Logistic Regression

H(x) = 1/(1 + exp^(-theta 0 + theta 1(x))

$H(x) = 1/(1 + exp^{(-theta\ 0 + theta\ 1(x))}$

Sigmoid function or logistic function

H(x) = 1/(1 + exp^(-theta 0 ~~+~~ -theta 1(x))

Sigmoid function or logistic function

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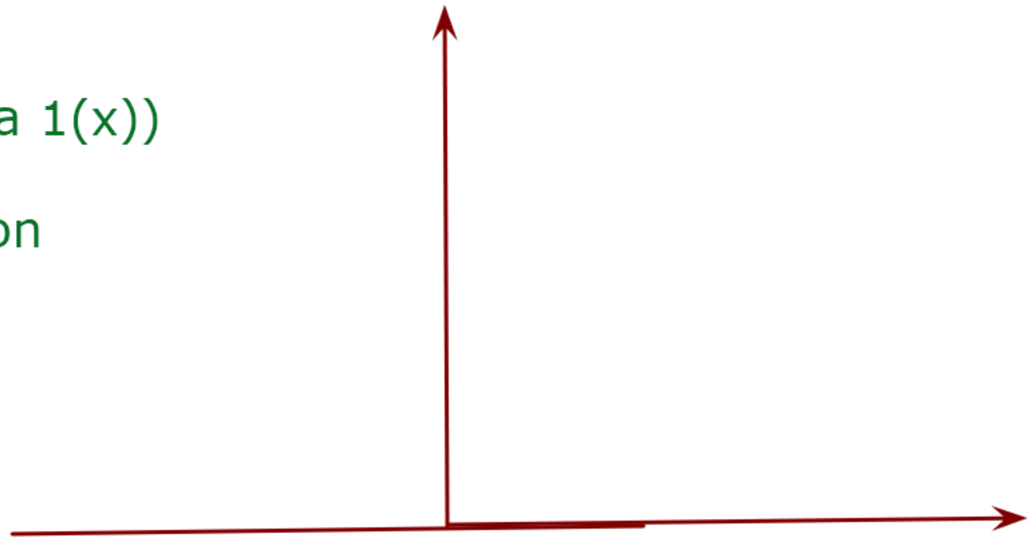
Sigmoid function or logistic function



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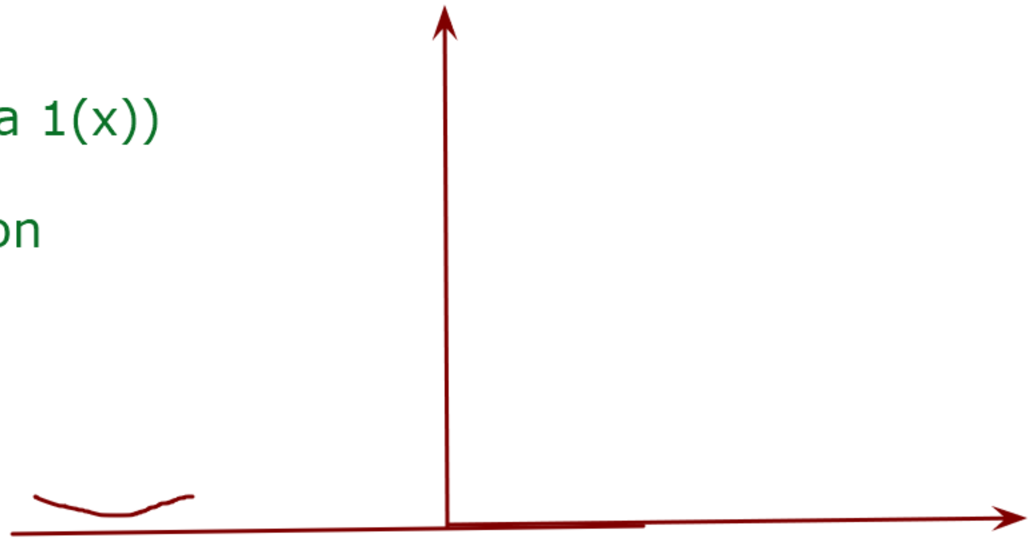
Sigmoid function or logistic function



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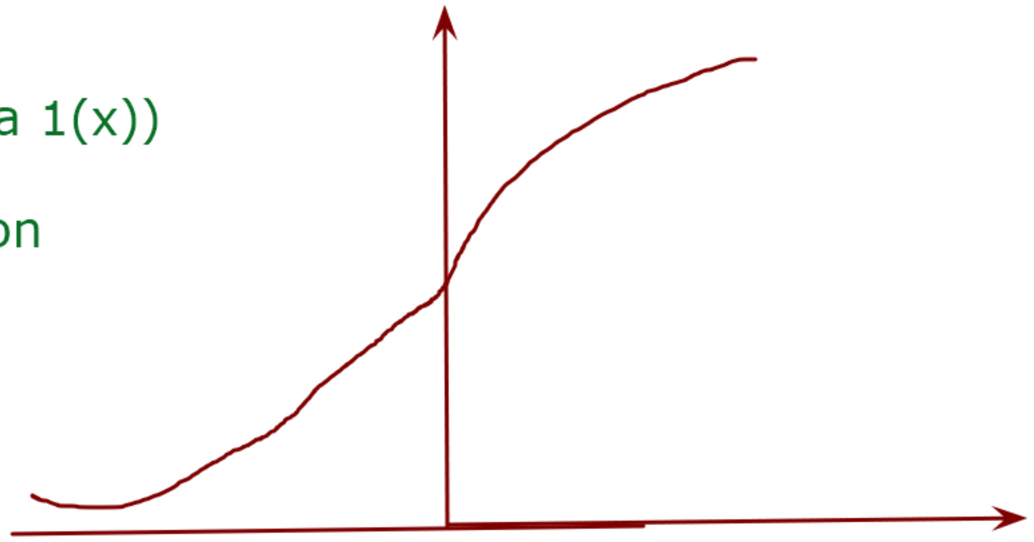

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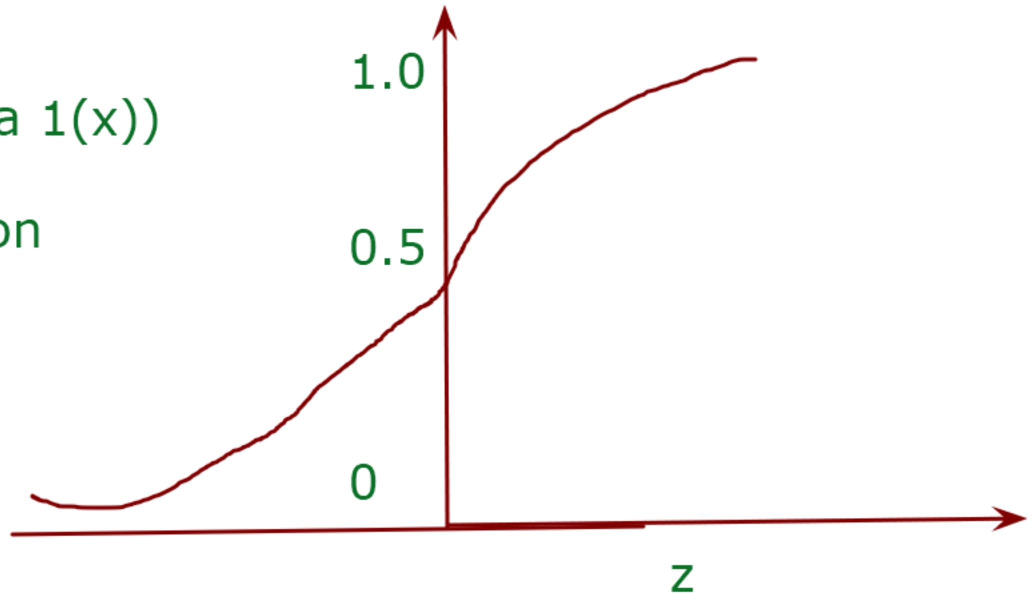
Sigmoid function or logistic function



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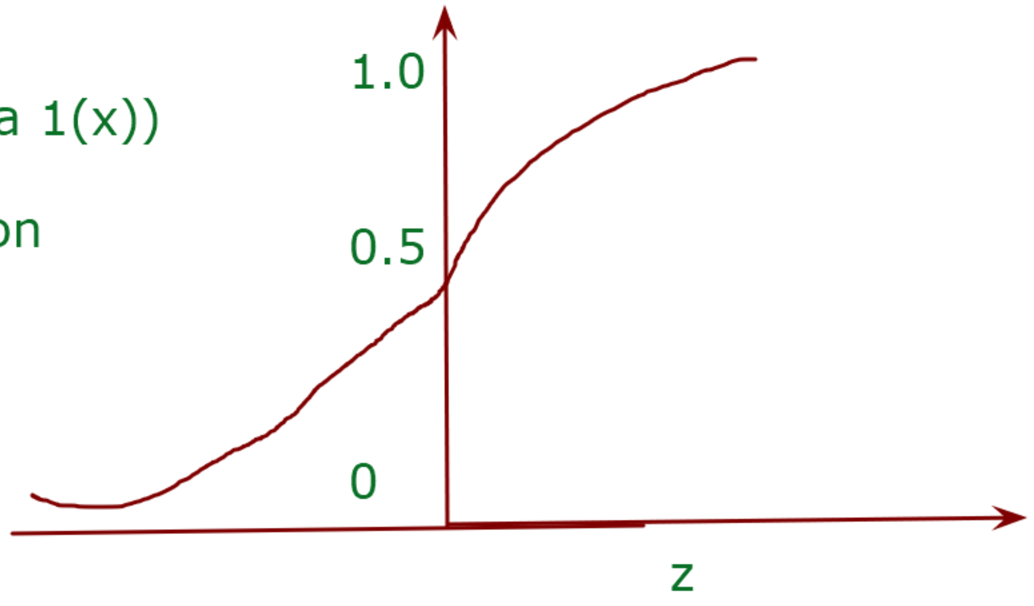
Sigmoid function or logistic function

H(x) >= 0.5; y = 1
H(x) < 0.5; y = 0



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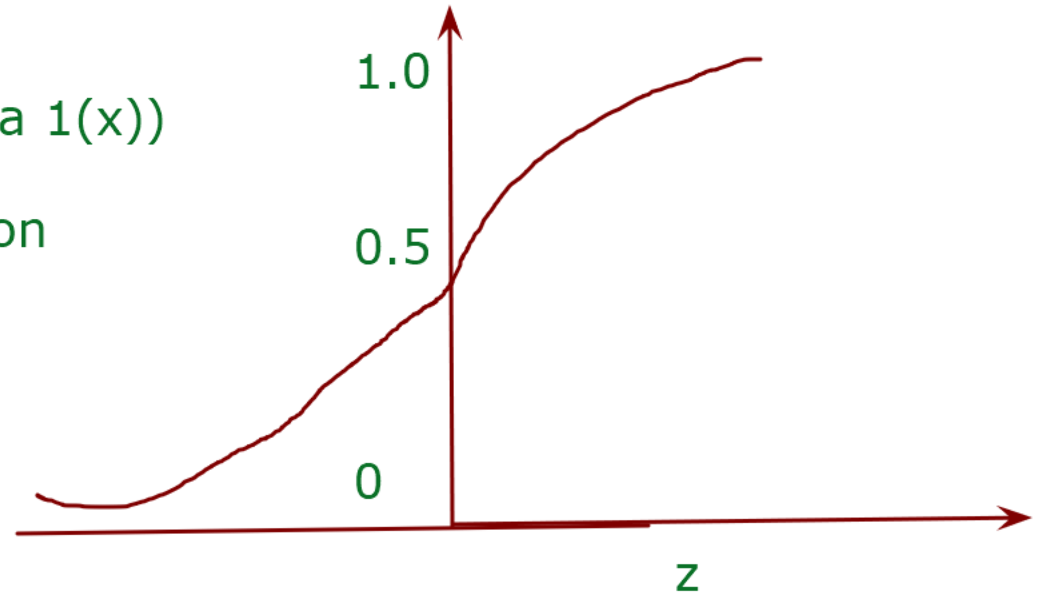

H(x) = 1/(1 + exp^(-theta 0 ~~+~~ -theta 1(x))

Sigmoid function or logistic function

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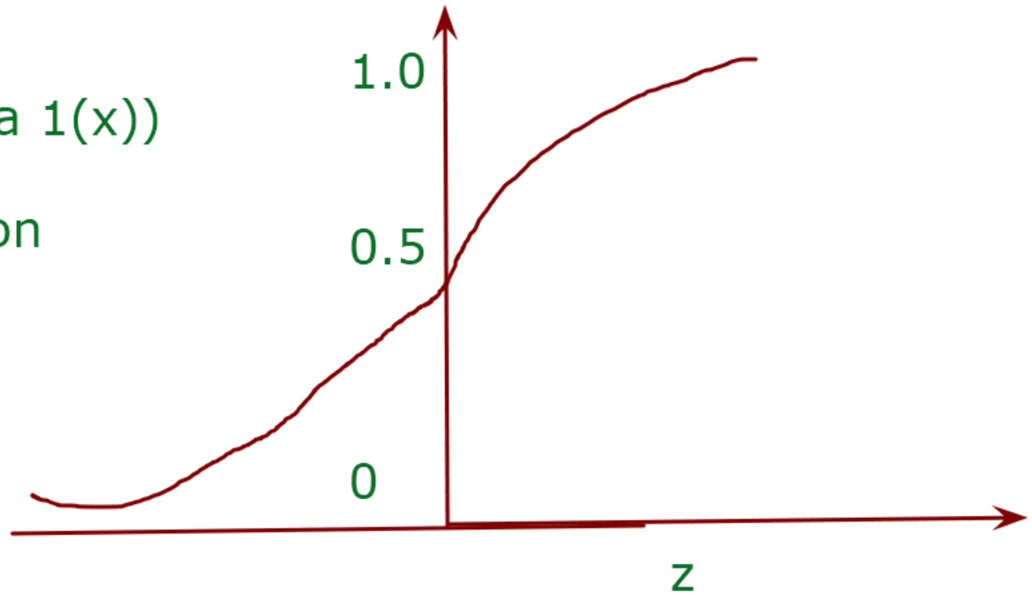
H(x) >= 0.5; y = 1 or z >= 0



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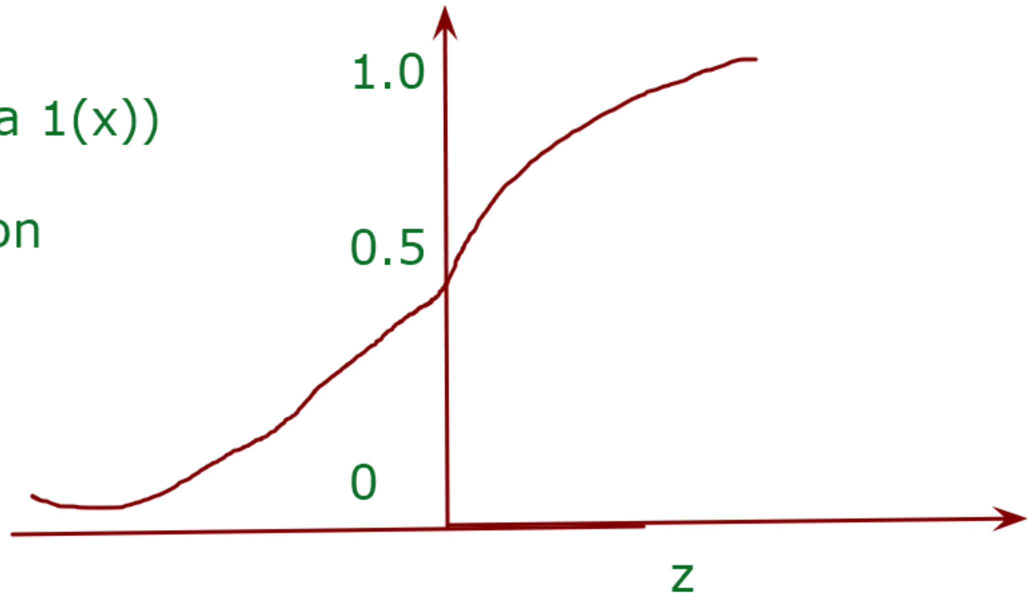

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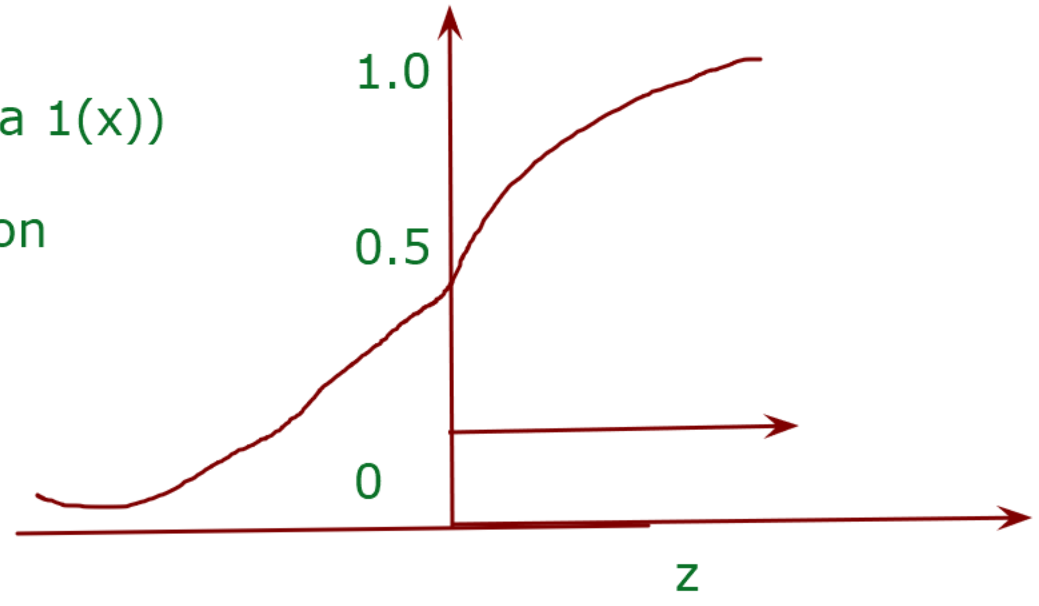

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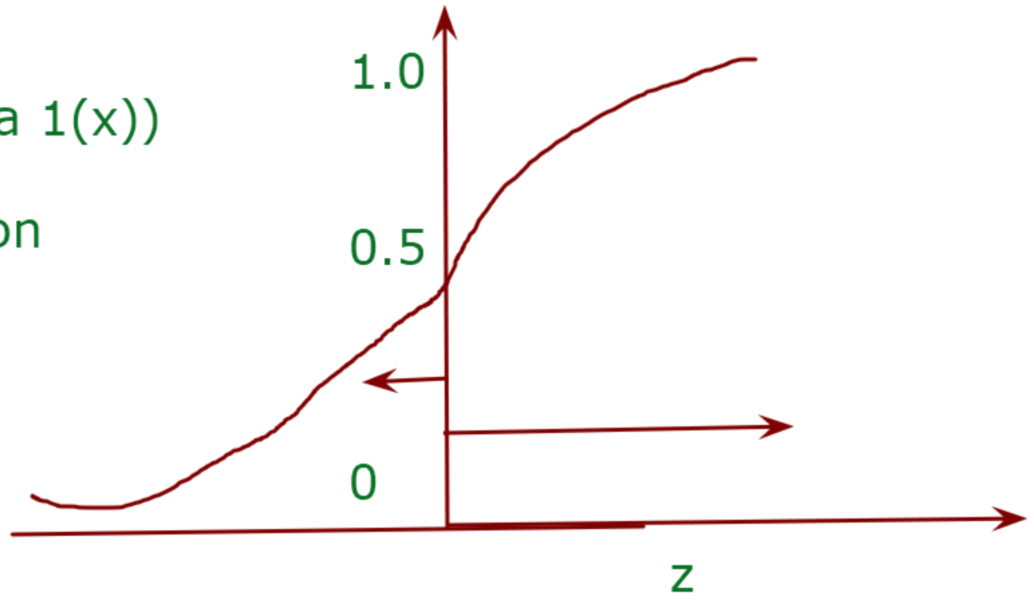

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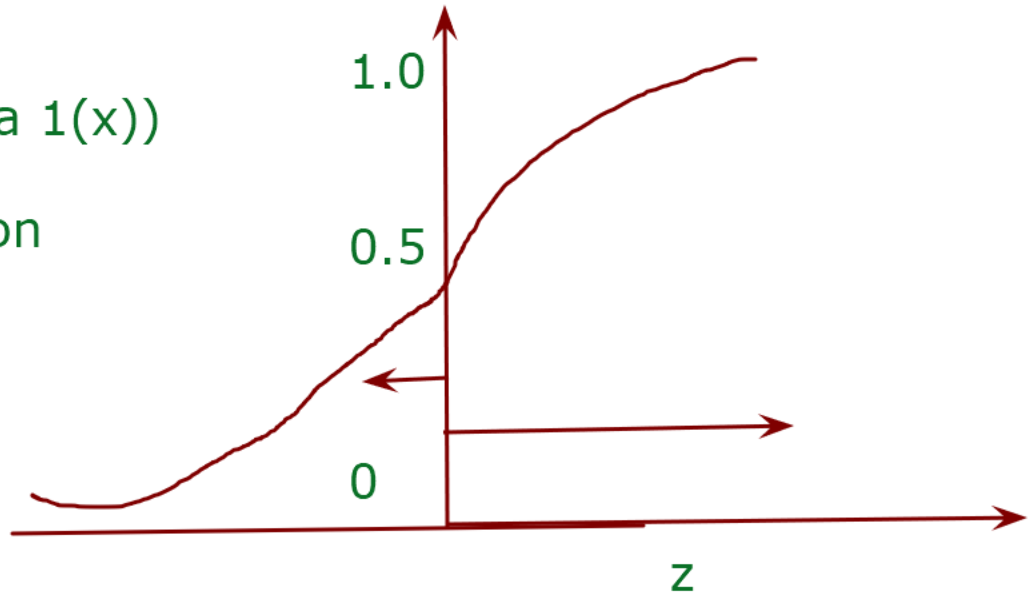
Sigmoid function or logistic function



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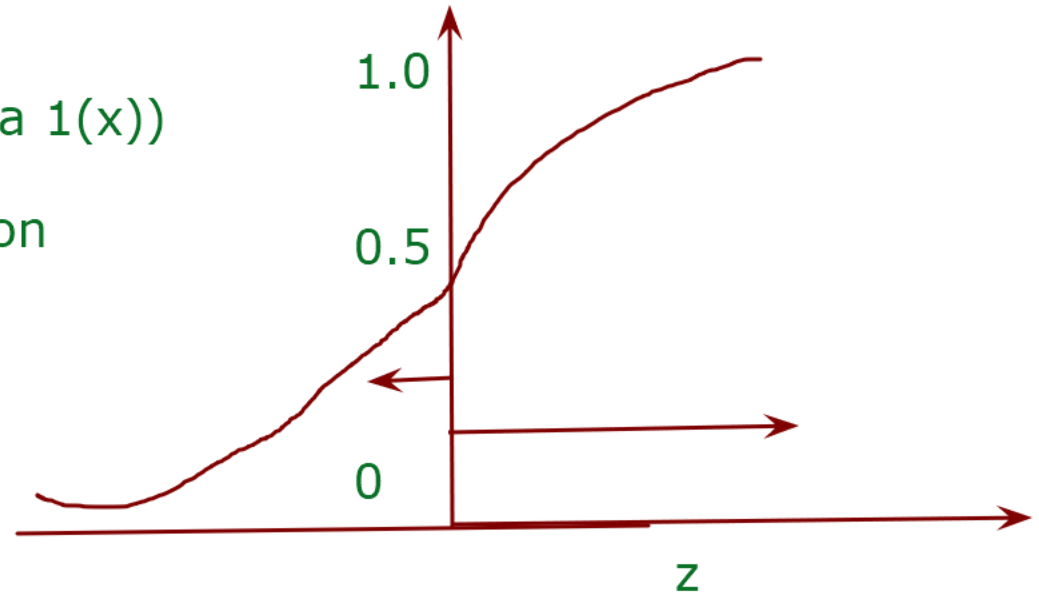
Decision Boundary

H(x) = 1/(1 + exp^(-theta 0 ~~+~~ -theta 1(x))

Sigmoid function or logistic function



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Decision Boundary

cost function = summation from i = 1 to m (h(xi) - yi)^2)

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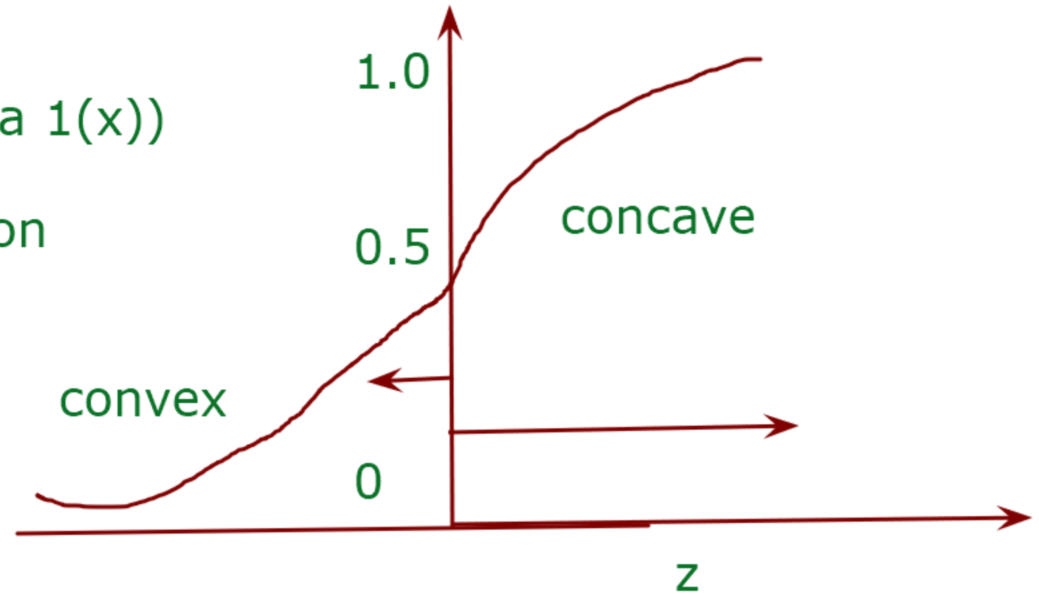
Sigmoid function or logistic function



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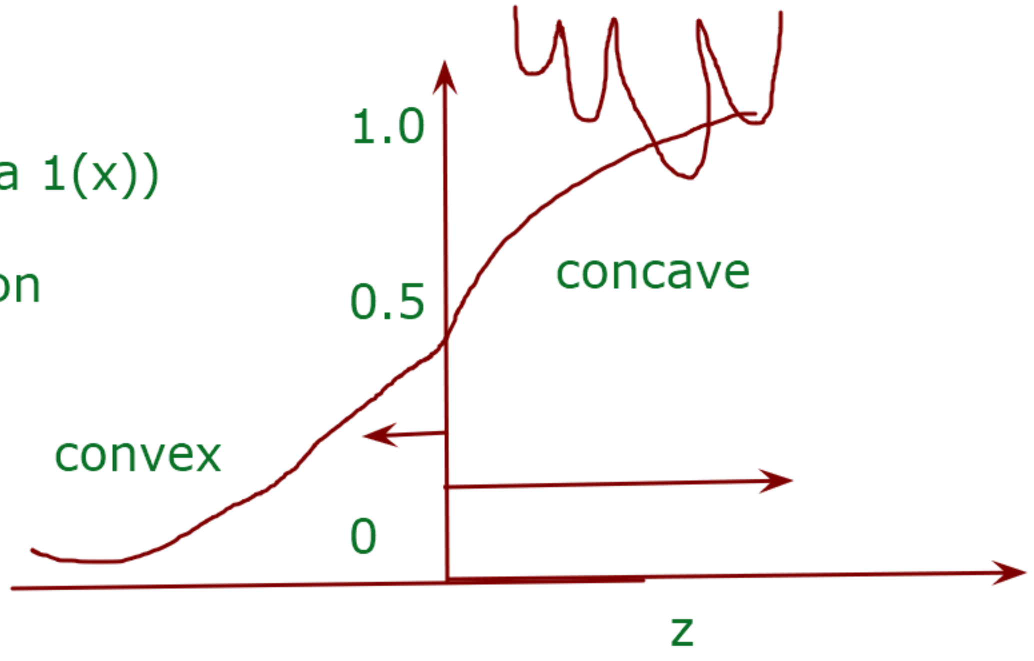

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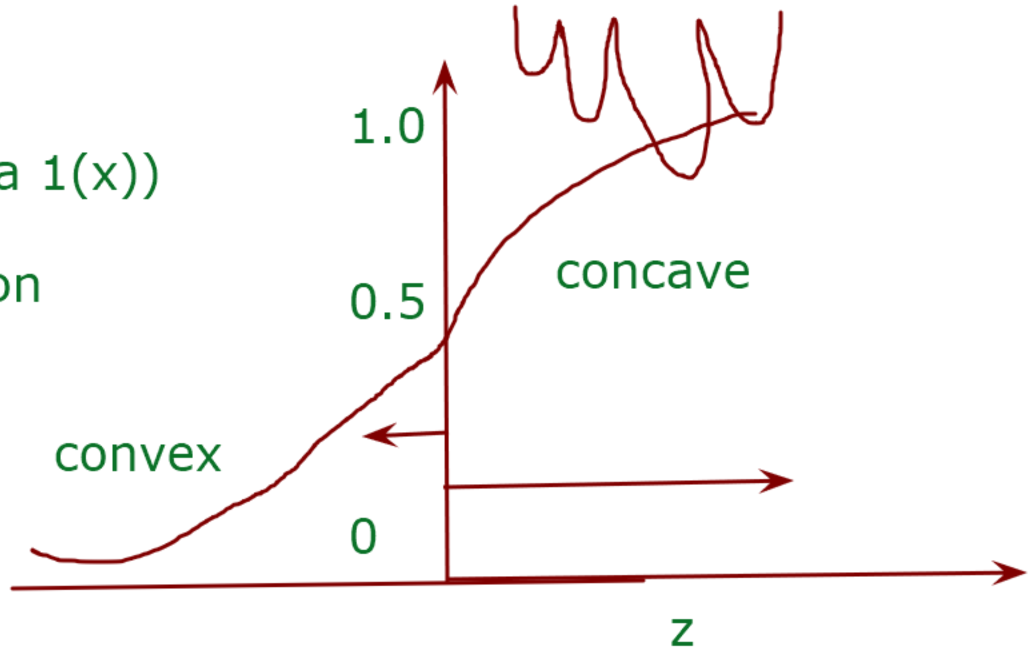

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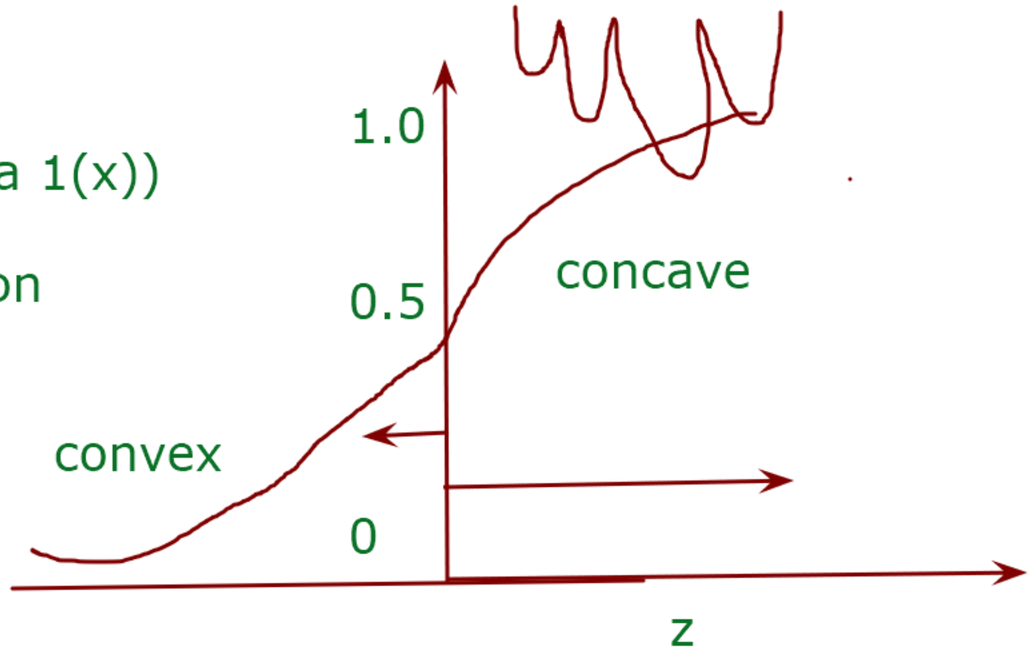

Decision Boundary

cost function = summation from i = 1 to m (h(xi) - yi)^2)

cost function (h(x), y) = -log h(x) ; if y = 1
= -log (1-h(x); if y = 0

H(x) = 1/(1 + exp^(-theta 0 ~~+~~ -theta 1(x))

Sigmoid function or logistic function

H(x) >= 0.5; y = 1
H(x) < 0.5; y = 0

H(x) >= 0.5; y = 1 or z >= 0

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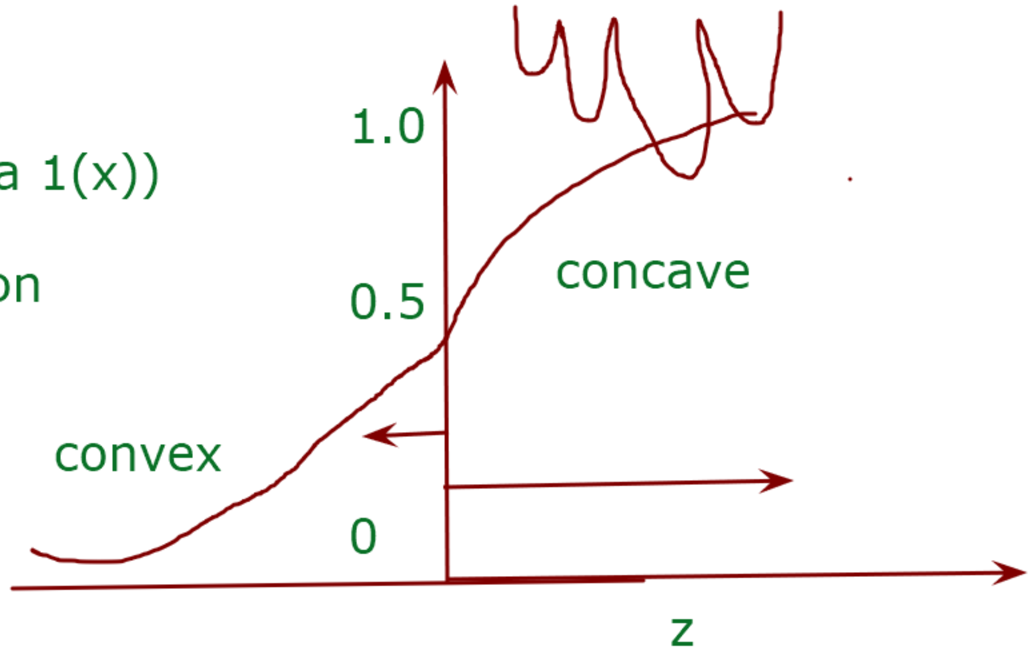

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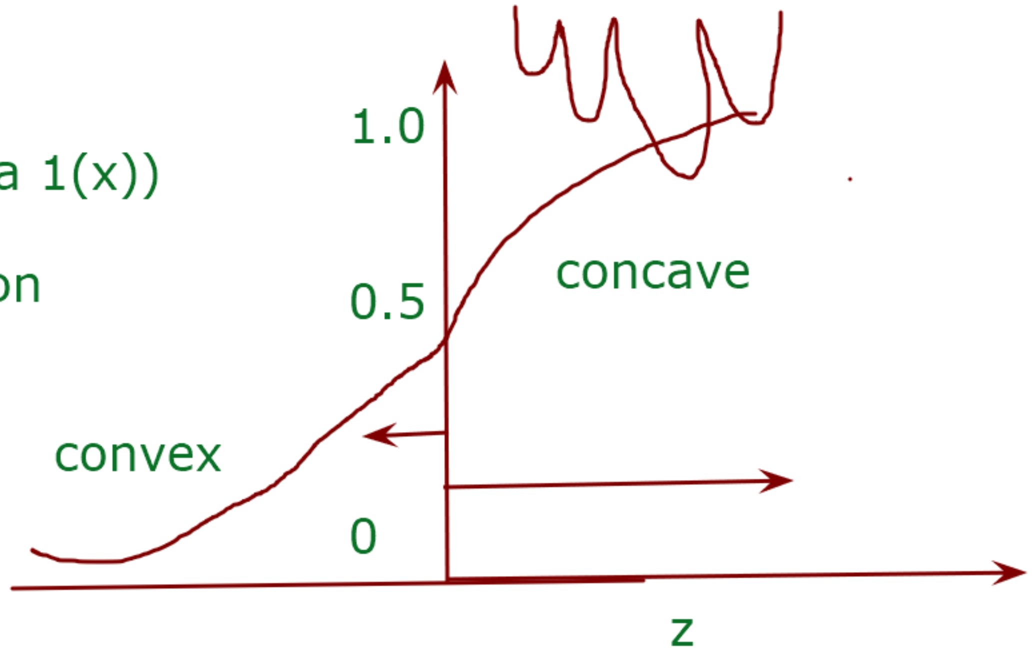

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H(x) = g(theta 0 + theta 1(x1) + theta2 (x2)

H(x) = g(theta 0 + theta 1(x1) + theta2 (x2)

theta 0 = -3; theta 1 = 1 & theta2 = 1

$H(x) = g(\theta_0 + \theta_1(x_1) + \theta_2(x_2))$

$\theta_0 = -3$; $\theta_1 = 1$ & $\theta_2 = 1$

$y = 1$; $z >= 0$; $z = -3 + x_1 + x_2 >= 0$
$x_1 + x_2 >= 3$; $y = 1$

H(x) = g(theta 0 + theta 1(x1) + theta2 (x2)) ; H(x) = g(z)

theta 0 = -3; theta 1 = 1 & theta2 = 1

y= 1; z >= 0; z = -3 + x1 + x2 >= 0
x1 + x2 >= 3; y = 1

H(x) = g(theta 0 + theta 1(x1) + theta2 (x2)) ; H(x) = g(z)

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y = 0; z<0; -3 + x1 + x2<0
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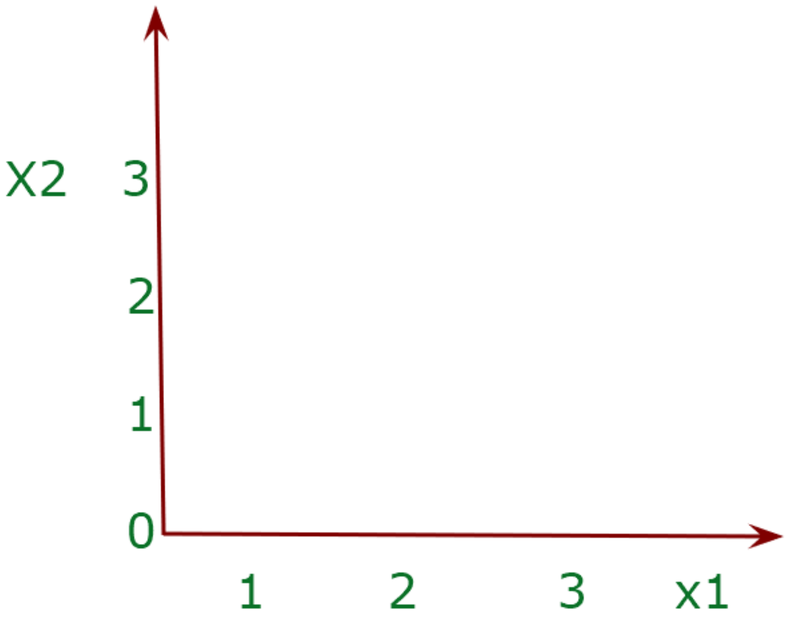

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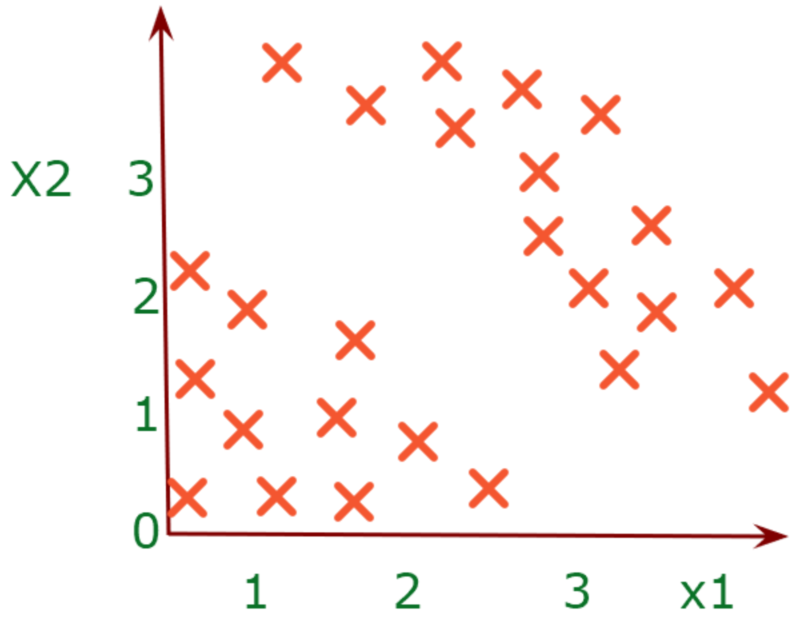

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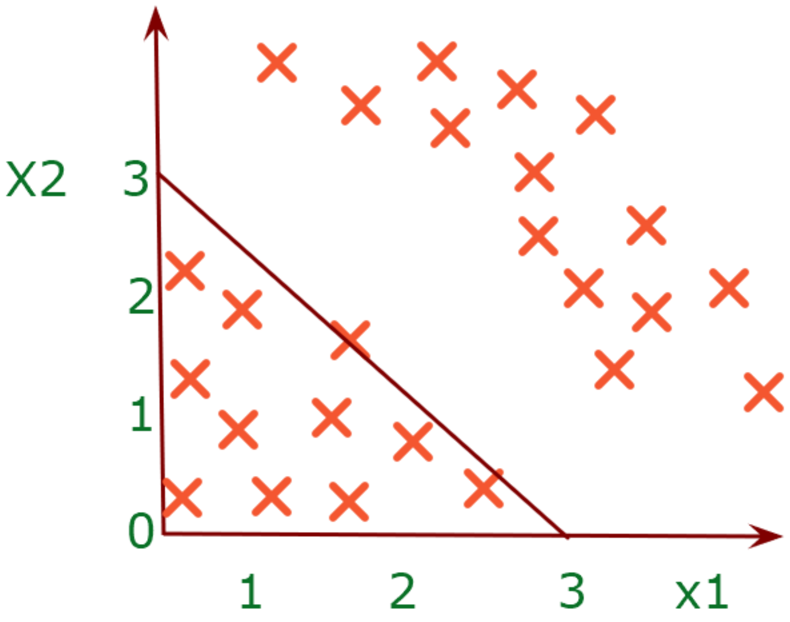

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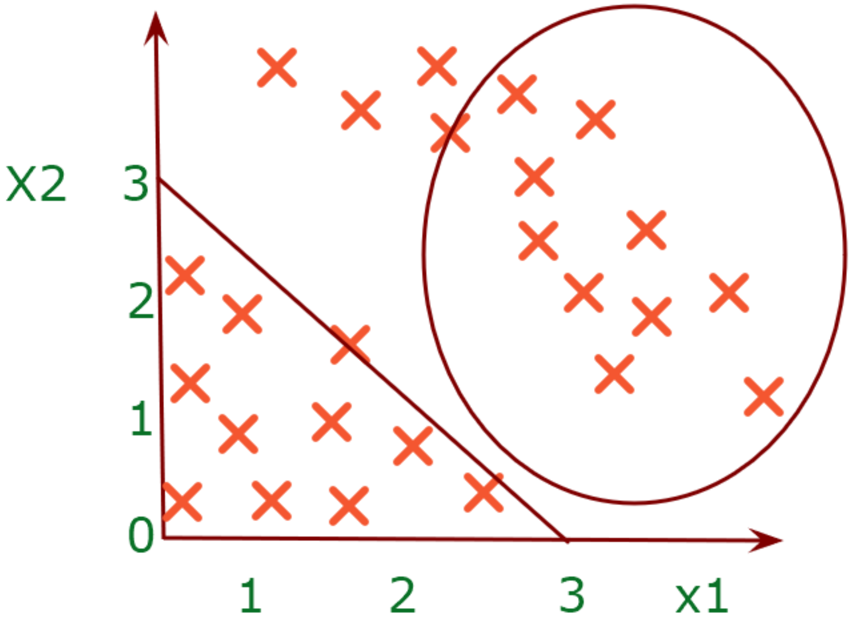

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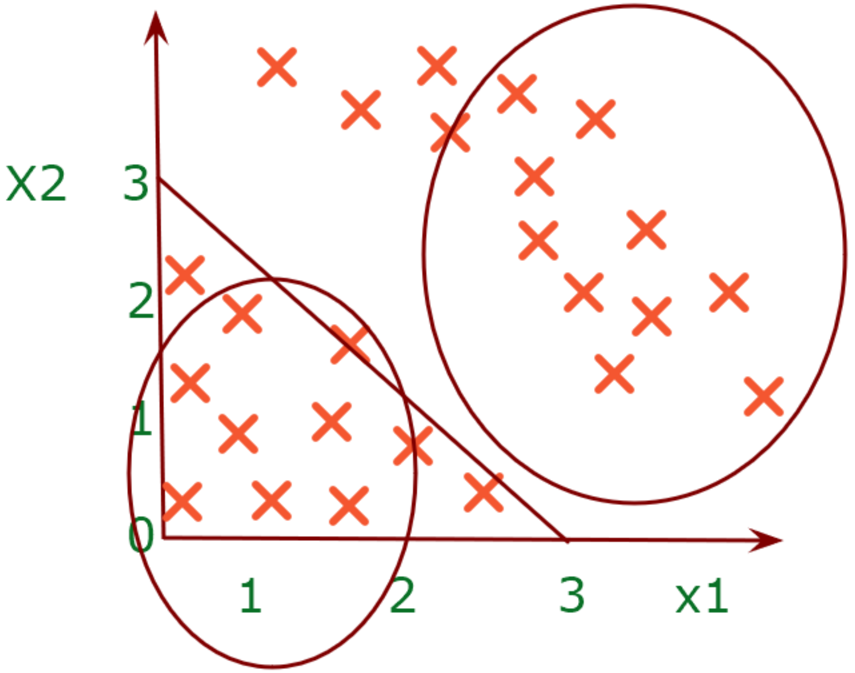

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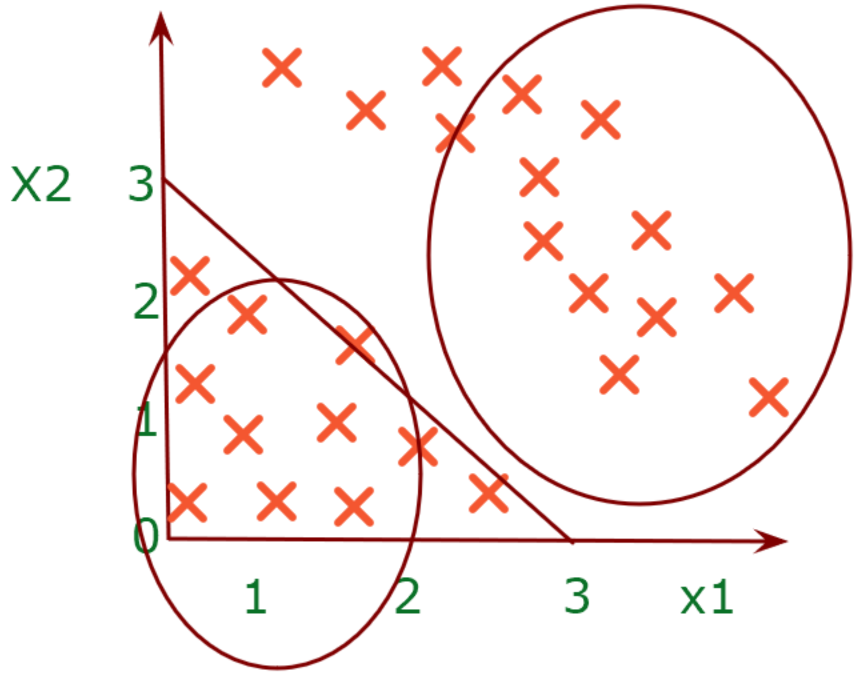

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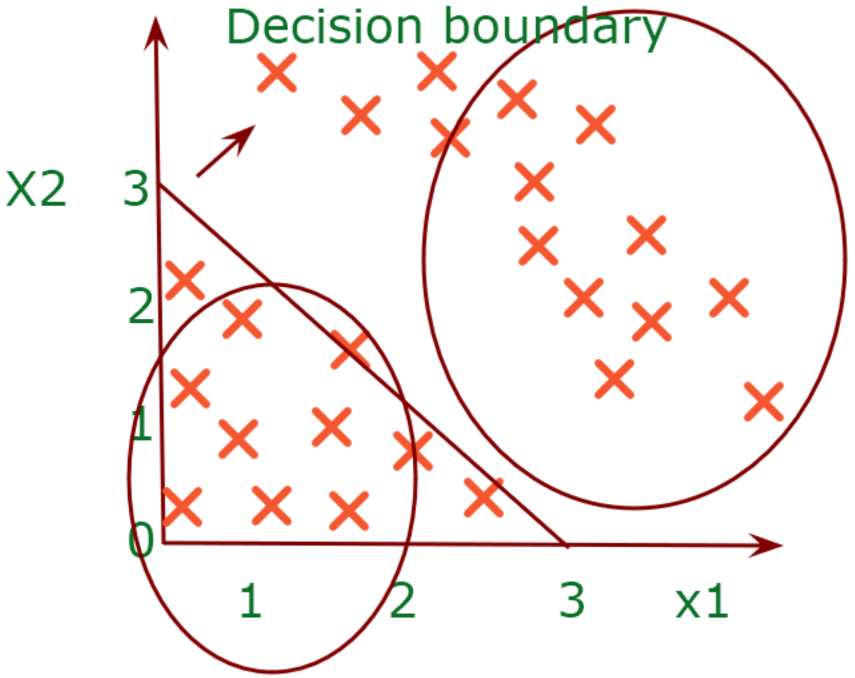

$$H(x) = p = 1/(1+e^{(-z)}) = g(z)$$

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$$H(x) = g(z) >= 0.5; y = 1$$
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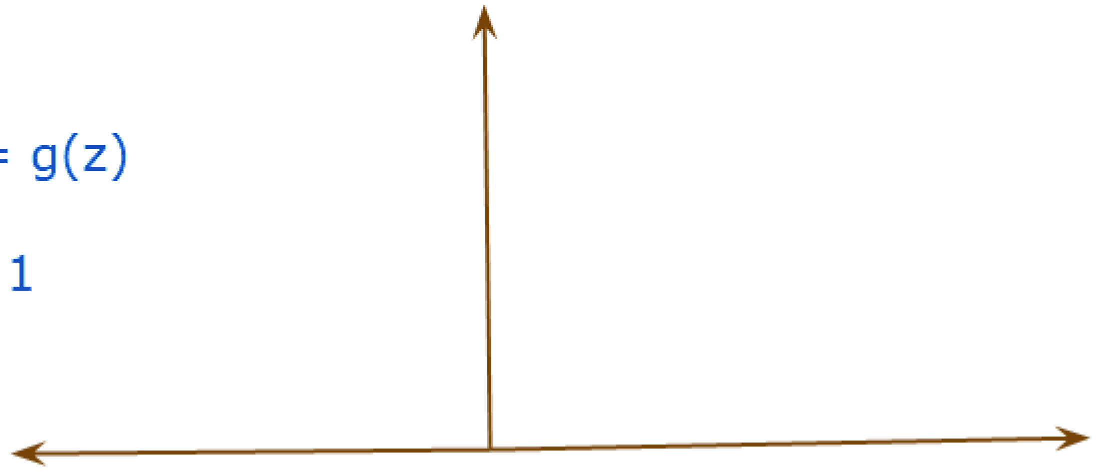
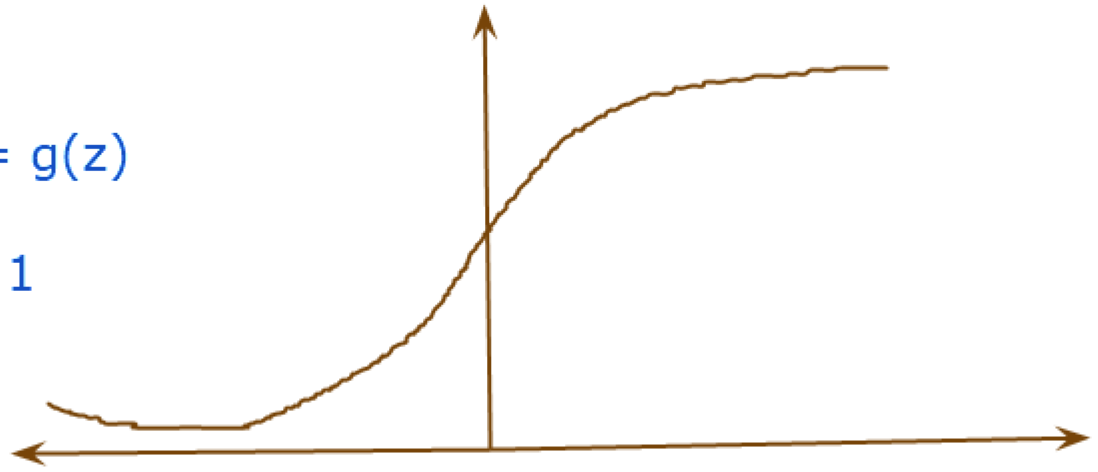


$$H(x) = p = 1/(1+e^{(-z)}) = g(z)$$

$$
\begin{aligned}
H(x) &= g(z) >= 0.5;\ y = 1 \\
&= g(z) < 0.5;\ y = 0
\end{aligned}
$$



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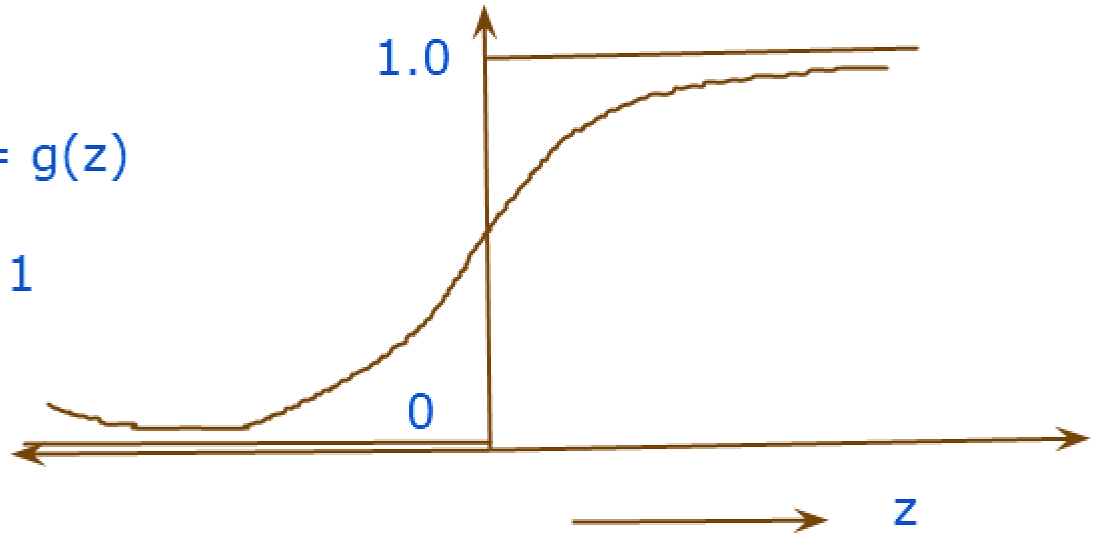

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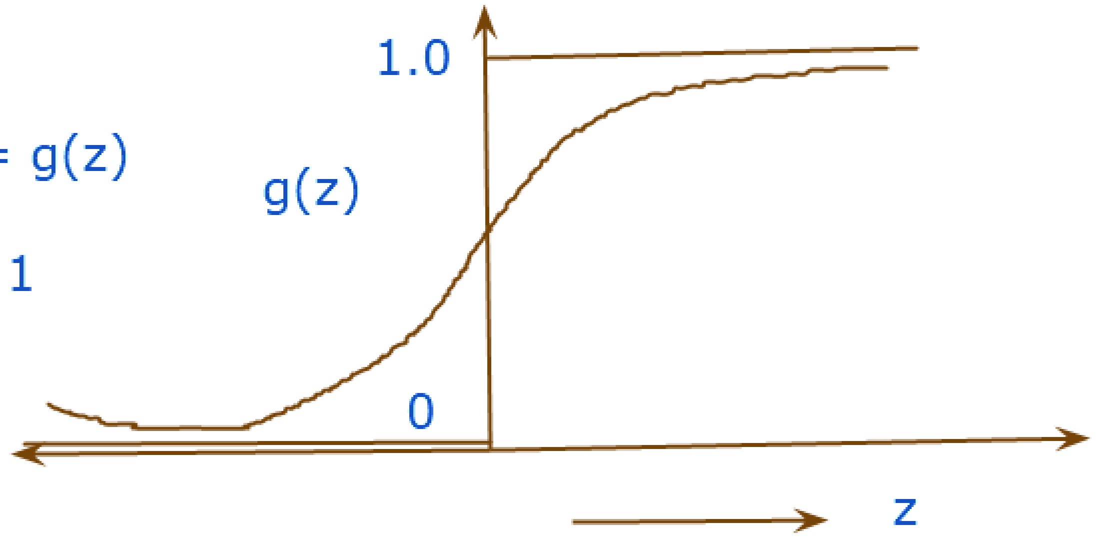

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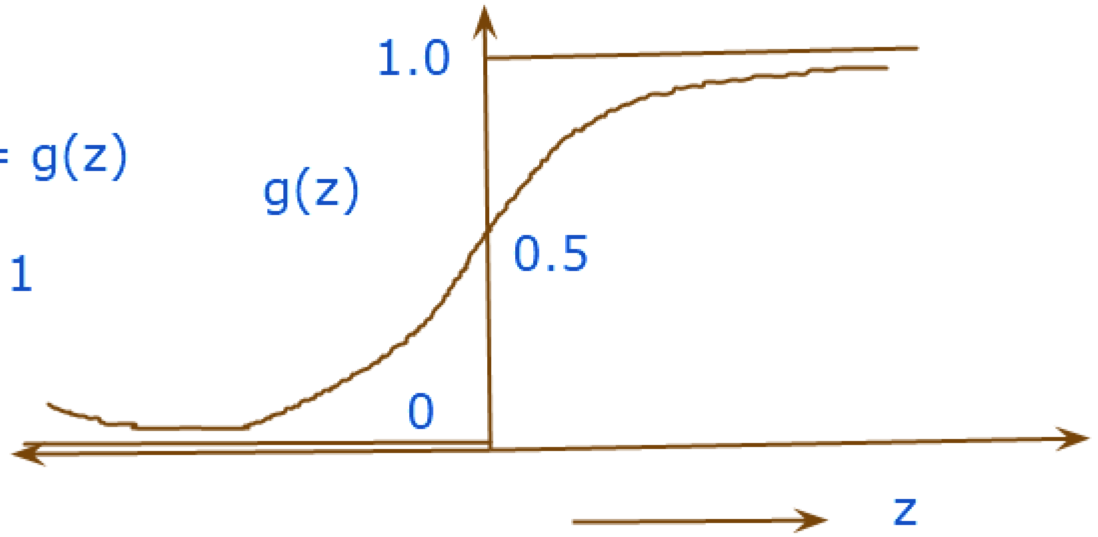

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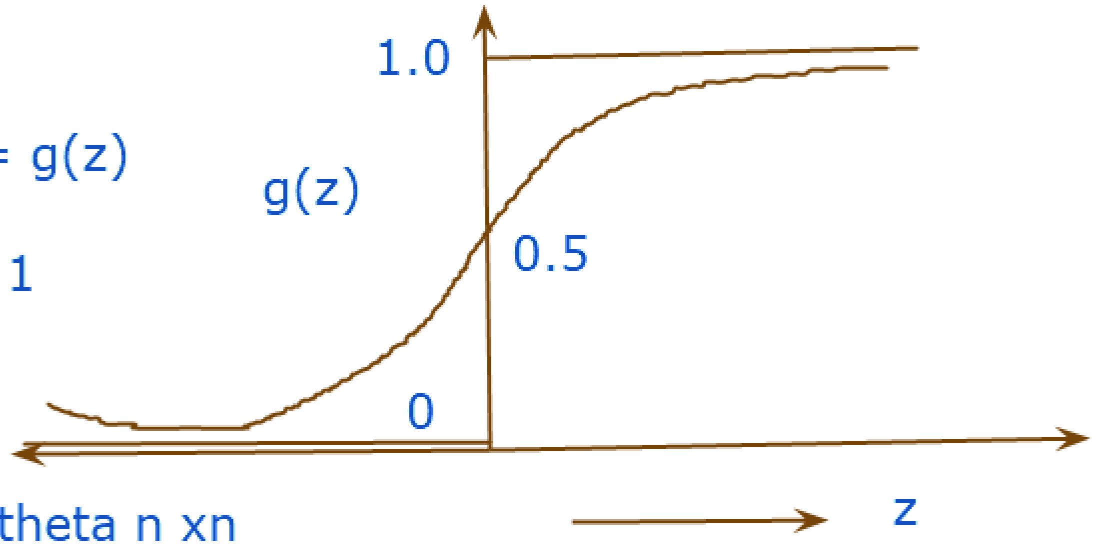

$z = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \ldots\ldots + \theta_n x_n$

$$H(x) = p = 1/(1+e^{(-z)}) = g(z)$$

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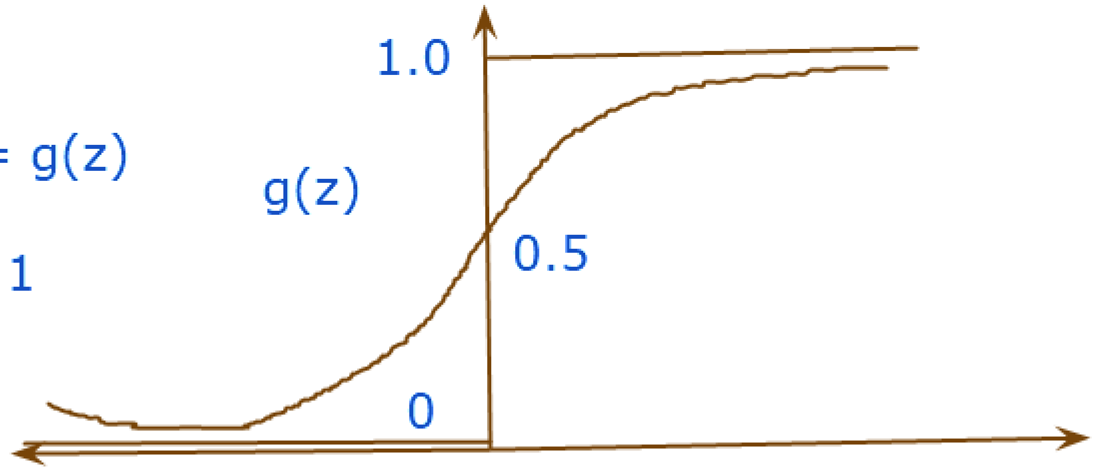

$$z = \text{theta } 0 + \text{theta } 1\ x1 + \text{theta } 2\ x2 + \ldots\ldots + \text{theta } n\ xn$$

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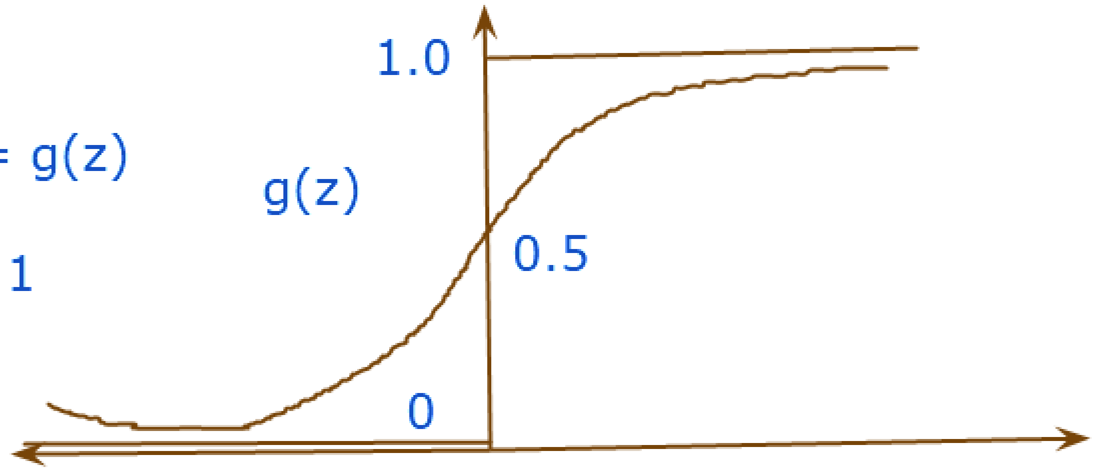

$z = \text{theta } 0 + \text{theta } 1\ x1 + \text{theta } 2\ x2 + \ldots\ldots + \text{theta } n\ xn$

z

Lets assume: $H(x) = g(\text{theta } 0 + \text{theta } 1\ x1 + \text{theta } 2\ x2)$

H(x) = p = 1/(1+e^(-z)) = g(z)

H(x) = g(z) >= 0.5; y = 1
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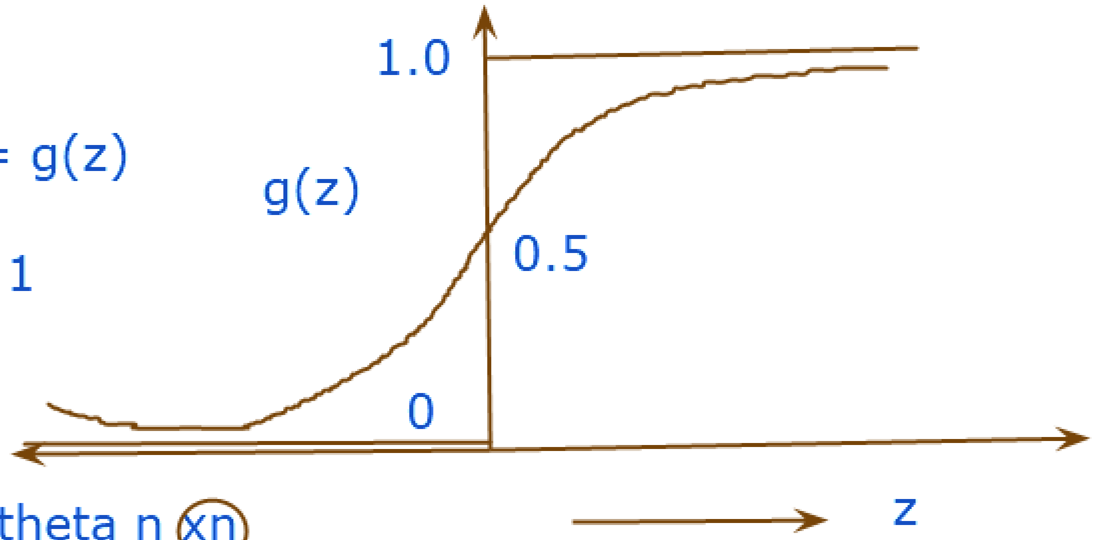

z= theta 0 + theta 1 x1 + theta 2 x2 +.......+ theta n xn

Lets assume: H(x) = g(theta 0 + theta 1 x1 + theta 2 x2)

-3 1 1

H(x) = p = 1/(1+e^(-z)) = g(z)

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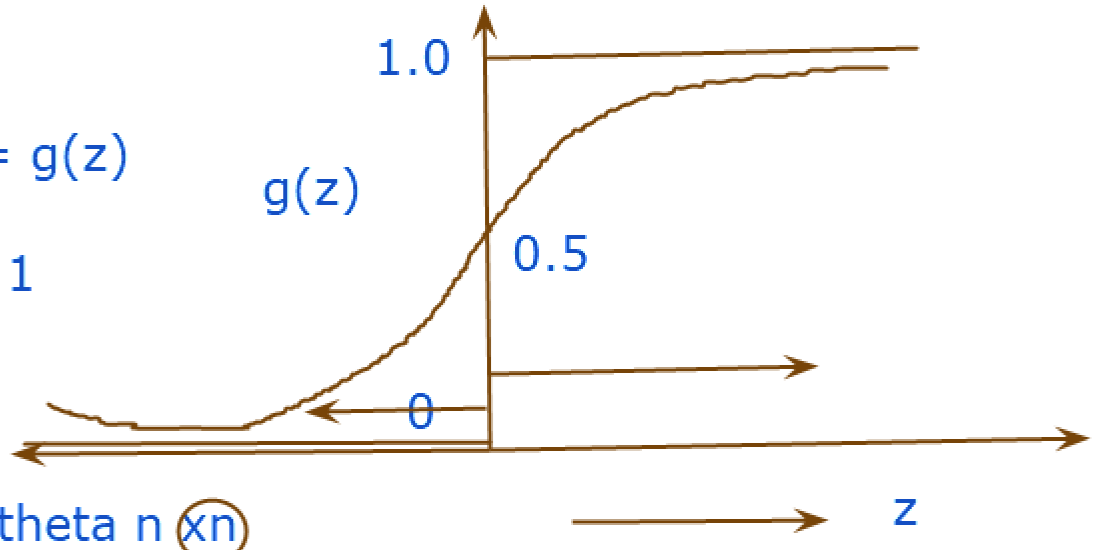
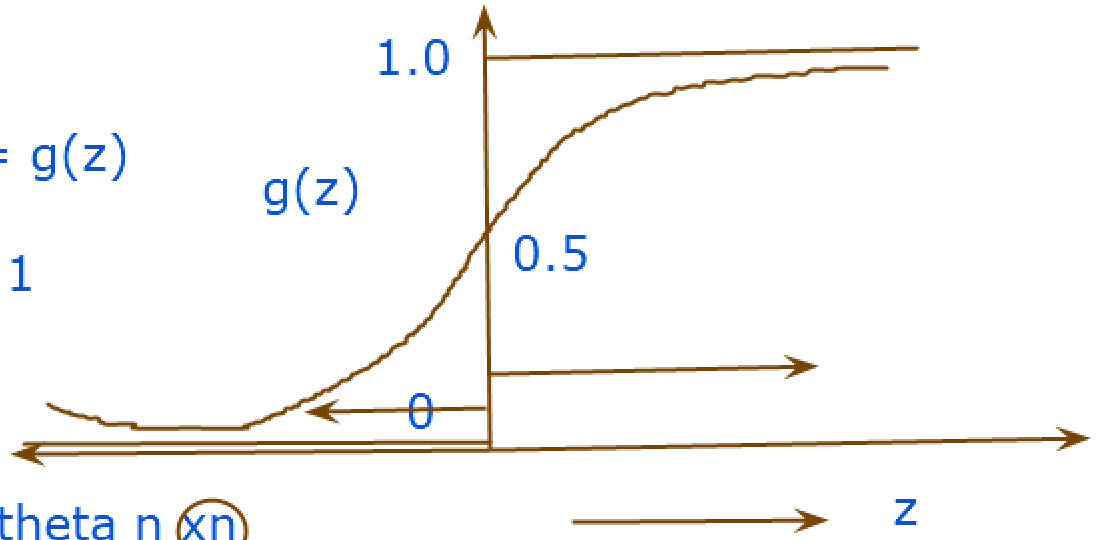


z= theta 0 + theta 1 x1 + theta 2 x2 +.......+ theta n xn

Lets assume: H(x) = g(theta 0 + theta 1 x1 + theta 2 x2)

-3 1 1

H(x) = -3 + x1 + x2



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$= g(z) < 0.5;\ y = 0$

z= theta 0 + theta 1 x1 + theta 2 x2 +.......+ theta n xn

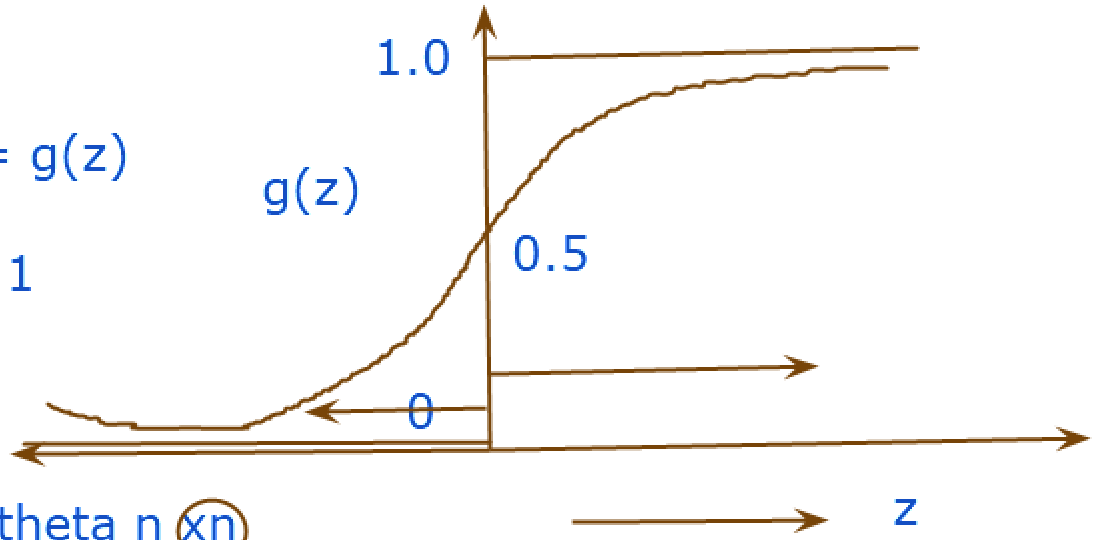
Lets assume: H(x) = g(theta 0 + theta 1 x1 + theta 2 x2)

-3 1 1

H(x) = -3 + x1 + x2 If H(x) >= 0.5 ; z >= 0; Y = 1

$H(x) = p = 1/(1+e^{(-z)}) = g(z)$

$H(x) = g(z) >= 0.5; y = 1$
$= g(z) < 0.5; y = 0$



z= theta 0 + theta 1 x1 + theta 2 x2 +.......+ theta n xn

Lets assume: H(x) = g(theta 0 + theta 1 x1 + theta 2 x2)

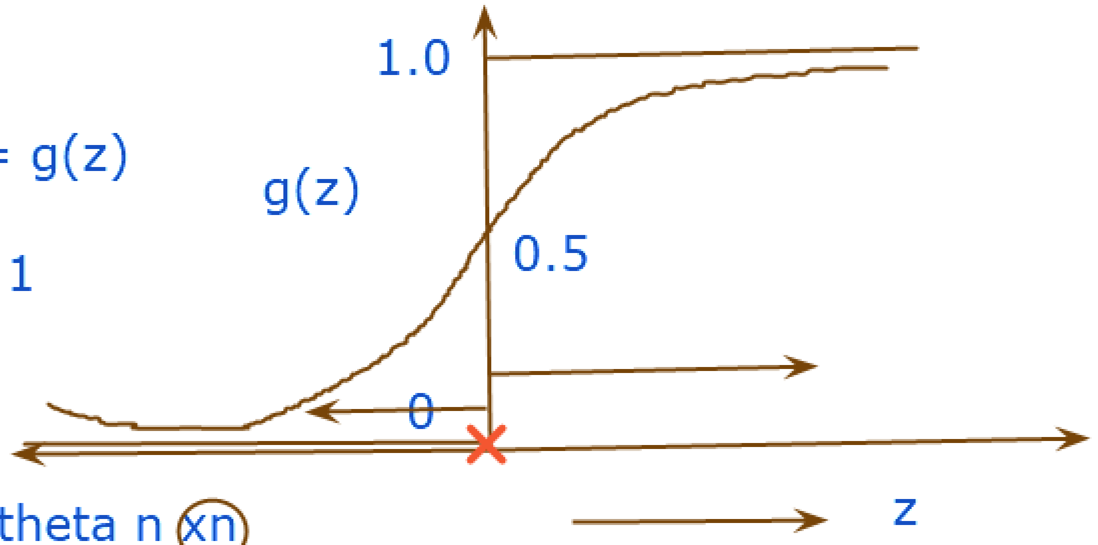
-3 1 1

H(x) = -3 + x1 + x2 If H(x) >= 0.5 ; z >= 0; Y = 1

-3 + x1 + x2 >= 0; y = 1
-3 + x1 + x2 < 0; y =0

$H(x) = p = 1/(1+e^{(-z)}) = g(z)$

$H(x) = g(z) >= 0.5; y = 1$
$= g(z) < 0.5; y = 0$



$z = \text{theta } 0 + \text{theta } 1\, x1 + \text{theta } 2\, x2 + \ldots\ldots + \text{theta } n\, xn$

Lets assume: $H(x) = g(\text{theta } 0 + \text{theta } 1\, x1 + \text{theta } 2\, x2)$

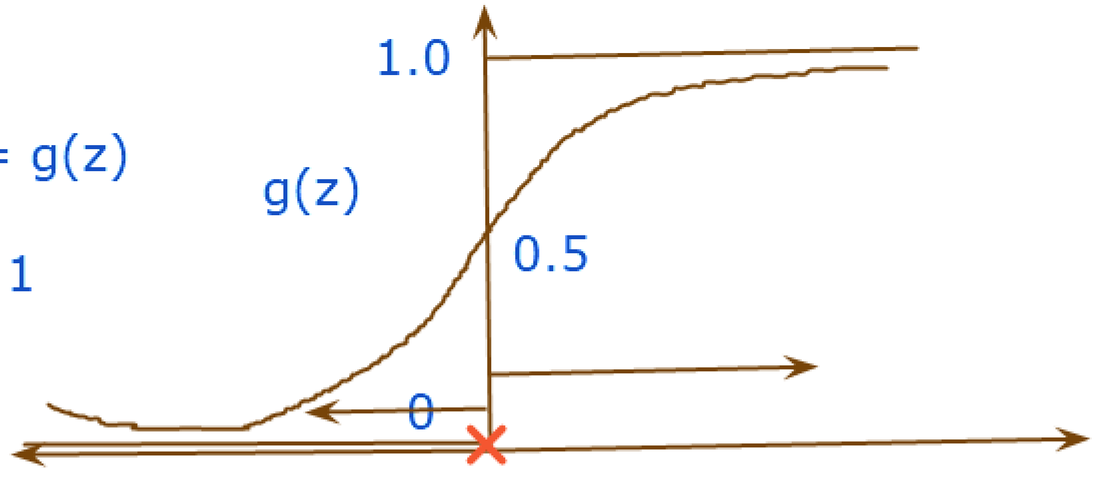
-3 1 1

$H(x) = -3 + x1 + x2$ If $H(x) >= 0.5$; $z >= 0$; $Y = 1$

$-3 + x1 + x2 >= 0; y = 1$
$-3 + x1 + x2 < 0; y = 0$ $-3 + x1 + x2 = 0$; decision boundary

$H(x) = p = 1/(1+e^{(-z)}) = g(z)$

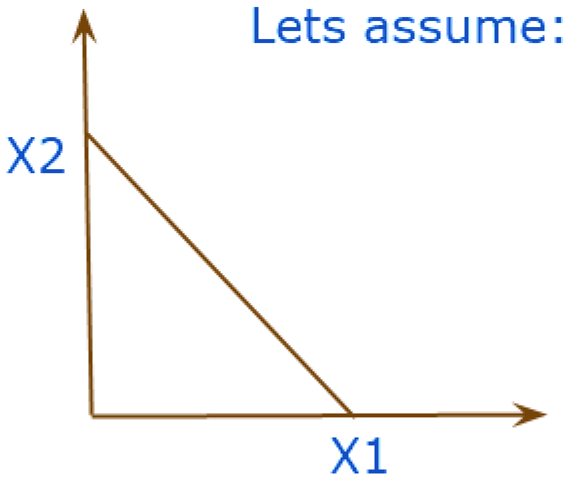
$H(x) = g(z) >= 0.5; y = 1$
$= g(z) < 0.5; y = 0$



$z = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \ldots\ldots + \theta_n x_n$

Lets assume: $H(x) = g(\theta_0 + \theta_1 x_1 + \theta_2 x_2)$

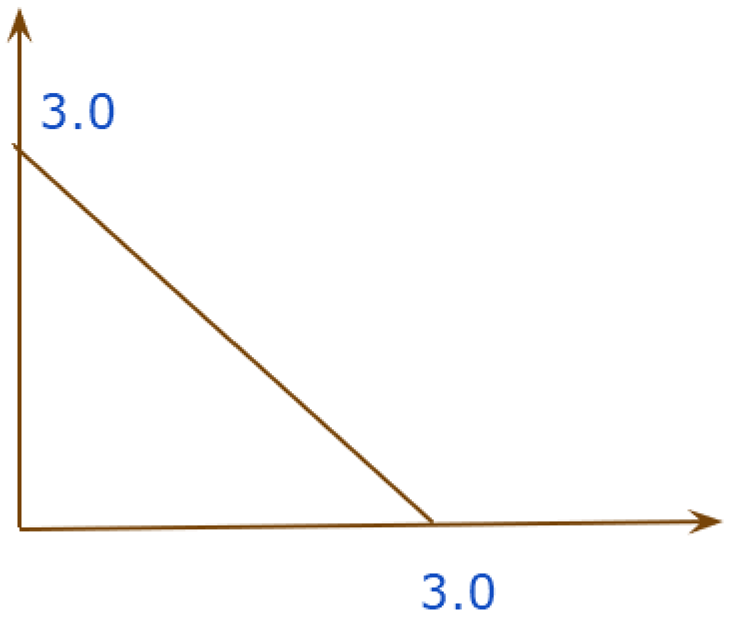
$\theta_0 = -3 \qquad \theta_1 = 1 \qquad \theta_2 = 1$

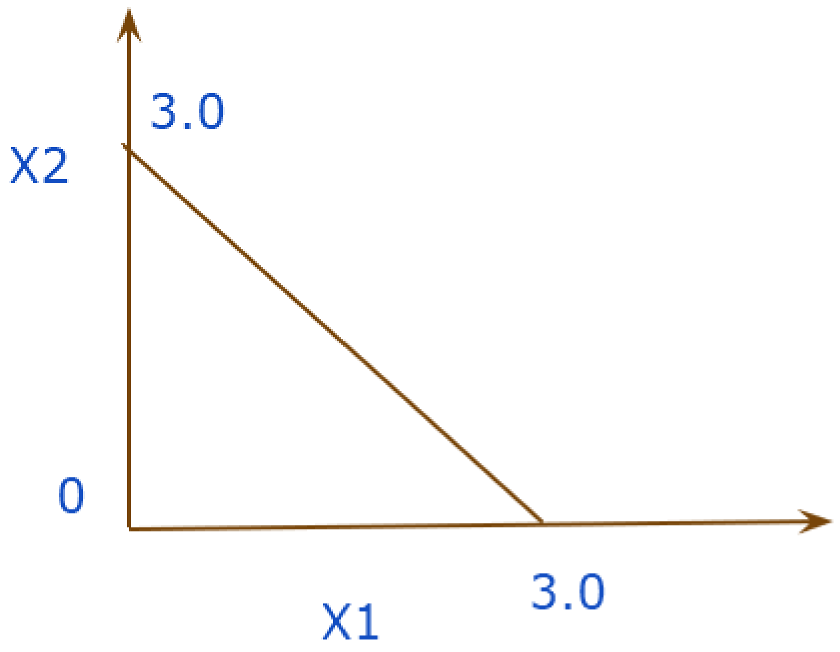


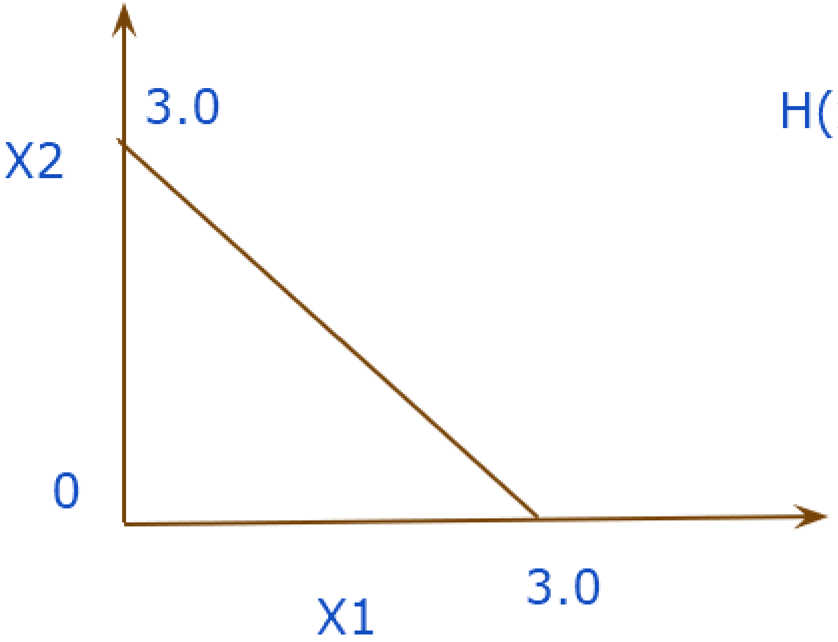
$H(x) = -3 + x_1 + x_2$ If $H(x) >= 0.5$; $z >= 0$; $Y = 1$

$-3 + x_1 + x_2 >= 0; y = 1$
$-3 + x_1 + x_2 < 0; y = 0$

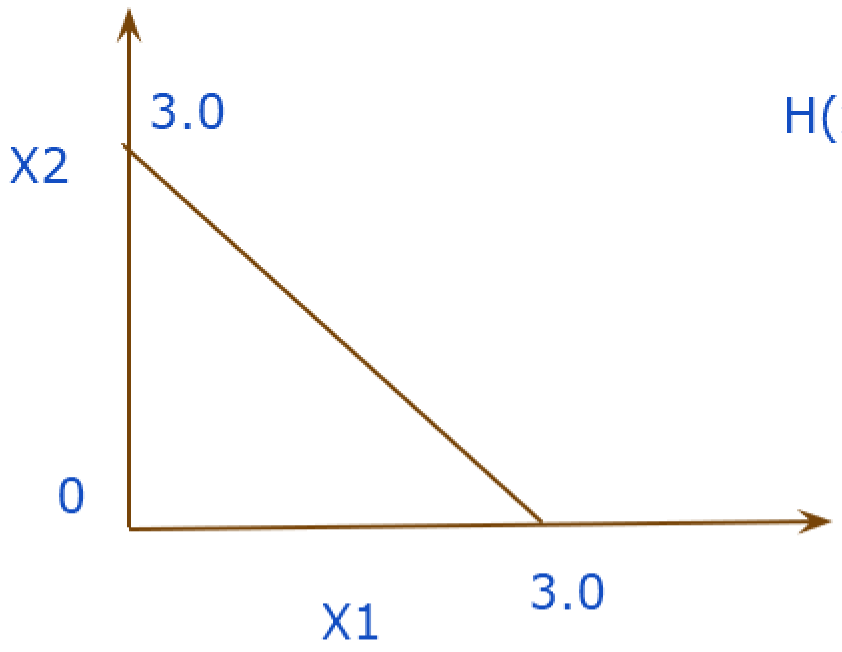
$-3 + x_1 + x_2 = 0$; decision boundary


3.0
3.0


3.0
X2
0
X1
3.0

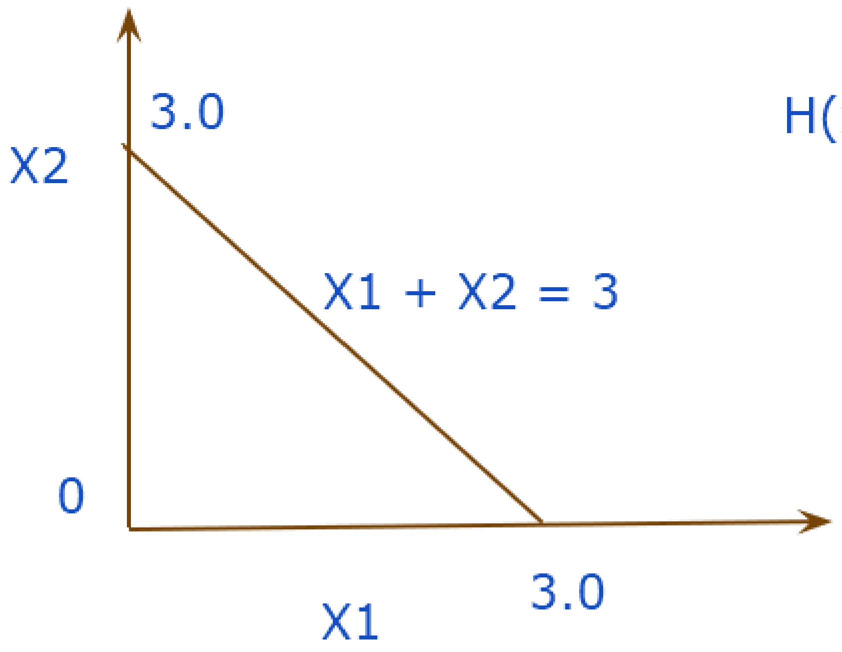


H(x)= -3 + X1 + X2



$$H(x) = -3 + X1 + X2$$

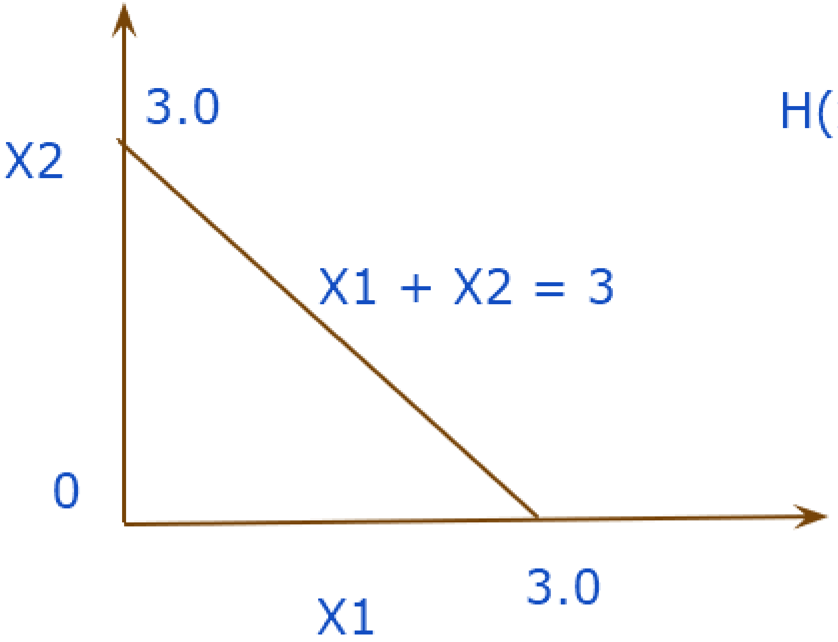
$$X1 + X2 = 3$$



$H(x) = -3 + X1 + X2$

$X1 + X2 = 3$

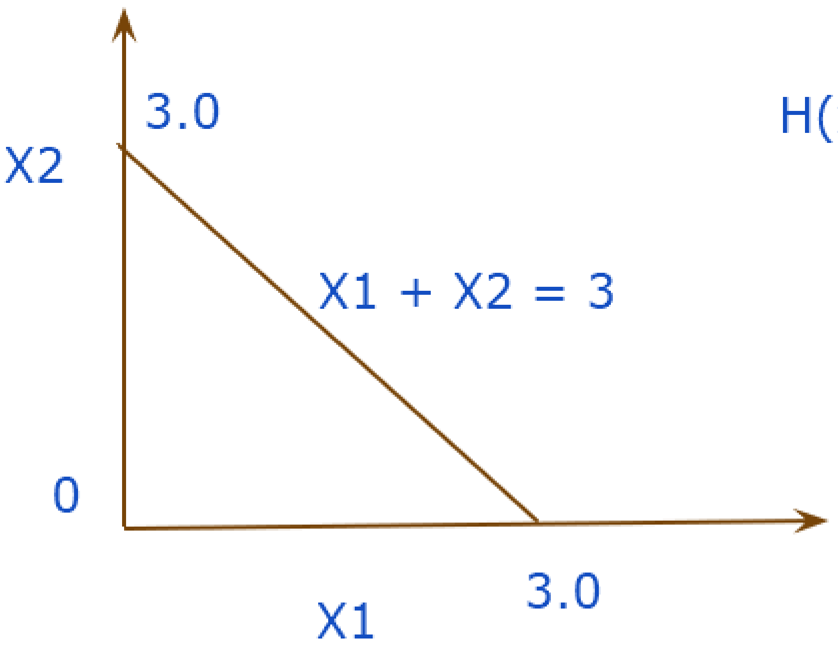
$H(X) = 0.5;\ z = 0$



$H(x) = g(-3 + X1 + X2$

$H(X) = 0.5; z = 0$

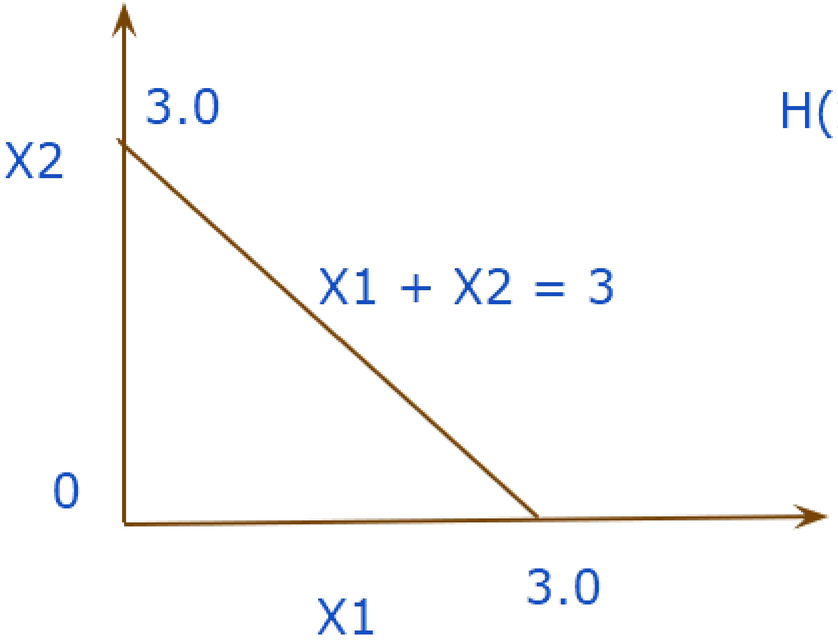
$X1 + X2 = 3$



$H(x)=g(-3 + X1 + X2)$

$X1 + X2 = 3$

$H(X) = 0.5; z = 0$

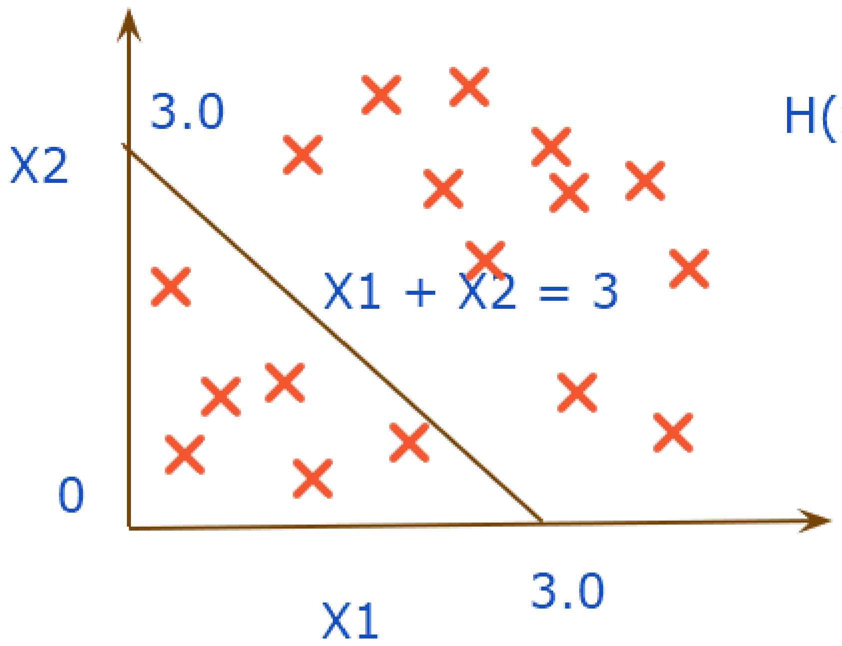


$H(x) = g(-3 + X1 + X2)$

$H(X) = 0.5;\ z = 0$

$X1 + X2 = 3$

Decision boundary

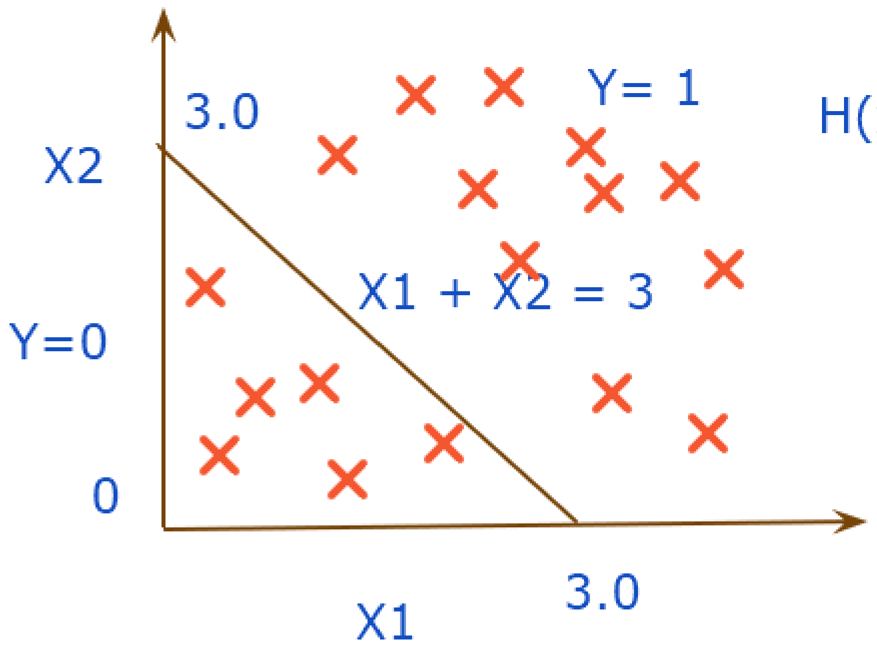


$H(x)=g-(3 + X1 + X2)$

$H(X) = 0.5; z = 0$

$X1 + X2 = 3$

Decision boundary

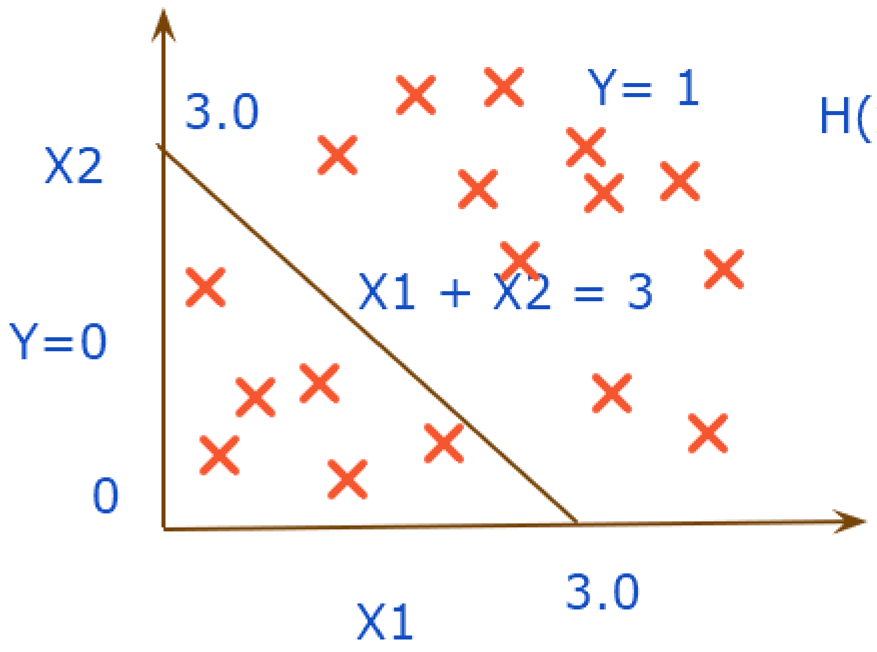


H(x)=g(3 + X1 + X2)

H(X) = 0.5; z = 0

X1 + X2 = 3

Decision boundary



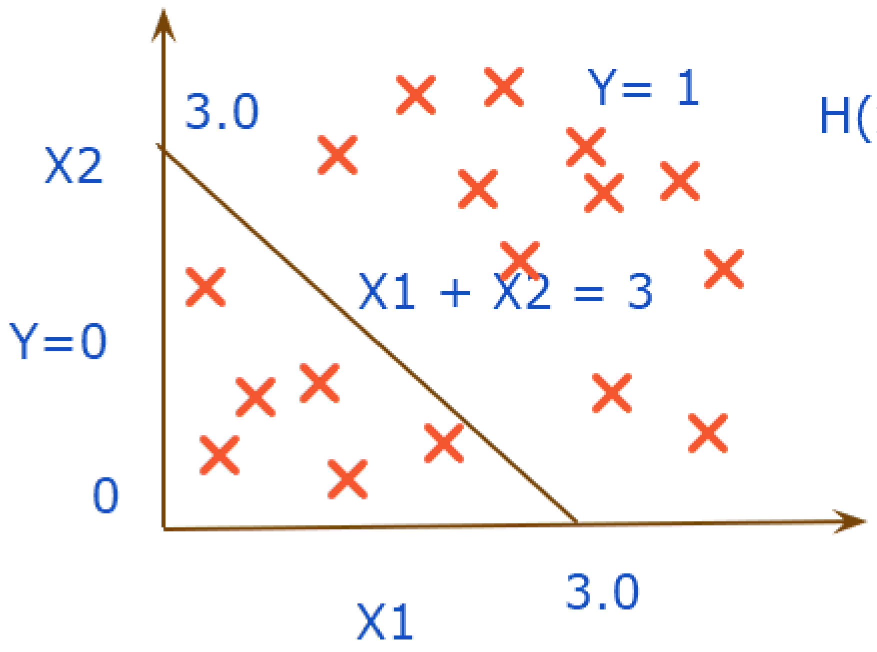
$H(x) = g(-3 + X1 + X2)$

$H(X) = 0.5; z = 0$

$X1 + X2 = 3$

Decision boundary

Linear decision boundary



H(x)=g(-3 + X1 + X2)

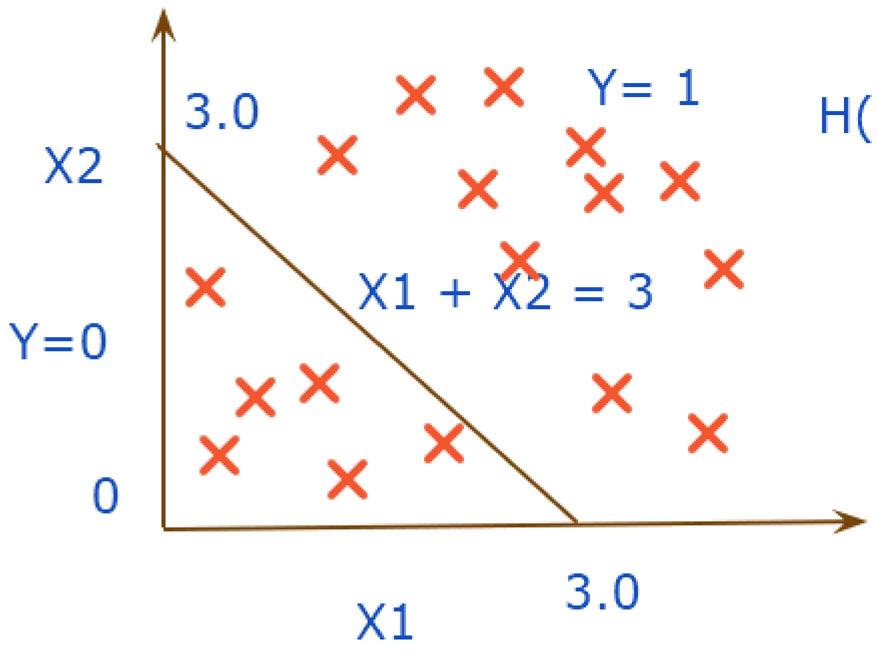
H(X) = 0.5; z = 0

X1 + X2 = 3

Decision boundary

Linear decision boundary

H(x) = g(theta 0 + theta 1x1 + theta 2 x2 + theta 3 x1^2 + theta 4 X2^2)



H(x)=g(-3 + X1 + X2)

H(X) = 0.5; z = 0

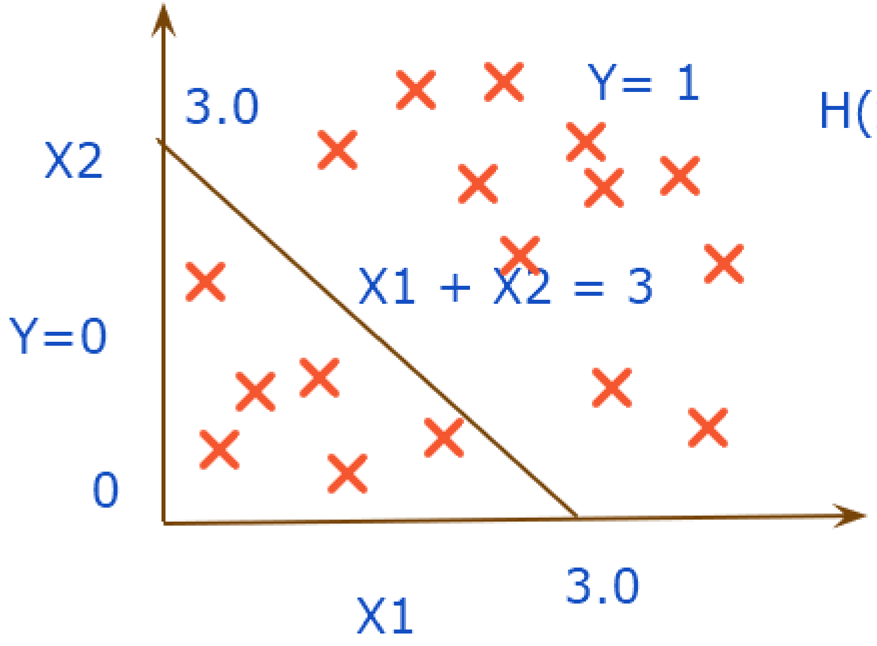
X1 + X2 = 3

Decision boundary

Linear decision boundary

H(x) = g(theta 0 + theta 1x1 + theta 2 x2 + theta 3 x1^2 + theta 4 X2^2)

theta 0 = -1; theta 1 = theta 2 = 0; theta 3 = 1 & theta 4 = 1



$H(x) = g(-3 + X1 + X2)$

$H(X) = 0.5;\ z = 0$

$X1 + X2 = 3$

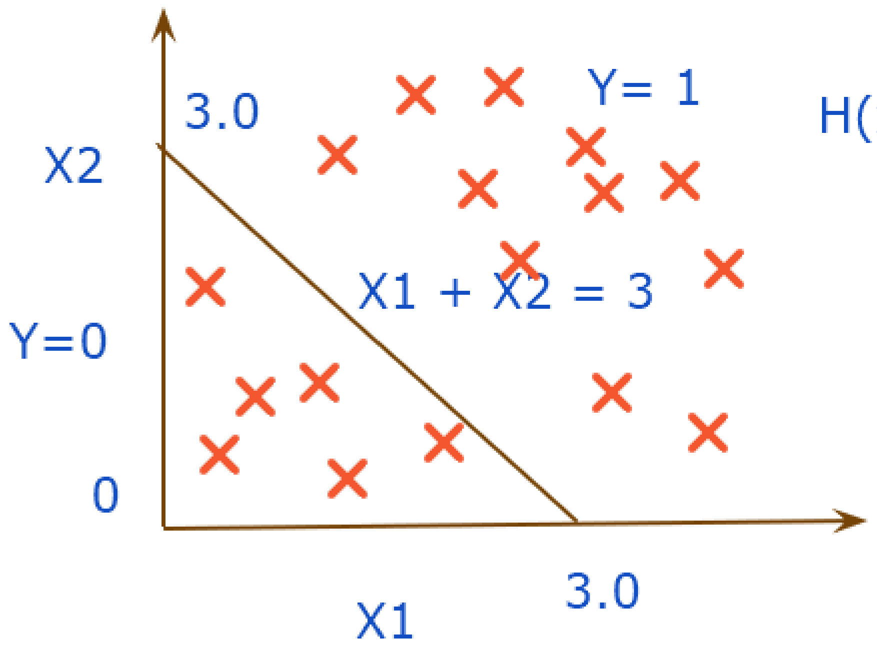
Decision boundary

Linear decision boundary

$H(x) = g(\theta_0 + \theta_1 x1 + \theta_2 x2 + \theta_3 x1^2 + \theta_4 X2^2)$

theta 0 = -1; theta 1 = theta 2 = 0; theta 3 = 1 & theta 4 = 1

$H(X) = g(-1 + 0 + 0 + X1^2 + X2^2)$



H(x)=g(-3 + X1 + X2)

H(X) = 0.5; z = 0

X1 + X2 = 3

Decision boundary

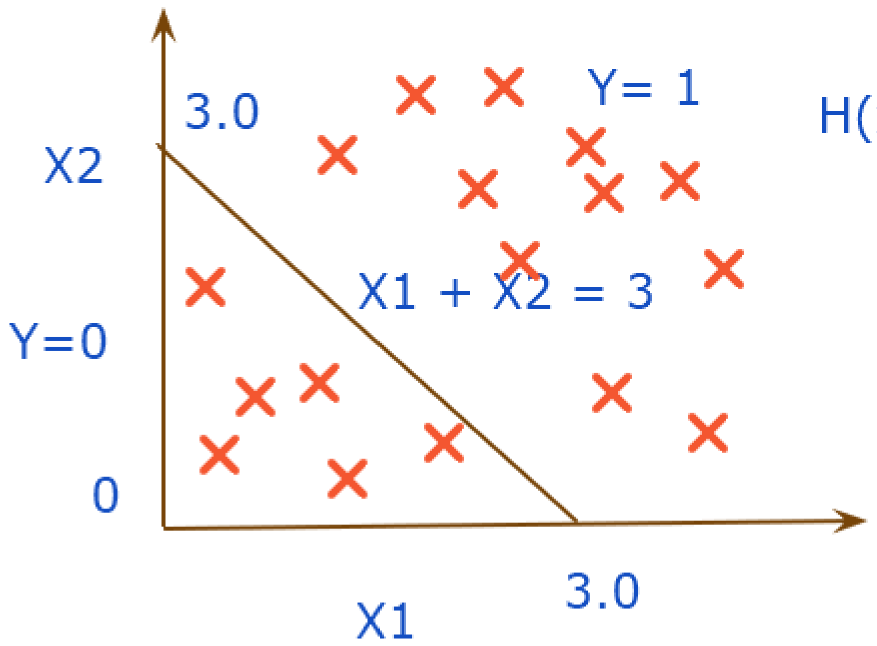
Linear decision boundary

H(x) = g(theta 0 + theta 1x1 + theta 2 x2 + theta 3 x1^2 + theta 4 X2^2)

theta 0 = -1; theta 1 = theta 2 = 0; theta 3 = 1 & theta 4 = 1

H(X) = g(-1 +0 + 0+ X1^2 + X2^2)

X1^2 + X2^2 = 1



H(x)=g(3 + X1 + X2)

H(X) = 0.5; z = 0

X1 + X2 = 3

Decision boundary

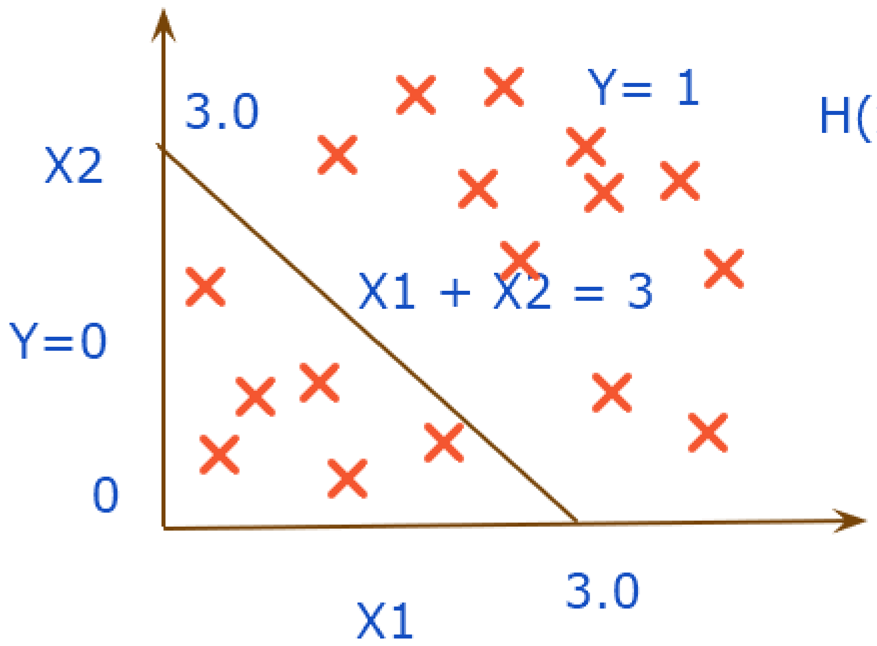
Linear decision boundary

H(x) = g(theta 0 + theta 1x1 + theta 2 x2 + theta 3 x1^2 + theta 4 X2^2)

theta 0 = -1; theta 1 = theta 2 = 0; theta 3 = 1 & theta 4 = 1

H(X) = g(-1 +0 + 0+ X1^2 + X2^2)

X1^2 + X2^2 = 1 Decision boundary; non-linear



H(x)=g(-3 + X1 + X2)

H(X) = 0.5; z = 0

X1 + X2 = 3

Decision boundary

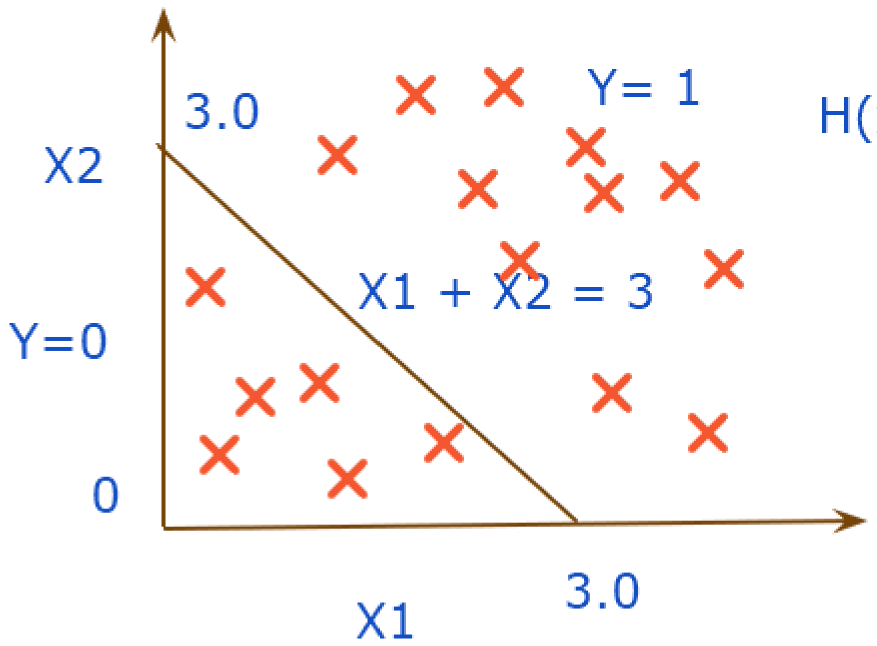
Linear decision boundary

H(x) = g(theta 0 + theta 1x1 + theta 2 x2 + theta 3 x1^2 + theta 4 X2^2)

theta 0 = -1; theta 1 = theta 2 = 0; theta 3 = 1 & theta 4 = 1

H(X) = g(-1 +0 + 0+ X1^2 + X2^2)

X1^2 + X2^2 = 1 Decision boundary; non-linear



H(x)=g(3 + X1 + X2)

H(X) = 0.5; z = 0

X1 + X2 = 3

Decision boundary

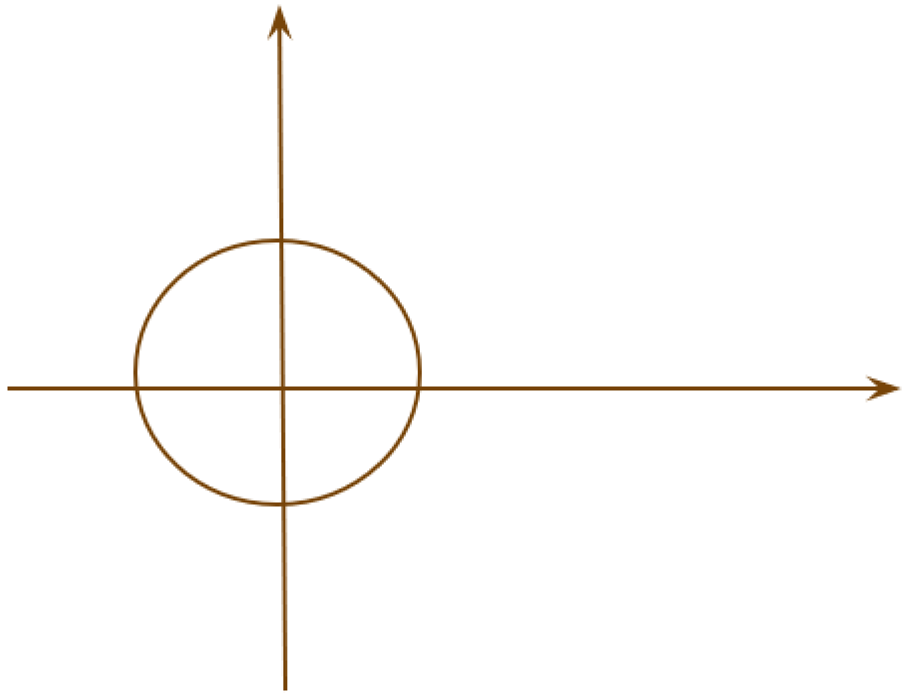
Linear decision boundary

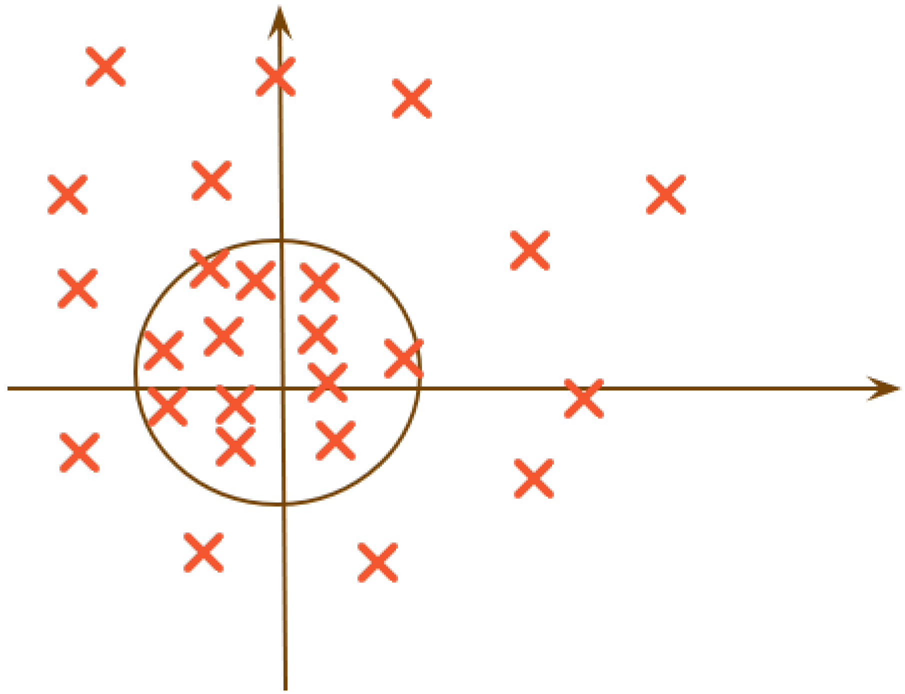
H(x) = g(theta 0 + theta 1x1 + theta 2 x2 + theta 3 x1^2 + theta 4 X2^2)

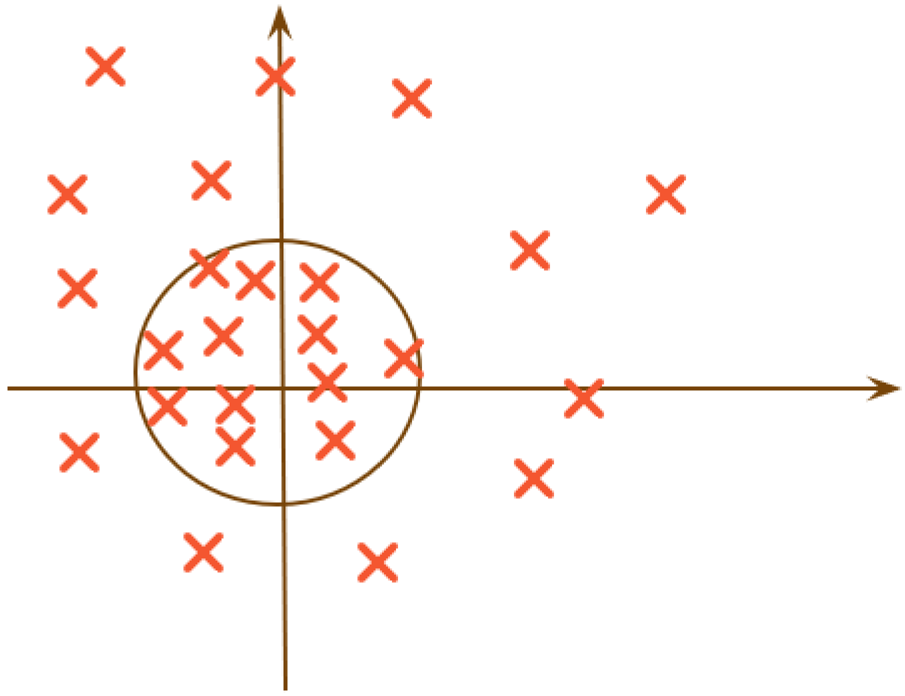
theta 0 = -1; theta 1 = theta 2 = 0; theta 3 = 1 & theta 4 = 1

H(X) = g(-1 +0 + 0+ X1^2 + X2^2)

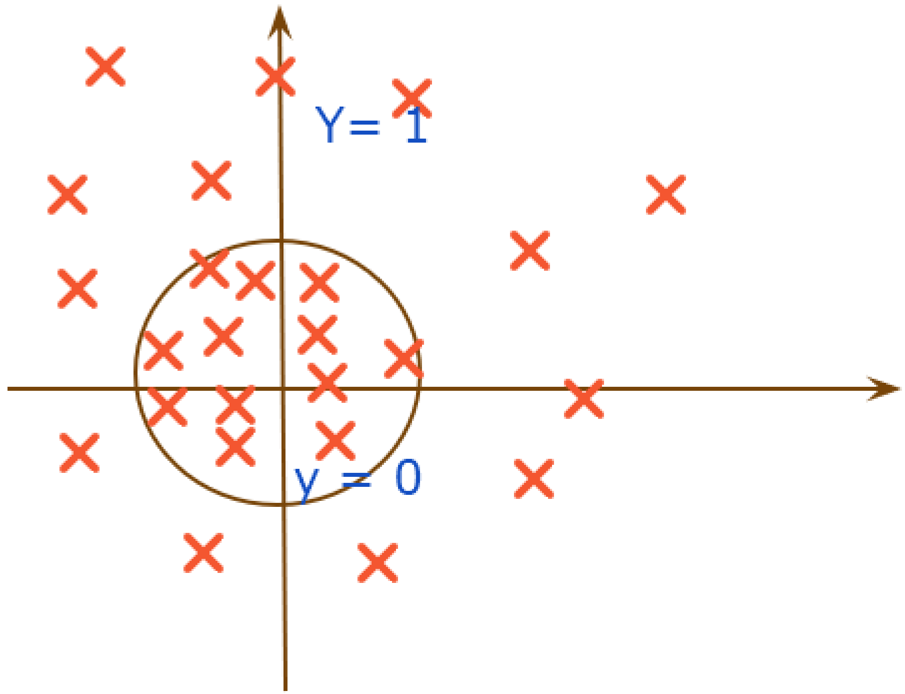
X1^2 + X2^2 = 1 Decision boundary; non-linear



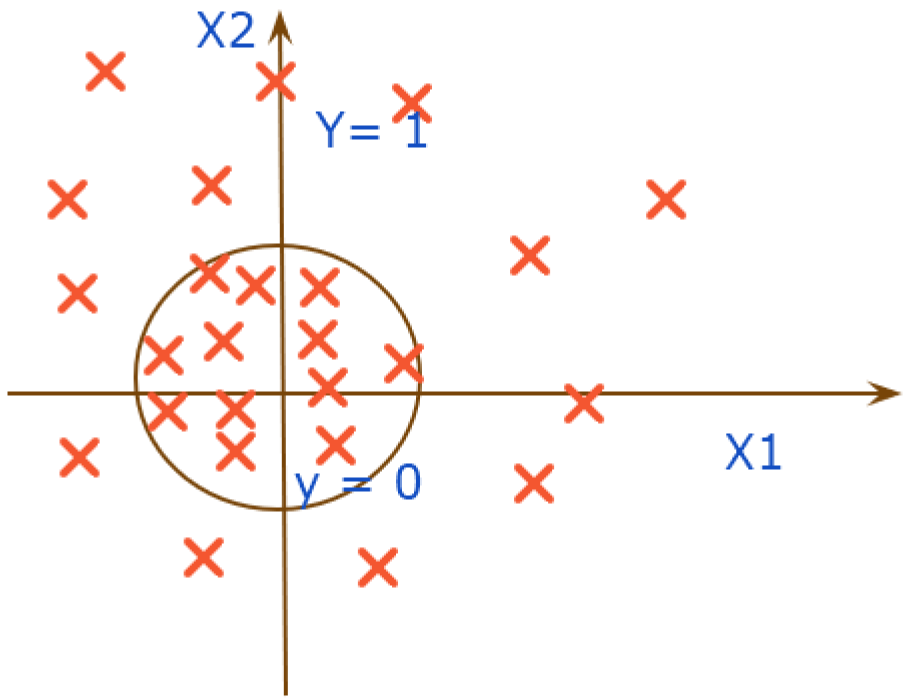




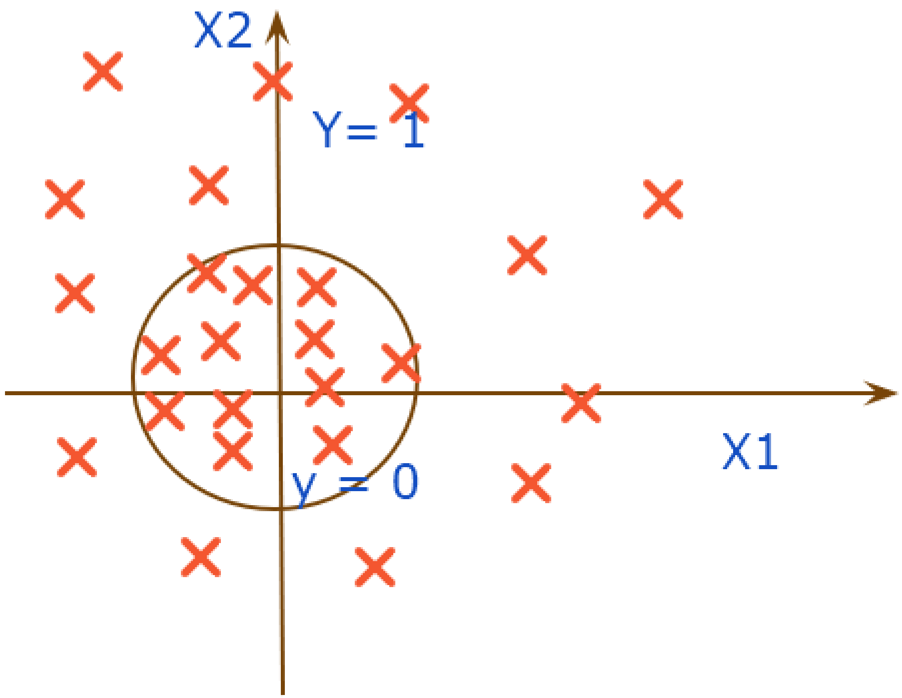
decision boundary
X1^2 + X2^2 = 1



decision boundary
$X1^2 + X2^2 = 1$

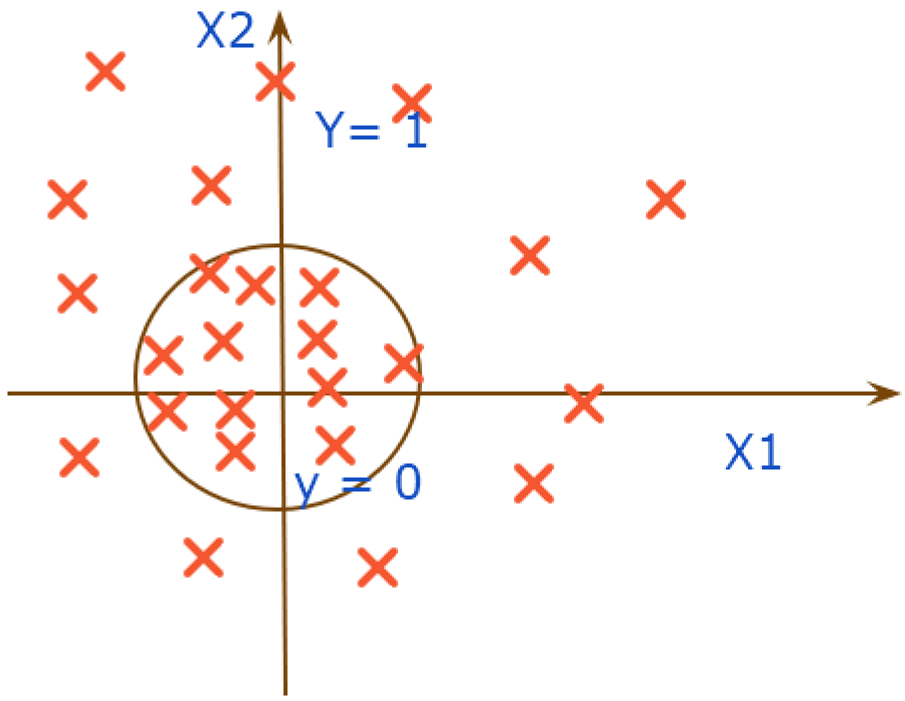


decision boundary
$X1^2 + X2^2 = 1$



decision boundary
X1^2 + X2^2 = 1

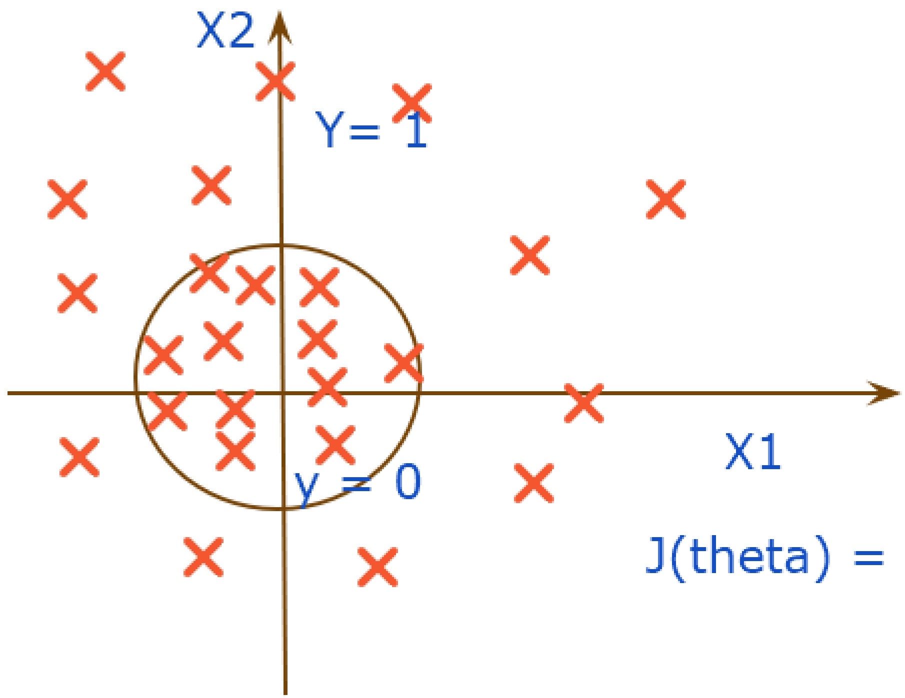
X1 + X2 = 3



decision boundary
$X1^2 + X2^2 = 1$

$X1 + X2 = 3$

theta 0, theta 1, theta 2, theta n

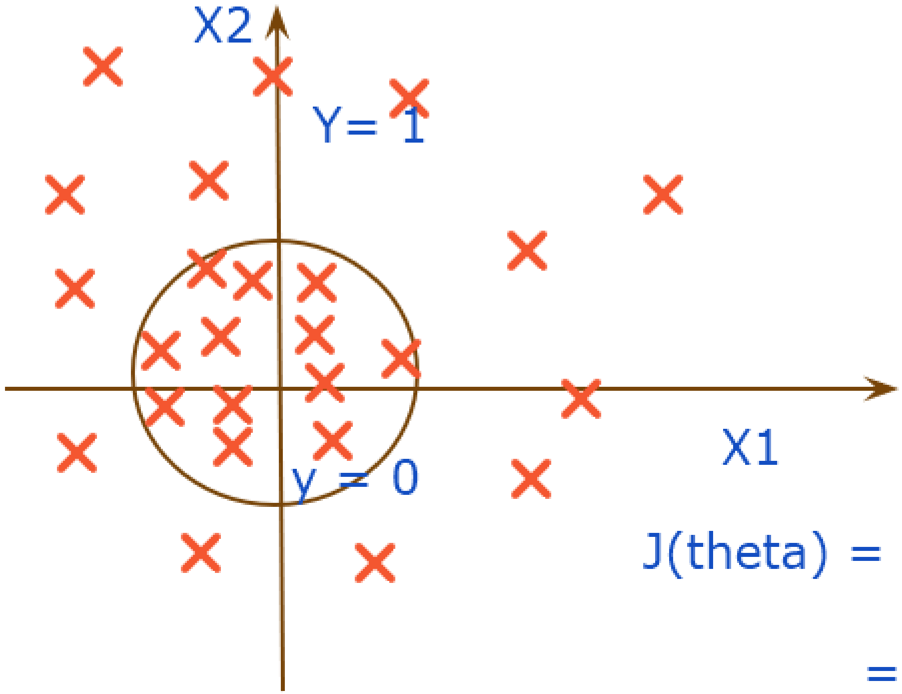


decision boundary
X1^2 + X2^2 = 1

X1 + X2 = 3

theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2



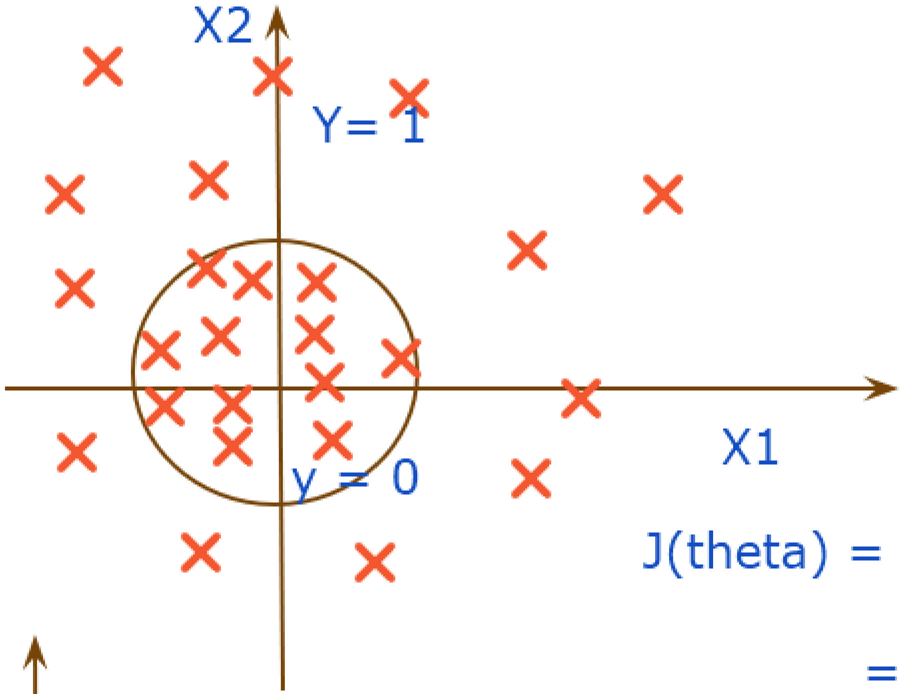
decision boundary
X1^2 + X2^2 = 1

X1 + X2 = 3

theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2

= Cost(h(x), y)



decision boundary

$X1^2 + X2^2 = 1$

$X1 + X2 = 3$

theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2

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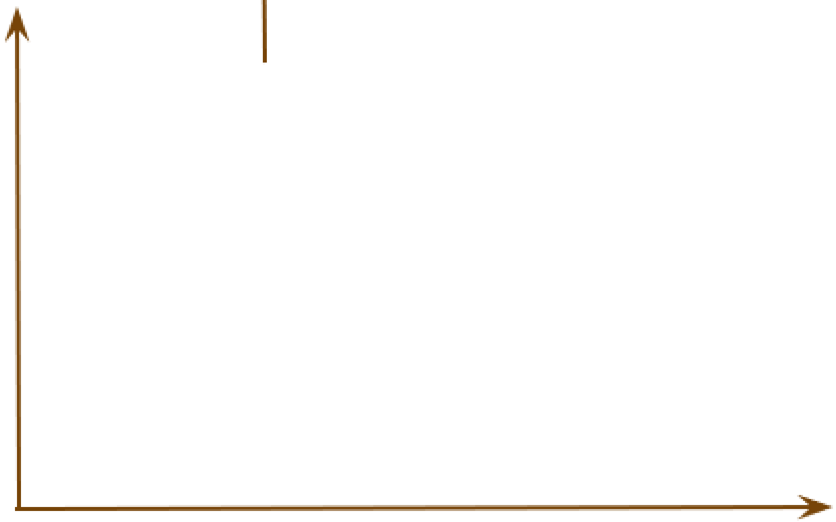

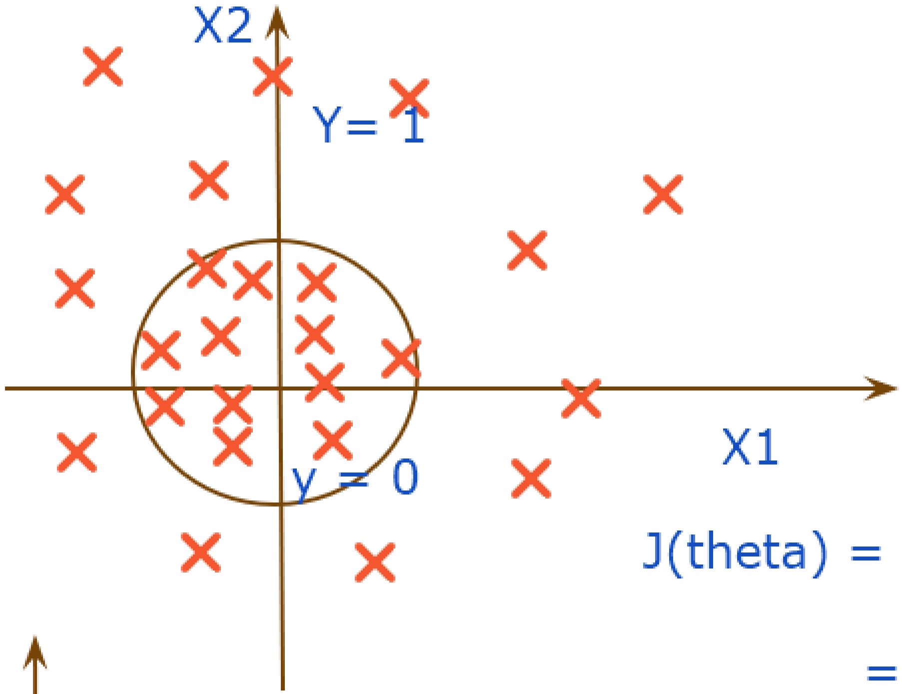

decision boundary
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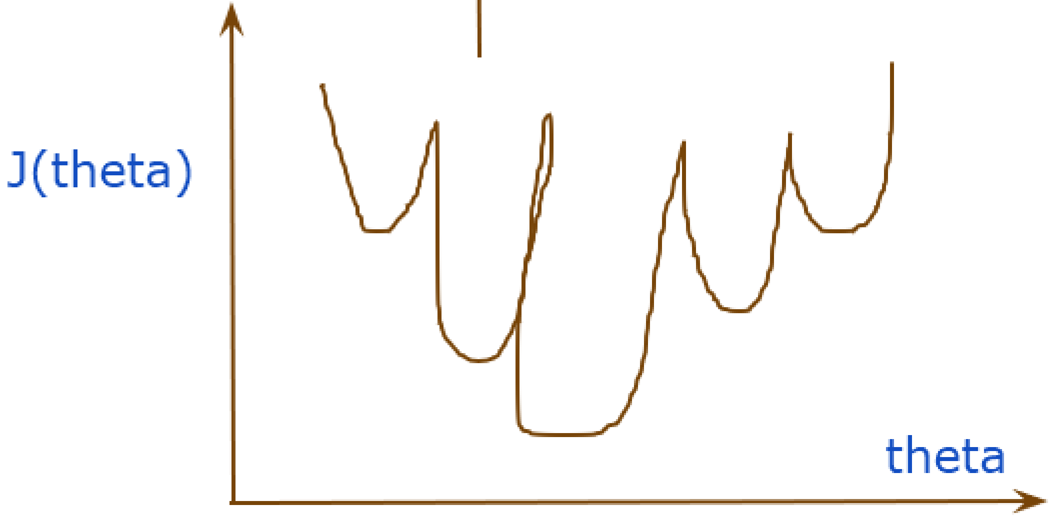

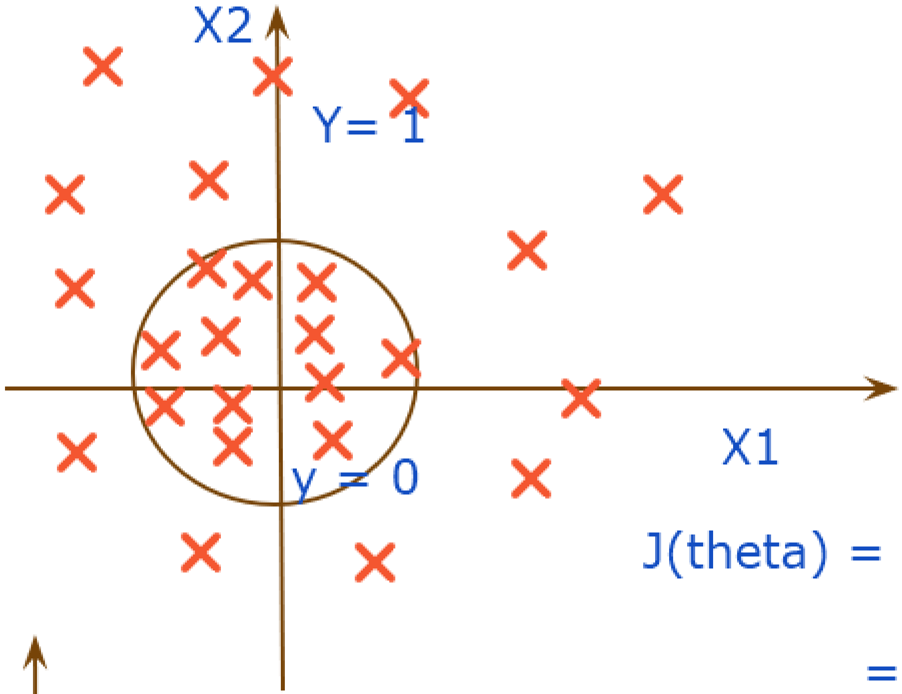

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X1^2 + X2^2 = 1

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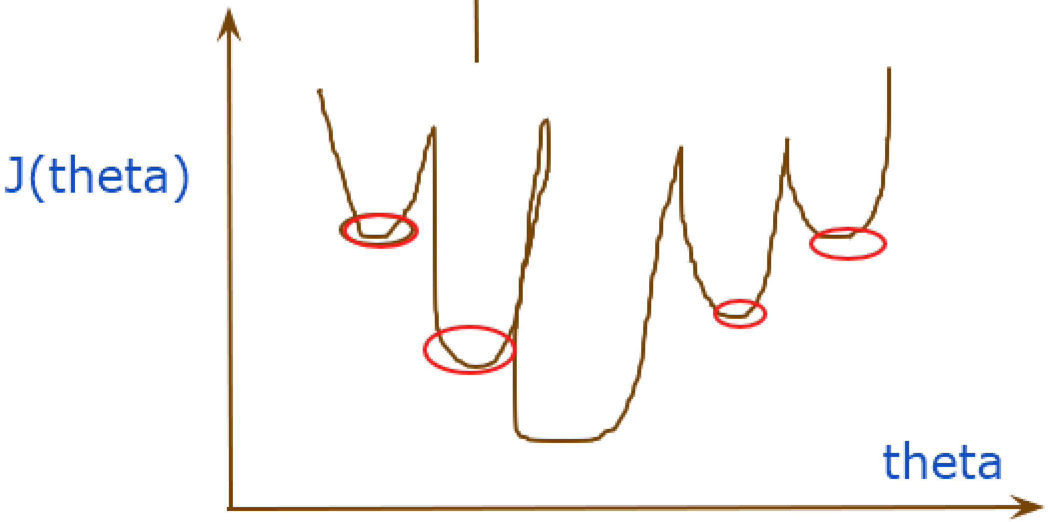

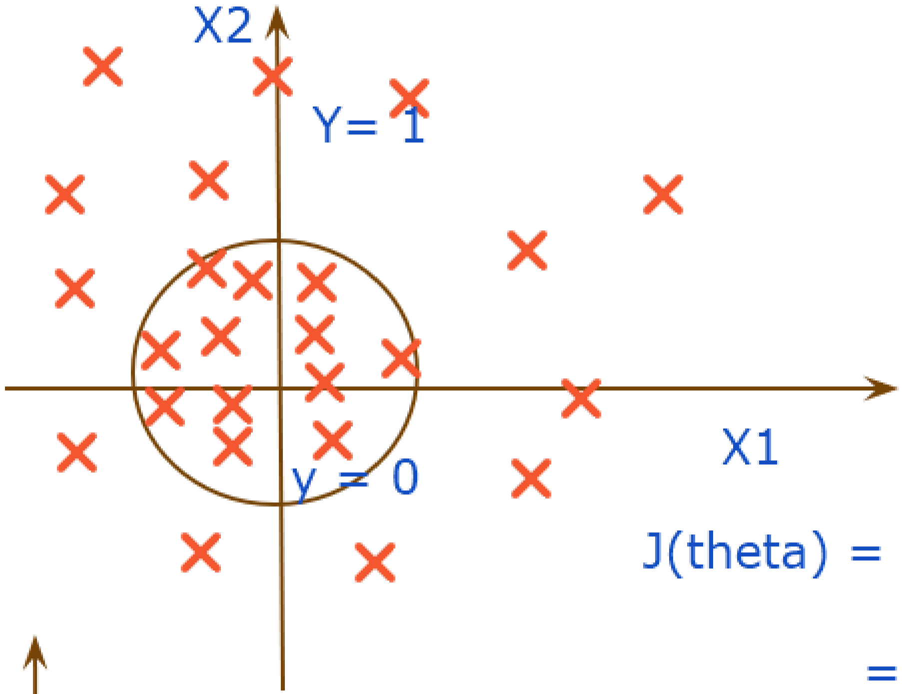

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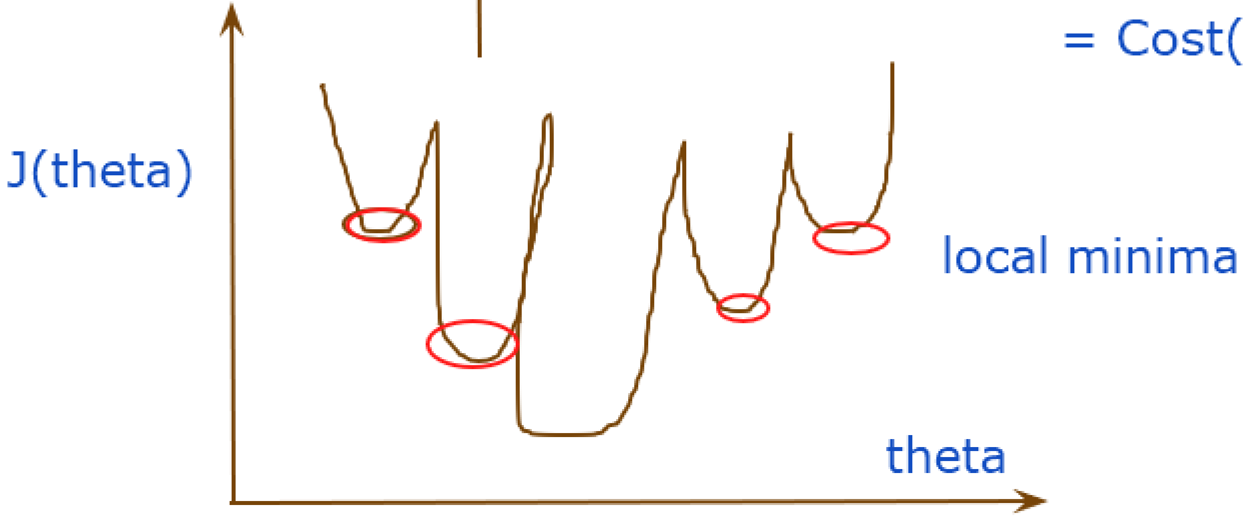

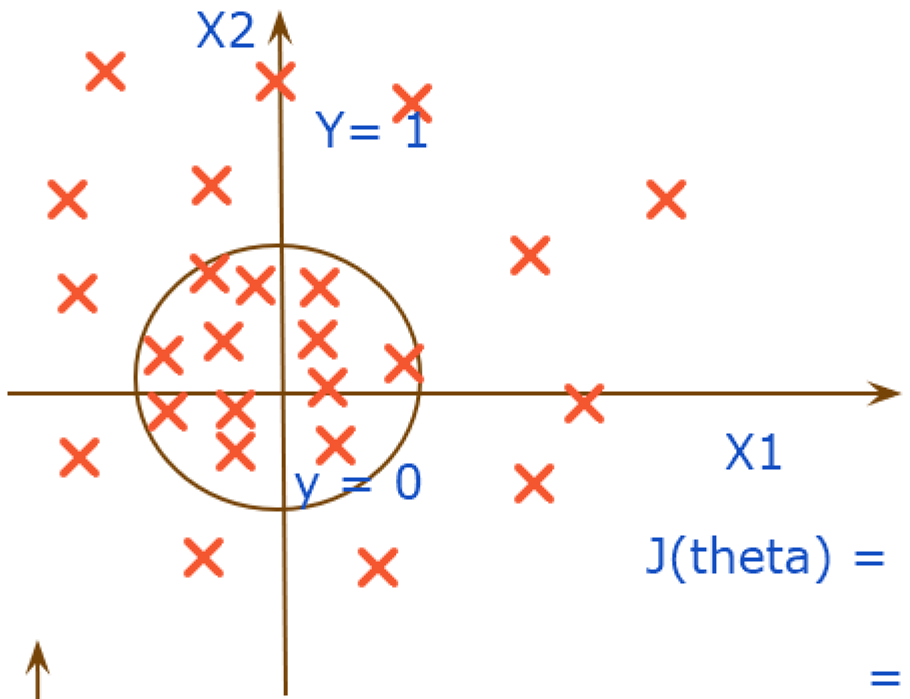

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X1^2 + X2^2 = 1

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theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2

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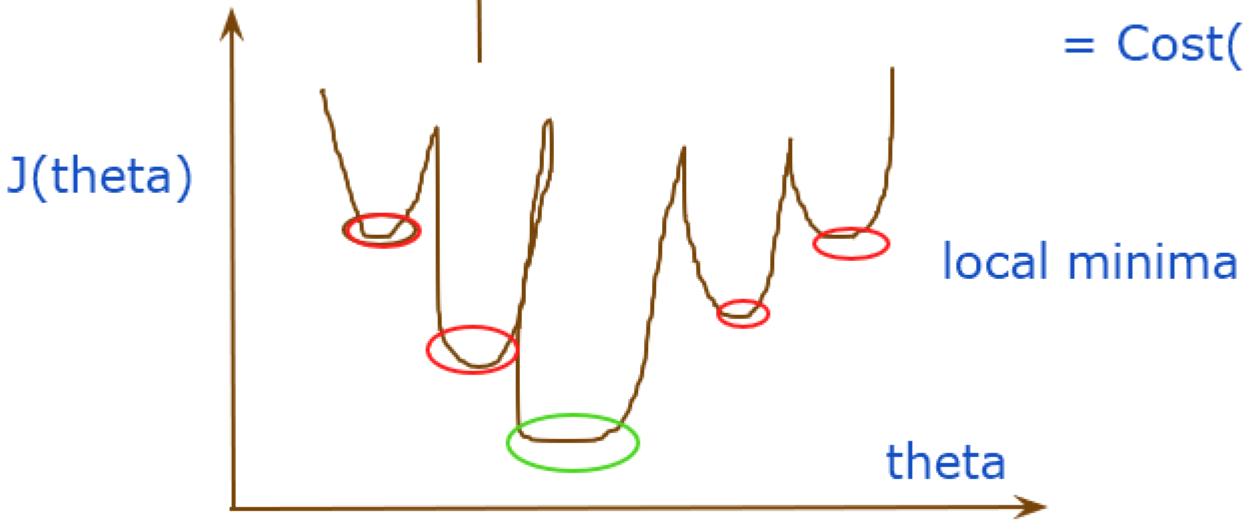

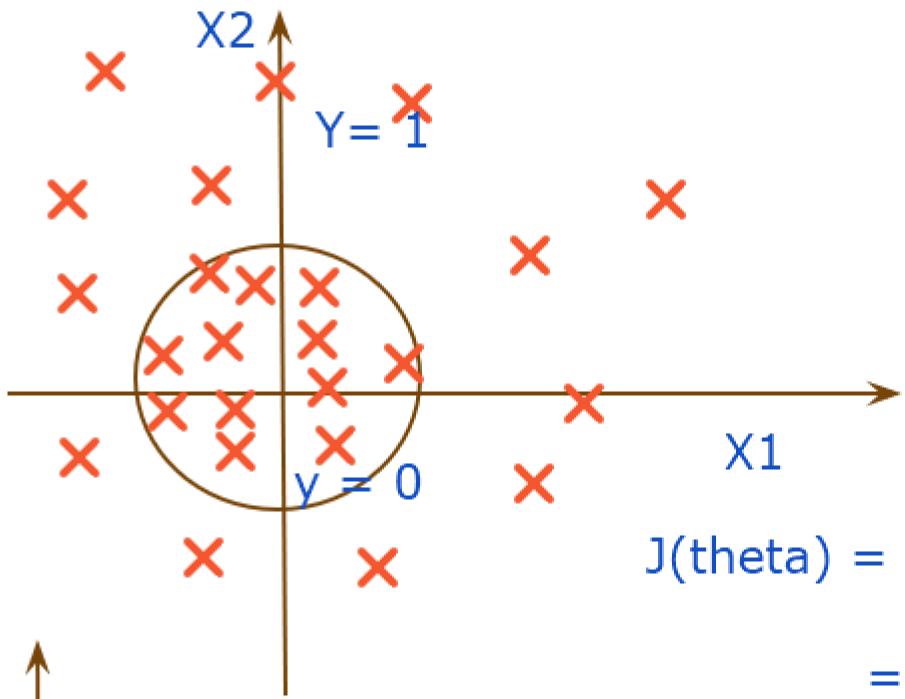

decision boundary
X1^2 + X2^2 = 1

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theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2

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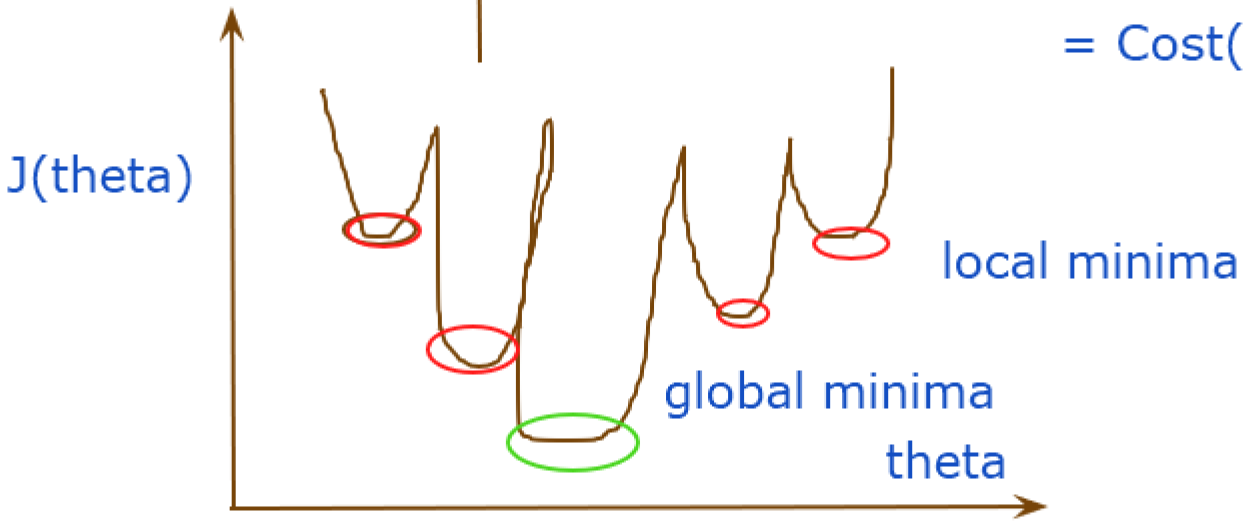

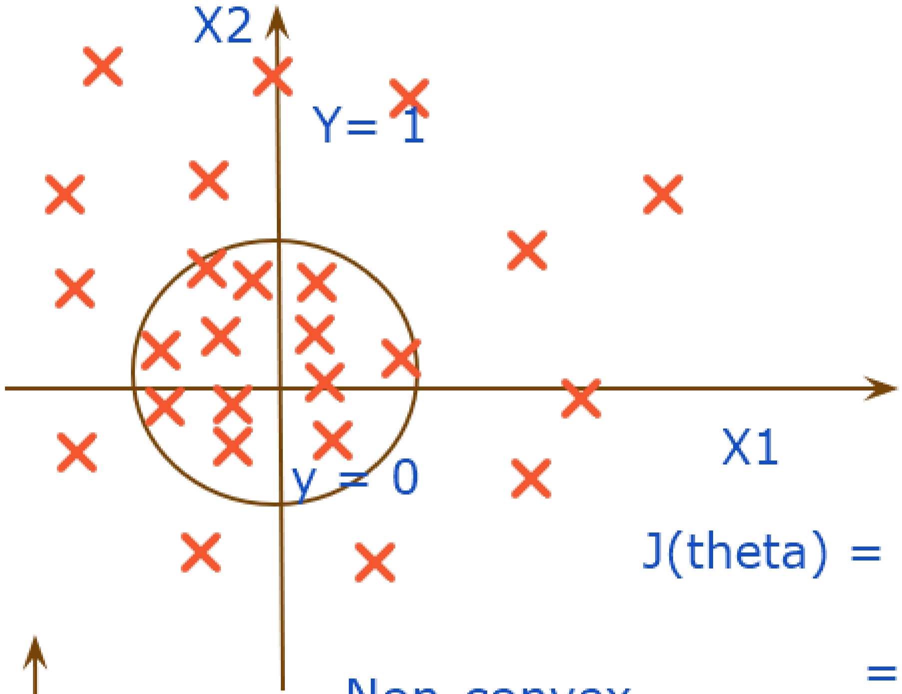

decision boundary
X1^2 + X2^2 = 1

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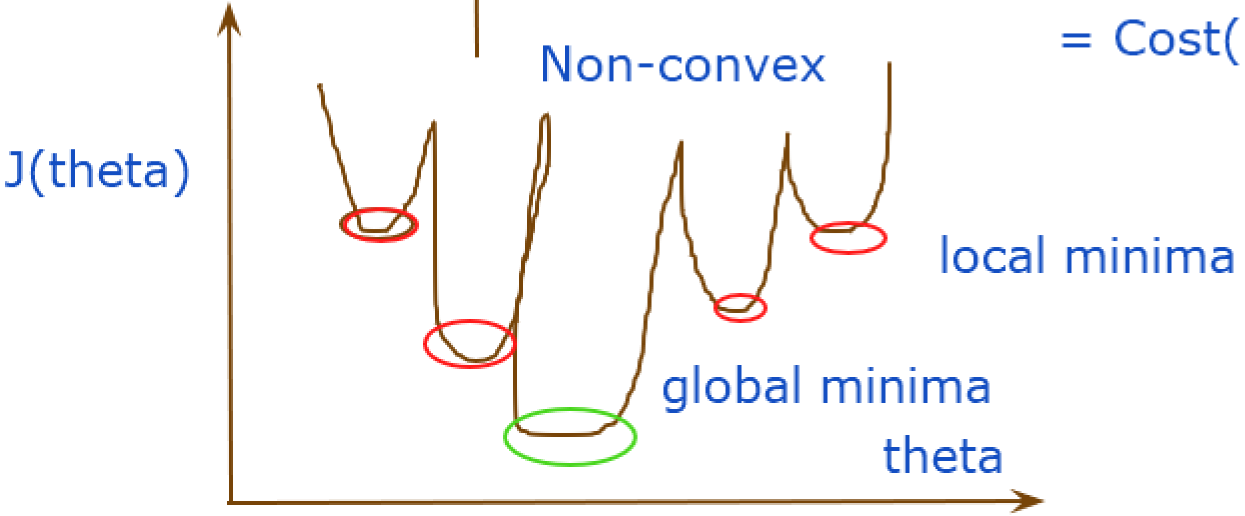
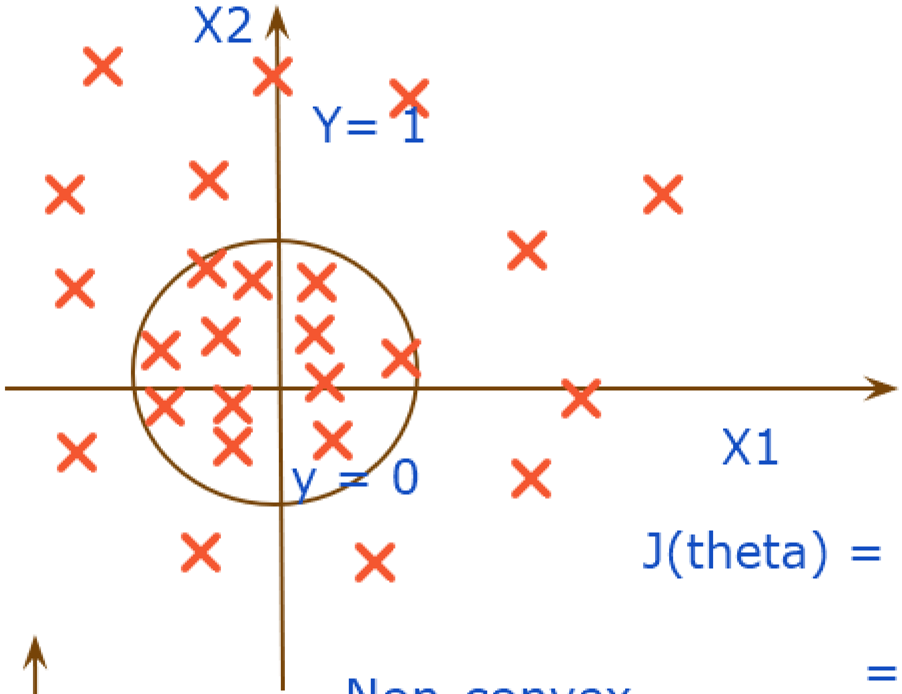
theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2

= Cost(h(x), y)





decision boundary
X1^2 + X2^2 = 1

X1 + X2 = 3

theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2

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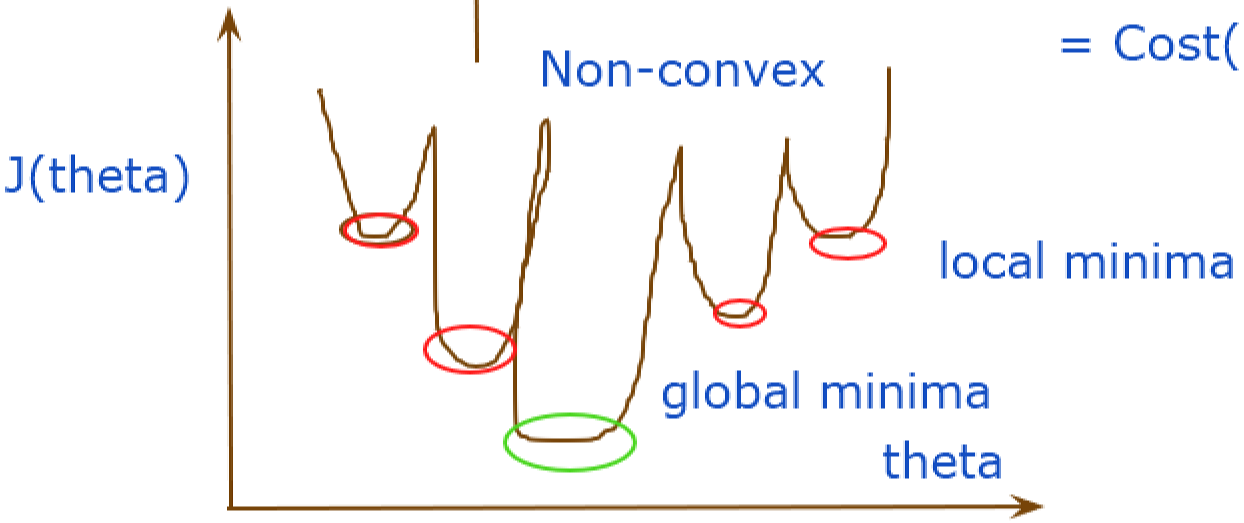
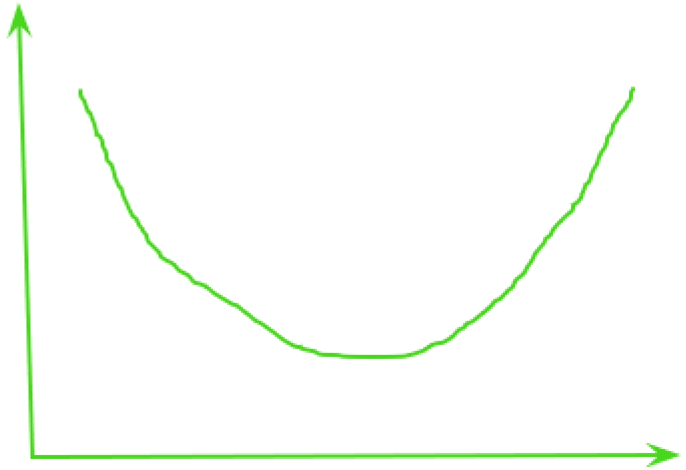
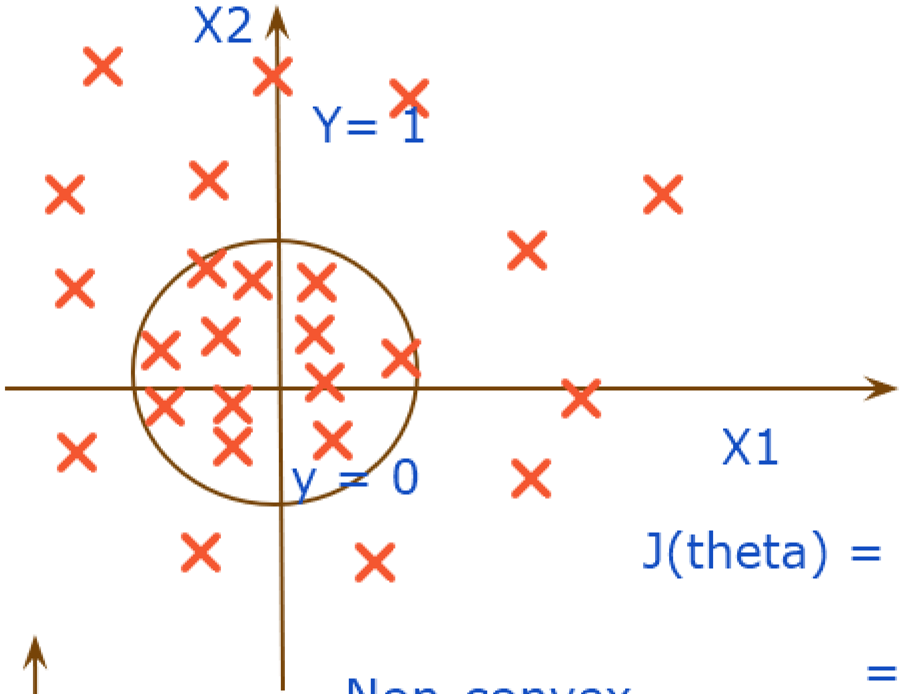






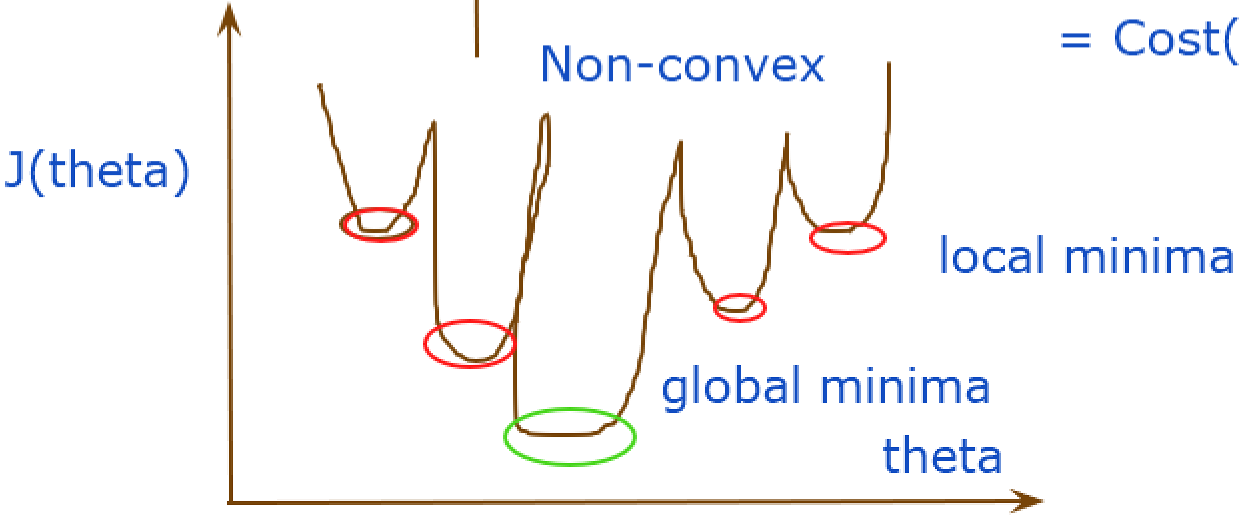
decision boundary
$X1^2 + X2^2 = 1$

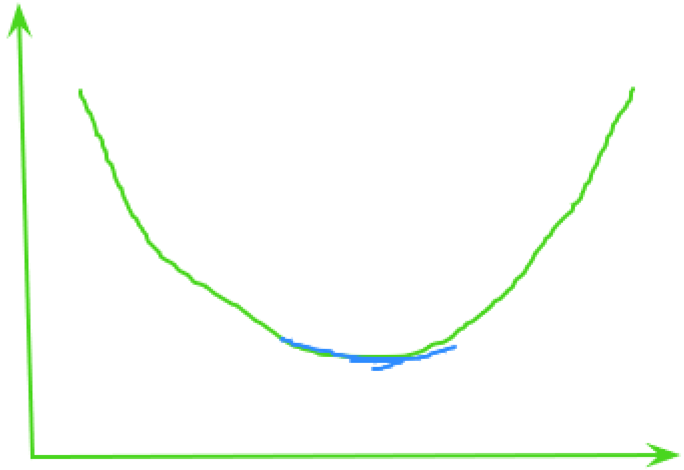
$X1 + X2 = 3$

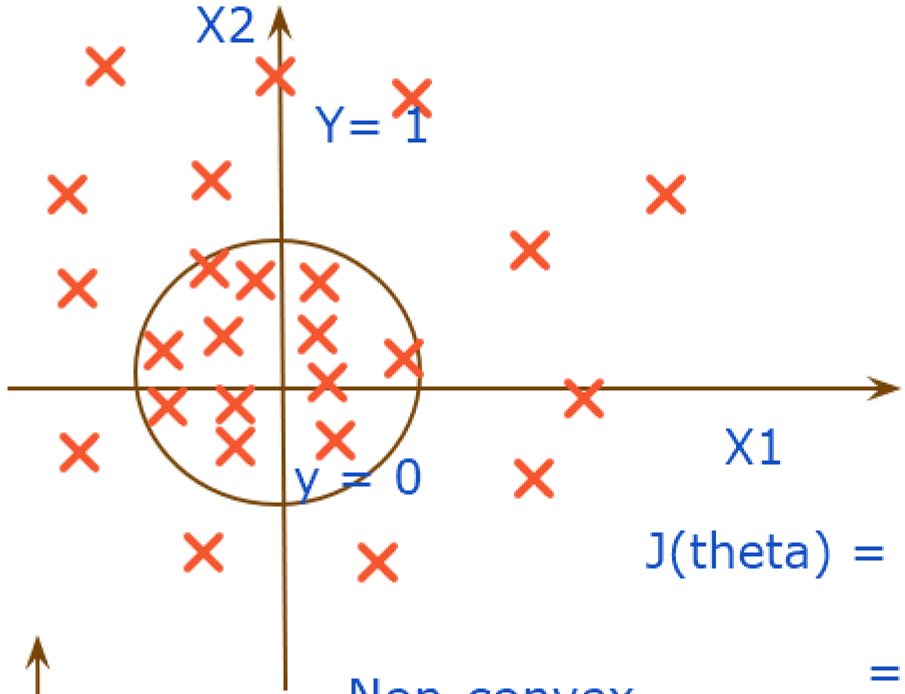
theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2

= Cost(h(x), y)







decision boundary

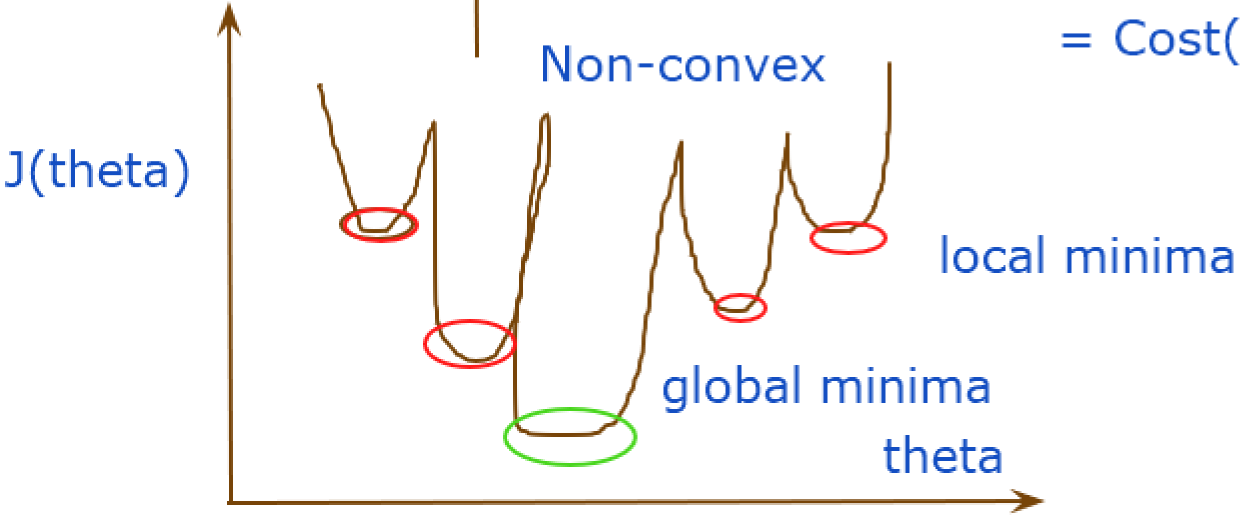
$X1^2 + X2^2 = 1$

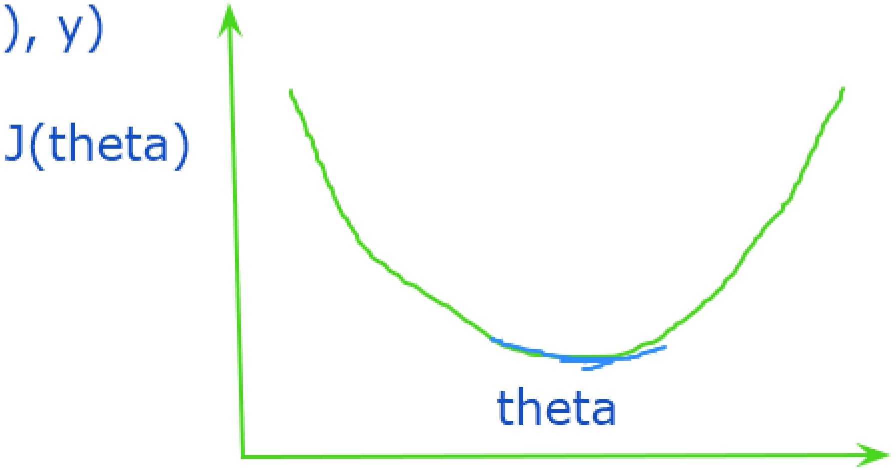
$X1 + X2 = 3$

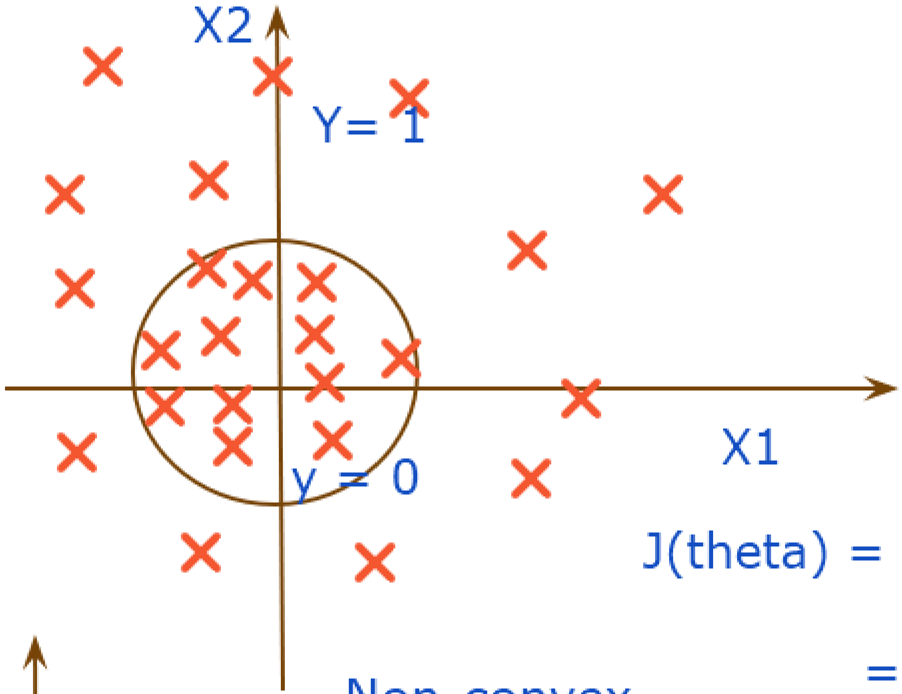
theta 0, theta 1, theta 2, theta n

J(theta) = 1/2m summation i = 1 to m [h(xi) - yi]^2

= Cost(h(x), y)







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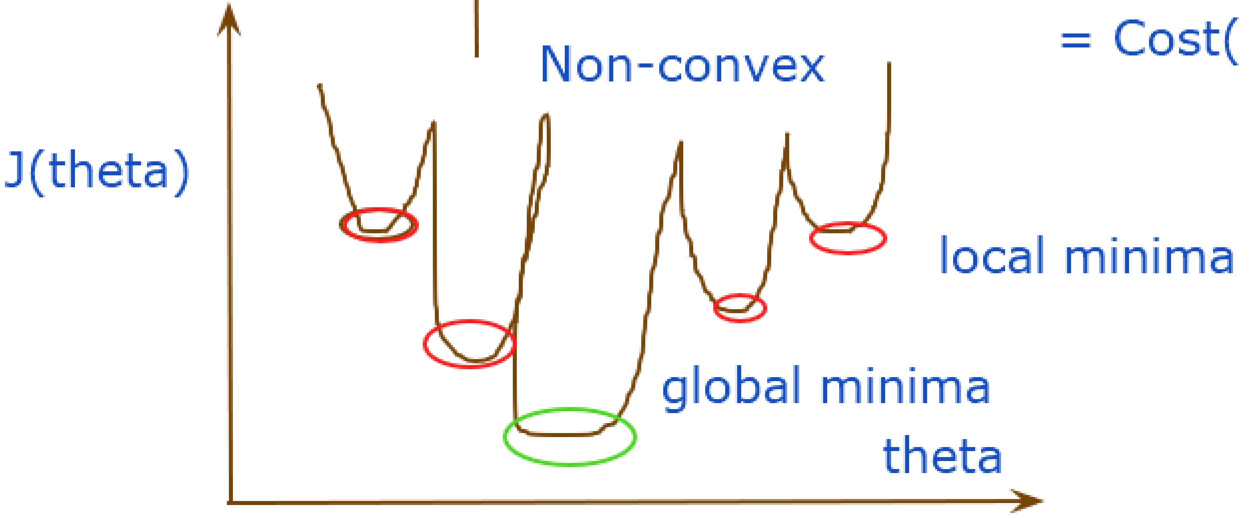

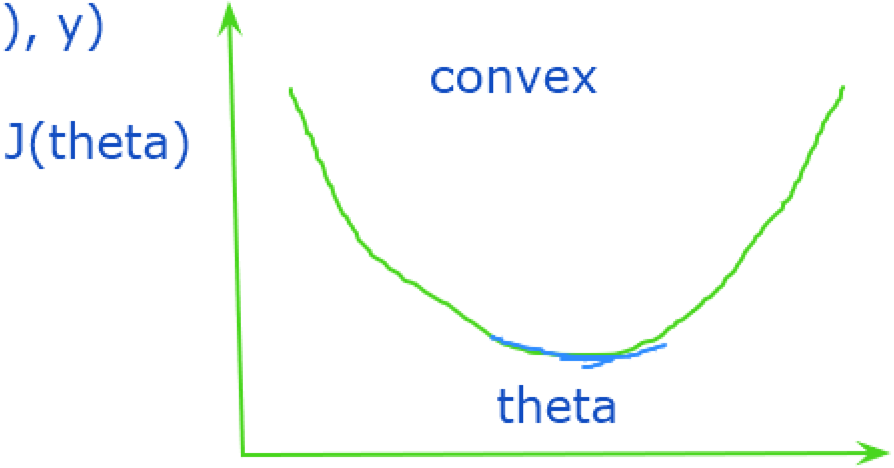

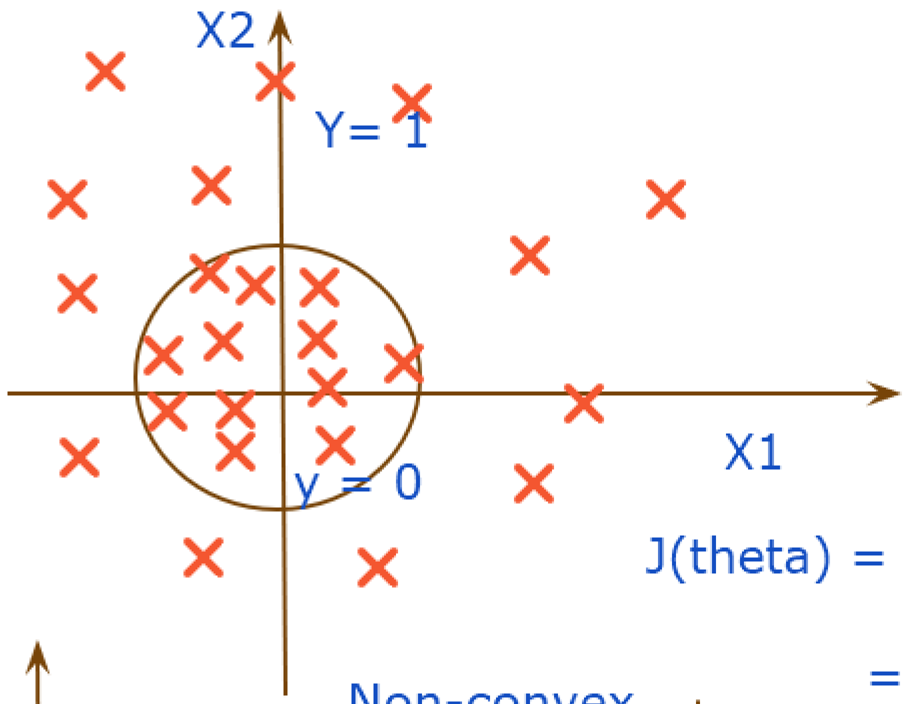

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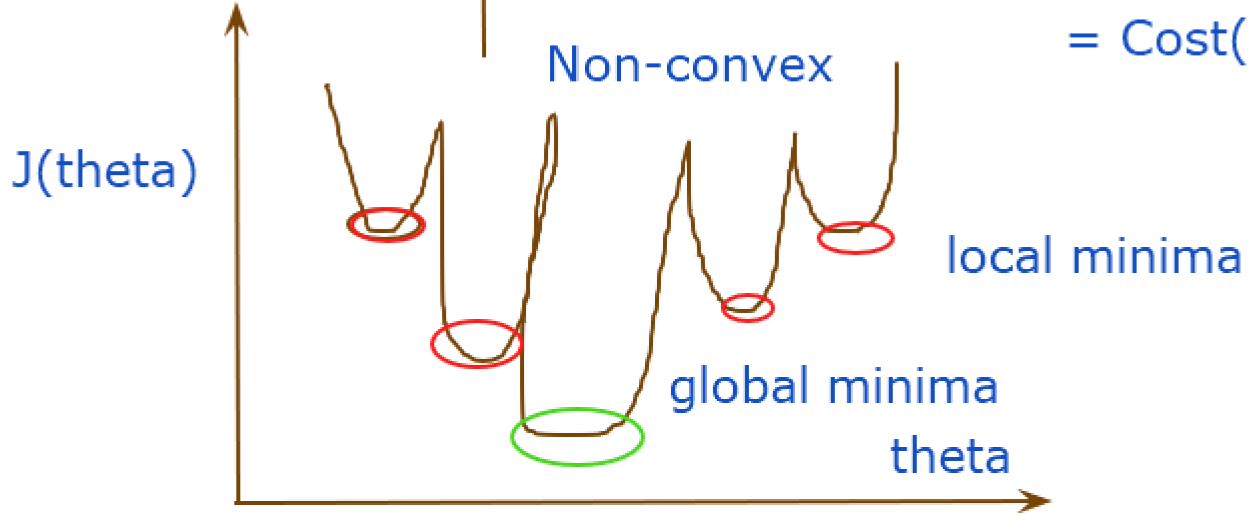
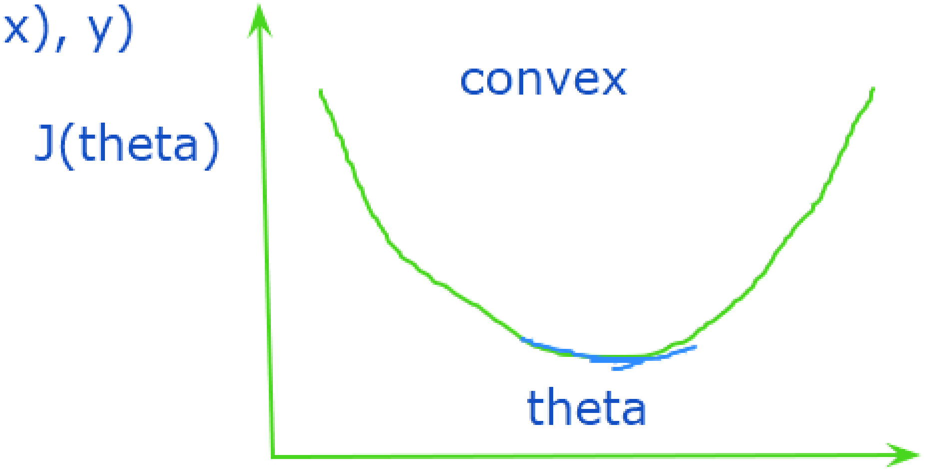
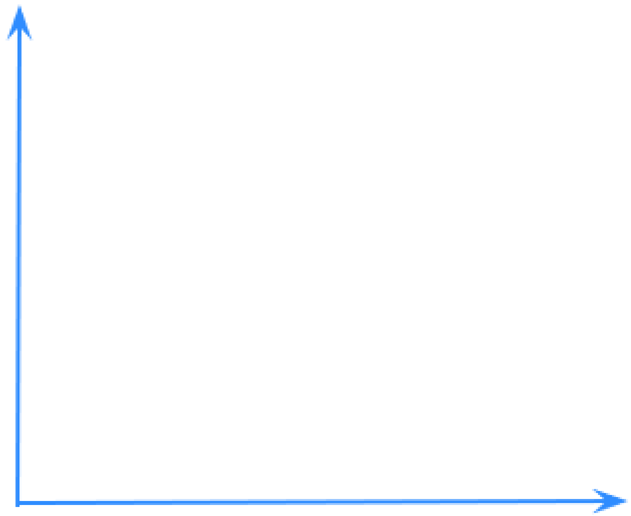




$$\text{cost}(h(x), y) = \begin{cases} -\log h(x) & \text{if } y = 1 \\ -\log(1-h(x)) & \text{if } y = 0 \end{cases}$$



h(x)

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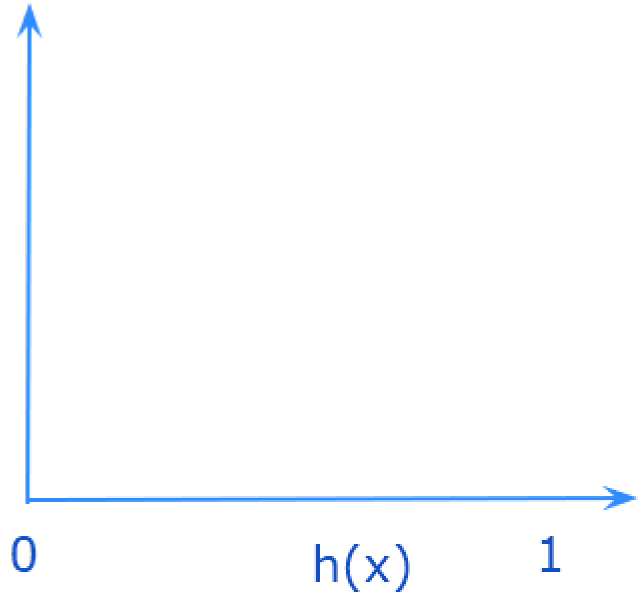

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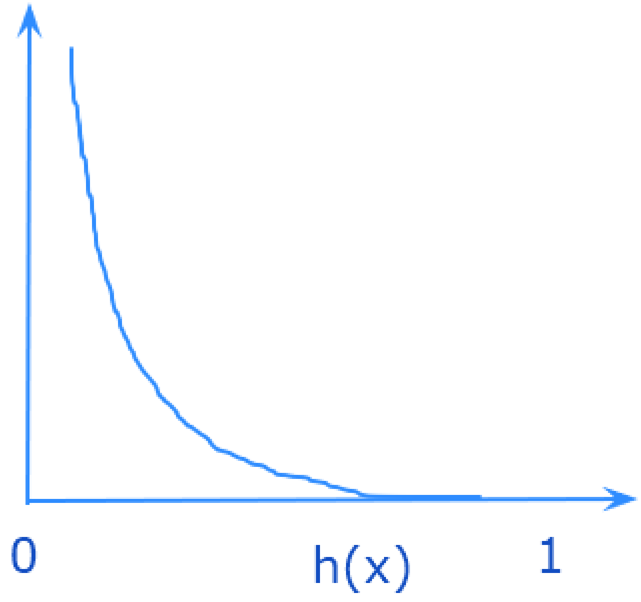
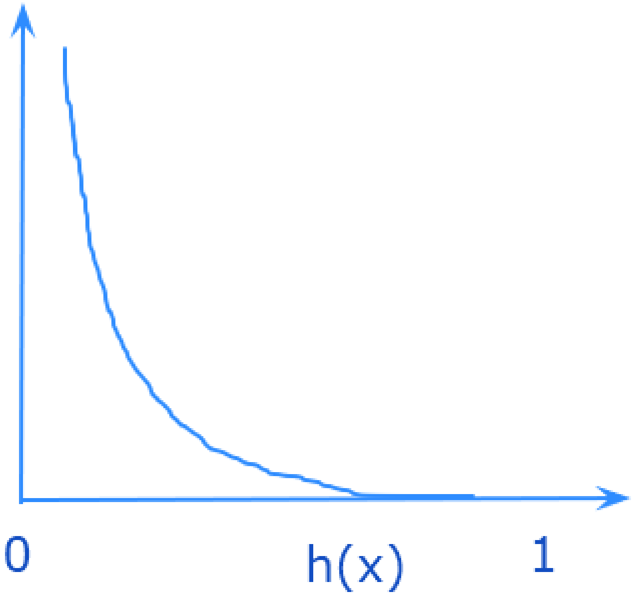


if $h(x) = 1$; then cost = 0
if $h(x) = 0$; then cost = infinity

cost (h(x), y) = {- log h(x) if y = 1
- log (1-h(x)) if y = 0}



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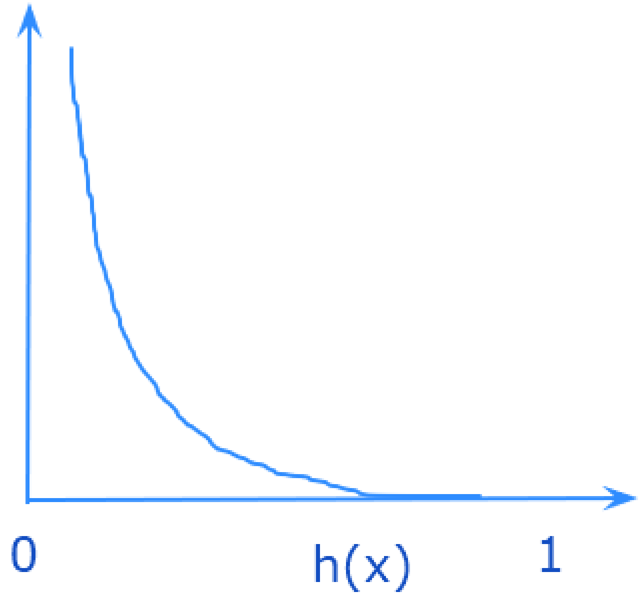

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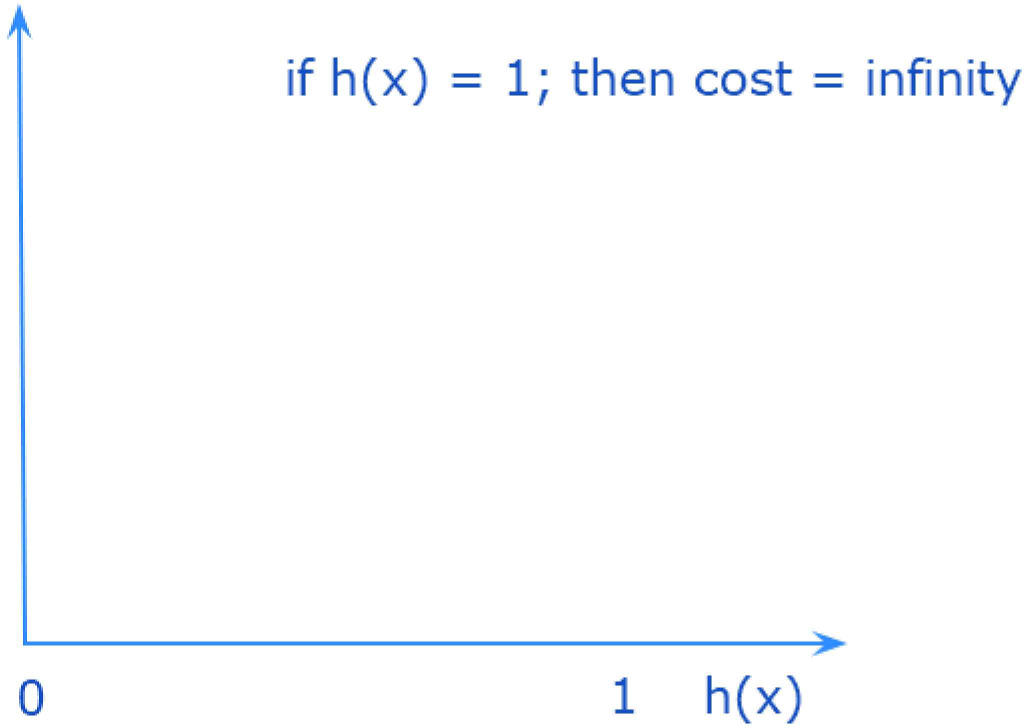
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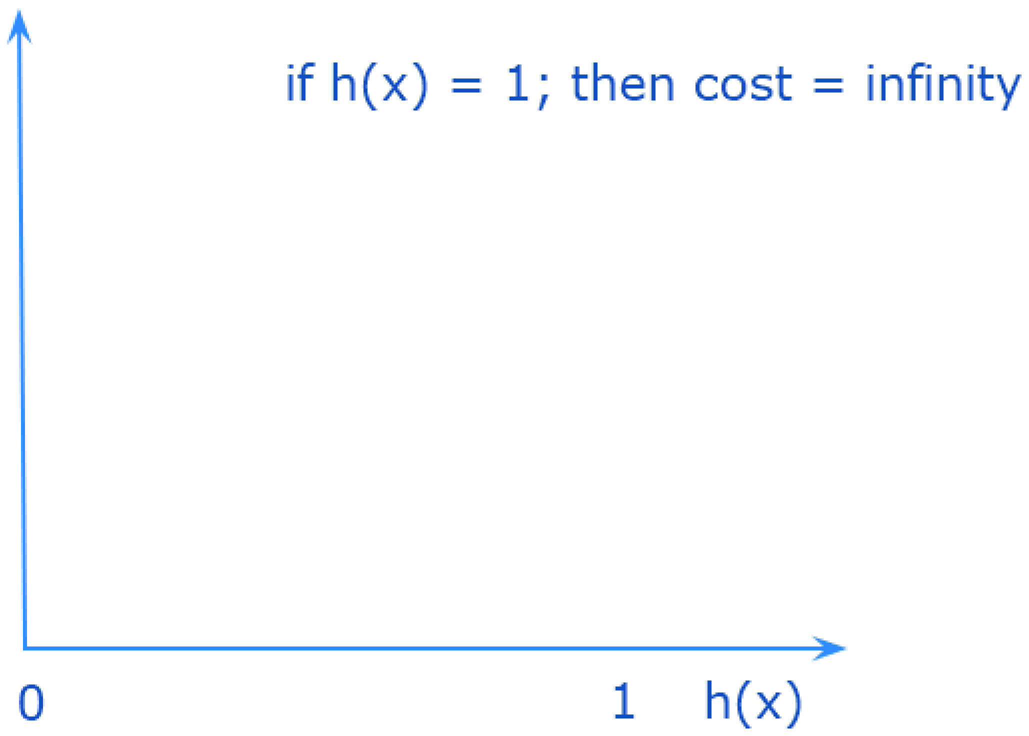
0
1
h(x)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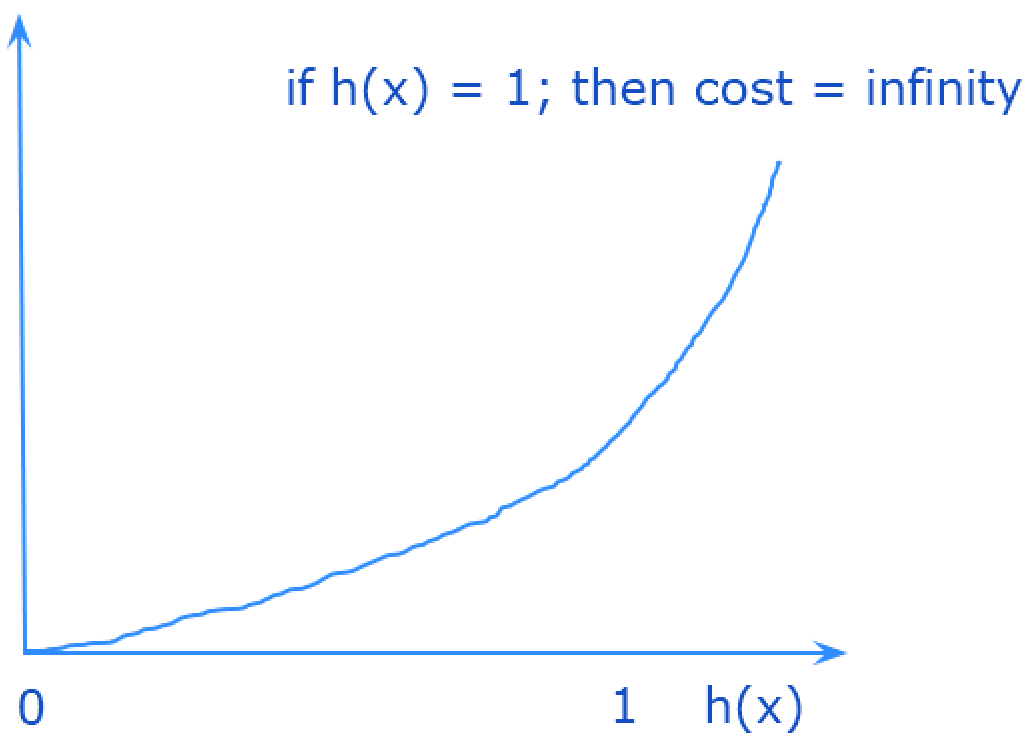
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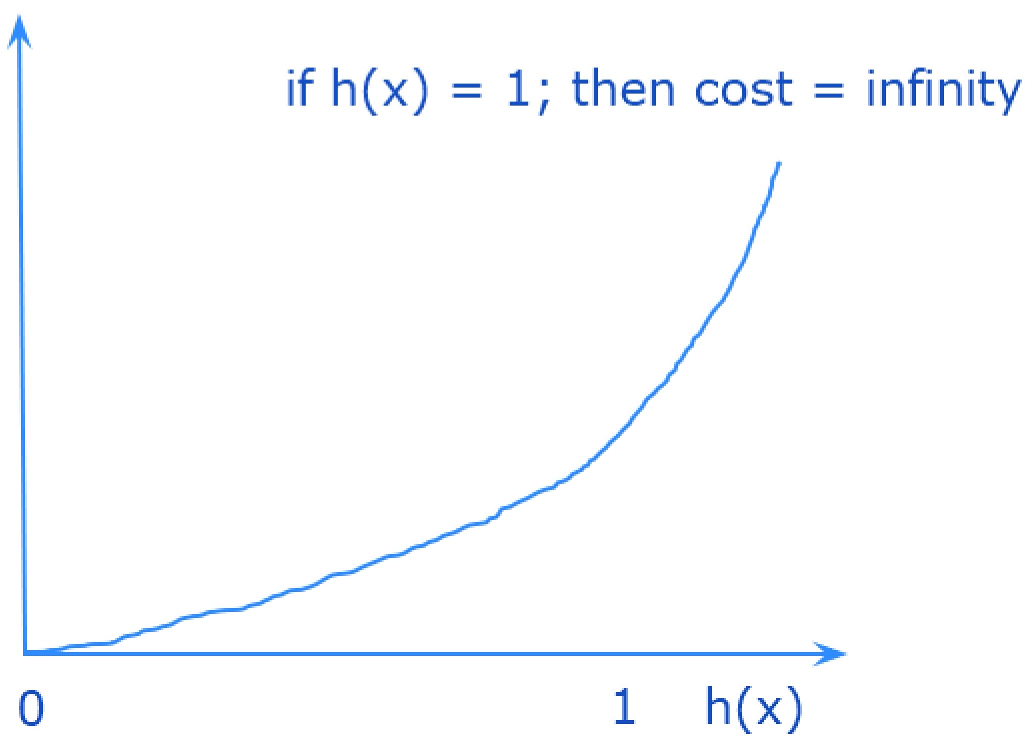

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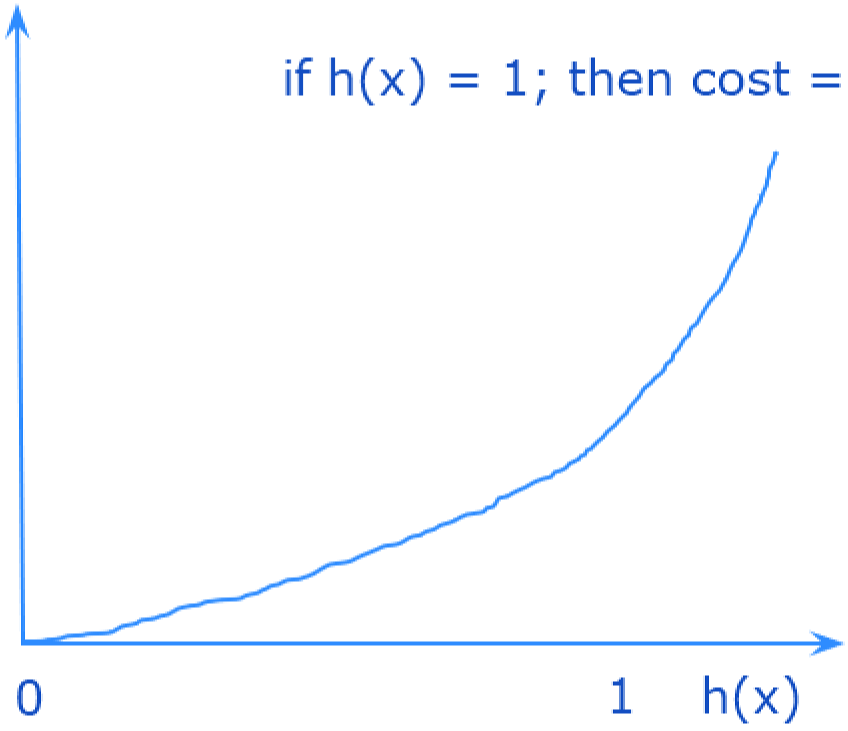
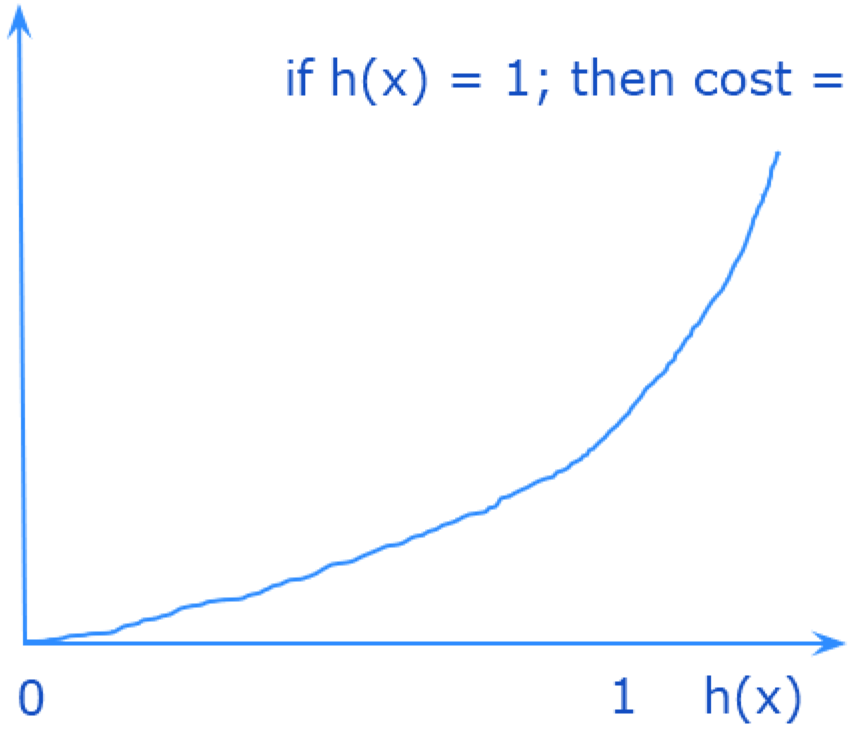


$$\text{cost}\,(h(x), y) = \{ -\log(h(x)) \text{ if } y = 1$$
$$= -\log(1 - h(x)) \text{ if } y = 0\}$$

if h(x) = 1; then cost = infinity



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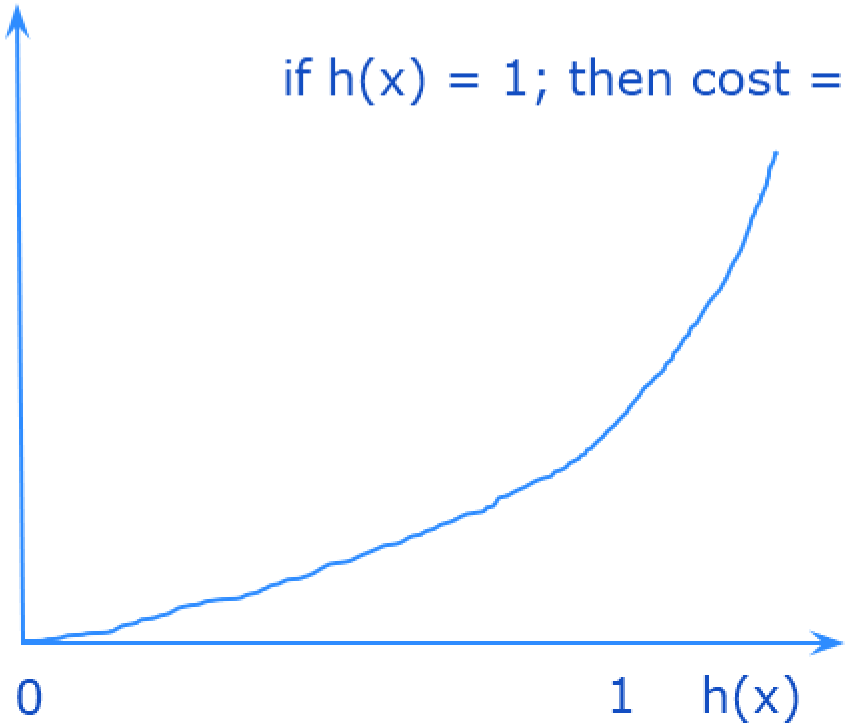

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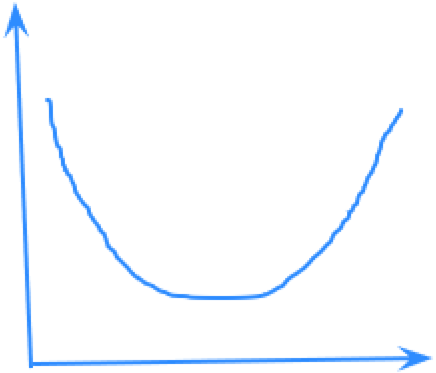

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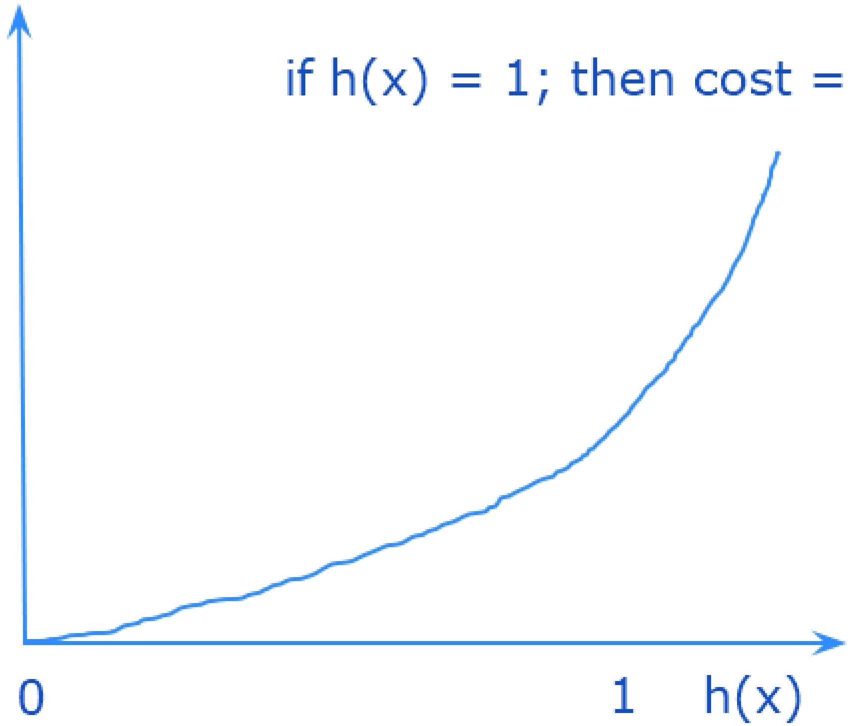

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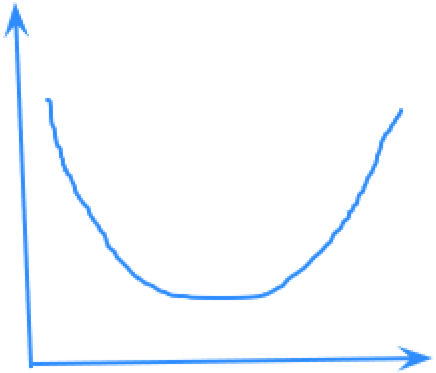

$$\text{cost}(h(x), y) = -y \log(h(x)) - (1-y)\log(1 - h(x))$$

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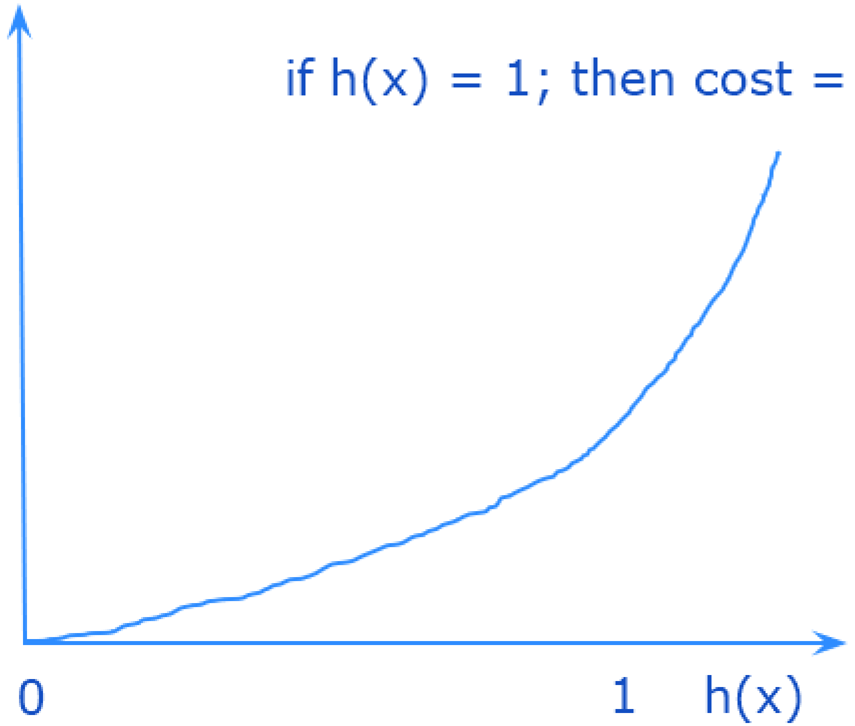

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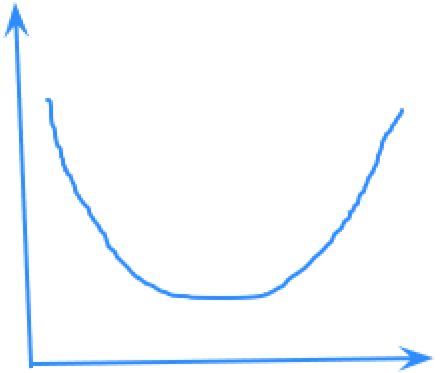

cost (h(x), y) = -y log (h(x)) - (1-y) log (1- h(x))

if y =1; cost(h(x), y) = - log (h(x))
if y = 0; cost (h(x), y) = -log (1-h(x))

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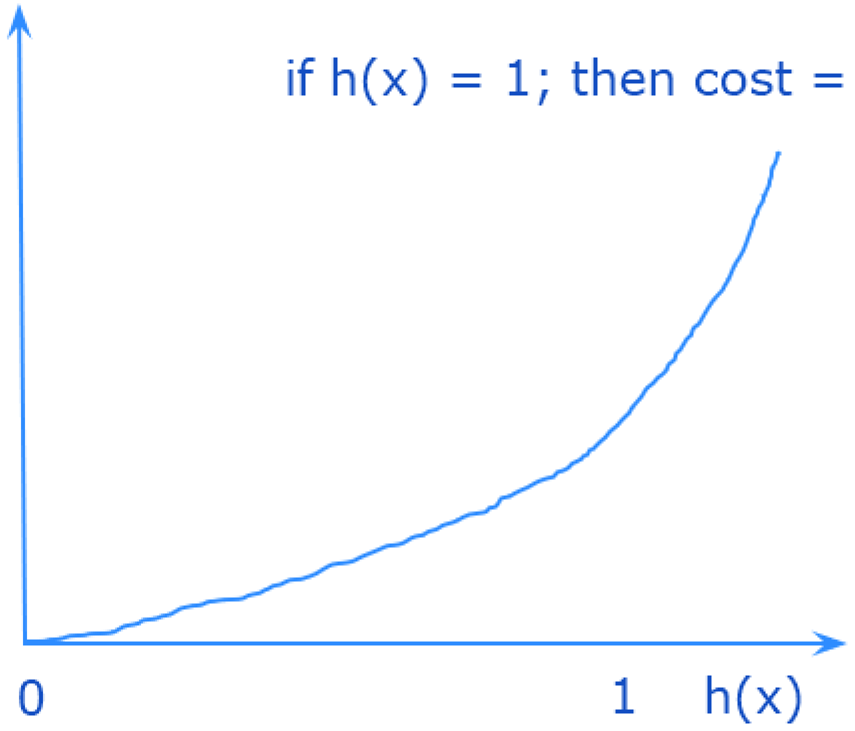

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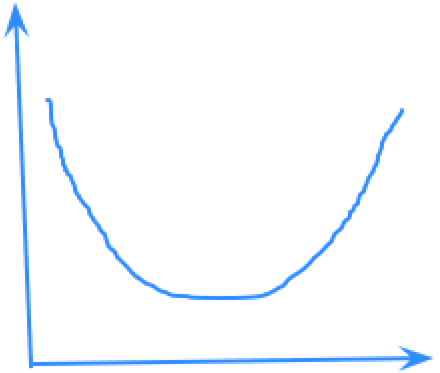

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