# BIAS AND VARIANCE TRADE-OFF

↳ Characteristics of a model

2 properties for generalization →

① Low training error

— Bias

② Train & test error is similar

— Variance

# BIAS (assumptions)

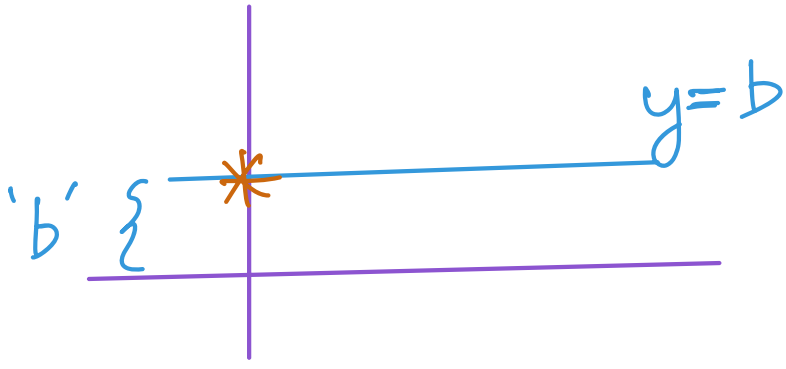
- "Inability of a model to capture the relationship in the training data"

$$y = wx + b$$ → bias

Task : Relationship $X \rightarrow Y$

When do you fail?

1. If 'b' is very large, it'll dominate the output
2. When input isn't present ($x = 0$), $y = b$, dictates the "assumptions" of the model



## What are the consequences of making these assumptions ?

① High Bias

⇒ Inability to map $X \rightarrow Y$

⇒ High training error

② Low Bias → DESIRED

⇒ Low training error

# VARIANCE

"Difference of fit in between different datasets"

different → train & test

① High variance

→ Diff. b/w train & test error is large

② Low variance

→ Diff. b/w train & test is low

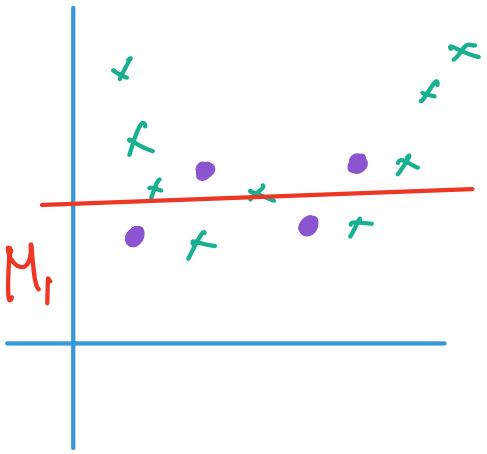
→ DESIRED

(Low train error) + (Train error ≈ Test error)

↓ Low bias

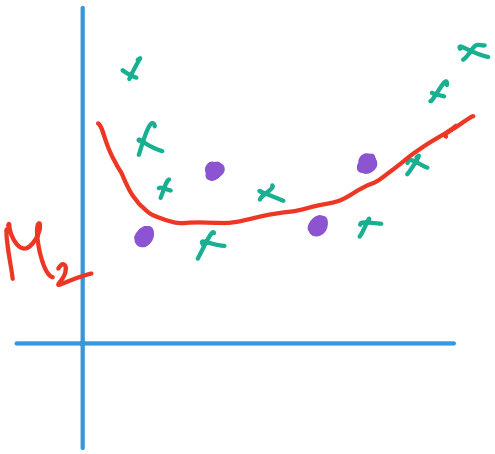
↓ Low variance

● TRAIN  x TEST



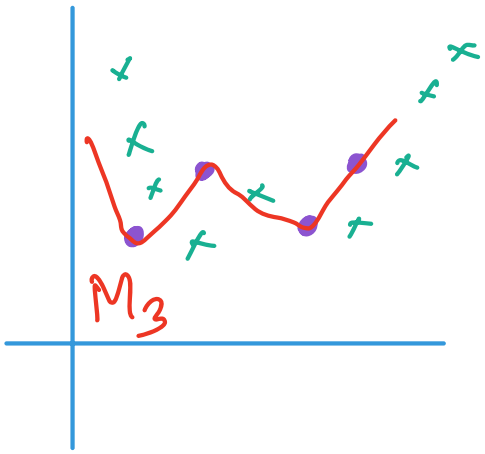

HIGH BIAS

LOW VARIANCE




LOW BIAS

LOW VARIANCE




LOW BIAS

HIGH VARIANCE

↓

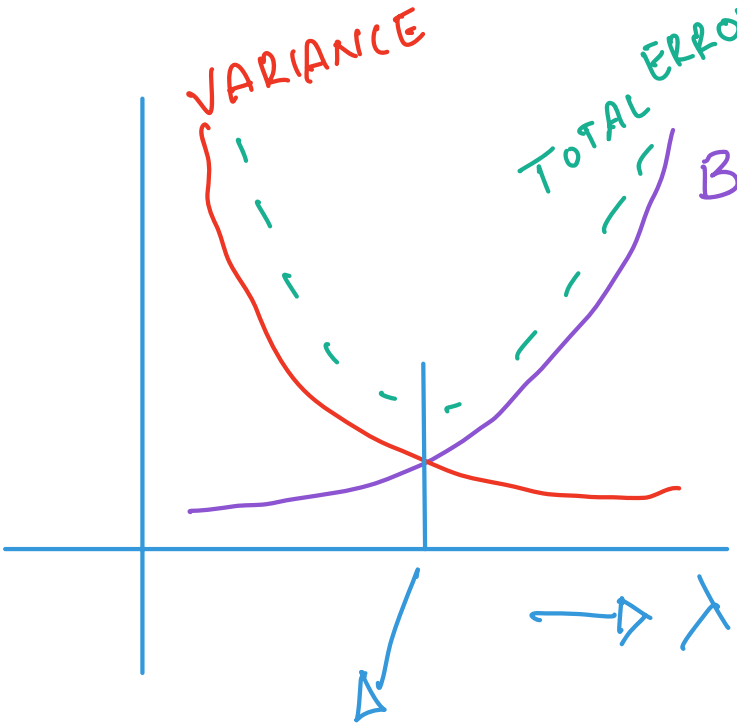
OVER FITTING

# PREVENTION OF OVERFITTING

1. Regularization
2. Bagging
3. Boosting

# PREVENTION OF OVERFITTING

① Regularization → Reducing reliance on training data (by changing slope)




⇒ ↑ BIAS

⇒ ↓ VARIANCE

"Choose this λ"

(Model complexity)

$$J = \|\hat{y} - y\|_2^2 + \lambda w^2$$