Neural Networks

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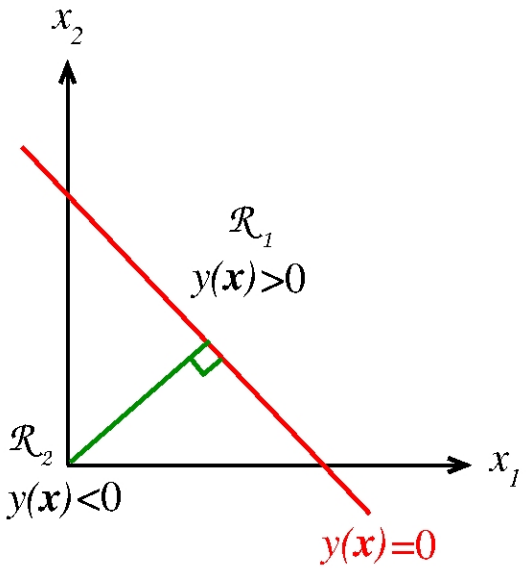
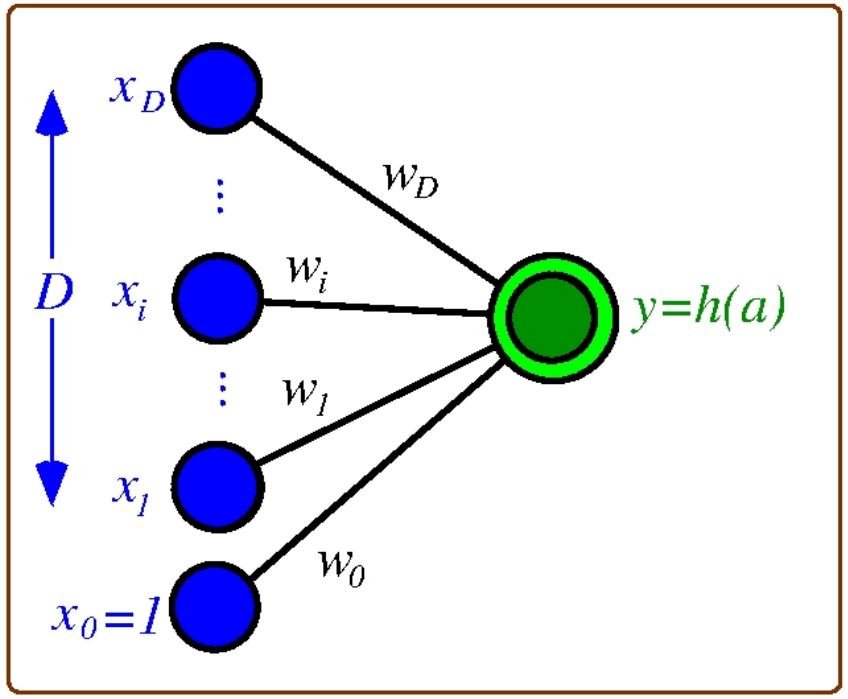
Perceptron: A Linear Classifier



- $y(\mathbf{x}) = \mathbf{w}^T\mathbf{x} + w_0$
- 2-D implicit from of eqn of a line is $ax + by + c = 0$. Here, $y(\mathbf{x}, \mathbf{w}) = w_2x_2 + w_1x_1 + w_0 = 0$
- $y(\mathbf{x}) = 0$: 1-D h'plane in 2-D
- Relative location of $\mathcal{R}_1$, $\mathcal{R}_2$ is immaterial: which is above/-below/to the left/to the right

- Non-neural implementation: weight learning
- $D-$ dimensional data: scalars e.g., salary, years of residence, outstanding debt
- output $y = \pm 1$: approve/deny credit/loan/CC
- Approve if $\sum_{i=1}^{D} w_i x_i > Thresh$ ($-b$ or $-w_0$), or deny
- Some $w_i < 0$ debt: adverse effect on credit rating

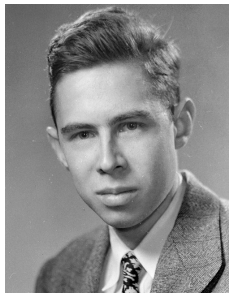
Rosenblatt's Perceptron: Neural



- A single-layer NN
- Sgn activation fn
- $h(a) = +1, a > 0$
- $h(a) = -1, a < 0$
- $y_i = y(\mathbf{x}_i) = y(\mathbf{x}_i, \mathbf{w})$
- $= \mathbf{w}^T \mathbf{x}_i + b$ nonhom
- $= \mathbf{w}^T \mathbf{x}_i$ hom
- $\mathbf{w}$: lin params/wts

- b (or w_0): 'bias': non-homogenous $D-$ dim $\mathbf{x}_i$
- homogeneous $(D+1)-$ dim $\mathbf{x}_i$ with $x_0 = 1$
- Learning problem: to learn the weights
- Some $w_i < 0$ debt: adverse effect on credit rating

The X-OR Problem



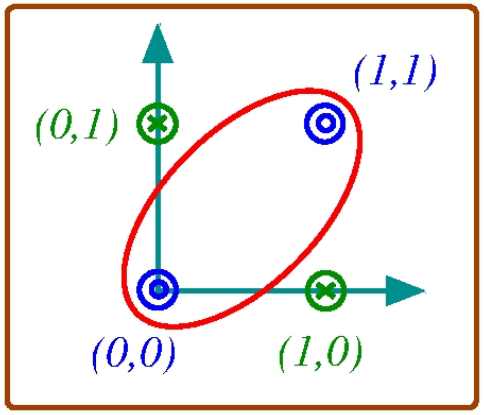
F. Rosenblatt [1928-71] M. L. Minsky [1927-2016]

https://news.cornell.edu/sites/default/files/styles/full_size/public/2019-09/0925_rosenblatt3.jpg?itok=glQnp70v

https://upload.wikimedia.org/wikipedia/commons/2/28/Marvin_Minsky_at_OLPCb.jpg

Rosenblatt: digit scanner, one-versus-rest classifiers

x_2	x_1	$x_2 \oplus x_1$
0	0	0
0	1	1
1	0	1
1	1	0



- Solutions?
- Not linear!
- More layers
- #neurons?[04:00]