Naive Baye's Algorithm (classification)
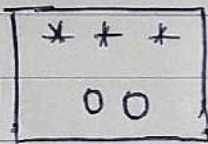
① Probability

② Baye's Theorm

Independent Events

Rolling a Dice $\{1,2,3,4,5,6\}$

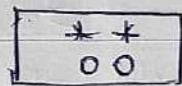$$Pr(1) = \frac{1}{6} \qquad P(2) = \frac{1}{6} \qquad Pr(3) = \frac{1}{6}$$

Dependent Event

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┌─────────┐
│ *  *  * │
│  o  o   │
└─────────┘
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① What is the probability of removing a star marble and then a circle marble

$$P(star) = \frac{3}{5} \rightarrow 1^{st} \text{ event} \rightarrow \text{star marble is remo}$$

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┌───────┐
│  *  * │
│  o  o │
└───────┘
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$$P(circle) = \frac{2}{4} = \frac{1}{2} \rightarrow 2^{nd} \text{ event.} \rightarrow \text{removed cir}$$

$$P(stare \text{ and } circle) = P(s) * P(c/s) \rightarrow \text{conditinal probabi}$$

$$= 3/5 * \frac{1}{2} = \frac{3}{10}$$

$$\boxed{P(A \text{ and } B) = P(A) + P(B/A)}$$

Baye's Theorm

$$P(A \text{ and } B) = P(B \text{ and } A)$$
$$P(A) * P(B/A) = P(B) * P(A/B)$$

$$\boxed{P(A/B) = \frac{P(A) + P(B/A)}{P(B)}} \longrightarrow \text{Bay's Theorm}$$

$P(A|B)$ = Probability of event A given B has occured
$P(A)$ = Probability of event A
$P(B)$ = Probability of event B.
$P(B/A)$ = Probability of event B given A has occured

$$\boxed{P(A|B) = \frac{P(A) + P(B/A)}{P(B)}} \quad \text{-1we predict } y$$

Independent feature

x_1	x_2	x_3	y -1 dependent feature
—	—	—	Ye_1
—	—	—	No

$$P(y|(x_1, x_2, x_3)) = \frac{P(y) * P(x_1, x_2, x_3 / y)}{P(x_1, x_2, x_3)}$$

$$= \frac{P(y) * P(x_1/y) + P(x_2/y) + P(x_3/y)}{P(x_1) + P(x_2) + P(x_3)}$$

$$Pr(ye_1/(x_1, x_2, x_3)) = \frac{P(ye_1) + P(x_1/ye_1) + P(x_2/ye_1) + P(x_3/ye_1)}{P(x_1) + P(x_2) + P(x_3)} = 1 \text{ constant}$$

$$Pr(No/(x_1, x_2, x_3)) = \frac{P(No) + P(x_1/No) * P(x_2/No) * P(x_3/No)}{P(x_1) * P(x_2) * P(x_3)} \approx \text{constant}$$

	Outlook	Temperature	Humidity	Wind	Play Tennis
1	Sunny	Hot	High	Weak	No
2	S	Hot	H	Strong	No
3	Overcast	Hot	H	W	Yes
4	Rain	mild	H	W	Yes
5	Rain	Cool	Normal	W	Yes
6	R	Cool	N	S	No
7	Overcast	Cool	N	S	Yes
8	Sunny	mid	H	W	No
9	S	Cool	N	W	Yes
10	Rain	mild	N	W	Yes
11	Sunny	mild	N	S	Yes
12	Overcast	mild	H	S	Yes
13	Overcast	Hot	N	W	Yes
14	Rain	mild	H	S	No

Outlook

	Yes	No	P(E/Yes)	P(E/No)
Sunny	2	3	2/9	3/5
Overcast	4	0	4/9	0/5
Rain	3	2	3/9	2/5

Total number of yes (9)

Total no of No's (5)

Temperature

	Yes	No	P(E/Yes)	P(E/No)
Hot	2	2	2/9	2/5
mild	4	2	4/9	2/5
Cool	3	1	3/9	1/5

Play

Yes 9   ~~P(y)~~ P(Yei) P(No)

No 5d   9/14 5/14

$P(Yei \mid Sunny, Hot) = \dfrac{P(Yei) + P_r(Sunny/Yei) + P_r(Hot/Yei)}{P_r(Sunny) * P(Hot)}$ ← Constant so

we can remove

$= \dfrac{9/14 * \frac{2}{9} + \frac{2}{9}}{7}$

$= \dfrac{2}{63} = 0.031$

$P(No/Sunny, Hot) = \dfrac{P(No) + P(Sunny/No) * P(Hot/No)}{7}$

$= \dfrac{5/14 * 3/5 * 2/5}{7}$

$= \dfrac{3}{35} = 0.085$

$Pr(Yei \mid Sunny, hot) = \dfrac{0.031}{(0.31 + 0.085)} = 0.27 = 27\%$

$Pr(No \mid Sunny, hot) = \dfrac{0.085}{(0.031 + 0.85)} = 0.73 = 73\%$

Out look	Temperature	O/P
Sunny	Hot	73% = They will not play tennis
		27% = They will play tennis

Variants of Naive Baye's

① Bernoulli Naive Baye's
② Multinomial Naive Bay's
③ Goussian Naive Bayes

1) <u>Bernouli Naive Bayes</u> only having (0,1). fail @1\sucess.
Whenever your feautures are following a Bernouli Distribution, th
we need ue Bernouli Naive Alogort

Bernouli → 0,1

Dataset

t1	t2	t3	O/P
Yes	Pass	Male	Yes
Yes	Fail	Female	No
No	Pass	Male	Yes

② <u>Multinomial Naive Baye's</u> ⟂ I/p = Text

Dataset → spam classificati   O/p
I/P   email Body   spam /notspam
      you have wom million   spam
      KR44 you have done   HAM
          good JOB
            ⟂
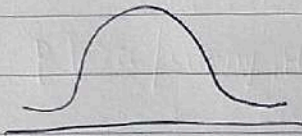   Numerical Values = Natural languag processing
                          ① Bow
                          ② Tf - Idf
                          ③ Wind v©

③ Gaussin Naive Baye's

If the features are following Gaussian Distribution, then we use
Gaussion Naive Baye

DATASET — Contineous.

Age	Height	Weight	Yes/No.
25	170	78	Yes
38	160	75	No
40	150	60	Yes