Boosting Algorithm

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1 Gradient Tree Boosting Algorithm

Algorithm 1 Gradient Tree Boosting Algorithm

procedure GBT(x, y)
 Initialize:
 $f_0(x) = argmin_\gamma \sum_{i=1}^{N} L(y_i, \gamma)$
 for `m = 1 to M:` **do**
  for `i = 1 to N: compute` **do**
   $r_{im} = -\left[\frac{\delta L(y_i, f(x_i))}{\delta f(x_i)}\right]$
  Fit a regression tree to the targets r_{im} giving terminal regions R_{jm}, j = 1,2,...,J_m
  for `j = 1 to` J_m`:  compute` **do**
   $\gamma_{jm}= argmin_\gamma \sum_{x_i \epsilon R_{jm}} L(y_i, f_{m-1}(x_i) + \gamma)$
  Update:
 $f_m(x) = f_{m-1}(x) + \sum_{j=1}^{J_m} \gamma_{jm} I(x \epsilon R_{jm})$
 Output $f(\hat{x}) = f_M(x)$

2 Nestrov Descent

Starting with x_0 and y_0

$$x_{t+1} = y_t - w \nabla f(y_t) \tag{1}$$

$$y_{t+1} = (1 - \gamma_t) x_{t+1} + \gamma_t x_t \tag{2}$$

where w is the step size, λ_0 , $\lambda_t = \frac{1+\sqrt{1+4\lambda_{t-1}}^2}{2}$ and $\gamma_t = \frac{1-\lambda_t}{\lambda_{t+1}}$

3 Accelerated Gradient Boosting

Algorithm 2 Accelerated Gradient Boosting Algorithm

procedure AGB(x, y)

    Initialize:

    $f_0(x) = argmin_\gamma \sum_{i=1}^{N} L(y_i, \gamma)$

    for `m = 1 to M:` **do**

        for `i = 1 to N: compute` **do**

            $r_{im} = -\left[\frac{\delta L(y_i, f(x_i))}{\delta f(x_i)}\right]$

        Fit a regression tree to the targets r_{im} giving terminal regions R_{jm}, j = 1,2,...,J_m

        for `j = 1 to` J_m`:  compute` **do**

            $\gamma_{jm} = argmin_\gamma \sum_{x_i \epsilon R_{jm}} L(y_i, f_{m-1}(x_i) + \gamma)$

        Update:

        $f_m(x) = g_{m-1}(x) + \sum_{j=1}^{J_m} \gamma_{jm} I(x \epsilon R_{jm})$

        $g_m(x) = (1-\gamma) f_m(x) + \gamma_t F_t$

        $\lambda_t = \frac{1+\sqrt{1+4\lambda_{t-1}}^2}{2}$ and $\lambda_{t+1} = \frac{1+\sqrt{1+4\lambda_t}^2}{2}$

        and $\gamma_t = \frac{1-\lambda_t}{\lambda_{t+1}}$

    Output $f\hat{(x)} = f_M(x)$