

MLRF Lecture 02

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Agenda for lecture 2

1. Introduction
2. Global image descriptors
3. Clustering
4. Texture descriptors
5. Local feature detectors

Introduction

Lecture 02 part 01

Previously, in MLRF...

Summary of last lecture

Machine learning

- Machine learning = searching for the best model in a hypothesis space
- Inductive machine learning, optimization-based
- Inductive bias, bias/variance compromise
- Supervised, reinforcement, unsupervised learning
- Regression, classification, density estimation
- Model validation: test generalisation, separate/decorrelate test & training sets

Template matching

- Sum of squared differences $(T-I)^2$, or correlation-based methods $(T \times I)$
- Normalization needed for correlation-based methods
- Tolerates translation and small noise, but not rotation, intensity shift, ...

Debriefing of practice session 1

PS1 content

1. Jupyter tricks
2. NumPy reminders
3. Intro to image manipulations
4. Twin it! part 1: Template matching
5. (Bonus level: segmentation)

Discussion

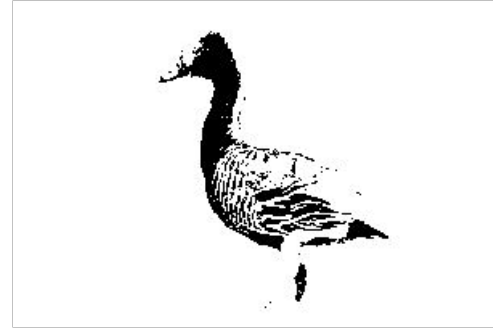
- Who completed part 1? 2? 3? 4? 5?
- Any remarks, comments, questions?
- Things to keep, change, remove?

Practice session 1: Take home messages (1/2)

background-less duck



mask



*How annoying was it
to manually adjust color thresholds
to select the duck?*

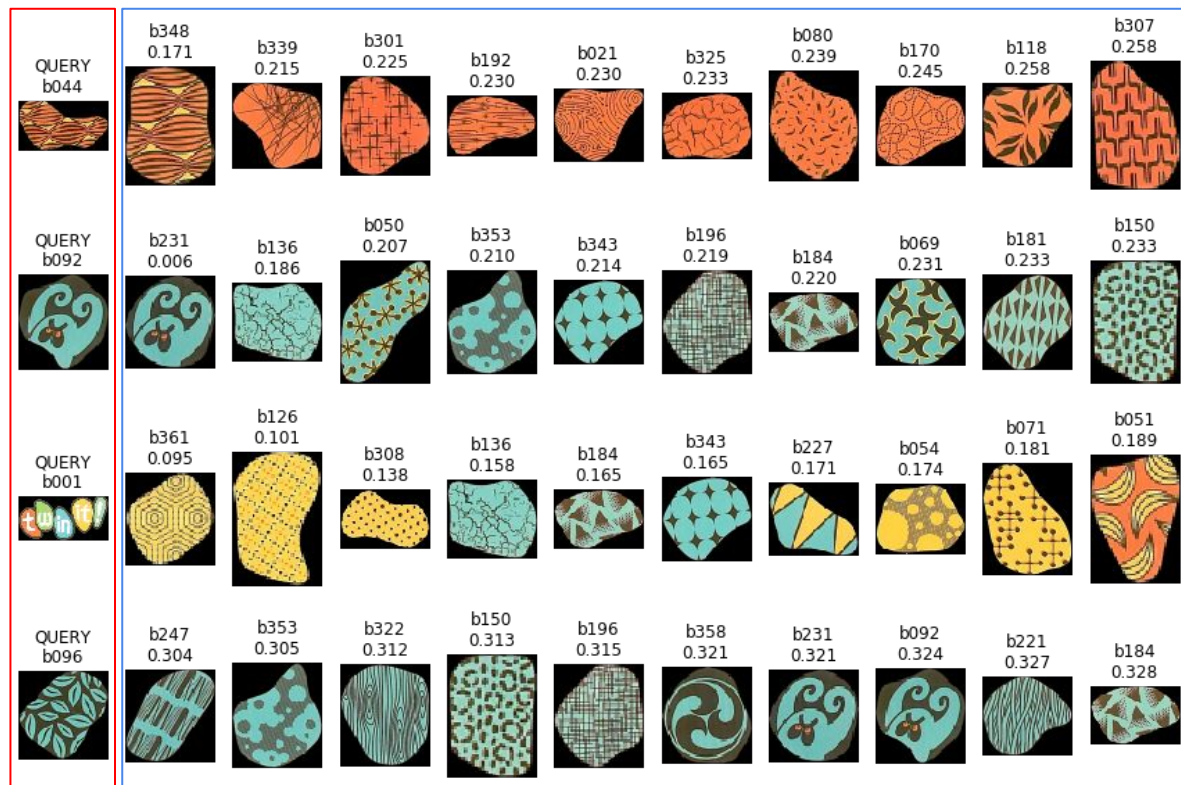
How could we have automated it?

Practice session 1: Take home messages (2/2)

Results with method
SQDIFF_NORMED →
(lower is better)

*Strengths and
weaknesses of
template matching
for the Twin it! case?*

Effects of normalization?



query images

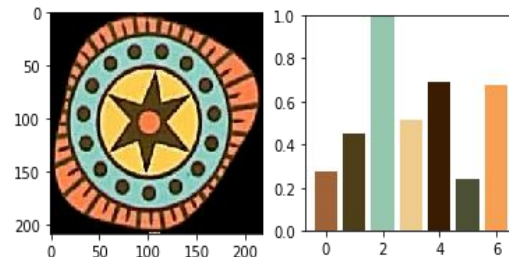
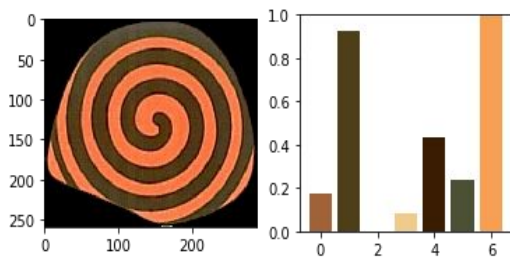
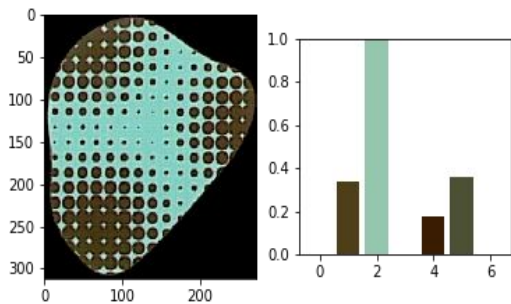
result images (closest to query according to method)

Next practice session(s)

Next practice session

Twin it!, again, with a slightly more elaborated approach:

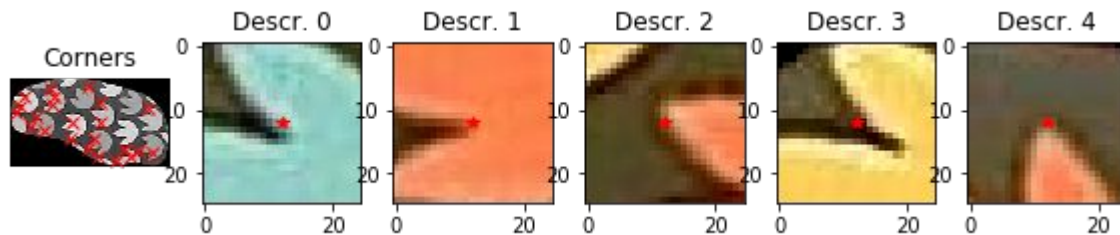
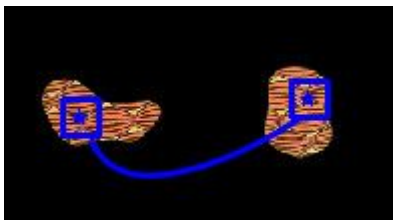
1. Pre-select bubbles based on their colors \Rightarrow Color histograms



Next practice session

Twin it!, again, with a slightly more elaborated approach:

1. Pre-select bubbles based on their colors \Rightarrow Color histograms
2. **For the pre-selected bubbles, check their content is similar**
 \Rightarrow **Detect stable points and extract the patches around them**



Next practice session

Twin it!, again, with a slightly more elaborated approach:

1. Pre-select bubbles based on their colors \Rightarrow Color histograms
2. **For the pre-selected bubbles, check their content is similar**
 \Rightarrow Detect stable points and extract the patches around them
 \Rightarrow **Compare (match) those patches**

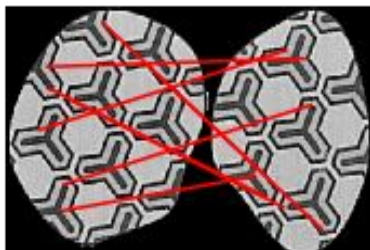


Image descriptors

Issues with methods based on pixel comparison

What is important? What do they consider? **Raw pixels!**

⇒ We want to be able to make use of **domain knowledge!**

Like sensitivity to shape, or dominant color information.

They are terribly **slow** and works **only for small images.**

⇒ We want to **summarize an image** to a much smaller vector.

They are **sensible to rotation, scaling**, and many other perturbations.

⇒ We want to adjust sensitivity/invariance to perturbations.

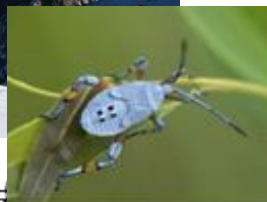
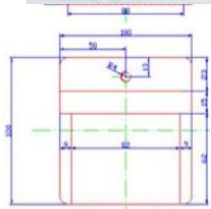
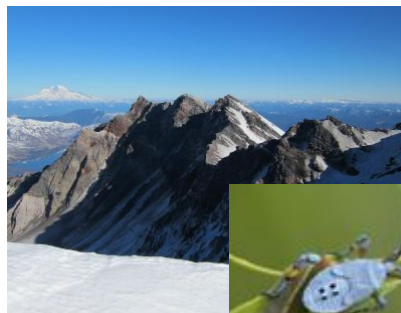
Do we tolerate translation? Rotation? Intensity shift?

How can we compare different pairs of images? **Metric issues.**

⇒ We want to be able to achieve **more than 1 vs all comparisons.**

Image descriptors: Overview

Different sizes and contents \Rightarrow Different kind of descriptors

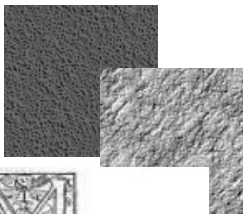


Large images, many parts

$\approx 500 \times 500$ px and more



Complex
small images



La parole se fit et fondit dedans
unoy, de le poule et de sans mousser. Si se
faulx, rendit les bonnettes flanchées, de
les -derrière- offardes à la mousser
de ce grand Chevalier François, ce fou-

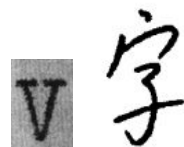
Textured
areas

Office for

Words



Logos



Isolated
symbols and
letters



Local image patches,
lines, etc.

$\approx 20 \times 20$ px and less

Image descriptors: Overview

Different sizes and contents ⇒ Different kind of descriptors

Different problems ⇒ Different choices

- Computation / memory constraints
- Which perturbations to we have to tolerate?
rotation, translation...
- What is the expected output?
classification, detection, ranking, segmentation...

Many, many approaches ⇒ Impossible to list them all

- Examples of several categories
- Focus on very useful or instructive ones