

☐ Goals of this course

☐ Machine learning

☐ Descriptive ML

☐ Predictive ML

☐ Generative ML

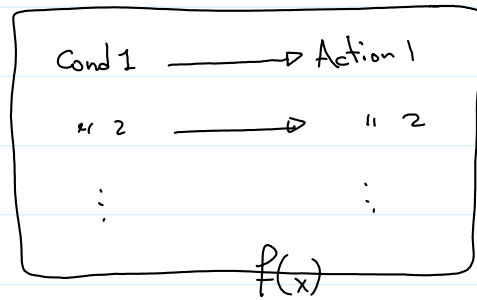
☐ Learning

☐ Notation

Goals

- Learn to use basic ML techniques
 - Improve ML → New algorithms
New models
New metrics
 - New paradigms → Quantum ML
-

Typically



$f(x)$: x is checked for $\{ \text{cond } i \}$ and the proper action is implemented.

But how do we learn?

We see/observe

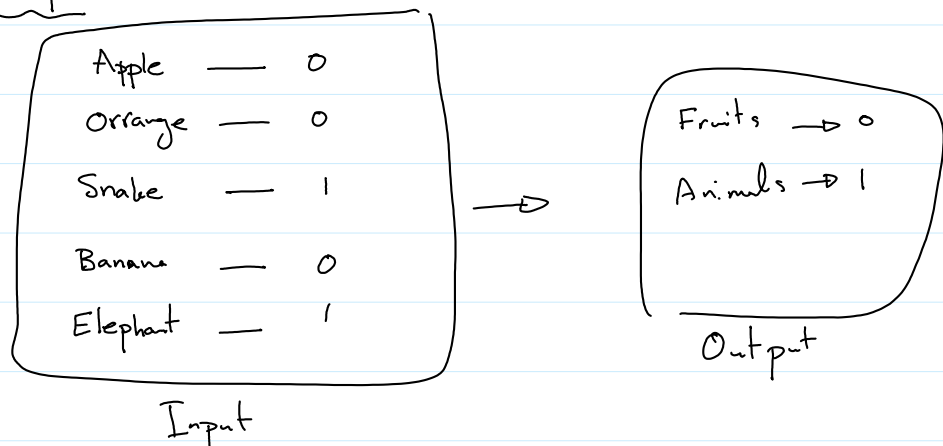
① and try to fit with some known outcome
→ Prediction

Instance 1 ↔ Output 1
" 2 ↔ Output 2
⋮ ⋮

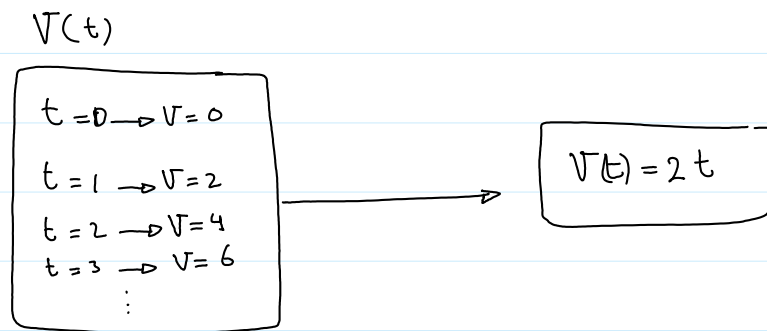
Output $i \in$ Set of outputs
* It is smaller than $\{ \text{instance } n \}$.

We infer the relation.

Example



This is known as "classification".



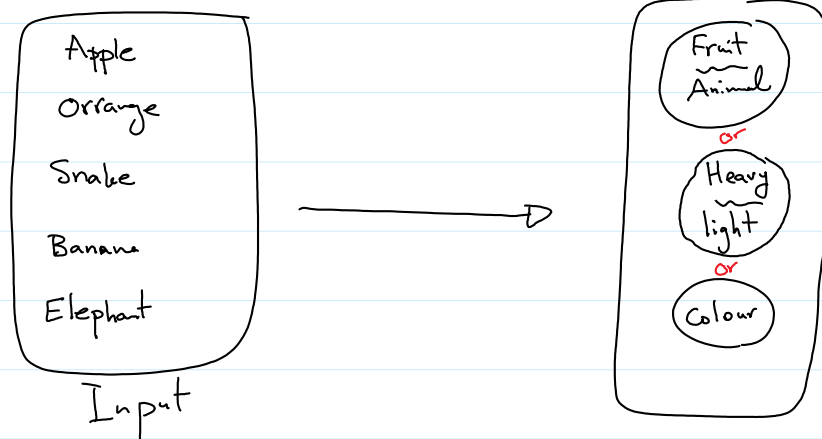
Regression

Both classification & regression come with some target values and the goal is to estimate / predict the outcome for some unseen instance.

③ try to recognize some pattern in the data.

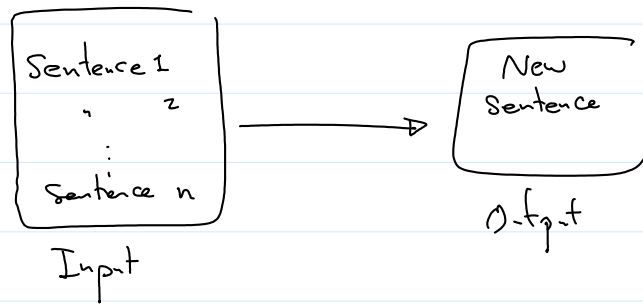
Sometimes only the instances are given and the task is to draw some conclusion / describe the data.

Example:



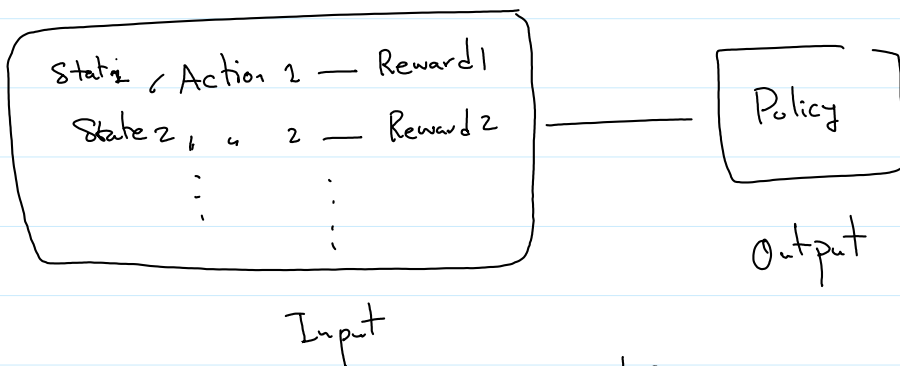
③ try to mimic the data we get: learning to speak
 draw
 sing
 play music

Generative



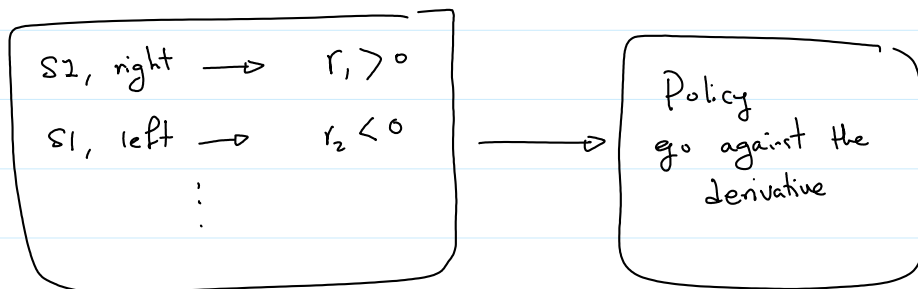
(C) try to learn a procedure: how to play a game, ...

* Learning ?!!

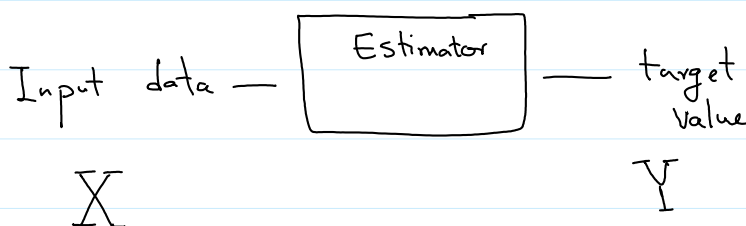


Example

Minimize
 Reward $\sim -\Delta \text{loss}$
 ↓
 change in the loss



Notation



X Y

$$X = \begin{bmatrix} x^{(1)} \\ x^{(2)} \\ \vdots \\ x^{(n_s)} \end{bmatrix} \begin{array}{l} \rightarrow \text{Sample 1} \\ \rightarrow \text{Sample 2} \\ \vdots \\ \rightarrow \text{Sample } n_s \end{array}$$

$$Y = \begin{bmatrix} y^{(1)} \\ y^{(2)} \\ \vdots \\ y^{(n_s)} \end{bmatrix} \begin{array}{l} \\ \\ \\ \text{Target} \end{array}$$

samples = n_s

Sample i $X^{(i)}$: $(x_1^{(i)}, x_2^{(i)}, \dots, x_{n_f}^{(i)}) \rightarrow$ Properties of each sample.

We refer to each property (column) as a "feature".

example:

Complet gas: $(P, V, n) \rightarrow T$

Measurement 1: $(P^{(1)}, V^{(1)}, n^{(1)}) \rightarrow T^{(1)}$

" 2: $(P^{(2)}, V^{(2)}, n^{(2)}) \rightarrow T^{(2)}$

:

$(P^{(100)}, V^{(100)}, n^{(100)}) \rightarrow T^{(100)}$

What's X & Y ?

What's n_f & n_s ?