

Thinning Operator

The background is a solid teal color. It features several decorative elements: a large, semi-transparent pie chart in the upper right quadrant; several smaller, semi-transparent pie charts scattered in the upper right and middle right areas; and a bar chart in the bottom right corner with four vertical bars of increasing height from left to right.

2018/11/20



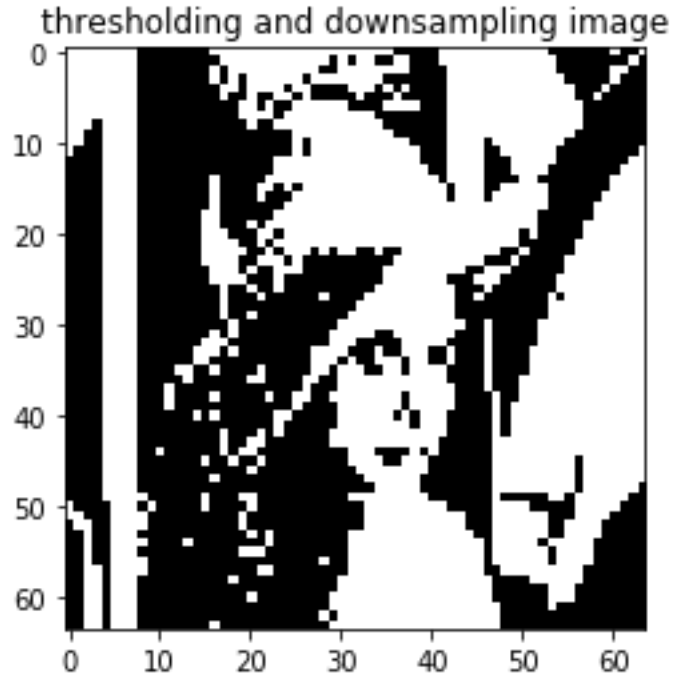
Homework 7

- ❑ Threshold: 128
 - ❑ 1, if pixel > 127
 - ❑ 0, if pixel < 128
- ❑ Downsample image to 64×64 pixels
- ❑ Do thinning operator (**4 connected**)





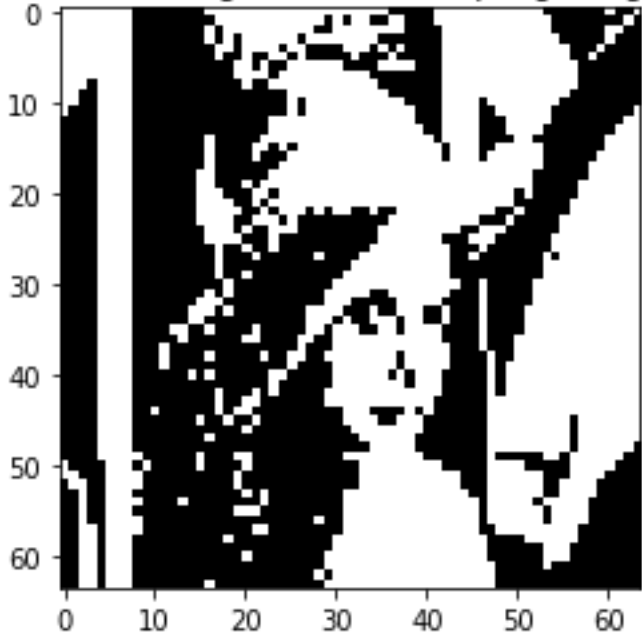
Homework 7 - Result



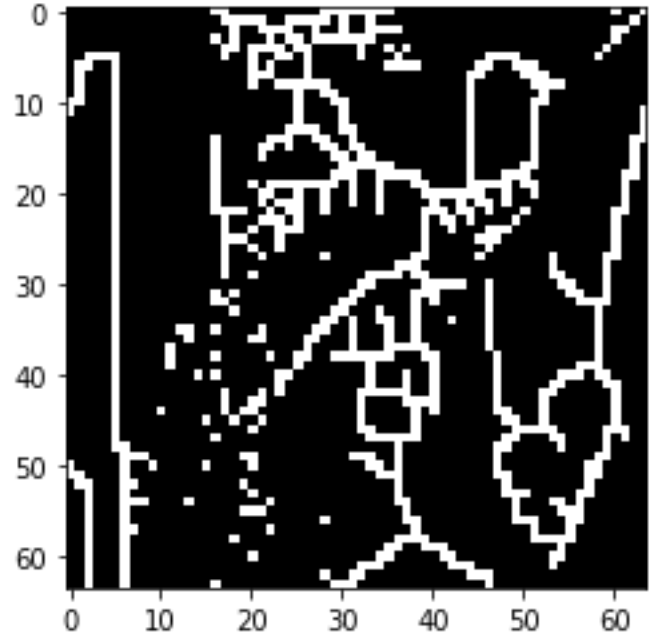


Homework 7 - Result

thresholding and downsampling image



7 iteration





Thinning Operator

- Create marked image
 1. Yokoi Operator
 2. Pair Relationship Operator
- Connected Shrink Operator
- Compare the shrink result with marked image



Pair Relationship Operator

➤ H function: (m ="1", means "edge" in Yokoi)

- $$h(a, m) = \begin{cases} 1, & \text{if } a = m \\ 0, & \text{otherwise} \end{cases}$$

➤ Output:

- $$y = \begin{cases} q, & \text{if } \sum_{n=1}^4 h(x_n, m) < 1 \text{ or } x_0 \neq m \\ p, & \text{if } \sum_{n=1}^4 h(x_n, m) \geq 1 \text{ and } x_0 = m \end{cases}$$



Pair Relationship Operator

original image

*	*			
	*	*		
		*	*	
		*	*	
		*	*	

Yokoi result

1	2			
	2	2		
		2	1	
		1	1	
		1	1	



Pair Relationship Operator

	1	2			
		2	2		
			2	1	
			1	1	
			1	1	

	q	q			



Pair Relationship Operator

	1	2			
		2	2		
			2	1	
			1	1	
			1	1	

	q	q			
		q	q		
			q	p	



Pair Relationship Operator

	1	2			
		2	2		
			2	1	
			1	1	
			1	1	

	q	q			
		q	q		
			q	p	
			p		



Pair Relationship Operator

	1	2			
		2	2		
			2	1	
			1	1	
			1	1	

	q	q			
		q	q		
			q	p	
			p	p	



Pair Relationship Operator

	1	2			
		2	2		
			2	1	
			1	1	
			1	1	

	q	q			
		q	q		
			q	p	
			p	p	
			p		



Pair Relationship Operator

	1	2			
		2	2		
			2	1	
			1	1	
			1	1	

	q	q			
		q	q		
			q	p	
			p	p	
			p	p	



Pair Relationship Operator

marked image

q	q			
	q	q		
		q	p	
		p	p	
		p	p	

original image

*	*			
	*	*		
		*	*	
		*	*	
		*	*	



Connected Shrink Operator

➤ H function: (yokoi corner => “q”)

- $$h(b, c, d, e) = \begin{cases} 1, & \text{if } b = c \text{ and } (d \neq b \text{ or } e \neq b) \\ 0, & \text{otherwise} \end{cases}$$

➤ Output:

- $$f(a_1, a_2, a_3, a_4, x) = \begin{cases} g, & \text{if exactly one of } a_n = 1, n = 1 \sim 4 \\ x, & \text{otherwise} \end{cases}$$



Thinning Operator

marked image

q	q			
	q	q		
		q	p	
		p	p	
		p	p	

original image

*	*			
	*	*		
		*	*	
		*	*	
		*	*	



Thinning Operator

q	q			
	q	q		
		q	p	
		p	p	
		p	p	

*	*			
	*	*		
		*	*	
		*	*	
		*	*	

*	*			
	*	*		
		*		
		*	*	
		*	*	



Thinning Operator

q	q			
	q	q		
		q	p	
		p	p	
		p	p	

*	*			
	*	*		
		*		
		*	*	
		*	*	

*	*			
	*	*		
		*		
		*	*	
		*	*	



Thinning Operator

q	q			
	q	q		
		q	p	
		p	p	
		p	p	

*	*			
	*	*		
		*		
		*	*	
		*	*	

*	*			
	*	*		
		*		
		*	*	
		*	*	



Thinning Operator

q	q			
	q	q		
		q	p	
		p	p	
		p	p	

*	*			
	*	*		
		*		
		*		
		*	*	
		*	*	
		*	*	

*	*			
	*	*		
		*		
		*		
		*	*	



Thinning Operator

q	q			
	q	q		
		q	p	
		p	p	
		p	p	

*	*			
	*	*		
		*		
		*		
		*	*	
		*	*	

*	*			
	*	*		
		*		
		*		
		*		