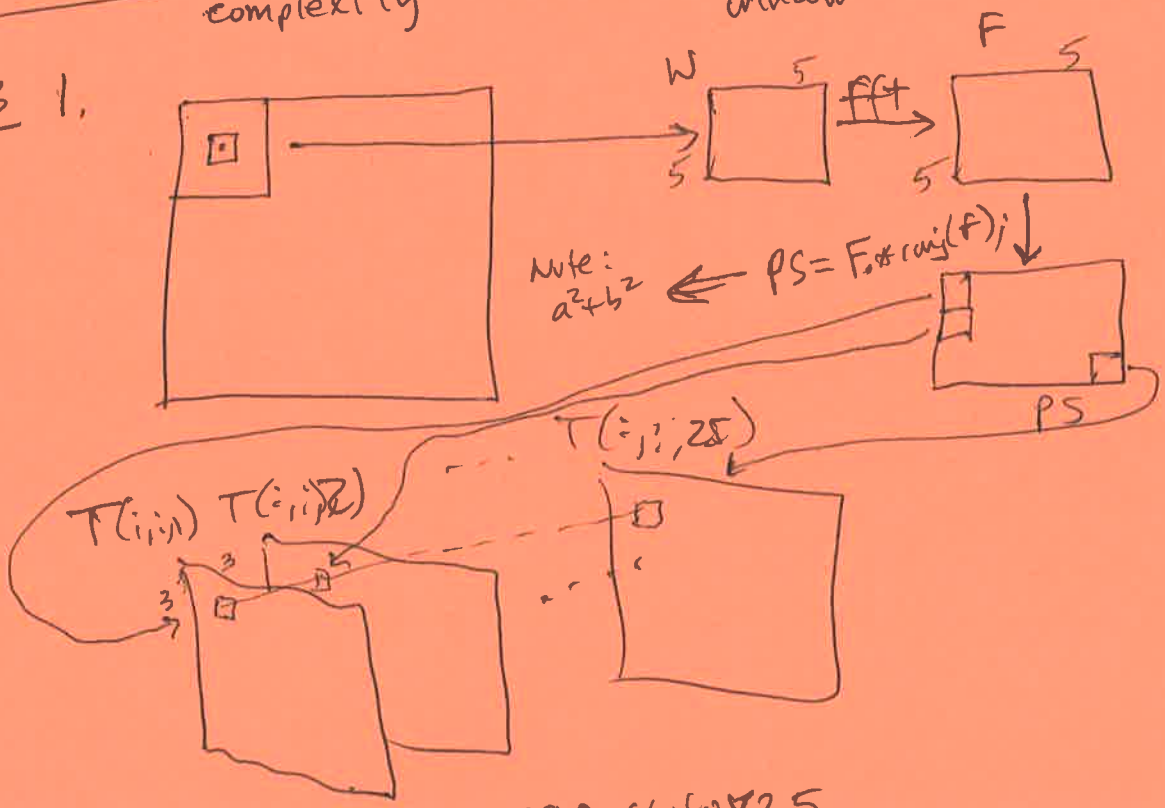
Week 7 Oct 1, 2018

Quiz 4 read slides; notes; gonzalez complexity

A3 1.




then reshape to 480*640X25

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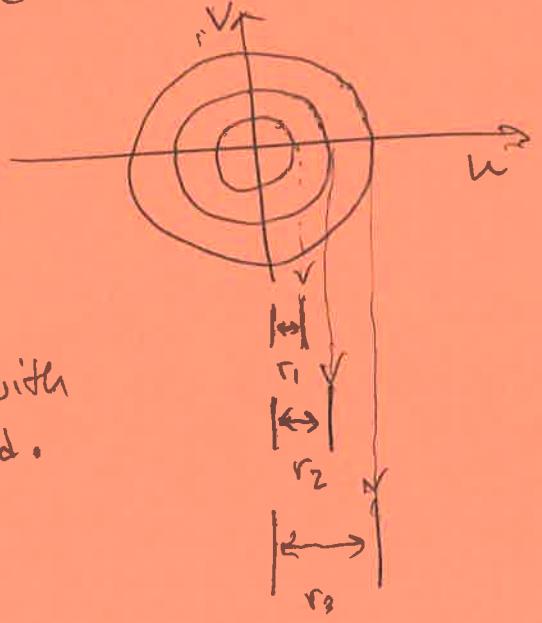
2. radial continuous PS




$$f_{r_1,r_2} = \sum_u \sum_v |F(u,v)|^2$$

$$r_1^2 \le u^2+v^2 < r_2^2$$

Problem:
How to do with square grid.

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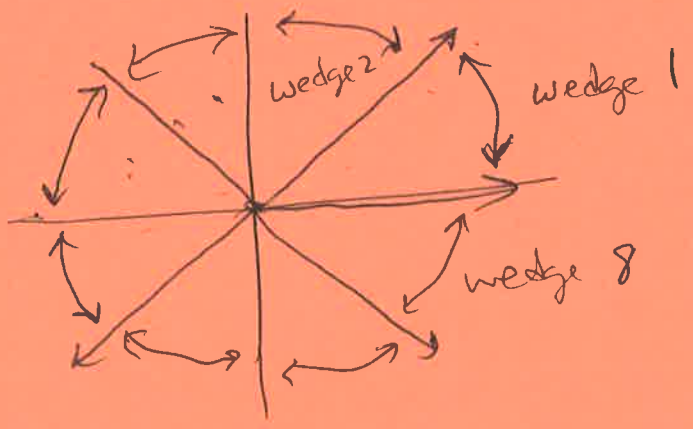
3. angular

continuous PS




$$f_{\theta_1,\theta_2} \sum_u \sum_v |F(u,v)|^2$$

$$\theta_1 \le \text{atan2}(v,u) < \theta_2$$

4. Fourier Shape Descriptors : (shape – not texture)

idea: take a boundary $\xrightarrow{\text{convert}}$ periodic 1D function

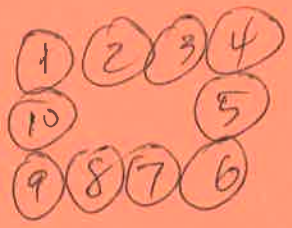
Given pixels on boundary of shape:

$$P = \{(x_i, y_i)\} \quad i = 1:N$$

angle at each point:

$$\theta(t) = \text{atan2}(y(t+w) - y(t), x(t+w) - x(t))$$

e.g.) $w = 1$




$\theta(1) = 0$
$\theta(2) = 0$
$\theta(3) = 0$
$\theta(4) = \frac{3}{2}\pi$
⋮

W7/0c

## cumulative change:

$$\phi(t) = (\theta(t) - \theta(0)) \bmod 2\pi$$

e.g., $\phi(1) = (0-0) \bmod 2\pi = 0$

$\phi(2) = 0$

$\phi(3) = 0$

$\phi(4) = -\frac{\pi}{2}$ ~~0~~

$\vdots$

only take mod $2\pi$ if $\phi(t)$ is outside $[-2\pi, 2\pi]$

also direction is change in direction from $\theta(0)$

## normalized cumulative angle

$$\psi(a) = \left(\phi\left(\frac{La}{2\pi}\right) + a\right) \bmod \pi$$

$a \in [0, 2\pi]$

Week 7 Math. morph (Chapter 9, Gonzalez)

sets: of pixels
foreground or background

set reflection: of $B$

$$\hat{B} = \{\bar{w} \mid \bar{w} = -\bar{b} \text{ for } \bar{b} \in B\}$$

need to know where origin is wrt $B$

$\Rightarrow (x, y) \in B$ goes to $(-x, -y) \in \hat{B}$

recall $T = \begin{bmatrix} -1 & & \\ & -1 & \\ & & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} -x \\ -y \\ 1 \end{bmatrix}$

↑ reflection

note $\cos(\pi) = -1$

so $T$ is a rotation by $180°$

set translation of $B$ by $\bar{z} = (z_1, z_2)$ : $(B)_z$

$$(B)_z = \{\bar{c} \mid \bar{c} = \bar{b} + \bar{z} \text{ for } \bar{b} \in B\}$$

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Erosion

consider $A, B \subseteq \mathbb{Z}^2$

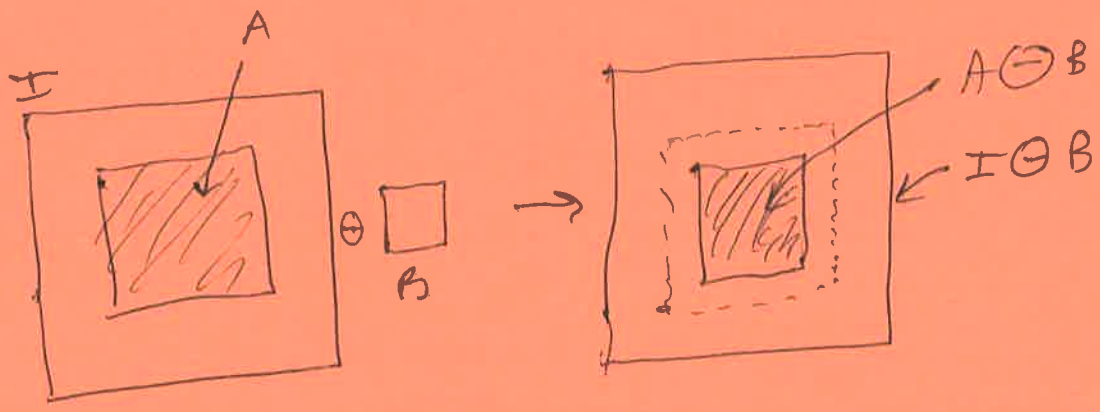
$$A \ominus B = \{z \mid (B)_z \subseteq A\}$$

↑ foreground ↑ structuring element — foreground values

erosion of $A$ by $B$

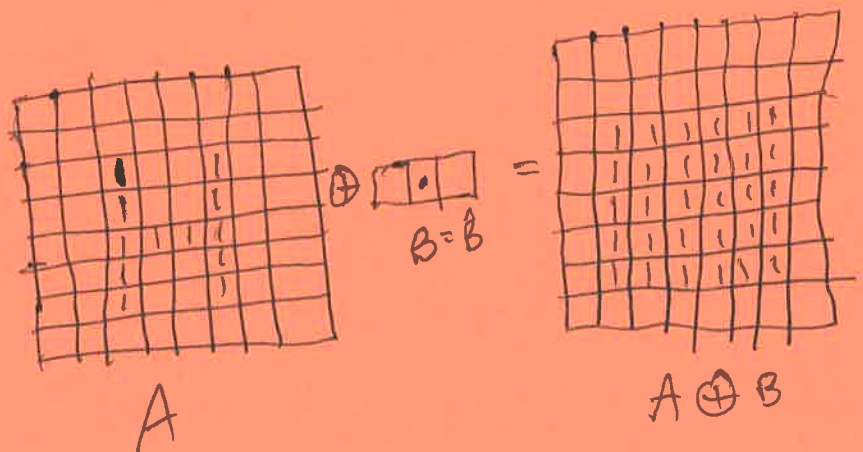
$A \ominus B$ : only foreground elements

$I \ominus B$ : foreground and background (+ don't care)




Dilation

$$A \oplus B = \{ z \mid (\hat{B})_z \cap A \neq \emptyset \}$$




Matlab: B = strel('line', 3, 0)

3 ← length, 0 ← angle

AdB = imdilate(A, B);

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Duality

$$(A \ominus B)^c = A^c \oplus \hat{B}$$

$$(A \oplus B)^c = A^c \ominus \hat{B}$$

opening: union of all translations of $B$ that stay in $A$

$$A \circ B = (A \ominus B) \oplus B$$

closing: complement of the union of all translates of $B$ that do not overlap $A$

$$A \bullet B = (A \oplus B) \ominus B$$

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hit-or-miss transform

$$I \circledast B_{12} = \{z \mid (B_1)_z \subseteq A \text{ and } (B_2)_z \subseteq A^c\}$$

$$= (A \ominus B_1) \cap (A^c \ominus B_2)$$

can look for simultaneous foreground and background conditions

see CS6640_week7

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strel
imerode
imdilate
bwmorph
bwlabel