Gradient Boosting

Gradient Boosting Model

$F_{n+1}(X) = F_n(X) + \gamma_n H(x, e_n)$

$F_0(X) =$ ��$_0$ $H_0(x, y) + e_0$

$F_1(X) = F_0(X) +$ ��$_1$ $H_1(x, e_0) + e_1$

$F_2(X) = F_1(X) +$ ��$_2$ $H_2(x, e_1) + e_2$

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$F_n(X) = F_{n-1}(X) +$ ��$_n$ $H_n(x, e_{n-1}) + e_n$

Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H(x, e_n)$$

$$F_0(X) = \gamma_0 \, H_0(x, y) + e_0$$

$$F_1(X) = F_0(X) + \gamma_1 \, H_1(x, e_0) + e_1$$

$$F_2(X) = F_1(X) + \gamma_2 \, H_2(x, e_1) + e_2$$

$$\vdots \qquad \qquad \vdots$$

$$F_n(X) = F_{n-1}(X) + \gamma_n \, H_n(x, e_{n-1}) + e_n$$

Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n H(x, e_n)$$

$$L = (y - y')^2$$

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Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n H(x, e_n)$$

$$L = (y - y')^2$$

$$L = (y - F_n(x))^2$$

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Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H(x, e_n)$$

$$L = (y - y')^2$$

$$L = (y - F_n(x))^2$$

$$\frac{dL}{dF_n(x)} = 2(y - F_n(x))$$

Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n H(x, e_n)$$

$$L = (y - y')^2$$

$$L = (y - F_n(x))^2$$

$$\frac{dL}{dF_n(x)} = -2(y - F_n(x))$$

Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n H(x, e_n)$$

$$L = (y - y')^2$$

$$L = (y - F_n(x))^2$$

$$\frac{dL}{dF_n(x)} = 2(y - F_n(x))$$

Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H\left(x, -\frac{dL}{dF_n(x)}\right)$$

$L = (y - y')^2$

$L = (y - F_n(x))^2$

$$-\frac{dL}{dF_n(x)} = 2(y - F_n(x))$$

Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H\left(x, -\frac{dL}{dF_n(x)}\right)$$

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Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H\left(x, -\frac{dL}{dF_n(x)}\right)$$

$$\text{Loss} = L(y, F_n(x))$$

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Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H\left(x, -\frac{dL}{dF_n(x)}\right)$$

$$\text{Loss} = L(y, F_n(x)) + \gamma_n L\left(\frac{dL}{dF_n(x)}, -\right))$$

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Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H\left(x, -\frac{dL}{dF_n(x)}\right)$$

$$Loss = \underbrace{L(y, F_n(x))} + \gamma_n \, L\left(\frac{dL}{dF_n(x)}, -\right)$$

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Gradient Boosting Model

$$F_{n+1}(X) = F_n(X) + \gamma_n H\left(x, -\frac{dL}{dF_n(x)}\right)$$

$$\text{Loss} = L(y, F_n(x)) + \underbrace{\gamma_n L\left(\frac{dL}{dF_n(x)}, -\right)\!)}$$

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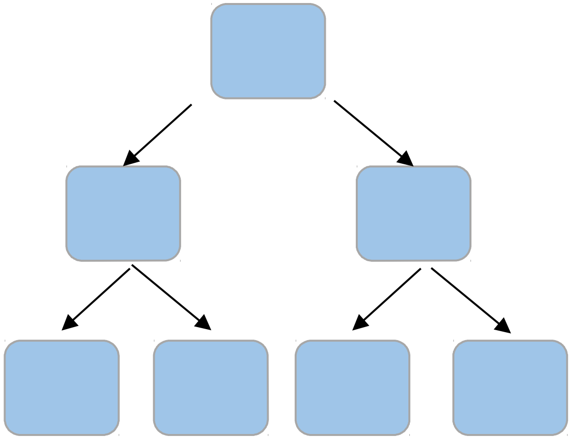
Gradient Boosting Decision Tree

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H\left(x, -\frac{dL}{dF_n(x)}\right)$$

Gradient Boosting Decision Tree

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H\left(x, -\frac{dL}{dF_n(x)}\right)$$



Gradient Boosting Decision Tree

$$F_{n+1}(X) = F_n(X) + \gamma_n \, H\left(x, -\frac{dL}{dF_n(x)}\right)$$