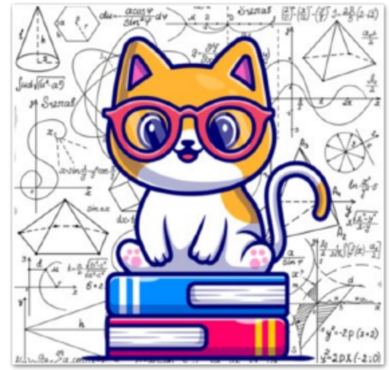
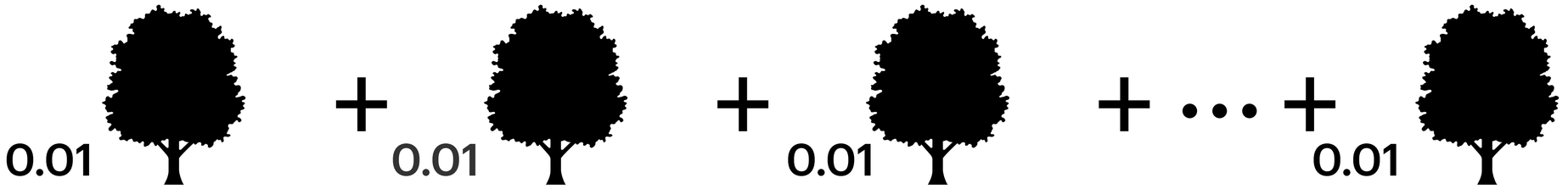
Gradient Boosting Trees: The Algorithm

1. Fit a simple model $T^{(0)}$ on the training data $\{(x_1, y_1), \ldots, (x_N, y_N)\}$
   Set $T \leftarrow T^{(0)}$ and compute residuals $\{r_1, \ldots, r_N\}$ fort T
2. Fit a simple model $T^{(1)}$ to the current **residuals**, i.e. train using $\{(x_1, r_1), \ldots, (x_N, r_N)\}$
3. Set $T \leftarrow T + \lambda T^{(1)}$ where λ is the learning rate (usually 0.01 or 0.001)
4. Compute residuals, set $r_n \leftarrow r_n - \lambda T^{(i)}(x_n),\ n = 1,\ldots,N$
5. Repeat steps 2-4 until stopping condition is met

Gradient Boosting Trees: The Math





$$z_0 + 0.01 z_1 + 0.01 z_2 + \cdots + 0.01 z_n$$

baseline prediction

how do we choose these errors to correct?

future trees predict error for a regression tree given defined loss function

let F_i be our predictions $F_i = \sum_{t=0}^{i} z_t$

$$F_1 = z_0 + z_1$$
$$F_2 = z_0 + z_1 + z_3$$
$$\vdots$$

$$F_i = F_{i-1} + z_i$$

$$z_i = -\frac{\partial Loss(y, F_i)}{\partial F_i}$$