①

$$\text{Entropy}(S) = -(P_{\oplus})\log_2 P_{\oplus} - P_{\ominus}\log_2 P_{\ominus}$$

↓

+ means 1 in target

- means 0 in target

4+

2-

$S: [4_+, 2_-]$

$$E = -\frac{4}{6} \times \log_2 \frac{4}{6} - \frac{2}{6} \times \log_2 \frac{2}{6} = -\frac{4}{6} \times (-0.585) - \frac{2}{6} \times (-1.585)$$

$$= 0.389 + 0.528 = \boxed{0.917}$$

		Target	
		1	0
Weather	cold	3	0
	hot	1	2

$$E(T,X) = \sum_{n} P(n)E(n)$$

$$E(3,0) = 0,\ E(1,2) = -\frac{1}{3}\log_2 \frac{1}{3} - \frac{2}{3}\log_2 \frac{2}{3}$$

$$= -\frac{1}{3} \times (-1.585) - \frac{2}{3} \times (-0.585) = 0.528 + 0.389 = 0.917$$

$$\Rightarrow E(\text{target}, \text{weather}) = P(\text{cold})E(3,0) + P(\text{hot})E(1,2)$$

$$= \frac{3}{6} \times 0 + \frac{3}{6} \times 0.917 = 0.4585$$

		Target	
		1	0
price	cheap	2	0
	emp.	2	2

$$E(2,0) = 0$$

$$E(2,2) = -\frac{2}{4}\log_2 \frac{2}{4} - \frac{2}{4}\log_2 \frac{2}{4} = \underline{1}$$

$$E(\text{target}, \text{price}) = P(\text{cheap})E(2,0) + P(\text{emp})E(2,2) =$$

$$0 + \frac{4}{6} = \frac{4}{6} = \frac{2}{3}$$

$$= 0.667$$

		target	
		1	0
weight	light	2	1
	heavy	2	1

[illegible]

[illegible]

$E(2,1) = -\frac{2}{3}\log_2\frac{2}{3} - \frac{1}{3}\log_2\frac{1}{3} = 0.917$

[illegible]

[illegible]

$E(\text{target}, \text{weight}) = P(\text{light})\,E(2,1) + P(\text{heavy})\,E(2,1) =$

$\frac{1}{2} \times 0.917 + \frac{1}{2} \times 0.917 = 0.917$

Information gain = H(target) − E(target, (_))

weather

=> 0.917 − 0.4585 = 0.4585]

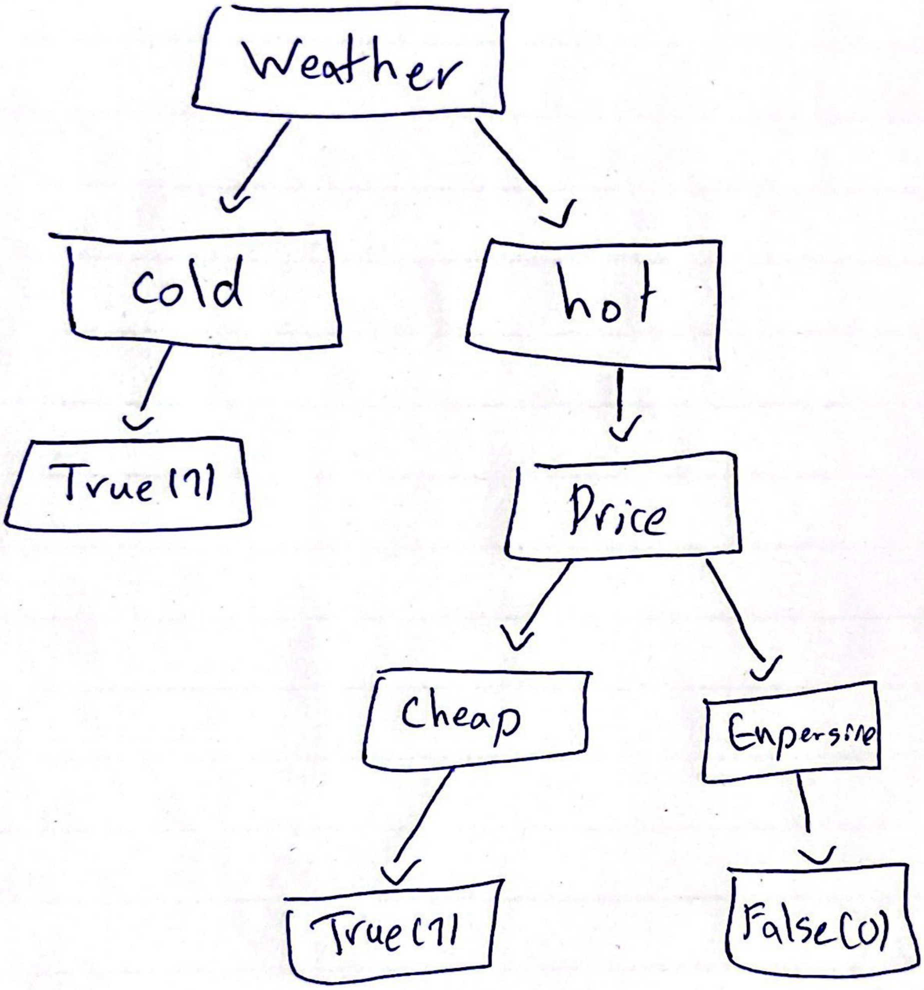
price

=> 0.917 − 0.667 = 0.25

weight

=> 0.917 − 0.917 = 0

①



٩٧٣٢٤٩٩ ساسان وحیدی نیا

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③ ML Learning vs MAP Learning:

(مقیاس زیاد)

در ML وقتی مشاهدات ما زیاد می شود، اهمیت $P(h_i)$ کم شده و تقریباً می توانیم آن را

از بین ببریم و فقط ماکسیمم کردن $P(d|h_i)$ برای ما مهم است (در MAP ما $P(d/h_i)P(h_i)$

را momimize می کردیم).

(4) ① $\forall s, u\ [\ study(s, l) \wedge \neg cheat(s) \wedge student(s,u)$

student   [illegible]   univers'y   studied

$\Rightarrow pass(s)\ ]$

② $student(Ashkan, Shiraz\ university)$

③ $\forall s, l, u\ [\ student(s,u) \wedge valid(u) \longrightarrow \sim cheat(s)\ ]$

④ $study(Ashkan)$

⑤ $valid(Shiraz\ university)$

---

convert to CNF,

① $\Rightarrow \sim student(s) \vee cheat(s) \vee \sim student(s,u) \vee pass(s)$

③ $\Rightarrow \sim student(s,u) \vee \sim valid(u) \vee \sim cheat(s)$

---

now wee and our ules with $\sim pass(Ashkam)$ so we reach a False statement

$(\sim student(s) \vee cheat(s) \vee \sim student(s,u)) \wedge (\sim student(s,u) \vee \sim valid(u) \vee \sim cheat(s))$

$\wedge \sim pass(Ashkan)$

$\sim student(s) \wedge (\sim student(s,u) \vee \sim cheat(s))$

$\Rightarrow \sim student(Ashkan, Shiraz) \vee \cancel{\sim valid(Shiraz)} \wedge \sim pass(Ashkan)$

$\Rightarrow \sim student(Ashkan, Shiraz) \wedge \sim pass(Ashkan)$

طبق . rule ما اشتباه است یعنی pass(Ashkan) درست است

⑤ $snow(Sanandaj)$

$\forall x\,[At(Kordestan, x) \to cold(x)]$

$\forall x\,[cold(x) \wedge cloudy(x) \to snow(x)]$

$cloudy(Sanandaj)$

برعکس

$centerOf(Sanandaj, Kordestan)$

$\forall x,y\,[Center(x,y) \to At(x,y)]$