HYPERPARAMETER TUNING & BOOSTING

Hyperparameter Tuning

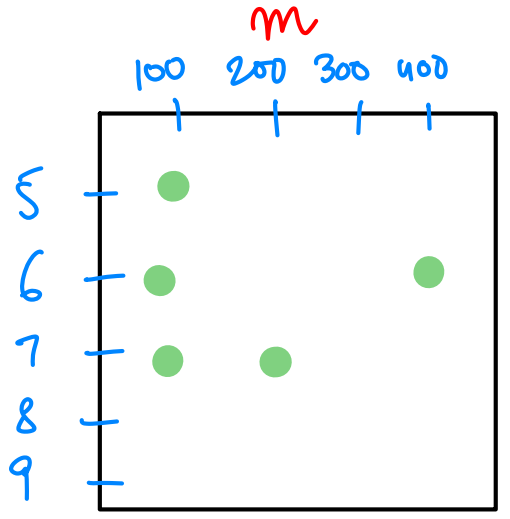
1. Grid Search
2. Randomised Search.

RF → d = depth
m = # of decision Trees

[5, 6, 7, 8, 9]

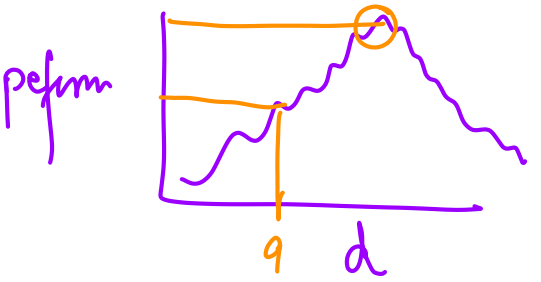
[100, 200, 300, 400]

1. Grid Search

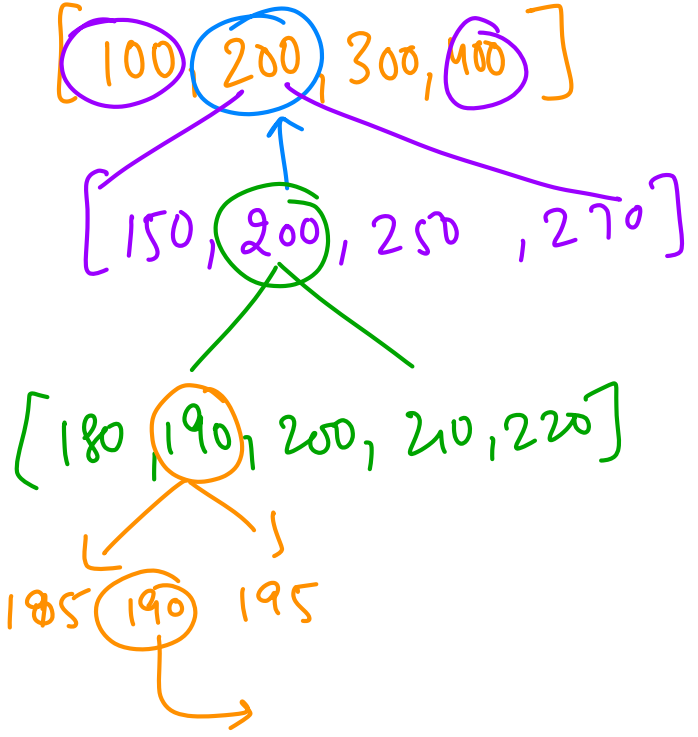


I1 ⇒ m = 200
d = 9

[ ] → 8, 9, 10, 11, 12



m = [100, 200, 300, 400]



for i in range(1, 1000):

A [. . . . .]5
B 5
C 5
D 5
E 5

① Time Consuming
② Computation Challenges.

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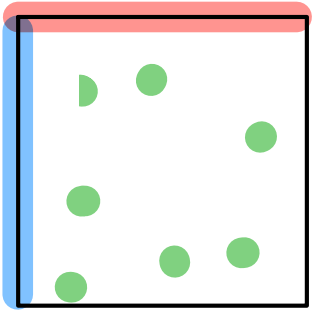
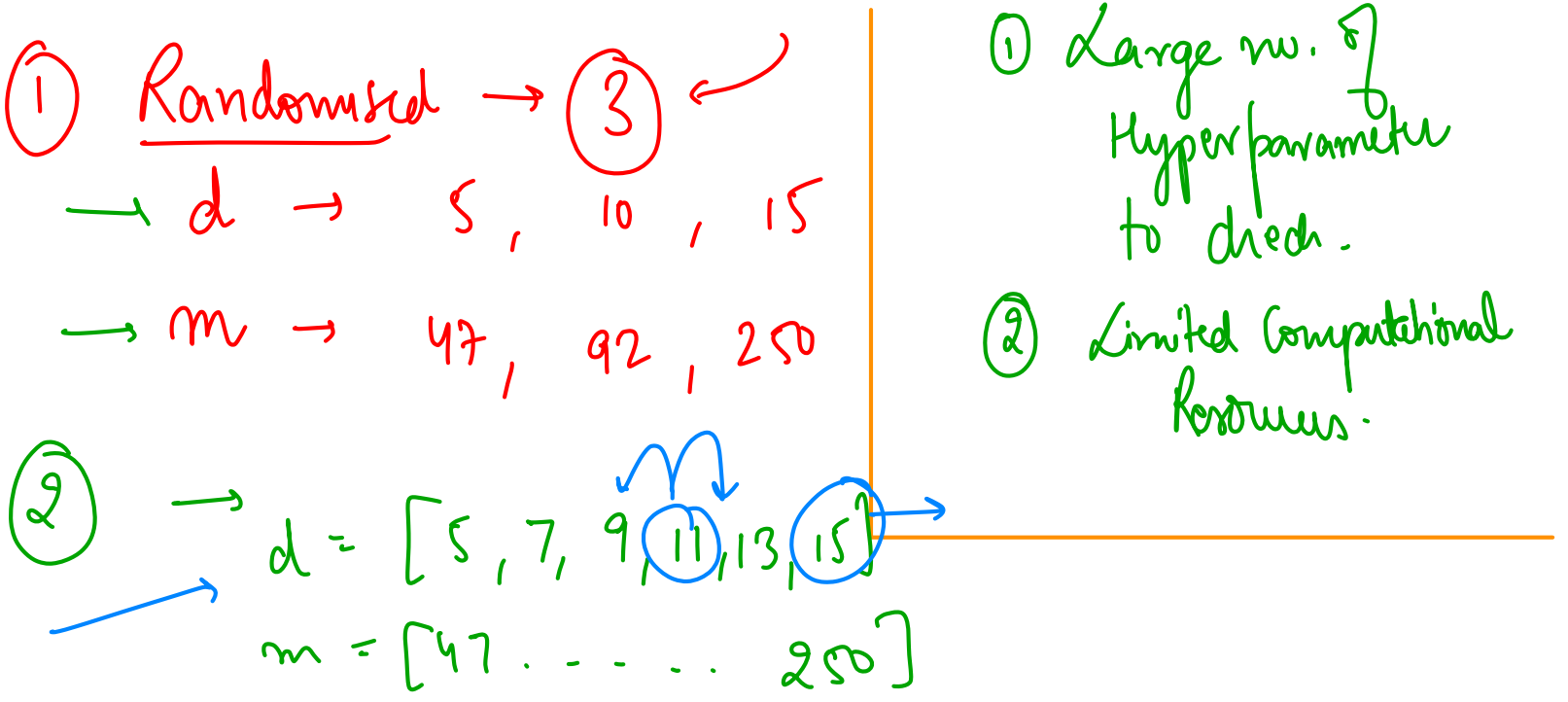
② Randomised Search → d ⇒ [1 100]
m ⇒ [1 . . . . 1000]



→ Best ??




```
Best params:  {'bootstrap': True, 'criterion': 'gini', 'max_depth': 10, 'max_features': 8,
'n_estimators': 200}
Best score:  0.9004329004329005
```

```
Best params:  {'bootstrap': False, 'criterion': 'gini', 'max_depth': 10, 'max_features': 8,
'n_estimators': 100}
Best score:  0.9020562770562771
```

```
Best params:  {'bootstrap': False, 'criterion': 'gini', 'max_depth': 11, 'max_features': 5,
'n_estimators': 200}
Best score:  0.9080086580086579
```

```
Best params:  {'bootstrap': False, 'criterion': 'gini', 'max_depth': 11, 'max_features': 3,
'n_estimators': 180}
Best score:  0.9123376623376623
```

```
Best params:  {'bootstrap': False, 'criterion': 'gini', 'max_depth': 12, 'max_features': 1,
'n_estimators': 200}
Best score:  0.9188311688311689
```

```
Best params:  {'bootstrap': False, 'criterion': 'gini', 'max_depth': 12, 'max_features': 2,
'n_estimators': 210}
Best score:  0.91504329004329
```

```
Best params:  {'bootstrap': False, 'criterion': 'gini', 'max_depth': 13, 'max_features': 1,
'n_estimators': 190}
Best score:  0.9193722943722943
```

BAGGING

Aggregated

Base Learner → Low Bias & High Variance

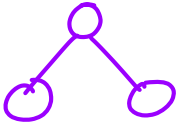
Reduced Variance → Aggregation + Randomisation.

BOOSTING

Base Learner → High bias & Low Variance

Underfit

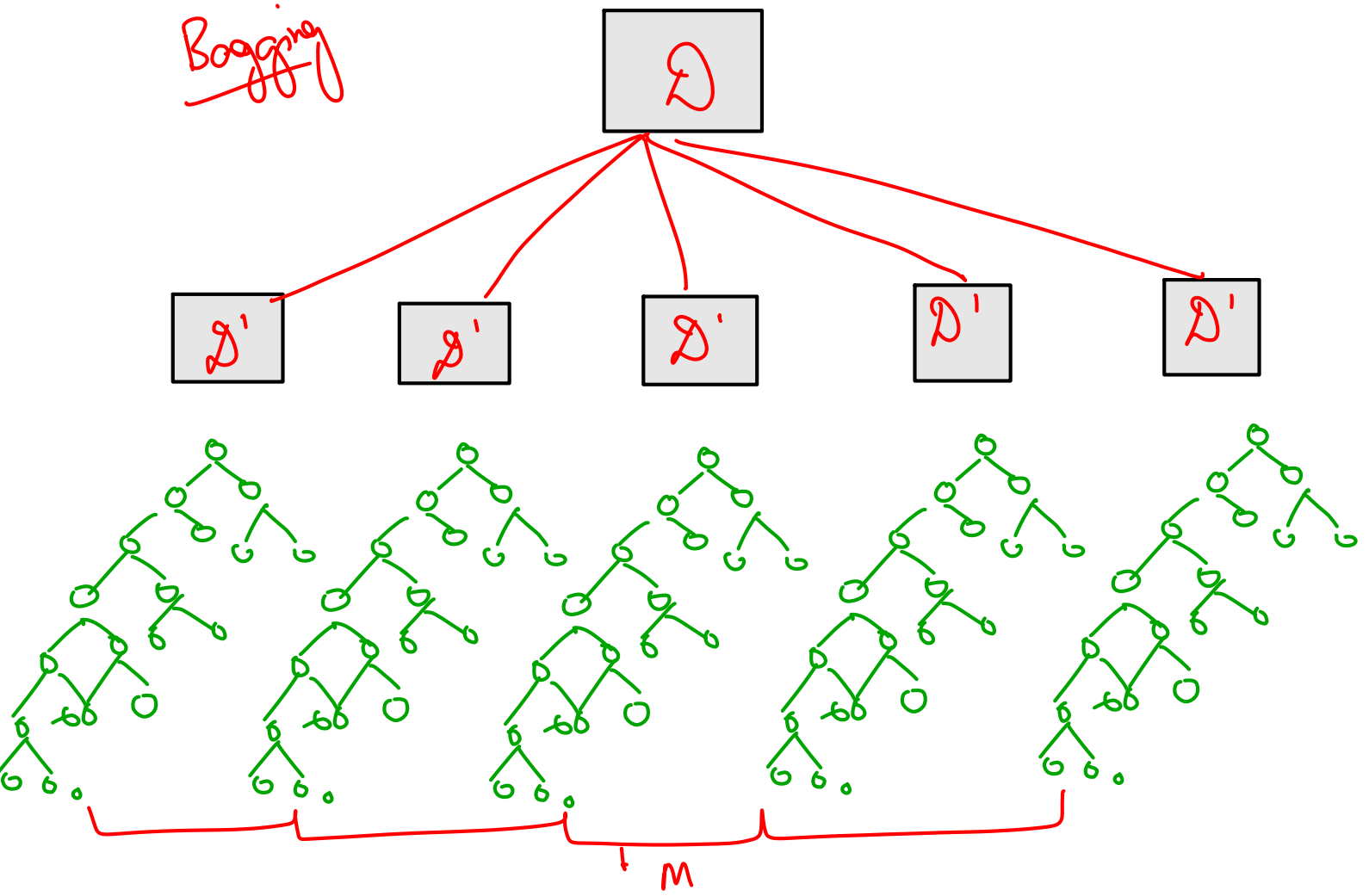
* mean model
* DecisionStump



M → Low bias + Low Variance

= ??

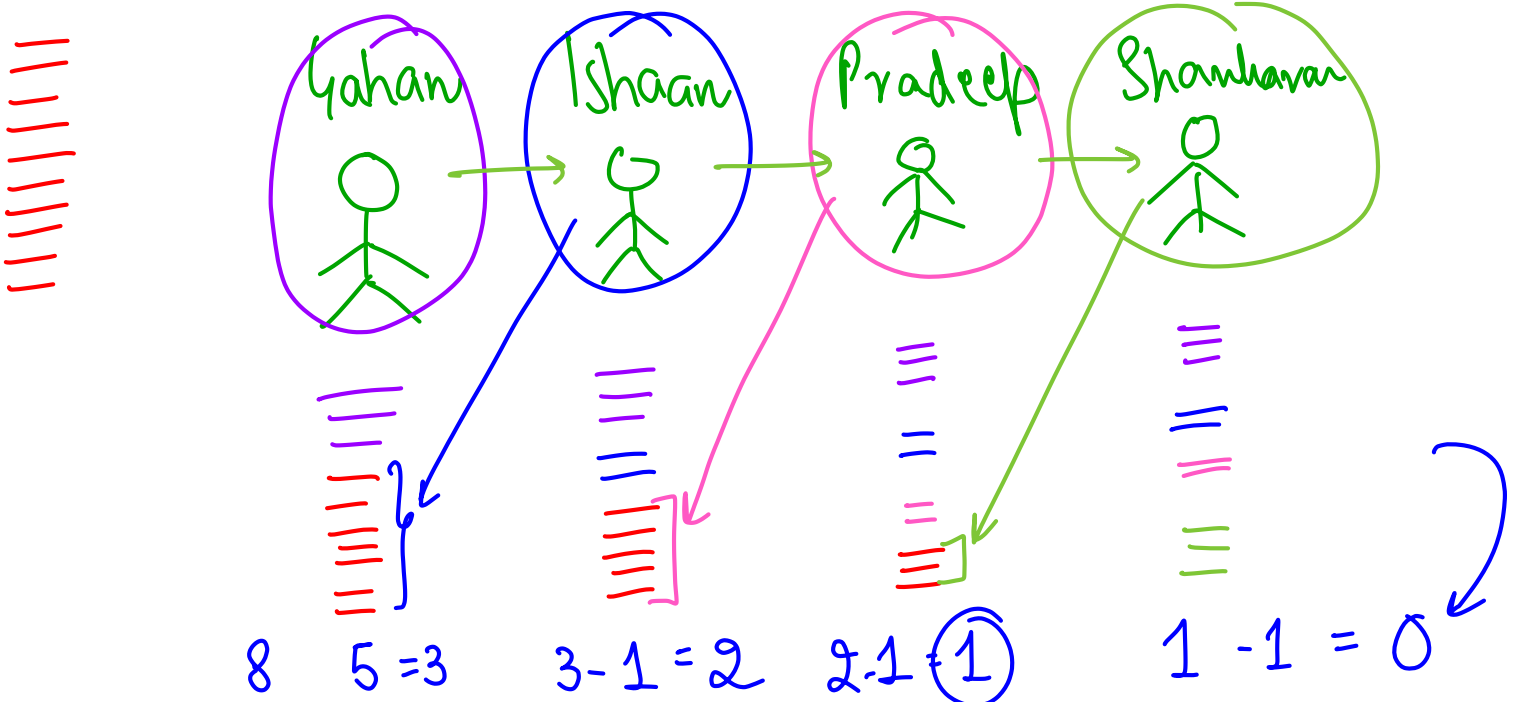
Additive Combining

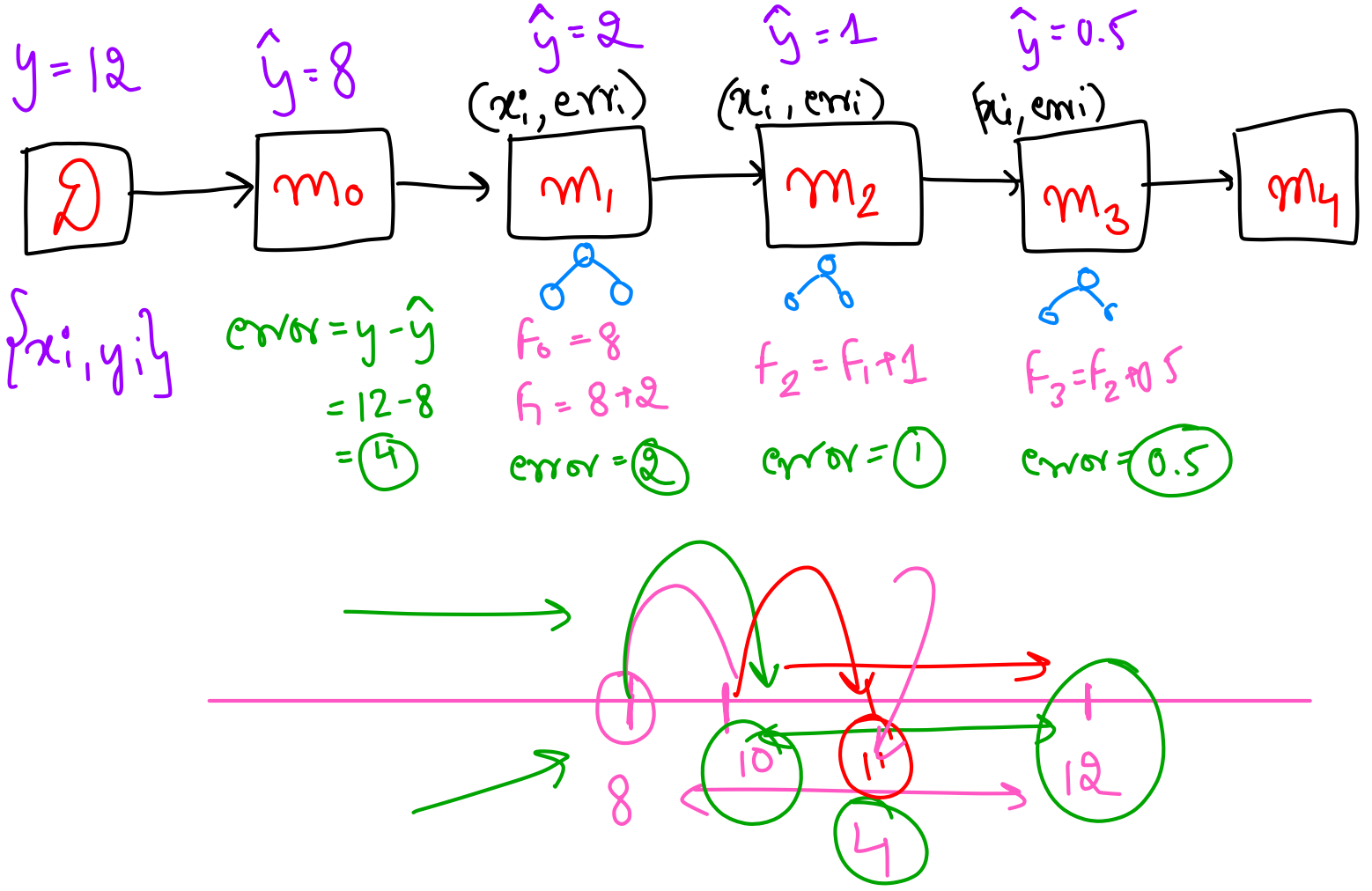

Bagging
D
D'
D'
D'
D'
D'
M

BOOSTING

Create models Sequentially

Next Model → learn mistakes from previous model.




y = 12
ŷ = 8
ŷ = 2
ŷ = 1
ŷ = 0.5
(xi, erri)
(xi, erri)
(xi, erri)
D
m0
m1
m2
m3
m4
{xi, yi}
error = y - ŷ
= 12 - 8
= 4
f0 = 8
f1 = 8 + 2
error = 2
f2 = f1 + 1
error = 1
f3 = f2 + 0.5
error = 0.5
8
10
11
12
4


m_0
$m_1\hat{y}_1$
$m_2\hat{y}_2$
$m_3\hat{y}_3$
f_1 f_2 f_3 y $\hat{y}_0$ err_0 (f_1,f_2,f_3,err_0) err_1 (f_1,f_2,f_3,err_1) err_2
3 5.5 -2.5 -1.5 -1 -0.5 -0.5
4 5.5 -1.5 -0.5 -1 -0.3 -0.7
6 5.5 0.5 0.5 0 0 0
9 5.5 3.5 2 1.5 1 0.5
mean of y's
$y-\hat{y}_0-\hat{y}_1$
$y-\hat{y}_0-\hat{y}_1-\hat{y}_2$
$12-8-2=2$

Quiz time!

Quiz Ended!

Which of the following model are underfit models ?

20 users have participated

✓	A	Decision Stump (Decision Tree with depth = 1)	95%
	B	Decision Tree with depth = 20	5%
	C	Decision Tree with depth = 10	0%
	D	None of the above.	0%

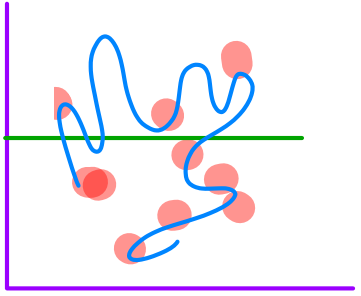
Quiz time!

Quiz Ended!

What model will have high bias low variance ? (Hint: think of simplest model)

20 users have participated

✓	A	Mean model (which predict mean value everytime)	95%
	B	Random model (model which predicts random value everytime)	0%
	C	A DT fit perfectly on training data	5%



Quiz time!

Quiz Ended!

underfitted

What will be the training error for high bias model ?

21 users have participated

A	High error	71%
B	No error	0%
C	Low error	29%

Quiz time!

Quiz Ended!

Why are we using DT with low depth here ?

18 users have participated

A	we are looking for high variance low bias mode	22%
B ✓	we are looking for high bias low variance model	72%
C	we are looking for overfit model	6%
D	no reason. just picked it randomly.	0%

Quiz time!

Quiz Ended!

What error shall we use here at stage 2 ?

19 users have participated

✓	A	Residual left after subtracting final model prediction (F_1(x)) from actual value	21%
	B	Residual left after subtracting Stage 1 model (M_1) from actual value	63%
	C	Residual left after subtracting Stage 0 model (M_0) from actual value	11%
	D	None of the above	5%

Binary $\Rightarrow$ $p(y_i) \boxed{-p \cdot \log_2(p/y_i))}$ $= 1$

Multi class $\Rightarrow$ $-p \cdot \log_2(3)$

	R	G	B
100	B	B	100 pure
	33	33	34