Gradient Boosting Trees: The Math

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

Negative Gradient of Loss w.r.t. Ensemble Prediction

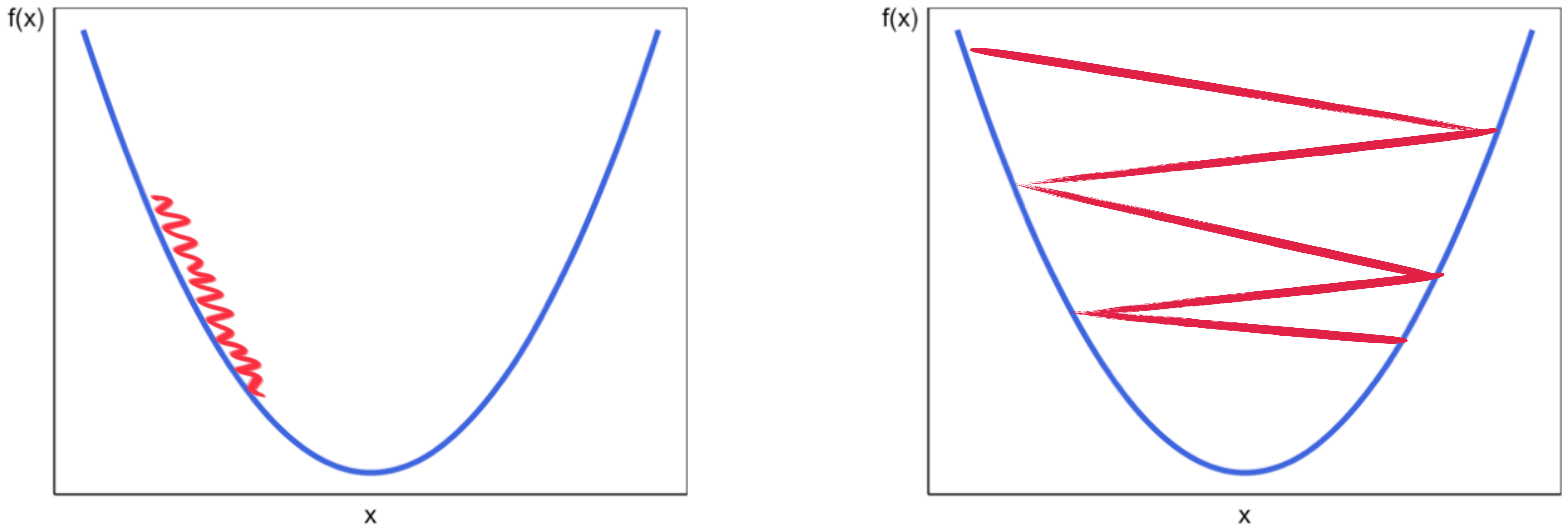
- The Negative Gradient tell us what adjustments we should make to our prediction F_i in order to decrease our loss
- Example:

$$Loss(y, \hat{y}) = (y - \hat{y})^2 \implies -\frac{\partial Loss(y, \hat{y})}{\partial \hat{y}} \implies 2(y - \hat{y})$$

- With squared loss, error is the negative gradient, but the negative gradient will work in other situations!

Choosing a Learning Rate: Convexity

- Under ideal conditions, gradient descent iteratively approximates and converges to the optimum
- For a constant learning rate λ
  - if λ is too small, it takes too many iterations to reach the optimum
  - if λ is too large, algorithm may 'bounce' around the optimum and never get close



  - Better to treat learning rate as a variable, that is let the value depend on gradient
  - around optimum λ is small, and far from optimum λ is larger