What is Machine Learning

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Contents:

- Part 1. Basics
- Part 2. Searching
- Part 3. Reasoning
- Part 4. Planning
- Part 5. Learning

Contents:

Objectives 教学目的

- To describe the agents how can improve their behavior through learning from data.
  描述智能体如何通过从数据中学习来改善其性能。
- To discuss the perspectives on so many learning algorithms we have been faced with.
  针对所面临的诸多机器学习算法，讨论一下我们的视角。

9. Perspectives about Machine Learning

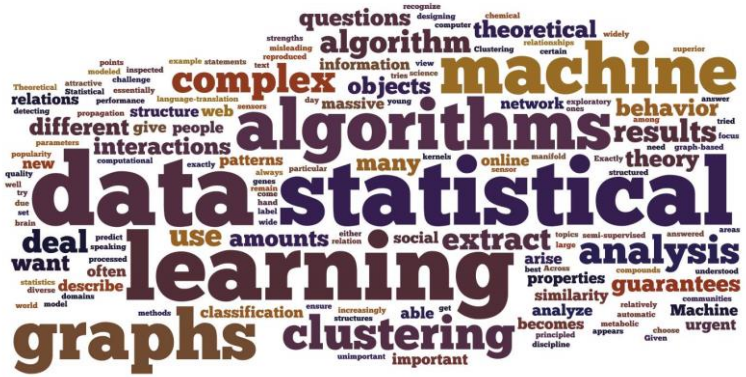
Contents:

What is Machine Learning 什么是机器学习

Machine learning is a branch of artificial intelligence, concerns the construction and study of systems that can learn from data.

机器学习是人工智能的一个分支，从事构建和研究可以从数据中学习的系统。

- Machine Learning used to be the **Queen**.
  机器学习曾经是王后。
- Machine Learning is now the **King**.
  如今机器学习是国王。



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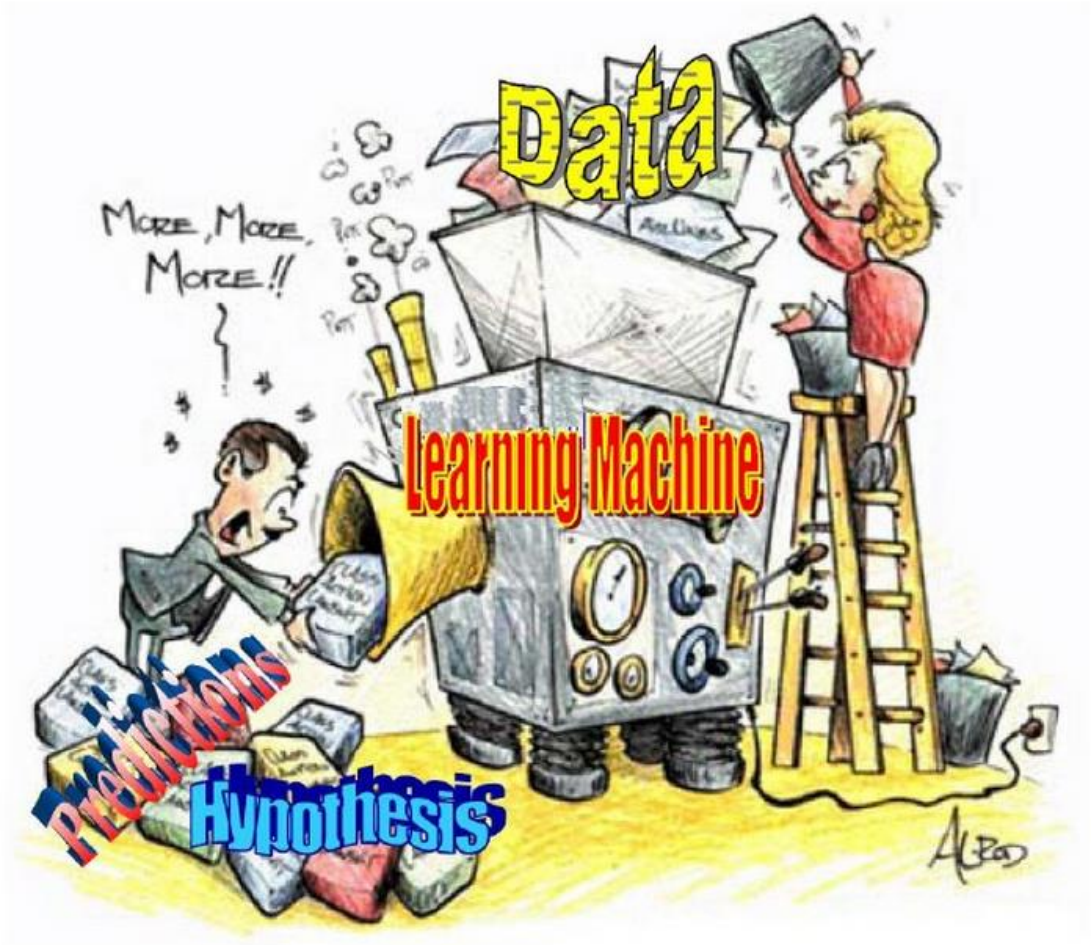
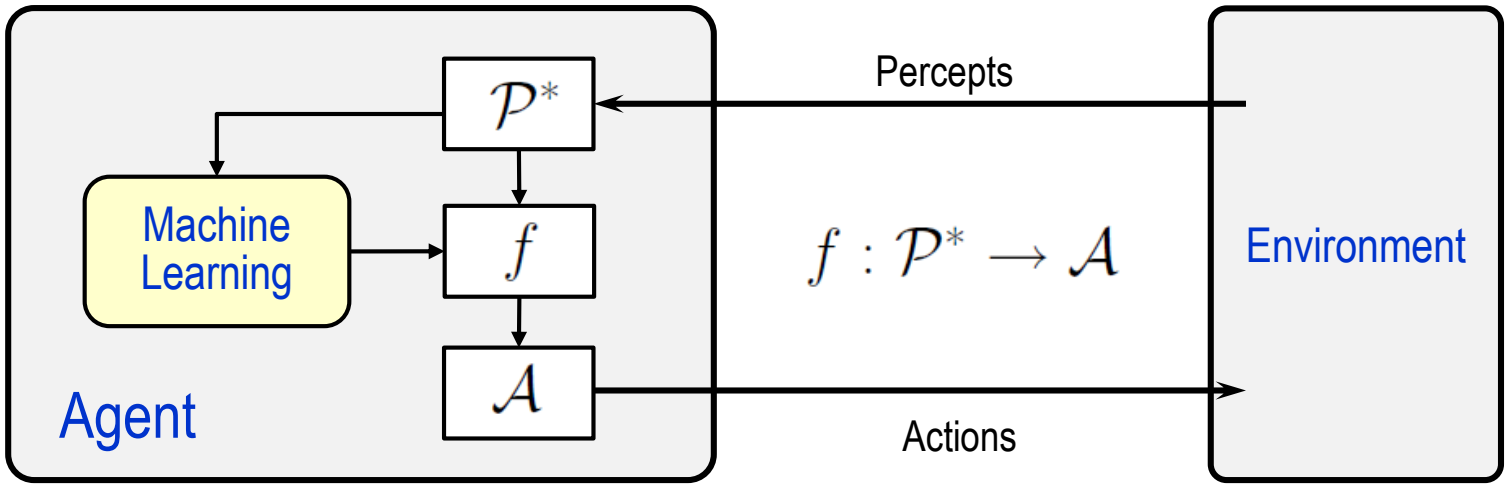

Data
More, More, More!!
Learning Machine
Predictions
Hypothesis

Artificial Intelligence vs. Machine Learning 人工智能与机器学习

- **Artificial Intelligence** (AI): 人工智能 (AI)
  to study "agents" that perceive the environment and take actions for some goal.
  研究感知外部环境并为某个目标采取行动的"**智能体**"。
- **Machine Learning**: 机器学习
  a branch of AI, concerns the construction of systems that can learn from data.
  人工智能的一个分支，从事构建可以从数据中学习的系统。



Relations to Other Disciplines 与其他学科的关系

Statistical Learning 统计学习

- a machine learning framework drawing from statistics.
  取自于统计学的机器学习框架。

Pattern Recognition 模式识别

- the recognition of patterns in data. (≈ machine learning + data patterns)
  识别数据中的模式。(≈ 机器学习 + 数据模式)

Data Mining 数据挖掘

- the discovery of unknown properties in data. (≈ machine learning + database)
  发现数据中的未知特性。(≈ 机器学习 + 数据库)

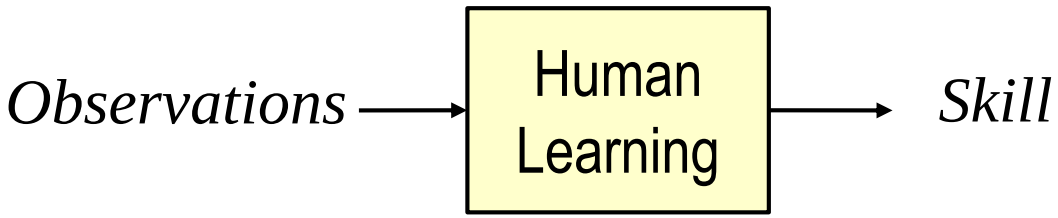
Computer Vision 计算机视觉

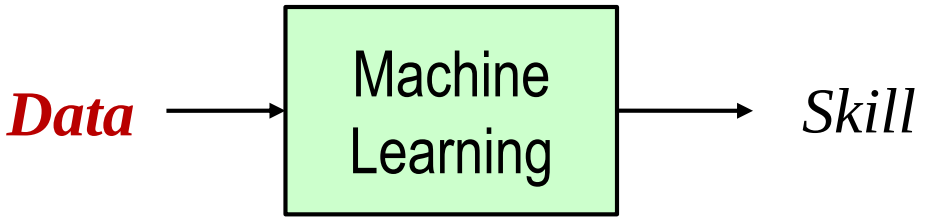
- to extract information from images. (≈ machine learning + image processing)
  从图像中提取信息。(≈ 机器学习 + 图像处理)

Human Learning vs. Machine Learning 人类学习与机器学习

- Human Learning **人类学习**
  acquiring skill with **experience**
  accumulated from observations.
  从**观察**中积累经验来获取技能。

- Machine Learning **机器学习**
  acquiring skill with experience
  accumulated/computed from data.
  从**数据**中积累或者计算的经验获取技能。



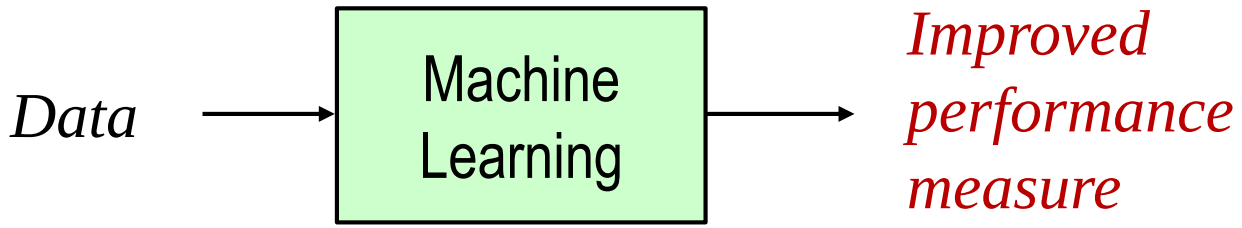


What is Skill in Machine Learning 什么是机器学习的技能

- Skill 技能
  improving some performance measure. (e.g. prediction accuracy)
  改善某些性能指标。(如预测精度)

Why Use Machine Learning 为什么使用机器学习

- Machine learning can improve some performance measure with experience computed from data.
  机器学习可以通过从数据中学到的经验来改善某些性能指标。



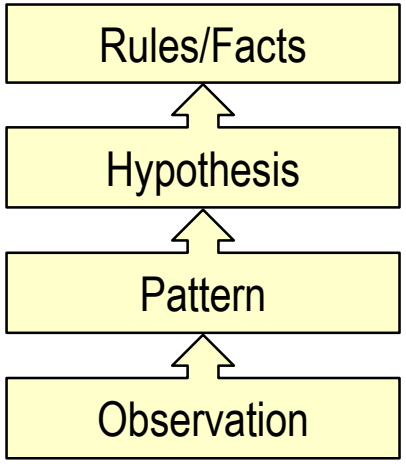
Two General Types of Learning 两种通用的学习类型

Inductive learning **归纳学习**

to obtain or discover general rules/facts from particular training samples.

从特定的训练实例中获得或发现通用的规则或事实。

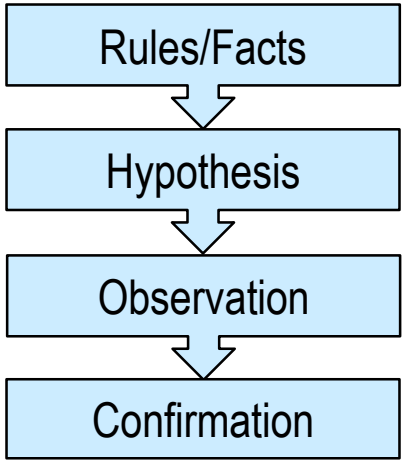
Inductive
(bottom-up logic)



Deductive learning 演绎学习

to use a set of known rules/facts to derive hypothesis that fit the training data.

使用一套已知的规则和事实去推导适合该训练数据的猜测。



Deductive
(top-down logic)

Some Definitions about Machine Learning 机器学习的若干定义

Who	When	Definition	Publication
Arthur Samuel, American pioneer of ML 亚瑟·塞缪尔，美国机器学习先驱	1959	The **field** of study that gives computers the ability to learn without being explicitly programmed. 研究给予计算机学习能力而不必显式编程的**领域**。	
Herbert Simon, American computer scientist 赫伯特·西蒙，美国计算机科学家	1983	A **process** by which a system improves its performance. 一种**系统**用它来改善其性能的过程。	
Ethem Alpaydin, Turkish professor 埃塞姆·阿培丁，土耳其教授	2004	**Programming computers** to optimize a performance criterion using example data or past experience. 运用示例数据或经验的**计算机程序**来优化性能指标。	“Introduction to Machine Learning”, MIT Press
Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar	2012	The **computational methods** using experience to improve performance or to make accurate predictions. 运用经验来改善性能或做出正确预测的**计算方法**。	“Foundations of Machine Learning”, MIT Press

A Formal Definition about Machine Learning 机器学习的形式化定义

- Tom Mitchell (CMU Professor) 汤姆·米切尔（CMU教授）

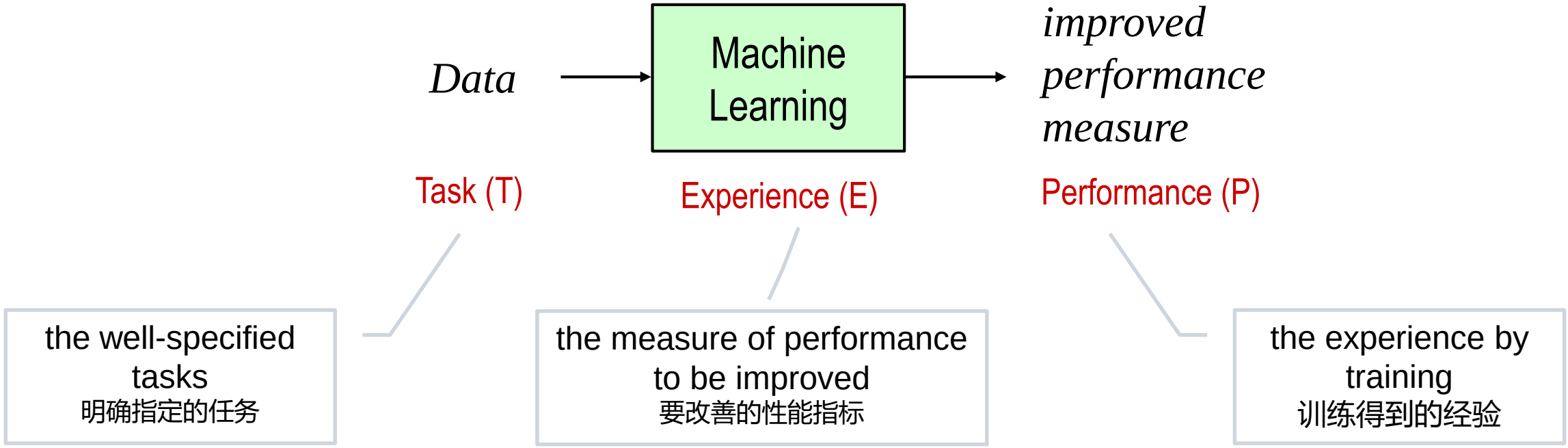
  in his 1997 publication of “Machine Learning”, provided a widely quoted, more formal definition of the algorithms studied in the machine learning field:

  在1997年出版的《机器学习》一书中，为机器学习领域研究算法提供了一个广泛引用、更为形式化的定义：

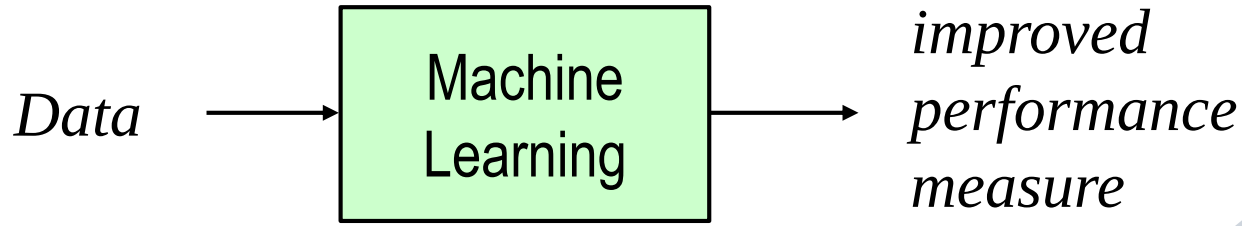
> A **computer program** is said to **learn from experience E** with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E.
>
> 一个针对某类任务T和性能度量P的计算机程序被称之为从经验E中学习，如果它在T中任务的性能，如P度量所示，随经验E而改善的话。

Three Key Elements in the Formal Definition 形式化定义的三要素

- To have a well-defined learning problem, we must identity those three features:
  要得到一个明确定义的学习问题，我们必须识别如下三个特性：



Example 1: A handwriting recognition problem 手写识别问题



Task (T)

recognizing and classifying handwritten words within images
对图像内的手写文字进行识别和分类

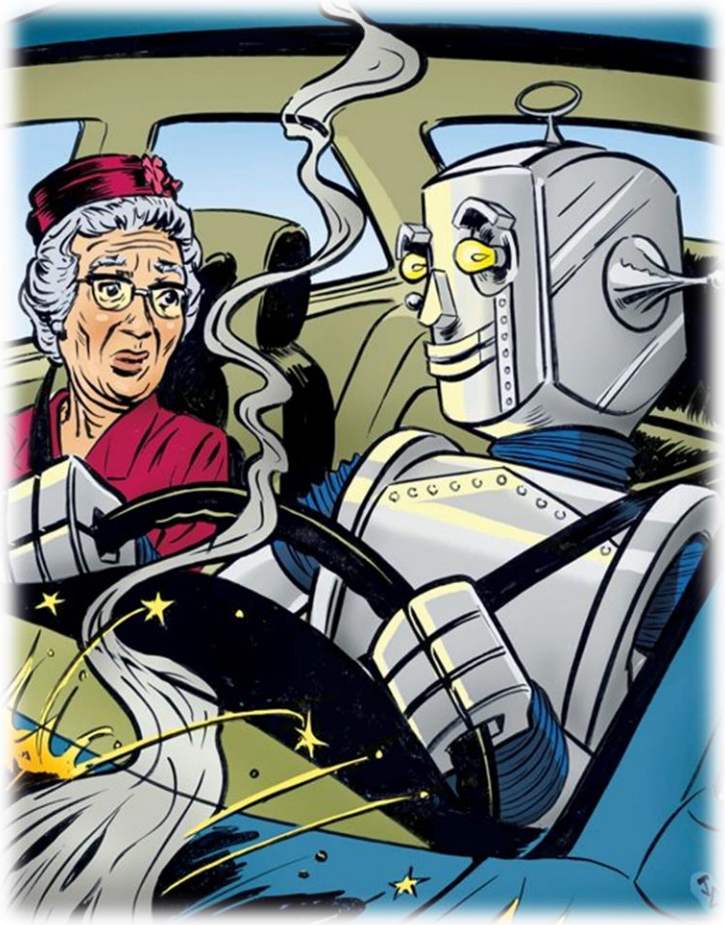
Experience (E)

a database of handwritten words with given classifications
具有给定分类的手写文字数据库

Performance (P)

percent of words correctly classified
正确分类文字的百分比

Example 2: A robot driving problem 机器人驾驶问题



- Task (T):
  driving on public four-lane highways using vision sensors
  使用视觉传感器在公共四车道高速公路上驾驶
- Performance (P):
  average distance traveled before an error (as judged by human overseer).
  出错之前行驶的平均距离（由人类督察评判）
- Experience (E):
  a sequence of images and steering commands recorded while observing a human driver
  观察人类驾驶员时所记录的一系列图像和操纵命令。

Thank you for your attention!

AI