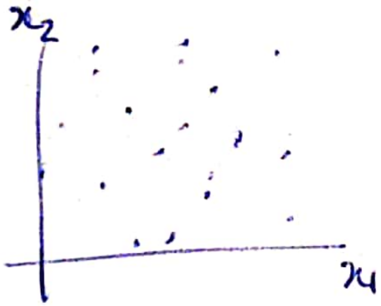
TAHA ENAYAT 2070865 Machine Learning

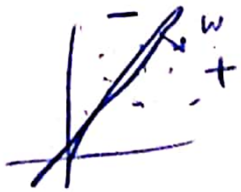
Lecture 03

① **binary classification** : depending on the problem and dimension of data, different Hypothesis spaces can be used.

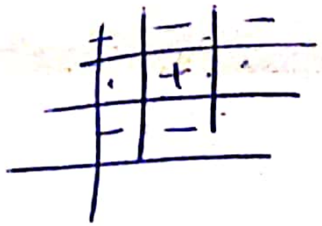
imagine data in 2-D :



we can use square, circle, and line as hypothesis space



$$\mathcal{H} = \{ f \mid f_{w,b}(x) = sgn(w.x + b),\ w \in \mathbb{R}^2,\ b \in \mathbb{R} \}$$

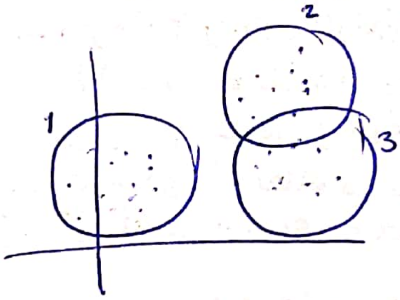


$$\mathcal{H} = \{ f \mid f(x) = sgn\left(\left|x - \frac{a_x + b_x}{2}\right|\right) sgn\left(\left|y - \frac{a_y + b_y}{2}\right|\right),\ a_x, b_x, a_y, b_y \in \mathbb{R} \}$$

multi class classification: we can consider a multiclass classification problem as $\underline{k}$ binary class classification; which k is the number of classes.

that is, if x_i (one instace of data) belongs to class j, then $h_j(x_i) = 1$ and $h_\ell(x_i) = 0 \quad \forall \ell \neq j$. $\vec{h} = (h_1, \dots, h_k)$

in this sense, the binary classification hypothesis space works.

e.g. 

regression: depending on degree of the function to be fitted (learned), we can define $\mathcal{H}_p$ as follows

$$\mathcal{H}_p = \{ f \mid f_{p,\vec{w}} = w_0 + w_1 x + \dots + w_p x^p \mid \vec{w} = (w_0, \dots, w_p) \in \mathbb{R}^p,\ p \in \mathbb{N} \}$$

(we can fix $\underline{P}$ further using cross validation).