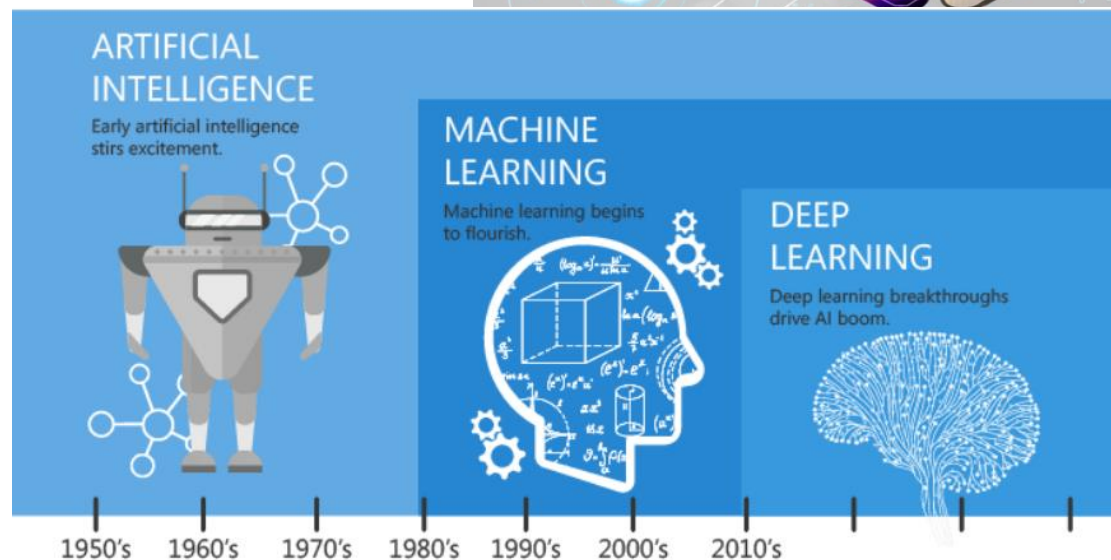# Lecture 13
Artificial Intelligence
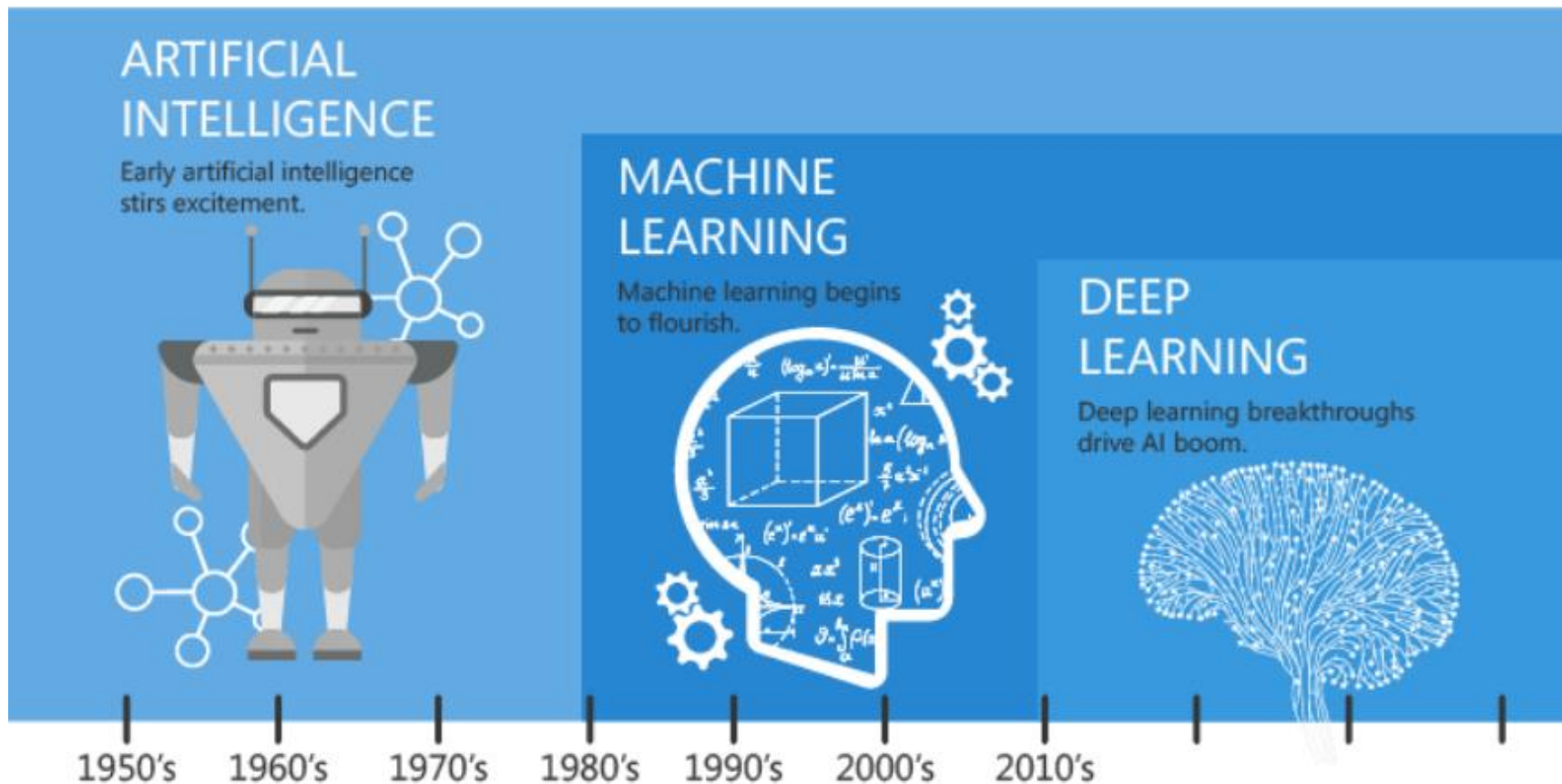
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Introduction of machine learning

➢ Machine learning

Introduction of machine learning

➢ Machine learning is a subfield of artificial intelligence (AI).

➢ Arthur Samuel, coined the term "Machine Learning "

➢ He defined machine learning as

  ➢ "the field of study that gives computers the ability to learn without being explicitly programmed ".

➢ However, there is no universally accepted definition for machine learning.

➢ given below another definition.

  ➢ The field of study known as machine learning is concerned with the question of how to construct computer programs that automatically improve with experience.

Introduction of machine learning

➢ 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 T, as measured by P , improves with experience E.

➢ A well-defined learning task is given by .

$$<P, T, E>.$$

Introduction of machine learning

➤ Traditional learning

Traditional Programming

Data ⟶ [Computer] ⟶ Output
Program ⟶

➤ Machine learning

Machine Learning

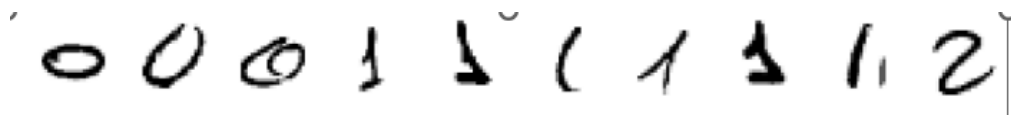Data ⟶ [Computer] ⟶ Program
Output ⟶

Introduction of machine learning

➢ Definition of learning:

> ➢ 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 T, as measured by P , improves with experience E.

➢ **Example:**

➢ Handwriting recognition learning problem

> ➢ Task T : Recognizing and classifying handwritten words within images
>
> ➢ Performance P : Percent of words correctly classified
>
> ➢ Training experience E : A dataset of handwritten words with given classifications

Introduction of machine learning

➢A robot driving learning problem

➢Task T : Driving on highways using vision sensors

➢Performance P : Average distance traveled before an error

➢Training experience E : A sequence of images and steering commands recorded while observing a human driver

➢Email Spam Filter:

➢T: Categorize email messages as spam or legitimate

➢ P: Percentage of email messages correctly classified
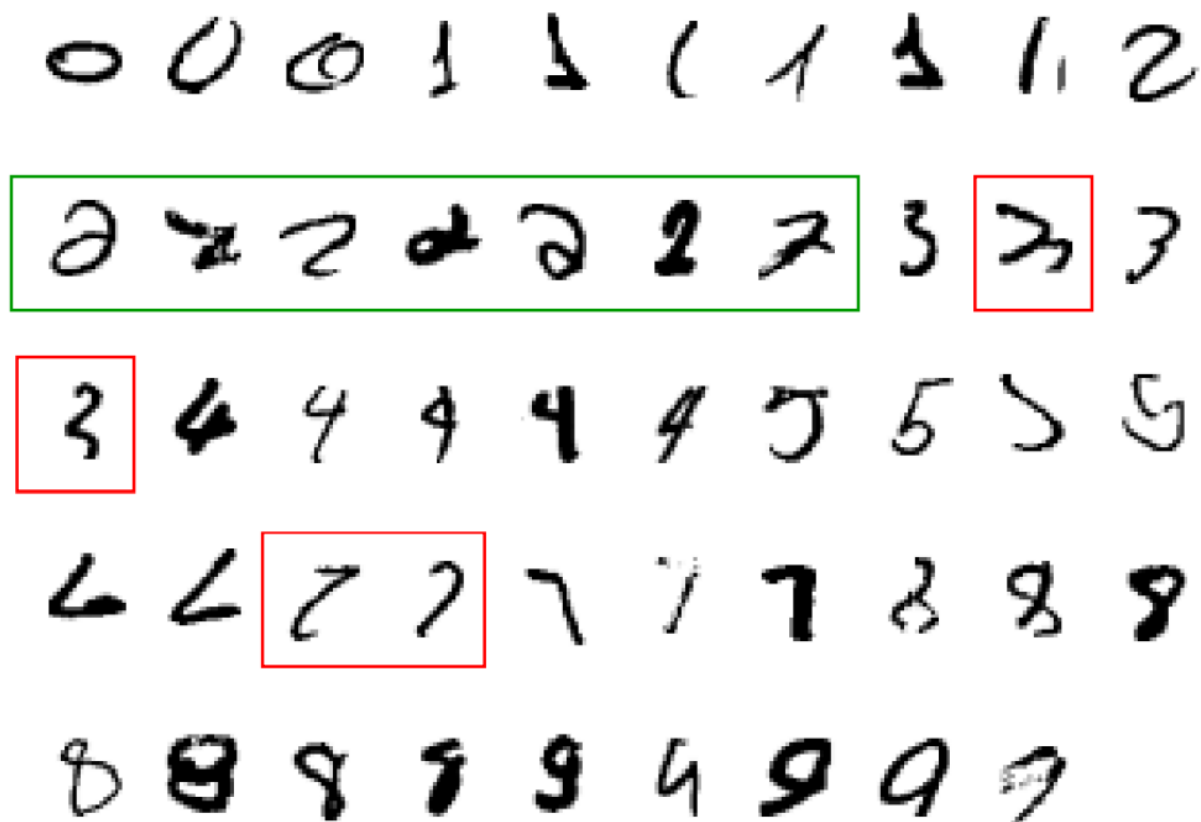
➢E: Database of emails, some with human-given labels

When Do We Use Machine Learning?

➤ ML is used when:

    ➤ Human expertise does not exist (navigating on Mars)

    ➤ (speech recognition)

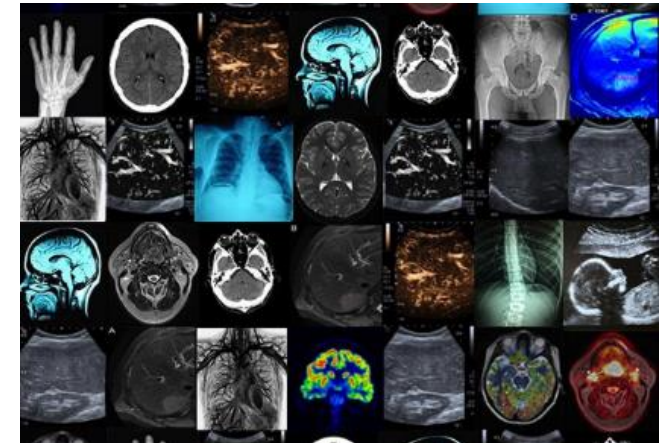   ➤ Models must be customized (personalized medicine)

When Do We Use Machine Learning?

➢A classic example of a task that requires machine

learning: It is very hard to say what makes a 2

When Do We Use Machine Learning?

➤ Recognizing patterns:

  ➢ Facial identities or facial expressions

  ➢ Handwritten or spoken words

  ➢ Medical images

When Do We Use Machine Learning?

➤ Generating patterns:

➤ Generating images

➤ Recognizing anomalies:

➤ Unusual credit card transactions

➤ Unusual patterns of sensor readings in a nuclear power plant

➤ Detecting anomalies (frauds)

➤ Prediction:

➤ Future stock prices or currency exchange rates
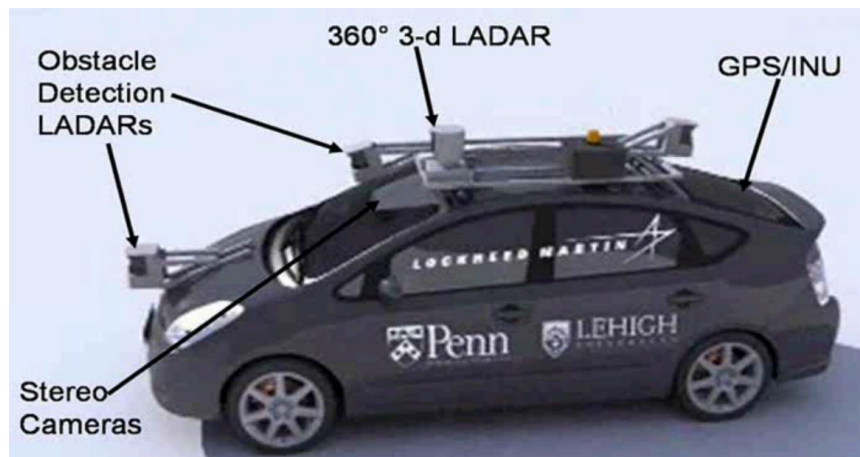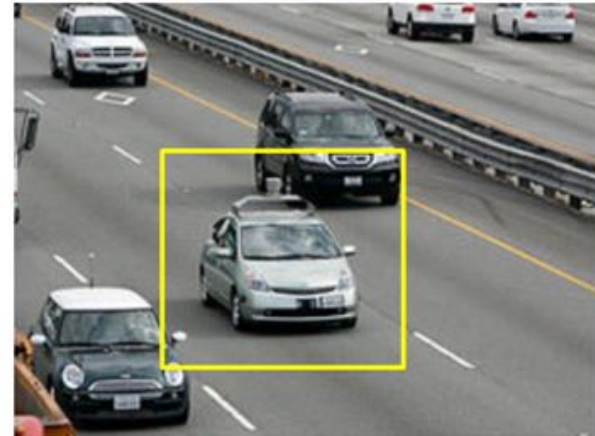
➤ Decision Making (AI, Robotics)

When Do We Use Machine Learning?

- **Sample Application:**

  - Web search

  - Computational biology

  - Finance

  - E-commerce

  - Space exploration

  - Robotics

  - Information extraction

  - Social networks

  - Ranking (Google search, author ranking)

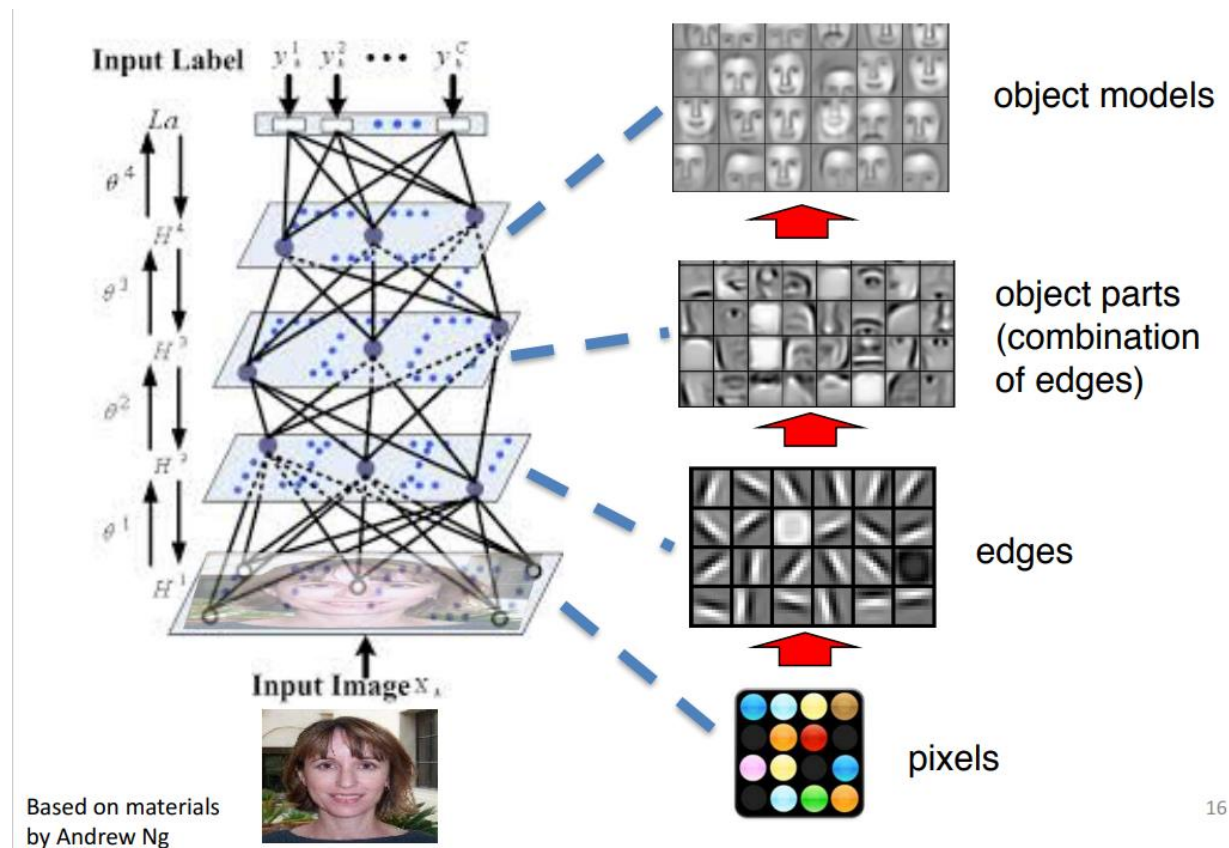 - Summarization (Social media sentiment)

When Do We Use Machine Learning?

➢Autonomous Cars

State of the art

➢Deep Learning

➢Deep Belief Net on Face Images

Machine learning

➢Types of learning

➢ Machine learning implementations are classified into four major categories, depending on the nature of the learning

1. Supervised learning

2. Unsupervised learning

3. Reinforcement learning

4. Semi-supervised learning

Machine learning

➤ Supervised learning:

➤ Supervised learning is the machine learning task of learning a function that maps an input to an output based on example input-output pairs.

➤ The given data is labeled

➤ Both *classification* and *regression* problems are supervised learning problems

  ➤ Example — Consider the following data regarding patients entering a clinic . The data consists of the gender and age of the patients and each patient is labeled as "healthy" or "sick".

Machine learning

➢ Supervised learning:

➢ Example

➢ Spam Filter

Enables the machine to be trained to classify observations into some class
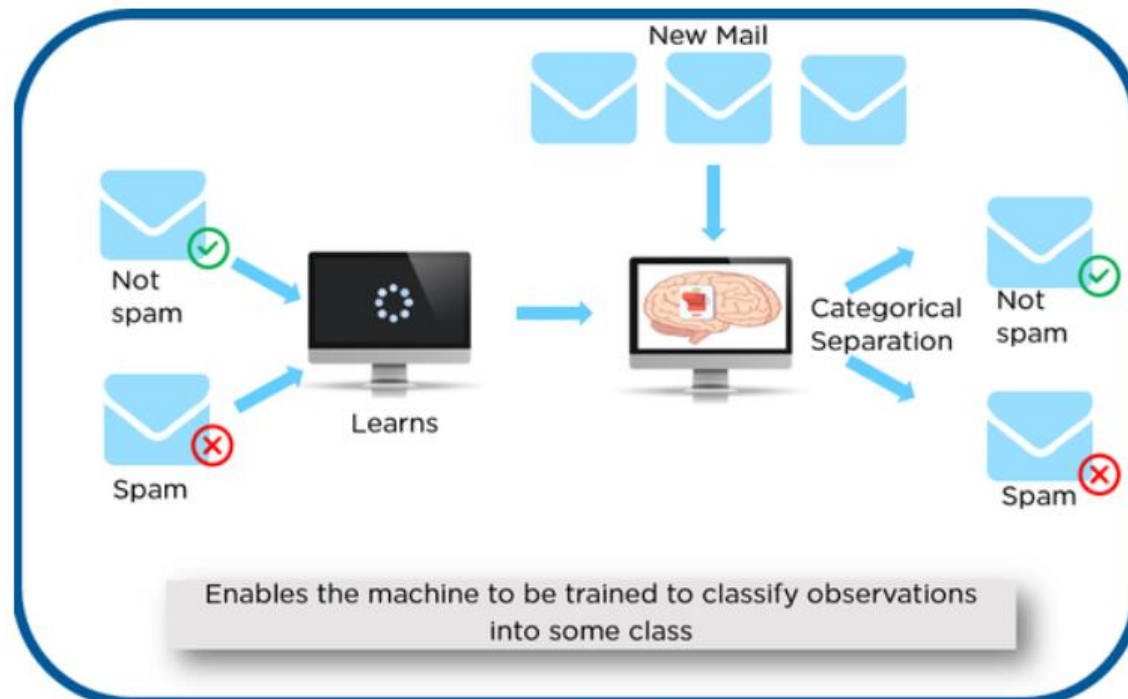
Machine learning

➤ Supervised learning:

➤ Example

➤ Consider the following data regarding patients entering a clinic The data consists of the gender and age of the patients and each patient is labeled as "healthy" or "sick".

gender	age	label
M	48	sick
M	67	sick
F	53	healthy
M	49	sick
F	32	healthy
M	34	healthy
M	21	healthy

Credit: Khola Naseem

Machine learning

➢ Unsupervised learning:

  ➢ Unsupervised learning is a type of machine learning algorithm used to draw inferences from datasets consisting of input data without labeled responses.

  ➢ In unsupervised learning algorithms, classification or categorization is not included in the observations.

  ➢ Consider the following data regarding patients entering a clinic. The data consists of the gender and age of the patients.

gender	age
M	48
M	67
F	53
M	49
F	34
M	21

Credit: Khola Naseem

Machine learning

➢ Unsupervised learning:

➢ As a kind of learning, it resembles the methods humans use to figure out that certain objects or events are from the same class, such as by observing the degree of similarity between objects.

➢ Some recommendation systems that you find on the web in the form of marketing automation are based on this type of learning.