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Learning Paradigms

Paradigm	Data	Objective Model
supervised learning	$(\underline{x}^{(1)}, y^{(1)}), \dots, (\underline{x}^{(P)}, y^{(P)})$ $\underline{x}$: observation, $\in \mathbb{R}^N$ y: label, $\in \mathbb{R}$ (regression), $\in \mathbb{R}^M$, $\in \{0,1\}$, $\in \{0,\dots,K-1\}$ (classification) often assumed: data independent & identically distributed (iid) ex: $\underline{x}$: pixel image patch of a scan y: ~~letter or word~~	discrimination function $y = f(\underline{x})$ conditional distribution $p(y \mid \underline{x})$
unsupervised learning	$\underline{x}^{(1)}, \dots, \underline{x}^{(P)} \in \mathbb{R}^N$ observation, often iid assumed ex: $\underline{x}$: user ratings (songs, albums, bands...)	generative model / data distribution $p(\underline{x})$ e.g. density estimation clustering / dimension reduction $\in \{0,\dots,K-1\}$ $\in \mathbb{R}^M$ with $M << N$ $\underline{y} = \underline{f}(\underline{x})$
reinforcement learning	$(\underline{x}^{(1)}, \underline{a}^{(1)}, r^{(1)}), \dots, (\underline{x}^{(P)}, \underline{a}^{(P)}, r^{(P)})$ state $\in \mathbb{R}^N$ or $\{0,\dots,K-1\}$, executed action $\in \mathbb{R}^M$ or $\{0,\dots,K-1\}$, reward $\in \mathbb{R}$ sequential data $\Rightarrow$ not iid! but: multiple such sequences are observed $\Rightarrow$ iid over sequences ex: $\underline{x}$: visual image $\underline{a}$: movement direction & velocity r: 1 when passed the Labyrinth, 0 elsewhere	optimal action-selection $\underline{a}^* = \underline{f}(\underline{x}, r)$ transition model ~~$(\underline{x}, \underline{a}) \to p(\underline{x})$~~ $p(\underline{x} \mid \underline{x}^{last}, \underline{a}^{last})$