Describing Shapes for Recognition

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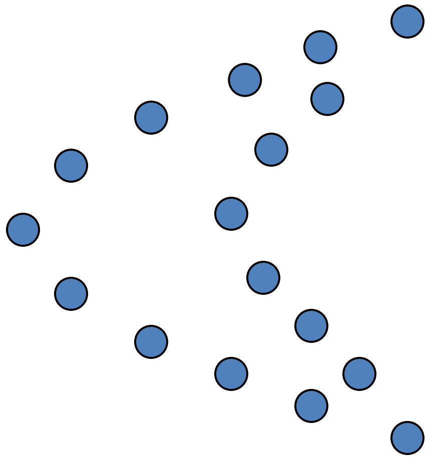
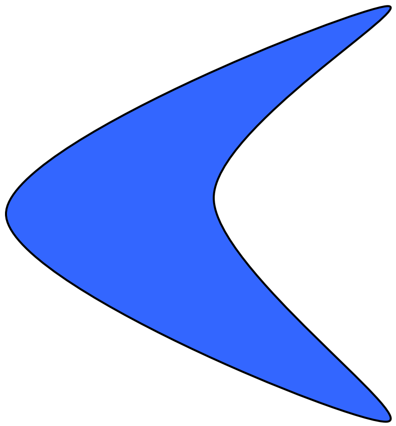
Slides credit:Bob Fisher & Vittorio Ferrari & others

What is a shape ?





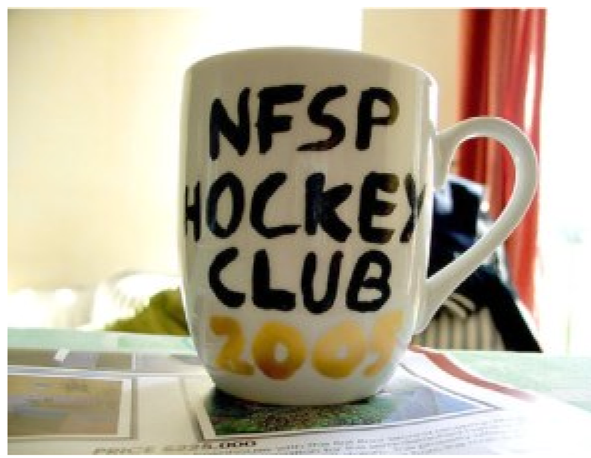
A set of points in the plane
(no 3D in this lecture)

A continuous outline
(silhouette)

Why care about shape ?

Cues from **interior** vs cues from **boundary**

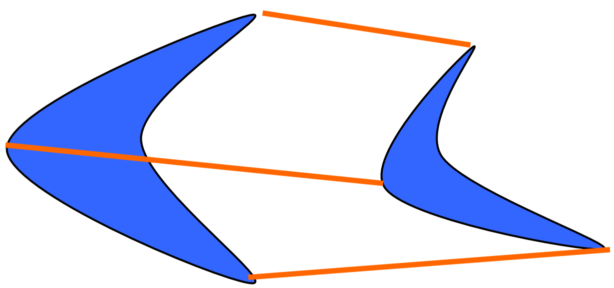
Some classes are defined by both



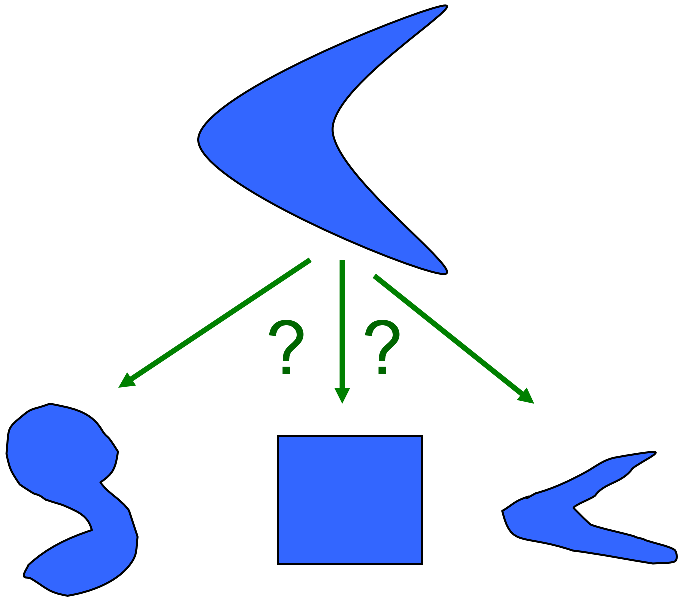
Some classes are defined purely by shape (interior bears no information)

Some classes are defined purely by texture/color (boundary bears no information)

Tasks: correspondence and recognition



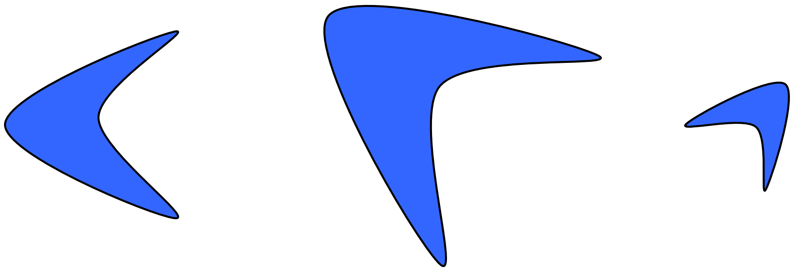
point-to-point correspondences



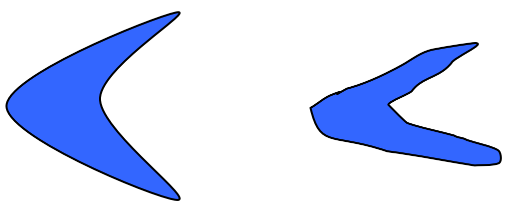
recognition as member of a class

Some methods compute point correspondences as a step towards recognition (but not all)

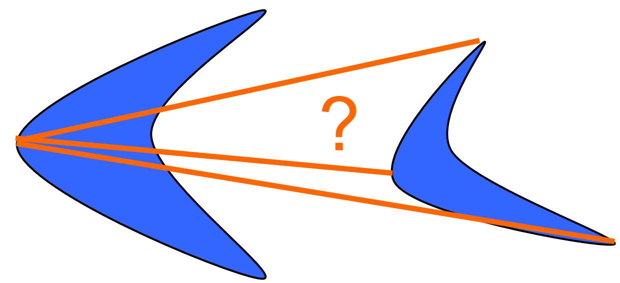
Challenges



invariance to rigid transformations:
(translation, rotation, scale) → similarities



tolerance to non-rigid deformations
(without confusing classes!)



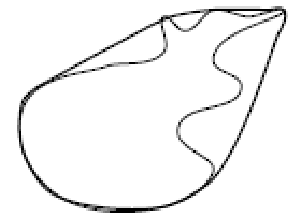
correspondences unknown

Simple global descriptors

Convexity

Perim(convex hull) / Perim(shape)

$$conv = \frac{P_{hull}}{P_{shape}}$$

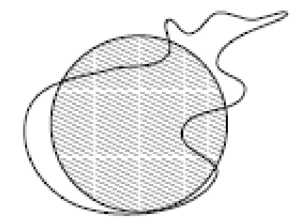


Convexity

Compactness

Perim(circle with equal area) / Perim(shape)

$$comp = \frac{2\sqrt{A\pi}}{P}$$

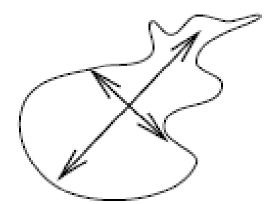


Compactness

Elongation

ratio of principal axis; principal axis cross at centroid with length = eigenvals of cov. matrix

$$prax = \frac{c_{yy} + c_{xx} - \sqrt{(c_{yy} + c_{xx})^2 - 4(c_{xx}c_{yy} - c_{xy}^2)}}{c_{yy} + c_{xx} + \sqrt{(c_{yy} + c_{xx})^2 - 4(c_{xx}c_{yy} - c_{xy}^2)}}$$



Principal axes

Images: A. Zweng

Simple global descriptors

Cope with challenges

+ invariance to translation/rotation/scale

+ robust to shape deformations

- no point correspondences

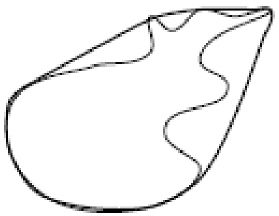
Advantages

+ simple

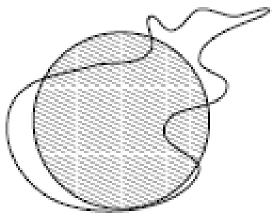
+ fast to compute

Disadvantages

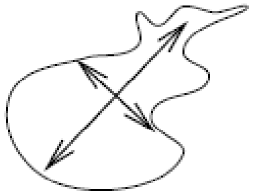
- little discriminative power



Convexity



Compactness



Principal axes

Images: A. Zweng

Lecture Overview

- A variety of simple descriptions: area, compactness, …
- Many invariant to different transformations, e.g. translation
- These don’t require correspondences between model and data instances