Tutorial 10 Answers

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a. We are unable to formulate an equation that describes the median filter in terms of linear equations.

b. Median filter is edge preserving

c. They filter noise $\Rightarrow$ high frequency. ie they are low-pass filters.

d. 1. Blur image with mean filter
2. Subtract Blur from original $\Rightarrow$ high frequency
3. Add this high frequency to image
= boost high frequency

$\Rightarrow$ Blur = Boost low frequence. Sharp = Boost high frequency

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(a) $\overset{1}{1}\ \overset{2}{2}\ \overset{3}{2}\ \overset{4}{3}\ \boxed{\overset{5}{6}}\ \overset{6}{7}\ \overset{7}{7}\ \overset{8}{8}\ \overset{9}{9}$ $\quad (9+1)/2 = 5$ = median index

(b) $\overset{1}{1} + \overset{3}{2} + \overset{5}{2} + \overset{8}{3} + \overset{14}{6} + \overset{21}{7} + \overset{28}{7} + \overset{36}{8} + \overset{45}{9}$ ...

$45/9 = 5$

(c) the filter extends beyond image
1. ignore border – crop (image smaller)
2. wrap
3. Extend border pixels
etc

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(a) Problem: what threshold value to use!

=> Assumption = Centre - symmetric distributions

=> Each peak represents a mean for object

=> monotonic decrease of probability away from peak

(b)

1	2	3	4	5	6	7	8	9	10
7	2	3	2	0	5	6	4	2	1
	9	12	14		19	25	29	31	32

Initialize: $j = 0$ $\quad N = 32 = \boxed{\sum H(q)}$

$\Theta_0 = (1)(7) + (2)(2) + (3)(3) + (4)(2) + (5)(0) + (6)(5) + (7)(6) + (8)(4) + (9)(2) + (10)(1)$

$= 7 + \overset{11}{4} + \overset{20}{9} + \overset{28}{8} + 0 + \overset{58}{30} + \overset{100}{42} + \overset{132}{32} + \overset{150}{18} + \overset{160}{10}$

$= 160/32 = 5 = \boxed{1/N \sum qH(q)}$

$$\boxed{\begin{aligned} N_{object} &= 7 + \overset{9}{2} + \overset{12}{3} + \overset{14}{2} + 0 = \underline{14} = \sum_{q=0}^{\Theta_j} H(q) \\ N_{BG} &= 5 + \overset{11}{6} + \overset{15}{4} + \overset{17}{2} + \overset{18}{1} = \underline{18} = \sum_{q=\Theta_j+1}^{max} H(q) \end{aligned}}$$

$$mean_{obj} = 1/N_{object} \sum_{q=0}^{\Theta_j} qH(q) = 1/14 \left(\overset{7}{(1)(7)} + \overset{11}{(2)(2)} + \overset{20}{(3)(3)} + \overset{28}{(4)(2)} \right)$$

$$= 28/14 = 2$$

$$mean_{BG} = 1/N_{BG} \sum_{q=\Theta_j+1}^{max} qH(q) = 1/18 \left(\overset{30}{(6)(5)} + \overset{\overset{72}{42}}{(7)(6)} + \overset{\overset{104}{32}}{(8)(4)} + \overset{\overset{122}{18}}{(9)(2)} + \overset{\overset{132}{10}}{(10)(1)} \right)$$

$$= 132/18 = 22/3$$

$$\Theta_1 = 1/2 \left(2 + 22/3 \right) = \left(6/3 + 22/3 \right) \times 1/2 = 28/6$$

$$= 4.666$$

Continue $5 \neq 4.666$ so yes!

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Tutorial 10

(a)

	1	2	3	4	5	6	7	8	9	= Hist
	3	3	1	0	1	2	2	2	2	
$C(q)$	3	6	7	7	8	10	12	14	16	

$$\frac{25 \times 16}{100} = 4 \qquad \frac{75 \times 16}{100} = 12$$

So smallest q_α such that $C(q_\alpha) < 4 = 2$

largest q_B such that $C_{q_B} < 12 = 6$

$$= \frac{255}{\underset{q_B}{6} - \underset{q_\alpha}{2}} (8 - \overset{q_\alpha}{2}) = 255 \times \left(\frac{6}{4}\right) = 255$$

(b) linear in terms of mapping

$$\frac{255}{q_B - q_\alpha}(x - q_\alpha) = \text{linear}$$

(c) $T[q] = Q \times (C(\overset{8}{q}) - C[\overset{3}{\min}]) / (C[\overset{9}{\max}] - C[\overset{3}{\min}])$

$$= \frac{255 \times (14 - 3)}{16 - 3}$$

$$= \frac{255 \times 11}{13}$$

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