LINEAR PROGRAMMING FORMULATIONS

$$\max \quad c_1 x_1 + c_2 x_2 + \ldots \qquad c^T x$$
$$a_{11} x_1 + a_{12} x_2 + \ldots \le b_1$$
$$a_{21} x_1 + a_{22} x_2 + \ldots \le b_2$$

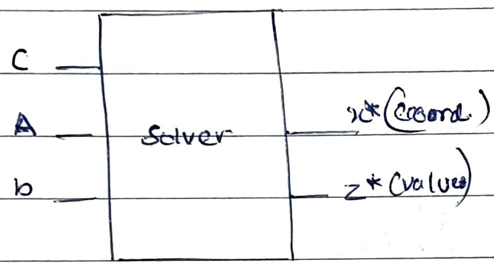
$$\max \; c^T x$$
$$Ax \le b$$
$$x \ge 0$$

$x_i \ge 0$

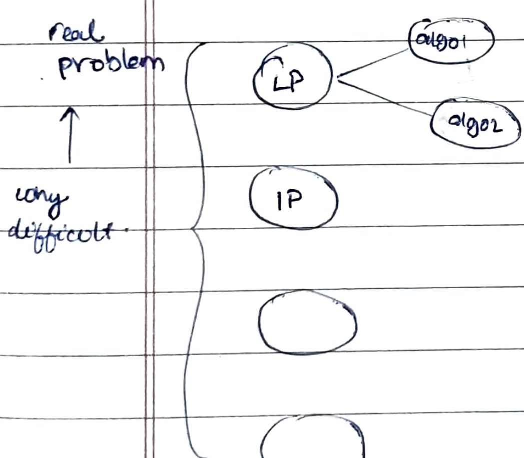
$x \in \mathbb{R}^n$ LP

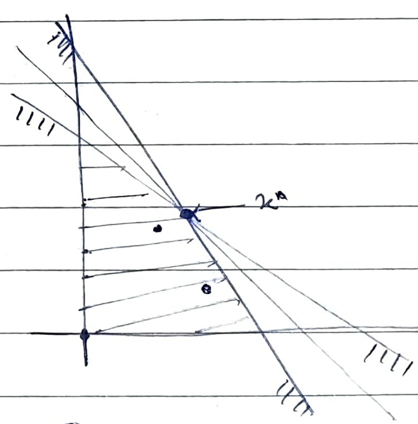
$x \in \mathbb{Z}^n$ IP

QP



skill to learn!
art of converting real world problem to LP.



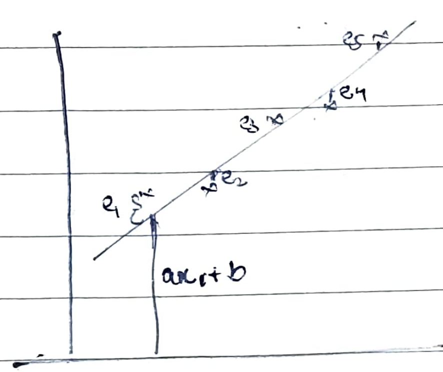


① unique ② infeasible ③ unbounded.

LINE FITTING

$$\min_{a,b} \left| y_i - (a x_i + b) \right|$$

$$\min \sum e_i$$



$$\min_{x} \sum e_i$$

st

$$|y_i - (ax_i + b)| \leq e_i \quad \longleftarrow \text{L1 norm.}$$

$$e_i \geq 0$$

$$\min. \sum e_i$$

st

$$y_i - (ax_i + b) \leq e_i$$

$$-(y_i - (ax_i + b)) \leq e_i$$

$$e_i \geq 0$$

$$\min_{a, b, e_1, \ldots e_N} \sum_{0}^{N} e_i$$

$$\min_{a, b} \left(y_i - (ax_i + b)\right)^2$$

ABS	MSE	
L1	L2	
max no. of pts.		norms
L0	L_∞	
↓	↓	
# nonzer	max. x_i	
	(least outlier)	

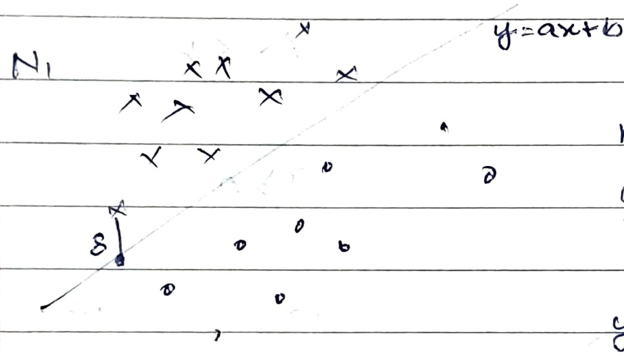
fit a line in L0 norm → hard

L1 norm → LP

L2 norm → easy

L∞ norm → ? ←

pattern classification as LP.



max. δ

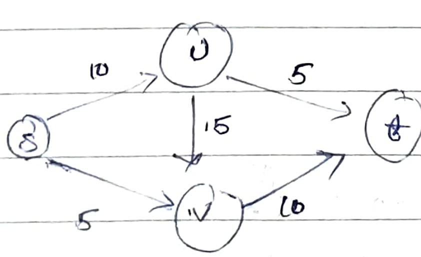
$y_i \geq ax_i + b + \delta$ N_1 cons.

$y_i \leq ax_i + b - \delta$ N_2 cons.

Shortest path

minimum

MAX FLOW PROBLEM



algorithm design strategy

max $f(su) + f(sv)$