

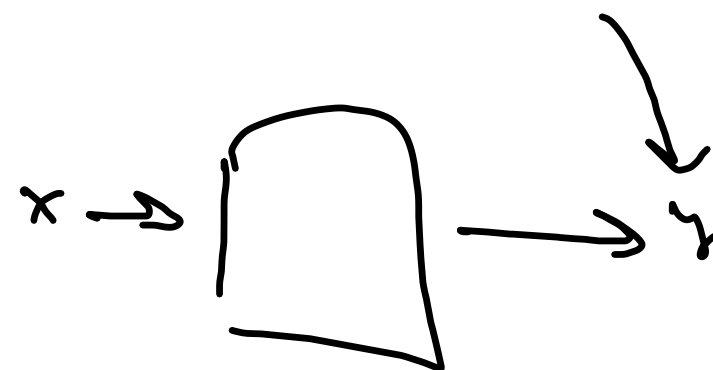


Regression

$y$   
infinite set  
 $\{0.1, 0.2, \dots\}$   
 $0.01$

classification

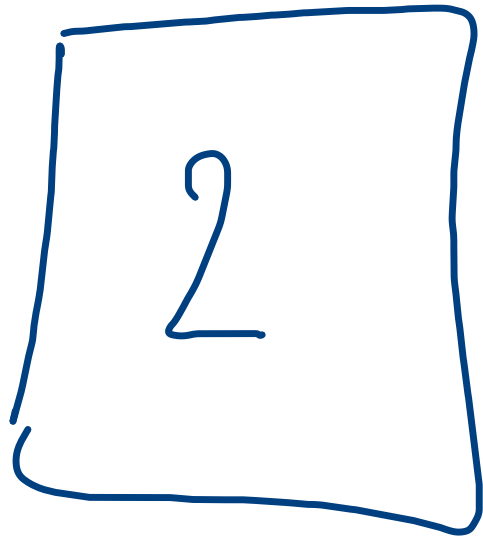
finite set  
 $\{0, 1, 2\}$



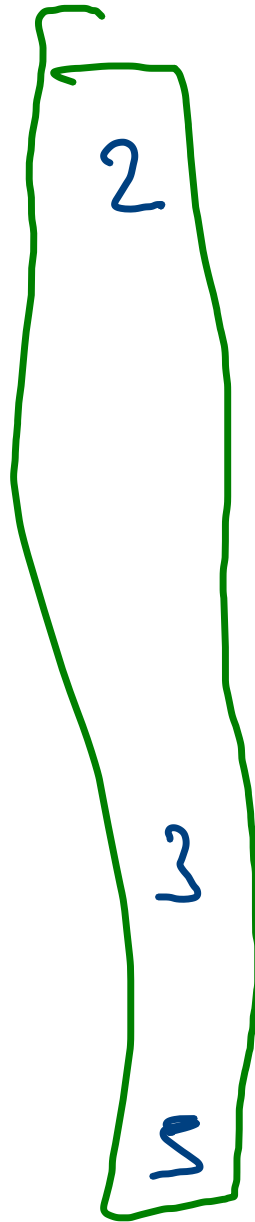
X  
mhist.dah

g  
mhist. tarsel

28

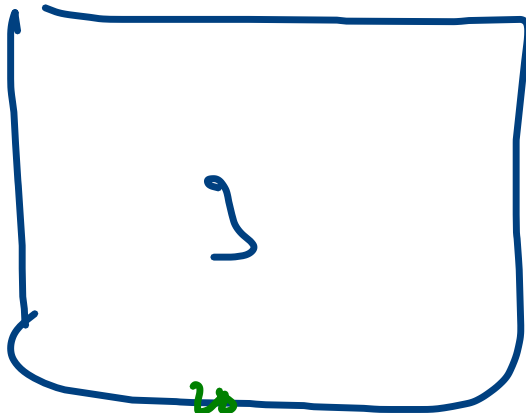


28



{ 0 ... 9 }

28

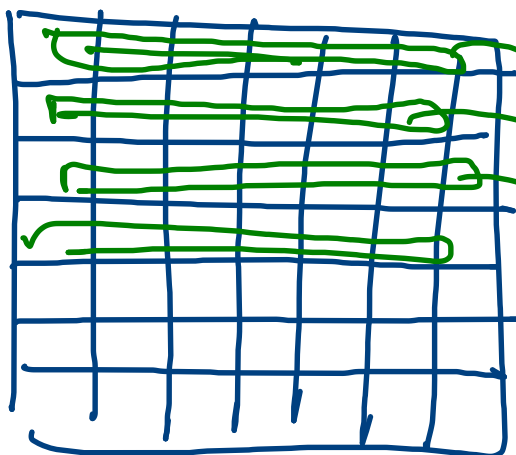


28



2D

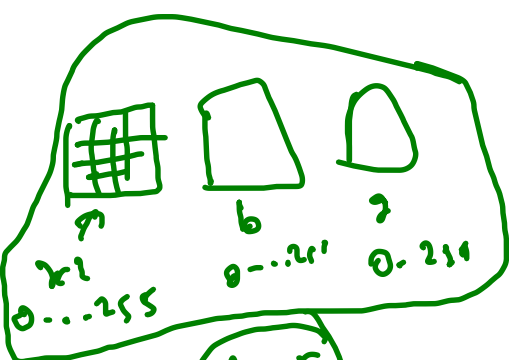
24



284

28

blw



24

2 → 7 8 9

black

white

multi class class  $\rightarrow > 2$  classes  $\{0, 1, \dots\}$

binary class class  $\rightarrow 2$  classes  $\{0, 1\}$

0  
1  
2  
3  
4  
5  
5  
6  
7  
8  
9  
}

false

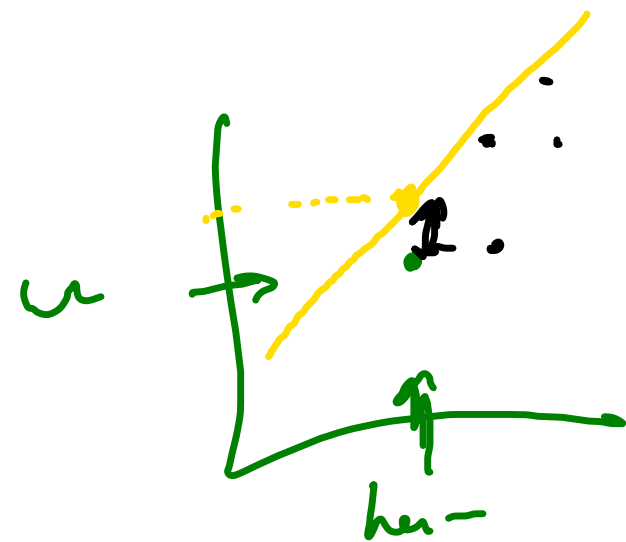
True

false

$\{0, 1\}$

Square error  $\rightarrow \sum (y_{act} - y_{pred})^2$

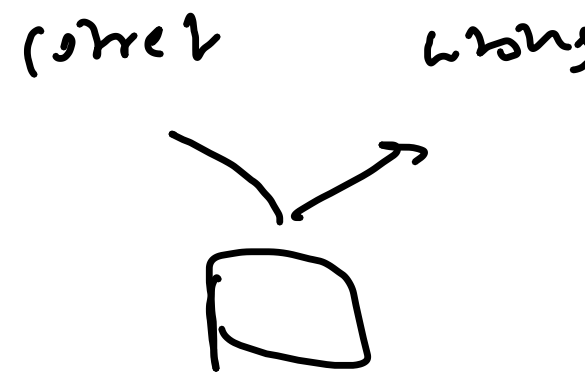
mean sq error  $\rightarrow \frac{\sum (y_{act} - y_{pred})^2}{N}$



accuracy =

$$\frac{\text{correct prediction}}{\text{Total prediction}}$$

Correct & Wrong



Cor  
Cor & Wro

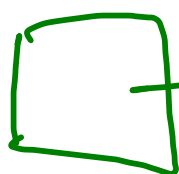
metric  
system

$n < 5$

$n \geq 5$

0	- 10k
1	- 10k
2	- 10k
3	
4	
5	- 10k
6	
7	- 10k
8	
9	- 10k

$x$   
 $\rightarrow$



label

a counter  $\rightarrow$

$\alpha$

$$\frac{\text{Total correct}}{\text{Total}} \rightarrow$$

$$\frac{9/10}{10/10}$$

$$\frac{9}{10} = \boxed{0.9}$$

True	False
10k	90k

$\leftarrow$  not a  
balanced  
dataset

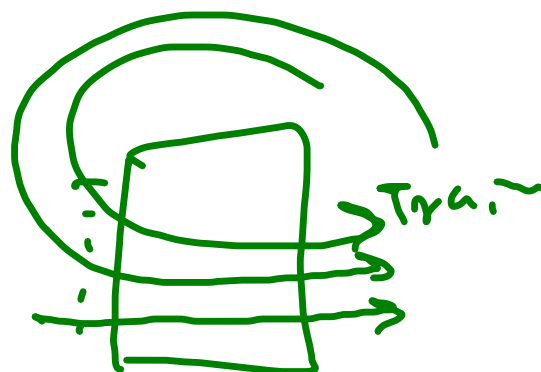
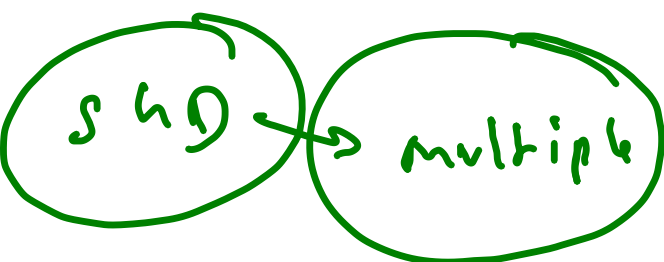
< 5

0 1 2 3 4

→ True

5 6 7 8 9

→ False





# Confusion Matrix

Actual

	prediction	
	!= 5 neg	= 5 pos
!= 5 neg	15863	837
= 5 pos	50	744

TP  
 TN  
 FP  
 FN

actual

	predict	
	neg	pos
neg	TN	FP
pos	FN	TP

correct  $\rightarrow$  T  
 wrong  $\rightarrow$  F

$\overline{P}$  —  $P$  model predict

Precision

$$= \frac{TP}{TP + FP}$$

you've kids video sale

Actual

	Predict	
	N	P
Actual	N	TN <span style="border: 2px solid yellow; padding: 2px;">FP</span>
	P	<span style="border: 2px solid green; padding: 2px;">FN</span> TP

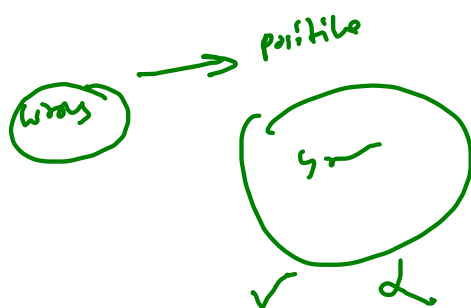
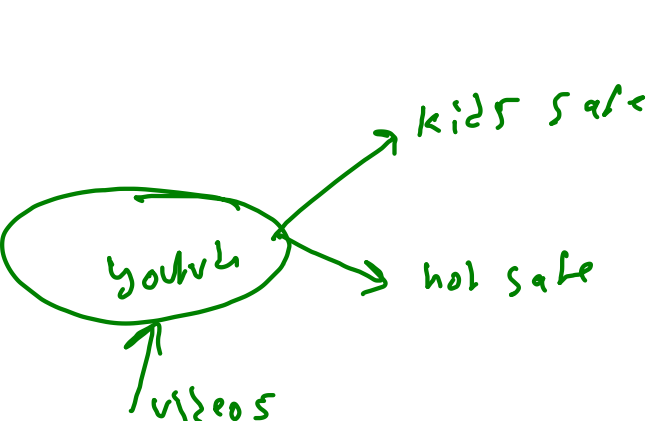
type 2 error

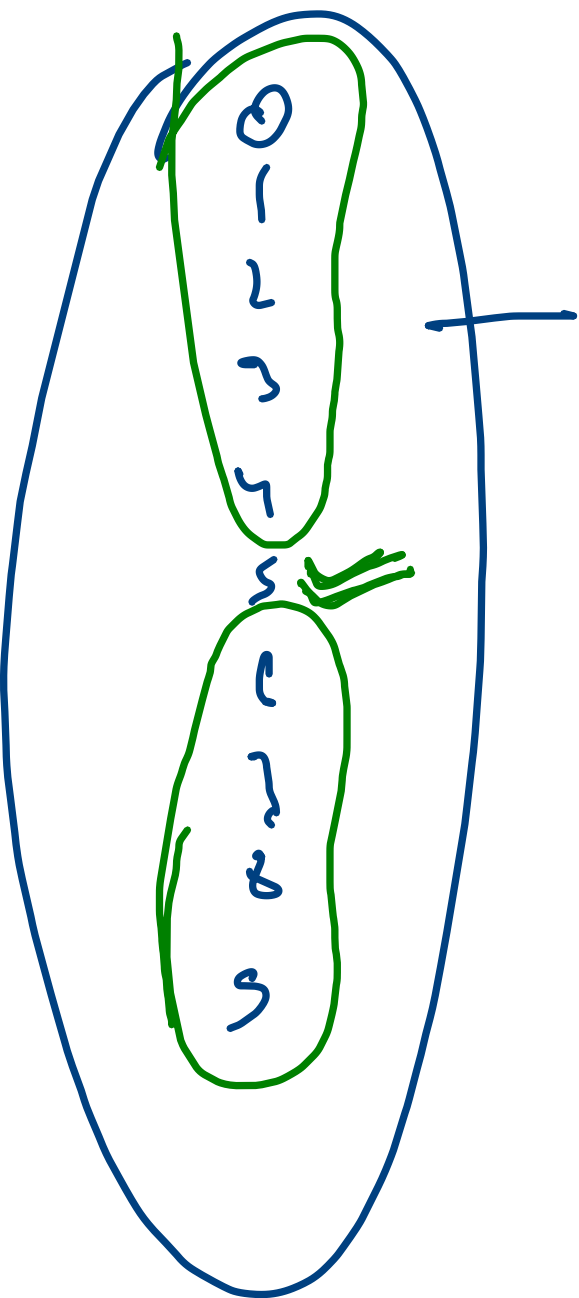
Type 1 error

Recall

$$= \frac{TP}{FN + TP}$$

Report post shop lister





True

HP → mean

PR

RC

$$\frac{\overset{\uparrow}{PR} + \overset{\circ}{RC}}{2}$$

Mean

PR

RC

resu

↓

↓

↓

↑

↓

↑

↓

↑

↑

↑

↑

↑

HP →

?

how

PR

RC

resu

↑

↑

↑

NP

a

b

c

d

$$\frac{1}{a}$$

$$\frac{1}{b}$$

$$\frac{1}{c}$$

$$\frac{1}{d}$$

PR

RC

$$b = \frac{a+c}{2}$$

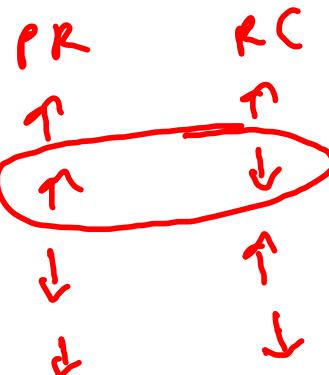
$$\frac{1}{b} = \frac{1}{\frac{a+c}{2}}$$

$$= \frac{2}{\frac{1}{\frac{1}{a}} + \frac{1}{\frac{1}{c}}}$$

$$= \frac{2}{\frac{1}{PR} + \frac{1}{RC}}$$

$$= \frac{2}{\frac{RC + PR}{PR \times RC}}$$

$$\frac{2 \times PR \times RC}{PR + RC}$$



Result  
↑  
↓  
↓  
↓

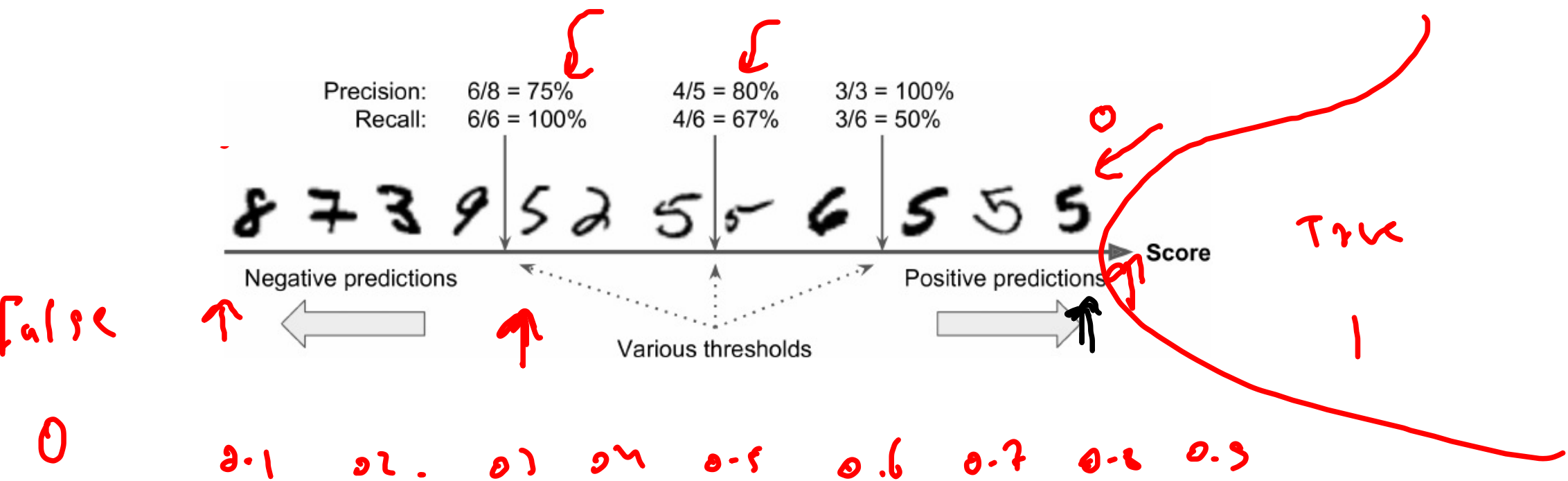
F1-Score

prob  
 A 0.1 0.5 0.6 B

True  $\rightarrow$  1  
 False  $\rightarrow$  0

0, 0.2, 0.4, 0.5, 0.6, 0.8

x	y	m	Precision				Recall
			0.6	0.5	0.3	0.4	
x <sub>1</sub>	1	0.95	1	1	1	1	1
x <sub>2</sub>	1	0.6	1	1	0	1	1
x <sub>3</sub>	0	0.55	0	1	0	1	1
x <sub>4</sub>	1	0.5	0	1	0	1	1
x <sub>5</sub>	0	0.45	0	0	0	1	1
x <sub>6</sub>	0	0.49	0	0	0	1	1
x <sub>7</sub>	0	0.3	0	0	0	0	0
			P	P	P	P	P
			R	R	R	R	R



ROC

TPR

actual positive  
model positive

$$\frac{TP}{TP + FN}$$

		predicted	
		N	P
Actual	N	TN	FP
	P	FN	TP

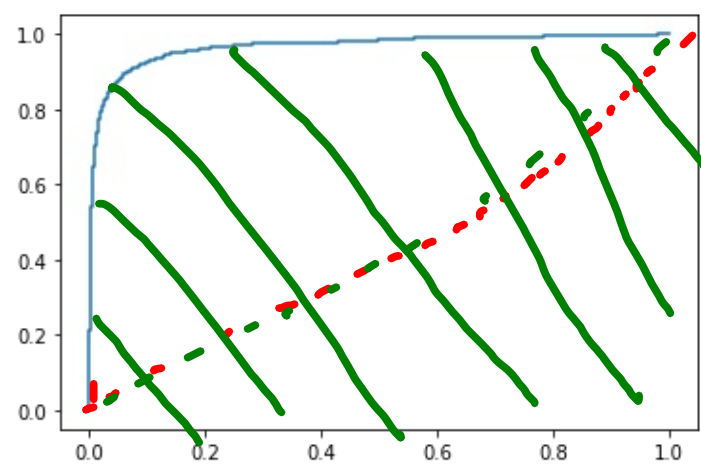
FPR

actual negative  
model positive

$$\frac{FP}{TN + FP}$$



TPY



FPY

Actual

1x2

	A <sub>N</sub>	B <sub>N</sub>	C <sub>P</sub>
A <sub>N</sub>	5	6	8
B <sub>N</sub>	7	8	4
C <sub>P</sub>	7	3	2

A 1 TP →  
 B 0 TN →  
 FP →  
 FN →

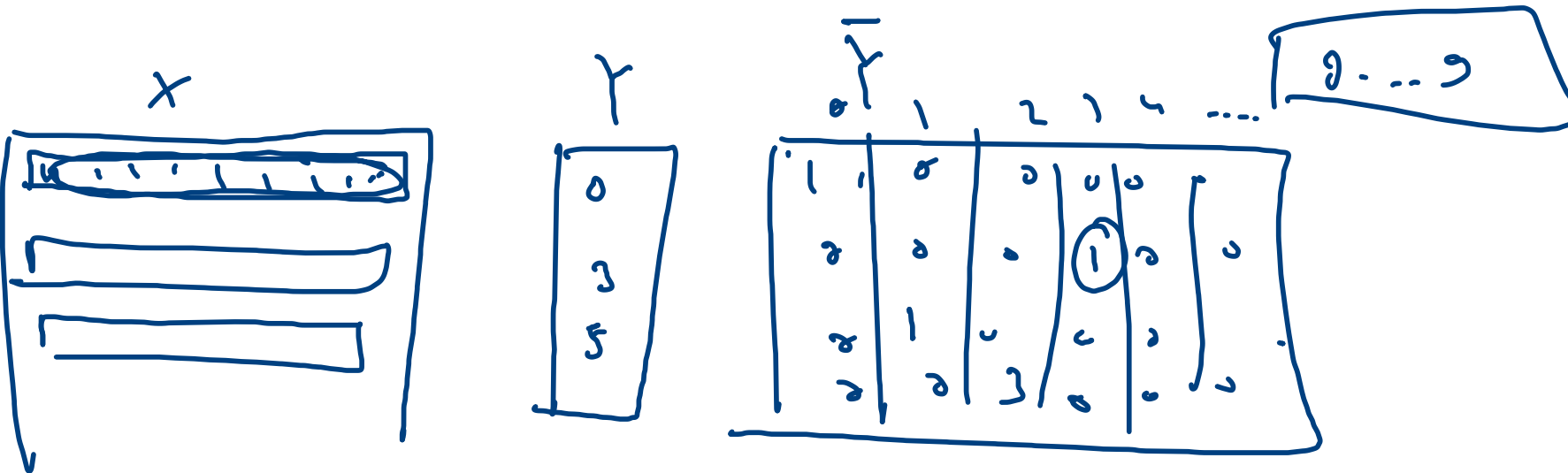
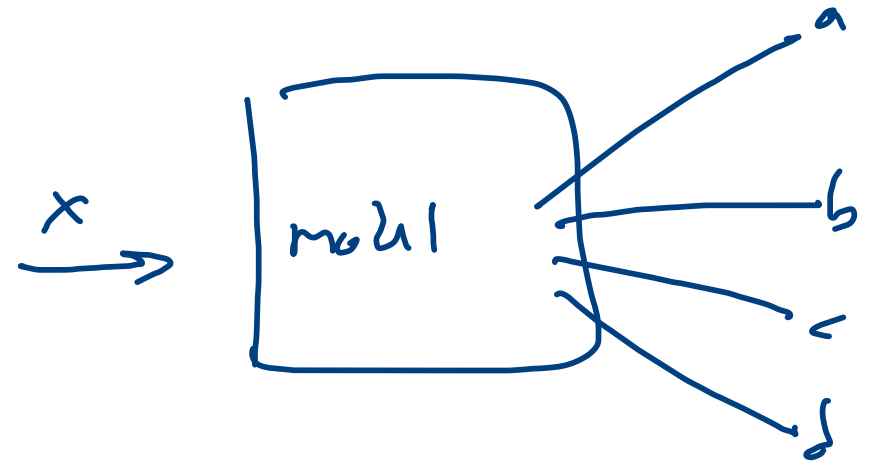
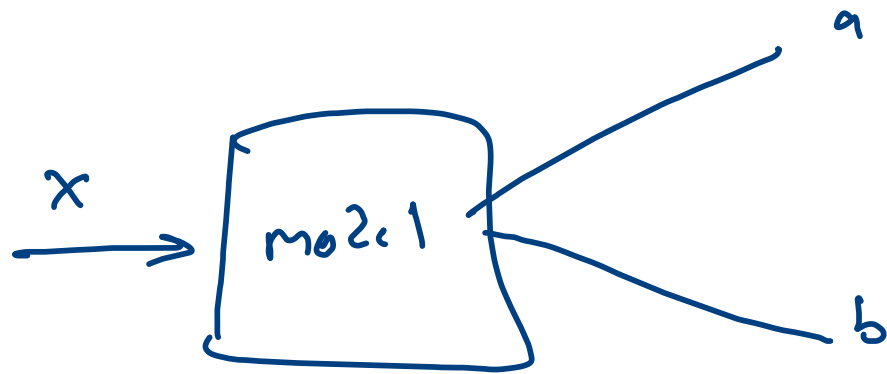
B 1 TP →  
 B 0 TN →  
 FP →  
 FN →

C 1 TP →  
 A B 0 TN →  
 FP →  
 FN →

Binary classification

==

multi class classification



~~One vs  
Rest~~

0  
1  
2  
3  
4  
5  
6  
7  
8  
9

number  
[ ]

mod 11

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

0 → a  
1...9 → b

1 → a  
rest → b

2 → a  
rest → b

3 →

4  
5  
6  
7  
8  
9

0 probabilities

1 prob

2 prob

3

4

5

6

7

8

9

0  
1  
2  
3  
4  
5  
6  
7  
8  
9

100 kb

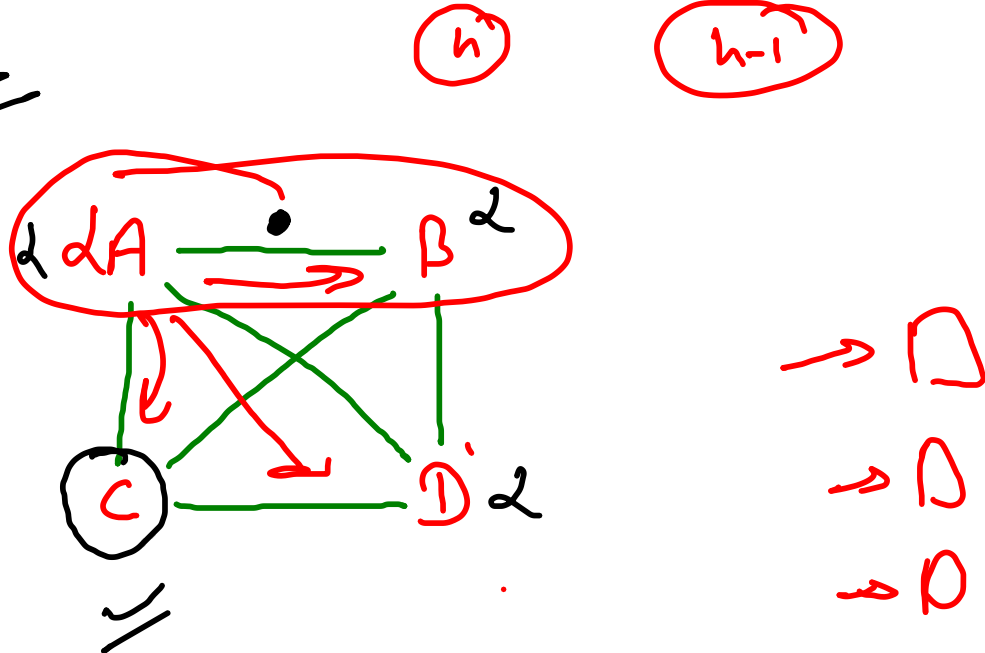
✓  
classes → 10

Total models = 10

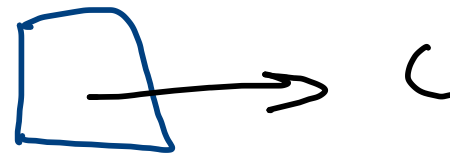
number of class x Dataset

1000

Ohe vs Ohe



unknown



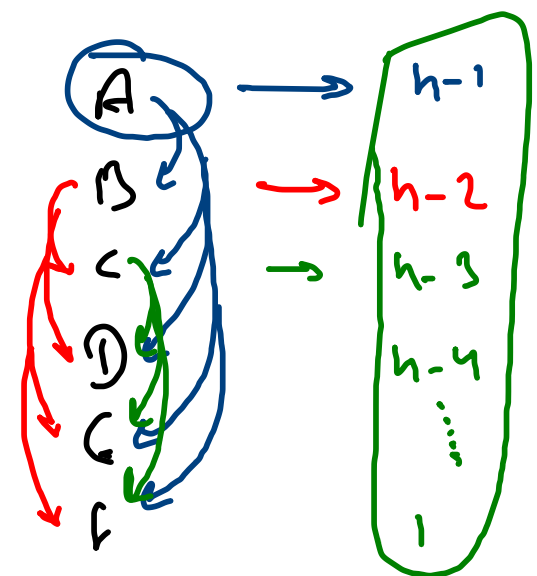
classes  $\rightarrow$   $\boxed{h}$



models  $\rightarrow 1+2+3+\dots+(h-1)$

$$= \frac{(h-1) \times h}{2}$$

$(h-1)$  Dataset



Bihar  $\rightarrow$  mulh'

mulh'  $\rightarrow$  kun  
random forest