CS6640 week 11

A9
A5
P3 due
A6 A6_criteria

dimension:

pt	0	in any dimension
line	1	any curve in any dimension
plane	2	any surface
cube	3	any solid

shape params
regionprops(im, 'all')   use Feret diam

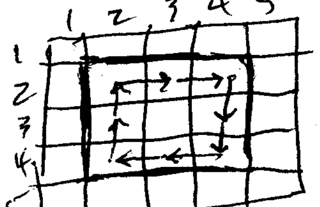
convexity: convex perimeter

stats.ConvexHull : pts defining convex boundary
.ConvexImage : binary image of convex hull
[⇒ use regionprops on it]

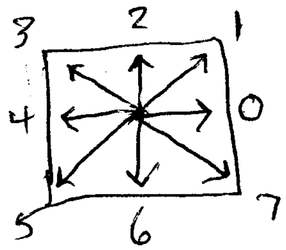
what is perimeter?

chain code: sequence of movements around boundary

A=



square at A(2:4,2:4)
start at (2,2)
0066442 2   all even
corners



$$\boxed{\begin{aligned} \text{perimeter} = & \ \text{sum(isEven)} * .980 \\ & + \text{sum(}\sim\text{isEven)} * 1.406 \\ & - \text{sum(isCorner)} * .091 \end{aligned}}$$

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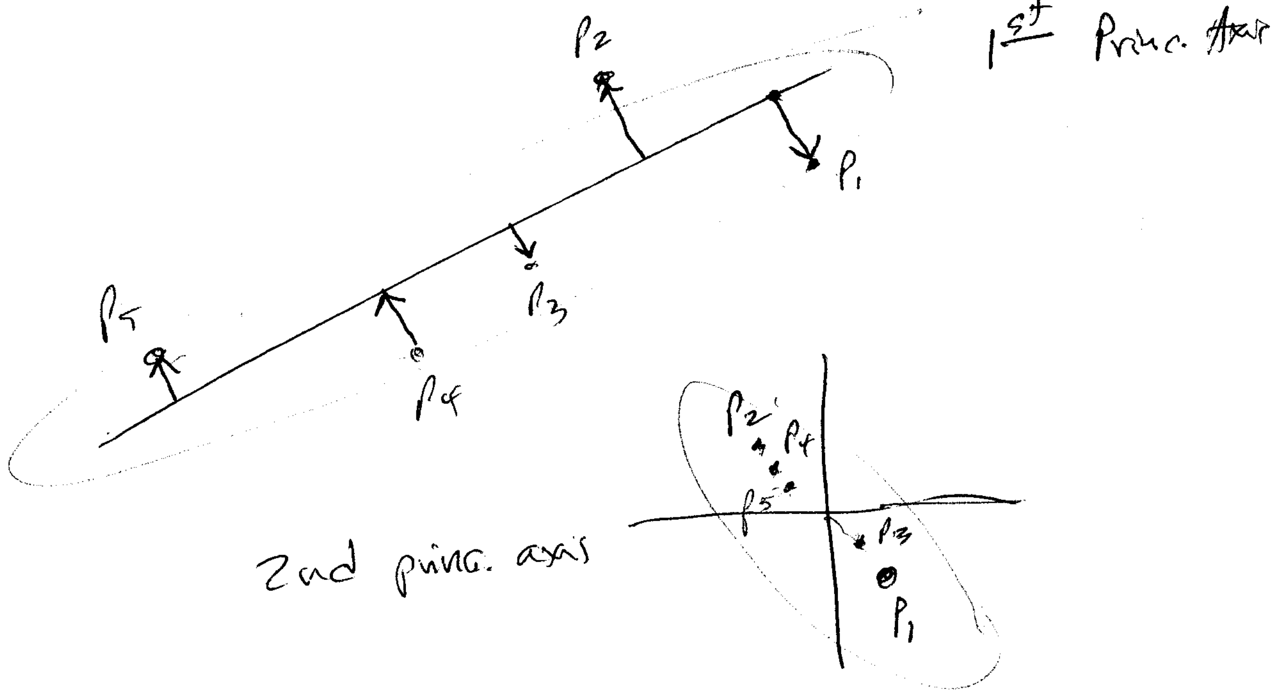
CS6640 Week 11

PCA

* Find principal axis (maximizes variance)
* project points onto that axis → p-pts
* create new pts → pts = pts − p-pts

repeat



Theory: version 1

N pts (observations) in M-D (M variables)

$\bar{X}_i \quad i = 1 : N$

Find linear combination so that new variables are uncorrelated:

$$\bar{Y}_i = \sum_{j=1}^{M} a_{ij} \bar{X}_j$$

$$\bar{y} = R\,\bar{x}$$

$$\langle \bar{y} \rangle = R\,\langle \bar{x} \rangle = 0$$

since zero-mean pts
$\langle \bar{x} \rangle$ averaging

Then covariance matrix $C_{\bar{y}}$:

$$C_{\bar{y}} = \langle \bar{y}\,\bar{y}^T \rangle = R \langle \bar{x}\,\bar{x}^T \rangle R^T = R\, C_{\bar{x}} R^T$$

$C_{\bar{y}}$ is diagonal :

$$C_{\bar{y}} = \langle \bar{y}\,\bar{y}^T \rangle = R\, C_{\bar{x}} R^T = \underbrace{\Lambda}_{\text{diagonal}}$$

it's an eigenvalue problem :

* Form covariance matrix $C_{\bar{x}} = \langle \bar{x}\,\bar{x}^T \rangle$
* Get eigenvectors and eigenvalues : R, Λ
* new variables computed

This is a rotation of the original coord system to new variables

Data in the new axes :

$$\bar{x} = R^T \bar{y}$$

Summary

* principal axes are mutually orthogonal
  ⇒ projection vectors are perpendicular to line

* data in new coordinate frame are uncorrelated
  ⇒ covariance matrix has zeros off-diagonal

* principal axes maximize variance
  ⇒ largest spread in that dimension

* eigenvalues directly specify variance

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A6 : PCA kmeans

To get a better texture analysis, combine all texture parameters:

Laws, FFT, color, etc.

T = ...FFT_texure ...

produces M * N x 25 array

each pixel (r,c) has a 1 x 25 texture vector

L = .. Laws ...

produces M x N x 16 array

each pixel (r,c) has a 1 x 16 texture vector

RGB = reshape(im, M * N, 3)

produces M * N x 3 array

~~convert T: T = reshape(T, M*N, 25)~~

~~produces M*N x 25 array~~

convert L: L = reshape(L, M * N, 16)

produces M * N x 16 array

combine: TT = [T, L, RGB]

produces M * N x 44 array

[cidx, ctrs] = CS6640_PCA_Kmeans(TT, 0.5, 6);

Keep to 50% dimensions