

# Introduction to Machine Learning

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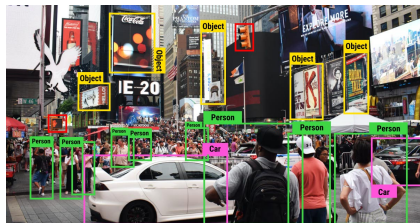
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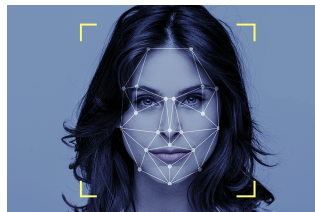
# What is Machine Learning?

- ▶ Arthur Samuel (1959). Machine learning is a “Field of study that gives computers the ability to learn without being explicitly programmed”.
- ▶ Tom Mitchell (1998). “A computer program 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  $E$ ”.

# Some applications - Image recognition



(a)



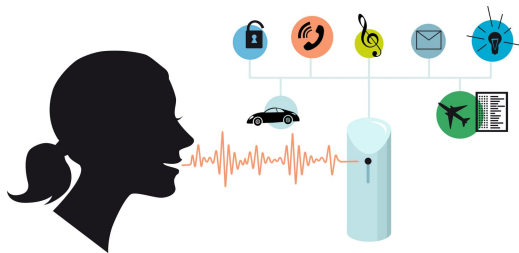
(b)

Two examples of image recognition.

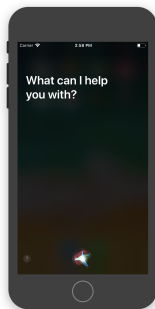
(a) Labelling different entities in a given image.

(b) Face recognition (as in our smartphones).

# Some applications - Speech and voice recognition



(c)



(d)

Two examples of speech and voice recognition.

(c) A general idea of speech recognition.

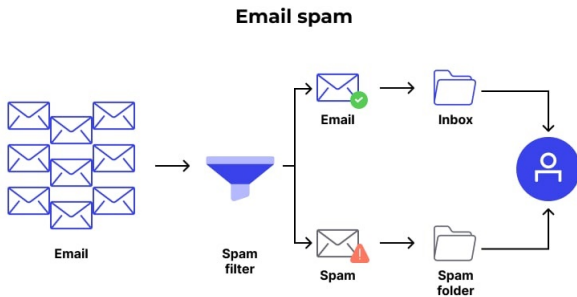
(d) Apple Siri.

## Some applications - Self driving cars



Using e.g. image recognition, companies are building self-driving cars increasingly efficient.

# Some applications - Email spam filtering



Determine if a given email is spam or not.

## Some applications - Learning how to play games



"AlphaGo is the first computer program to defeat a professional human Go player, the first to defeat a Go world champion, and is arguably the strongest Go player in history."

More info: <https://www.deepmind.com/research/highlighted-research/alphago>

# Supervised Learning

In **supervised learning**, a dataset of input-output relations is provided. The learning is supervised because we already know how the current looks like.

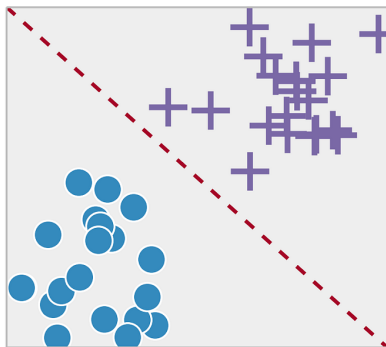
Two type of supervised learning problems:

- ▶ **Regression.** Predict results within a continuous output.  
Example: Predict the price of an house given its size.
- ▶ **Classification.** Predict results within a discrete output (categorical data).  
Example: Given an email, predict if it is spam or not (*binary classification*)

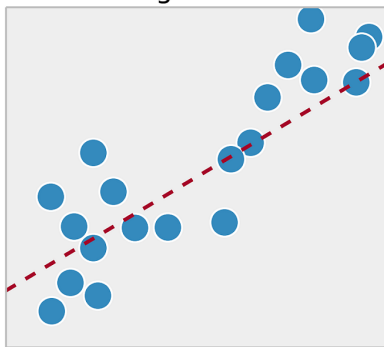


# Supervised Learning - an example

Classification



Regression



# Unsupervised Learning

In **unsupervised learning**, we have no idea how the output looks like (unlabeled data). We have to derive structure and different relationships from data.

Examples:

- ▶ Take a collection of essays and find a way to automatically group them based on word frequency, sequence length, page counts etc.
- ▶ Recommender systems. Automatically provide suggestions for an item that is most pertinent to a particular user.

# Unsupervised Learning - an example

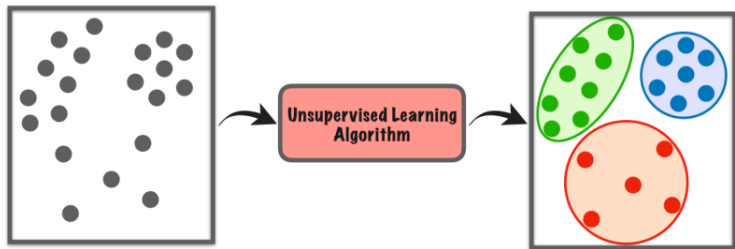


Figure: A clustering example.