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AI Theory - Week 1

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Homework

Part 1

AI Theory Homework 1.
Clemence Goh (1002075).

(output class).
① $\operatorname{argmax}_c P_c = C_{\uparrow}$, $\max_c P_c = P_{\uparrow}$ (probability), let n be number of data points.

Vanilla accuracy: $\frac{1}{n} \sum_{i=1}^n 1_{P_{\uparrow}}$

$= \frac{1}{n} n P_{\uparrow} = P_{\uparrow}$

class-wise accuracy: $\frac{1}{c} \sum_{c=1}^c a_c$

Here, $c = 3$ (P_1, P_2, P_3).

$= \frac{1}{3} [n P_{\uparrow}]$

let number of true positives be n .

$= \frac{1}{3} \left[\frac{1}{n} n P_{\uparrow} \right] + \frac{1}{3} [0] + \frac{1}{3} [0]$ since ~~prob~~ predicting as C_{\uparrow} .

$= \frac{1}{3} P_{\uparrow}$

② Similarly, replace the above with P_{\downarrow} (~~max~~ $\min_c P_c$) since predicting all as P_{\downarrow} instead!

Parts 2 and 3

as C_1 .

$$= \frac{1}{3} P_{\uparrow}$$

(2) Similarly, replace the above with P_{\downarrow} (~~max~~ $\min_c P_c$)
 since predicting all as P_{\downarrow} instead:

vanilla accuracy: P_{\downarrow}

class-wise accuracy: $\frac{1}{3} P_{\downarrow}$

(3) vanilla : ~~$\frac{1}{3} P_1 + \frac{1}{3} P_2 + \frac{1}{3} P_3$~~
 $P_1 q_1 + P_2 q_2 + P_3 q_3$

classwise : $\frac{1}{3} \sum_{c=1}^C a_c$

$a_1 = \frac{1}{P_1} (q_1 P_1)$
 $a_2 = \frac{1}{P_2} (q_2 P_2)$
 $a_3 = \frac{1}{P_3} (q_3 P_3)$

$\therefore A = \frac{1}{3} (q_1 + q_2 + q_3)$

$P_1, P_2, P_3 \rightarrow$ Actual prob.
 $q_1, q_2, q_3 \rightarrow$ prob to output.
 $\therefore \text{Actual} = P_1 q_1 + \dots$

Parts 4 and 5

④ If $P_c = q_c$:

$$\text{Vanilla accuracy} = \frac{P_1^2 + P_2^2 + P_3^2}{3} \#$$

\Rightarrow accuracy will be reduced if original $q_i < P_i$.

\Rightarrow For class-wise, just replace.

$$\text{class-wise accuracy: } A = \frac{1}{3} (P_1 + P_2 + P_3) \#$$

⑤ (A) vanilla == class-wise:

Since $\arg\max_c P_c$ is used:

$$\text{if } P_1 = P_2 = P_3 = 0.3333 \#$$

$$\text{vanilla} = \max_c P_c = 0.33$$

$$\text{class-wise} = \frac{1}{3} [0.33 + 0.33 + 0.33]$$

$$= 0.33$$

$$= \text{vanilla.}$$

$$\therefore P_1, P_2, P_3 \rightarrow \{0.33, 0.33, 0.33\}.$$

⑥ (B) If we set P_1 to > 0.90 and $P_2 + P_3 + P_1 = 1$:

$$P_1, P_2, P_3 = \{0.95, 0.04, 0.01\} \#$$

$$\text{vanilla} = \max_c P_c = 0.95$$

$$\text{class-wise} = \frac{1}{3} [0.95] + \frac{1}{3} [0.04] + \frac{1}{3} [0.01]$$

$$= 0.3333$$

$$\approx \frac{1}{3} \#$$