Section 2

Artificial Intelligence, Concept and Application

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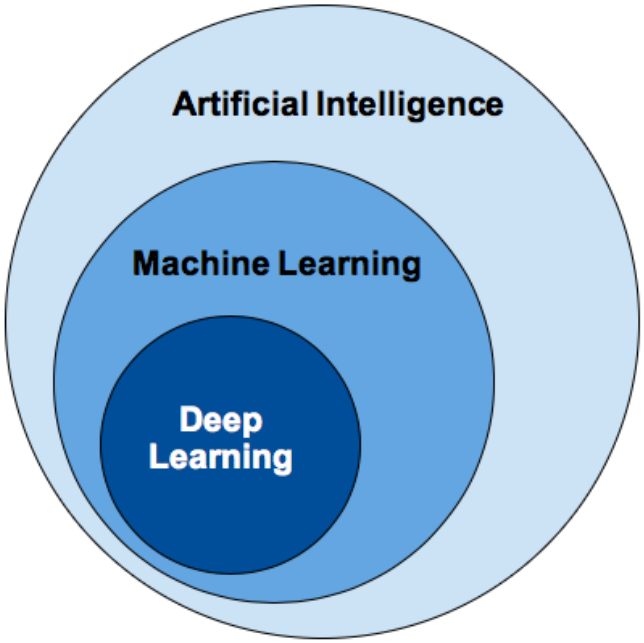
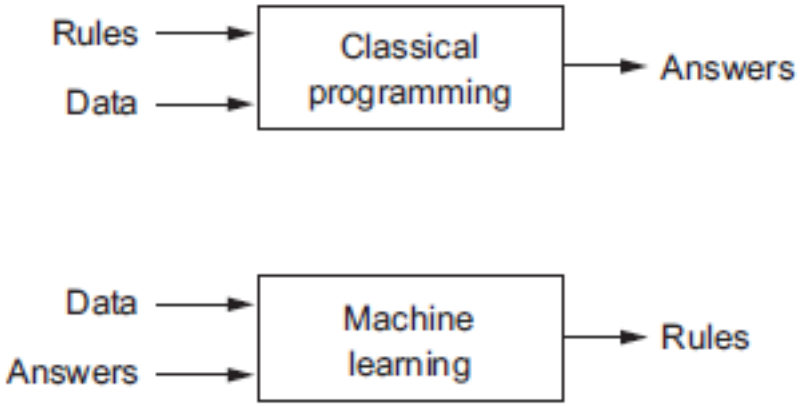
Artificial Intelligence (AI)



- **Artificial Intelligence (AI), born in 1950s**: is a general field that encompasses machine learning and deep learning, but that also includes many more approaches that don't involve any learning.
- Early chess programs, for instance, only involved hardcoded rules crafted by programmers, and didn't qualify as machine learning.
- For a fairly long time, many experts believed that human-level artificial intelligence could be achieved by having programmers handcraft a sufficiently large set of explicit rules for manipulating knowledge. This approach is known as symbolic AI, and it was the dominant paradigm in AI from the 1950s to the late 1980s. It reached its peak popularity during the expert systems boom of the 1980s.

Machine Learning (ML)

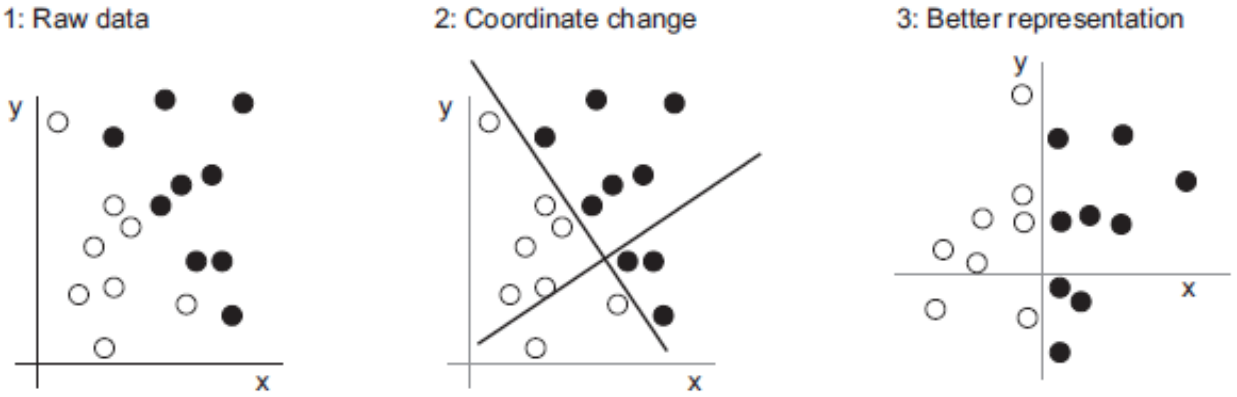


- A new approach arose to take symbolic AI's place: machine learning.
- In classical programming, the paradigm of symbolic AI, humans input rules (a program) and data to be processed according to these rules, and out come answers (see figure). With machine learning, humans input data as well as the answers expected from the data, and out come the rules. These rules can then be applied to new data to produce original answers.
- **A machine-learning (ML) system is:** trained rather than explicitly programmed. It's presented with many examples relevant to a task, and it finds statistical structure in these examples that eventually allows the system to come up with rules for automating the task.

Machine Learning (ML)

- To define deep learning and understand the difference between deep learning and other machine-learning approaches, first we need some idea of what machine learning algorithms do. I just stated that machine learning discovers rules to execute a data-processing task, given examples of what's expected. So, to do machine learning, we need three things:
  1. Input data points—For instance, if the task is speech recognition, these data points could be sound files of people speaking. If the task is image tagging, they could be pictures.
  2. Examples of the expected output—In a speech-recognition task, these could be human-generated transcripts of sound files. In an image task, expected outputs could be tags such as "dog," "cat," and so on.
  3. A way to measure whether the algorithm is doing a good job—This is necessary in order to determine the distance between the algorithm's current output and its expected output. The measurement is used as a feedback signal to adjust the way the algorithm works. *This adjustment step is what we call learning*.

Machine Learning (ML)

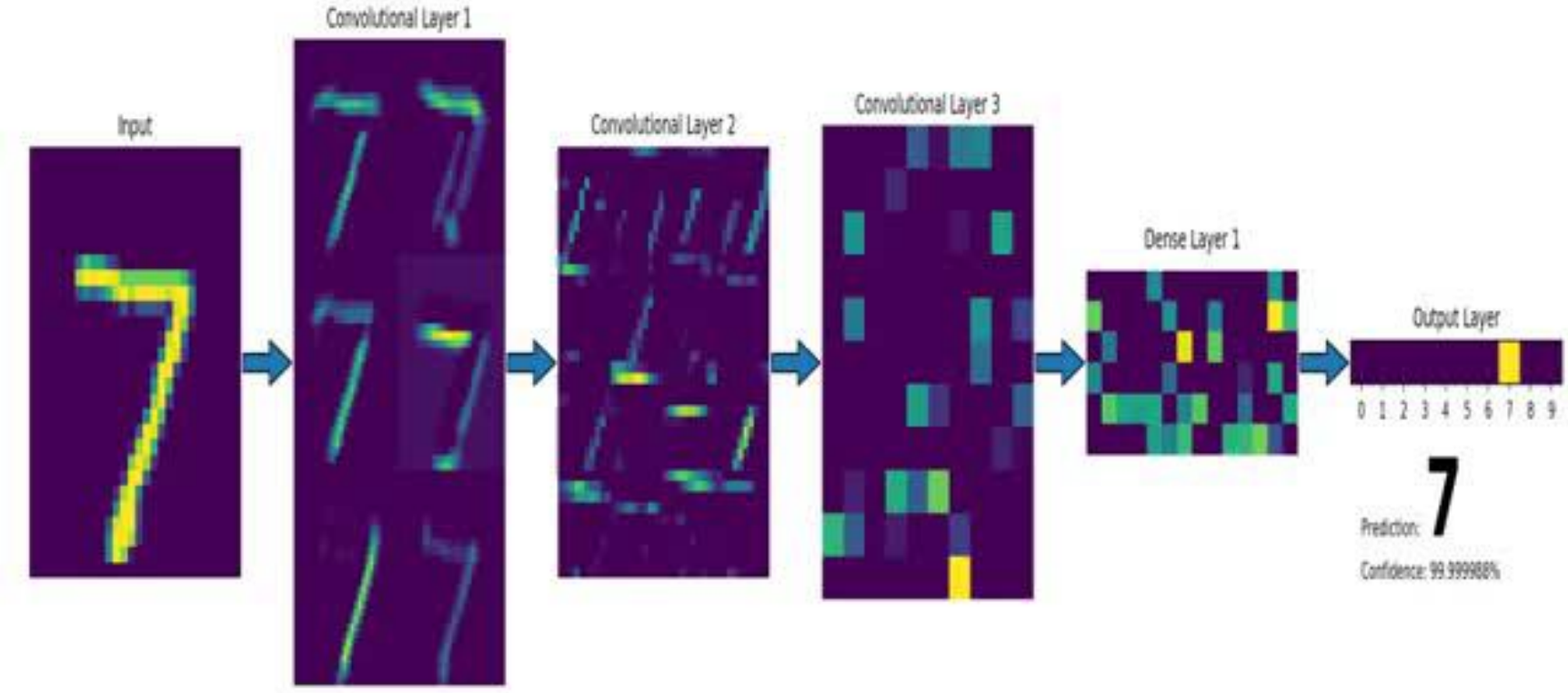


"In this case, we defined the coordinate change by hand. But if instead we tried systematically searching for different possible coordinate changes and used as feedback the percentage of points being correctly classified, then we would be doing machine learning. Learning, in the context of machine learning, describes an automatic search process for better representations."

Deep Learning (DL)

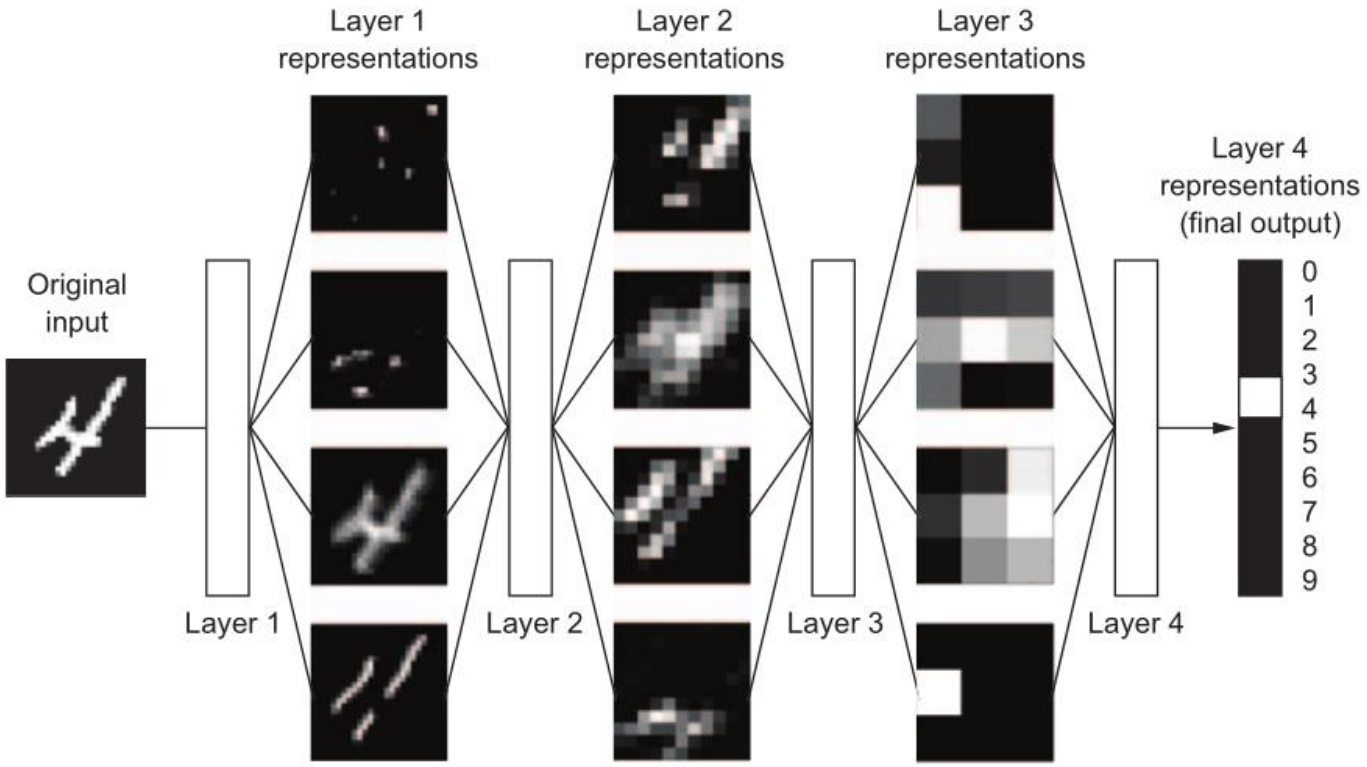
- **Deep learning (DL) is:** a specific subfield of machine learning: a new take on learning representations from data that puts an emphasis on learning successive layers of increasingly meaningful representations.
- The deep in deep learning isn't a reference to any kind of deeper understanding achieved by the approach; rather, it stands for this idea of successive layers of representations. How many layers contribute to a model of the data is called the depth of the model.
- In deep learning, these layered representations are (almost always) learned via models called neural networks, structured in literal layers stacked on top of each other.
- The term neural network is a reference to neurobiology, but although some of the central concepts in deep learning were developed in part by drawing inspiration from our understanding of the brain, deep-learning models are not models of the brain.
- For our purposes, deep learning is a mathematical framework for learning representations from data.

Deep Learning (DL)



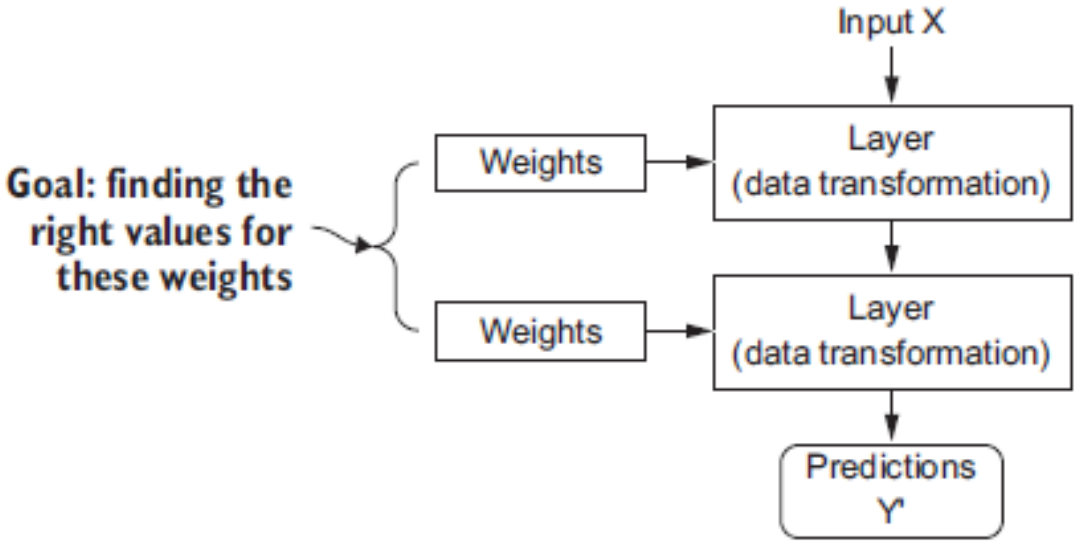
Deep Learning (DL)

- How Do Deep Learning Work?



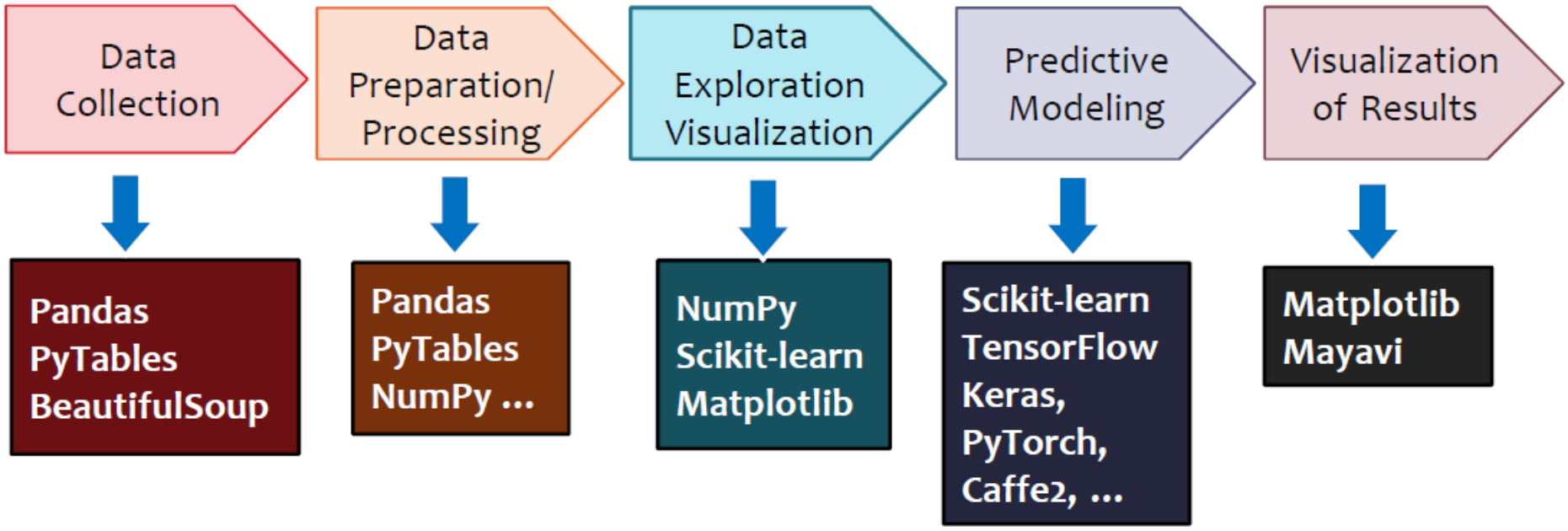
Deep representations learned by a digit-classification model

Deep Learning (DL)



"At this point, you know that machine learning is about mapping inputs (such as images) to targets (such as the label "cat"), which is done by observing many examples of input and targets. You also know that deep neural networks do this input-to-target mapping via a deep sequence of simple data transformations (layers) and that these data transformations are learned by exposure to examples."

Data Analysis (Process)



"All these activities can be grouped as above"

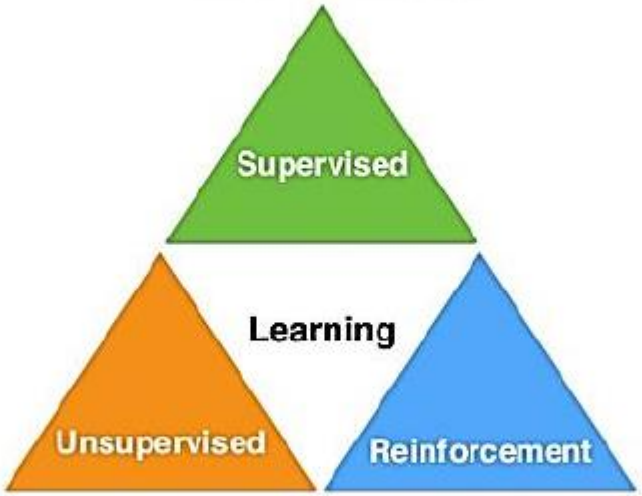
Conclusion of ML

- Machine learning is often categorized as a subfield of artificial intelligence.
- In the data science application of machine learning methods, it's more helpful to think of machine learning as a means of building models of data.
- Fundamentally, machine learning involves building mathematical models to help understand data.

Categories of ML

- Supervised learning
- Unsupervised learning
- Reinforcement Learning

- Labeled data
- Direct feedback
- Predict outcome/future



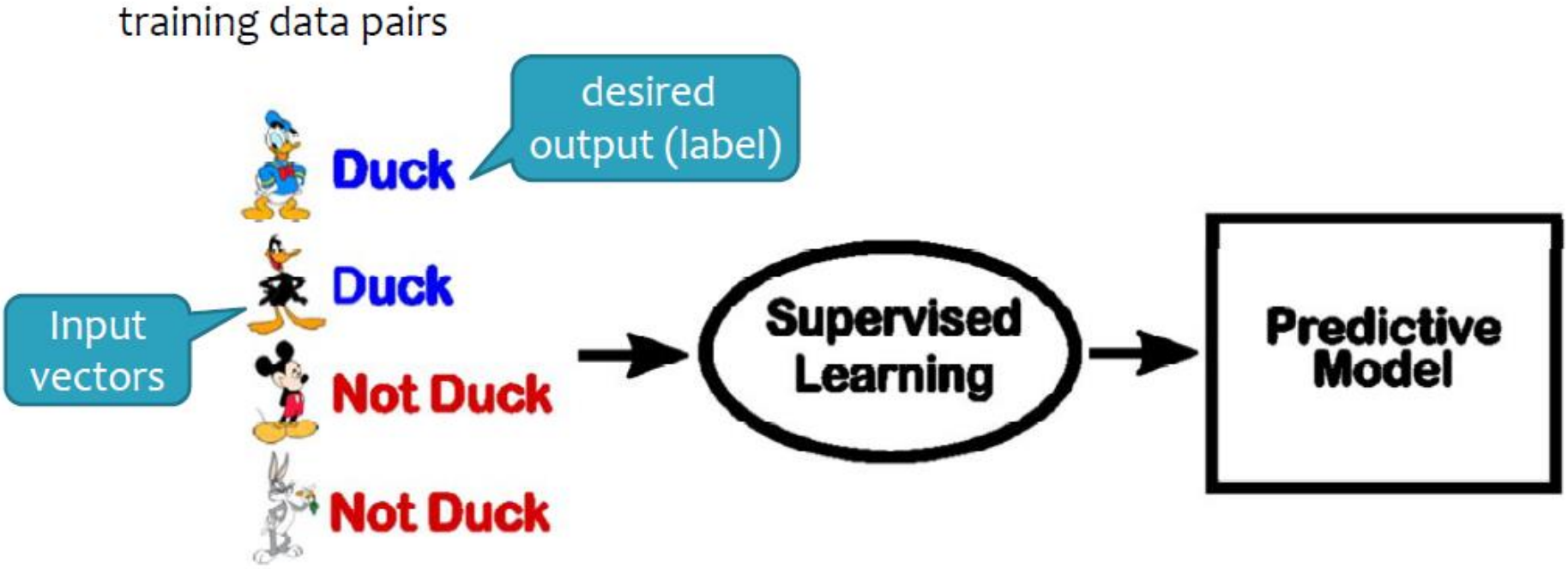
- No labels
- No feedback
- "Find hidden structure"

- Decision process
- Reward system
- Learn series of actions

Supervised Learning

- Supervised learning
  - The training data consist of a set of training examples.
  - Each example is a pair consisting of an input object (typically a vector) and a desired output.
  - A supervised learning algorithm analyzes the training data and produces an inferred model.
  - Classification problems: Convolutional Neural Networks are a great example of this, as the images are the inputs and the outputs are the classifications of the images (dog, cat, etc).

Supervised Learning

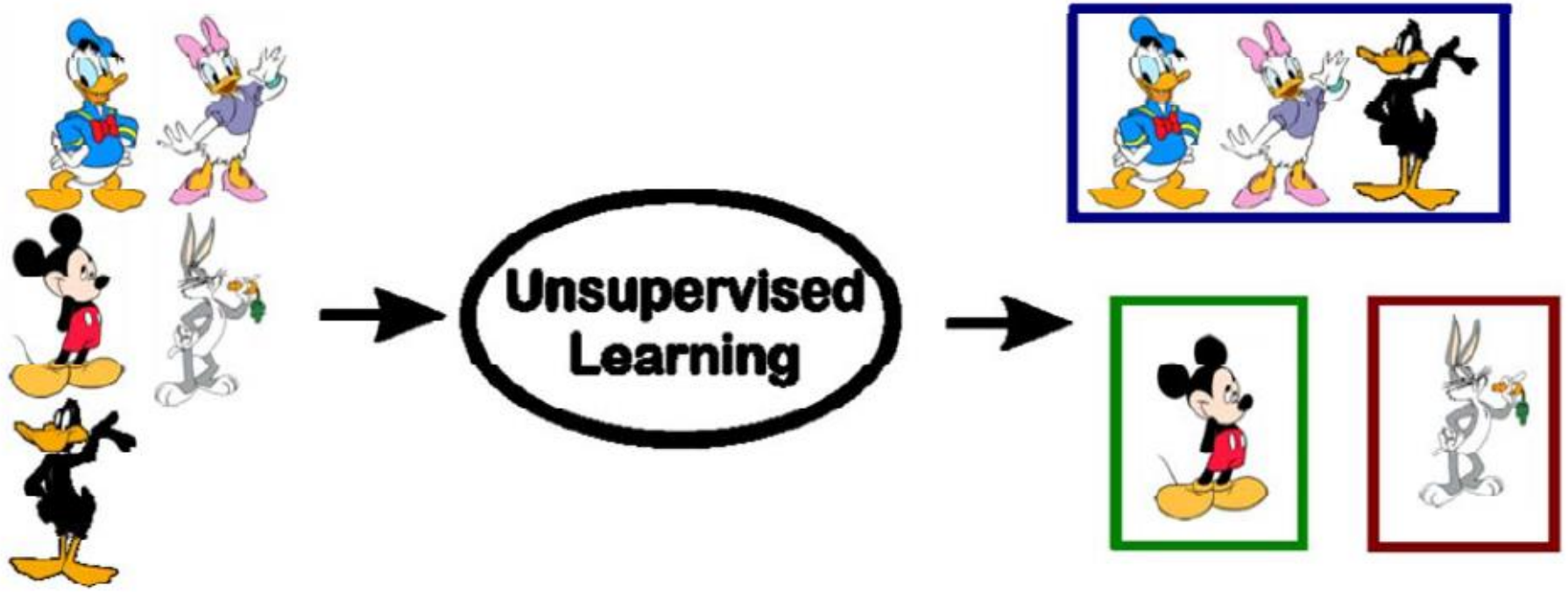


Unsupervised Learning

- Unsupervised learning
  - Training data consist of a set of input vectors x without any corresponding target values.
  - The goal in such unsupervised learning problems is to discover groups of similar examples within the data.
  - Clustering problems: K-Means, is an example of unsupervised learning.

Unsupervised Learning

It can be regarded as a clustering problem.



Reinforcement Learning

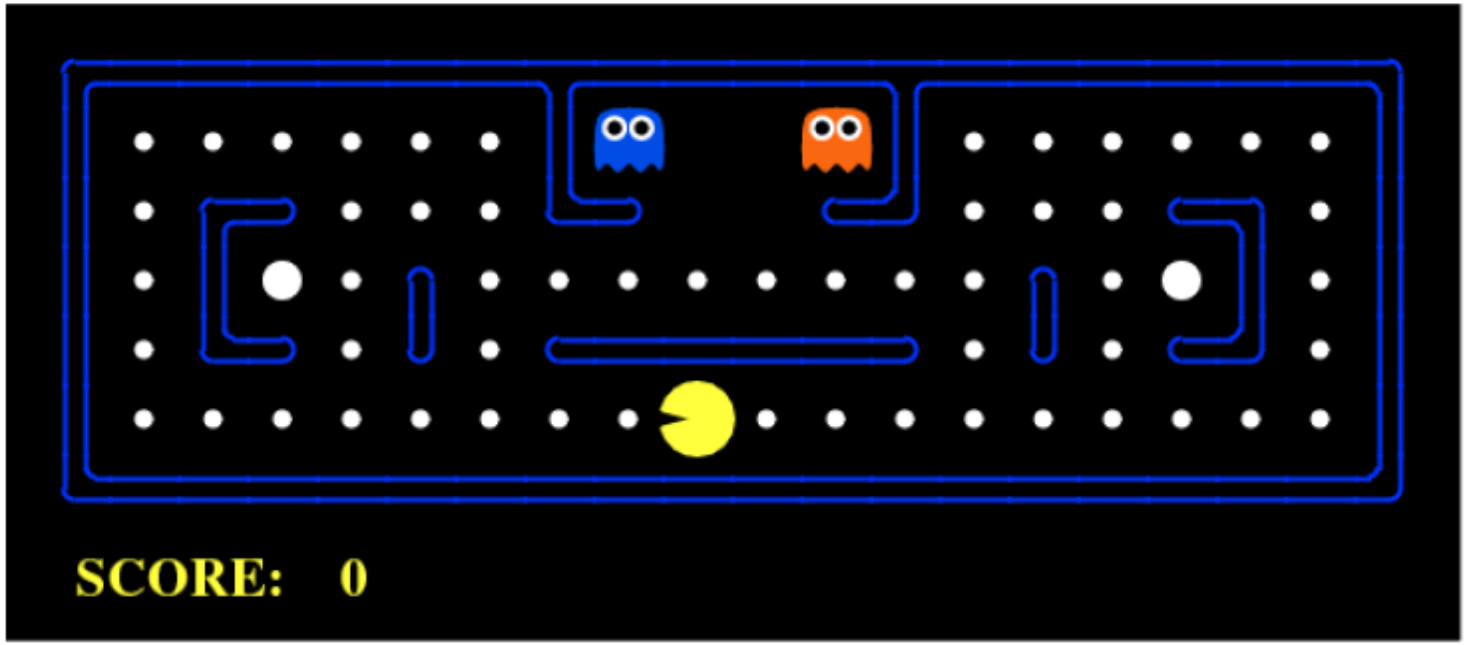
- Reinforcement learning
  - RL is the task of learning what actions to take, given a certain situation/environment, so as to maximize a reward signal.
  - This reward signal simply tells you whether the action (or input) that the agent takes is good or bad.
  - It doesn't tell you anything about what the best action is.
  - Another unique component of RL is that an agent's actions will affect the subsequent data it receives.
    - For example, an agent's action of moving left instead of right means that the agent will receive different input from the environment at the next time step.

Reinforcement Learning

- The major components of reinforcement learning
  - **Set of Environment States:** Such as the different states in the game at a point in time.
  - **Set of Actions:** Such as Up , Down ,Left ,Right and a Fire button.
  - **Rules of transitioning between states:** We need to keep track of the best next state we can go to.
  - **Rules that determine the scalar immediate reward of a transition:** For every transition that the algorithm decides to take there is an associated reward associated with that step.
    - For example when you kill an opponent you get a positive reward and when you get hurt you get a negative reward.

Reinforcement Learning

PacMan game



Introducing Scikit-Learn

- There are several Python libraries that provide solid implementations of a range of machine learning algorithms.
- One of the best known is Scikit-Learn, a package that provides efficient versions of a large number of common algorithms.
- https://scikit-learn.org/stable/index.html

Introducing Scikit-Learn

Telkom University

Classification

Identifying to which category an object belongs to.

Applications: Spam detection, Image recognition.
Algorithms: SVM, nearest neighbors, random forest, ... — Examples

Regression

Predicting a continuous-valued attribute associated with an object.

Applications: Drug response, Stock prices.
Algorithms: SVR, ridge regression, Lasso, ... — Examples

Clustering

Automatic grouping of similar objects into sets.

Applications: Customer segmentation, Grouping experiment outcomes
Algorithms: k-Means, spectral clustering, mean-shift, ... — Examples

Dimensionality reduction

Reducing the number of random variables to consider.

Applications: Visualization, Increased efficiency
Algorithms: PCA, feature selection, non-negative matrix factorization. — Examples

Model selection

Comparing, validating and choosing parameters and models.

Goal: Improved accuracy via parameter tuning
Modules: grid search, cross validation, metrics. — Examples

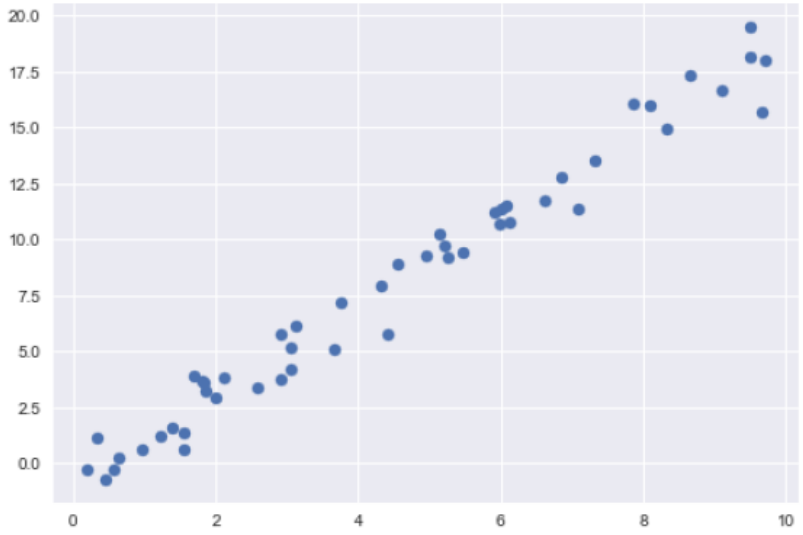
Preprocessing

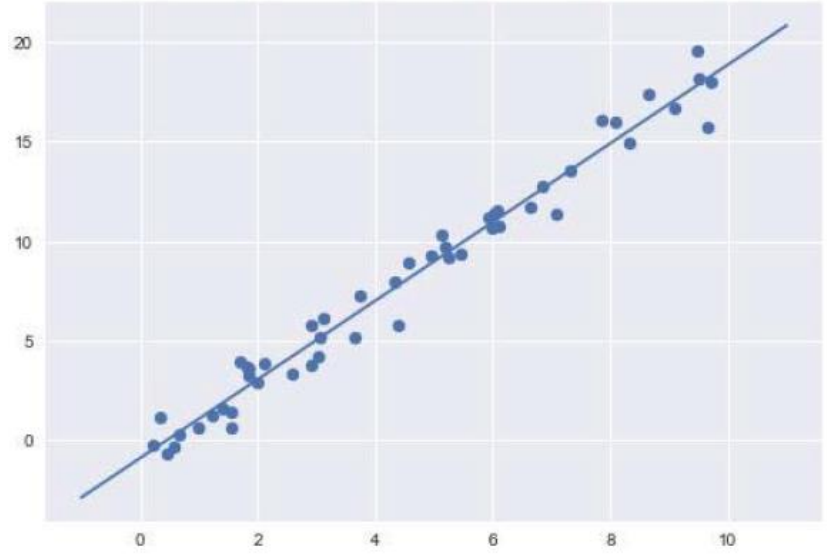
Feature extraction and normalization.

Application: Transforming input data such as text for use with machine learning algorithms.
Modules: preprocessing, feature extraction. — Examples

Supervised Learning example

- Simple linear regression
  - The common case of fitting a line to (x, y) data.





- Once the model is trained, the main task of supervised machine learning is to evaluate it based on what it says about new data that was not part of the training set.

Homework 2

homework no:

name: student ID:

(x) My reference (if yes): name and student id

(v) I totally write by myself

1. Install scikit-learn and show this result.

In [2]: [redacted]

In [7]: [redacted]

```
My name is: ... with student id: ... I have installed The scikit-learn on my computer with version 0.24.1.
```

2. Answer this questions

Scikit-Learn

Author: `Fityanul Akhyar <https://github.com/fityanul>` _

1. What is Scikit Learn?
2. What is Classification? Explain with it Applications and Algorithms.
3. What is Regression? Explain with it Applications and Algorithms.
4. What is Clustering? Explain with it Applications and Algorithms.

Thank You