models have different hypotheses.
- **Inductive bias:** some hypotheses are more probable than others.
 - Next week!

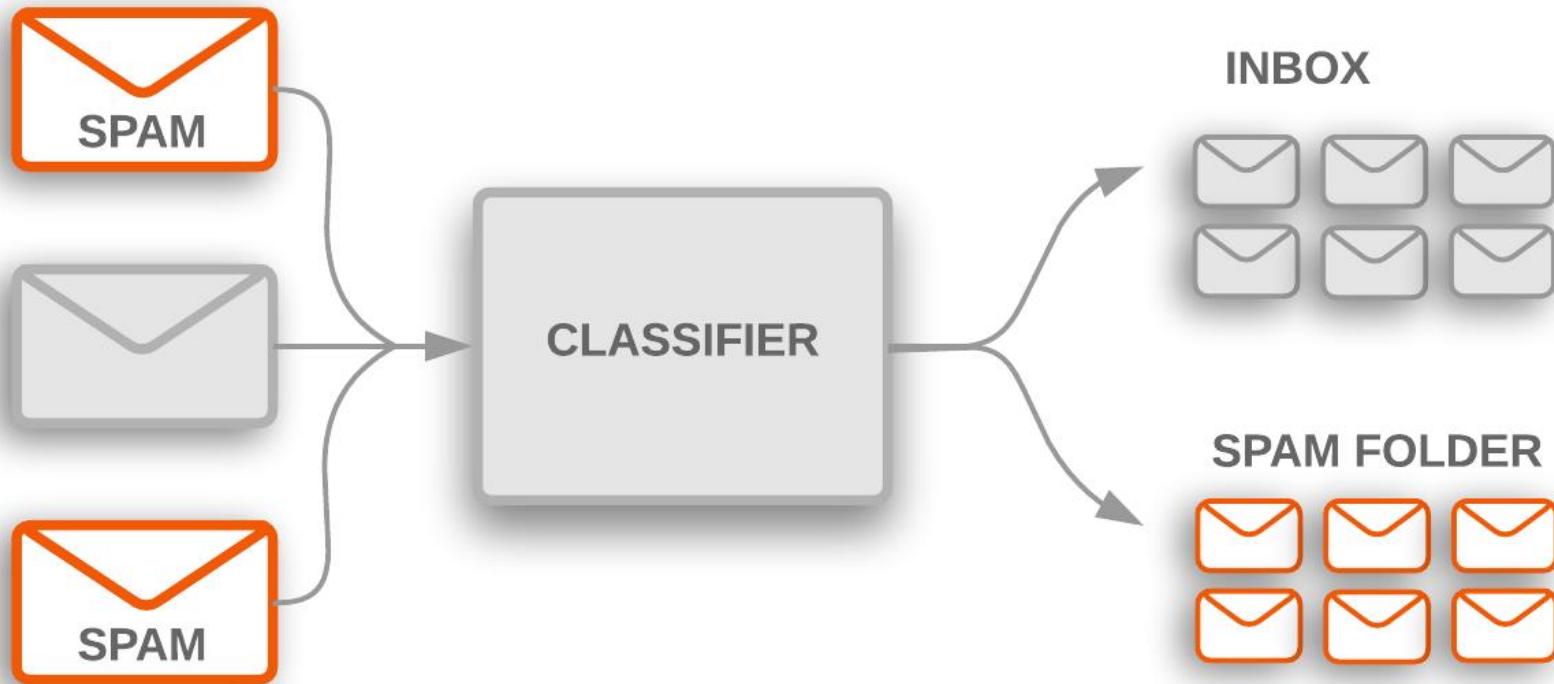
How is learning represented?

- Learning is captured in a ***model*** learned from discovering patterns (***through model parameters***) in data (***training examples***).
- Trained model should be ***a good and useful approximation*** of the data.
 - used later for prediction.
- Done by following a ***learning algorithm***.
 - each has a “bias”.



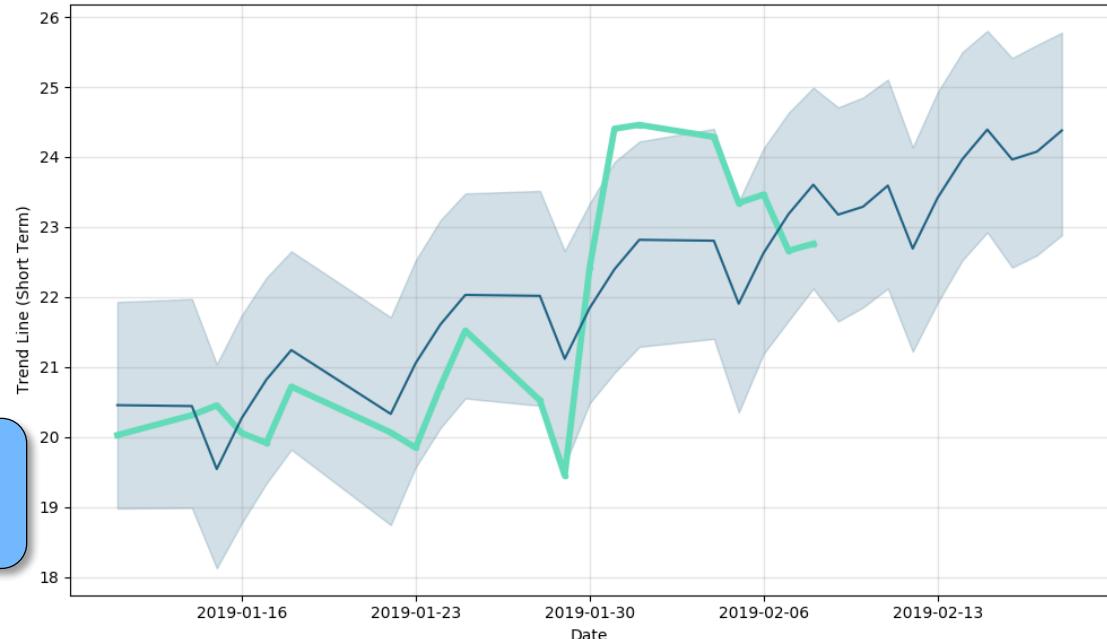
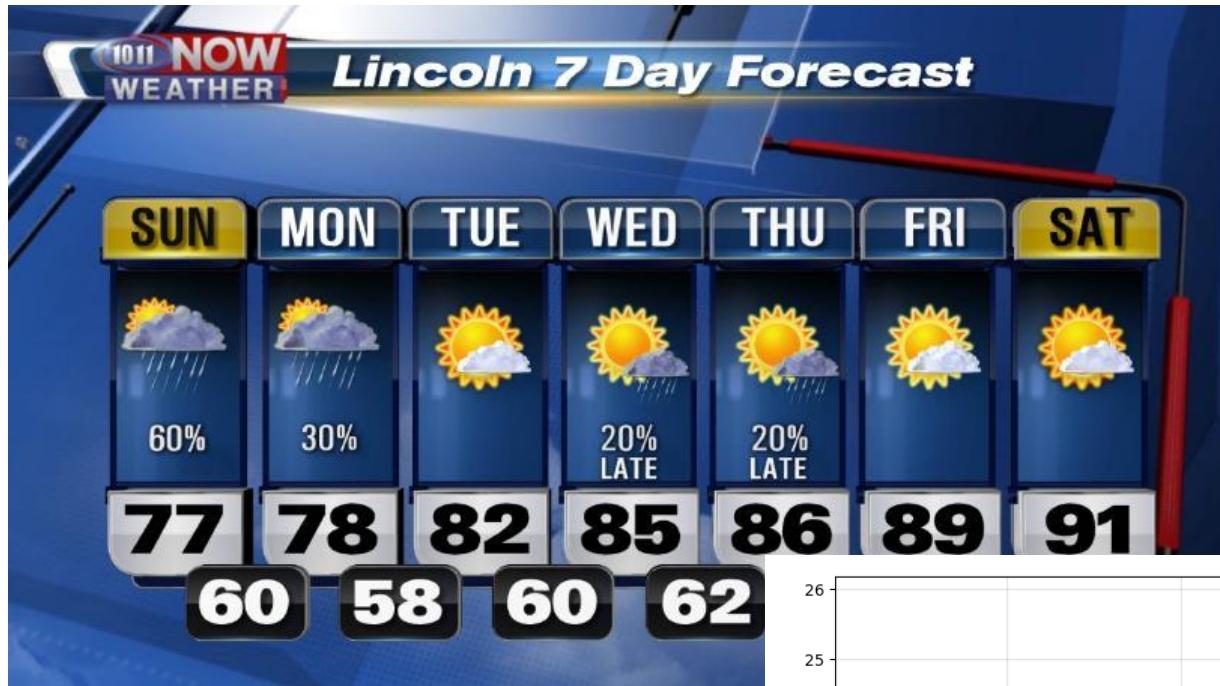
Types of Machine Learning

Is it A or B?



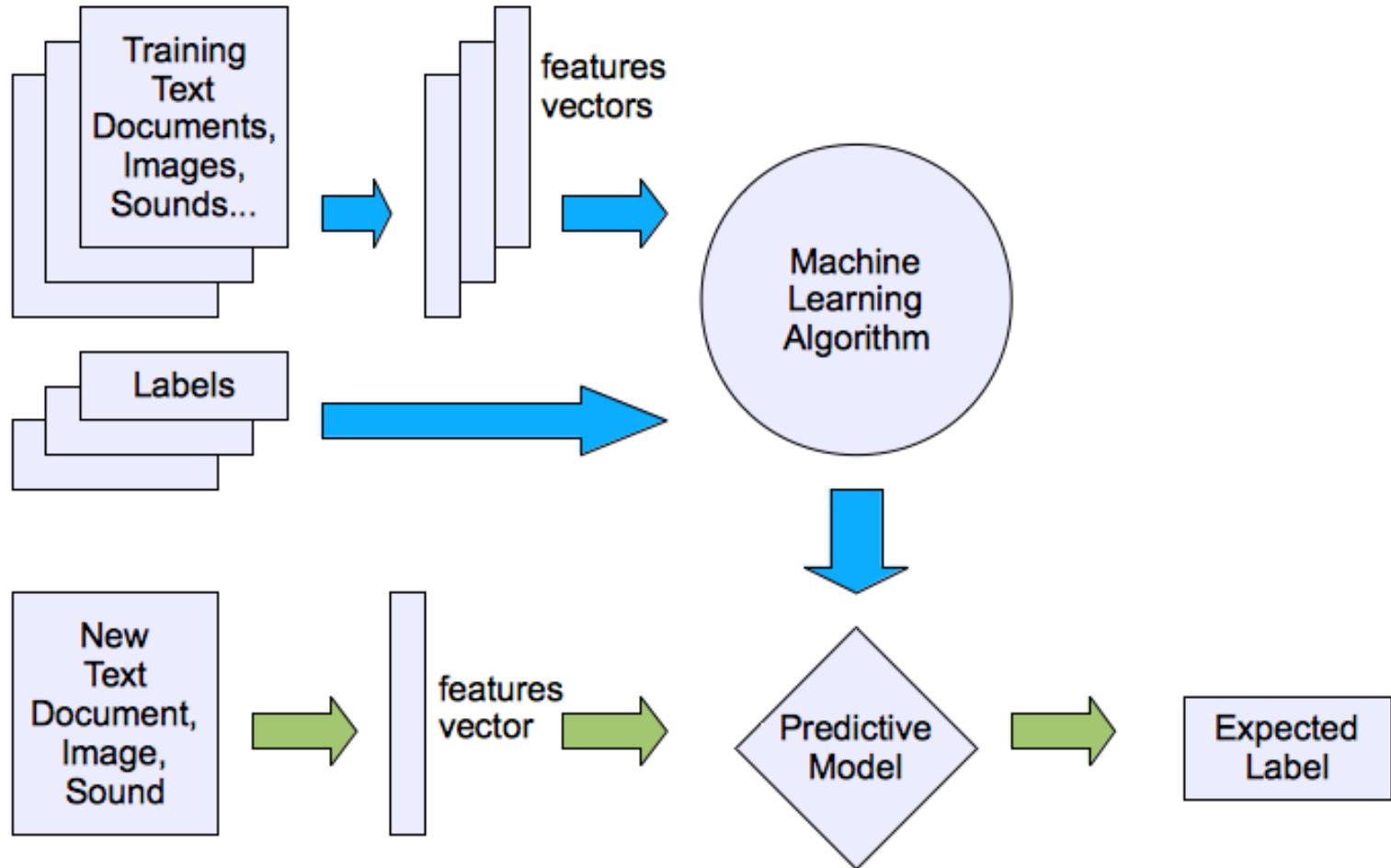
Classification

How much? How many?



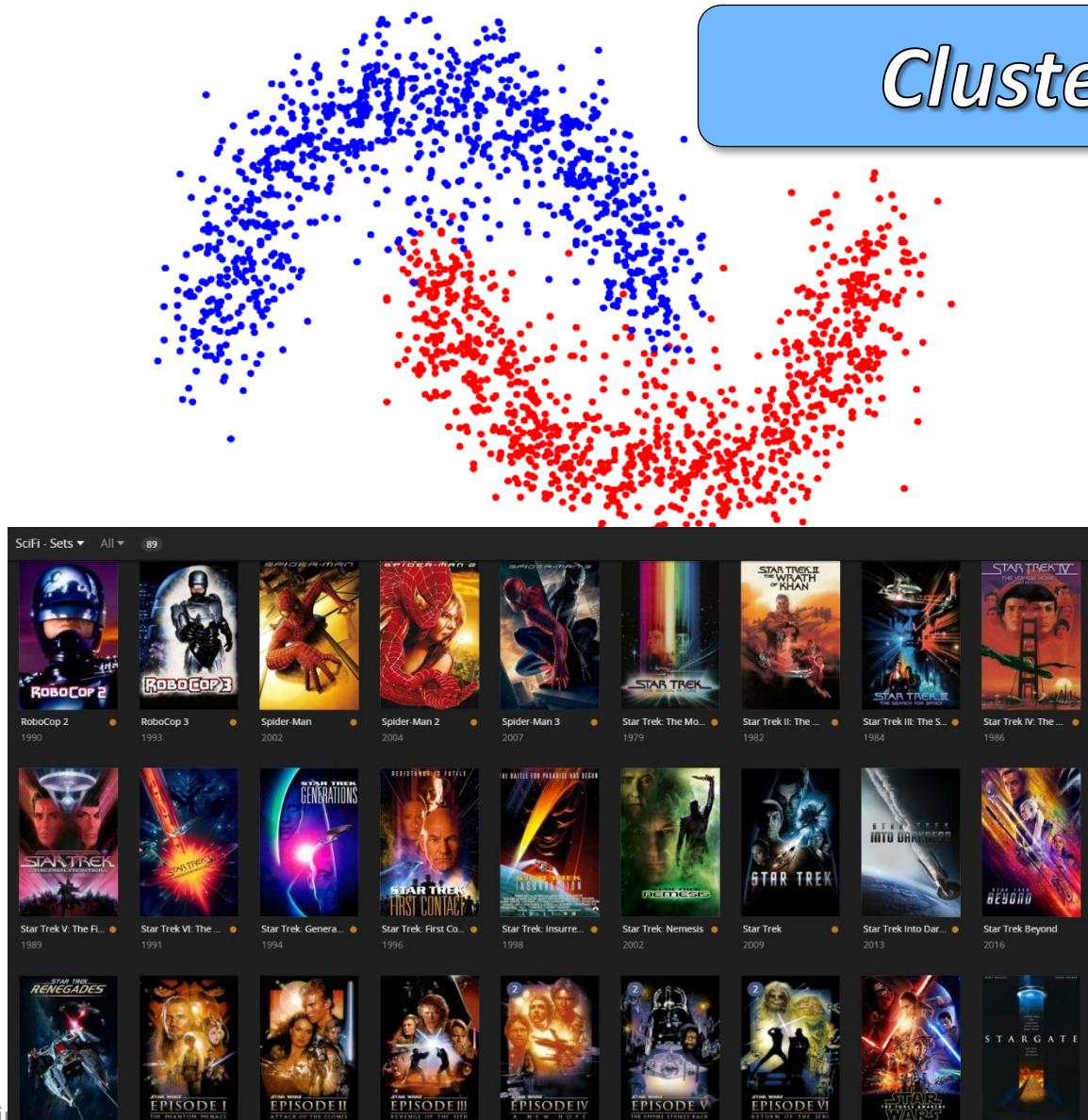
Regression

Supervised Learning

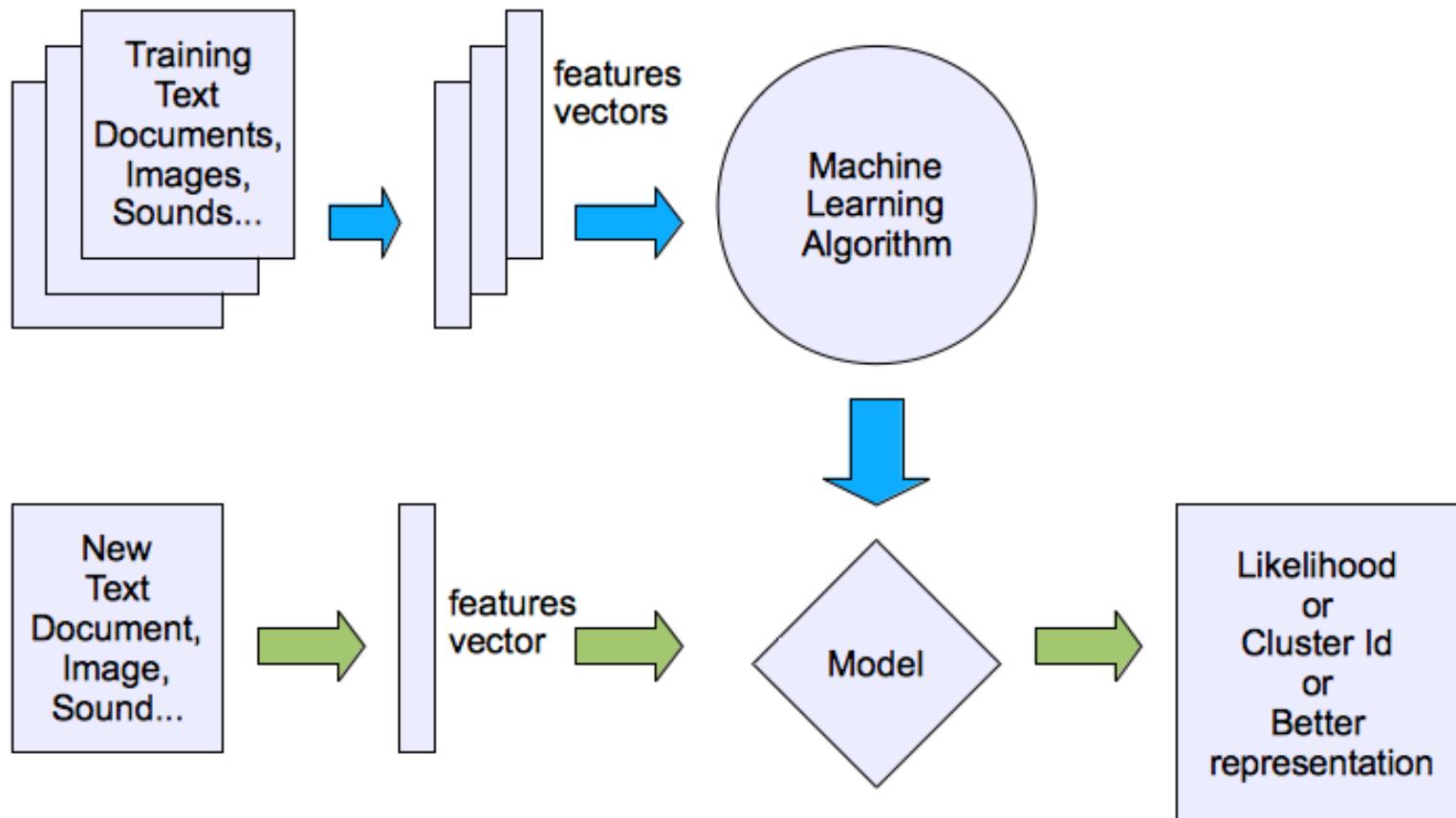


How is this organized?

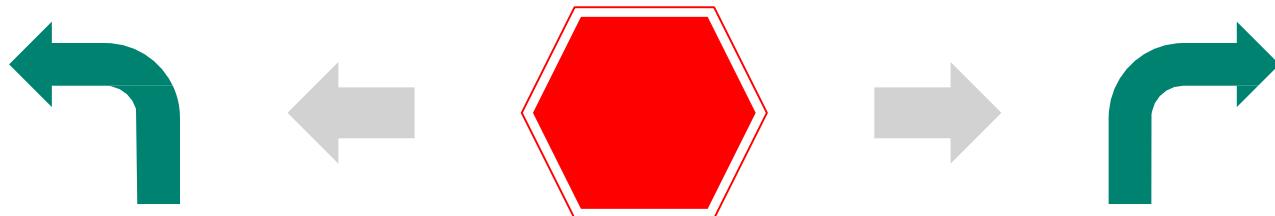
Clustering



Unsupervised Learning



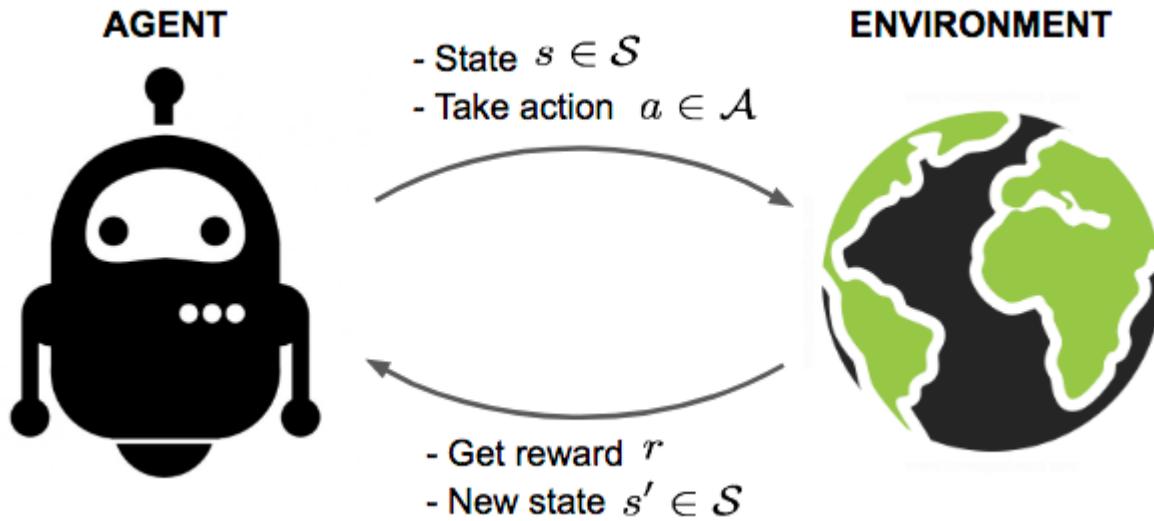
What should I do now?



Reinforcement Learning



Reinforcement Learning



Types of Machine Learning

Supervised

- Classification
- Regression
- Ranking

Training data includes desired outputs

Unsupervised

- Clustering
- Dim. Reduction
- Association

Training data does not include desired outputs

Reinforcement

Learn from mistakes & rewards