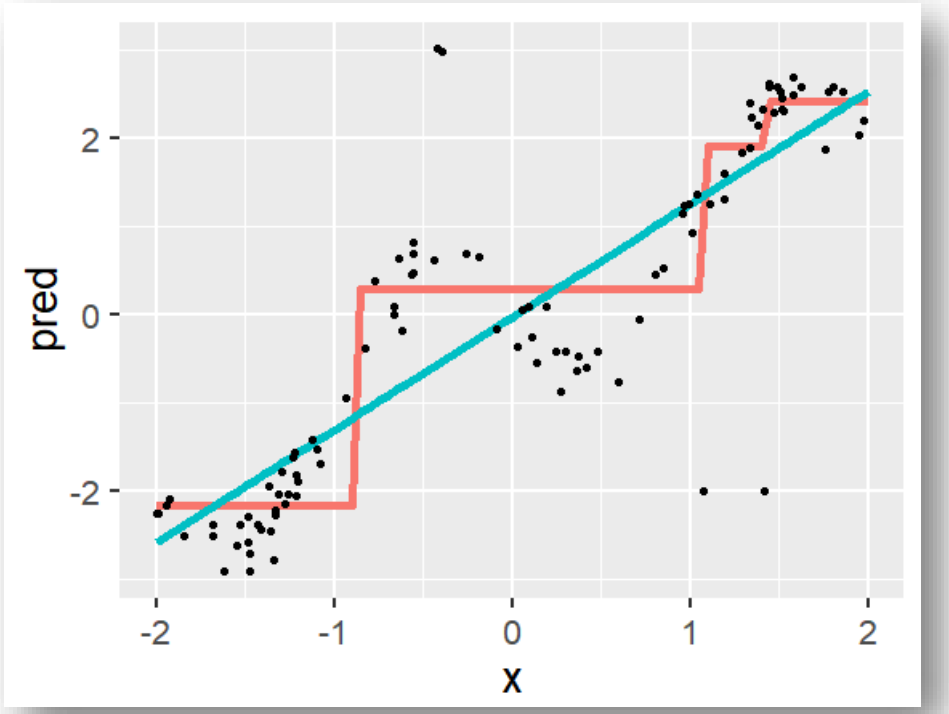
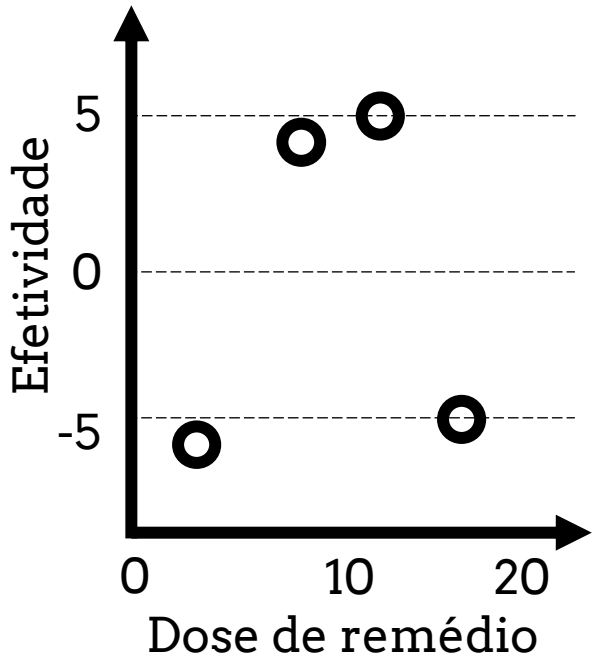


$$Y \approx f(X)$$

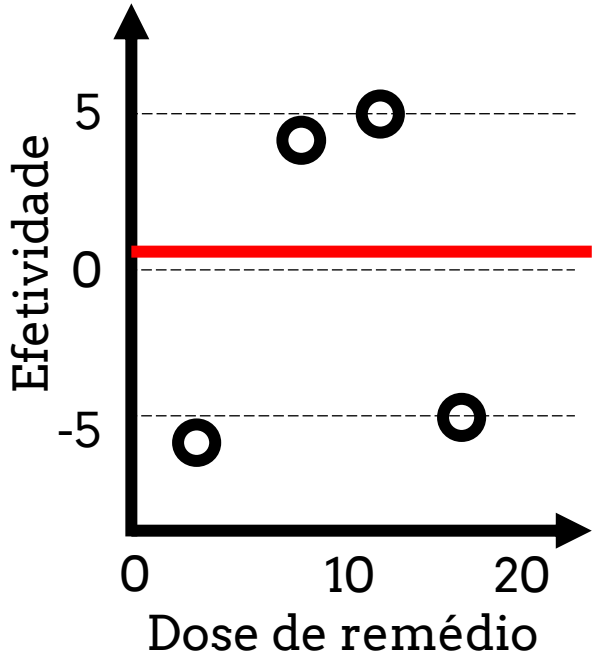
Hiperparam	valor
λ	
γ	
ε	
Tree Depth	
Trees	

f(x) =

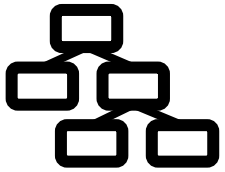


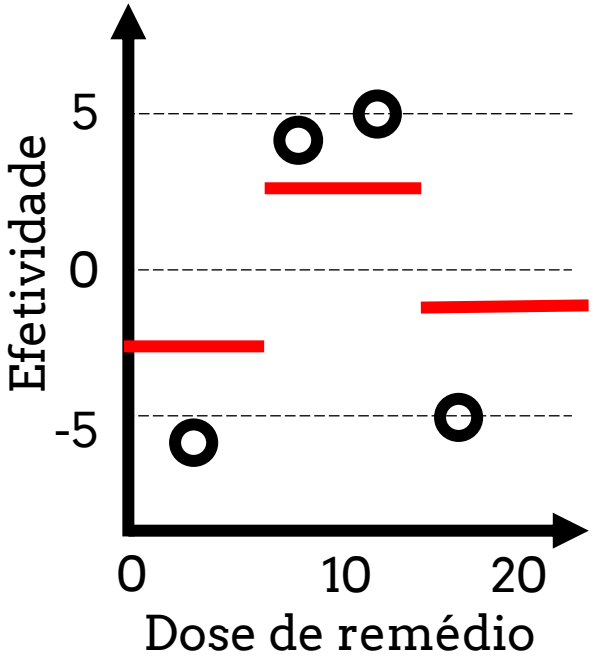
Hiperparam	valor
λ	
γ	
ε	
Tree Depth	
Trees	2

$$f(x) = 0.5$$

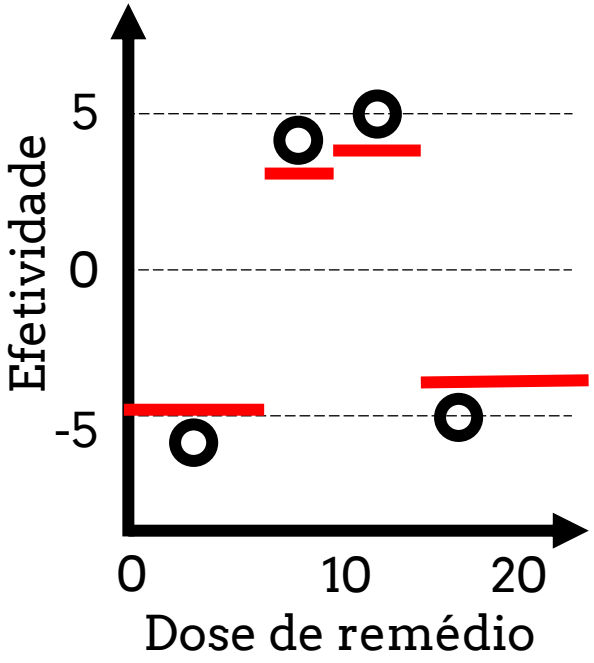


Hiperparam	valor
λ	
γ	
ε	
Tree Depth	
Trees	2

$$f(x) = 0.5 + \varepsilon \times$$ 

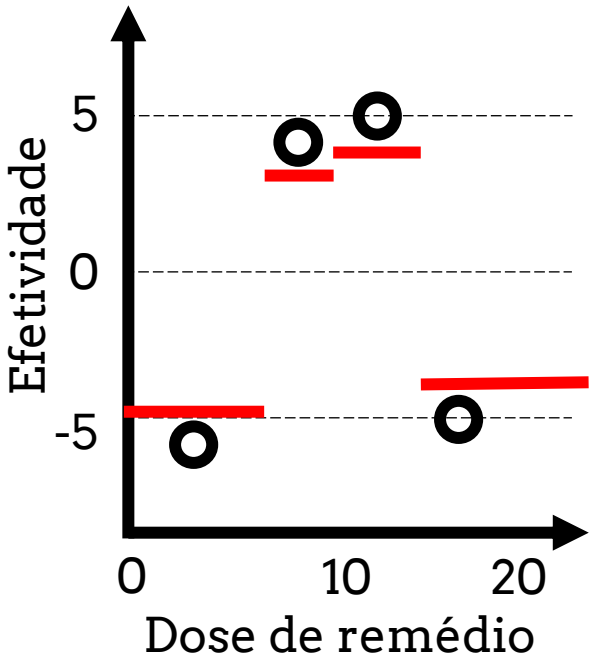


Hiperparam	valor
λ	
γ	
ε	
Tree Depth	
Trees	2



$$f(x) = 0.5 + \varepsilon \times \text{🌳} + \varepsilon \times \text{🌳}$$

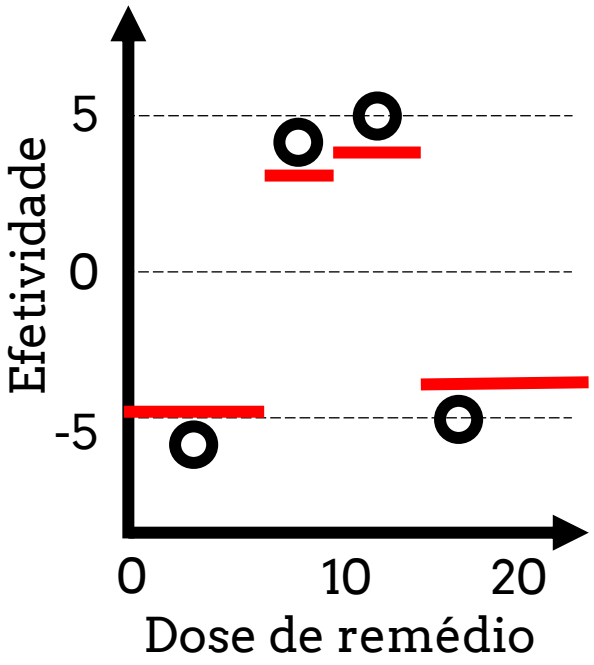
Hiperparam	valor
λ	
γ	
ε	
Tree Depth	
Trees	2



$$f(x) = 0.5 + \varepsilon \times \text{🌳} + \varepsilon \times \text{🌳}$$

"Learning Rate"

Hiperparam	valor
λ	
γ	
ε	0.3
Tree Depth	
Trees	2

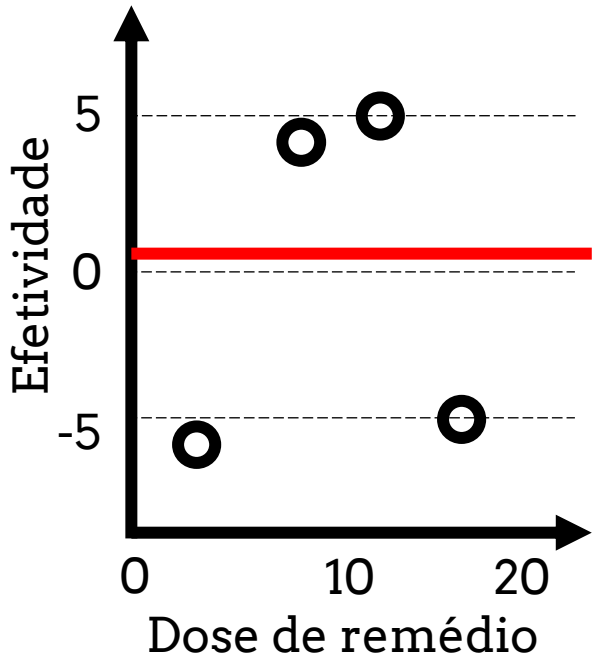


$$f(x) = 0.5 + 0.3 \times \text{tree} + 0.3 \times \text{tree}$$

"Learning Rate"

Hiperparam	valor
λ	
γ	
ε	0.3
Tree Depth	
Trees	2

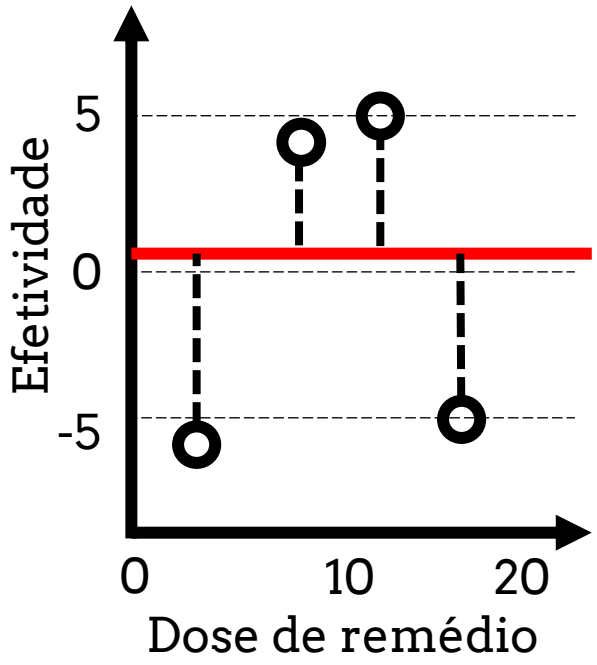
$f(x) = 0.5$



Hiperparam	valor
λ	
γ	
ε	0.3
Tree Depth	
Trees	2

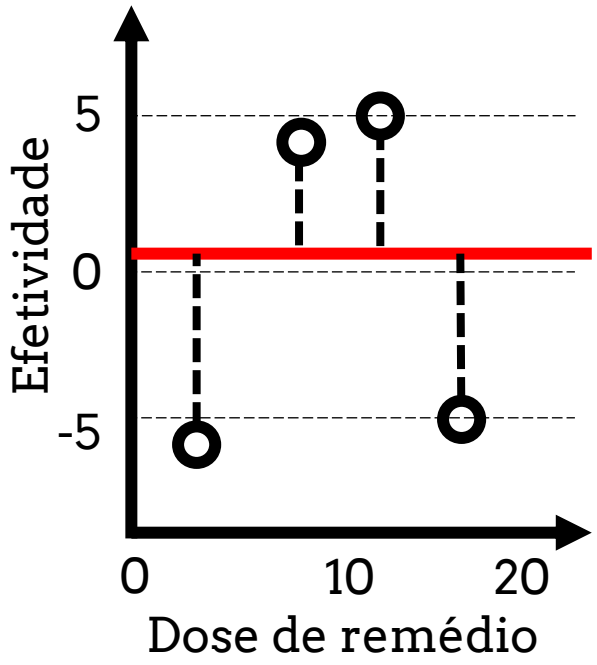
f(x) = 0.5

$$resíduo_i = y_i - f(x_i)$$



Hiperparam	valor
λ	
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$



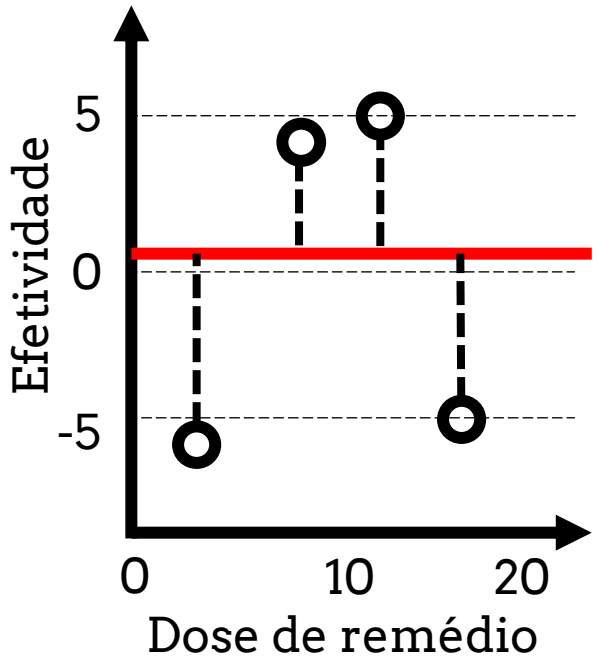
$$resíduo_i = y_i - f(x_i)$$

$$resíduo_1 = -6 - 0.5 = -6.5$$
$$resíduo_2 = 4 - 0.5 = 3.5$$
$$resíduo_3 = 5 - 0.5 = 4.5$$
$$resíduo_4 = -5 - 0.5 = -5.5$$

Hiperparam	valor
λ	
γ	
ε	0.3
Tree Depth	
Trees	2

f(x) = 0.5

-6.5, 3.5, 4.5, -5.5

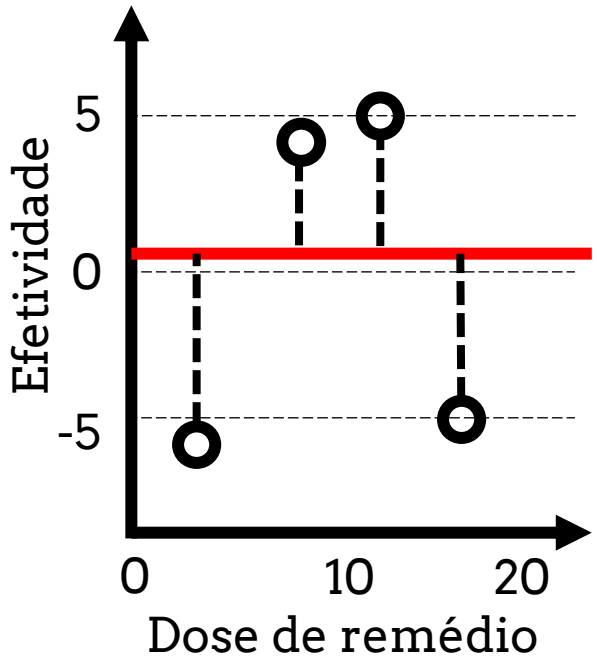


$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$

-6.5, 3.5, 4.5, -5.5



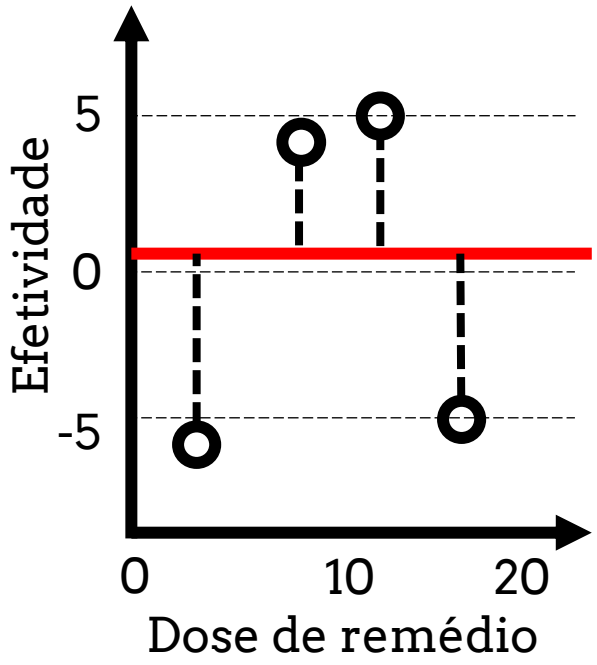
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

"Regularization Parameter"
Ou "loss reduction"

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$

-6.5, 3.5, 4.5, -5.5



$$Similaridade = \frac{}{}$$

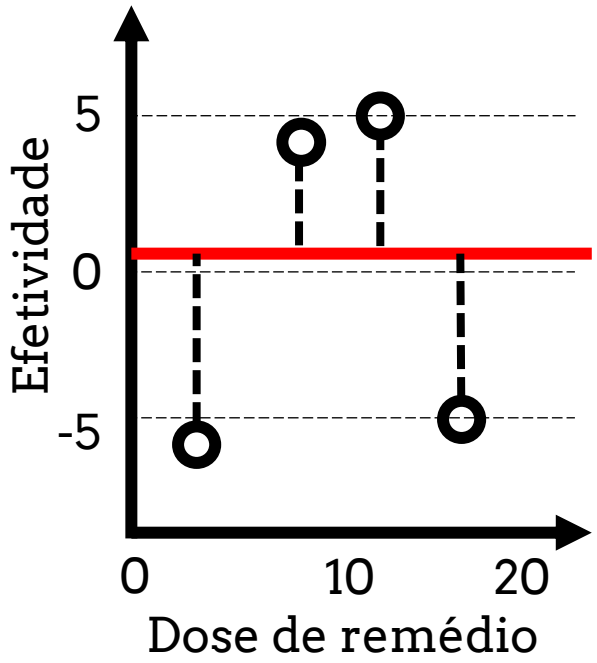
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

f(x) = 0.5

$Similaridade = 4$

-6.5, 3.5, 4.5, -5.5



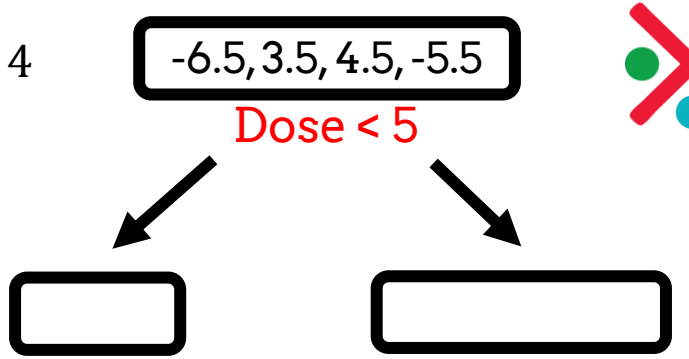
Hora da primeira árvore

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

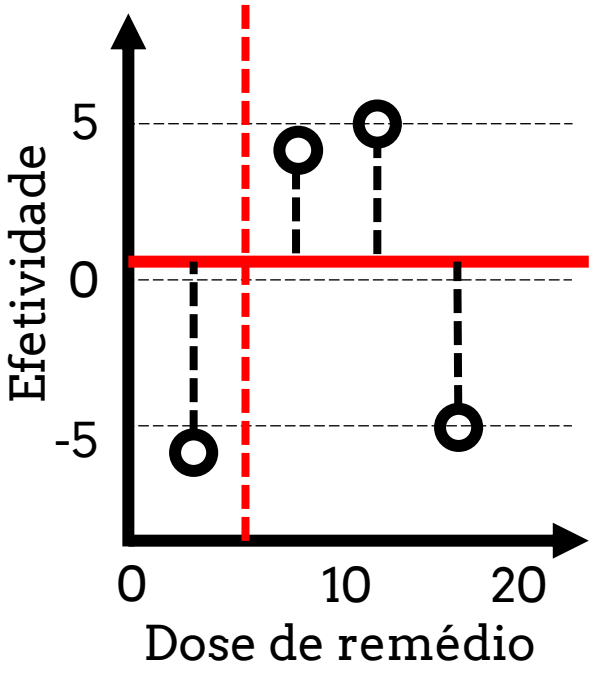
$f(x) = 0.5$

$Similaridade = 4$



$Similaridade_{esq} = \text{————————} =$

$Similaridade_{dir} = \text{————————} =$

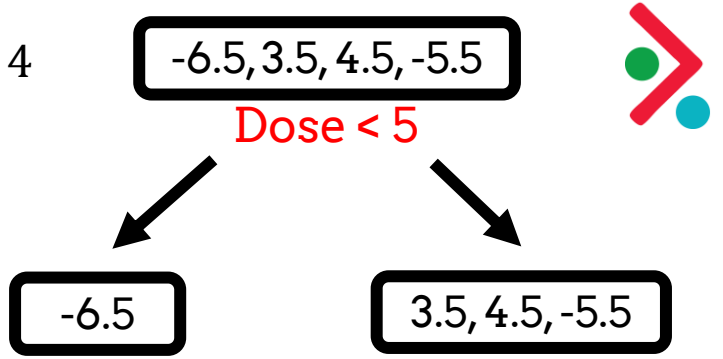


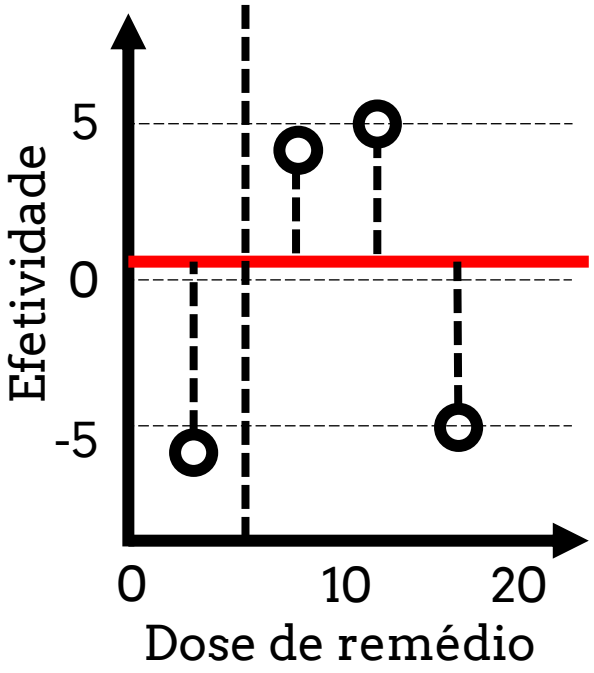
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$

$Similaridade = 4$





$$Similaridade_{esq} = \frac{(-6.5)^2}{1+0} = 42.25$$

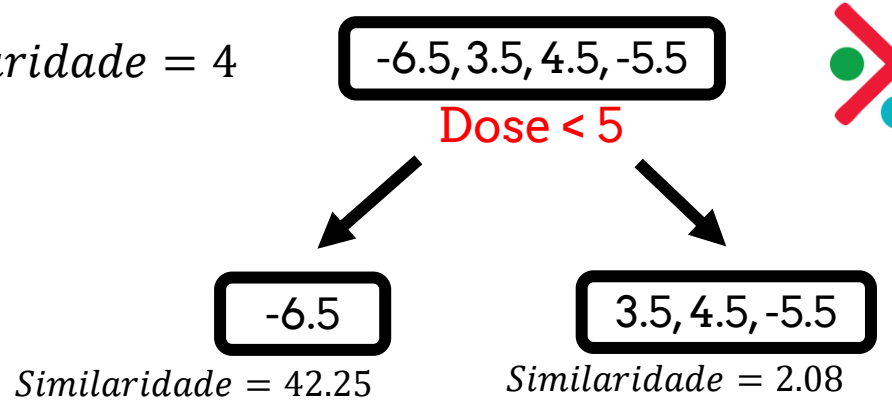
$$Similaridade_{dir} = \frac{(3.5 + 4.5 - 5.5)^2}{3+0} = 2.08$$

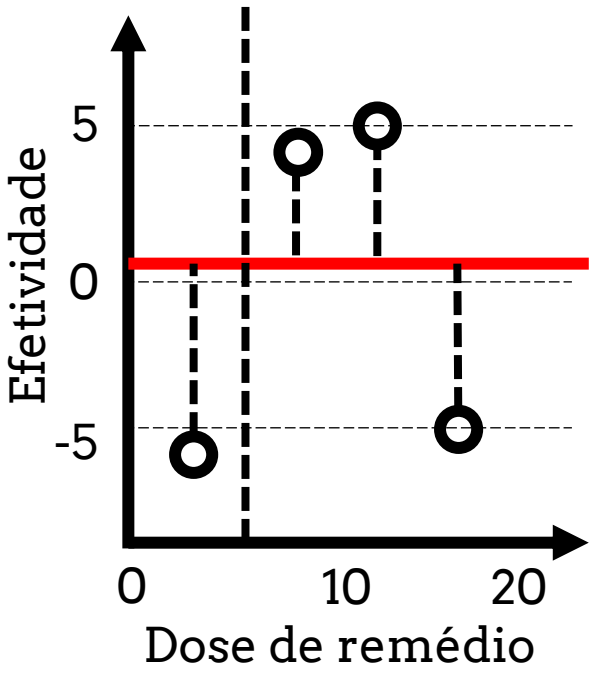
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$

$Similaridade = 4$





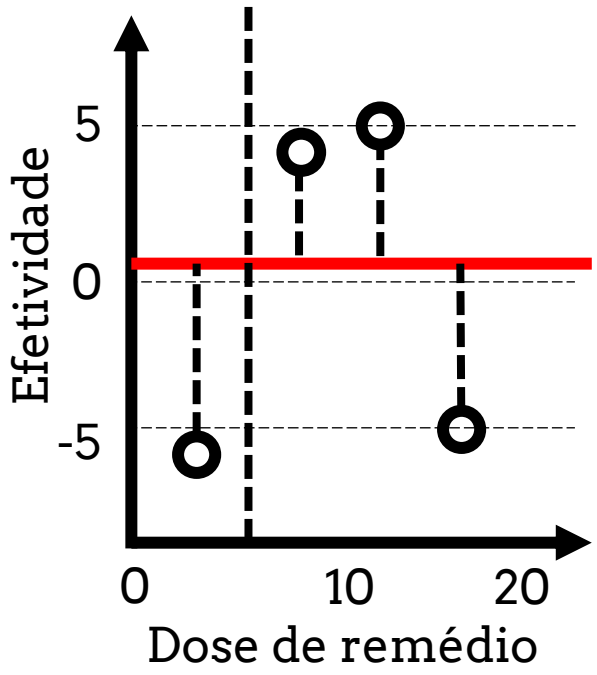
$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3

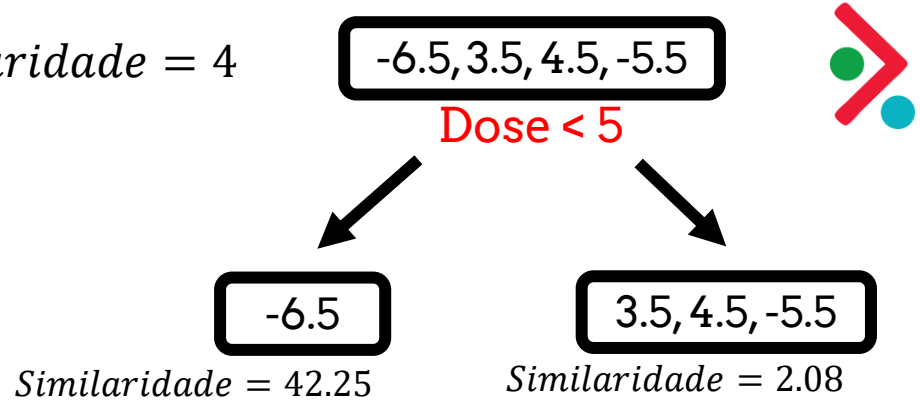
Tree Depth

Trees 2



$f(x) = 0.5$

$Similaridade = 4$



$$Gain =$$

Pergunta	Gain
Dose < 5	

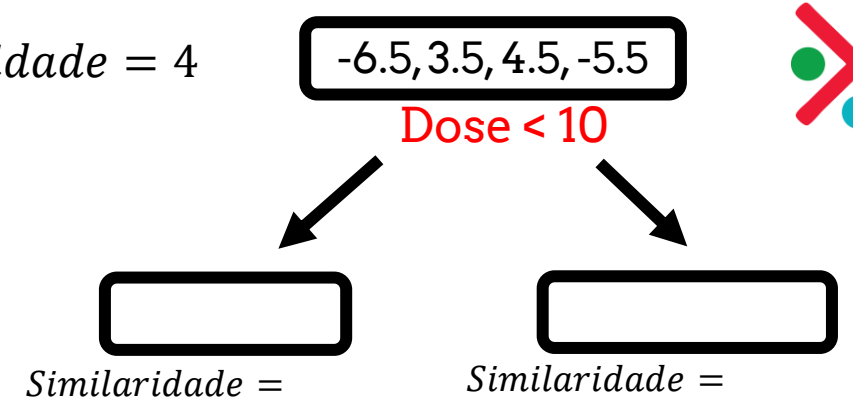
$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

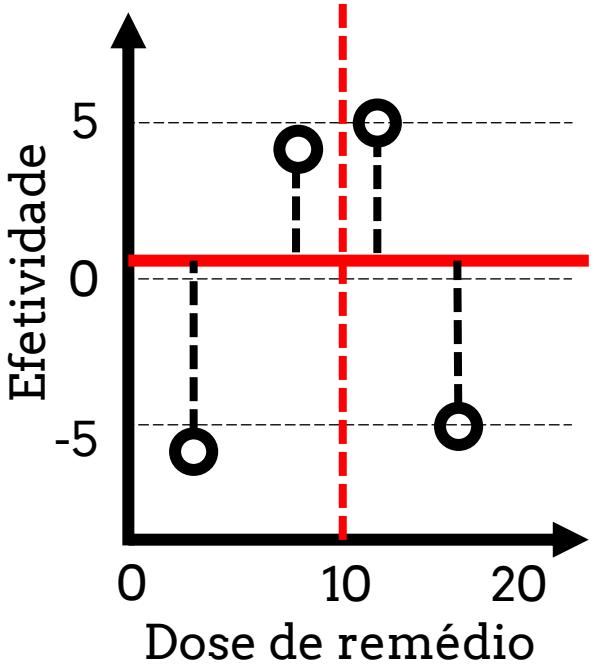
$f(x) = 0.5$

$Similaridade = 4$



$Similaridade_{esq} = \text{————————} =$

$Similaridade_{dir} = \text{————————} =$



Pergunta	Gain
Dose < 5	40.33
Dose < 10	

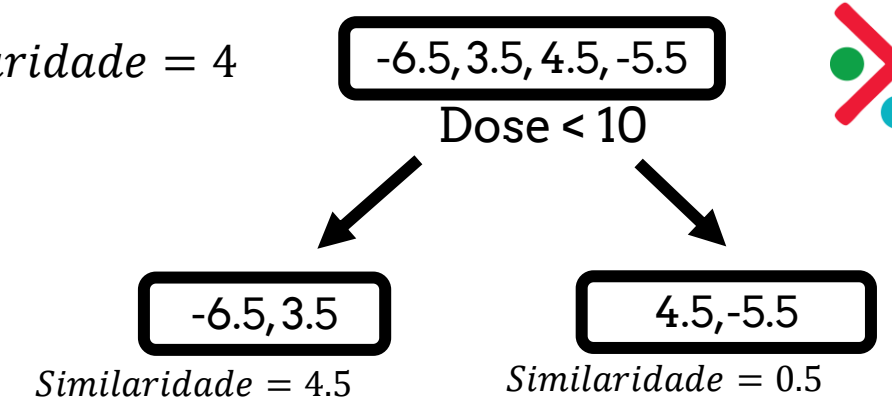
$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

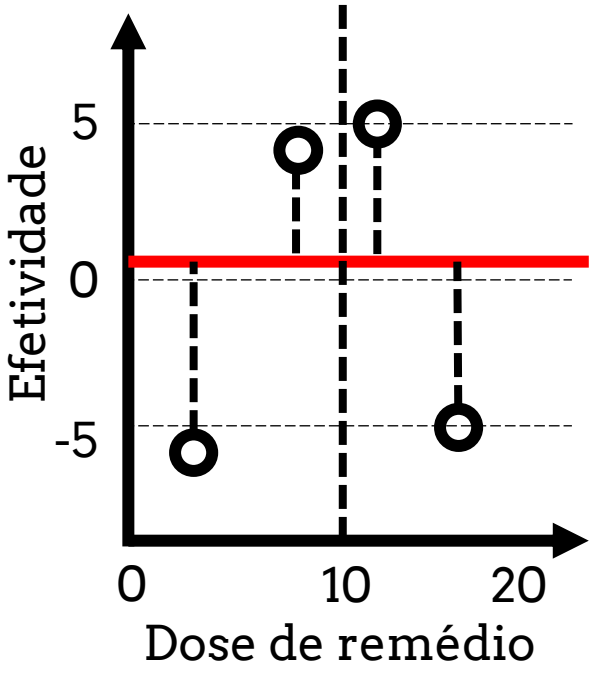
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$

$Similaridade = 4$





$$Similaridade_{esq} = \frac{(-6.5 + 3.5)^2}{2 + 0} = 4.5$$

$$Similaridade_{dir} = \frac{(4.5 - 5.5)^2}{2 + 0} = 0.5$$

Pergunta	Gain
Dose < 5	40.33
Dose < 10	

$$Gain =$$

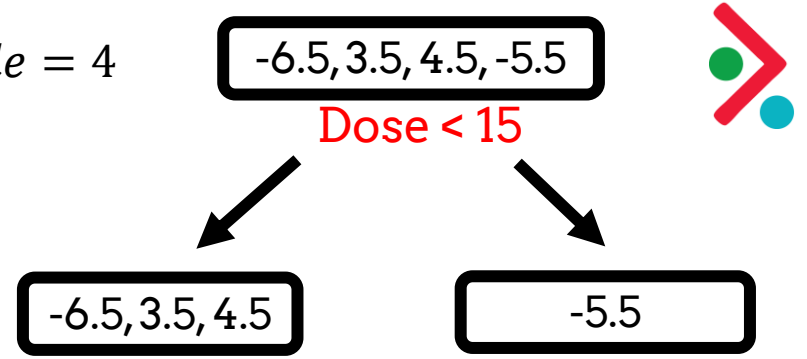
$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

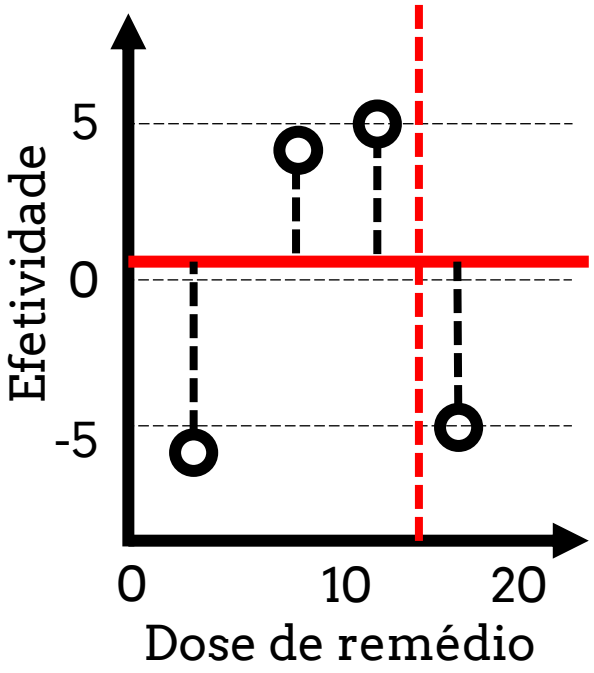
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$

$Similaridade = 4$





Pergunta	Gain
Dose < 5	40.33
Dose < 10	1
Dose < 15	

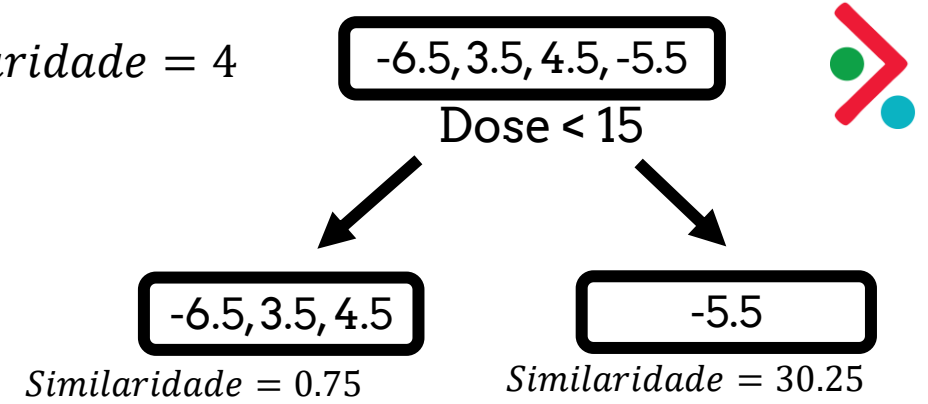
$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

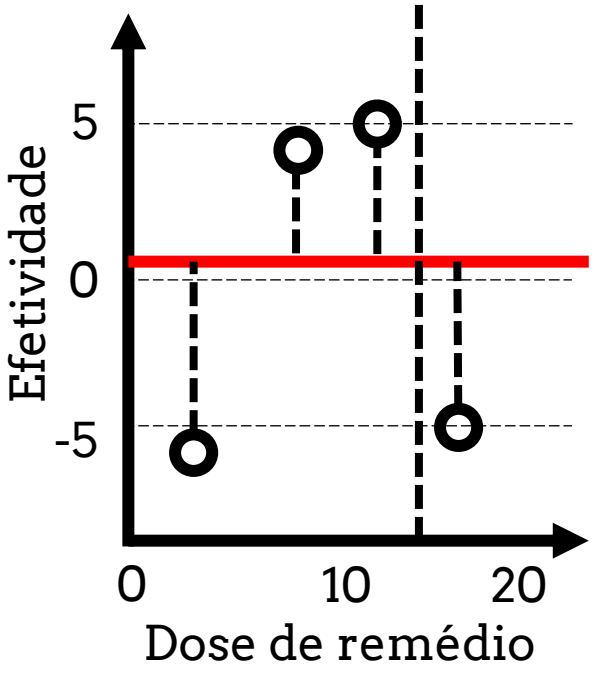
$f(x) = 0.5$

$Similaridade = 4$



$$Similaridade_{esq} = \frac{(-6.5 + 3.5 + 4.5)^2}{3 + 0} = 0.75$$

$$Similaridade_{dir} = \frac{(-5.5)^2}{1 + 0} = 30.25$$



Pergunta	Gain
Dose < 5	40.33
Dose < 10	1
Dose < 15	27

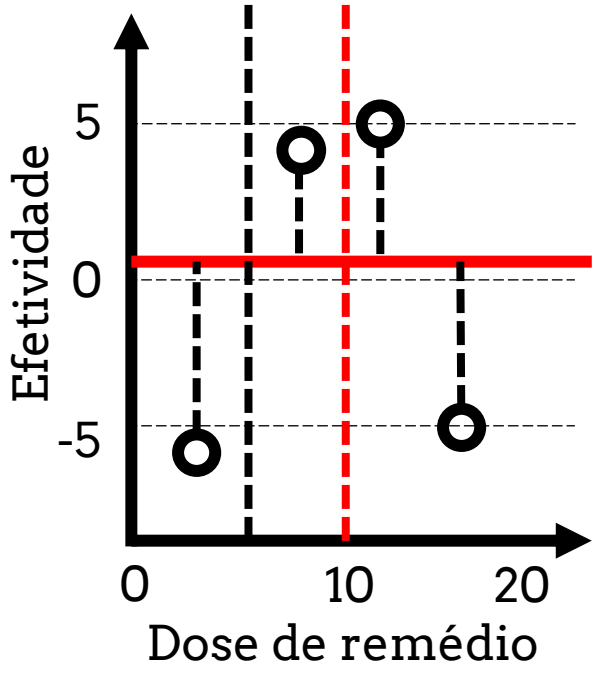
$$Gain = 30.25 + 0.75 - 4 = 27$$

$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$

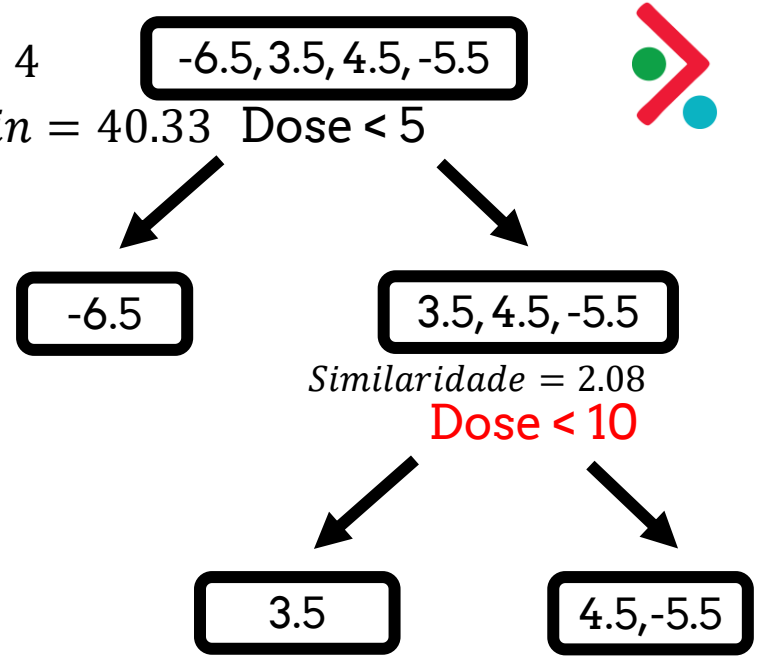


$$Similaridade_{esq} = \frac{(3.5)^2}{1+0} = 12.25$$

$$Similaridade_{dir} = \frac{(4.5-5.5)^2}{2+0} = 0.5$$

Pergunta	Gain
Dose < 10	10.67
Dose < 15	

$Similaridade = 4$



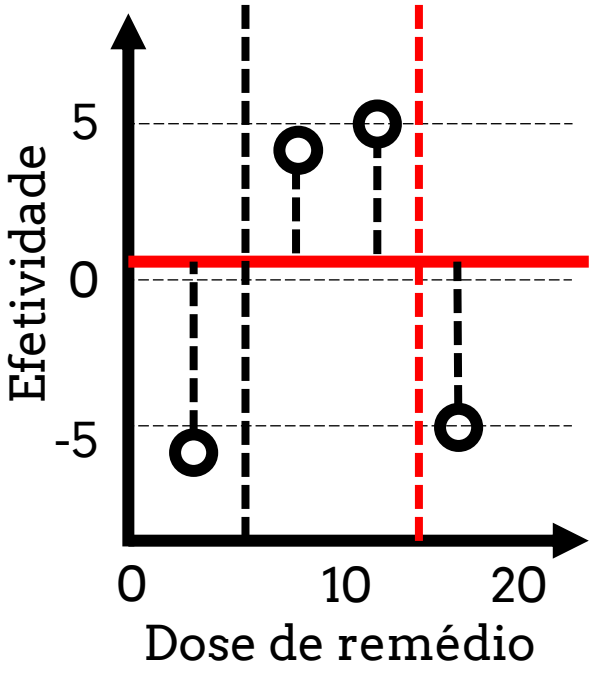
$$Gain = 12.25 + 0.5 - 2.08 = 10.67$$

$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	
Trees	2

$f(x) = 0.5$



$$Similaridade_{esq} = \frac{(+3.5 + 4.5)^2}{2 + 0} = 32$$

$$Similaridade_{dir} = \frac{(-5.5)^2}{1 + 0} = 30.25$$

Pergunta	Gain
Dose < 10	10.67
Dose < 15	60.17

$Similaridade = 4$ -6.5, 3.5, 4.5, -5.5

$Gain = 40.33$ Dose < 5

-6.5

3.5, 4.5, -5.5

$Similaridade = 2.08$

Dose < 15

3.5, 4.5

-5.5

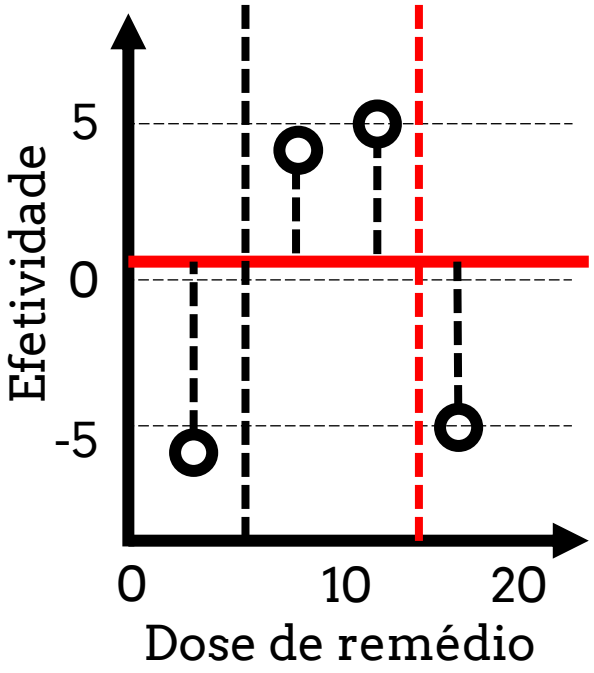
$$Gain = 30.25 + 32 - 2.08 = 60.17$$

$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$

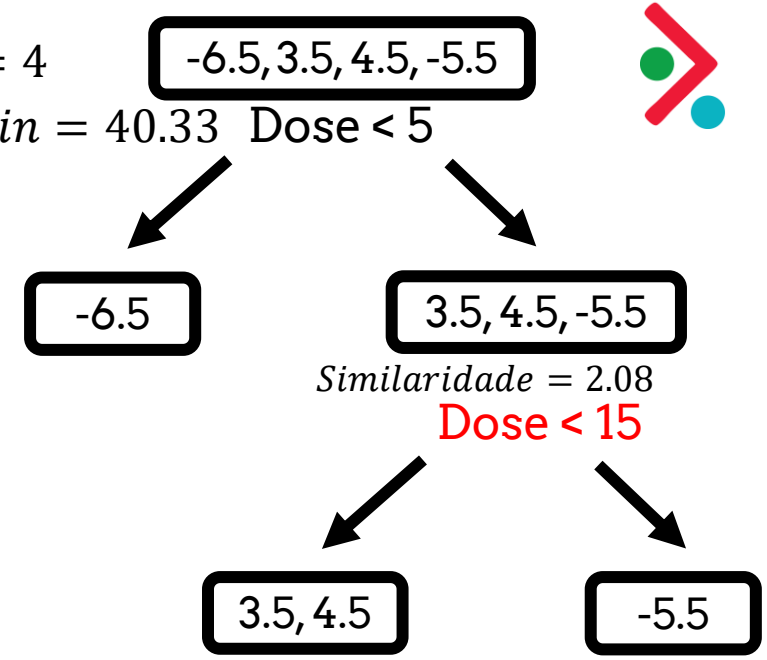


$$Similaridade_{esq} = \frac{(+3.5 + 4.5)^2}{2 + 0} = 32$$

$$Similaridade_{dir} = \frac{(-5.5)^2}{1 + 0} = 30.25$$

Pergunta	Gain
Dose < 10	10.67
Dose < 15	60.17

$Similaridade = 4$



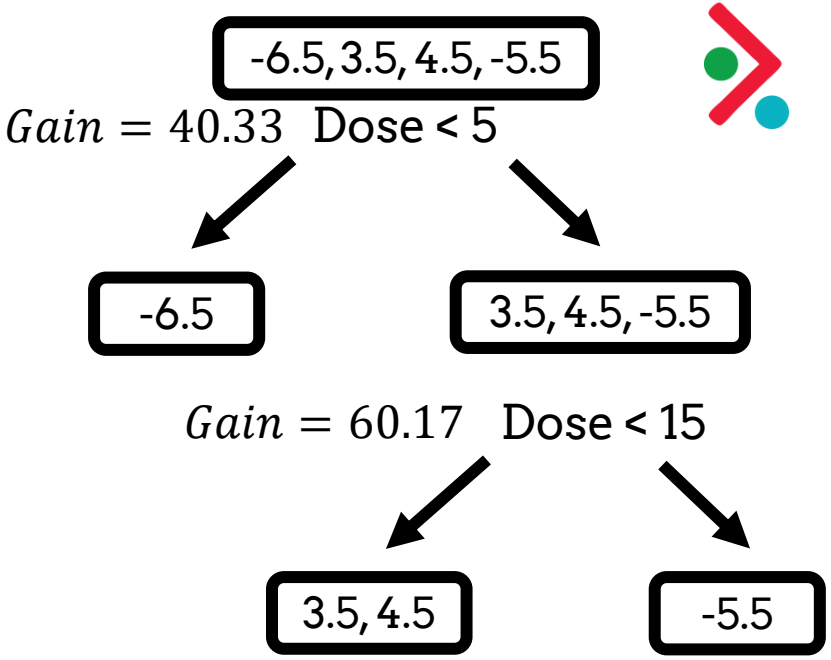
$$Gain = 30.25 + 32 - 2.08 = 60.17$$

$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

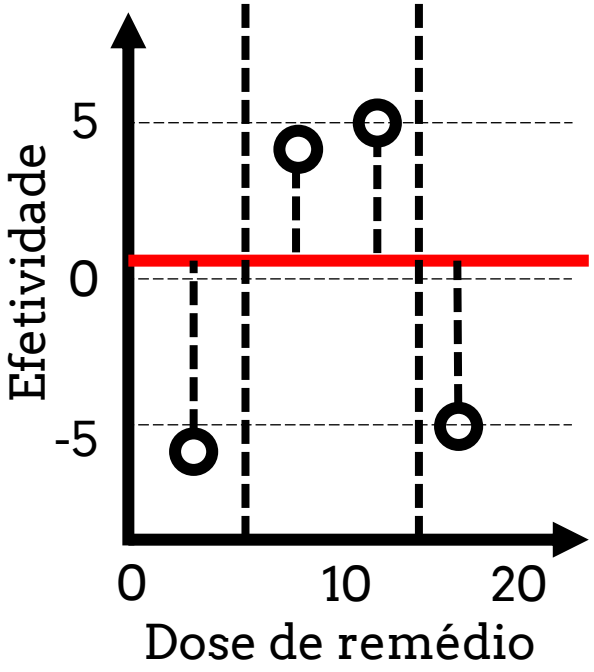
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$

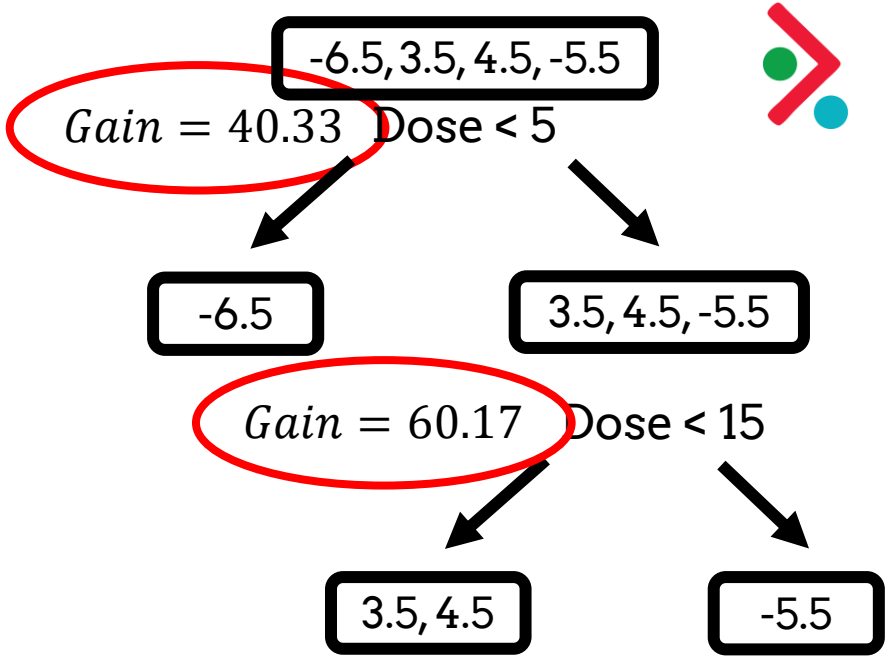


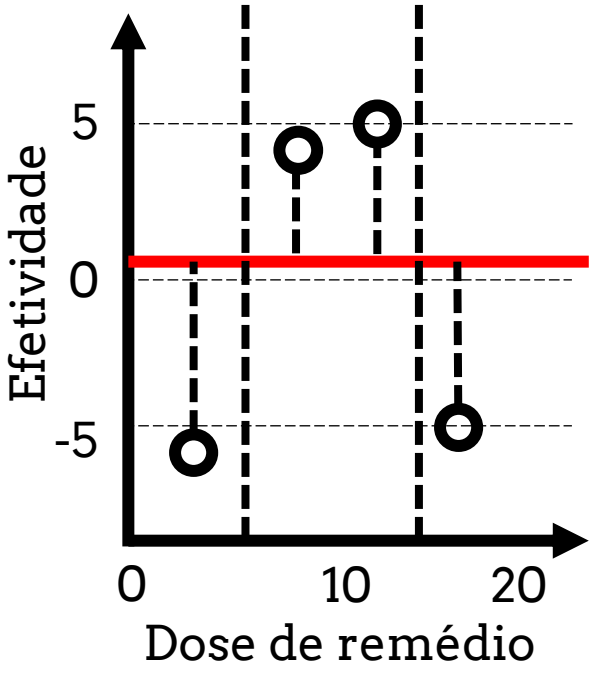
Hora da poda



Hiperparam	valor
λ	0
γ	
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$





Hora da poda

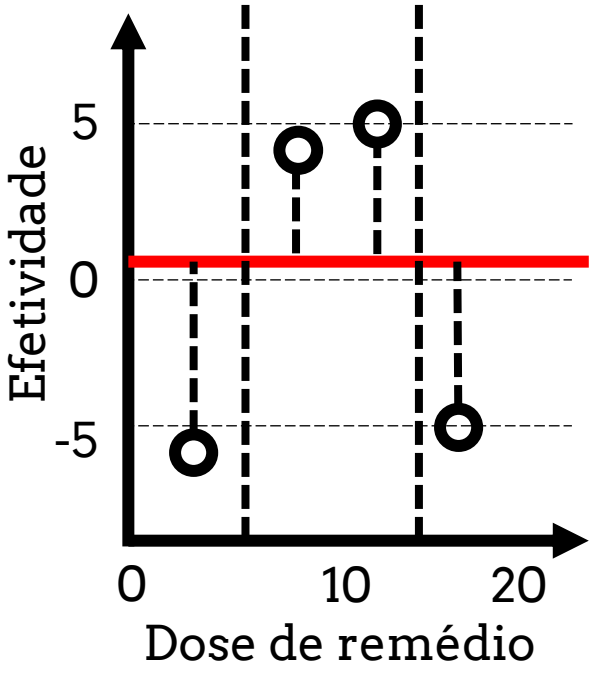
XGBoost usa o Gain para fazer a poda das árvores.

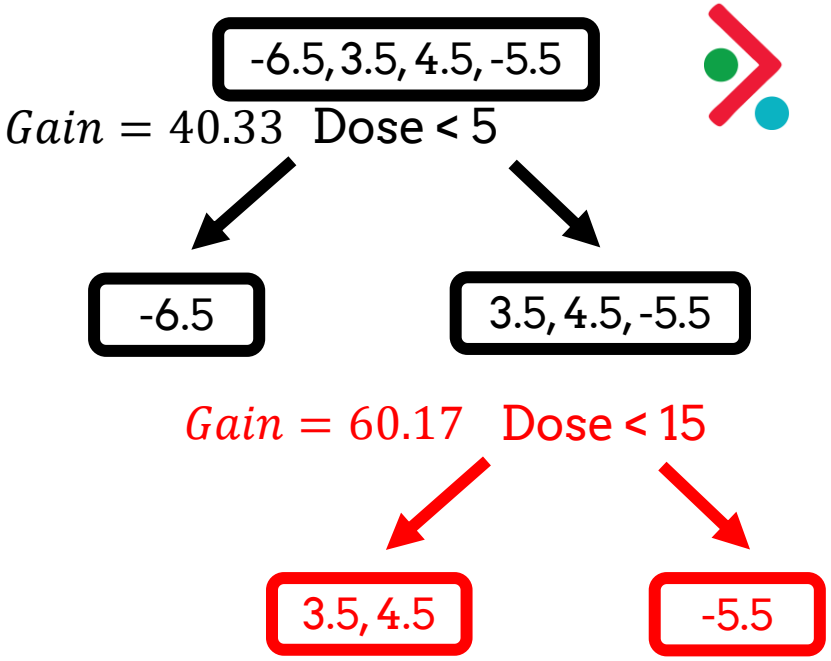
γ

"gamma": nota de corte para o Gain.
Se gain – γ for positivo, então não poda!

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

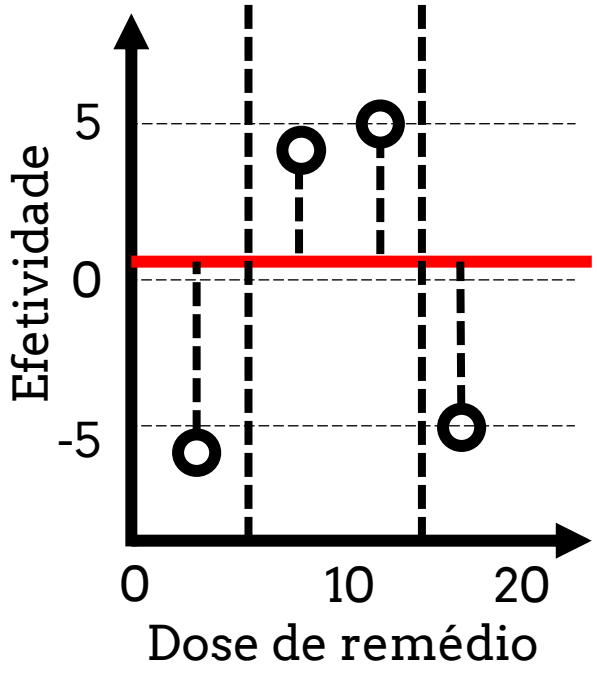
$f(x) = 0.5$



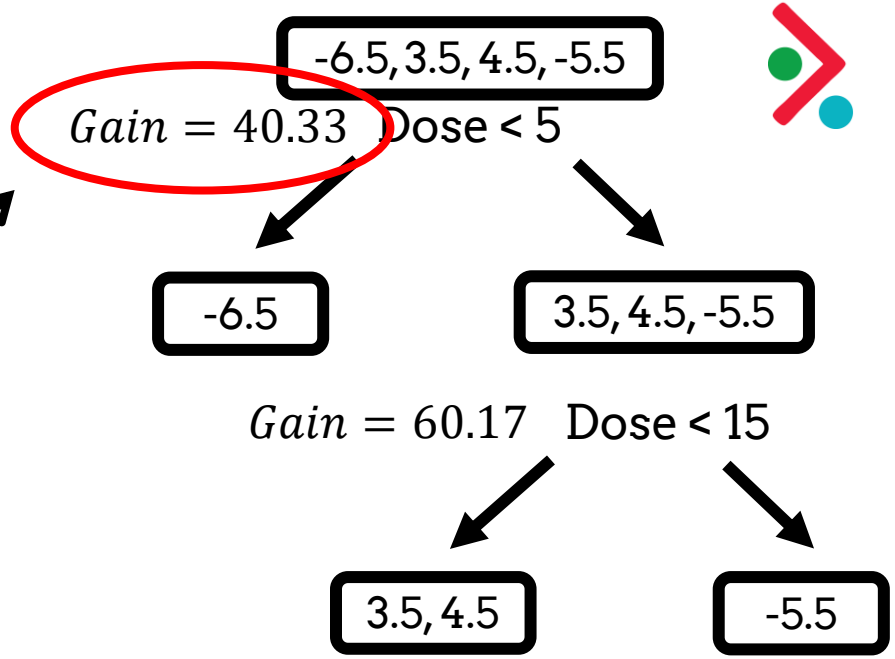


Se gain – γ for positivo,
então não poda!

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



$f(x) = 0.5$

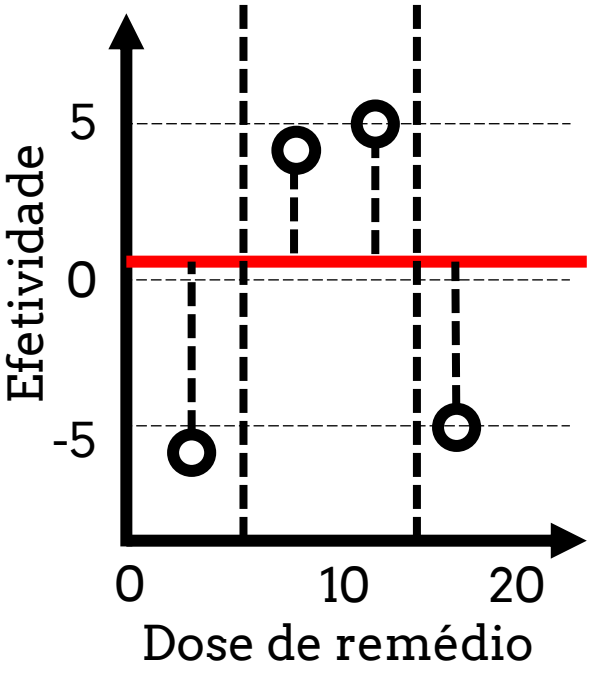


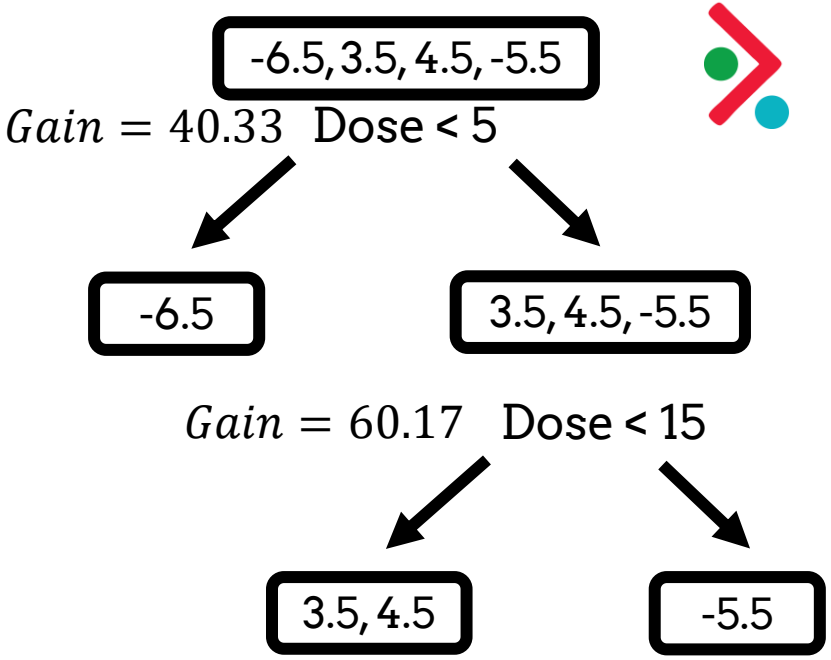
OBSERVAÇÃO: o gain do primeiro nó é menor que 50, indicando para podar. Porém o ramo filho não foi podado, por isso não podamos o pai também.

Se gain – γ for positivo, então não poda!

Hiperparam	valor
λ	0
γ	70
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$

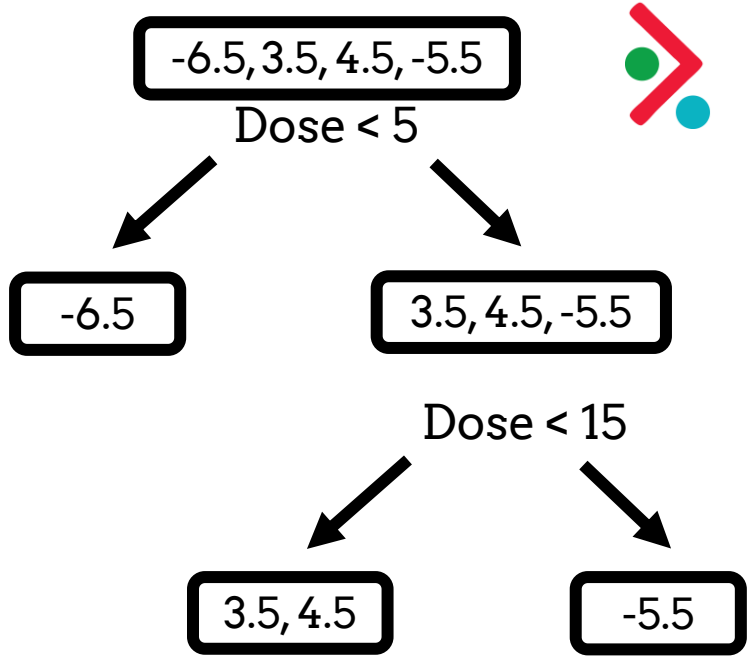


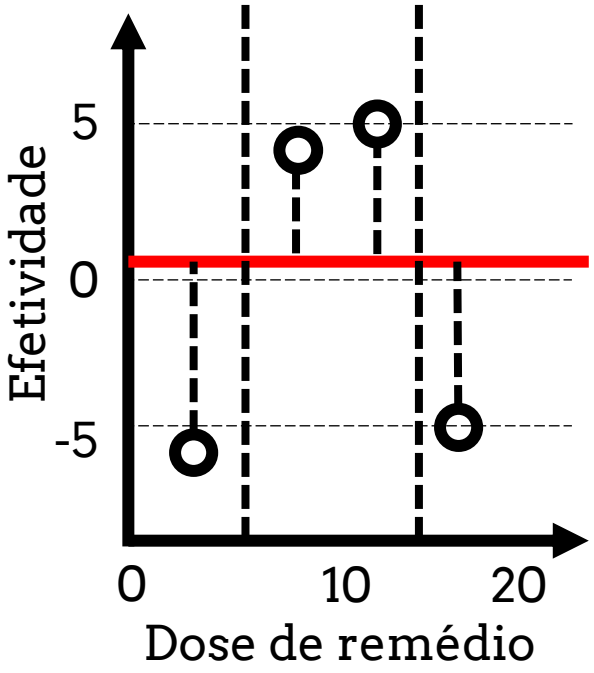


Se gain – γ for positivo,
então não poda!

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$

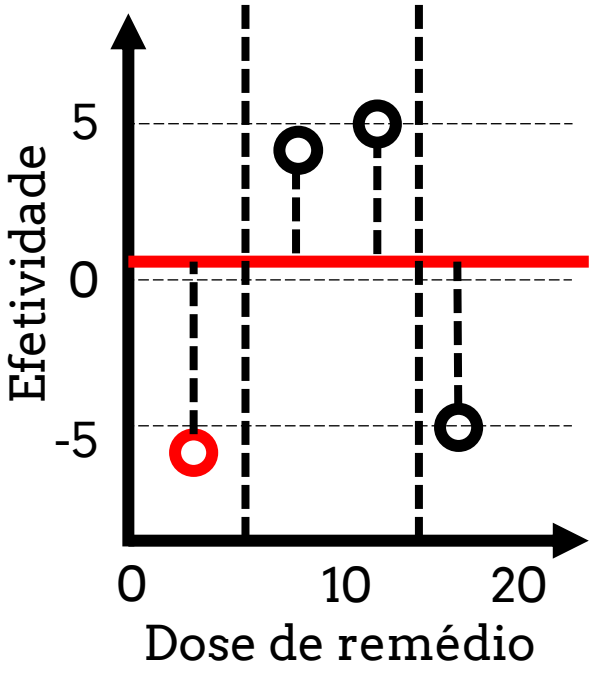




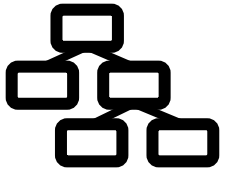
Hora das predições

Ou “escoragem”

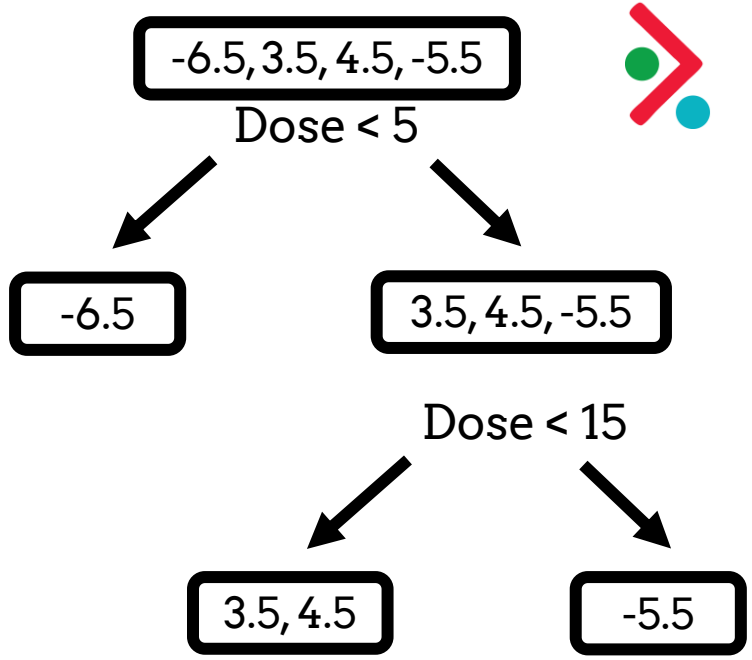
Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



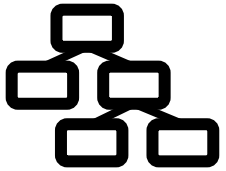
$$f(x) = 0.5 + 0.3 \times$$

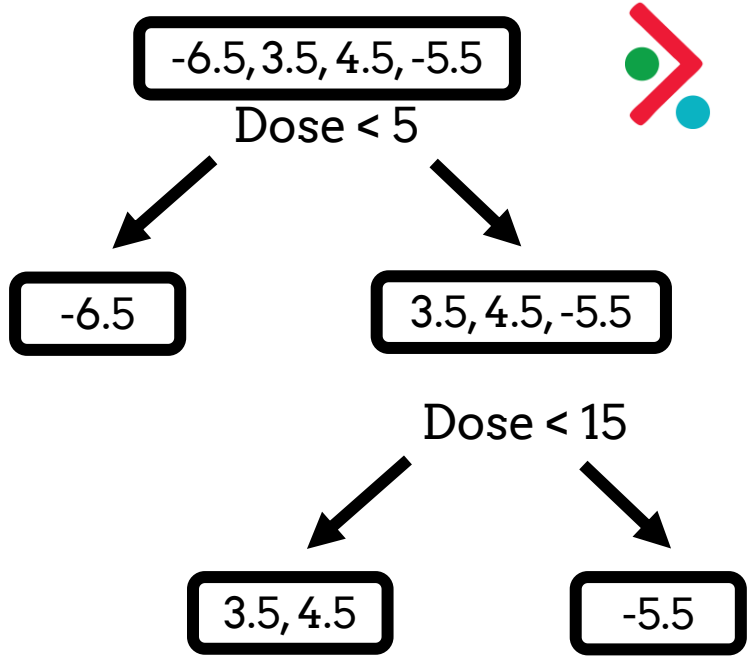


$f(x_1)$

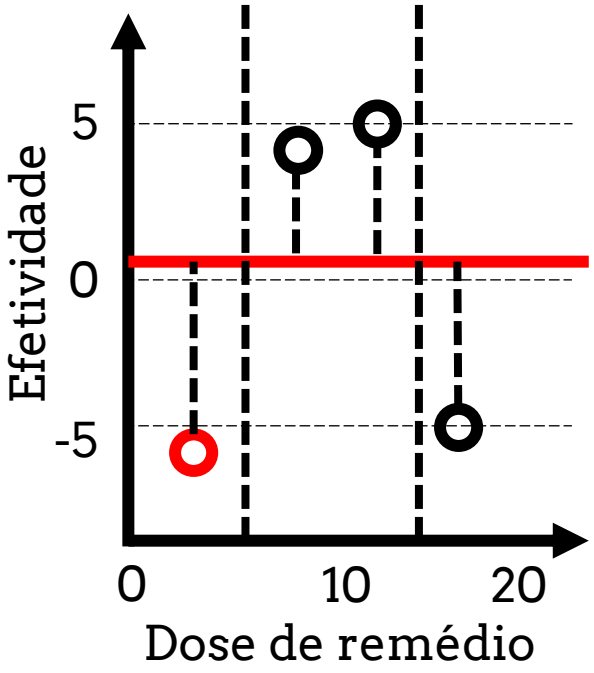


Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

$$f(x) = 0.5 + 0.3 \times$$ 

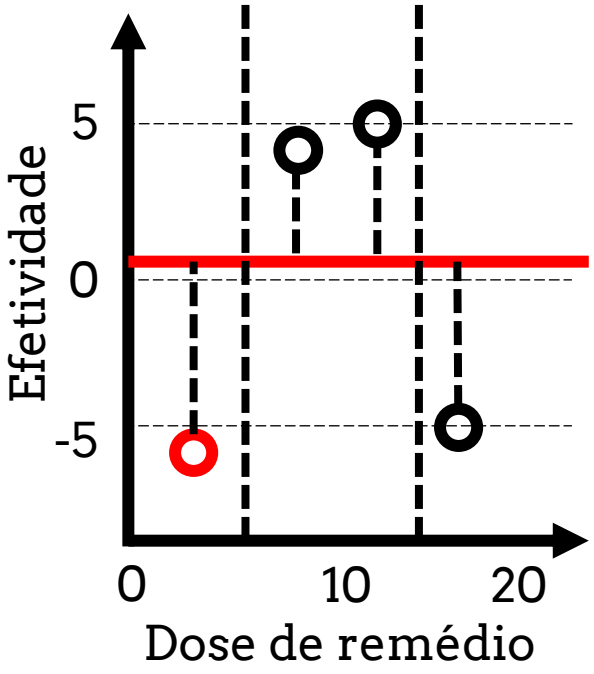


$$f(2) = 0.5 + 0.3 \times$$

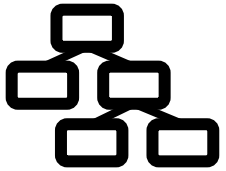


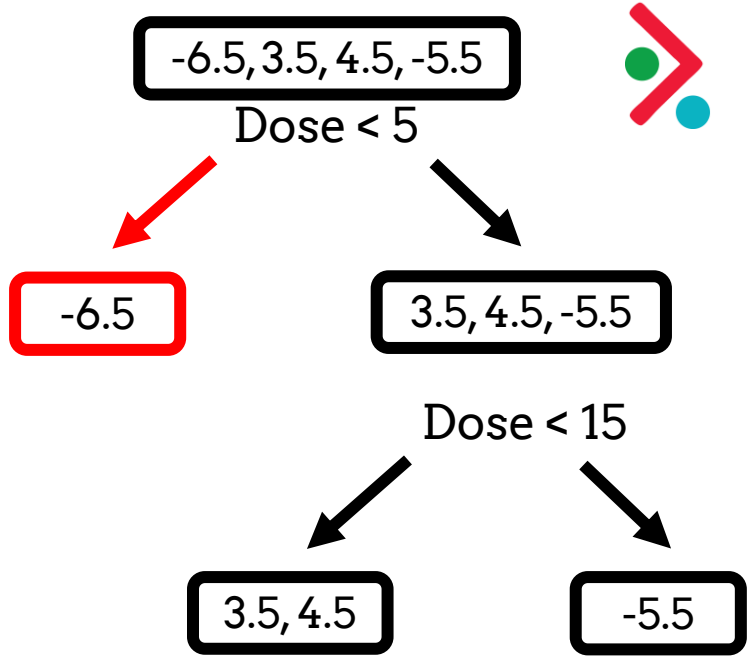
$$predição = \frac{\sum resíduos}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



$$f(x) = 0.5 + 0.3 \times$$



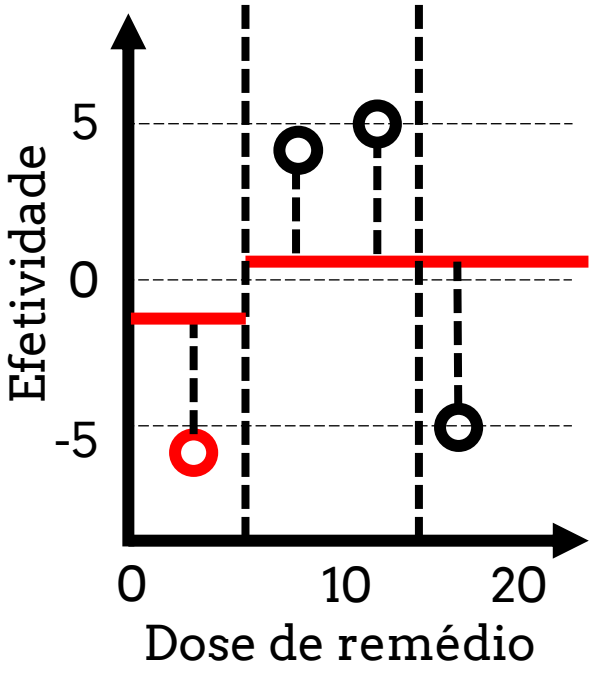


$$f(2) = 0.5 + 0.3 \times -6.5$$

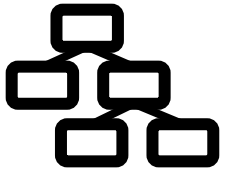
$$predição = \frac{-6.5}{1+0} = -6.5$$

$$predição = \frac{\sum resíduos}{\#resíduos + \lambda}$$

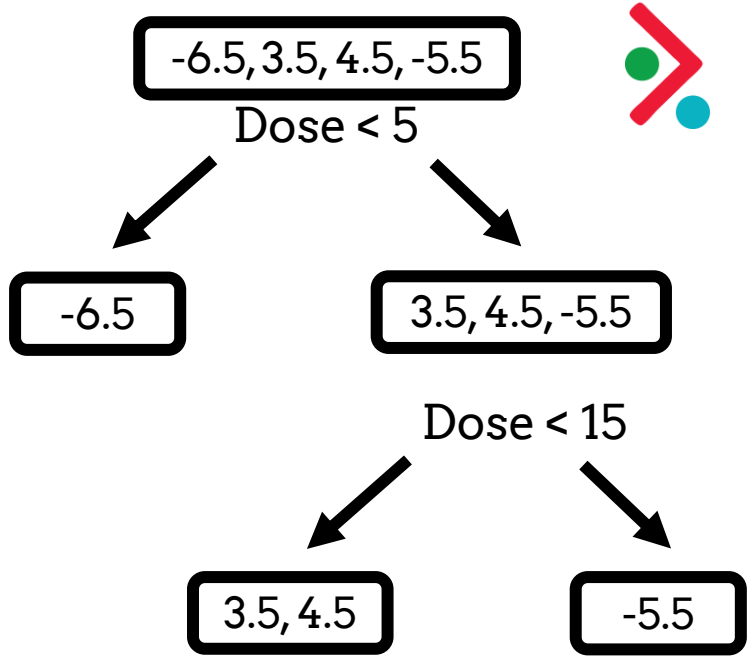
Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



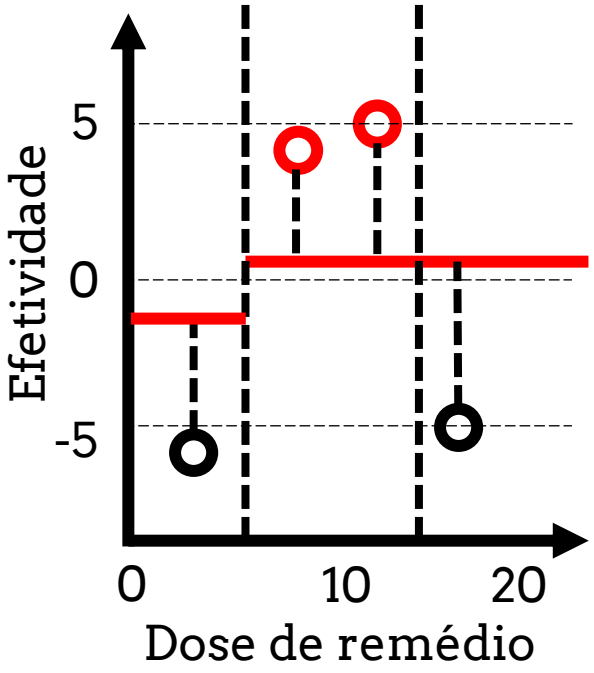
$$f(x) = 0.5 + 0.3 \times$$



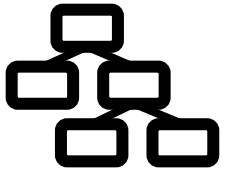
$$f(2) = 0.5 + 0.3 \times -6.5 = -1.56$$



Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



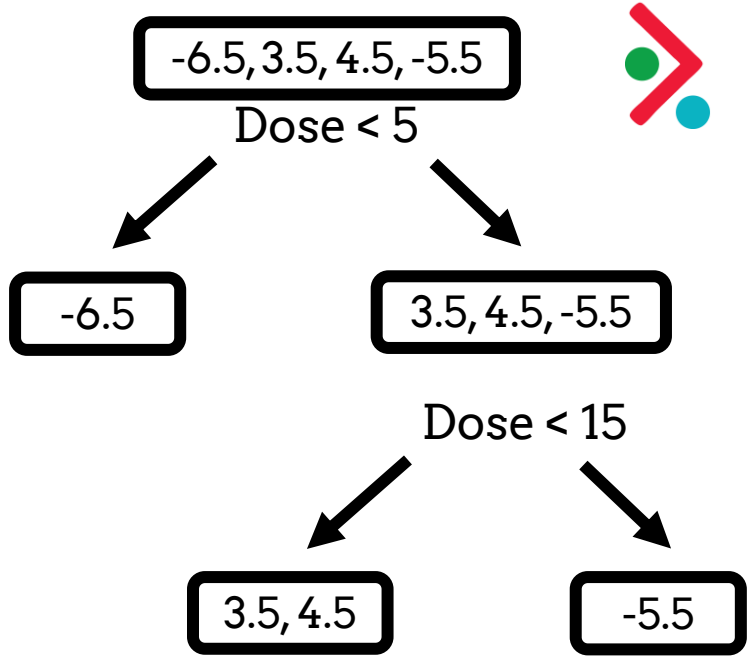
$$f(x) = 0.5 + 0.3 \times$$



$f(2) = 0.5 + 0.3 \times -6.5 = -1.56$

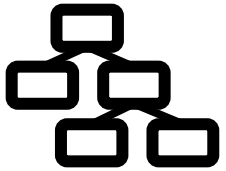
$f(x_2) = 0.5 + 0.3 \times$

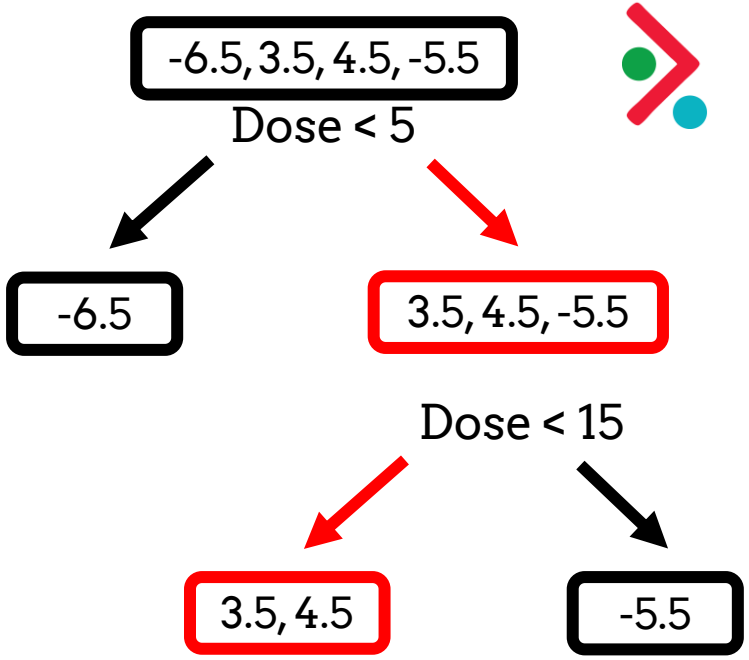
$f(x_3) = 0.5 + 0.3 \times$



Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

$$f(x) = 0.5 + 0.3 \times$$

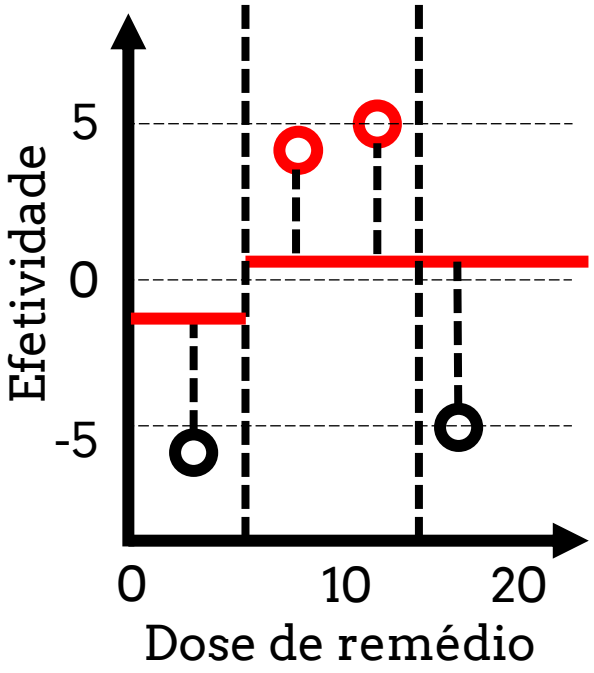




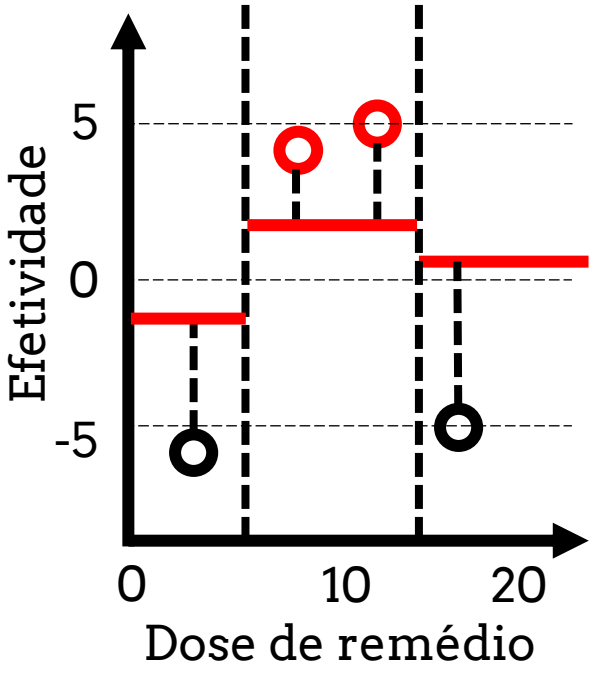
$f(2) = 0.5 + 0.3 \times -6.5 = -1.56$

$f(8) = 0.5 + 0.3 \times$

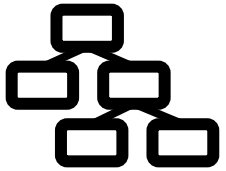
$f(12) = 0.5 + 0.3 \times$

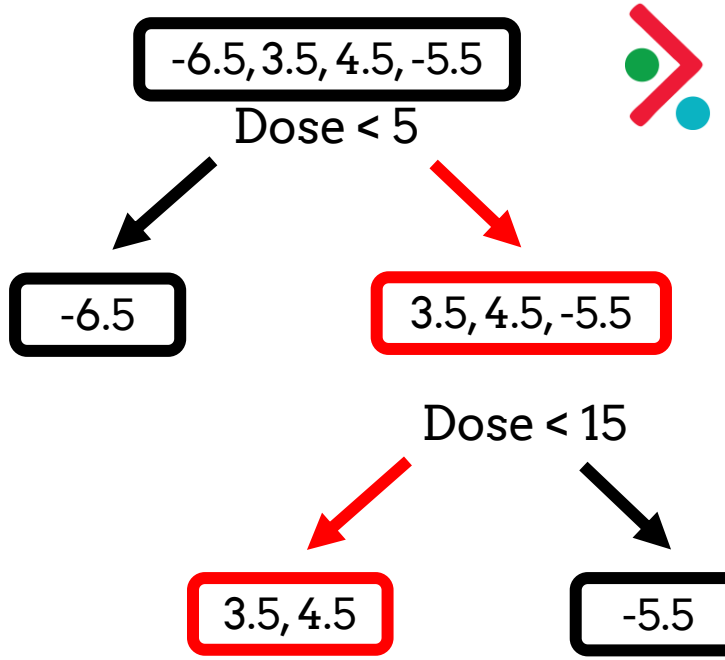


Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



$$f(x) = 0.5 + 0.3 \times$$

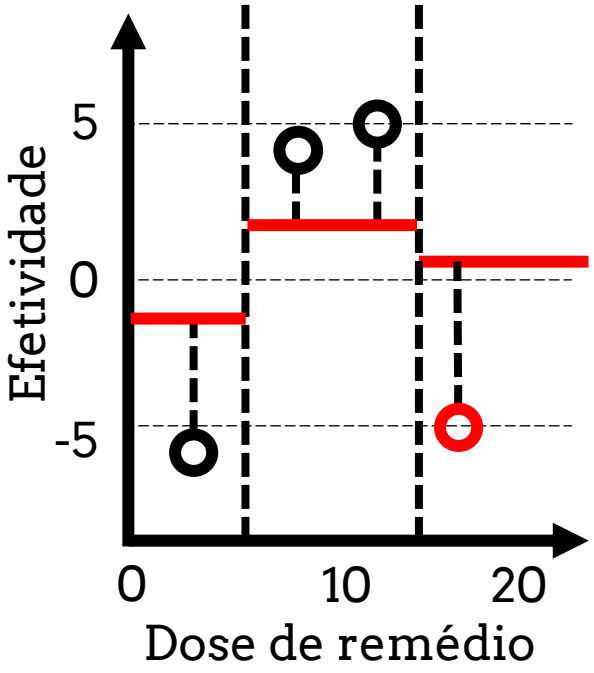




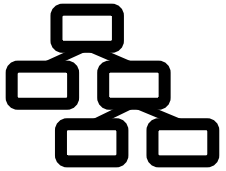
f(2) = 0.5 + 0.3 × -6.5 = -1.56
f(8) = 0.5 + 0.3 × 4 = 1.7
f(12) = 0.5 + 0.3 × 4 = 1.7

$$predição = \frac{3.5 + 4.5}{2 + 0} = 4$$

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



$$f(x) = 0.5 + 0.3 \times$$

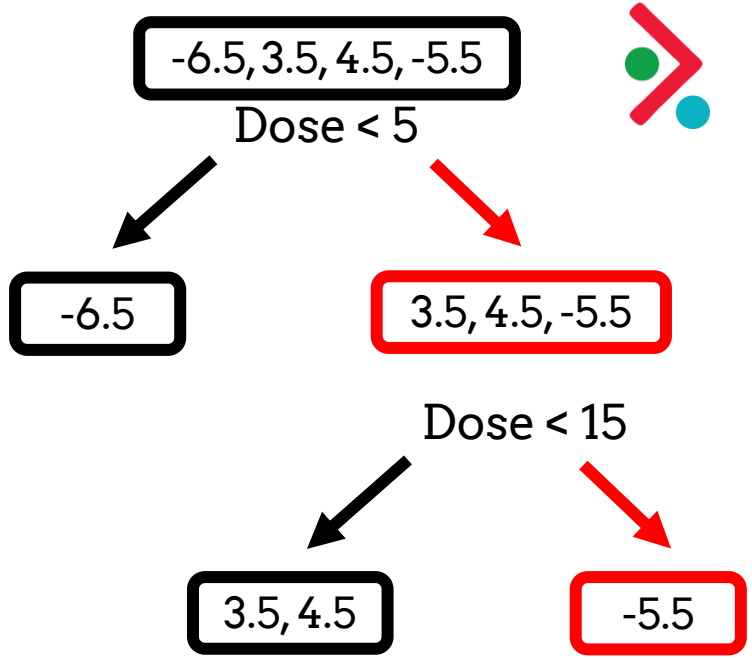


$f(2) = 0.5 + 0.3 \times -6.5 = -1.56$

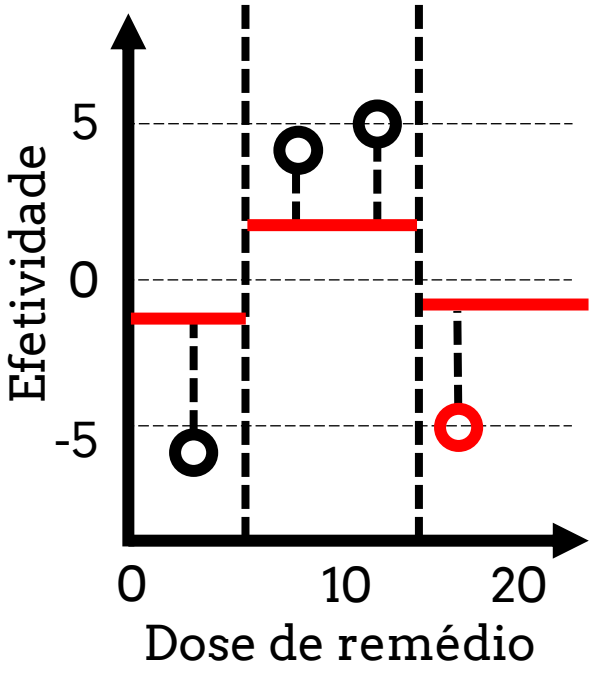
$f(8) = 0.5 + 0.3 \times 4 = 1.7$

$f(12) = 0.5 + 0.3 \times 4 = 1.7$

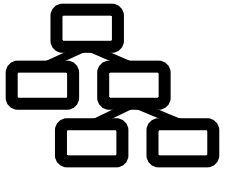
$f(16) = 0.5 + 0.3 \times$

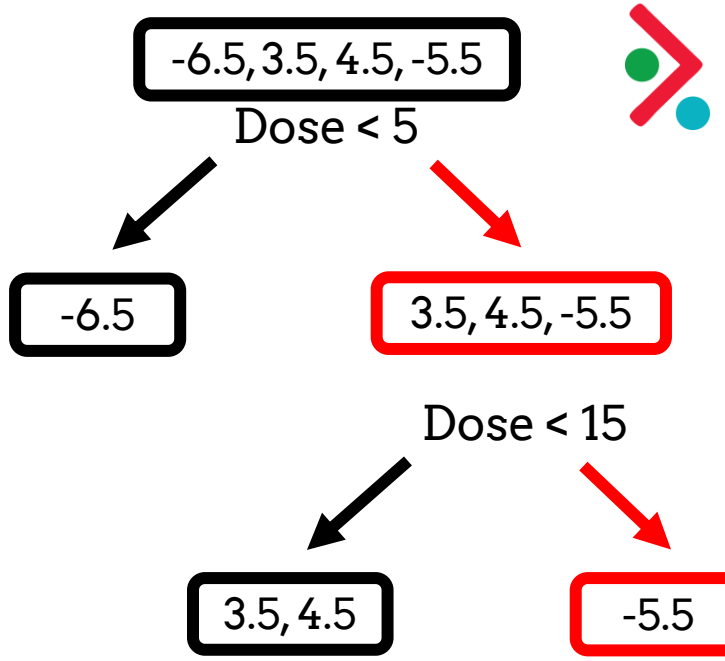


Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



$$f(x) = 0.5 + 0.3 \times$$

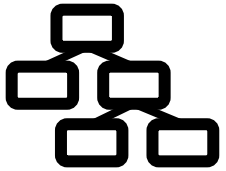




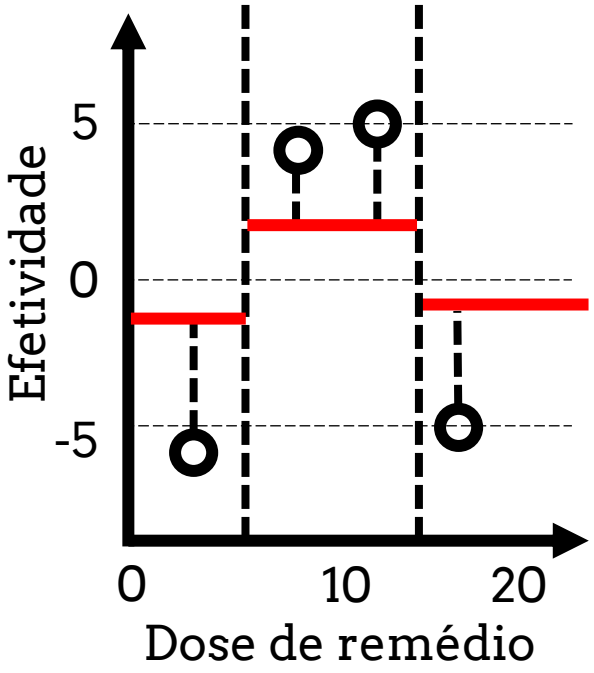
f(2) = 0.5 + 0.3 × -6.5 = -1.56
f(8) = 0.5 + 0.3 × 4 = 1.7
f(12) = 0.5 + 0.3 × 4 = 1.7
f(16) = 0.5 + 0.3 × -5.5 = -1.15

$$predição = \frac{-5.5}{1 + 0} = -5.5$$

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

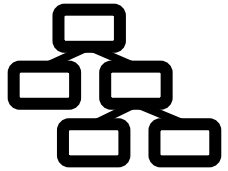
$$f(x) = 0.5 + 0.3 \times$$ 

$$f(2) = 0.5 + 0.3 \times -6.5 = -1.56$$
$$f(8) = 0.5 + 0.3 \times 4 = 1.7$$
$$f(12) = 0.5 + 0.3 \times 4 = 1.7$$
$$f(16) = 0.5 + 0.3 \times -5.5 = -1.15$$

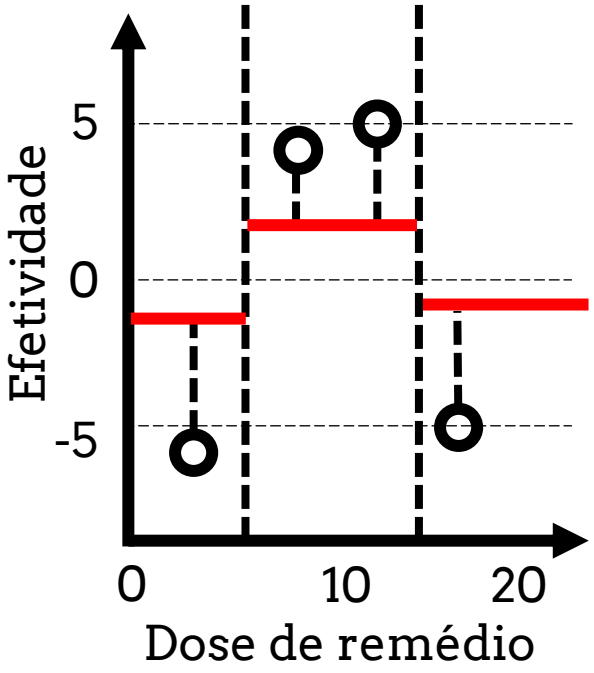


$$\text{resíduo1} = -6 - (-1.56) = -4.44$$
$$\text{resíduo2} = 4 - 1.7 = 2.3$$
$$\text{resíduo3} = 5 - 1.7 = 3.3$$
$$\text{resíduo4} = -5 - (-1.15) = -3.85$$

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

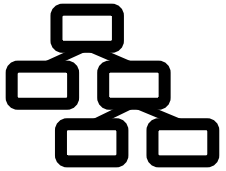
$$f(x) = 0.5 + 0.3 \times$$ 

-4.44,2.3,3.3,-3.85

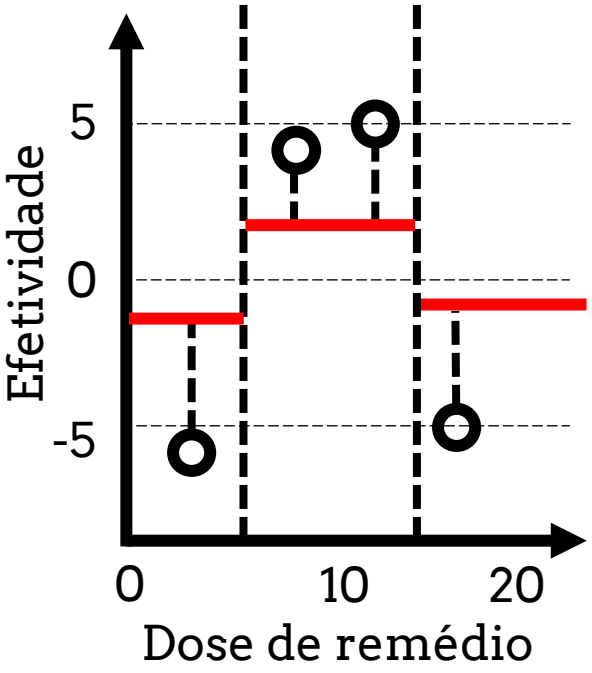


Hora da segunda árvore

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

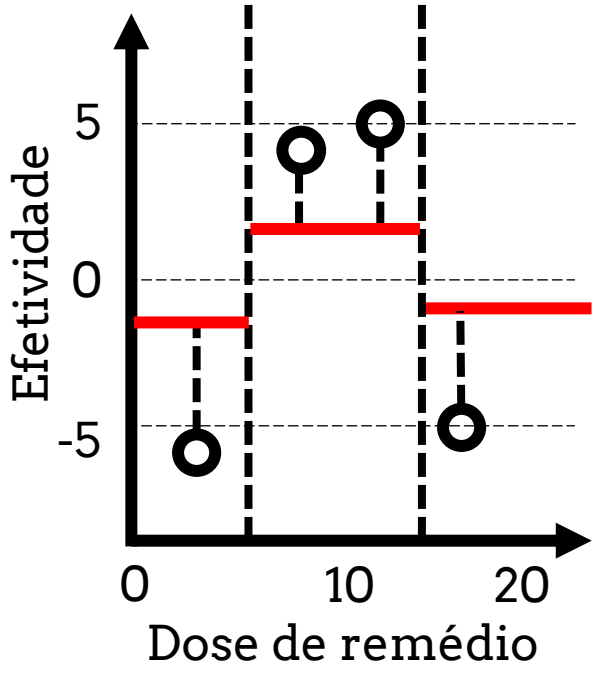
$$f(x) = 0.5 + 0.3 \times$$ 

-4.44,2.3,3.3,-3.85

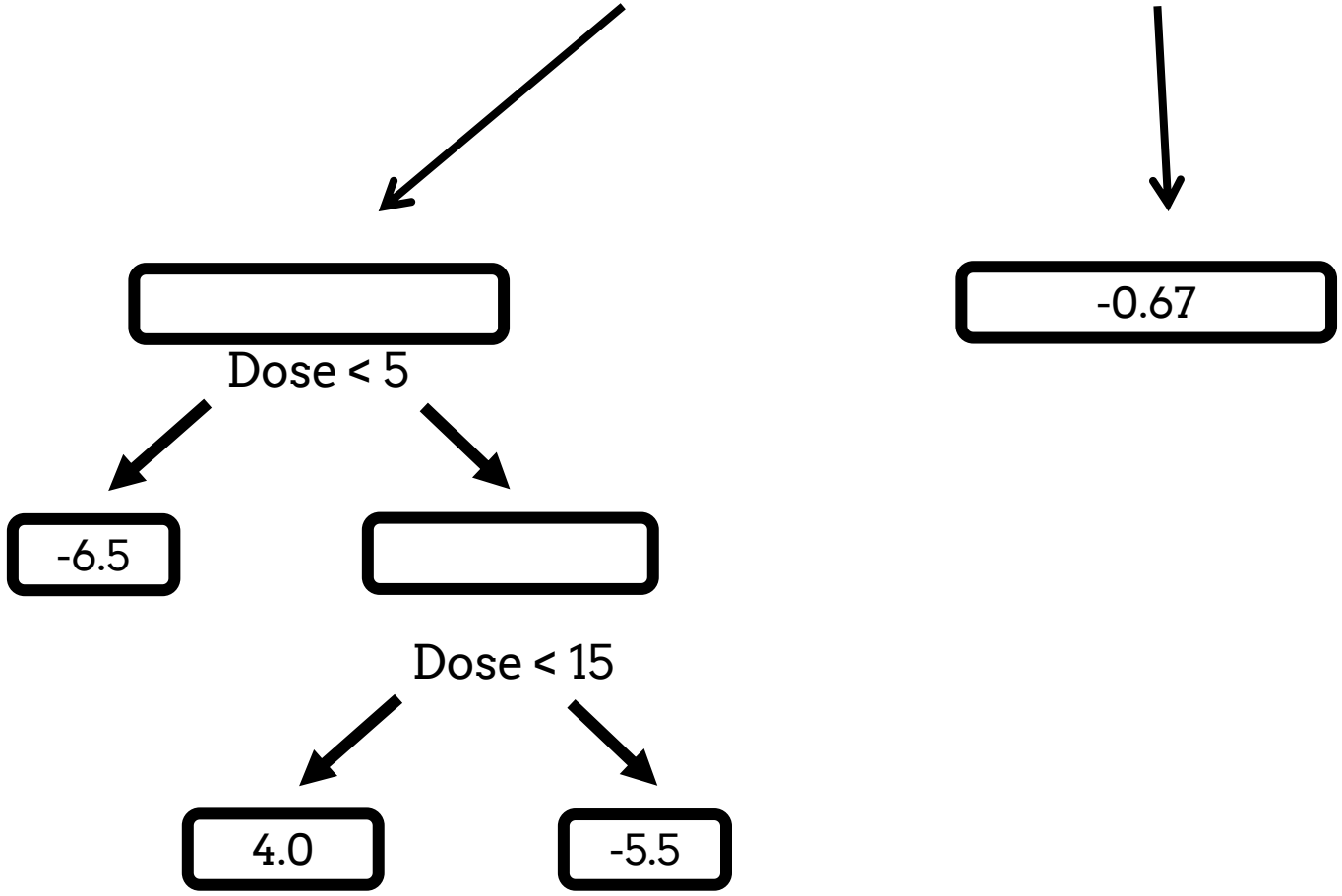


(sim salamin...)

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

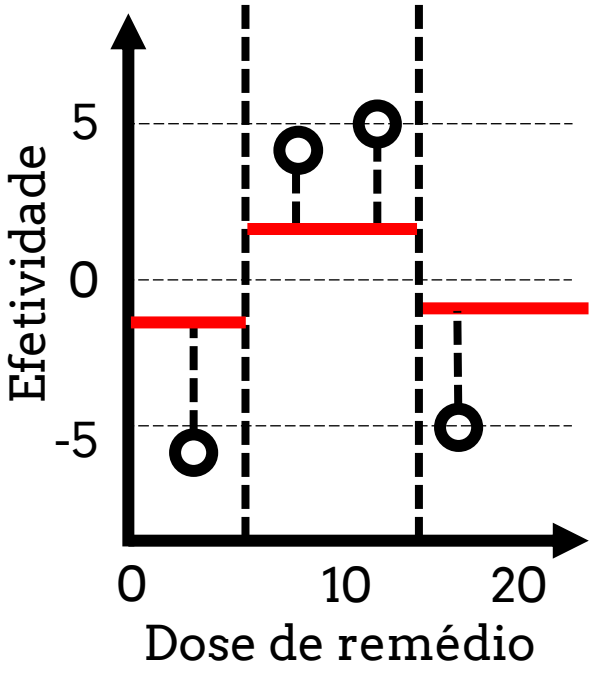


$$f(x) = 0.5 + 0.3 \times \text{tree} + 0.3 \times \text{tree}$$

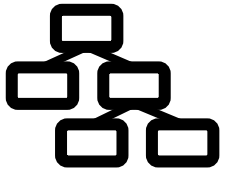


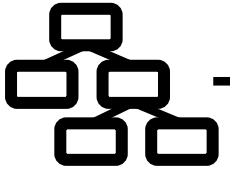
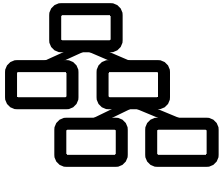
Modelo Final!

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2

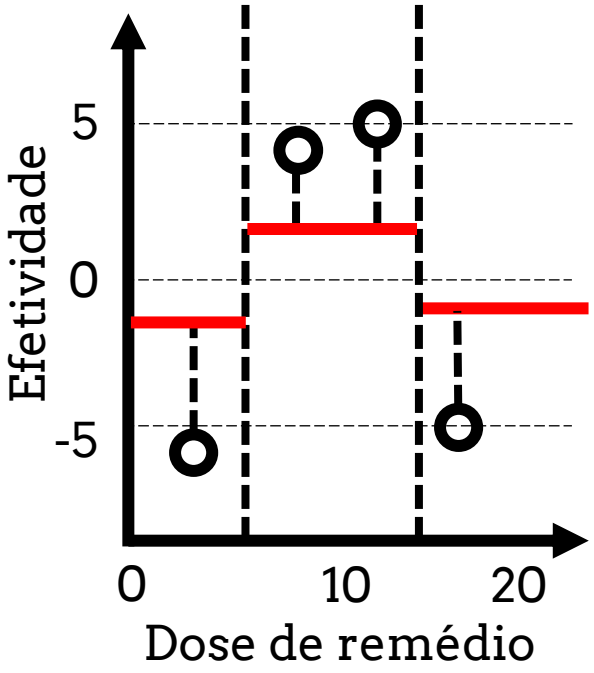


$f1(x) = 0.5$

$f2(x) = 0.5 + 0.3 \times$ 

$f3(x) = 0.5 + 0.3 \times$  $+ 0.3 \times$ 

Hiperparam	valor
λ	0
γ	50
ε	0.3
Tree Depth	2
Trees	2



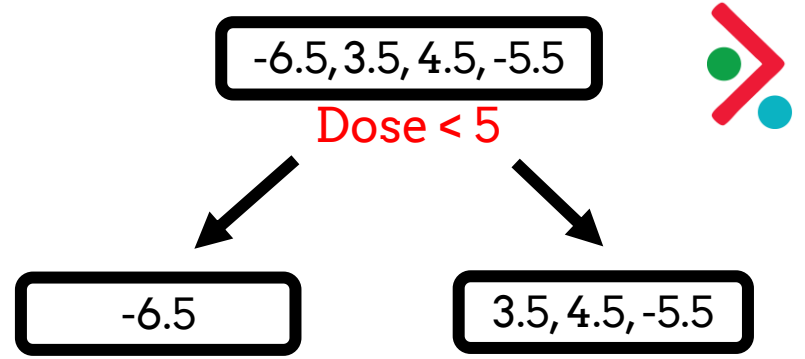
$$f1(x) = 0.5$$

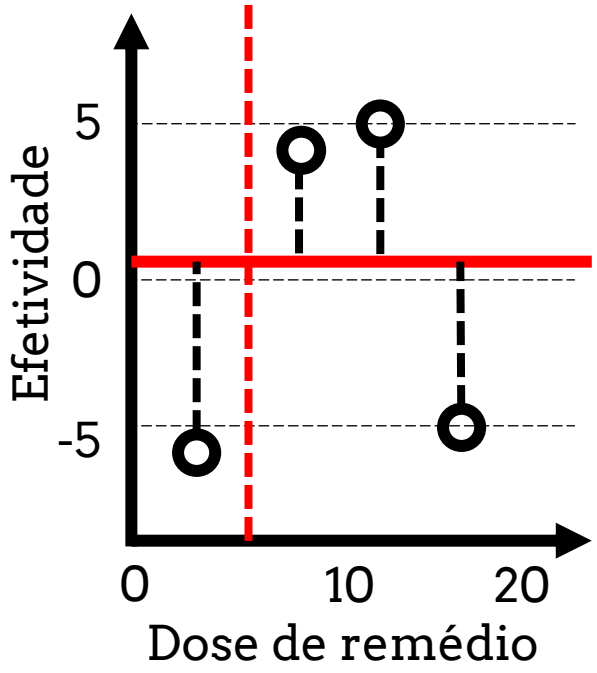
$$f2(x) = f1(x) + 0.3 \times$$

$$f3(x) = f2(x) + 0.3 \times$$

Hiperparam	valor
λ	1
γ	20
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$





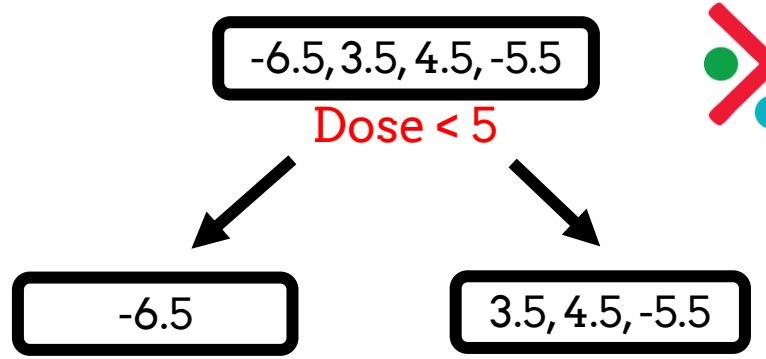
Pergunta	**λ=0**	**λ=1**
Dose < 5	40.33	
Dose < 10	1	
Dose < 15	27	

$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	1
γ	20
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$

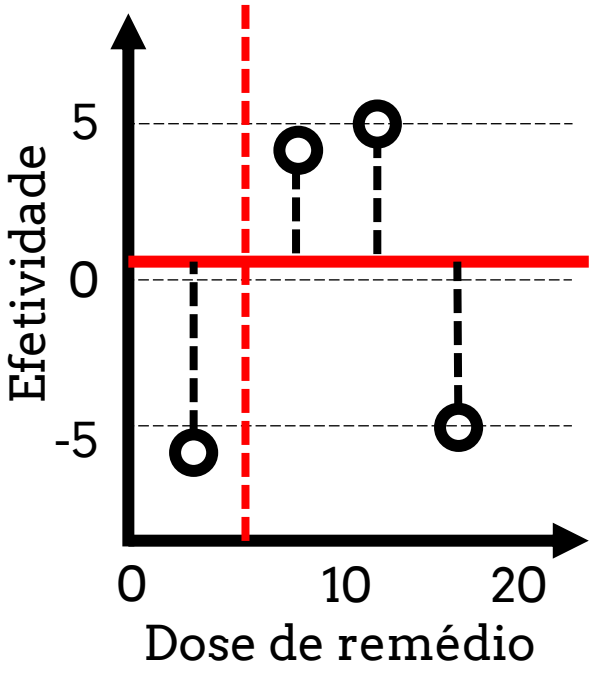


$$Similaridade_{pai} = \frac{(-6.5 + 3.5 + 4.5 - 5.5)^2}{4 + 1} = 3.2$$

$$Similaridade_{esq} = \frac{(-6.5)^2}{3 + 1} = 21.125$$

$$Similaridade_{dir} = \frac{(3.5 + 4.5 - 5.5)^2}{1 + 1} = 3.125$$

$$Gain = 3.125 + 21.125 - 3.2 = 21.05$$



Pergunta	λ=0	λ=1
Dose < 5	40.33	21.05
Dose < 10	1	
Dose < 15	27	

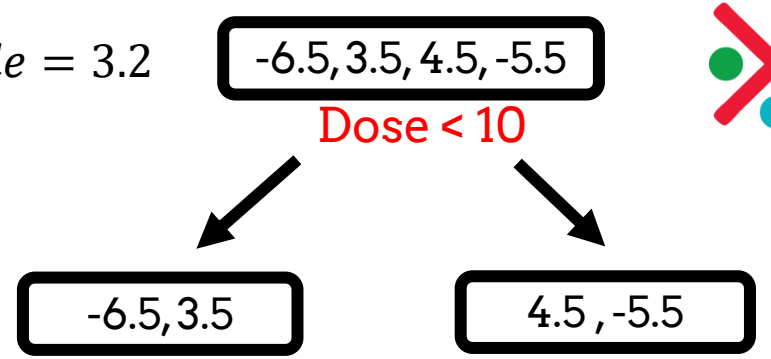
$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

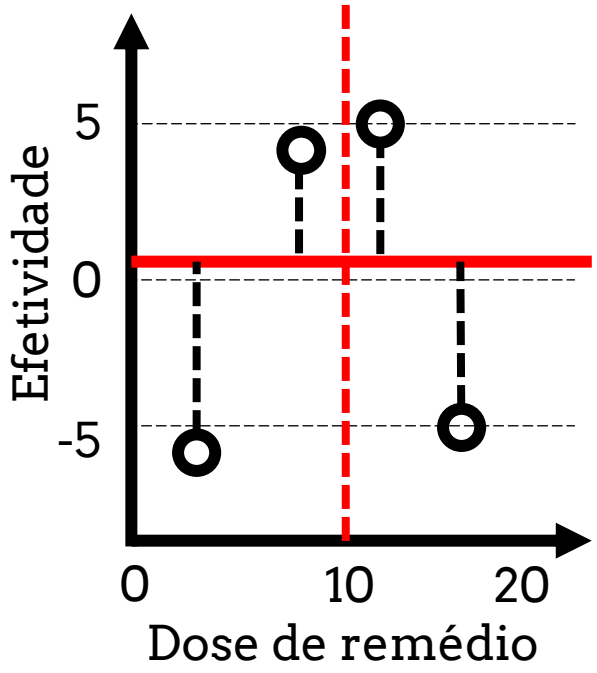
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	1
γ	20
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$

$Similaridade = 3.2$





$$Similaridade_{esq} = \frac{(-6.5 + 3.5)^2}{2 + 1} = 3$$

$$Similaridade_{dir} = \frac{(4.5 - 5.5)^2}{2 + 1} = 0.33$$

$$Gain = 3 + 0.33 - 3.2$$

Pergunta	**λ=0**	**λ=1**
Dose < 5	40.33	21.05
Dose < 10	1	0.13
Dose < 15	27	

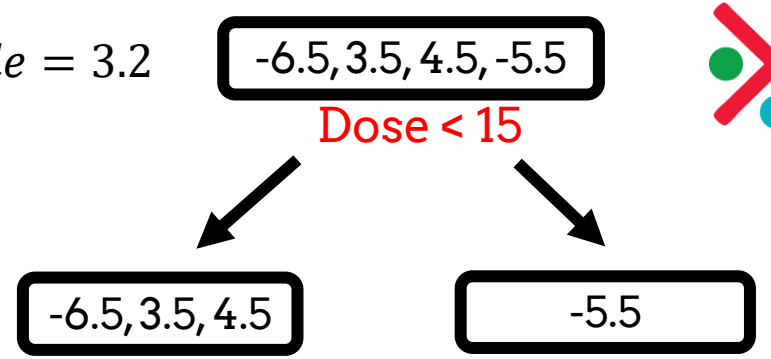
$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

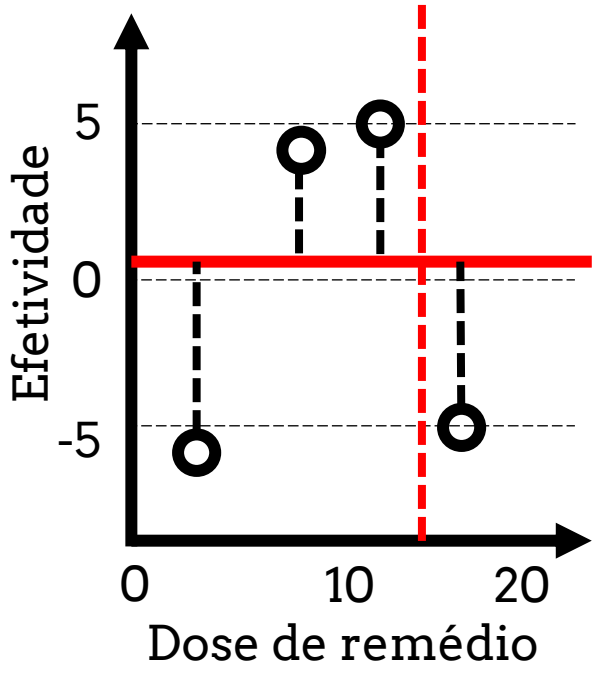
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	1
γ	20
ε	0.3
Tree Depth	2
Trees	2

$f(x) = 0.5$

$Similaridade = 3.2$





$$Similaridade_{esq} = \frac{(-6.5 + 3.5 + 4.5)^2}{3 + 1} = 0.56$$

$$Similaridade_{dir} = \frac{(-5.5)^2}{1 + 1} = 15.12$$

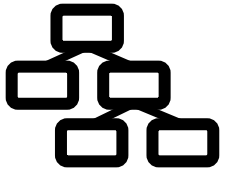
$$Gain = 15.12 + 0.56 - 3.2 = 12.48$$

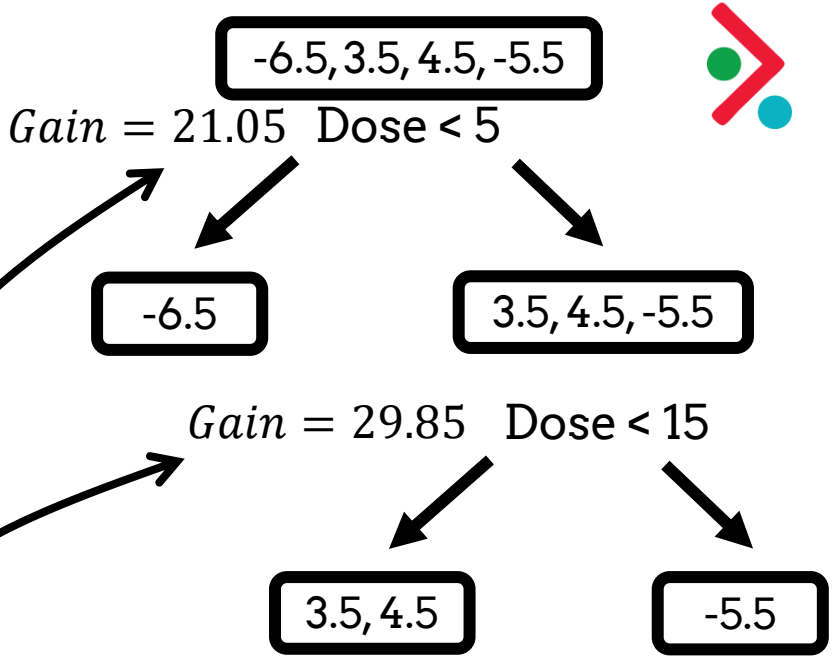
Pergunta	**λ=0**	**λ=1**
Dose < 5	40.33	21.05
Dose < 10	1	0.13
Dose < 15	27	12.48

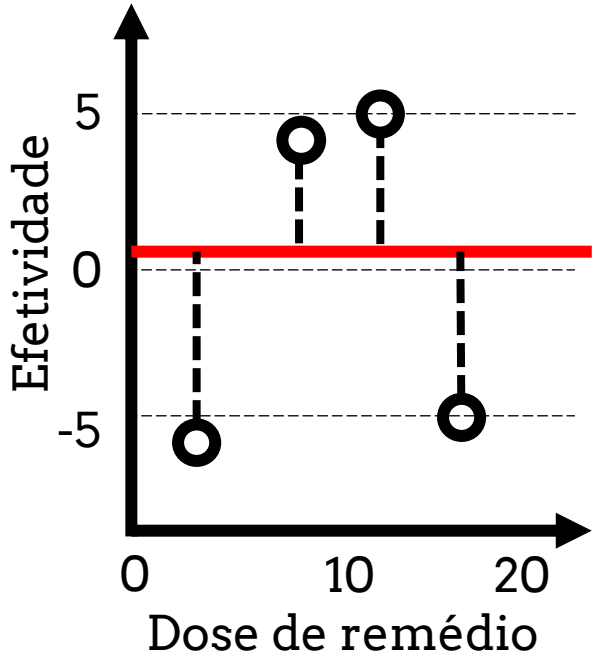
$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	1
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$f(x) = 0.5 + 0.3 \times$$ 



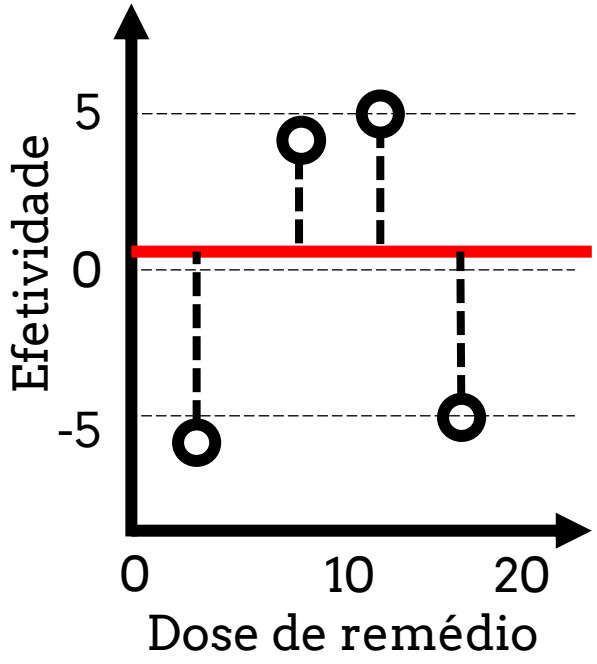


Gains menores,
mais fáceis de podar!

$$Gain = Sim_{esq} + Sim_{dir} - Sim_{pai}$$

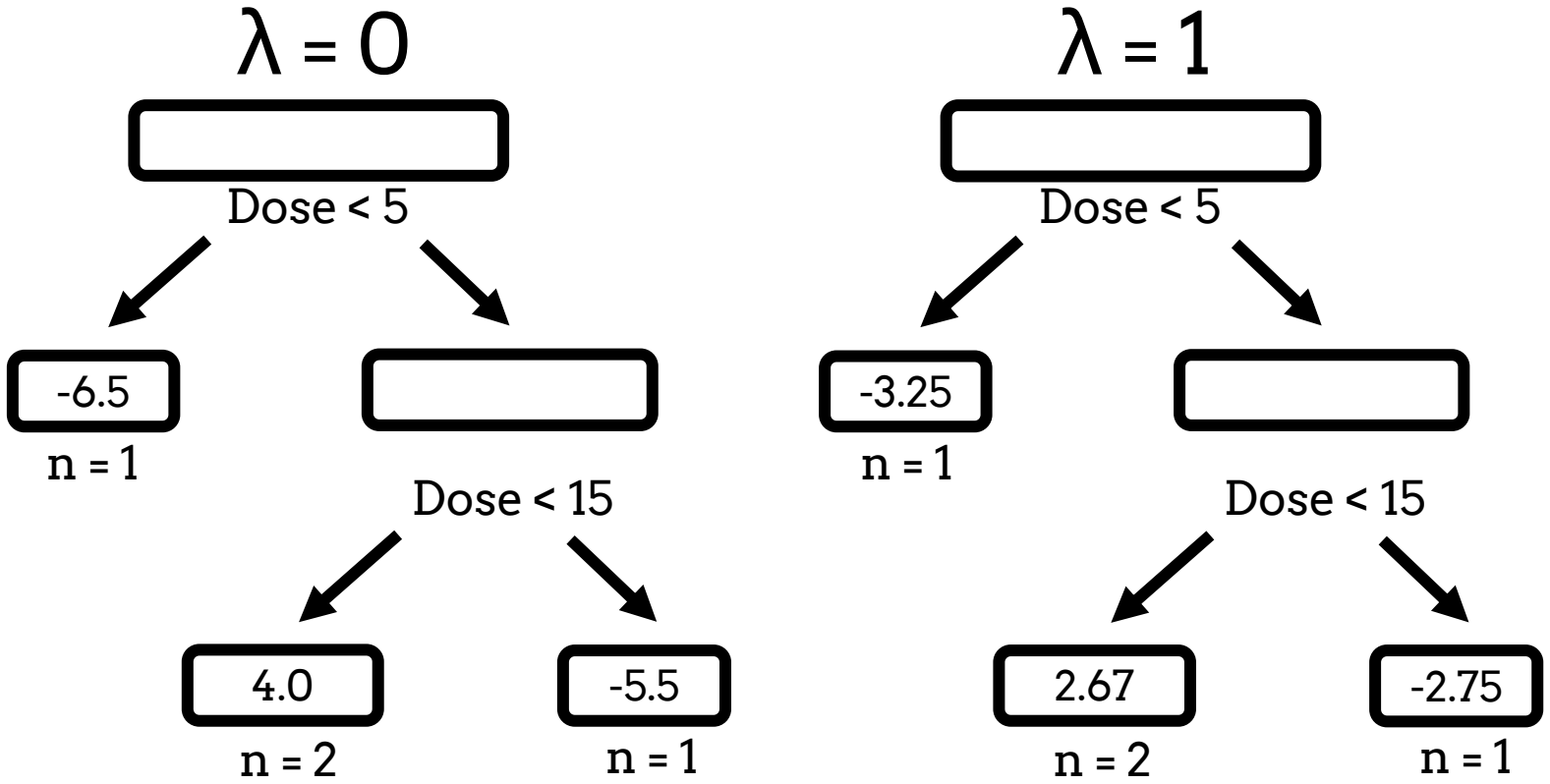
$$Similaridade = \frac{(\sum resíduos)^2}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	1
γ	20
ε	0.3
Tree Depth	2
Trees	2



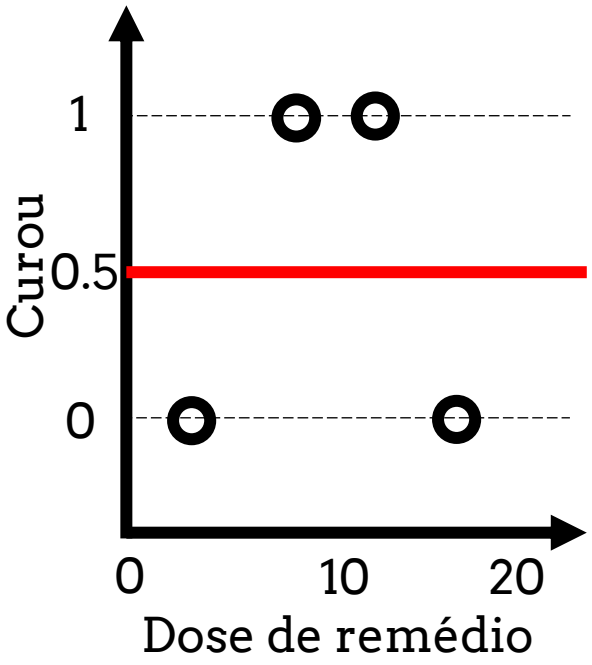
$$f(x) = 0.5 + 0.3 \times$$

Além disso, os scores também diminuíram...



$$predição = \frac{\sum resíduos}{\#resíduos + \lambda}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

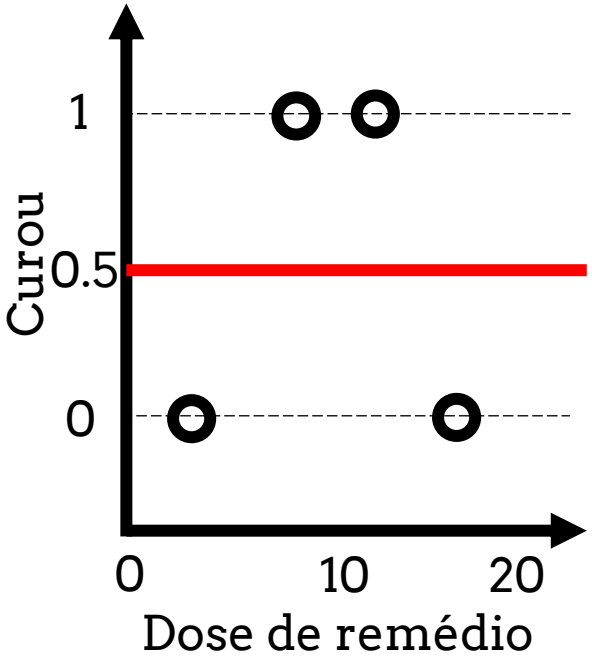


Regressão	Classificação
$\frac{(\sum resíduos)^2}{\#resíduos + \lambda}$	$\frac{(\sum resíduos)^2}{\sum p(1-p) + \lambda}$
$\frac{\sum resíduos}{\#resíduos + \lambda}$	$\frac{\sum resíduos}{\sum p(1-p) + \lambda}$
$f(x) = 0.5 +$ 	$\log\left(\frac{f(x)}{1 - f(x)}\right) = 0.0 +$ 

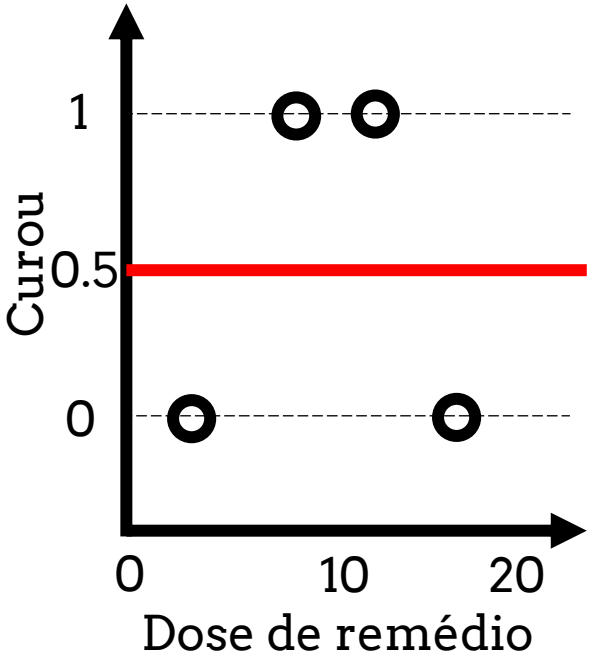
Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

No caso de classificação, vamos trocar f() por p() para relacionar com o fato de que estamos calculando probabilidades.



Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2



$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

No caso de classificação, vamos trocar f() por p() para relacionar com o fato de que estamos calculando probabilidades.

E uma rápida revisão sobre as função logística:

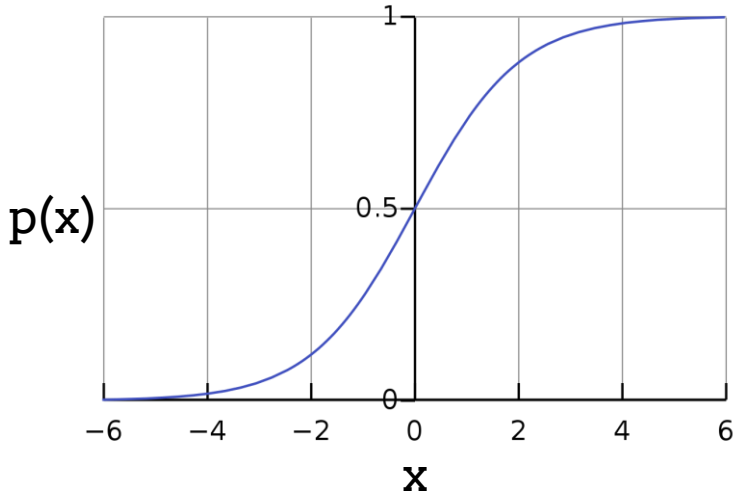
$$\log\left(\frac{p(x)}{1 - p(x)}\right) = x$$

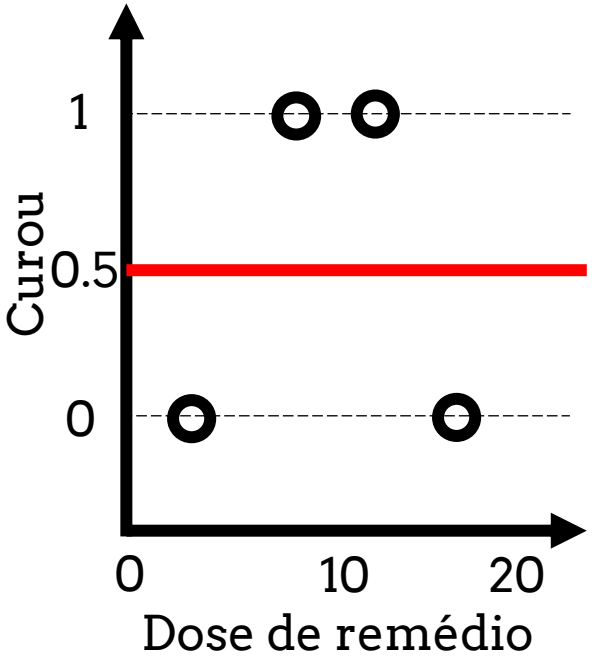
Logaritmo da chance,
ou log-odds,
ou logit

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

No caso de classificação, vamos trocar f() por p() para relacionar com o fato de que estamos calculando probabilidades.





E uma rápida revisão sobre as função logística:

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = x$$

inversa

$$p(x) = \frac{1}{1 + e^{-x}}$$

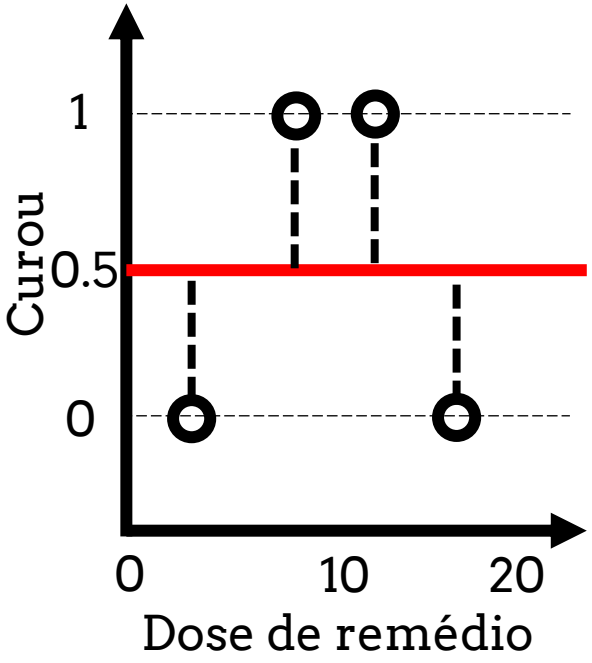
Logaritmo da chance, ou log-odds, ou logit

Função logística, ou sigmoide

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

$$\text{resíduo} = y - p(x)$$

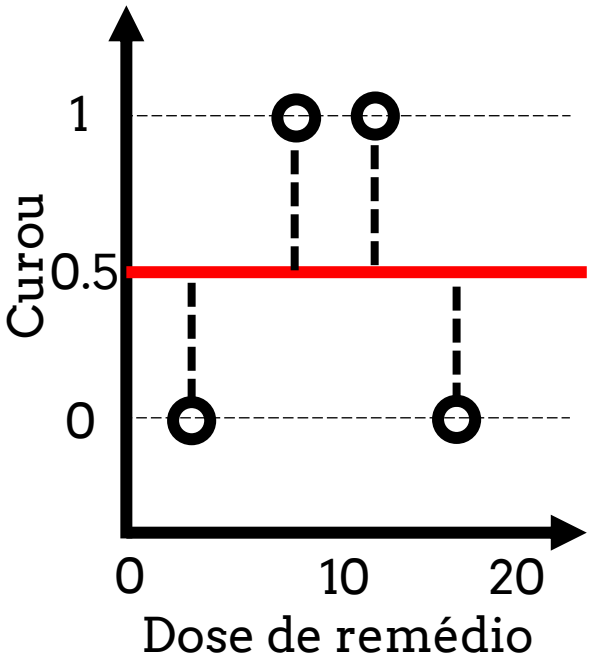


$$p(x) = \frac{1}{1 + e^{-x}}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

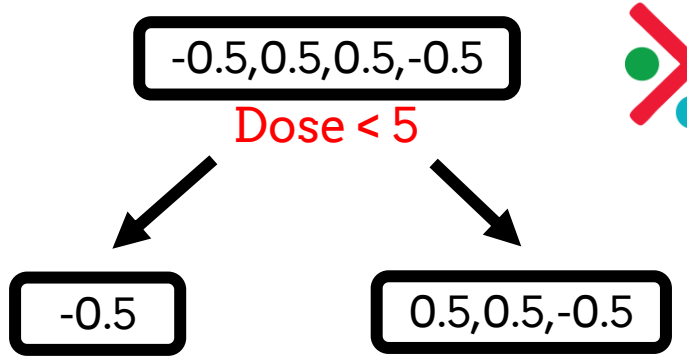
-0.5,0.5,0.5,-0.5

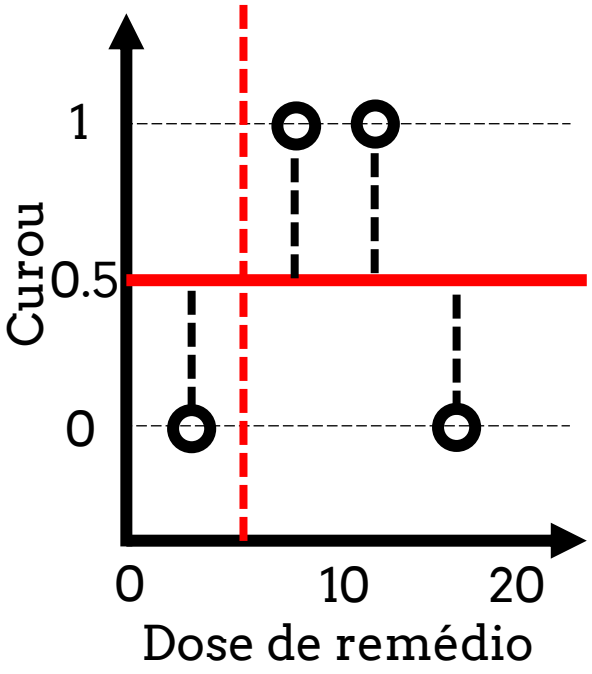


$$p(x) = \frac{1}{1 + e^{-x}}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$





$$Similaridade_{pai} = \text{\_\_\_\_\_} =$$

$$Similaridade_{esq} = \text{\_\_\_\_\_} =$$

$$Similaridade_{dir} = \text{\_\_\_\_\_} =$$

$$Gain =$$

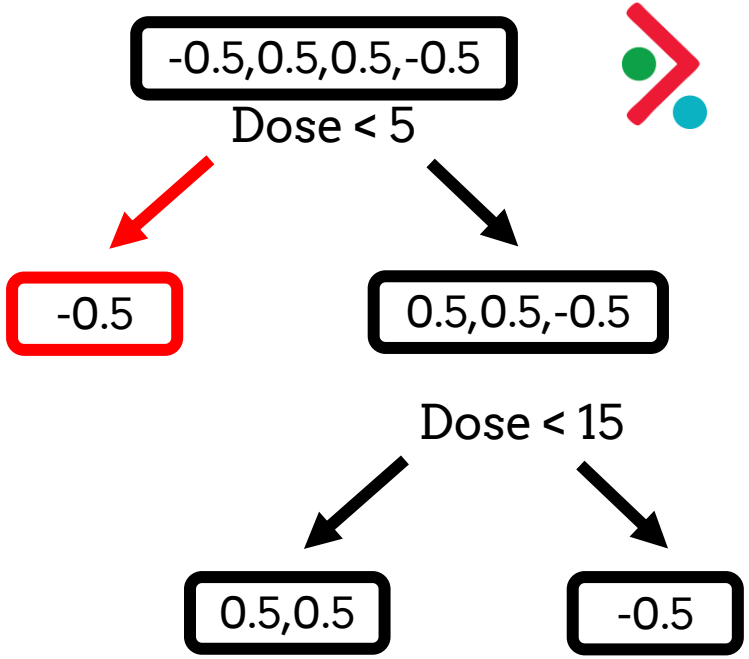
$$Similaridade = \frac{(\sum resíduos)^2}{\sum p(1-p) + \lambda}$$

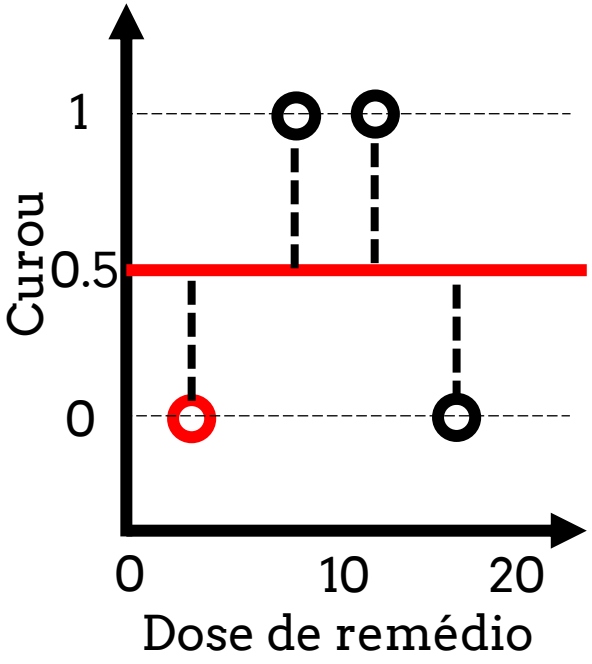
$$p(x) = \frac{1}{1 + e^{-x}}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

$$\log\left(\frac{p(2)}{1 - p(2)}\right) = 0.0$$





$$predição = \frac{\sum resíduos}{\sum p(1-p) + \lambda}$$

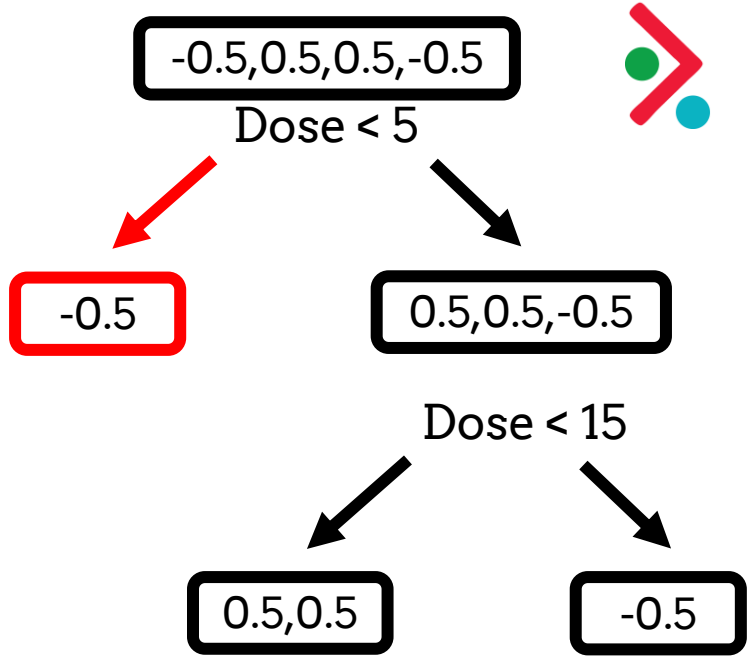
$$p(x) = \frac{1}{1 + e^{-x}}$$

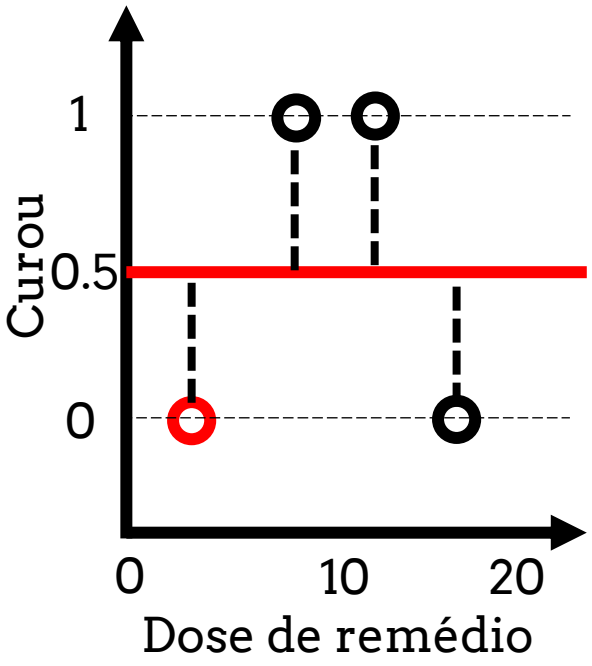
Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

$$\log\left(\frac{p(2)}{1 - p(2)}\right) = 0.0 + 0.3 \times (-2)$$

$$\frac{-0.5}{0.5(1 - 0.5) + 0} = -2$$





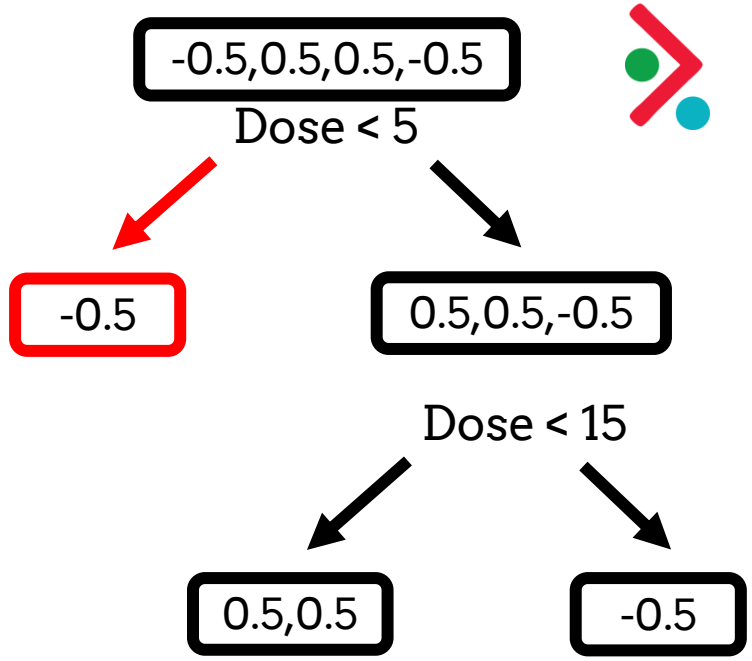
$$predição = \frac{\sum resíduos}{\sum p(1 - p) + \lambda}$$

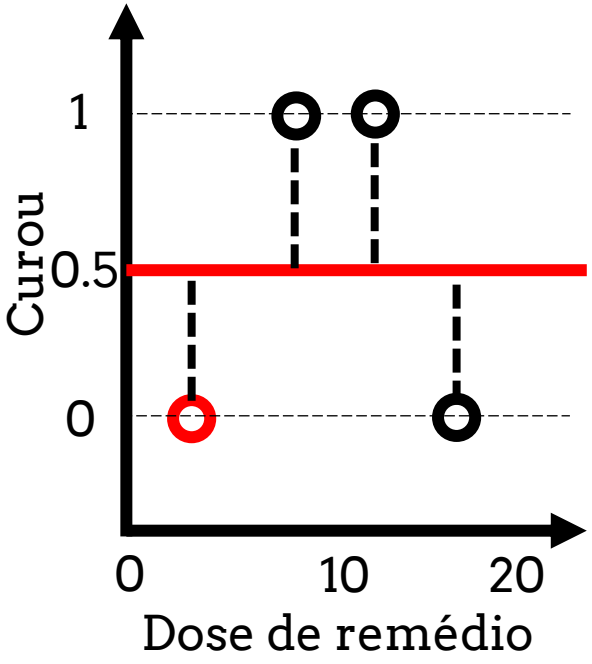
$$p(x) = \frac{1}{1 + e^{-x}}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

$$\log\left(\frac{p(2)}{1 - p(2)}\right) = 0.0 + 0.3 \times (-2) = -0.6$$





$$predição = \frac{\sum resíduos}{\sum p(1-p) + \lambda}$$

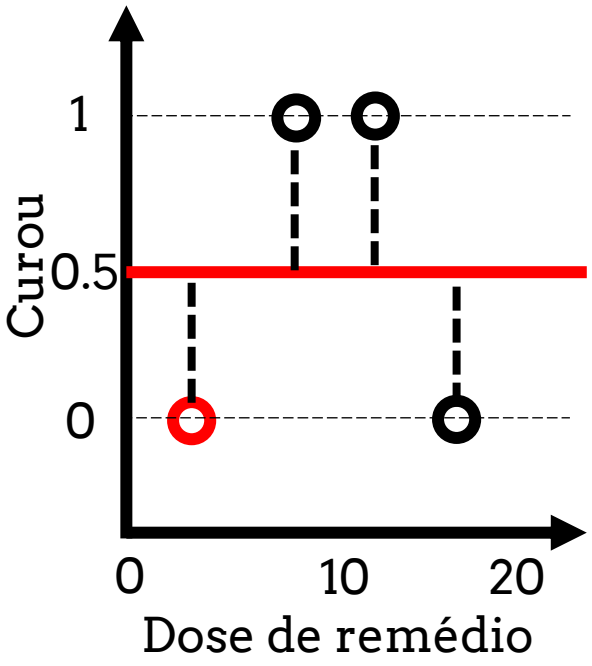
$$p(x) = \frac{1}{1 + e^{-x}}$$

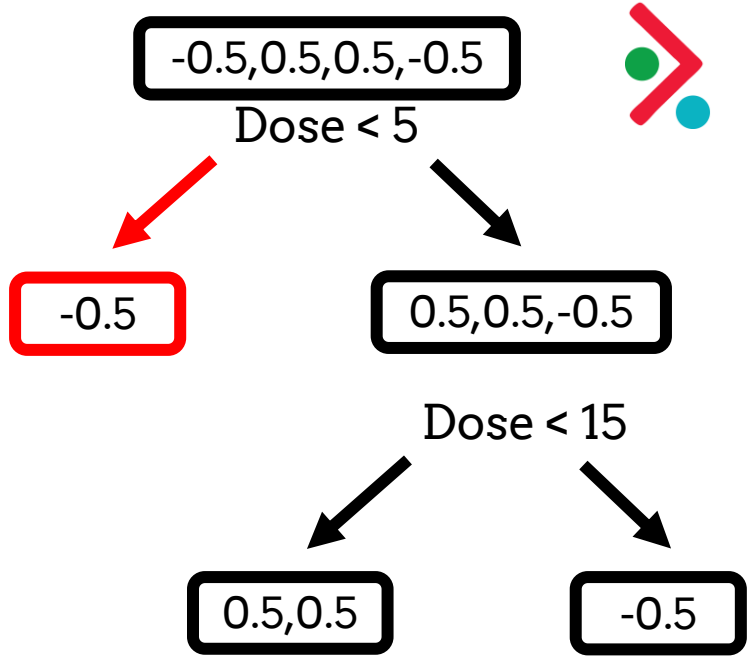
Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$

$$\log\left(\frac{p(2)}{1 - p(2)}\right) = 0.0 + 0.3 \times (-2) = -0.6$$

$$p(2) = \frac{1}{1 + e^{-(-0.6)}} = 0.354$$



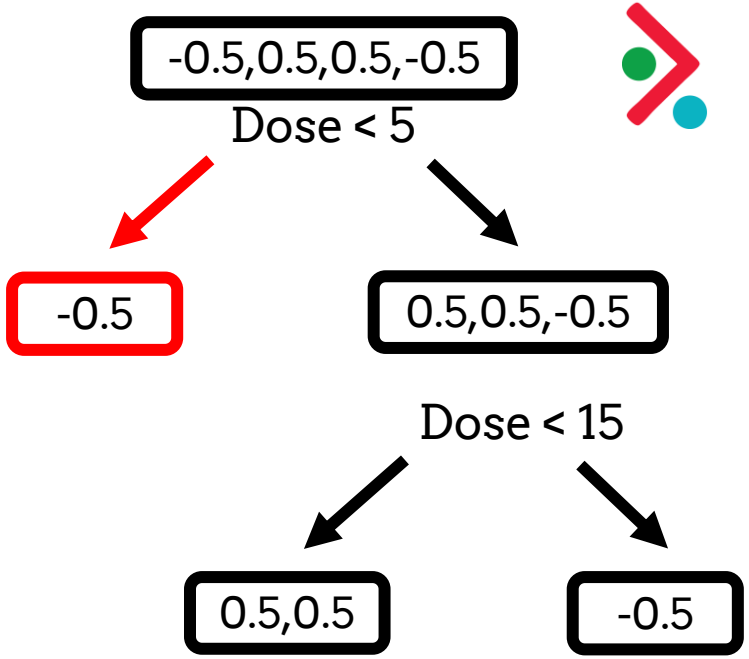


$$predição = \frac{\sum resíduos}{\sum p(1-p) + \lambda}$$

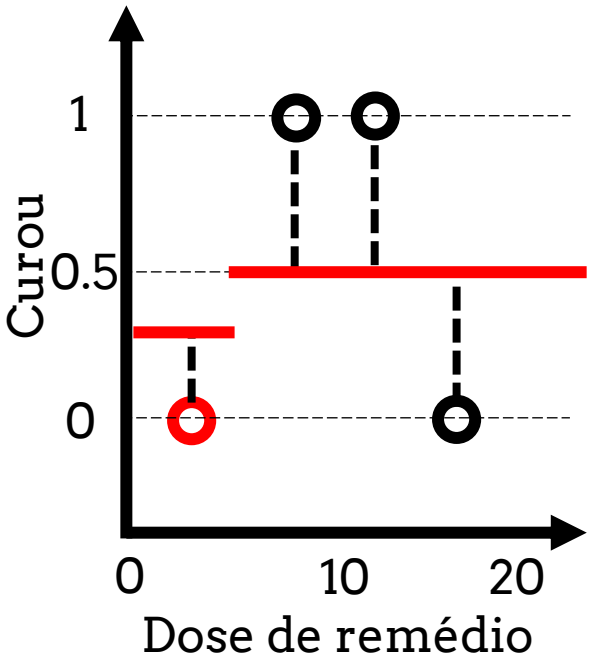
$$p(x) = \frac{1}{1 + e^{-x}}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2

$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0$$



$$\log\left(\frac{p(2)}{1 - p(2)}\right) = 0.0 + 0.3 \times (-2) = -0.6$$

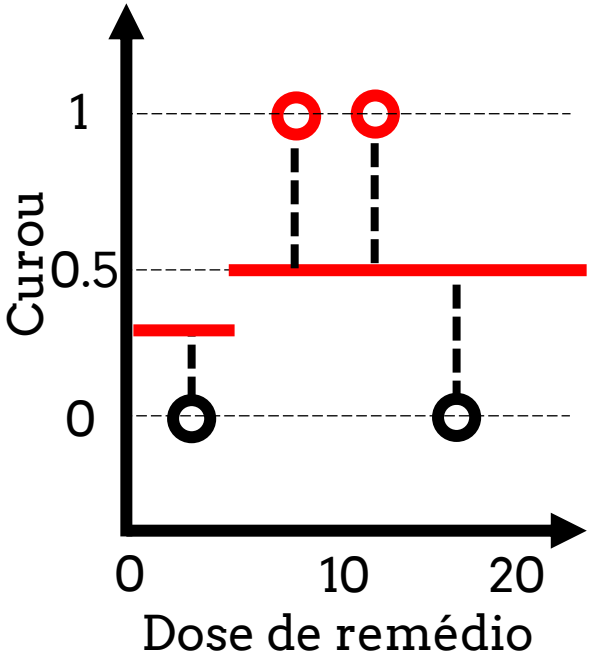


$$p(2) = \frac{1}{1 + e^{-(-0.6)}} = 0.354$$

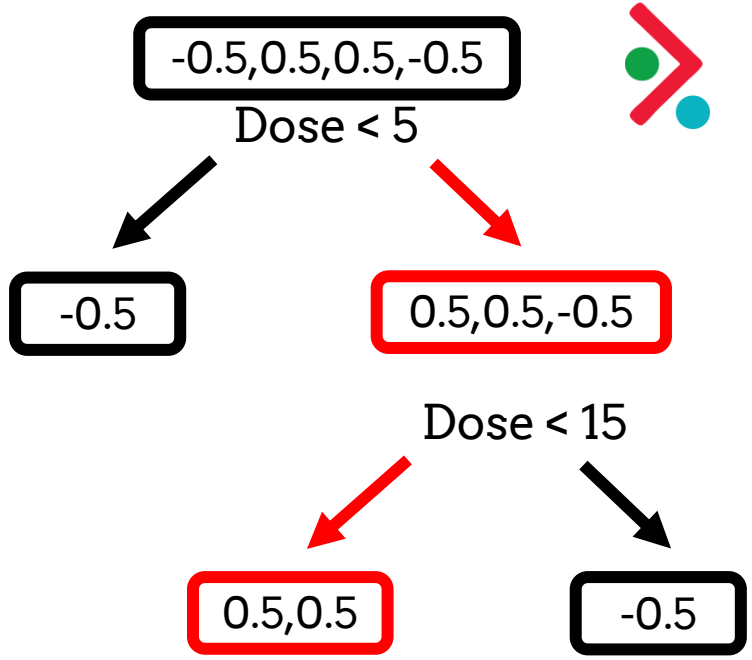
$$predição = \frac{\sum resíduos}{\sum p(1-p) + \lambda}$$

$$p(x) = \frac{1}{1 + e^{-x}}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2



$$\log\left(\frac{p(x)}{1-p(x)}\right) = 0.0$$



$$\log\left(\frac{p(2)}{1-p(2)}\right) = 0.0 + 0.3\times(-2)$$

$$\log\left(\frac{p(8)}{1-p(8)}\right) = 0.0 + 0.3\times 2$$

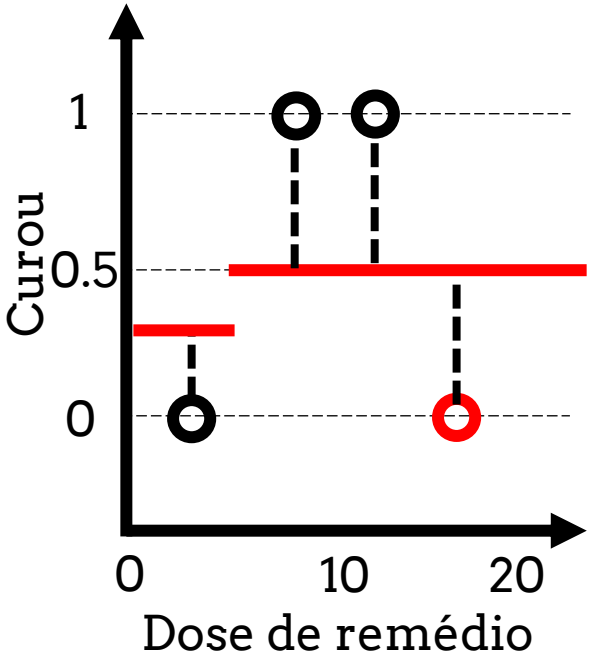
$$\log\left(\frac{p(12)}{1-p(12)}\right) = 0.0 + 0.3\times 2$$

$$\frac{0.5+0.5}{0.5(1-0.5)+0.5(1-0.5)+0} = 2$$

$$predição = \frac{\sum resíduos}{\sum p(1-p)+\lambda}$$

$$p(x) = \frac{1}{1+e^{-x}}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2



$$\log\left(\frac{p(x)}{1-p(x)}\right) = 0.0$$

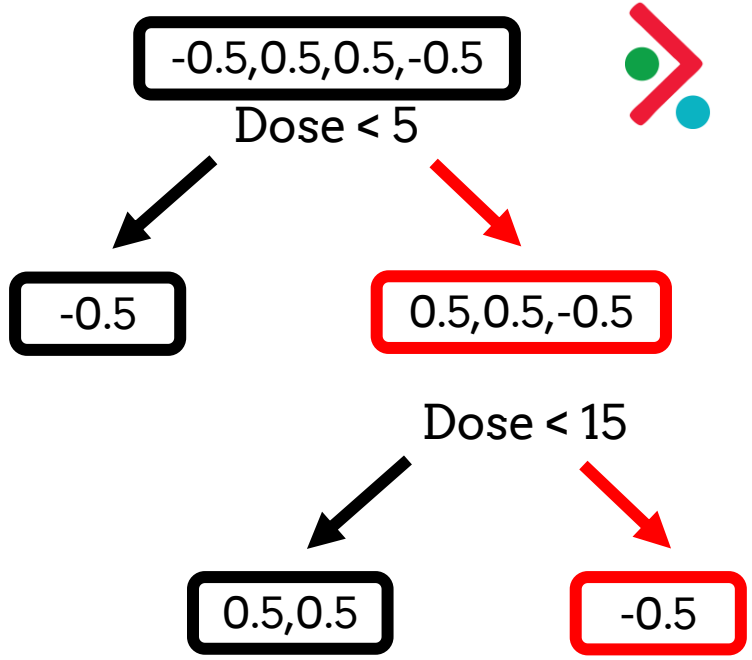
$$\log\left(\frac{p(2)}{1-p(2)}\right) = 0.0 + 0.3\times(-2)$$

$$\log\left(\frac{p(8)}{1-p(8)}\right) = 0.0 + 0.3\times 2$$

$$\log\left(\frac{p(12)}{1-p(12)}\right) = 0.0 + 0.3\times 2$$

$$\log\left(\frac{p(16)}{1-p(16)}\right) = 0.0 + 0.3\times(-2)$$

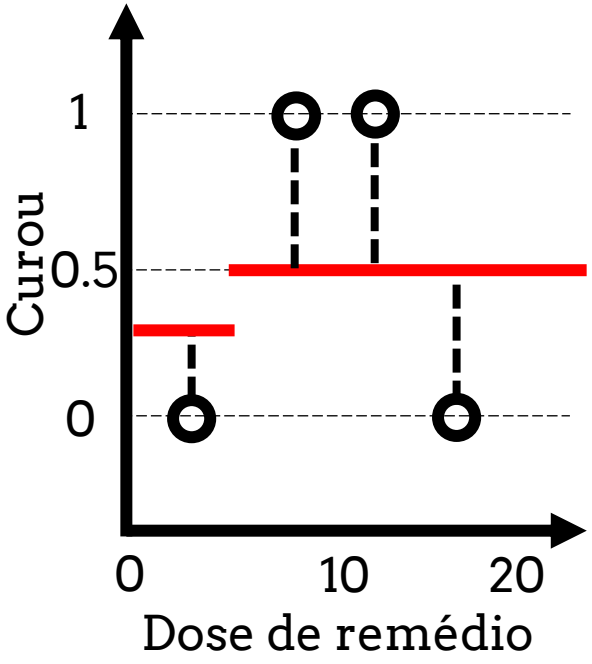
$$\frac{-0.5}{0.5(1-0.5)+0} = -2$$



$$predição = \frac{\sum resíduos}{\sum p(1-p) + \lambda}$$

$$p(x) = \frac{1}{1+e^{-x}}$$

Hiperparam	valor
λ	0
γ	20
ε	0.3
Tree Depth	2
Trees	2



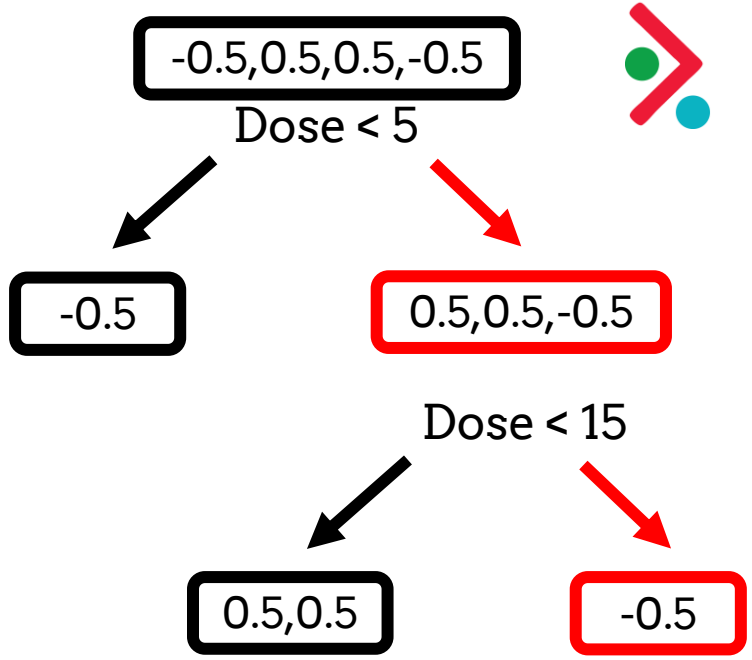
$$\log\left(\frac{p(x)}{1-p(x)}\right) = 0.0$$

$$\log\left(\frac{p(2)}{1-p(2)}\right) = 0.0 + 0.3\times(-2) = -0.6$$

$$\log\left(\frac{p(8)}{1-p(8)}\right) = 0.0 + 0.3\times 2 = 0.6$$

$$\log\left(\frac{p(12)}{1-p(12)}\right) = 0.0 + 0.3\times 2 = 0.6$$

$$\log\left(\frac{p(16)}{1-p(16)}\right) = 0.0 + 0.3\times(-2) = -0.6$$



$$predição = \frac{\sum resíduos}{\sum p(1-p) + \lambda}$$

$$p(x) = \frac{1}{1+e^{-x}}$$

Hiperparam	valor
λ	0
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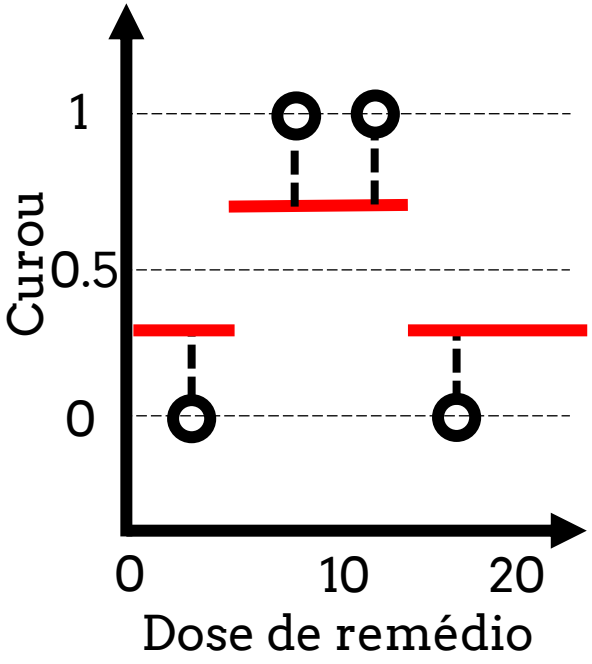
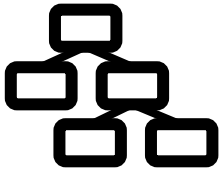
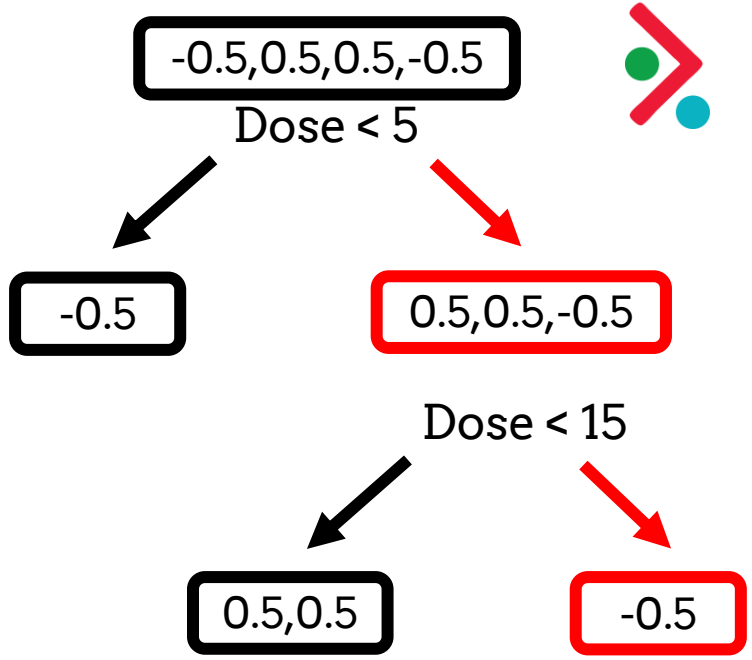
Tree Depth	2
Trees	2



$$\log\left(\frac{p(x)}{1 - p(x)}\right) = 0.0 + 0.3 \times$$





$$p(2) = \frac{1}{1 + e^{-(-0.6)}} = 0.35$$

$$p(8) = \frac{1}{1 + e^{-(0.6)}} = 0.65$$

$$p(12) = \frac{1}{1 + e^{-(0.6)}} = 0.65$$

$$p(16) = \frac{1}{1 + e^{-(-0.6)}} = 0.35$$

$$predição = \frac{\sum resíduos}{\sum p(1-p) + \lambda}$$

$$p(x) = \frac{1}{1 + e^{-x}}$$