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PACD Exercise

No.

Date. / /

0	2	1	3	1
3	2	4	3	1
1	0	2	3	1
0	1	0	2	4
0	4	3	4	0

tentukan optimal threshold dengan otsu

freq	6	6	4	5	4	= 25
	0	1	2	3	4	

$T_0 =$

$$W_{b0} = \frac{0}{25} = 0$$

$$W_{f0} = \frac{6+6+4+5+4}{25} = 1$$

$$\text{Mean } b_0 = \frac{0}{25} = 0$$

$$\text{Mean } f_0 = \frac{0+6+8+15+16}{25} = 1,8$$

$$\sigma_{b0}^2 = 0$$

$$\sigma_{f0}^2 = \frac{((0-1,8)^2 \times 6) + ((1-1,8)^2 \times 6) + ((2-1,8)^2 \times 4) + ((3-1,8)^2 \times 5) + ((4-1,8)^2 \times 4)}{25}$$

$$= 2$$

$$\sigma_{w0}^2 = 0 \times 0 + 1 \times 2 = 2$$

T_1

$$W_{b1} = \frac{6}{25} = 0,24$$

$$W_{f1} = \frac{6+4+5+4}{25} = 0,76$$

$$\text{Mean } b_1 = \frac{(0 \times 6)}{6} = 0$$

$$\text{Mean } f_1 = \frac{6+8+15+16}{19} = 2,36$$

$$\sigma_{b1}^2 = \frac{(0-0)^2}{6} = 0$$

$$\sigma_{f1}^2 = \frac{(1-2,36)^2 \times 6 + (2-2,36)^2 \times 4 + (3-2,36)^2 \times 5 + (4-2,36)^2 \times 4}{19}$$

$$= 1,28$$

$$\sigma_{w1}^2 = (0,24 \times 0) + (0,76 \times 1,28) = 0,9728$$

T₂

$$W_{b2} = \frac{6+6}{25} = 0,48$$

$$W_{f2} = \frac{9+5+9}{25} = 0,52$$

$$\text{mean}_{b2} = \frac{(0 \times 6) + (1 \times 6)}{12} = 0,5$$

$$\text{mean}_{f2} = \frac{(2 \times 9) + (3 \times 5) + (9 \times 9)}{13}$$

$$\sigma_{b2}^2 = \frac{(0-0,5)^2 \times 6 + (1-0,5)^2 \times 6}{12}$$

$$= 3$$

$$= 0,25$$

$$\sigma_{f2}^2 = \frac{(2-3)^2 \times 9 + (3-3)^2 \times 5 + (9-3)^2 \times 9}{13}$$

$$= 0,61$$

~~sigma_w2~~

$$\sigma_{w2}^2 = (0,48 \times 0,25) + (0,52 \times 0,61) = \text{error} = 0,4372$$

T₃

$$W_{b3} = \frac{6+6+9}{25} = 0,64$$

$$W_{f3} = \frac{5+9}{25} = 0,36$$

$$\text{mean}_{b3} = \frac{(0 \times 6) + (1 \times 6) + (2 \times 9)}{16}$$

$$\text{mean}_{f3} = \frac{(3 \times 5) + (9 \times 9)}{9} = 3,44$$

$$= 0,875$$

$$\sigma_{f3}^2 = \frac{(3-3,44)^2 \times 5 + (9-3,44)^2 \times 9}{9}$$

$$\sigma_{b3}^2 = \frac{(0-0,875)^2 \times 6 + (1-0,875)^2 \times 6 + (2-0,875)^2 \times 9}{16}$$

$$= 0,296$$

$$= 0,609$$

$$\sigma_{w3}^2 = (0,64 \times 0,609) + (0,36 \times 0,296)$$

$$= 0,478$$

T₉

$$W_{b9} = \frac{6 + 6 + 9 + 5}{25} = 0,84$$

$$W_{f9} = \frac{9}{25} = 0,16$$

$$\text{mean}_{b9} = \frac{(0 \times 6) + (1 \times 6) + (2 \times 9) + (3 \times 5)}{21}$$

$$\text{mean}_{f9} = \frac{(9 \times 9)}{9} = 9$$

$$= 1,38$$

$$\sigma_{f9}^2 = \frac{(9 - 9)^2 \times 9}{9} = 0$$

$$\sigma_{b9}^2 = \frac{(0 - 1,38)^2 \times 6 + (1 - 1,38)^2 \times 6 + (2 - 1,38)^2 \times 9 + (3 - 1,38)^2 \times 5}{21}$$

$$= 1,28$$

$$\sigma_{w9}^2 = (0,84 \times 1,28) + (0,16 \times 0)$$

$$= 1,0752$$

telah didapatkan within Class Variance dari $T=0$ hingga $T=9$

$$T_0 \rightarrow \sigma_w^2 = 2$$

$$T_1 \rightarrow \sigma_w^2 = 0,9728$$

$$T_2 \rightarrow \sigma_w^2 = 0,4372$$

$$T_3 \rightarrow \sigma_w^2 = 0,478$$

$$T_4 \rightarrow \sigma_w^2 = 1,0752$$

berdasarkan hasil yang diperoleh didapat nilai variance terendah ada pada nilai threshold 2 (0,4372). Sehingga optimal threshold ada pada $T = 2$.

Step by step otsu:

- Cari nilai within class variance dari threshold = 0 hingga threshold = 4. (Weigh, Mean, dan Variance untuk masing-masing background dan foreground).
- Kemudian cari nilai within class variance terkecil.
- Pilih threshold dengan variance within class terkecil sebagai threshold optimal.