

CS-671: DEEP LEARNING AND ITS APPLICATIONS

Lecture: 03

Intuition of Neural Networks

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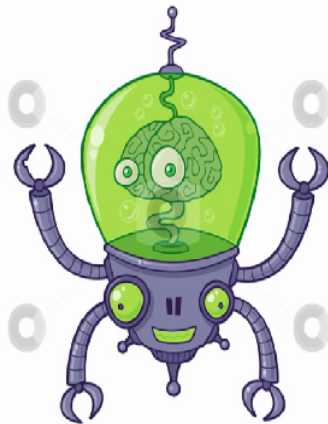
Presentation for CS-671@IIT Mandi (27 February, 2019)

(*Slides Credit : A friendly introduction to deep learning by Luis Serrano)

<https://www.youtube.com/watch?v=BR9h47Jtqyw>

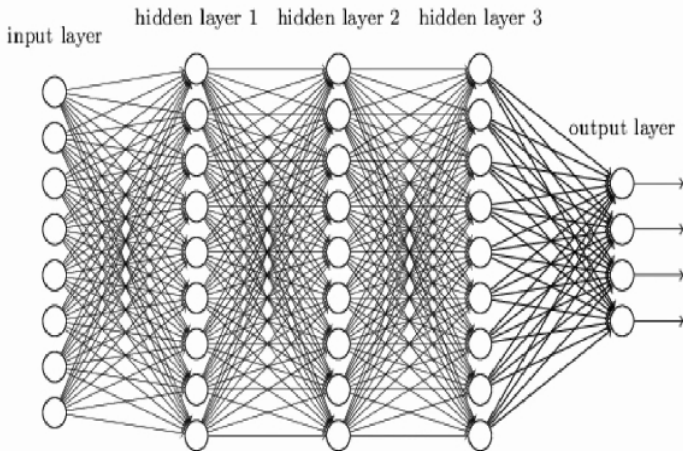
February - May, 2019

Neural Networks



Slide

Neural Networks

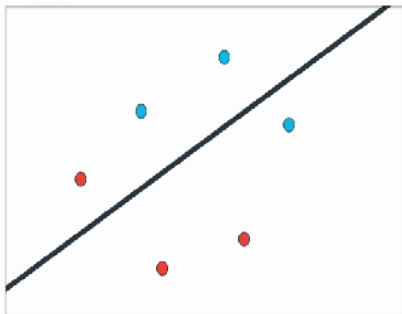


Neural Networks



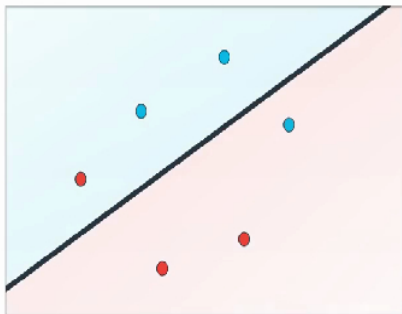
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Goal: Split Data



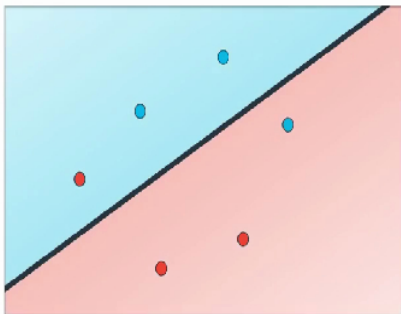
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Goal: Split Data



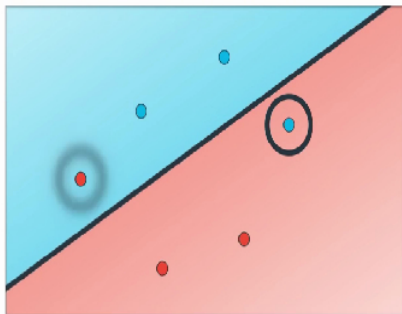
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Goal: Split Data



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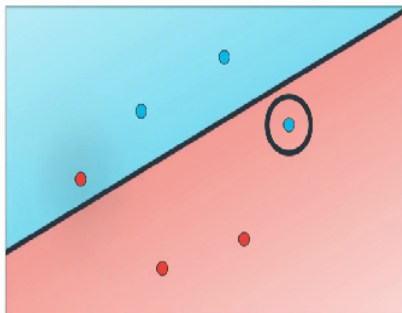
Goal: Split Data



2 errors

Slide

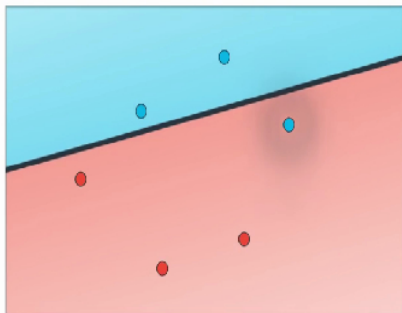
Goal: Split Data



2 errors

Slide

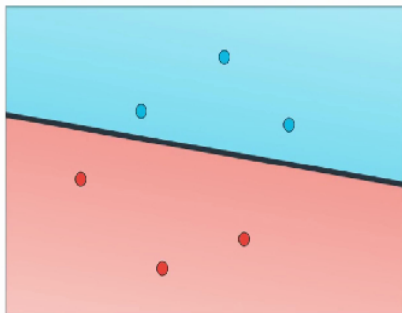
Goal: Split Data



Linear regression: Gradient descent & stochastic gradient descent

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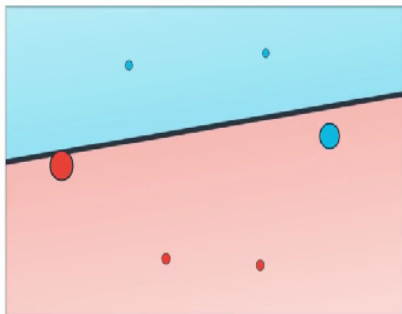
Goal: Split Data



0 errors

Hot!

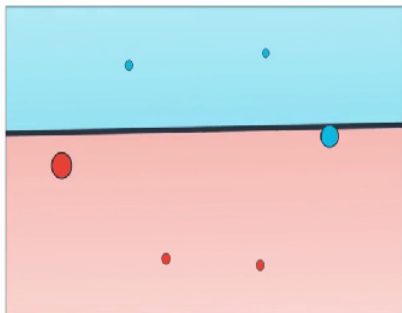
Logistic Regression



$$\text{Error} = \text{small blue dot} + \text{small blue dot} + \text{large blue circle} + \text{large red circle} + \text{small red dot} + \text{small red dot}$$

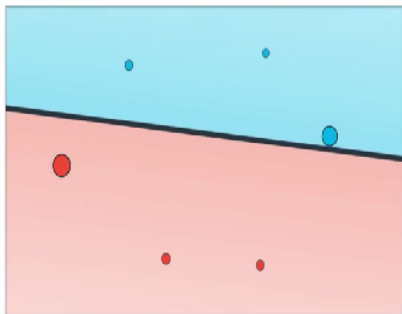
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Logistic Regression



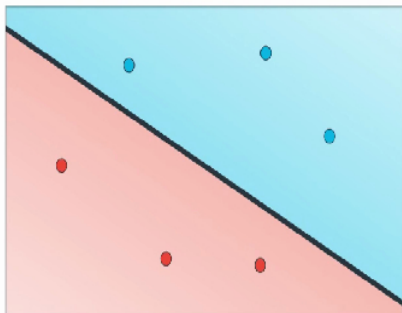
$$\text{Error} = \text{blue dot} + \text{blue dot} + \text{large blue circle} + \text{large red circle} + \text{red dot} + \text{red dot}$$

Logistic Regression



$$\text{Error} = \text{small blue dot} + \text{small blue dot} + \text{large blue circle} + \text{large red circle} + \text{small red dot} + \text{small red dot} + \text{small red dot}$$

Logistic Regression



$$\text{Error} = \text{small blue dot} + \text{small blue dot} + \text{large blue dot} + \text{large red dot} + \text{small red dot} + \text{small red dot}$$

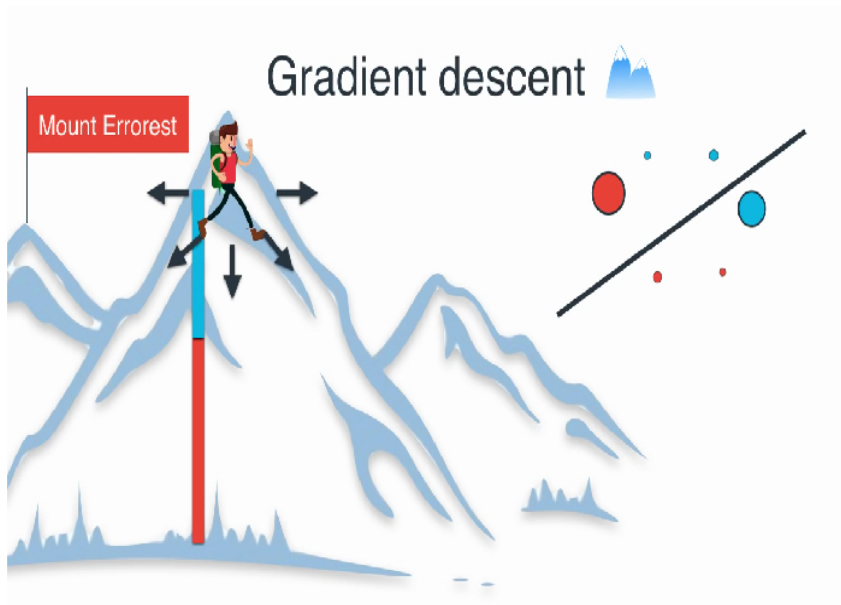
$$\text{Error} = \text{small blue dot} + \text{small blue dot} + \text{small blue dot} + \text{small red dot} + \text{small red dot} + \text{small red dot}$$

Minimize error

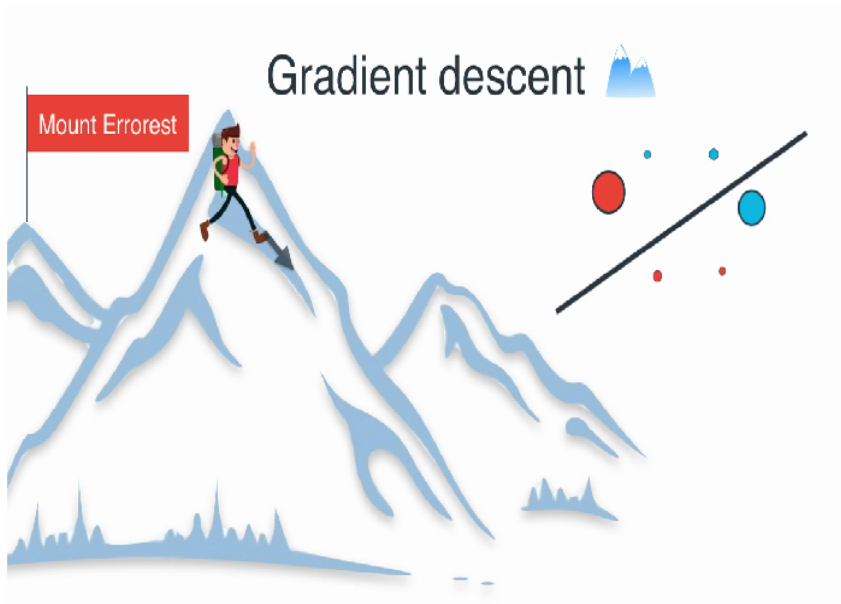


Gradient descent

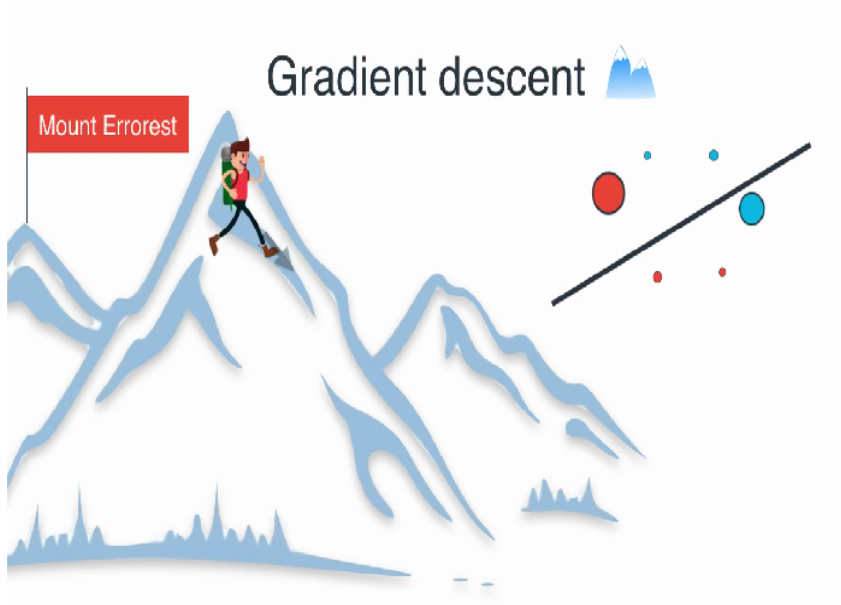
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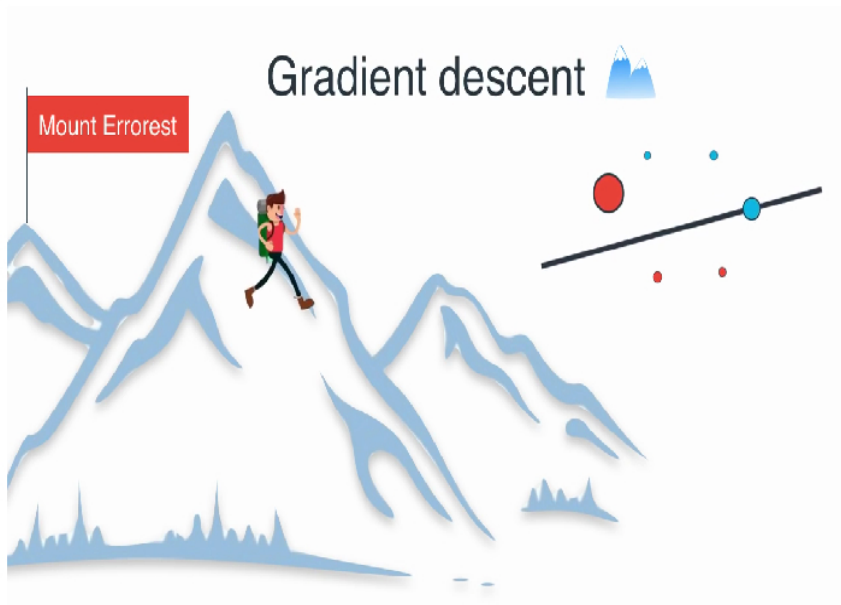


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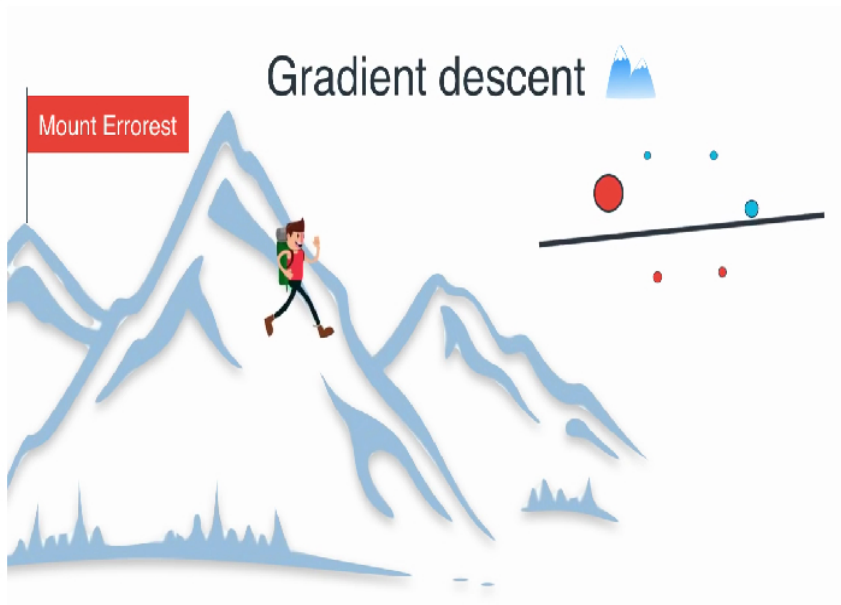
Gradient descent



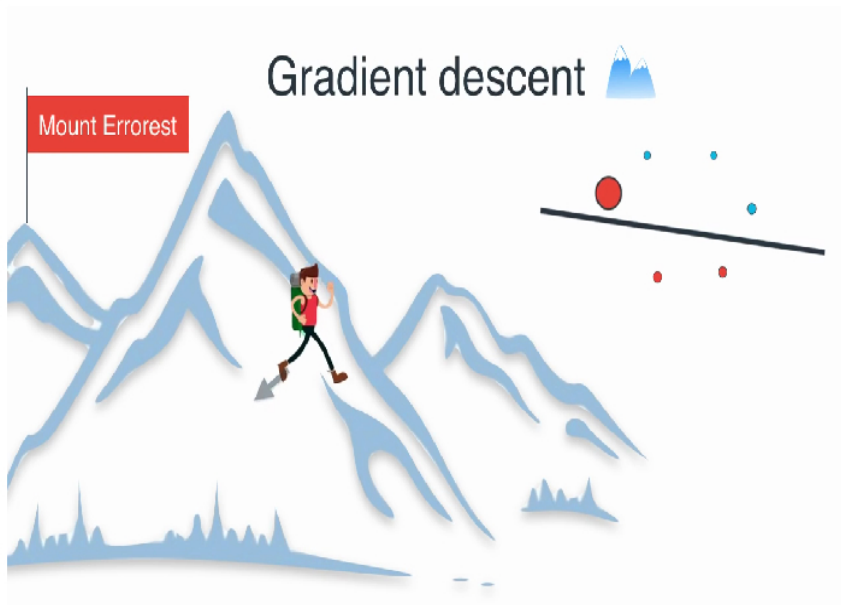
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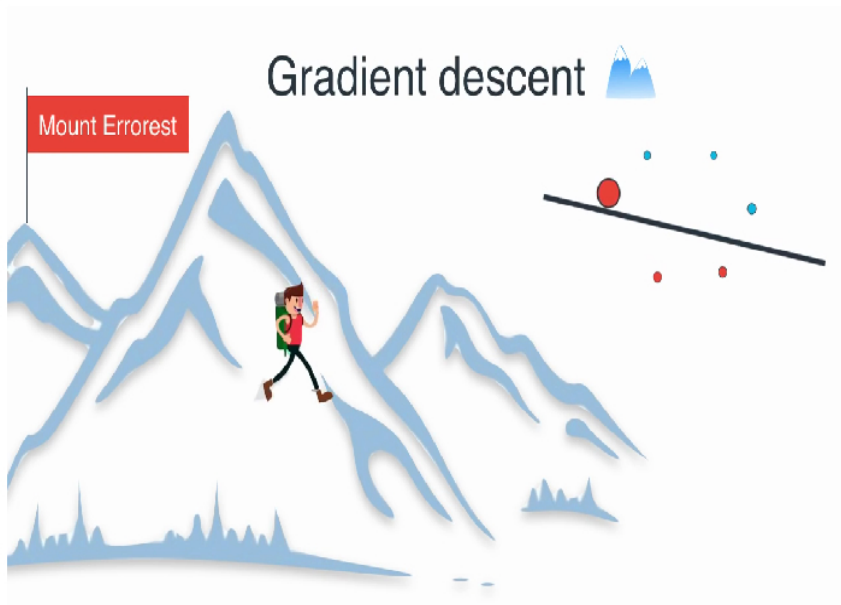
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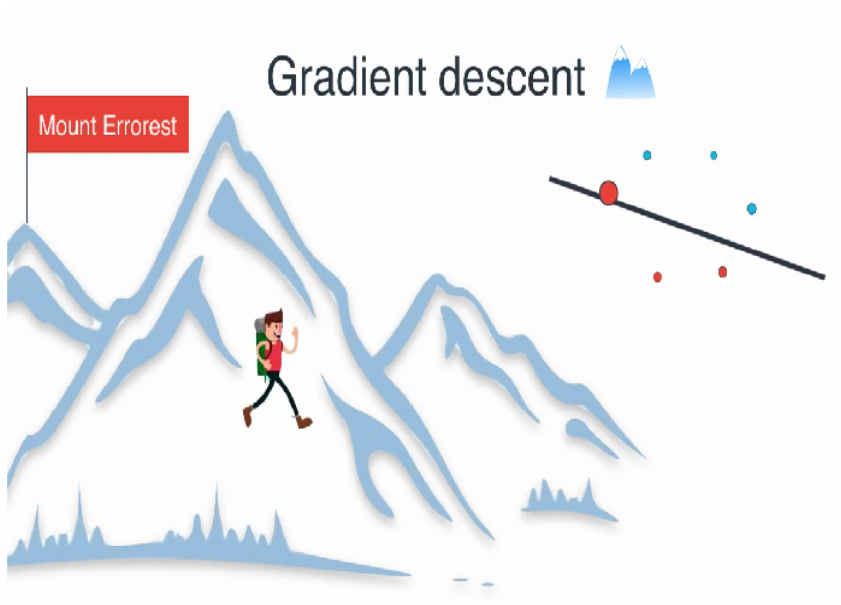
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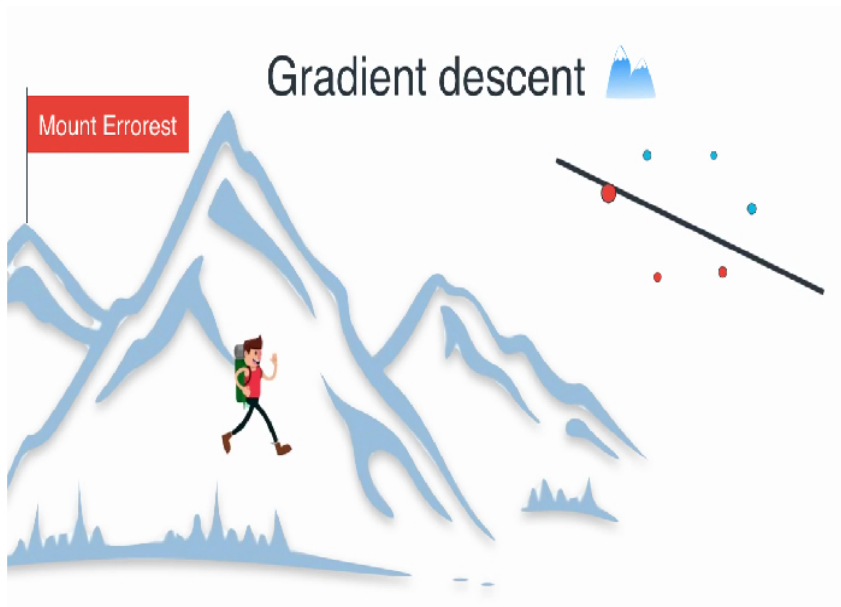
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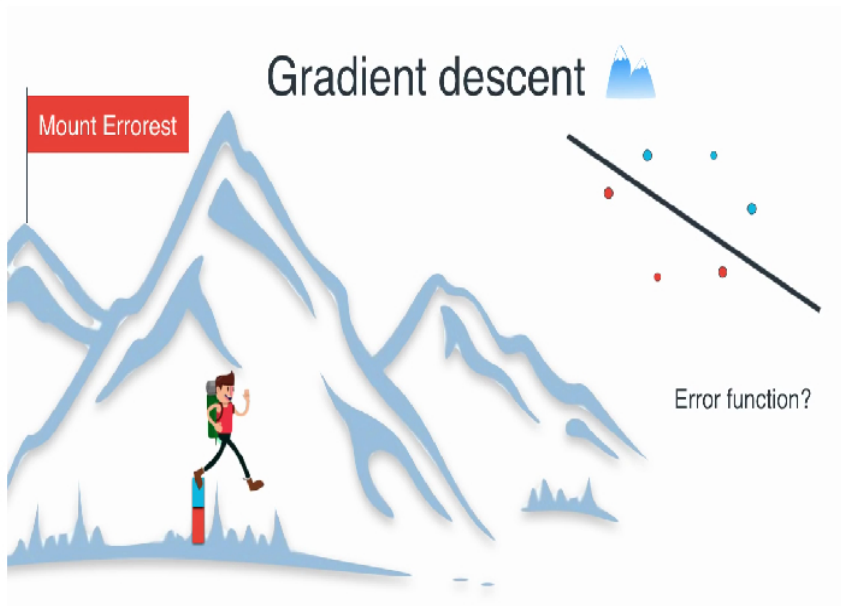
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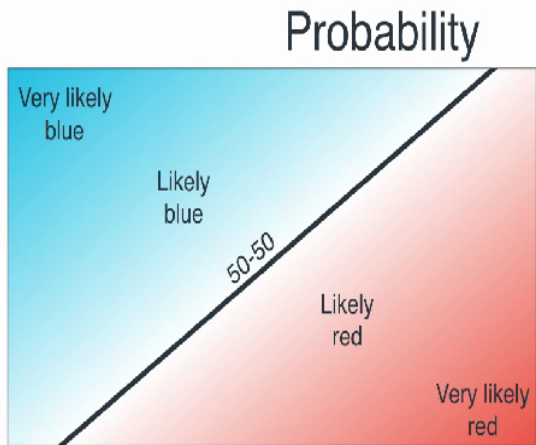
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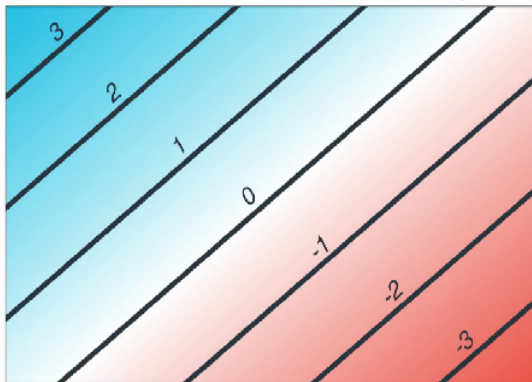


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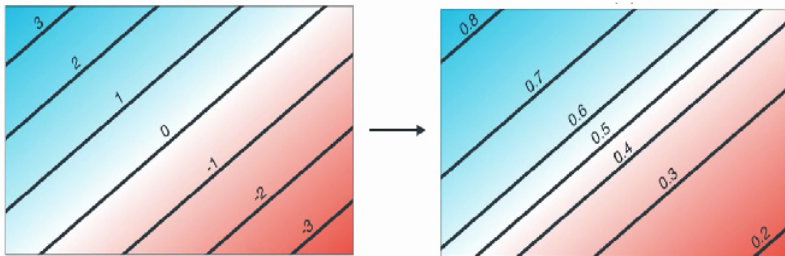
Probability



Blueness

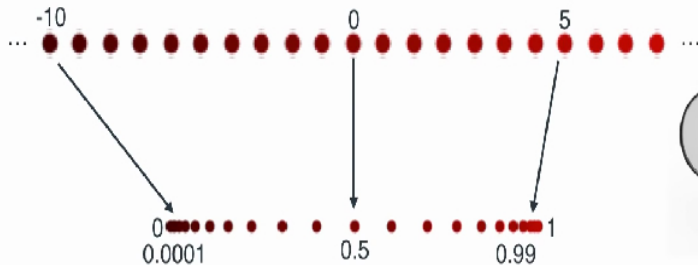
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Probability



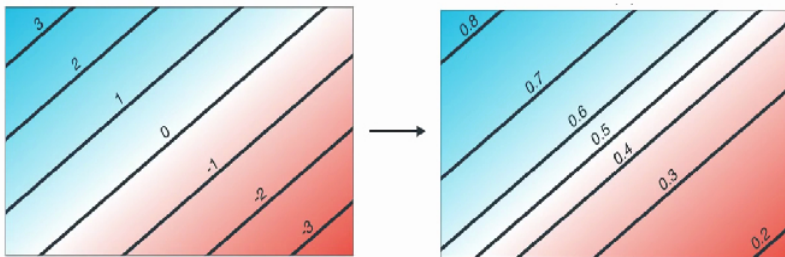
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Activation function



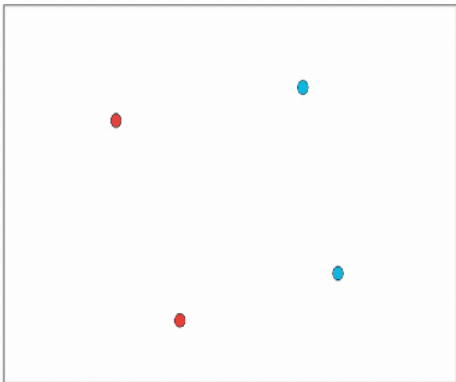
Linear regression: direct minimization

Probability



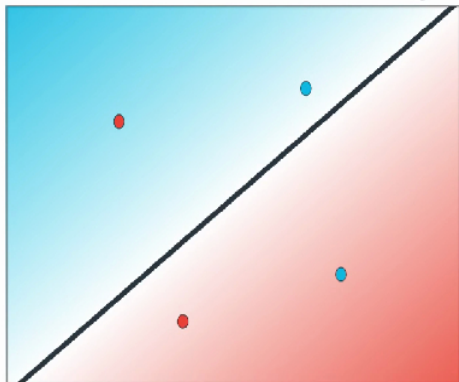
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Probability



Slide

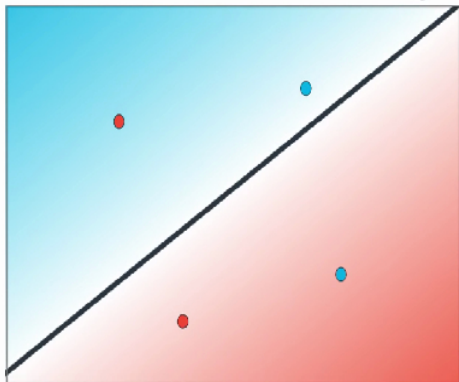
Probability



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

Slide

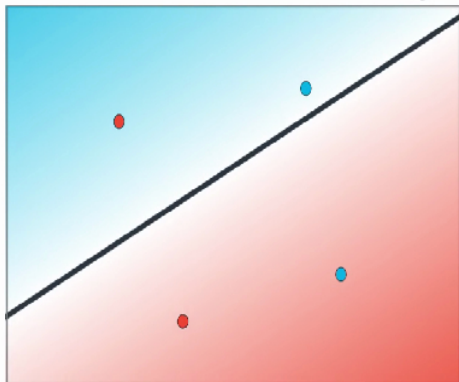
Probability



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

Slide

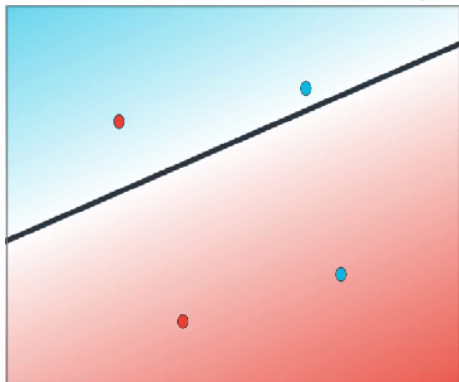
Probability



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

Slide

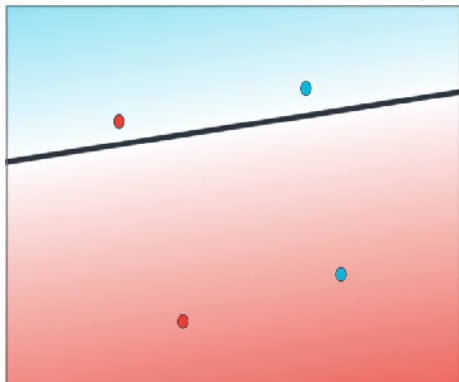
Probability



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

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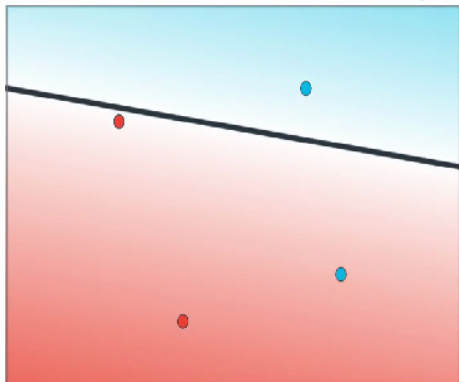
Probability



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

Slide

Probability

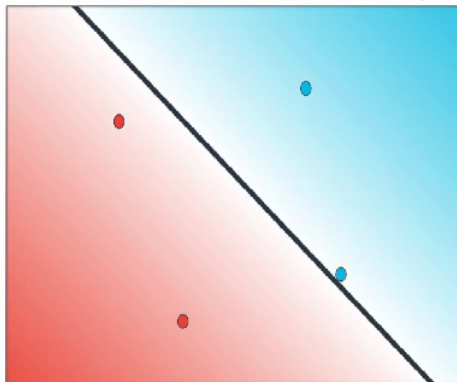


$$0.6 \cdot 0.2 \cdot 0.1 \cdot 0.7 = 0.0084$$

Linear regression: nonlinear features

Slide

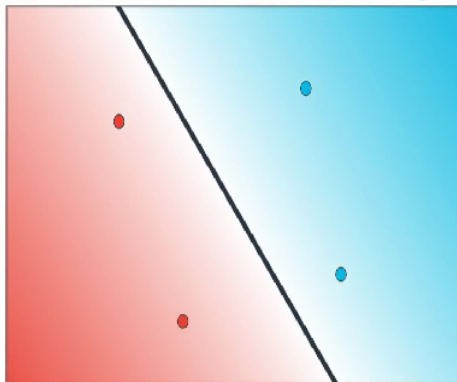
Probability



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

Slide

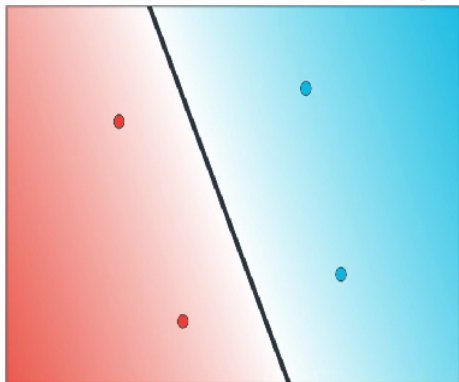
Probability



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

Slide

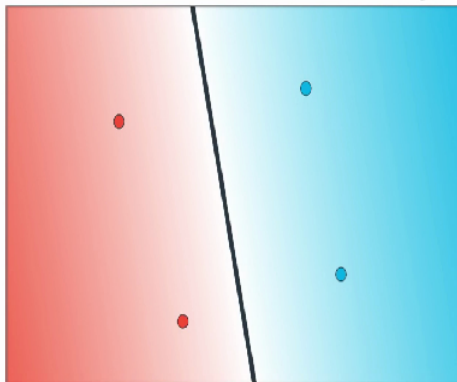
Probability



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

Slide

Probability

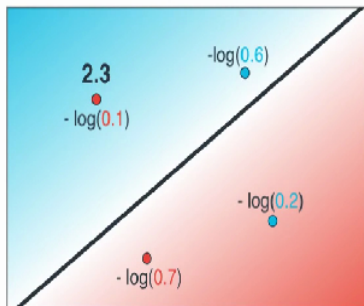


$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

$$0.7 * 0.9 * 0.8 * 0.6 = 0.3024$$

Maximum Likelihood

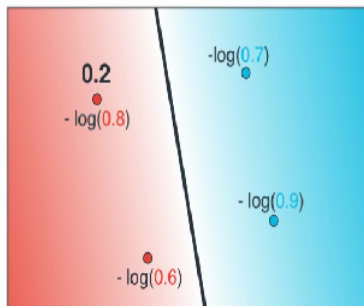
Error function



$$0.6 * 0.2 * 0.1 * 0.7 = 0.0084$$

$$-\log(0.6) - \log(0.2) - \log(0.1) - \log(0.7) = 4.8$$

2.3



$$0.7 * 0.9 * 0.8 * 0.6 = 0.3024$$

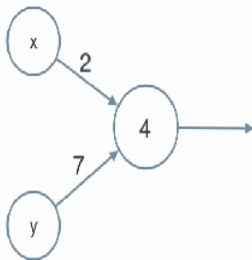
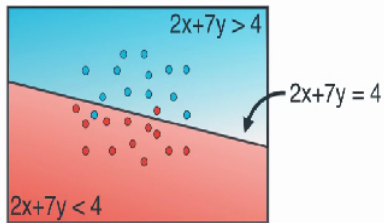
$$-\log(0.7) - \log(0.9) - \log(0.8) - \log(0.6) = 1.2$$

0.2



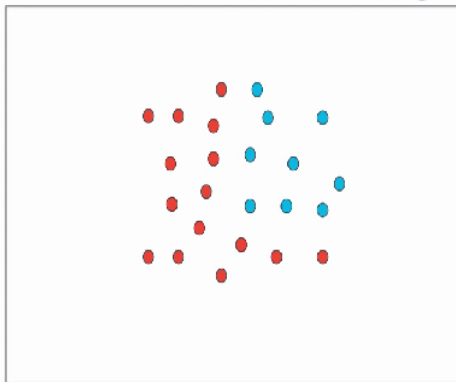
Slide

Neuron



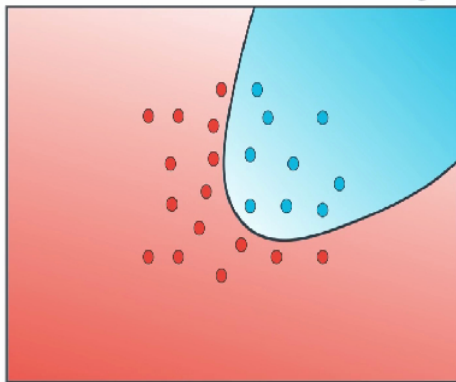
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Non-linear regions

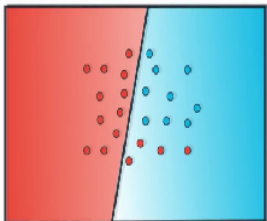
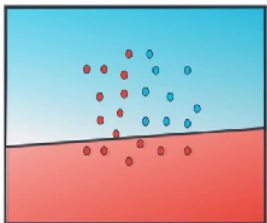


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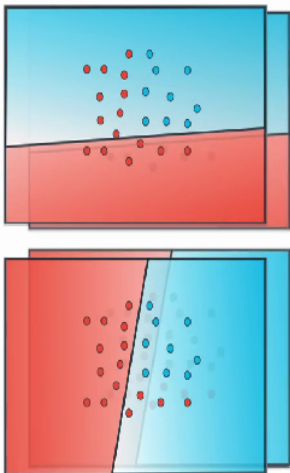
Non-linear regions



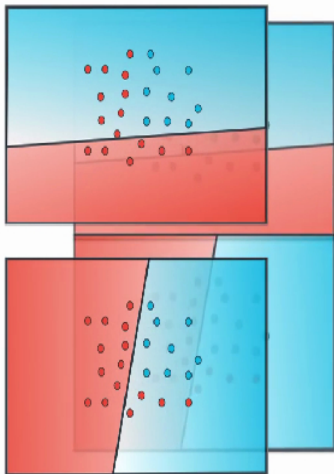
Combining Regions



Combining Regions

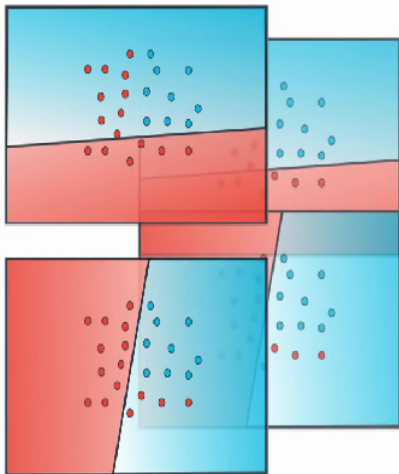


Combining Regions

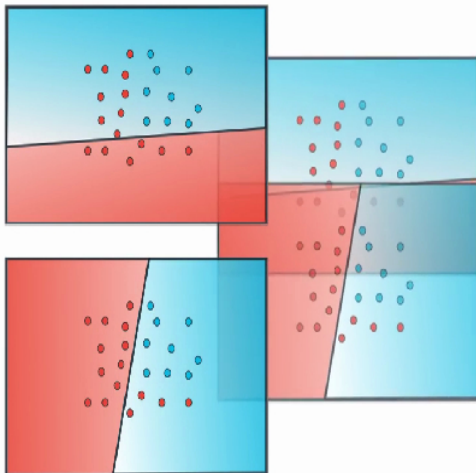


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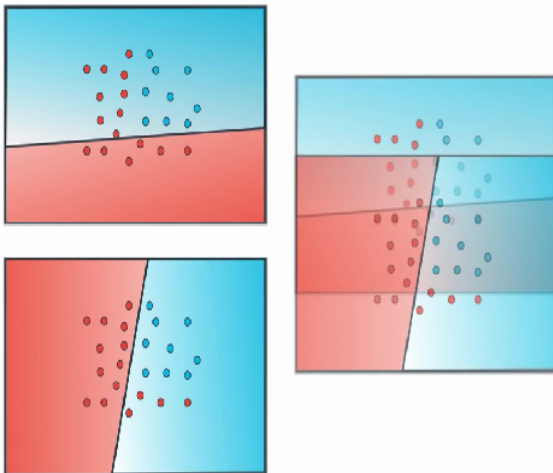
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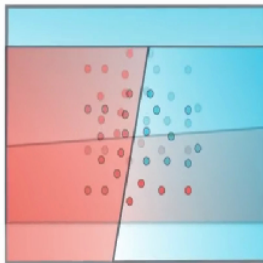
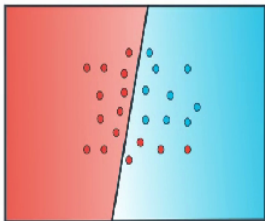
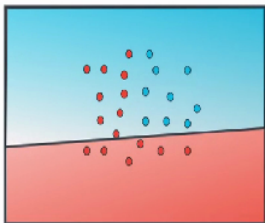
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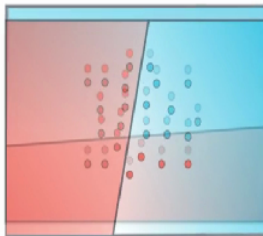
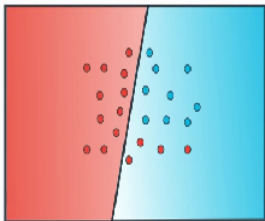
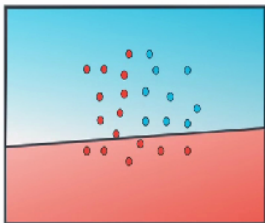
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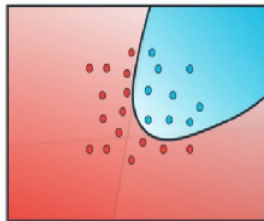
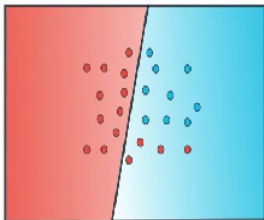
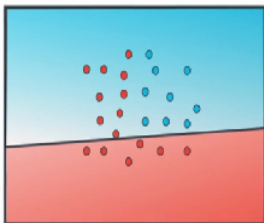
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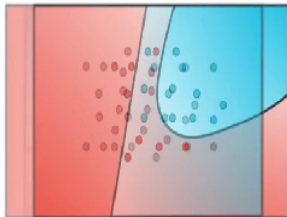
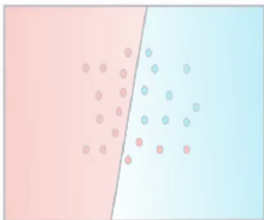
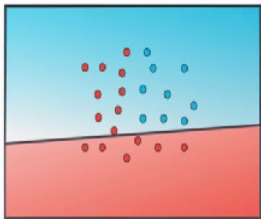
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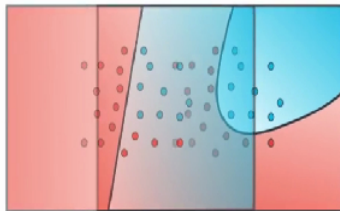
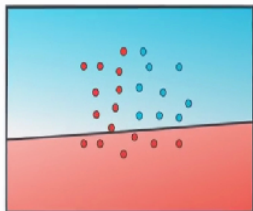
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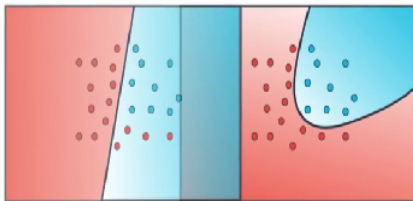
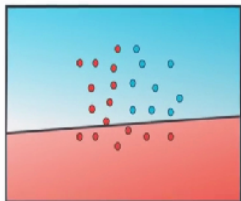
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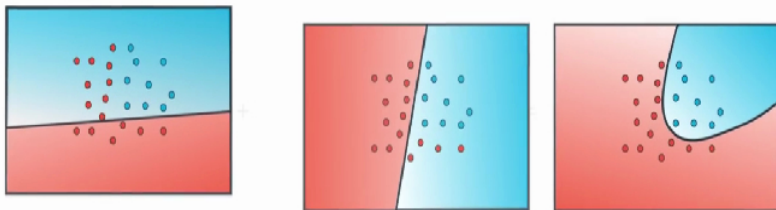
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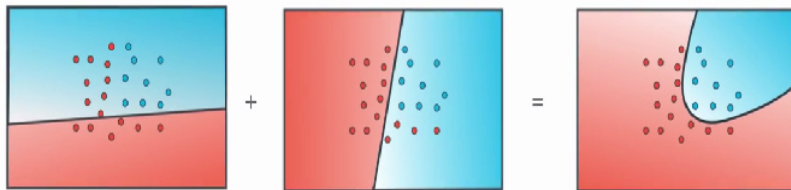
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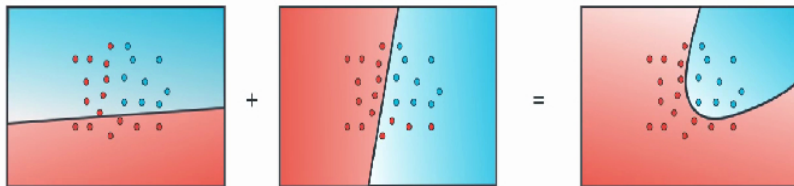
Combining Regions



Combining Regions

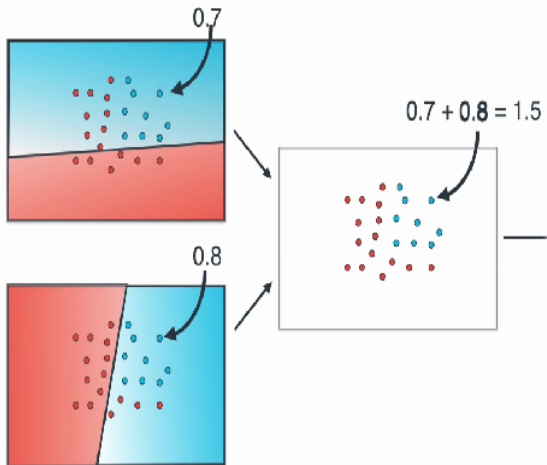


Combining Regions



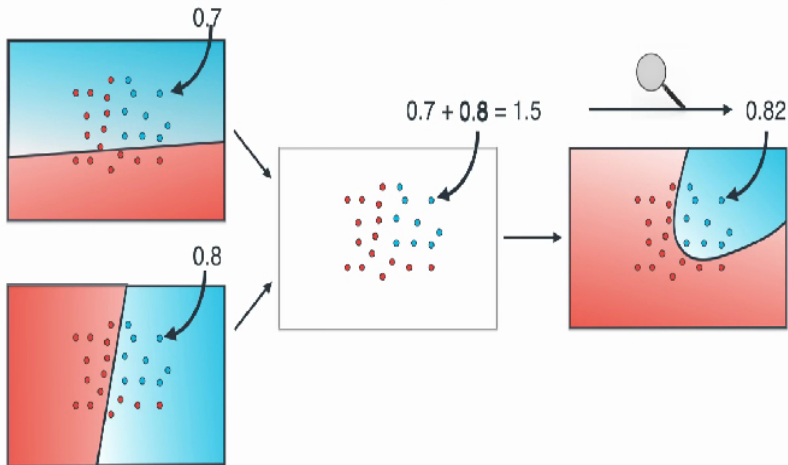
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Neural Network

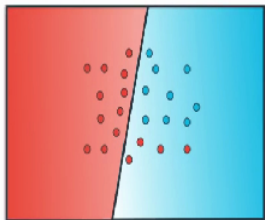
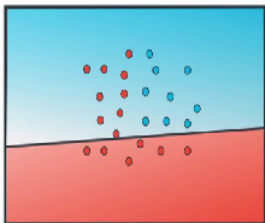


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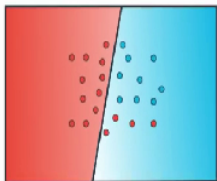
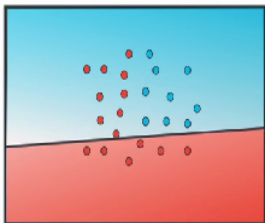
Neural Network



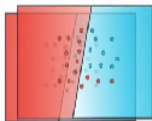
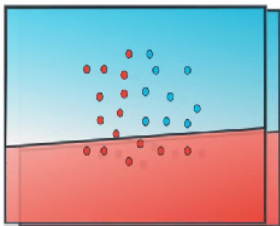
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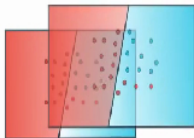
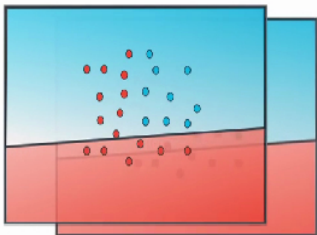
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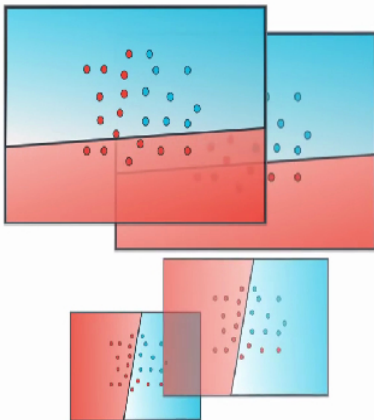
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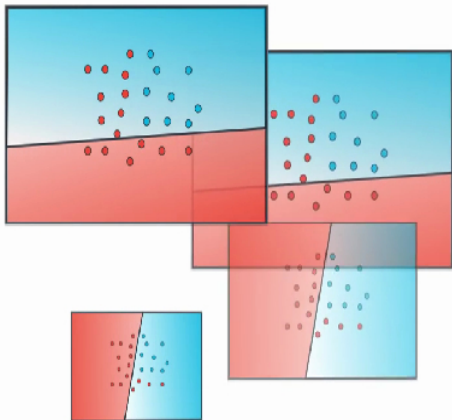
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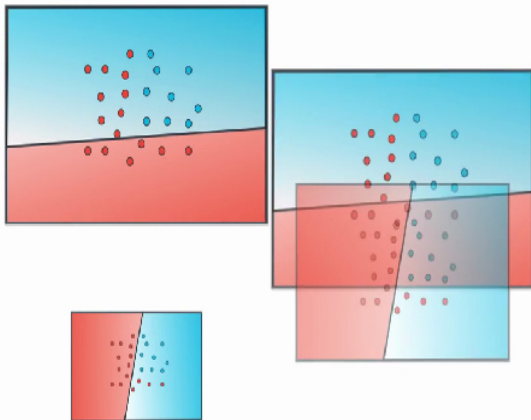
Combining Regions



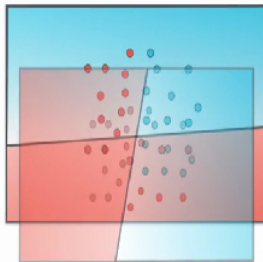
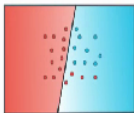
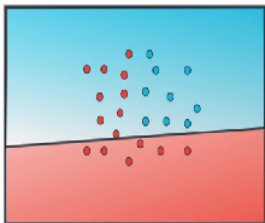
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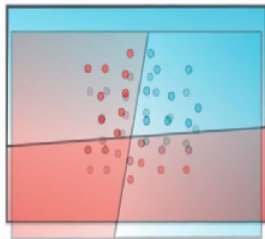
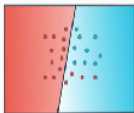
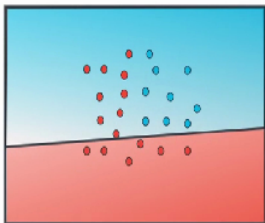
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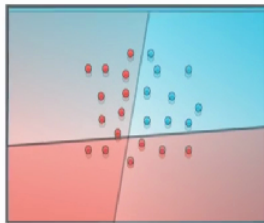
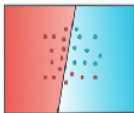
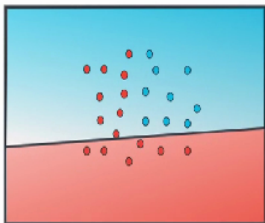
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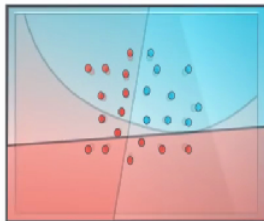
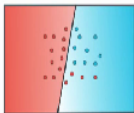
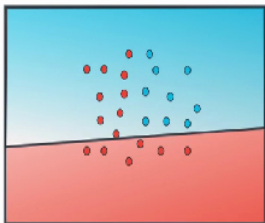
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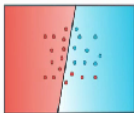
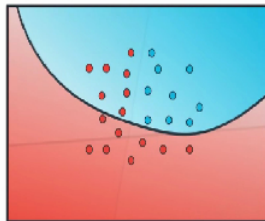
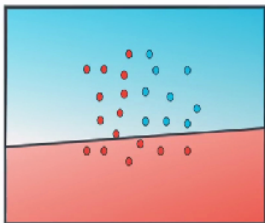
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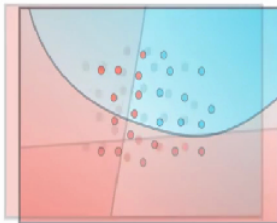
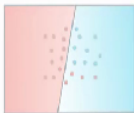
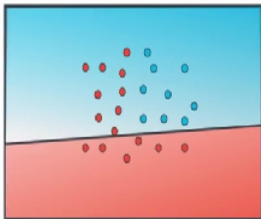
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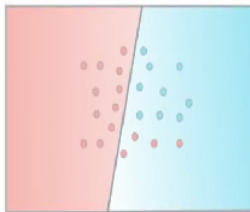
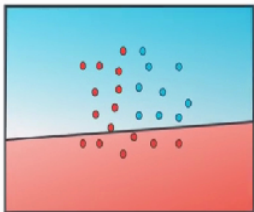
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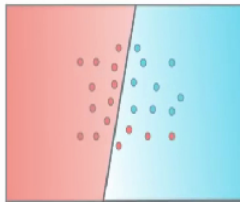
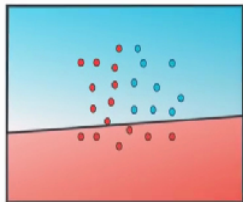
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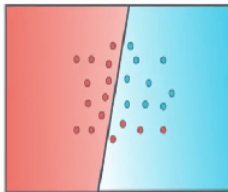
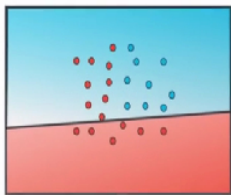
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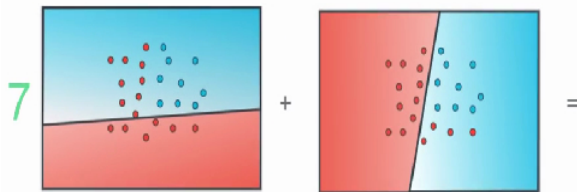
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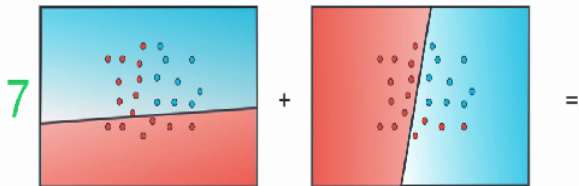
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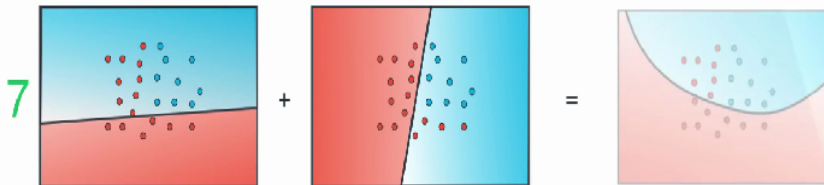
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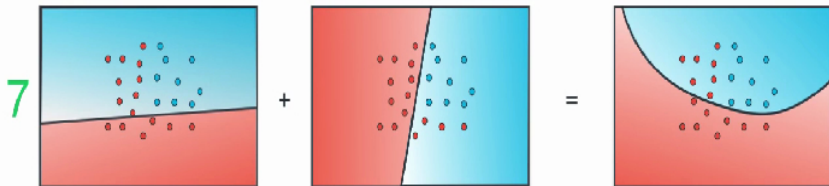
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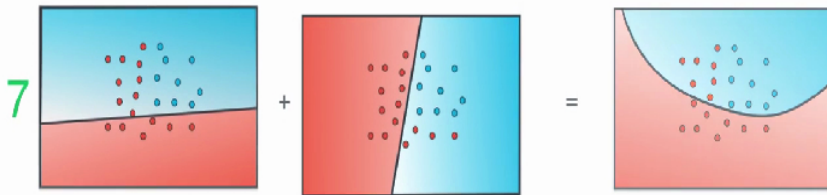
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Combining Regions

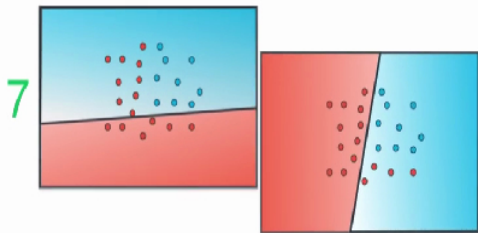


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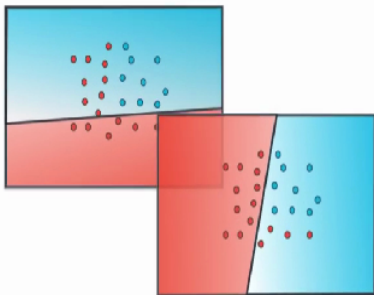
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Combining Regions

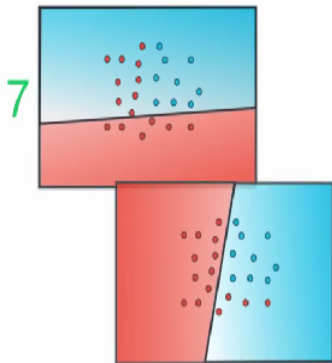


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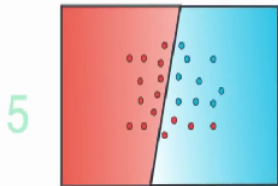
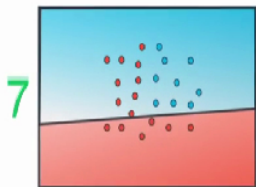


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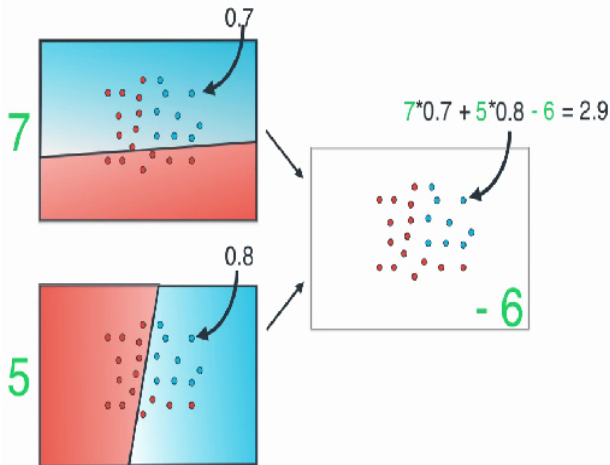
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Neural Network



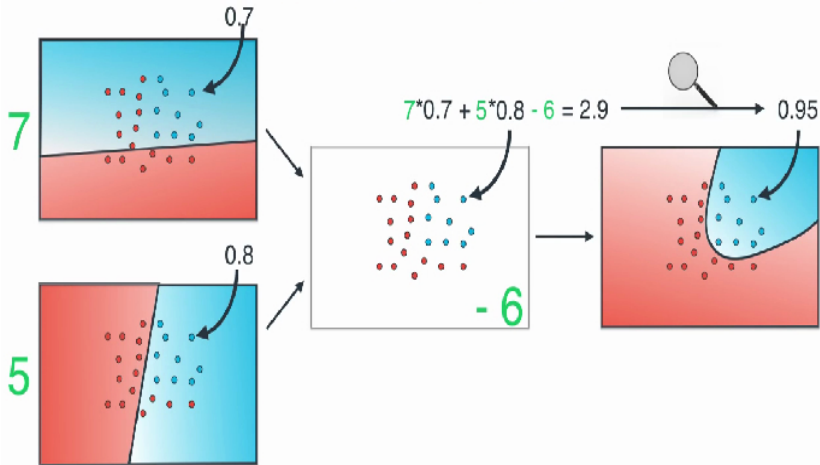
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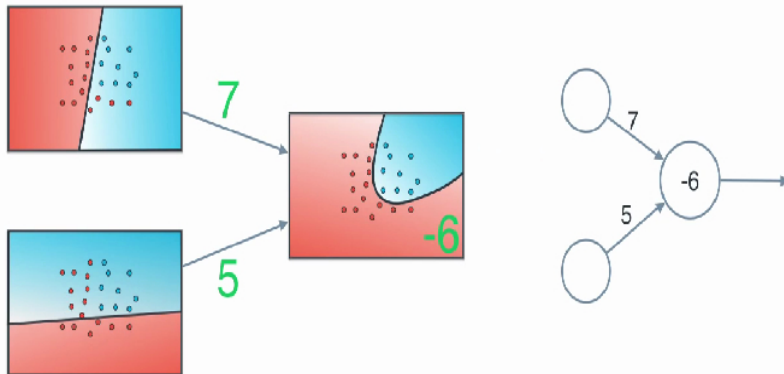
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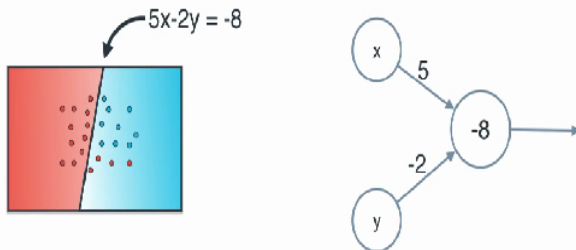
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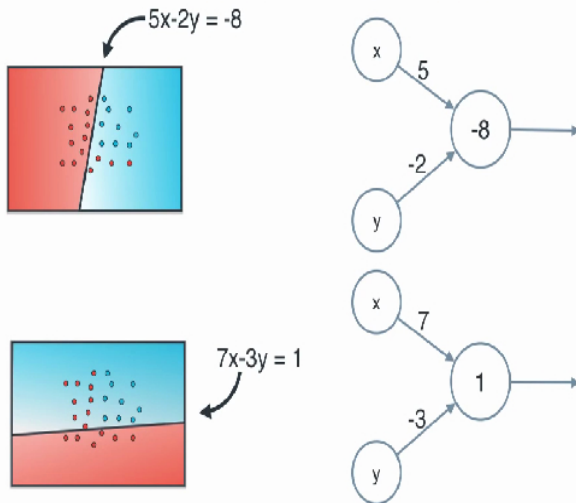
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Neural Network



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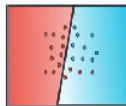
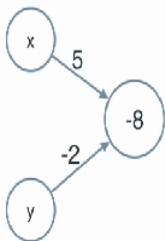


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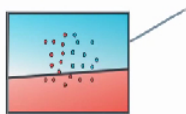
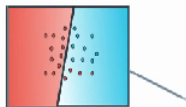
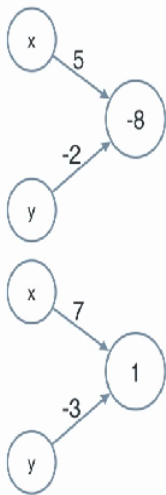
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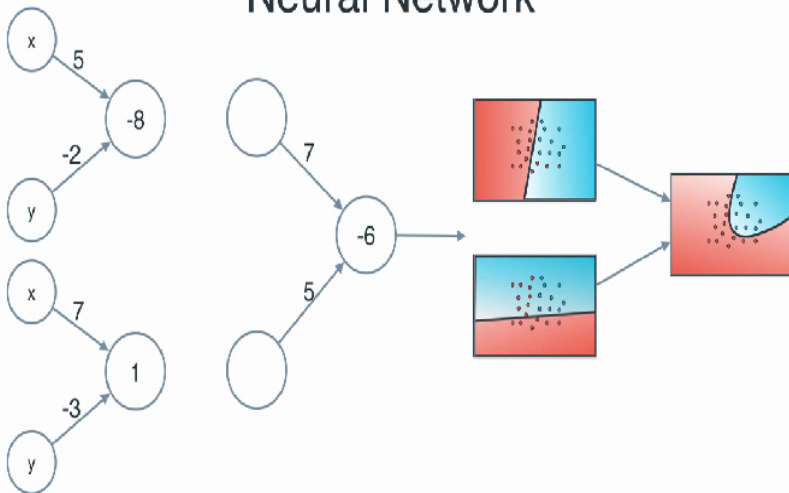


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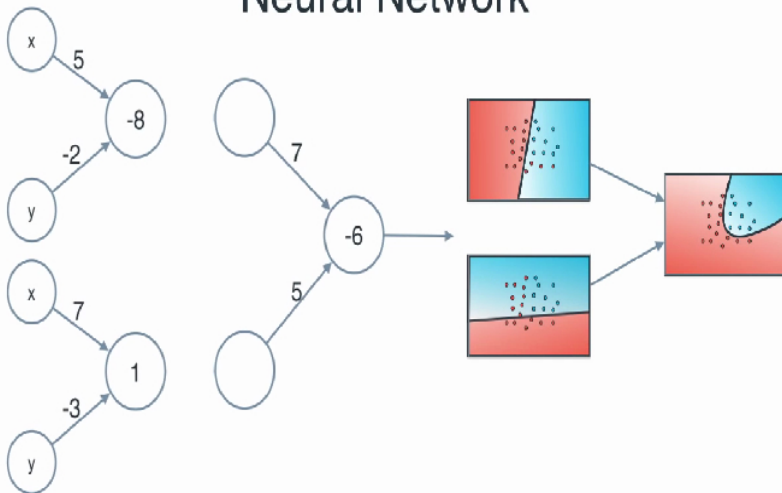
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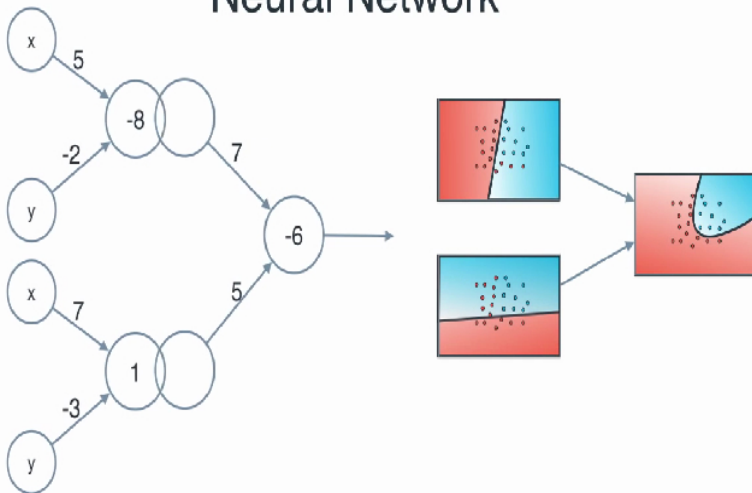
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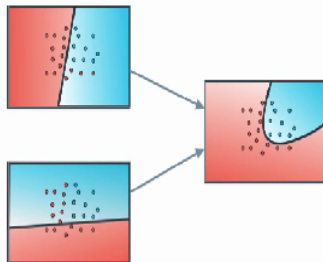
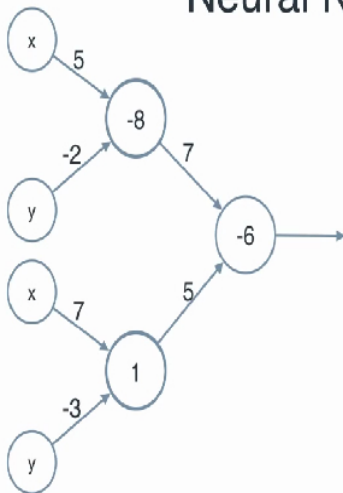


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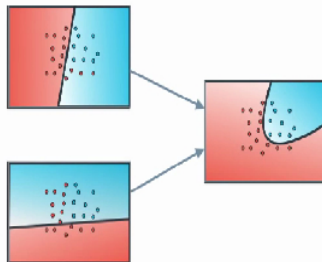
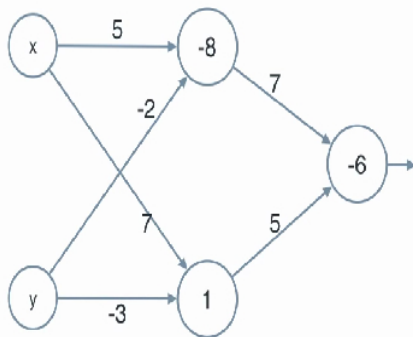
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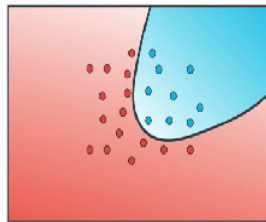
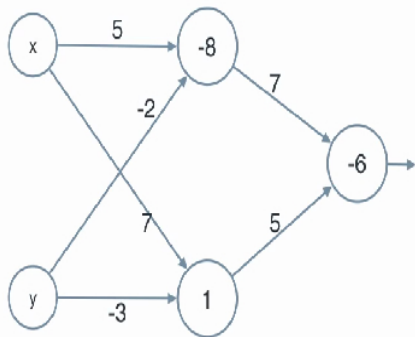
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Neural Network

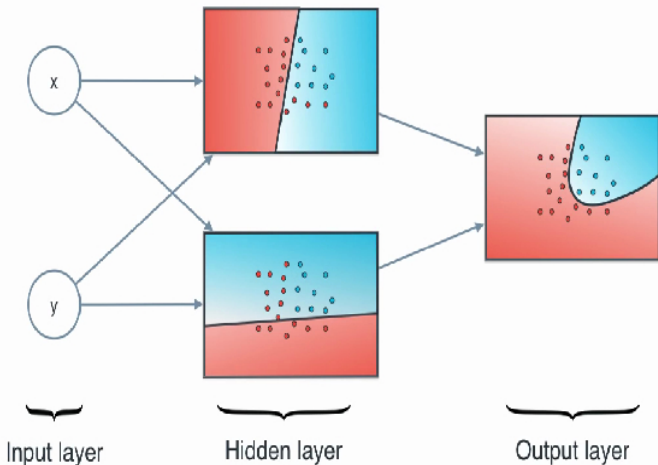


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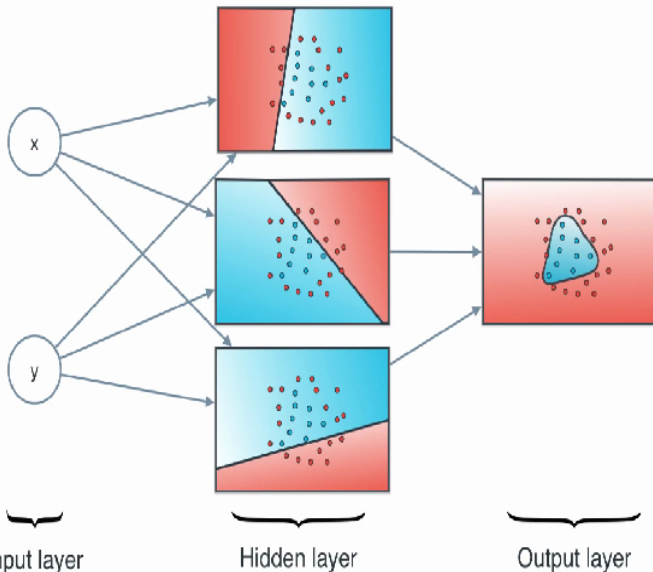


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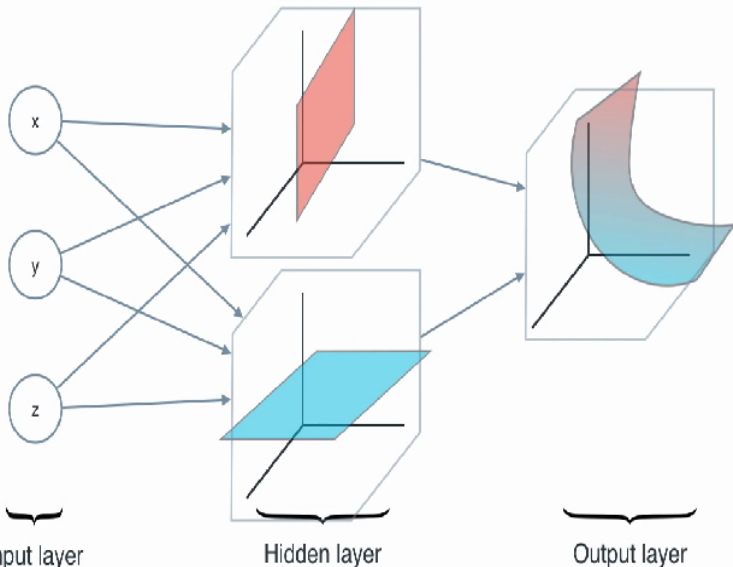
Neural Network



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Deep Neural Network

