# Formalizing Bias Variance Trade-Off

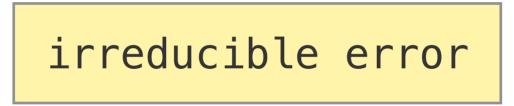
#### [try it out: <a href="https://floswald.shinyapps.io/bias variance/l">https://floswald.shinyapps.io/bias variance/l</a>

## Expected test MSE

$$F\left(v_{\alpha} - \hat{f}(v_{\alpha})\right)^{2} - Var\theta$$

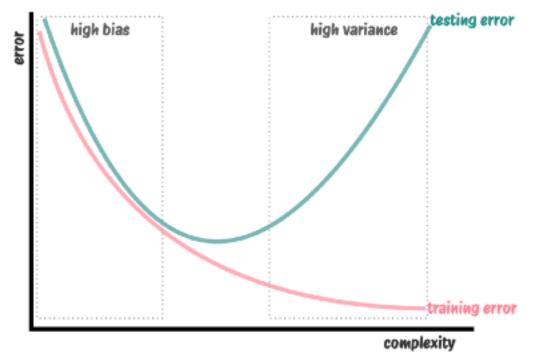
$$E\left(y_0 - \hat{f}(x_0)\right)^2 = \operatorname{Var}(\hat{f}(x_0)) + \left[\operatorname{bias}(\hat{f}(x_0))\right]^2 + \operatorname{Var}(\epsilon)$$

expected MSE at  $\mathcal{X}_0$  if we repeatedly estimated f(x)with different training sets

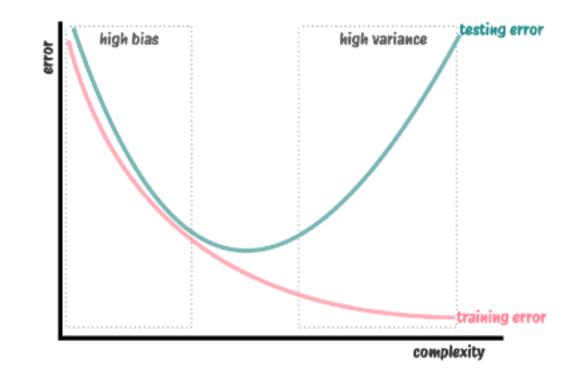








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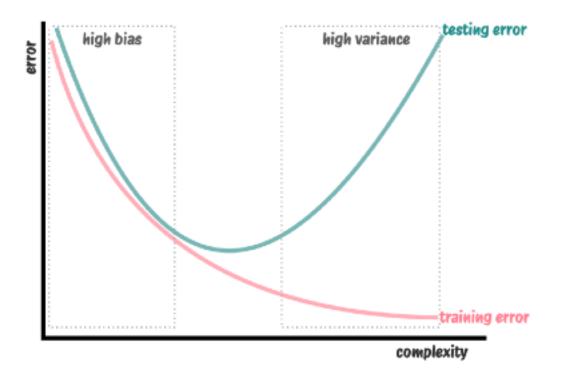
### Expected test MSE

$$E\left(y_0 - \hat{f}(x_0)\right)^2 = \operatorname{Var}(\hat{f}(x_0)) + \left[\operatorname{bias}(\hat{f}(x_0))\right]^2 + \operatorname{Var}(\epsilon)$$

expected MSE at  $x_0$  if we repeatedly estimated f(x) with different training sets

irreducible error

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### Expected test MSE

$$E\left(y_0 - \hat{f}(x_0)\right)^2 = \operatorname{Var}(\hat{f}(x_0)) + \left[\operatorname{bias}(\hat{f}(x_0))\right]^2 + \operatorname{Var}(\epsilon)$$