

Overview of Machine Learning

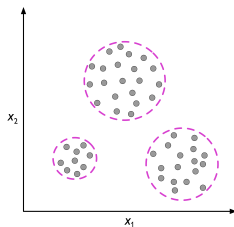
Supervised learning	<ul style="list-style-type: none">> Labeled data> Direct feedback> Predict outcome/future
Unsupervised learning	<ul style="list-style-type: none">> No labels/targets> No feedback> Find hidden structure in data
Reinforcement learning	<ul style="list-style-type: none">> Decision process> Reward system> Learn series of actions

The idea is to use **data** to produce an output:

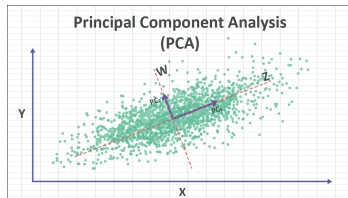
- ▶ Supervised Learning produces *functions*.
- ▶ Unsupervised Learning produces *probability distributions*.
- ▶ Reinforcement Learning produces *heuristics*.

Unsupervised Learning

Clustering:

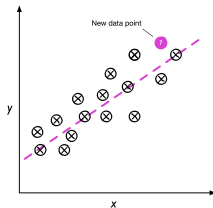


Dimensionality Reduction:

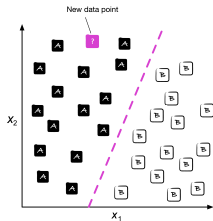


Supervised Learning

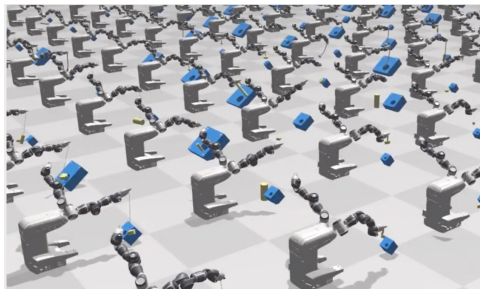
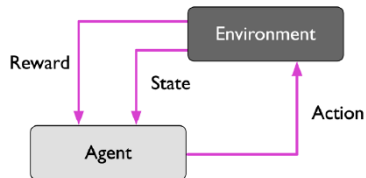
Regression:



Classification:



Reinforcement Learning



(Probabilistic) Generative Models



Question: How are these two pictures the same?

The goal of a *generative* model is to find a multivariate probability distribution

$$P(x_1, x_2, \dots, x_n)$$

and a way to sample from this distribution.

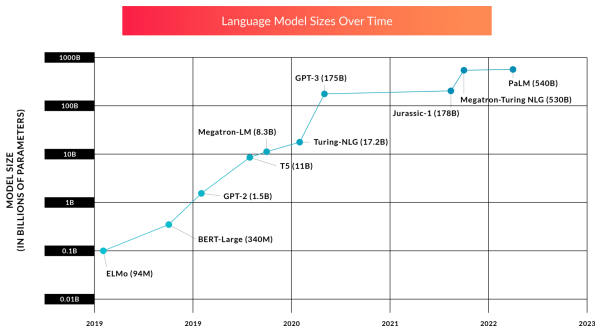
Actually, you've been doing this since STAT 200 ...

Large Language Models

LLMs are a form of supervised learning ... but they are related to generative models:

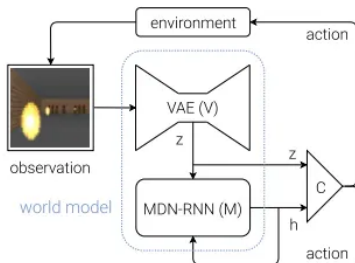
$$P(x_1, x_2, \dots, x_n) = P(x_1 | x_2, \dots, x_n) \cdot P(x_2, \dots, x_n)$$

LLMs are *really sophisticated* **next token prediction** models, all based on a single architecture called *Transformer*.



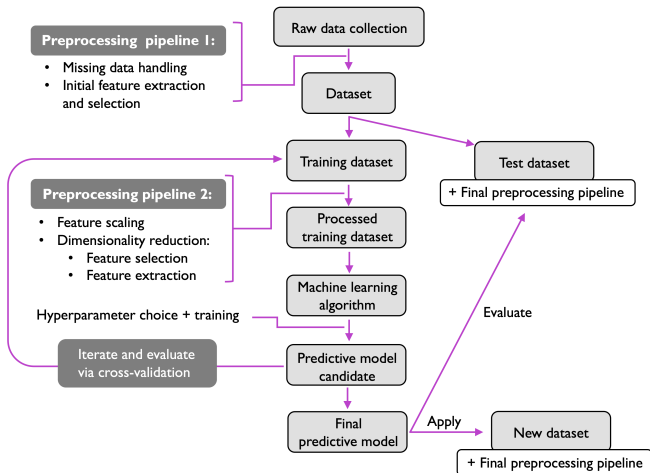
Whither AGI?

Big question: Will Transformer get us to AGI?



Yann Lecun: “We need machines that understand the world; [machines] that can remember things, that have intuition, have common sense, things that can reason and plan to the same level as humans . . . Despite what you might have heard from some of the most enthusiastic people, current AI systems are not capable of any of this.”

Machine Learning Workflows



There are python software packages for every step of this process.