



Hochschule  
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# Introduction to Machine Learning

Foundations Course Winter Semester 2021

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# What is Artificial Intelligence?

A revision from the previous session ....



# Guessing Time .... For AI!



Let's play a game of Kahoot!

# What is Machine Learning?

A new topic for today!!!



# Guessing Time .... For ML!



How about another game of Kahoot?

# Machine Learning



Figure 1: Applications of ML [1]

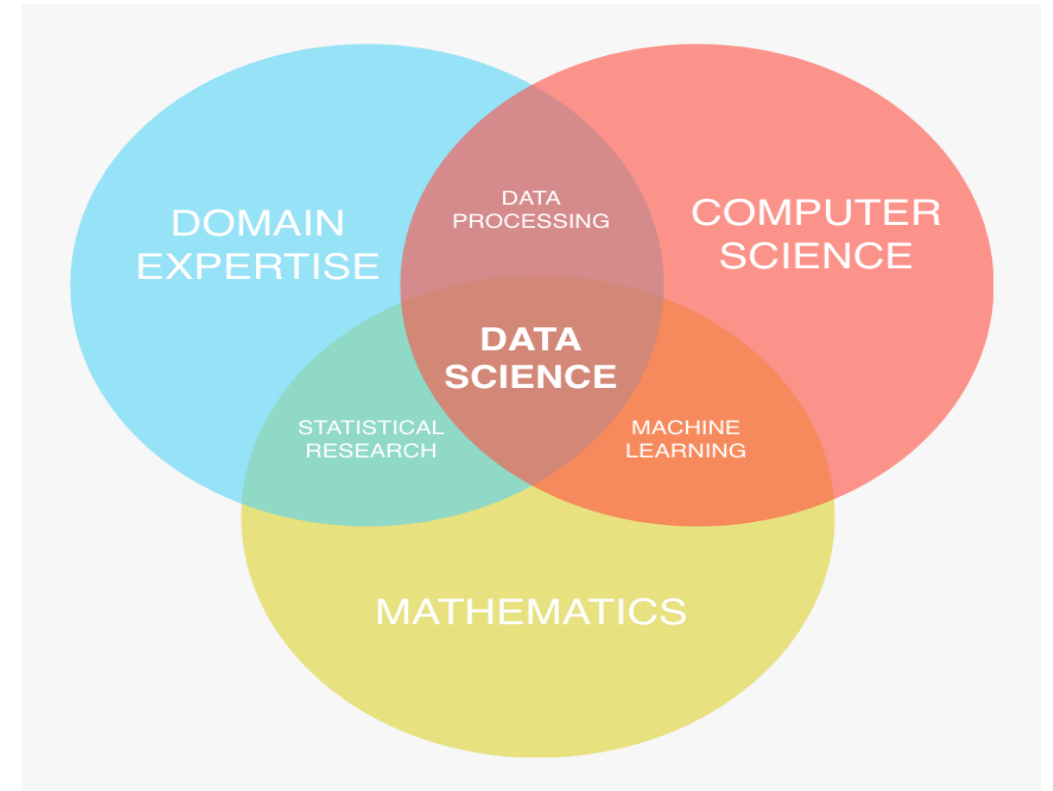


Figure 2: Overview of ML [2]

# What is the difference between AI vs ML?

Isn't it the same?



# AI v/s ML

## Formal Definitions:

### Artificial Intelligence...

Artificial intelligence (AI) is the ability of a computer or a robot controlled by a computer to do tasks that are usually done by humans because they require human intelligence and discernment. [3]

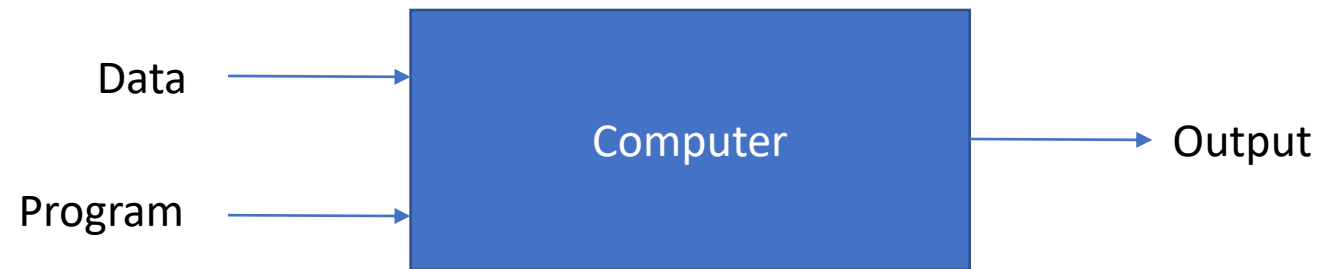
### Machine Learning...

A machine is said to learn from experience  $E$  with respect to some class of tasks  $T$  and performance measure  $P$  if its performance at tasks in  $T$ , as measured by  $P$ , improves with experience  $E$ . [4]



# Traditional Programming v/s Machine Learning

Traditional Programming:



Machine Learning:

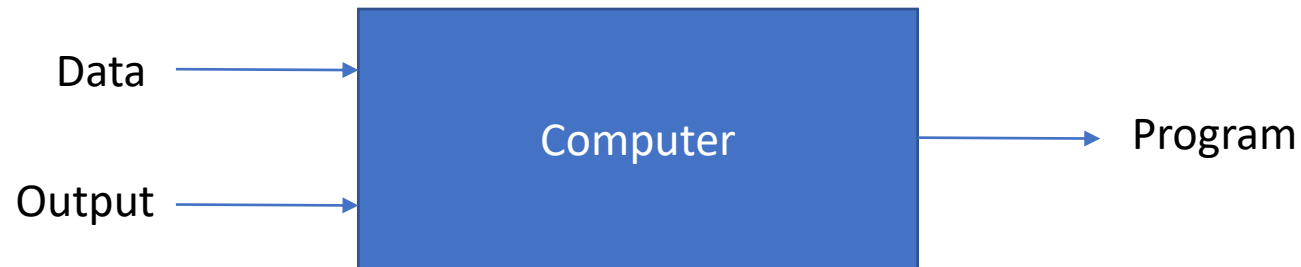


Figure 3: Traditional Programming vs Machine Learning [5]

# AI vs ML

In simple terms...

## Artificial Intelligence...

make intelligent systems that may or may not learn from data [6].

## Machine Learning...

make predictive systems that learn from data [6].

# AI vs ML

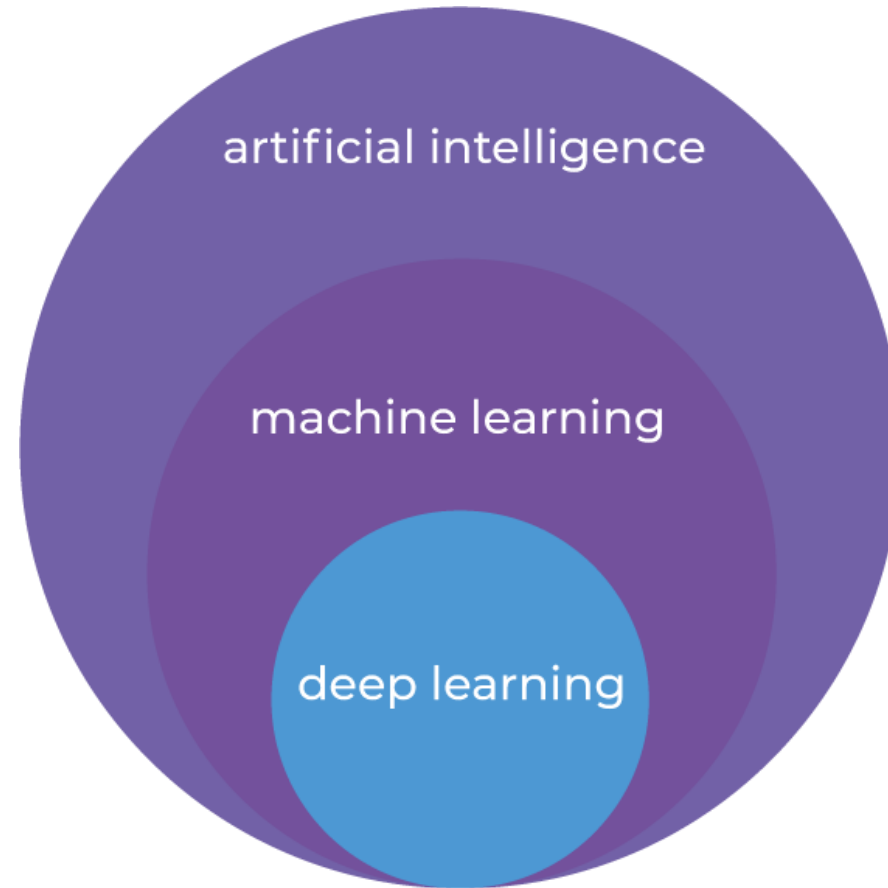


Figure 4: How AI and ML are related [7]

# Are there multiple ML Algorithms?

How can we classify them?



# Exploring some ML Algorithms...

## Classifying Algorithms based on how they learn:

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning

## Some other ML Algorithms we will touch upon today:

- Artificial Neural Networks
- Deep Learning Algorithms

# Machine Learning Paradigms

Grouping ML Algorithms by Learning Technique



# Supervised Learning

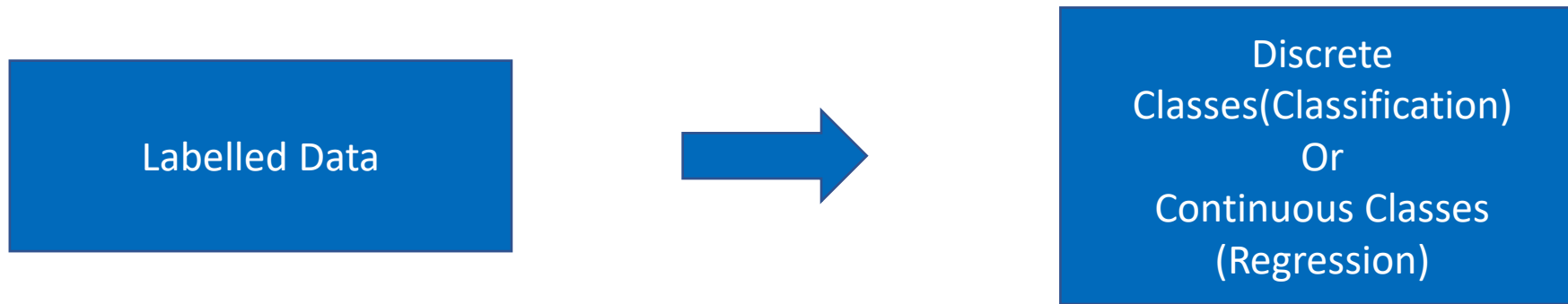


Figure 5: Overview of Supervised Learning [8]

# Supervised Learning

Time for some examples!



# Supervised Learning – Example of Labelling

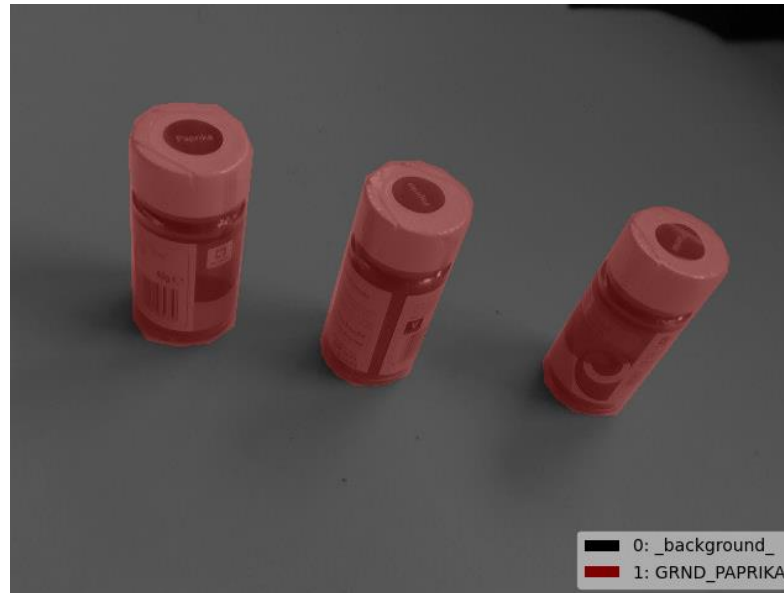


Figure 6: Supervised Learning – Labelled Data – RoboCup@Work[9]

# Supervised Learning - Classification

## Examples:

- 1. Spam Detection

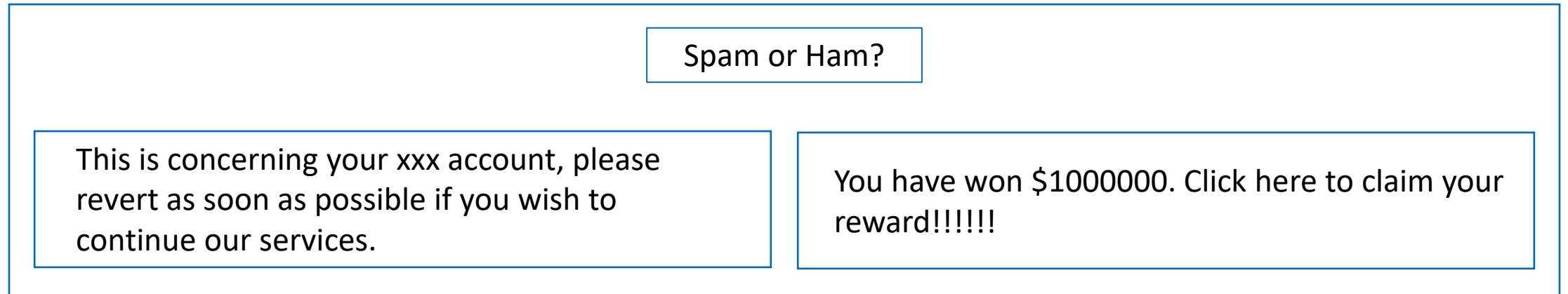


Figure 7: Spam Email Classification [9]

# Supervised Learning - Classification

## Examples:

- 1. Spam Detection

This is concerning your xxx account, please revert as soon as possible if you wish to continue our services.

Ham

You have won \$1000000. Click here to claim your reward!!!!!!

Spam

Figure 7: Spam Email Classification [9]

# Supervised Learning - Classification

## Examples:

- 1. Spam Detection

This is concerning your xxx account, please  
revert as soon as possible if you wish to  
continue our services.

Ham

You have won \$1000000. Click here to claim  
your reward!!!!!!

Spam

Figure 7: Spam Email Classification [9]

# Supervised Learning - Classification

## Examples:

- 1. Spam Detection

## Steps involved in Spam Detection:

- a. Create classes (Spam or Ham)
- b. Represent each message by features (keywords, spelling, etc.)
- c. Create reasonable rules.

# Supervised Learning - Classification

## Examples:

1. Spam Detection
2. Image Classification

## Example for Image Classification

Follow this [link](#)

# Supervised Learning - Regression

## Example:

### 1. Predicting the temperature

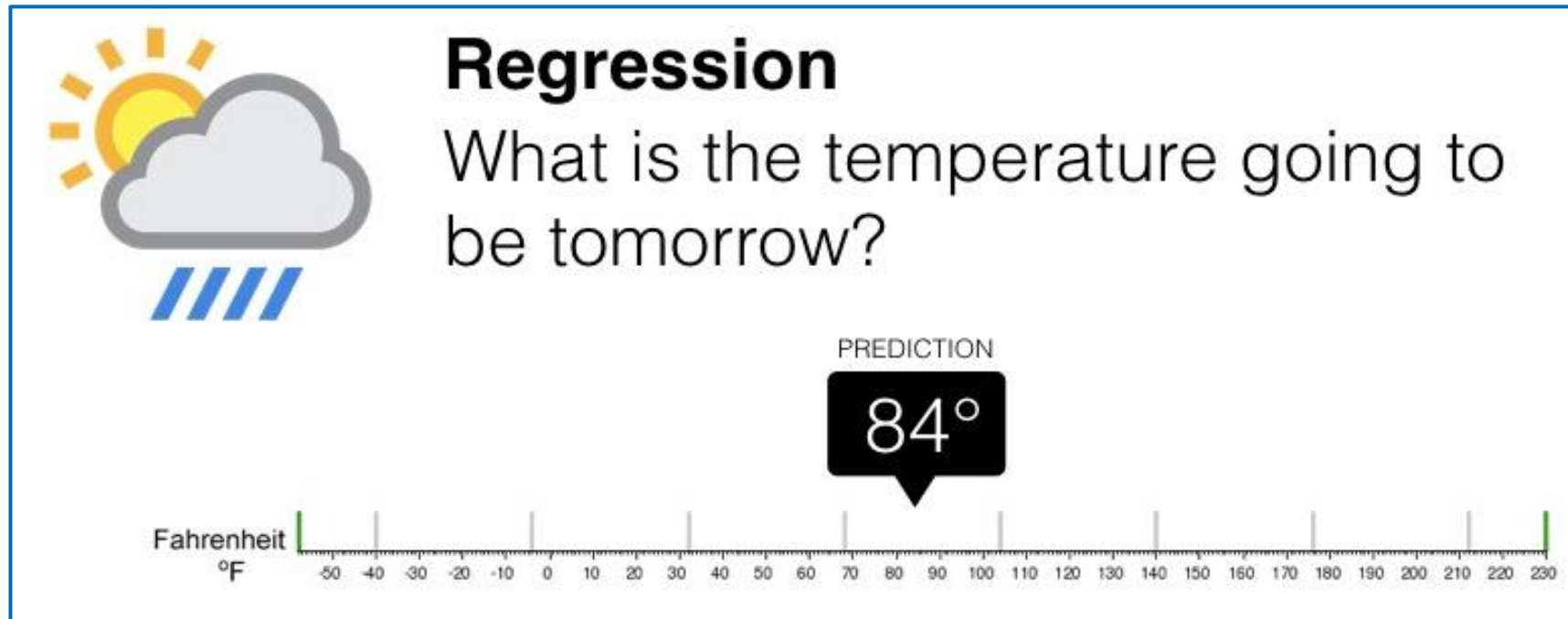


Figure 8: Predicting the temperature – Regression Example [10]

# Unsupervised Learning

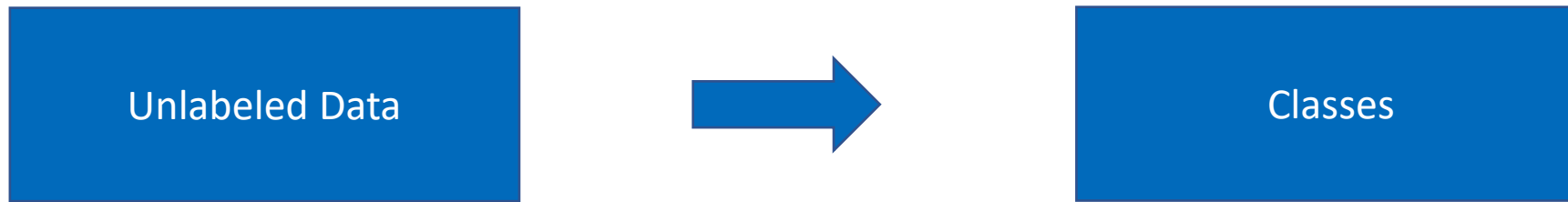


Figure 9: Overview of Unsupervised Learning [8]



# Unsupervised Learning

Time for some examples!

# Unsupervised Learning - Clustering

## Examples:

- 1. Customer Segmentation

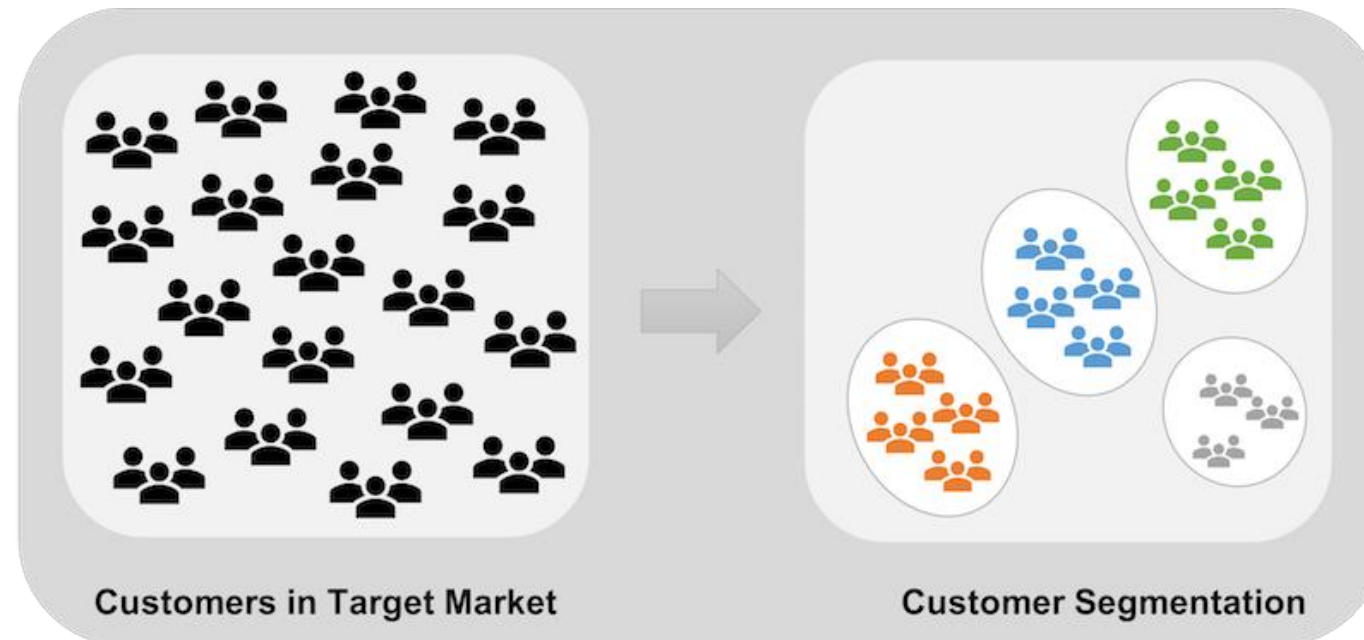


Figure 10: Clustering Customers [11]

# Unsupervised Learning - Clustering

## Examples:

1. Customer Segmentation
2. Social Network Analysis



Figure 11: Analysis Social Connections [12]

# Unsupervised Learning – Anomaly Detection

## Examples:

### 1. Golf Cart – Anomaly

**Normal Clip**



**Abnormal Clip**



Figure 12: Golf Cart as an anomaly [12]

# Unsupervised Learning – Anomaly Detection

## Examples:

1. Golf Cart
2. Credit Card Fraud Detection

## Real Time Anomaly Detection

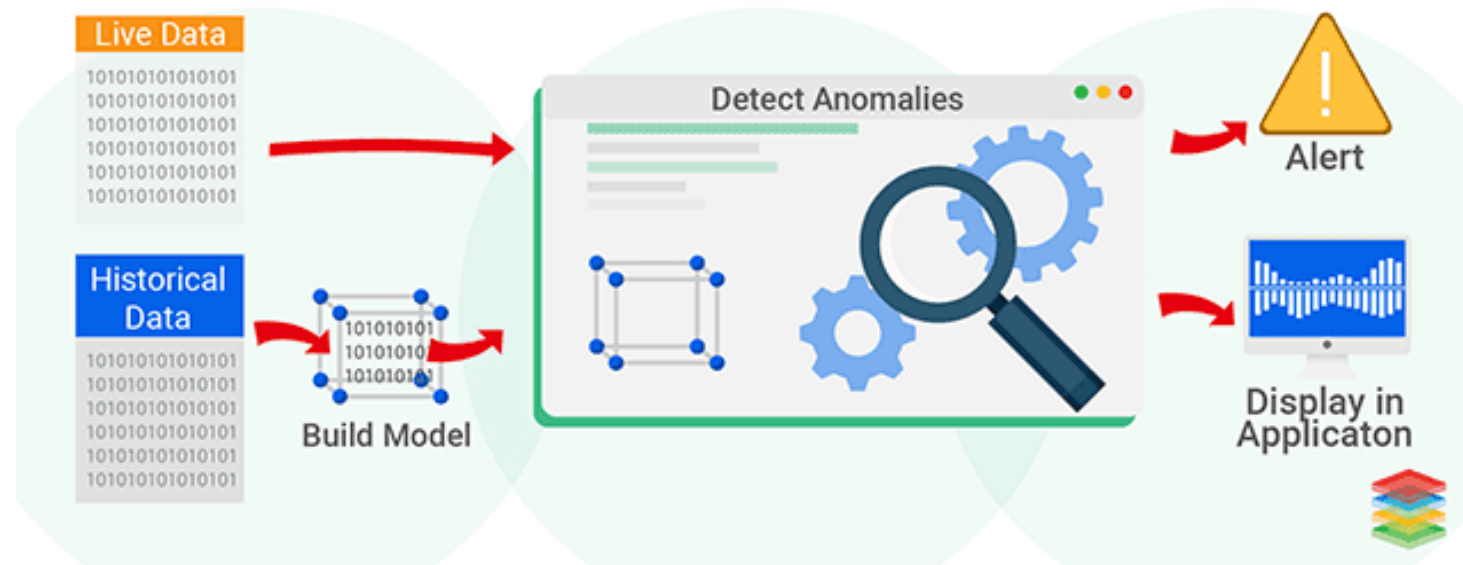


Figure 13: Credit Card Fraud Detection [13]

# Reinforcement Learning

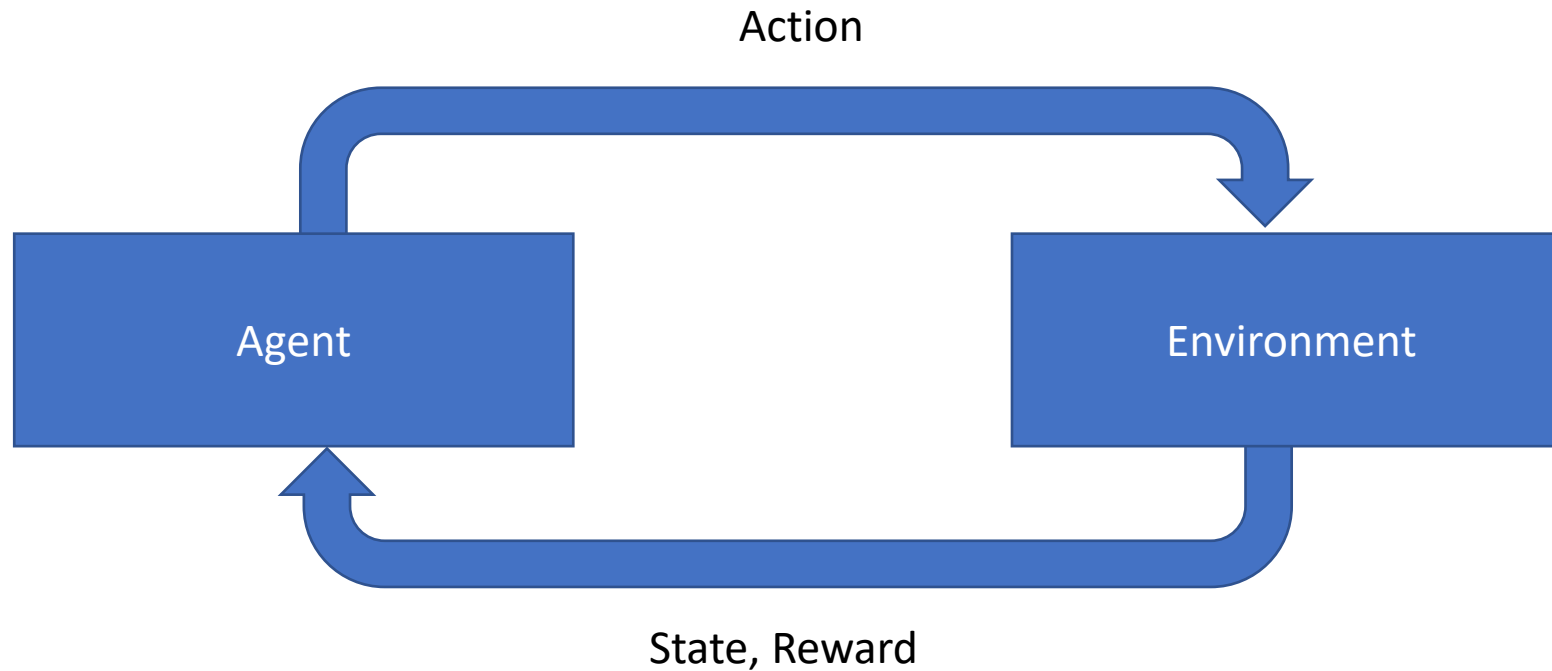


Figure 14: Overview of Reinforcement Learning [8]

# Reinforcement Learning

Time for some examples!

# Reinforcement Learning



Video 1: Deep Q Learning - Reinforcement Learning Example [8]



# A bit more about Machine Learning

Exploring the basics of Neural Networks!



# Neural Networks

A simple neural network

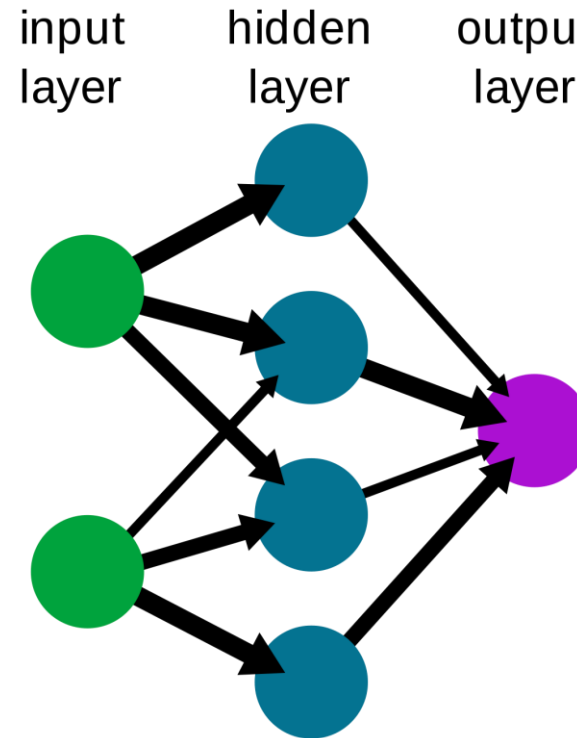


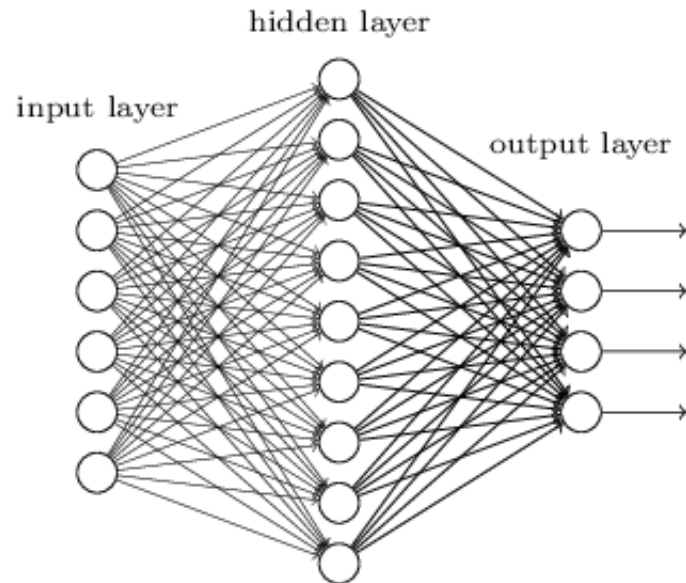
Figure 15: Structure of Neural Networks [14]

# Let's train a Neural Networks model!

Open this [link](#) in your browser!

# Deep Neural Networks

"Non-deep" feedforward neural network



Deep neural network

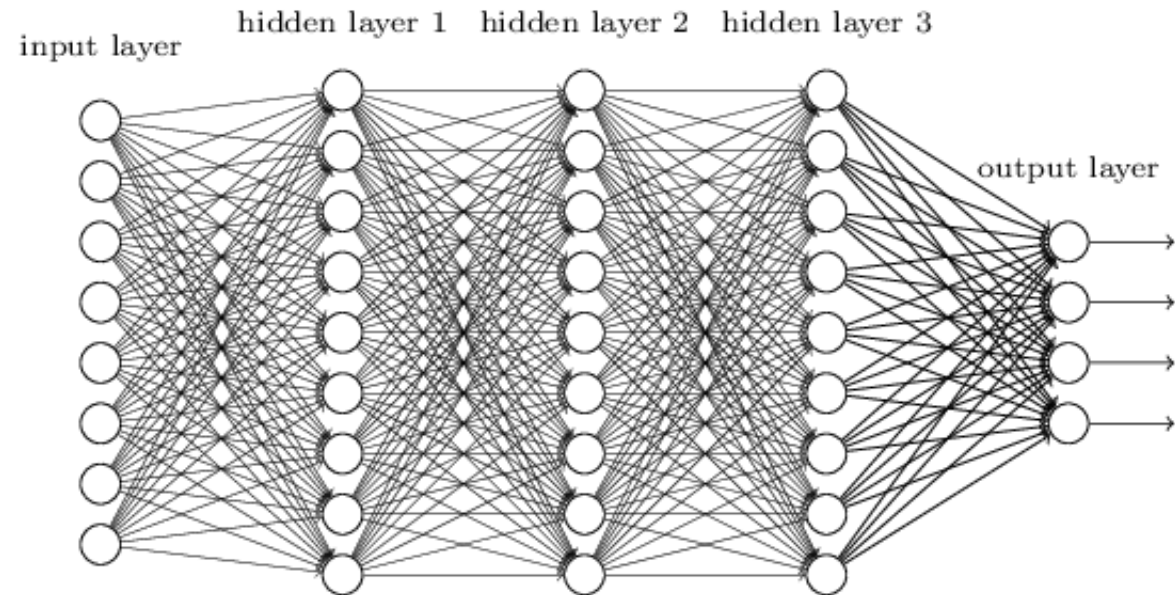


Figure 16: Structure of Deep Neural Networks [15]

# Tools and Frameworks for ML

A quick overview



# Frameworks and Tools for ML

- Programming languages
  - Python
  - R
  - C++
  - ...
- Machine Learning libraries:
  - scikit-learn - For Classical ML
  - PyTorch
  - TensorFlow
  - Keras
  - ⋮

For Deep Learning
- Data Visualization:
  - Matplotlib
  - Seaborn
  - plotly
  - ...
- Data Loading/ Pre-processing
  - numpy
  - pandas
  - ⋮

List 1: Some useful tools for Machine Learning [16]

# What are the limitations?

Or are there any?

# Data hungry models

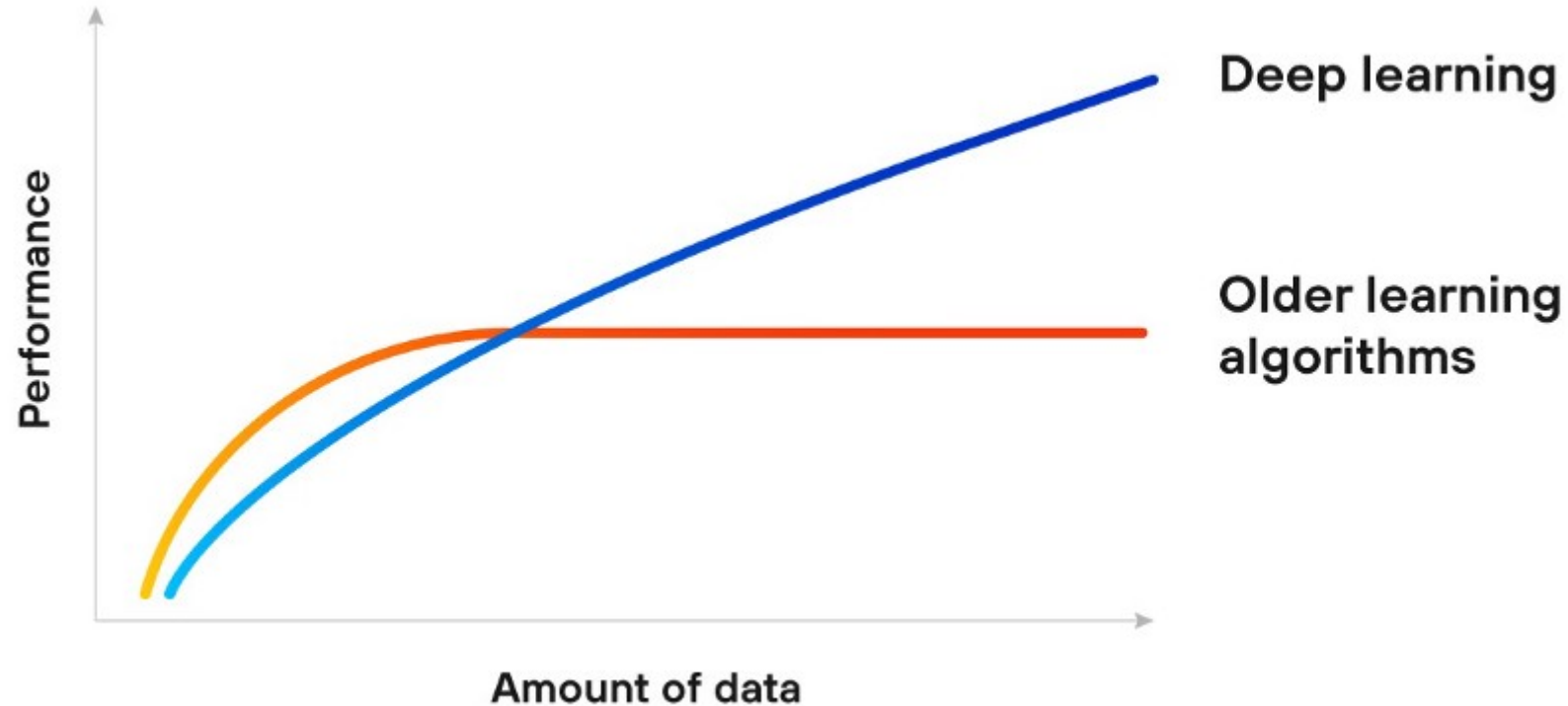


Figure 17: Huge volume of Data – Deep Learning [17]



# Narrow vs General AI

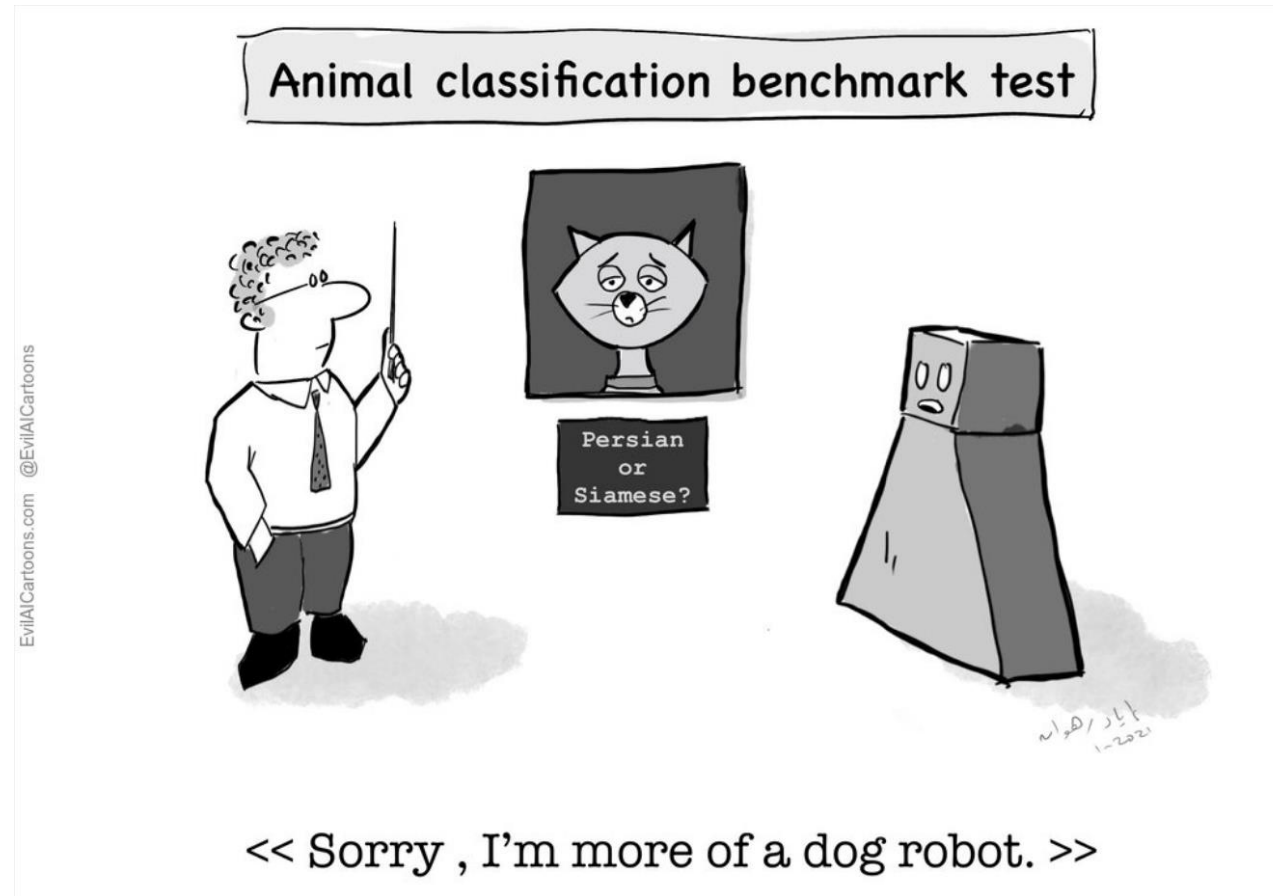


Figure 18: Limiting Models to Specific Tasks [18]

# ML as a Black Box

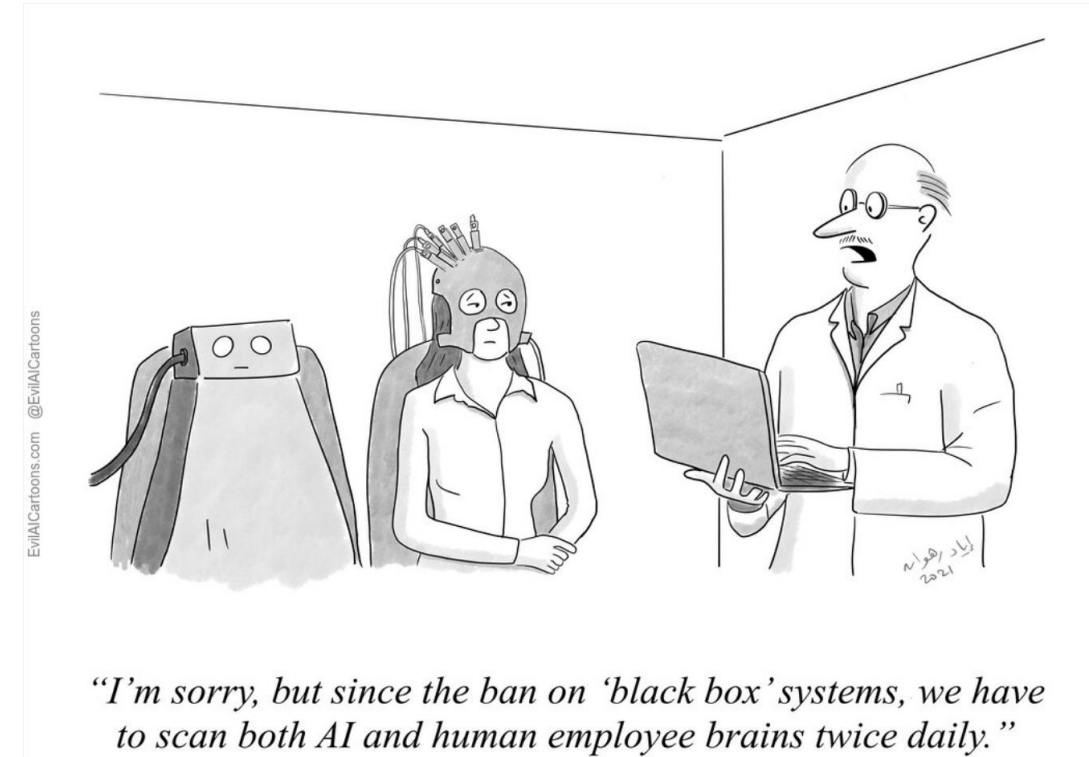
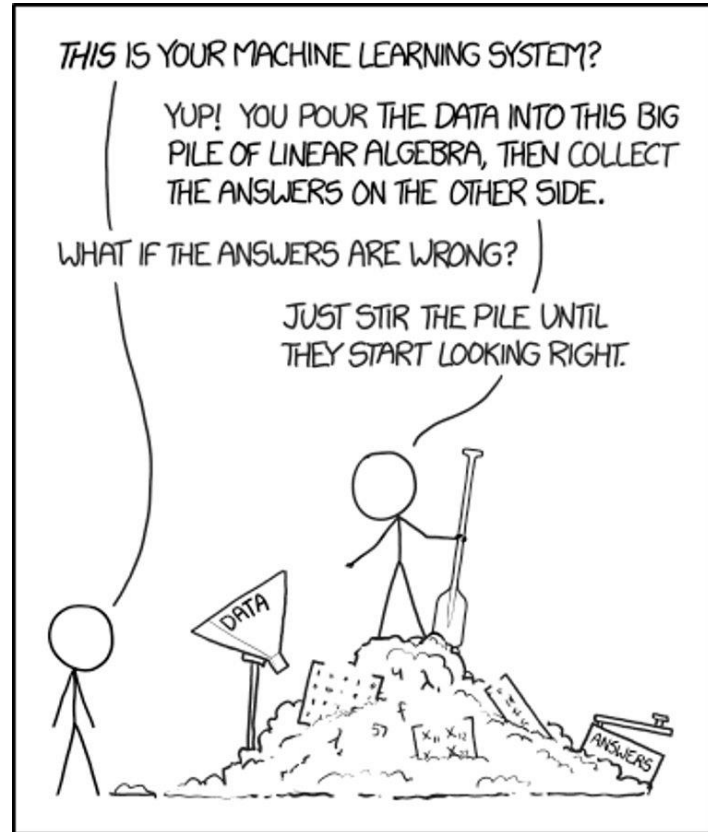


Figure 19: Machine Learning as a Black Box [19] [20]

# Ethics & AI

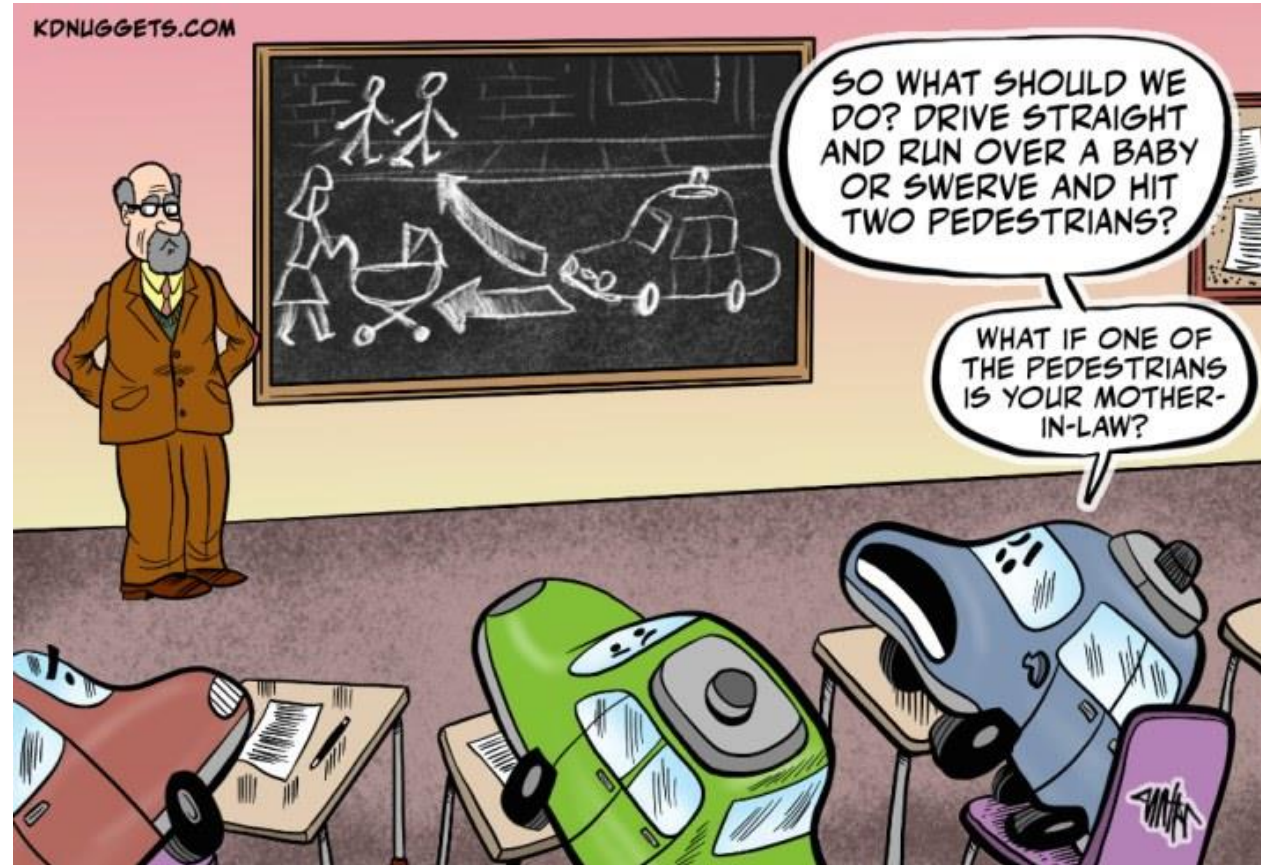


Figure 20: Creating Ethical Models [21]

# Some failures regarding ML projects

Such failures occur because you are ...

- Asking the wrong question
- Trying to solve the wrong problem
- Not having enough data
- Not having the right data
- Having too much data
- Using the wrong tools
- Not having the right model
- ⋮

List 2: Common reasons for ML project failure [22]

# References (1/6)

[1] <https://swisscognitive.ch/2021/03/18/applications-of-machine-learning>

[2] <https://crate.io/a/machine-learning-cratedb-jupyter/>

[3] <https://www.aitimejournal.com/@nisha.arya.ahmed/what-is-artificial-intelligence-ai>

[4] Mitchell, Tom. (1997). Machine Learning. McGraw Hill. p. 2. ISBN 0-07-042807-7.

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[5] Adapted from slides by Pedro Domingos

[6] <https://brilliant.org/wiki/machine-learning/>

[7] <https://neurospace.io/blog/2019/03/ai-and-ethics/>

[8] Adapted from "Machine Learning 10-401, Spring 2018" by Maria-Florina (Nina) Balcan

# References (3/6)

[9] Adapted from "Machine Learning 10-401, Spring 2018" by Maria-Florina (Nina) Balcan

[10] <https://in.springboard.com/blog/regression-vs-classification-in-machine-learning/>

[11] <https://datalya.com/customer-segmentation-services.php>

[12] <https://towardsdatascience.com/prototyping-an-anomaly-detection-system-for-videos-step-by-step-using-lstm-convolutional-4e06b7dcdd29>

# References (4/6)

[13] <https://www.xenonstack.com/blog/real-time-anomaly-detection>

[14] [https://en.wikipedia.org/wiki/Neural\\_network/](https://en.wikipedia.org/wiki/Neural_network/)

[15] <https://stats.stackexchange.com/a/184921>

[16] Adapted from "Introduction to machine learning/AI" by Geert Jan Bex, Jan Ooghe, Ehsan Moravveji



# References (5/6)

[17] <https://towardsdatascience.com/is-deep-learning-hitting-the-wall-d2f560419daf>

[18] <https://www.evilaicartoons.com/archive/terminology-narrow-vs-general-ai/>

[19] <https://www.evilaicartoons.com/archive/terminology-black-box>

[20] <https://xkcd.com/1838/>

# References (6/6)

[21] <https://www.kdnuggets.com/2020/01/cartoon-teaching-ethics-ai.html/>

[22] Adapted from "Introduction to machine learning/AI" by Geert Jan Bex, Jan Ooghe, Ehsan Moravveji/

# Further Reading(s)

