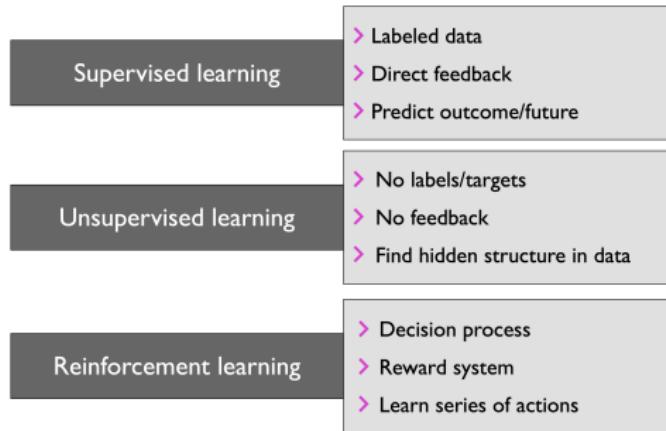


# Overview of Machine Learning

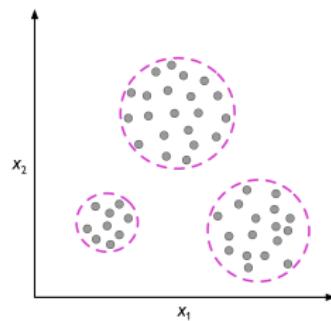


The idea is to use **data** to produce an output:

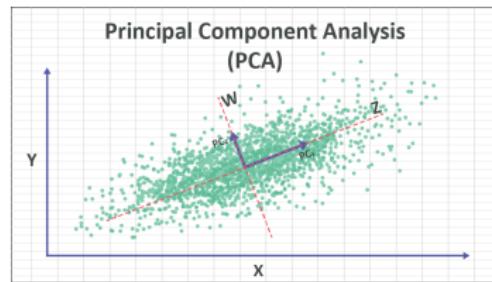
- ▶ Supervised Learning produces *functions*.
- ▶ Unsupervised Learning produces *probability distributions*.
- ▶ Reinforcement Learning produces *heuristics*.

# Unsupervised Learning

## Clustering:

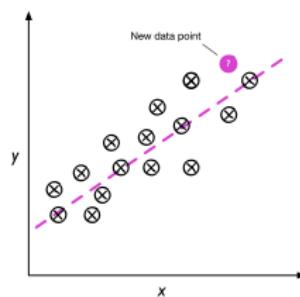


## Dimensionality Reduction:

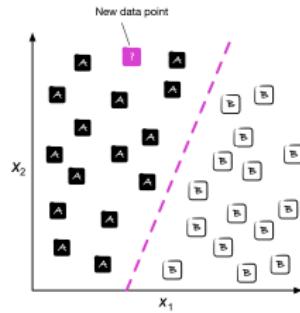


# Supervised Learning

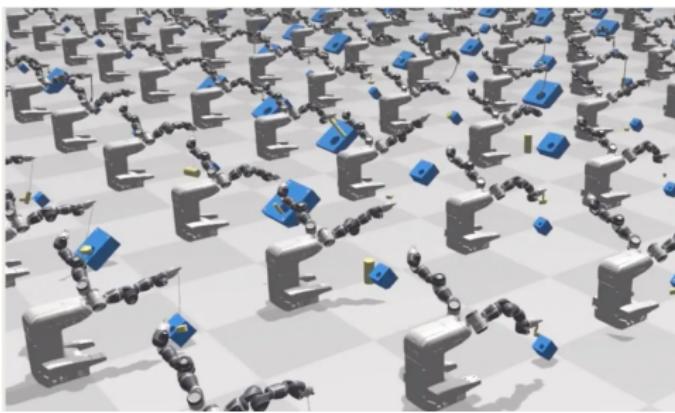
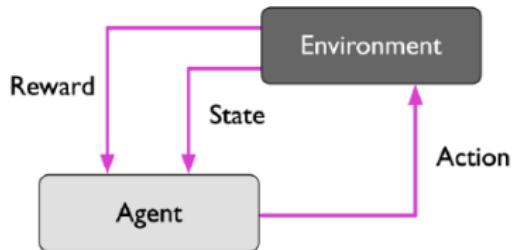
## Regression:



## 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.

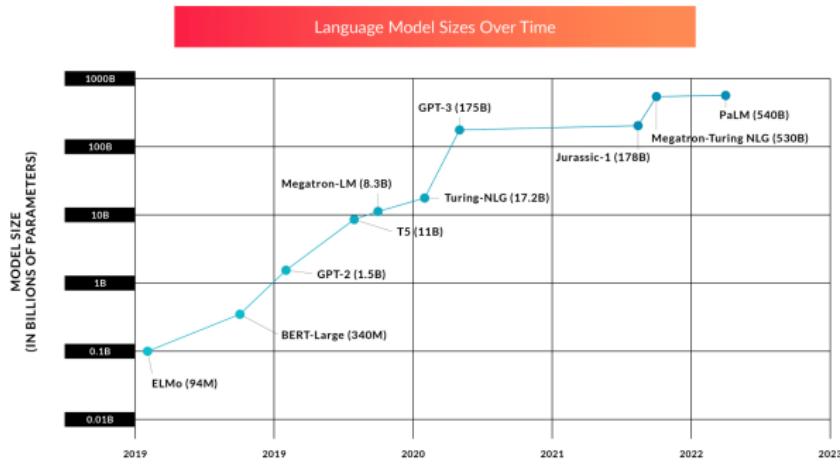
Actually, you've been doing this since STAT 200 ...

# Large Language Models

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

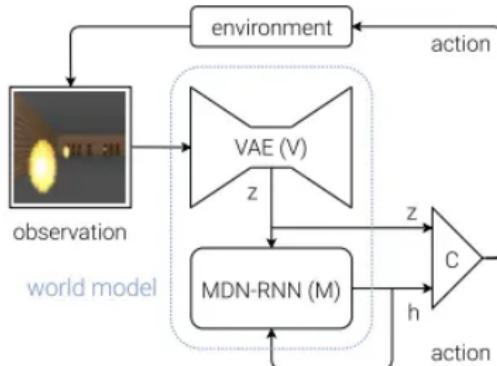
$$P(x_1, x_2, \dots, x_n) = P(x_1|x_2, \dots, x_n) \cdot P(x_2, \dots, x_n)$$

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



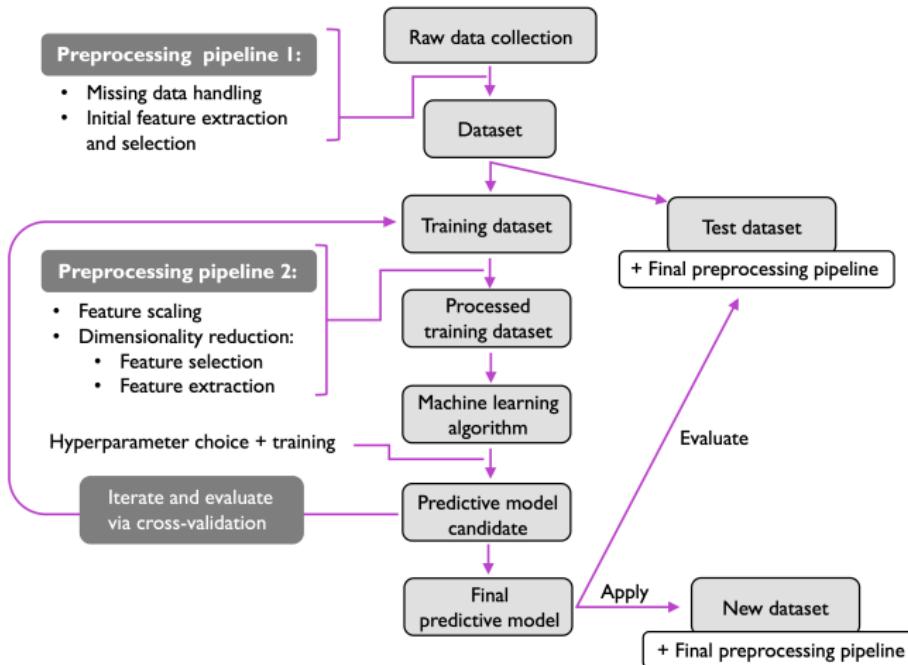
# Whither AGI?

**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.