Algorithm

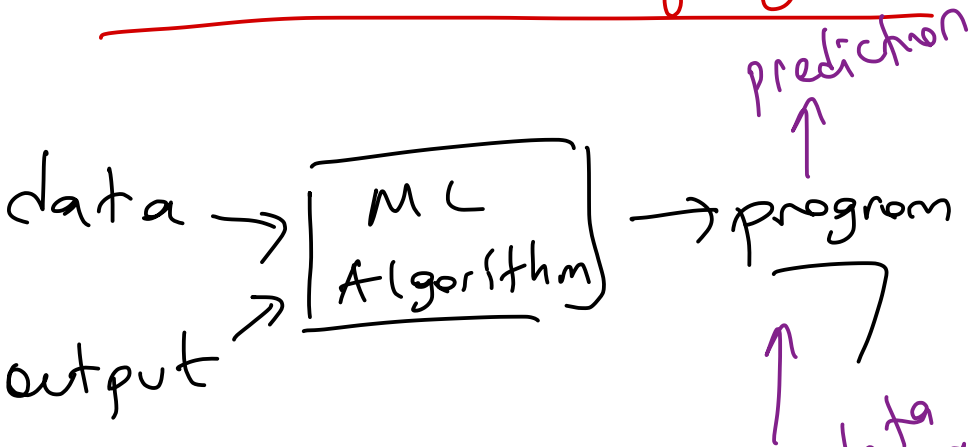
- sorting
- searching
- ....

- given a list of #s
- task: to order these #s from smallest to largest

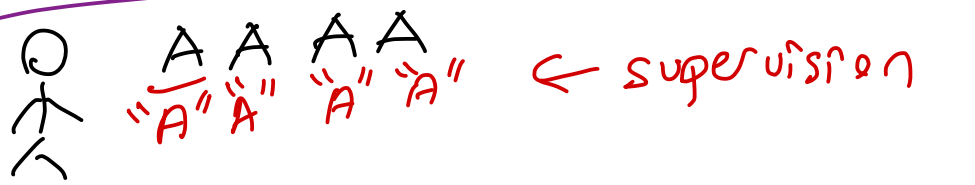
- fixed set of rules
- deterministic

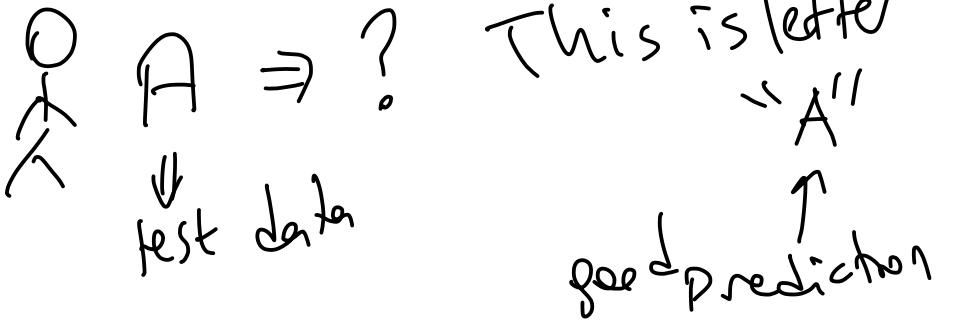
vs

Machine Learning Algorithm



- subjectivity (example data, past experience)





Machine Learning: programming computers to optimize a performance criterion using example data or past experience.

↓↓

depends on the application

inputs	predictions	
A	A	✓
B	B	✓
C	D	✗
D	D	✓
E	E	✓

$$\text{Accuracy} = \frac{4}{5} = 80\%$$

Truth	Prediction
32°C	33°C
	31°C
	20°C

absolute error

$$|y_i - \hat{y}_i|$$

$\hat{y}_i$: predicted output

y_i: true output

Supervised Learning:

$$\mathcal{X} = \{(x_i, y_i)\}_{i=1}^{N}$$

$N \rightarrow$ # of data points

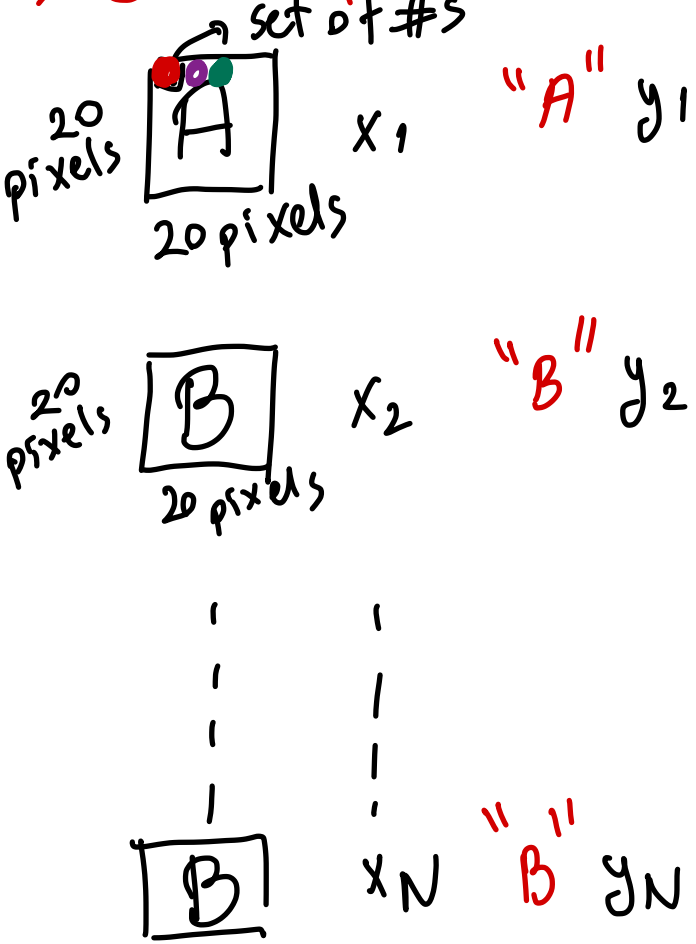
$i \rightarrow$ index for the data points

x_i: training points

y_i: labels or target outputs

$$\mathcal{X} = \{(x_1, y_1), (x_2, y_2), \ldots, (x_N, y_N)\}$$

⇒ Classification



$$x_1 = \begin{bmatrix} \\ \\ \\ \end{bmatrix}_{400 \times 1} \qquad y_1 = [A]$$

$$\mathcal{X} = \{([\,], \square)\}_{i=1}^{N}$$

$$x_i \in \mathbb{R}^{400}$$

$$y_i \in \{A, B, \ldots Z\}$$

test data ⇒ K

$y_{N+1} = ?$

$f(\quad) = \hat{y}_{N+1}$ ← prediction

x_{N+1}

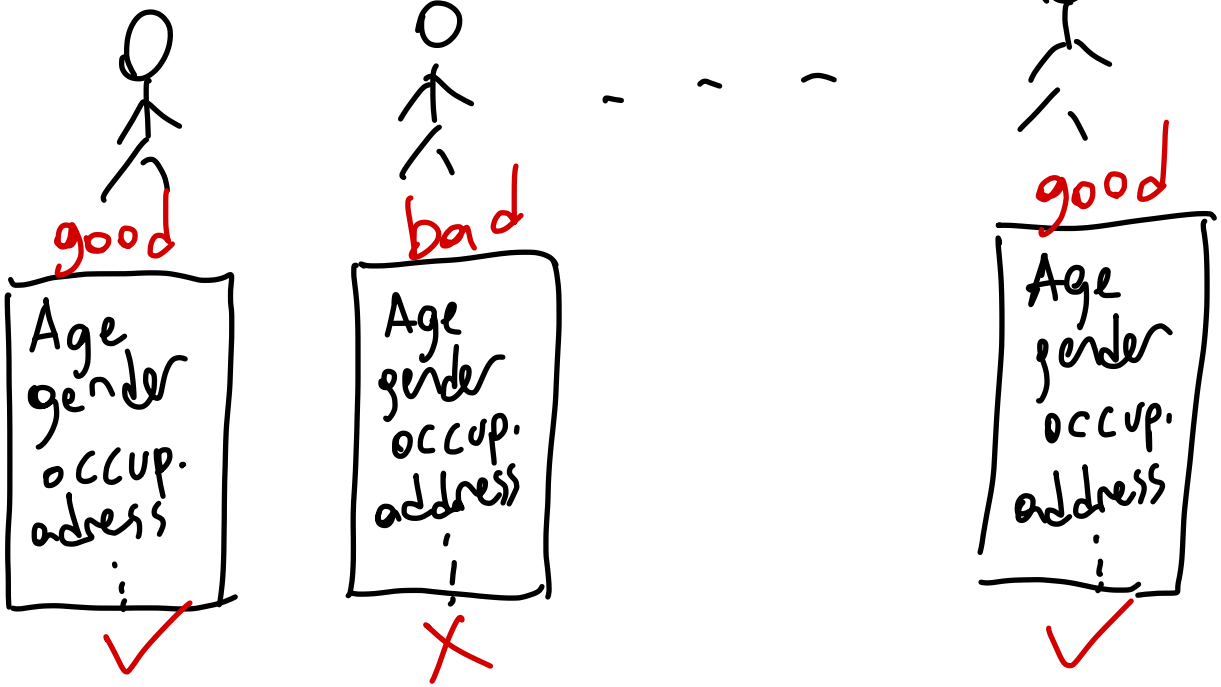
R^{400}

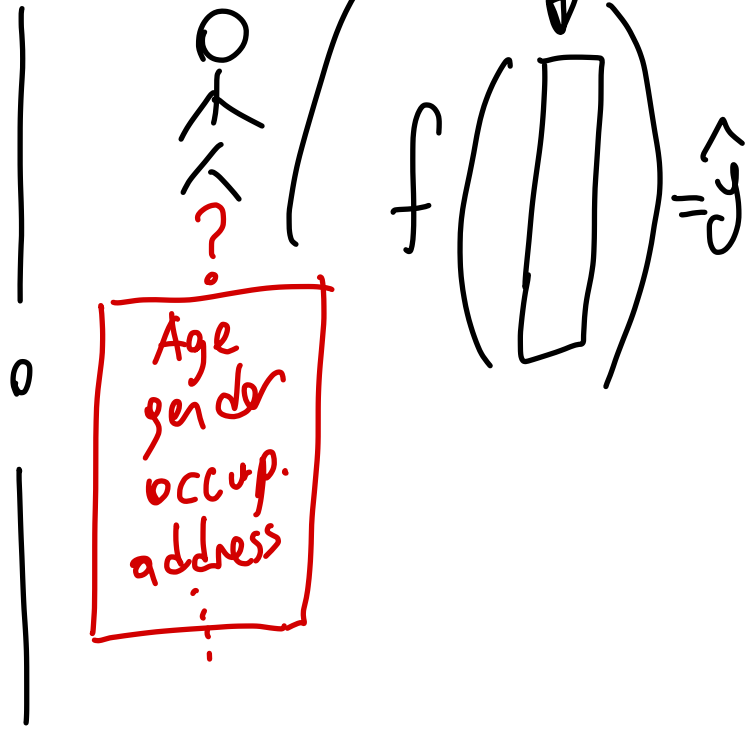
Multiclass classifcaton

# of classes > 2

Binary classifcaton

# of classes = 2



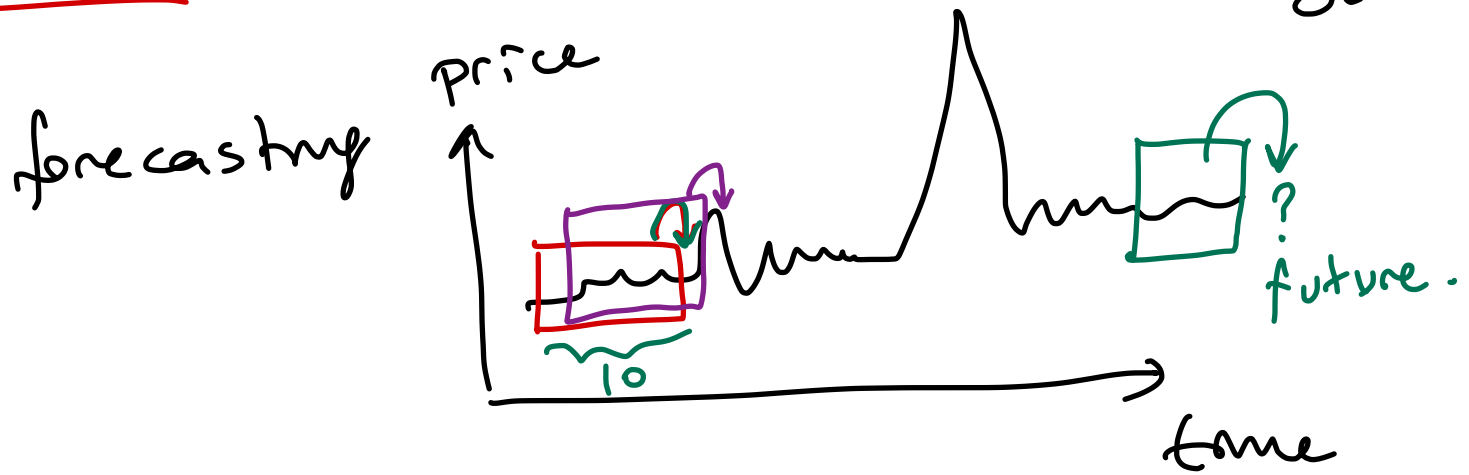


Regression :

$$\mathcal{X} = \{(x_i, y_i)\}_{i=1}^{N}$$

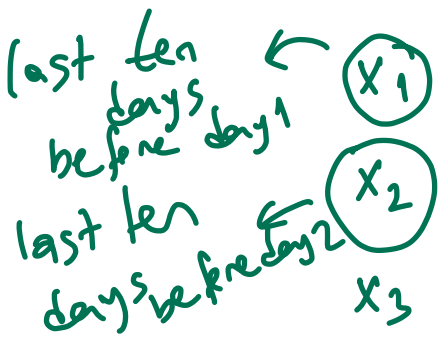
$x_i \in \mathbb{R}^D$

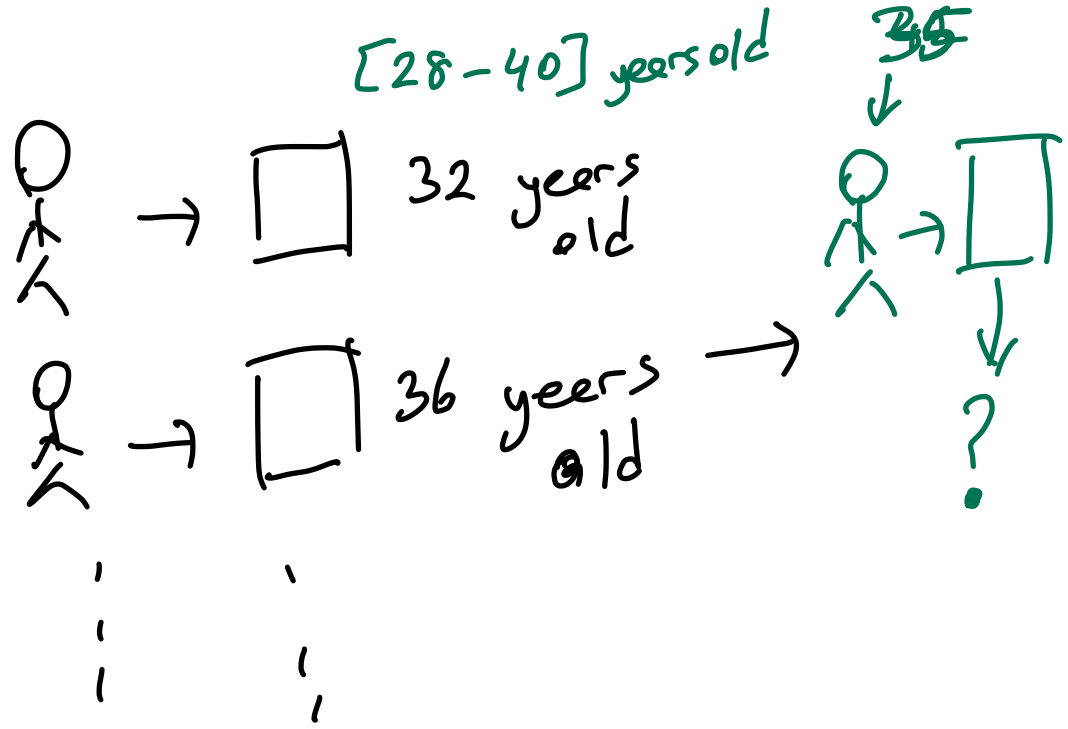
$y_i \in \mathbb{R}$



$$y_t = f(y_{t-1}, y_{t-2}, \dots, y_{t-10})$$

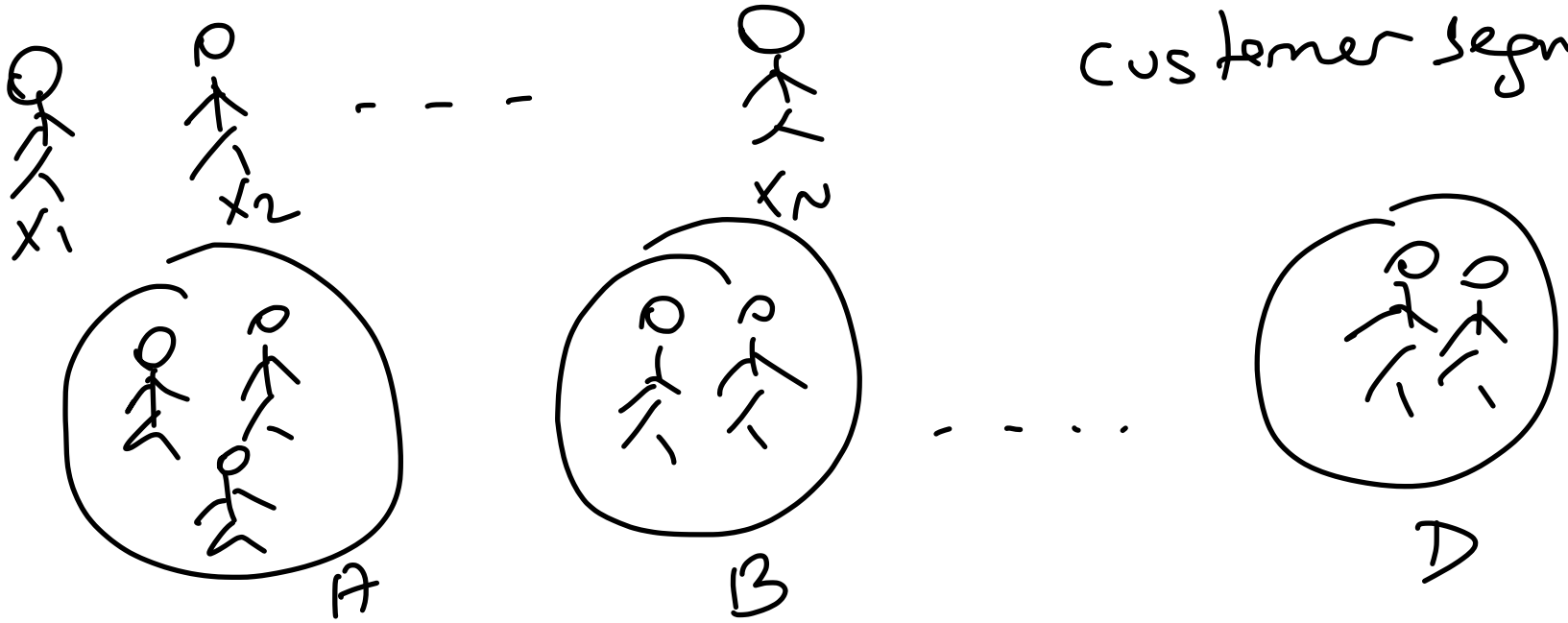
window size 10



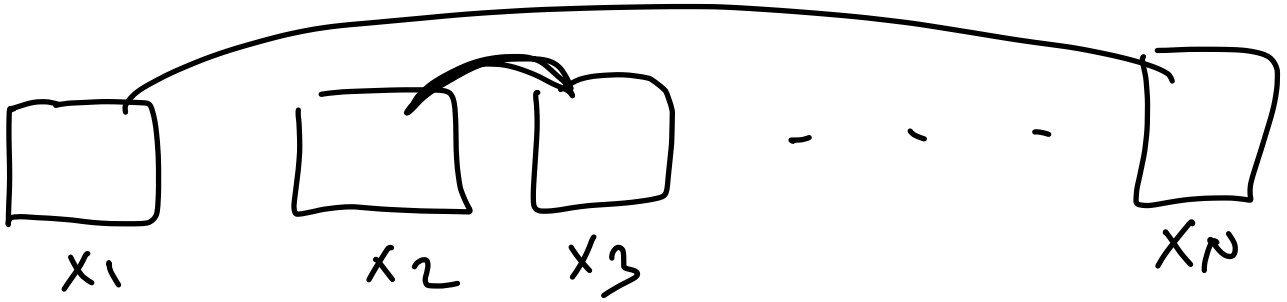


Unsupervised Learning:

Clustering: $\chi = \{x_i\}_{i=1}^{N}$



customer segmentation



text categorization

match, score, budget, stock option, ...