Three Perspectives on Machine Learning

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9. Perspectives about Machine Learning

Contents:

- 9.1. What is Machine Learning
- 9.2. History of Machine Learning
- 9.3. Why Different Perspectives
- 9.4. Three Perspectives on Machine Learning
- 9.5. Applications and Terminologies

9.4. Three Perspectives on Machine Learning

Contents:

What are Learning Tasks 什么是学习任务

- The learning tasks are used to denote the general problems that can be solved by learning with desired output.
  学习任务用于表示可以用机器学习解决的基本问题。

Why Study Learning Tasks 为什么要研究学习任务

- Various types of problems arising in applications:
  应用中会产生各种类型的**问题**：
  - computer vision, 计算机视觉，
  - pattern recognition, 模式识别，
  - natural language processing, 自然语言处理，
  - etc. 等等。

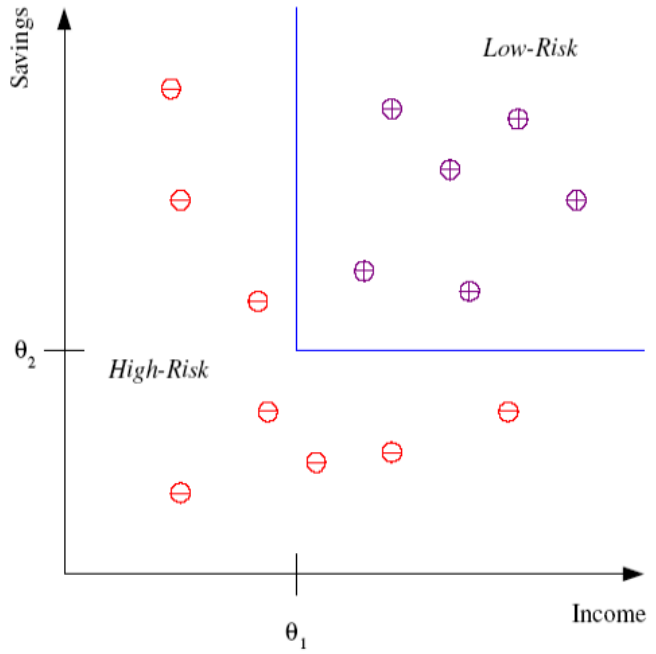
Typical Tasks in Machine Learning 机器学习中的典型任务

Tasks 任务	Brief Statements 简短描述	Typical algorithm 典型算法
Classification 分类	Inputs are divided into two or more known classes. 将输入划分成两个或多个类别。	SVM 支撑向量机
Regression 回归	Outputs are continuous values rather than discrete ones. 输出是连续值而不是离散的。	Bayesian linear regression 贝叶斯线性回归
Clustering 聚类	Inputs are divided into groups which are not known beforehand. 输入被划分为若干个事先未知的组。	k-means k-均值
Ranking 排名	Data transformation in which values are replaced by their rank. 用它们的排名来代替值的数据转换。	PageRank 网页排名
Density estimation 密度估计	Find the distribution of inputs in some space. 寻找某个空间中输入的分布。	Boosting Density Estimation 增强式密度估计
Dimensionality reduction 降维	Simplify inputs by mapping them into a lower dimensional space. 通过将输入映射到低维空间来将其简化。	Isomap 等距特征映射
Optimization 优化	Find the best solution from all feasible solutions 从所有可能的解中寻找最优解。	Q-learning Q-学习

Case study: Credit scoring 信用评分

- Two classes: Low-risk and high-risk customers.
  二分类：低风险和高风险客户。
- A customer information makes up the input to one of the two classes.
  客户信息使该输入构成二分类中的一个。
- After training with past data, a classification rule learned may be:
  用过去的数据训练之后，可以学习得到如下分类规则:

IF *income* > θ_1 AND *savings* > θ_2
THEN *low-risk*
ELSE *high-risk*



9.4. Three Perspectives on Machine Learning

Contents:

What are Learning Paradigms 什么是学习范式

- The learning paradigms are used to denote the typical scenarios that are happened in machine learning.

  学习范式用于表示机器学习中发生的典型场景。

How to Distinguish Learning Paradigms 怎样区分学习范式

- by the *scenarios* or *styles* in machine learning about

  根据机器学习的**典型场景或样式**：

  - how it learns from data,

    它怎样从数据中学习，

  - how it interactives with environment.

    它如何同环境互动。

Typical Paradigms in Machine Learning 机器学习中的典型范式

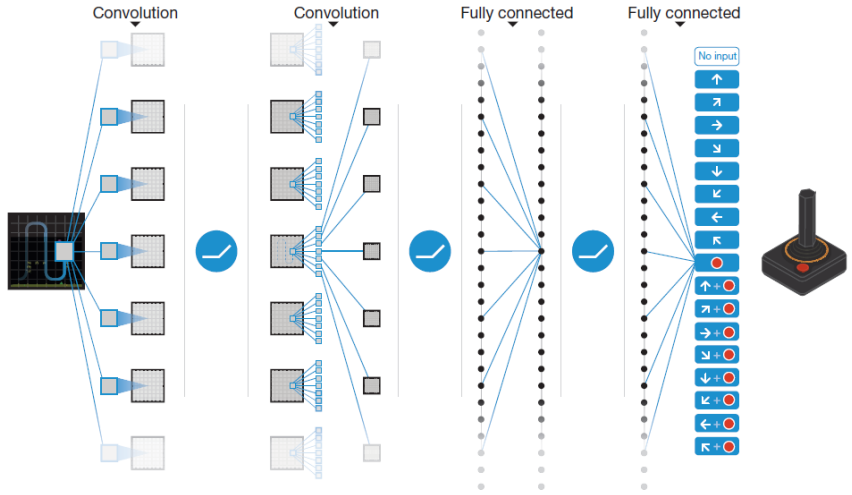
Paradigms 范式	Brief Statements 简短描述	Typical Algorithm 典型算法
Supervised 有监督	The algorithm is trained by a set of labeled data, and makes predictions for all unseen points. 算法采用一组标注好的数据进行训练，再对所有的未知点做出预测。	Support vector machines 支撑向量机
Unsupervised 无监督	The algorithm exclusively receives unlabeled data, and makes predictions for all unseen points. 算法仅接收未标注的数据，再对所有的未知点做出预测。	k-means k-均值
Reinforcement 强化	The algorithm interacts with environment, and receives an reward for each action. 算法与外部环境交互，每个动作得到一个回报。	Q-learning Q-学习

Case Study: Deep Reinforcement Learning 深度强化学习

- Reinforcement Learning **强化学习**

  learning from state and reward, take better action to the environment.

  从状态和回报中学习，对环境采取更好的动作。



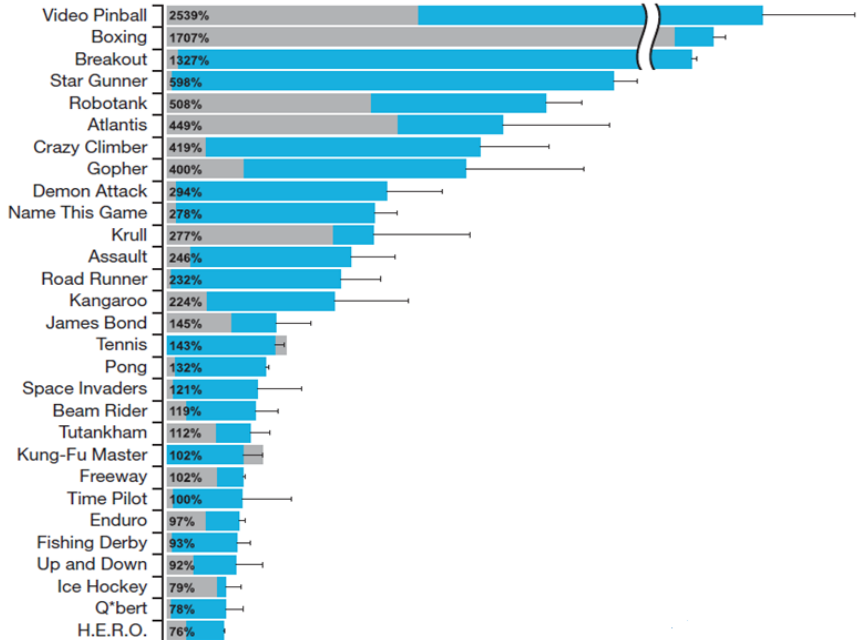
- Deep Q-network (DQN) 深度Q-网络 (DQN)
  - combines CNN with Q-learning (a form of reinforcement learning),
    将CNN与Q-学习（一种强化学习的形式）相结合，
  - input is raw pixels and output is a value function estimating rewards.
    输入是原始像素，输出是估计回报的价值函数。

Case Study: Deep Reinforcement Learning 深度强化学习

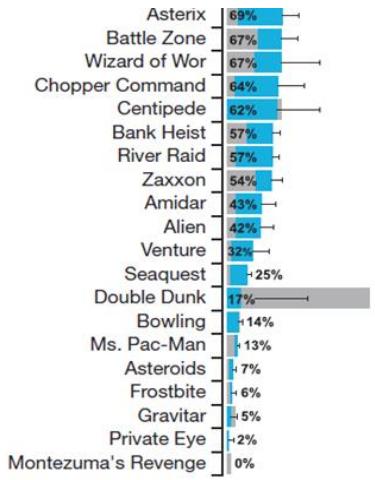
- Feb. 2015, Google DeepMind published Deep Q-Network, the human-level control through deep reinforcement learning.

  2015年2月，谷歌DeepMind发表了**深度Q-网络**，通过深度强化学习达到人类水平的操控。

Tested on classic Atari video games (late-1970s and early-1980s)



Source: NATURE, Feb. 2015



At human-level or above (29/49 ≈ 59.18%)

Below human-level (20/49 ≈ 40.82%)

9.4. Three Perspectives on Machine Learning

Contents:

What are Learning Models 什么是学习模型

- The learning models are used to denote the approaches that can handle to fulfil a learning task.

  学习模型用于表示可以处理完成一个学习任务的方法。

Why Study Learning Models 为什么要研究学习模型

- The result of machine learning is heavily dependent on the choice of an approach for solving the learning task.

  机器学习的效果在很大程度上取决于解决该学习任务时所选用的方法。

Typical Models for Machine Learning 机器学习的代表性模型

Models 模型	Brief Statements 简短描述	Sub-models 子模型	Typical Algorithm 典型算法
Geometric 几何	Use geometric models such as line, plane, distance or manifold to construct learning algorithms. 采用线、面、距离或流行等几何图形模型来构建学习算法。	Line 线	Linear Regression 线性回归
		Plane 面	SVM 支撑向量机
		Distance 距离	k-NN k-近邻
		Manifold 流行	Isomap 等距映射
Logical 逻辑	Use logical models to construct learning algorithms. 采用逻辑模型来构建学习算法。	Logic 逻辑	Inductive Logic Program. 归纳逻辑编程
		Rule 规则	Association Rule 相关规则
Networked 网络	Use networked models to construct learning algorithms. 采用网络模式构建机器学习算法。	Shallow 浅层	Perceptron 感知机
		Deep 深层	CNN 卷积神经网络
Probabilistic 概率	Use probabilistic models to denote the conditional dependence between random variables. 采用概率模式来表示随机变量之间的条件相关性。	Bayes 贝叶斯	Bayesian Network 贝叶斯网络
		Generative 生成	Probabilistic Program. 概率规划
		Statistic 统计	Linear Regression 线性回归

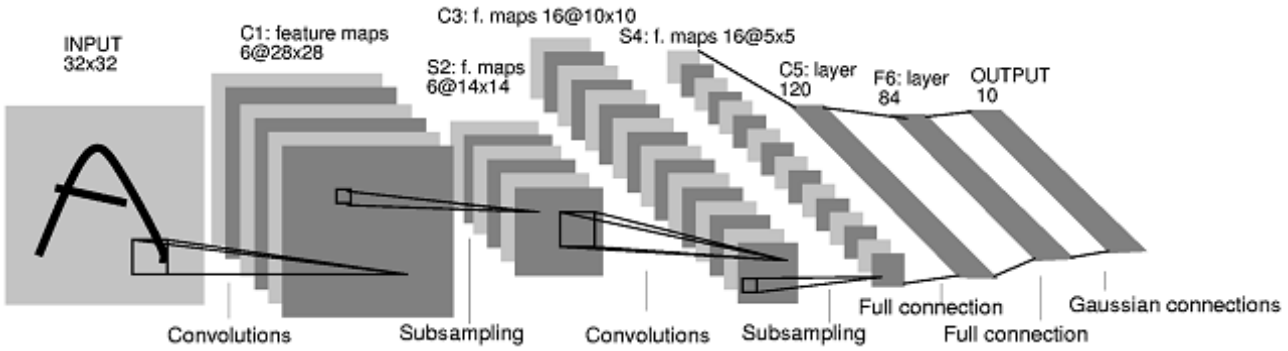
Case Study: Convolutional neural network (CNN) 卷积神经网络

- CNN can be designed to recognize visual patterns directly from pixel images with minimal preprocessing.

  CNN可以设计为用最少的预处理来直接从像素图像中识别视觉模式。

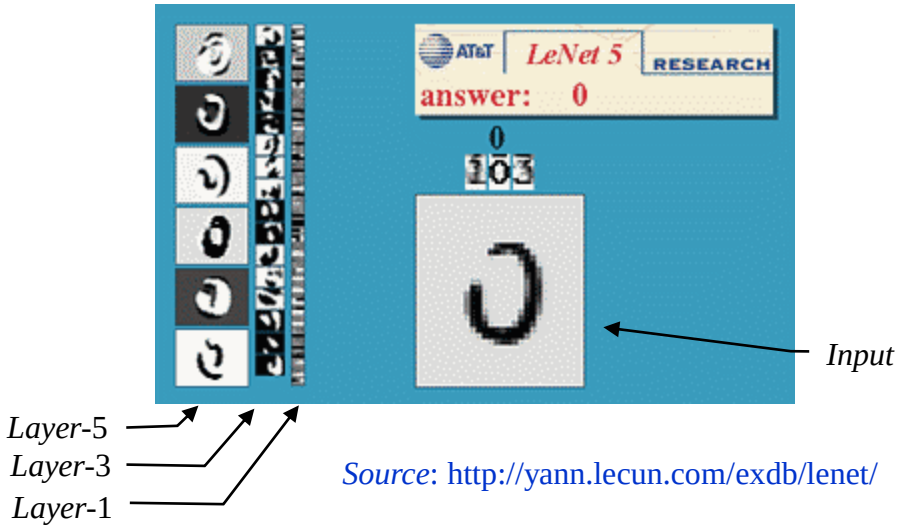
- CNN can recognize patterns with extreme variability, and with robustness to distortions and simple geometric transformations.

  CNN可以识别一些特殊情况的模式，如手写字符识别，对扭曲的以及几何形变的手写字符具有很强的鲁棒性。



LeNet-5, a pioneering 7-level convolutional neural network

LeNet-5, 一种开创性的7层卷积神经网络



Source: http://yann.lecun.com/exdb/lenet/

Yann LeCun and Rene Descartes 雅恩·乐库与雷内·笛卡尔

Yann LeCun (1960-Current)

Rene Descartes (1596-1650)

- Yann LeCun (born near Paris, France, in 1960) 雅恩·乐库（1960年生于法国附近）
  - One of the fathers of Deep Learning, a founding father of CNN.
    深度学习的奠基人之一，CNN的创始人。
  - Professor at NYU, Director of AI Research at Facebook.
    美国纽约大学教授、Facebook人工智能实验室主任。
  - 2014 IEEE Neural Network Pioneer Award.
    2014年获得IEEE神经网络先锋奖。
  - Thought as a modern day Descartes.
    被认为是当代的笛卡尔。

Thank you for your attention!

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