ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

BIWI Computer Vision

Shape Context and Shape Matching

Computer Vision

Exercise session 8

Teaching assistant:

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Assignment Tasks:

Shape Matching

Hand-out: 21-11-2019
Hand-in: 28-11-2019 23:00

Shape Matching
Objectives

1. Compute shape context descriptors

2. Match a template shape to a target set of points using shape contexts

Task 1

Overview of Algorithm

Given a set of template and target points:

a. Compute shape context descriptors for both sets of points

b. Estimate cost matrix between two sets of descriptors

c. Use cost matrix to solve the correspondence problem between two sets of descriptors (e.g. with Hungarian algorithm)

d. From the correspondence, estimate a transformation from template to target points (e.g. with Thin Plate Splines) and perform this transformation on the template points

e. Iterate steps a-d.

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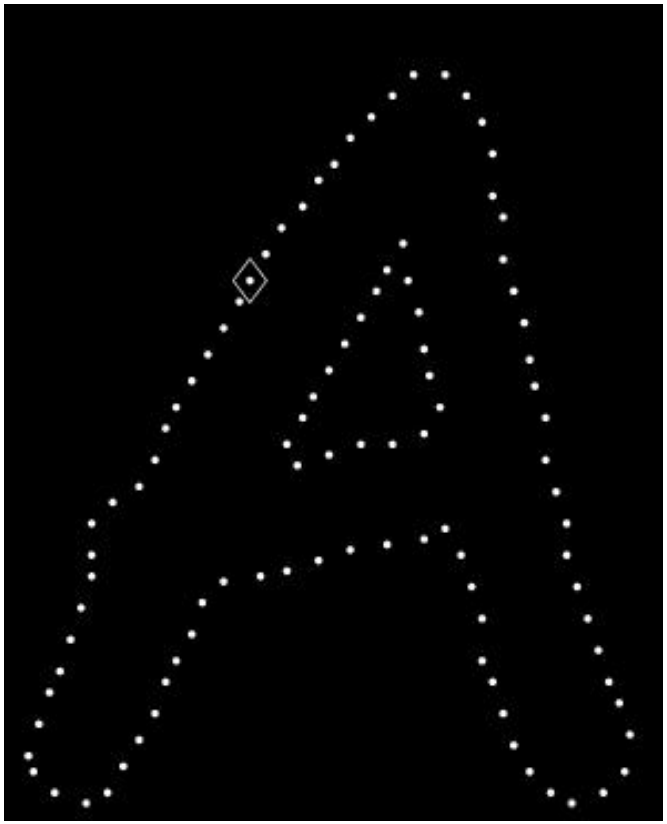
Task 1

How to Represent Shapes?



Task 1

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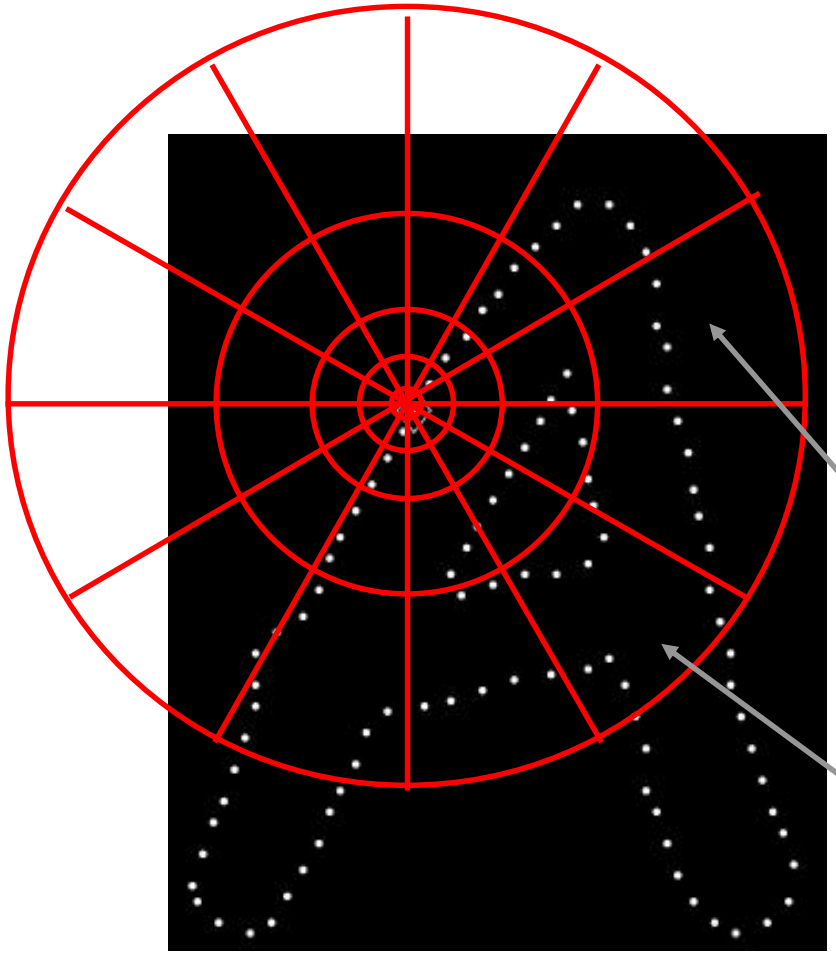
Shape Context Descriptor



- Count number of points inside each bin
- Compact representation of distribution of points relative to each point

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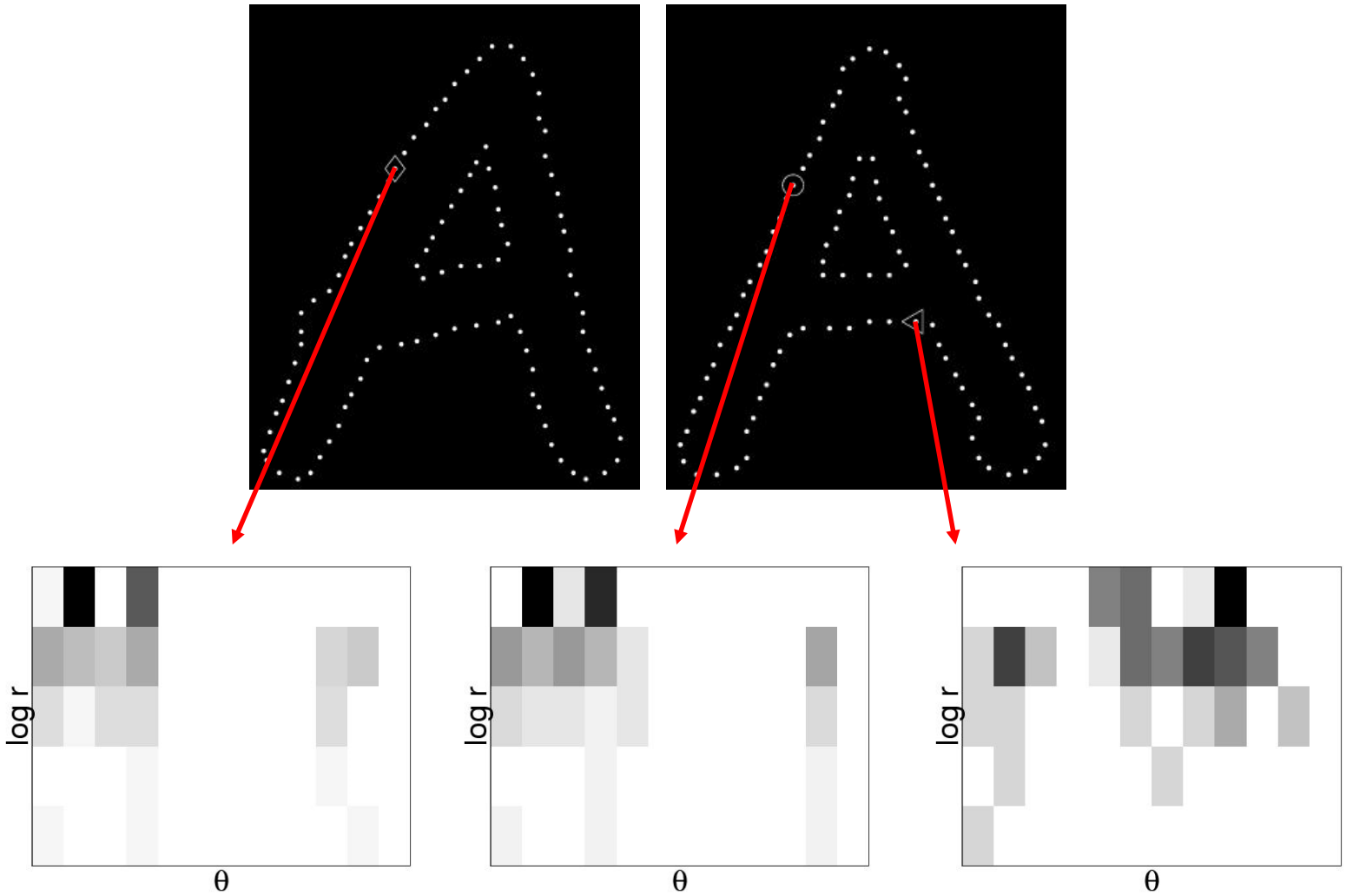
Shape Context Descriptor (2)



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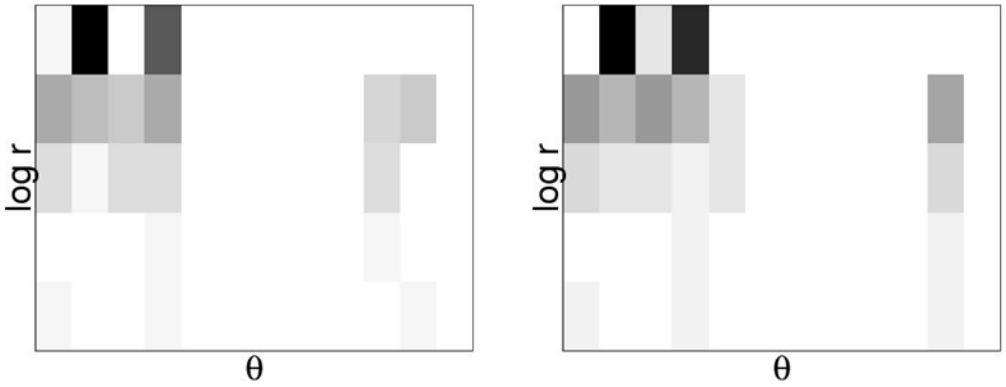
Matching Costs

Chi-squared distance between descriptors *i* and *j*.

$$C_{ij} \equiv C(p_i, p_j) = \frac{1}{2}\sum_{k=1}^{K} \frac{\left[p_i(k) - p_j(k)\right]^2}{p_i(k) + p_j(k)}$$

p_i p_j



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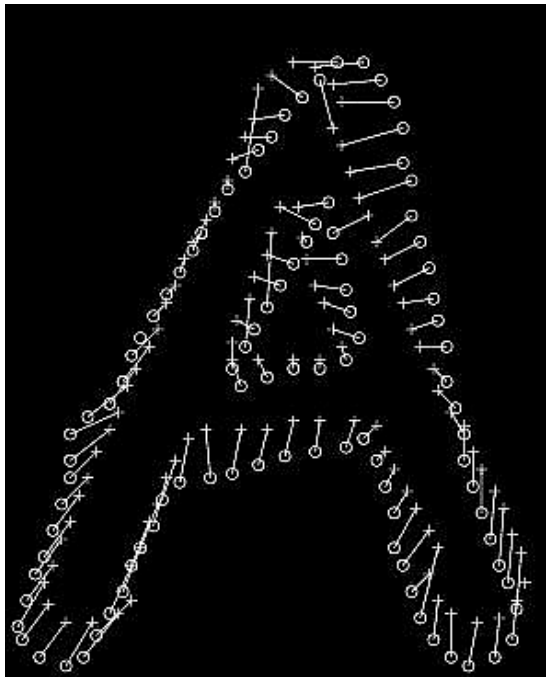
Correspondence Problem



- Minimize total cost of matching such that matching is one-to-one
- E.g. with Hungarian algorithm

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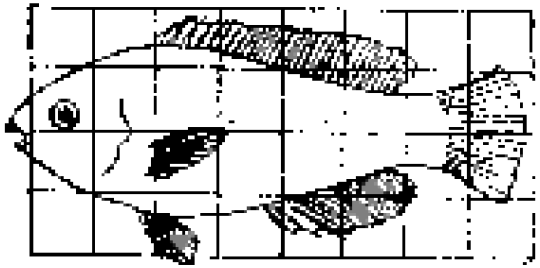
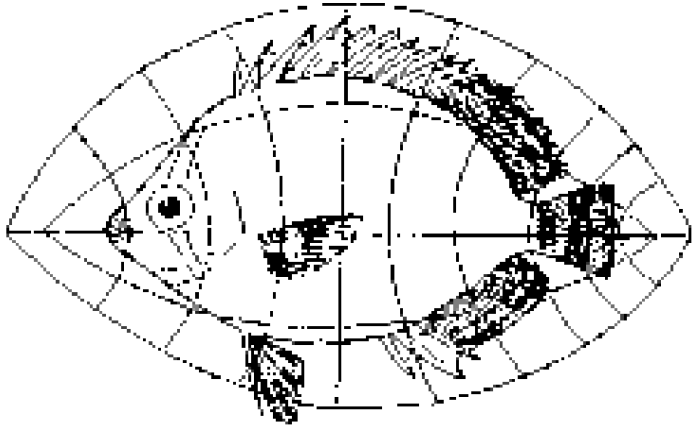
Transformation



Model



Target

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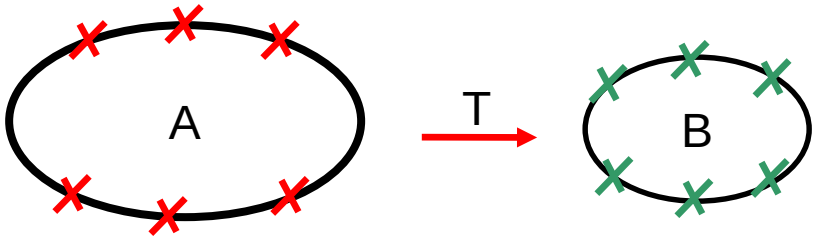
Thin Plate Splines(1)



- We are given a set of correspondences
- We want to estimate the function T: $R^2 \rightarrow R^2$ that transforms A into B

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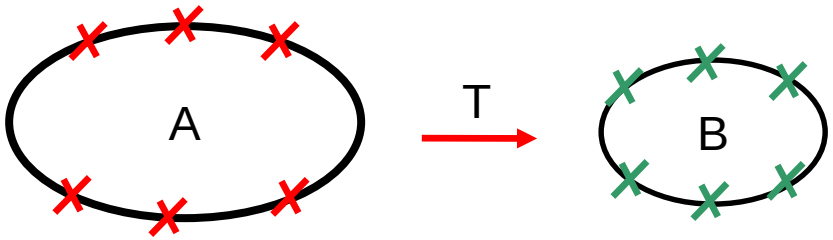
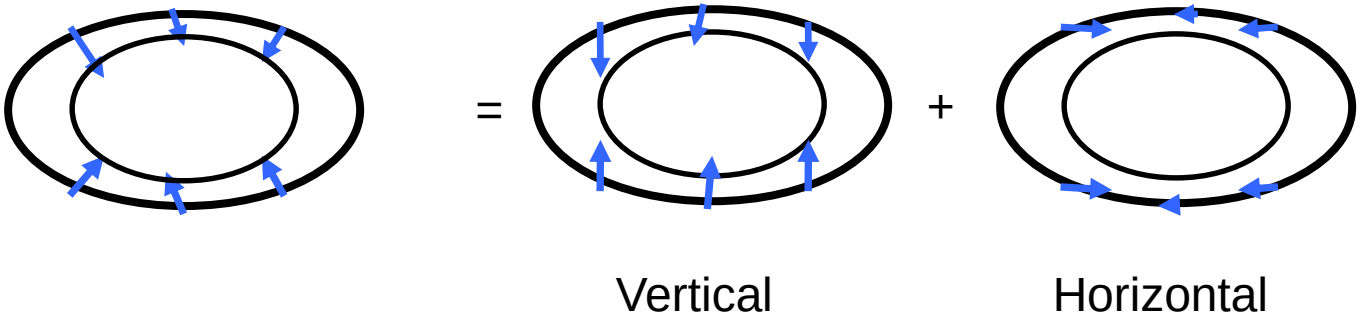
Thin Plate Splines(2)

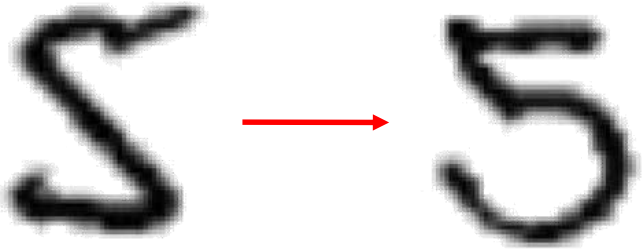


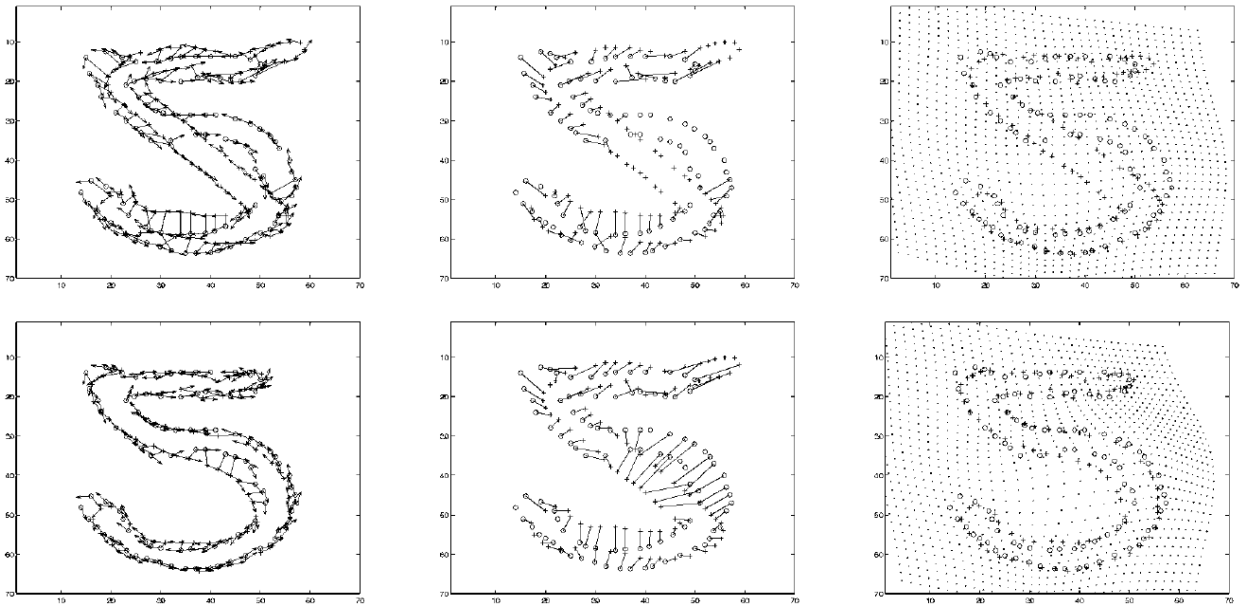
•From the correspondences, we get a displacement:



•Each component (vertical and horizontal) is a single function that we want to interpolate with a TPS.

Thin Plate Splines(3)





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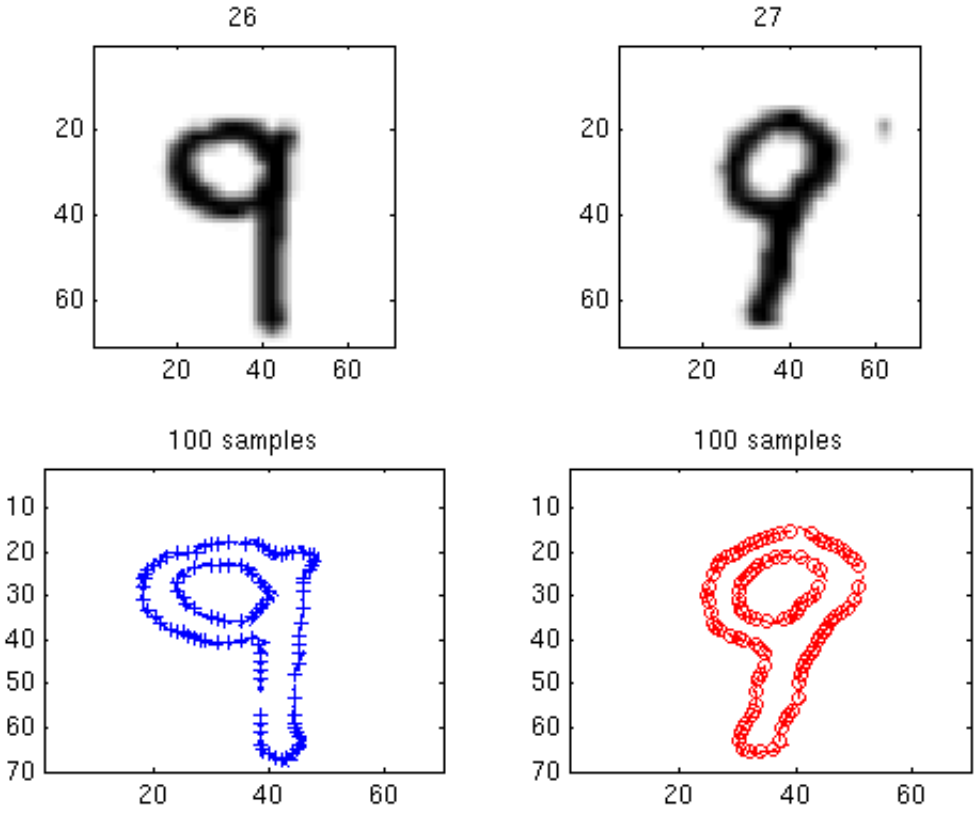
Example 1 - Numbers



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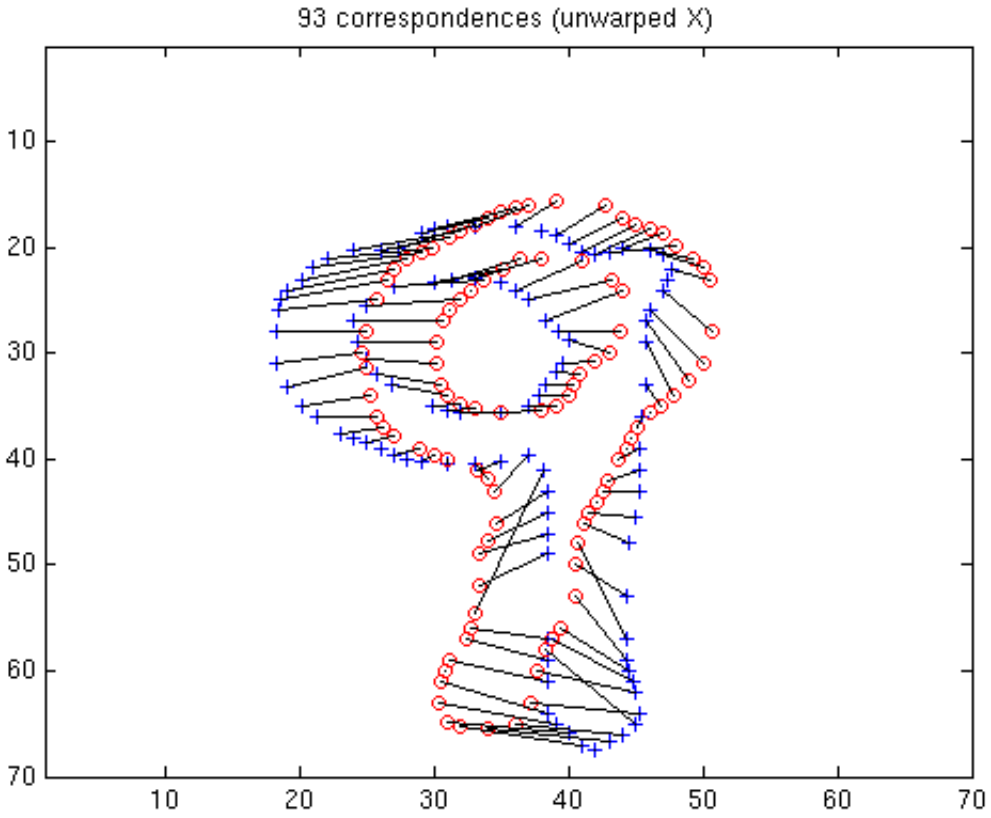

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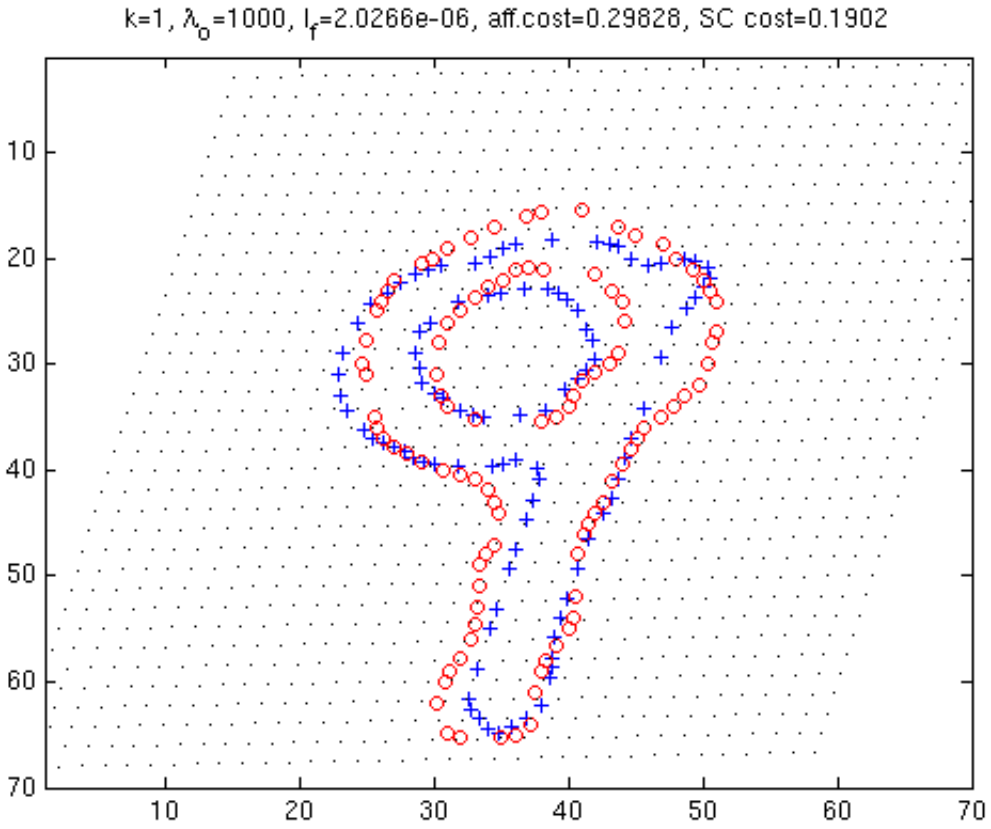

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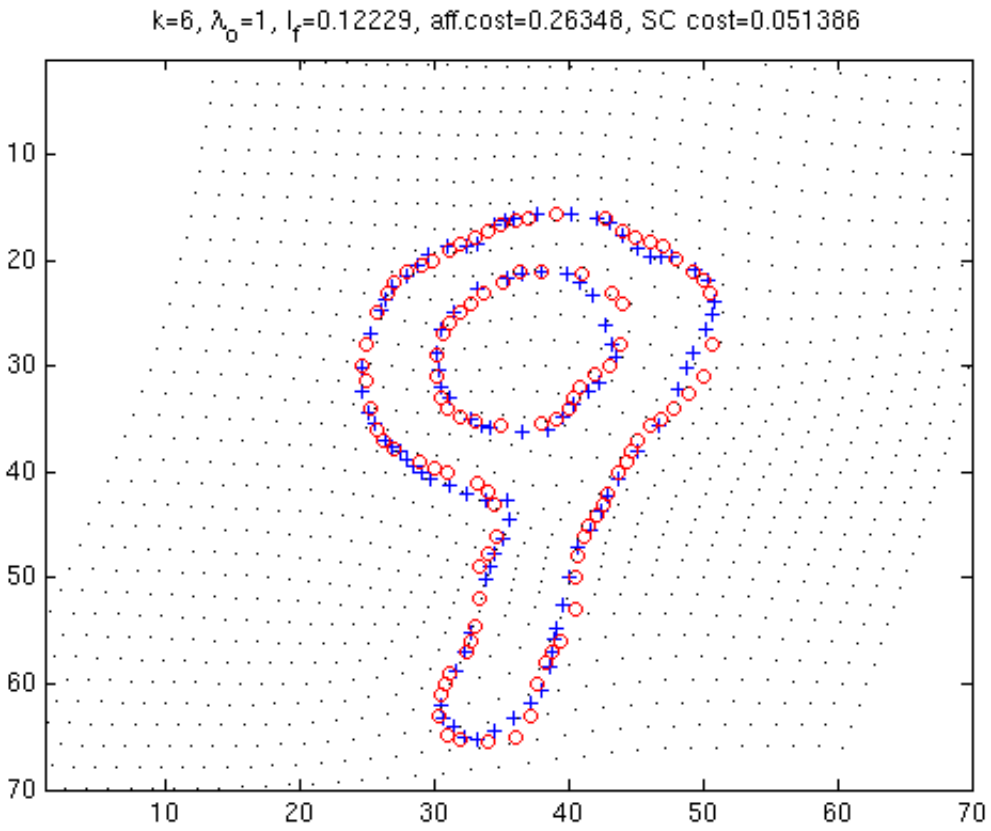

Task 1

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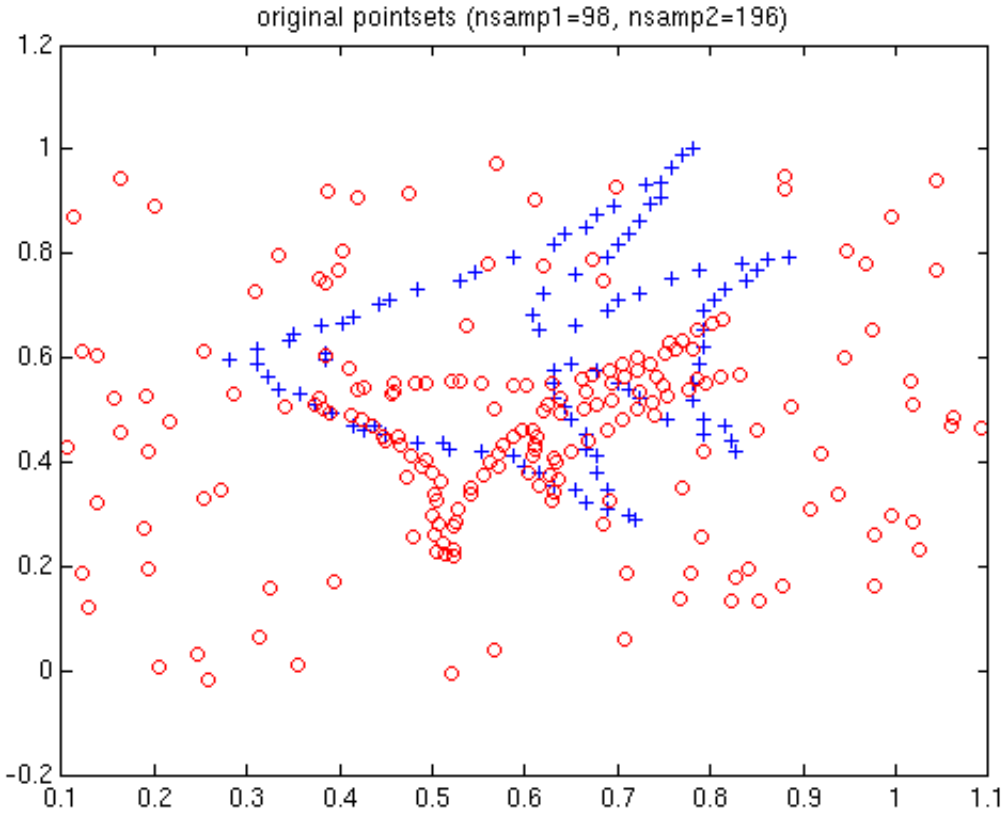
Example 2 - Fish



Task 1

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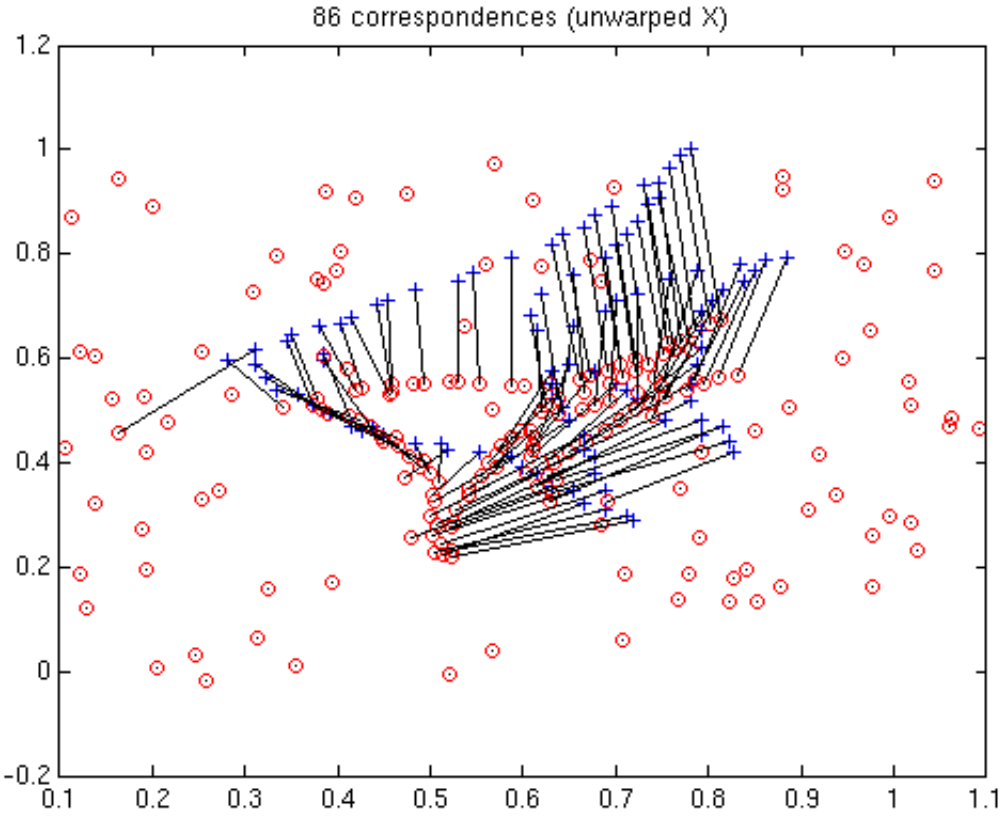

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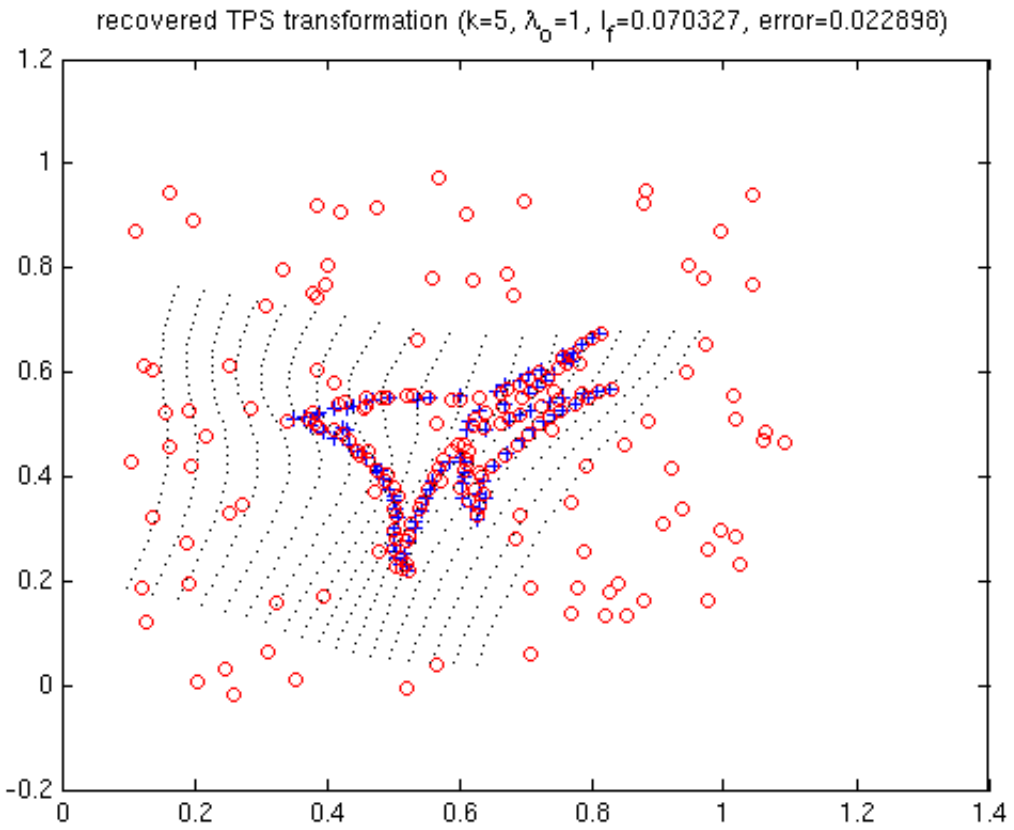

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- Send your reports and your implementation of the required Matlab functions
  - explain main steps of your implementation
  - comment the results
  - answer the questions in the hand-out paper
- Ask questions: email to yawei.li@vision.ee.ethz.ch