Master in Computer Vision Barcelona

Project Module 1

# Content based image retrieval

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## Week 4

# W3 Homework

## Query results evaluation

QSD1 W2 - Text only

| Team | Method | map@1 |
|---|---|---|
| Team4 | method1 | 0,77 |
| Team4 | method2 | 0,77 |
| Team5 | method1 | 0,76 |
| Team5 | method2 | 0,76 |
| Team8 | method2 | 0,69 |
| Team8 | method1 | 0,67 |
| Team3 | method1 | 0,40 |
| Team1 | method1 | 0,40 |
| Team2 | method1 | 0,30 |
| Team2 | method2 | 0,30 |
| Team6 | method1 | 0,20 |
| Team6 | method2 | 0,20 |
| Team7 | method1 | 0,05 |
| Team7 | method2 | 0,05 |

QSD1 W2 - Color only

| Team | Method | map@1 |
|---|---|---|
| Team5 | method1 | 0,77 |
| Team5 | method2 | 0,73 |
| Team3 | method1 | 0,71 |
| Team6 | method2 | 0,70 |
| Team7 | method1 | 0,70 |
| Team7 | method2 | 0,70 |
| Team6 | method1 | 0,67 |
| Team8 | method1 | 0,67 |
| Team8 | method2 | 0,67 |
| Team1 | method1 | 0,60 |
| Team2 | method1 | 0,60 |
| Team2 | method2 | 0,57 |
| Team4 | method1 | 0,57 |
| Team4 | method2 | 0,53 |

QSD1 W2 - Texture only

| Team | Method | map@1 |
|---|---|---|
| Team1 | method1 | 1,00 |
| Team6 | method1 | 1,00 |
| Team8 | method1 | 1,00 |
| Team5 | method2 | 0,97 |
| Team8 | method2 | 0,95 |
| Team6 | method2 | 0,93 |
| Team3 | method1 | 0,91 |
| Team7 | method1 | 0,90 |
| Team7 | method2 | 0,90 |
| Team5 | method1 | 0,67 |
| Team4 | method1 | 0,67 |
| Team2 | method1 | 0,60 |
| Team4 | method2 | 0,60 |
| Team2 | method2 | 0,50 |

# W3 Homework

## Query results evaluation

QSD1 W3

| Team | Method | map@1 | Brief method description |
|---|---|---|---|
| Team5 | method2 | 1,00 | 0.2*3DColor + 0.7*DCT + 0.1*Text |
| Team6 | method1 | 1,00 | HoG |
| Team6 | method2 | 0,97 | HoG + YCrCb blocks |
| Team5 | method1 | 0,96 | 0.2*Text + 0.6*3DColor + 0.2*LBP |
| Team7 | method1 | 0,93 | Text + DCT + 3D Histogram |
| Team8 | method2 | 0,93 | HOG*0.7+0.3*Multi 3D Histogram |
| Team7 | method2 | 0,90 | DCT |
| Team8 | method1 | 0,90 | HOG+Multi 3D Histogram |
| Team3 | method1 | 0,87 | DCT*0.25+0.75*MultiScale-3D-Histo |
| Team4 | method2 | 0,87 | LBP + text |
| Team4 | method1 | 0,87 | HSV + LBP + text |
| Team1 | method1 | 0,83 | 3D Histogram + HOG |
| Team2 | method1 | 0,80 | 0.75*3D Histogram + 0.25*LBP |
| Team2 | method2 | 0,80 | 0.5*3D Histogram + 0.5*LBP |

QSD2 W3

| Team | Method | map@1 | Brief method description |
|---|---|---|---|
| Team7 | method1 | 0,77 | Text + DCT + 3D Histogram |
| Team5 | method2 | 0,73 | 0.2*3DColor + 0.8*DCT |
| Team3 | method1 | 0,73 | DCT*0.25+0.75*MultiScale-3D-Histo |
| Team7 | method2 | 0,70 | DCT + 3D Histogram |
| Team5 | method1 | 0,67 | 0.5*3DColor + 0.5*LBP |
| Team8 | method1 | 0,63 | HOG+Multi 3D Histogram |
| Team6 | method1 | 0,63 | Daisy + YCrCb blocks |
| Team4 | method1 | 0,62 | HSV + text |
| Team6 | method2 | 0,58 | HoG + YCrCb blocks |
| Team4 | method2 | 0,56 | LBP + HSV + text |
| Team2 | method1 | 0,36 | 0.75*3D Histogram + 0.25*LBP |
| Team2 | method2 | 0,32 | 0.5*3D Histogram + 0.5*LBP |
| Team1 | method1 | 0,13 | Text + 3D Histogram + HOG |

# W3 Homework

## Query results evaluation

### QST1 (Simple)

| Team | Method | map@1 |
|---|---|---|
| Team6 | method1 | 1.000 |
| Team5 | method1 | 0.980 |
| Team8 | method1 | 0.920 |
| Team1 | method1 | 0.880 |
| Team4 | method1 | 0.780 |
| Team2 | method1 | 0.740 |
| Team3 | method1 | 0.660 |
| Team4 | method2 | 0.640 |
| Team7 | method1 | 0.90 |

### QST2 (Complex)

| Team | Method | map@1 |
|---|---|---|
| Team4 | method2 | 0.641 |
| Team5 | method1 | 0.590 |
| Team4 | method1 | 0.564 |
| Team8 | method1 | 0.538 |
| Team3 | method1 | 0.513 |
| Team6 | method1 | 0.513 |
| Team1 | method1 | 0.487 |
| Team7 | method1 | 0.744 |
| Team2 | method1 | 0.026 |

# W3 Homework

QST1 (Simple)

**Query results partial evaluation**

None

| Team | Method | map@1 |
|---|---|---|
| Team5 | method1 | 1.000 |
| Team6 | method1 | 1.000 |
| Team4 | method1 | 0.900 |
| Team8 | method1 | 0.900 |
| Team1 | method1 | 0.850 |
| Team3 | method1 | 0.750 |
| Team2 | method1 | 0.700 |
| Team4 | method2 | 0.650 |
| Team7 | method1 | 0.900 |

Noise

| Team | Method | map@1 |
|---|---|---|
| Team6 | method1 | 1.000 |
| Team5 | method1 | 0.917 |
| Team8 | method1 | 0.917 |
| Team1 | method1 | 0.833 |
| Team3 | method1 | 0.750 |
| Team2 | method1 | 0.667 |
| Team4 | method1 | 0.583 |
| Team4 | method2 | 0.500 |
| Team7 | method1 | 0,917 |

Color change

| Team | Method | map@1 |
|---|---|---|
| Team5 | method1 | 1.000 |
| Team6 | method1 | 1.000 |
| Team1 | method1 | 0.944 |
| Team8 | method1 | 0.944 |
| Team2 | method1 | 0.833 |
| Team4 | method1 | 0.778 |
| Team4 | method2 | 0.722 |
| Team3 | method1 | 0.500 |
| Team7 | method1 | 0.889 |

# W3 Homework

QST1 (Simple)

## Text evaluation

| Team | Method | Text distance | Total lines | Valid lines |
|---|---|---|---|---|
| Team4 | method1 | 0,62 | 50 | 47 |
| Team4 | method2 | 0,62 | 50 | 47 |
| Team5 | method1 | 4,50 | 50 | 50 |
| Team8 | method1 | 4,62 | 50 | 47 |
| Team7 | method1 | 5,36 | 50 | 50 |
| Team3 | method1 | 6,40 | 50 | 50 |
| Team2 | method1 | 8,98 | 50 | 50 |
| Team6 | method1 | 10,16 | 50 | 49 |
| Team1 | method1 | 11,58 | 50 | 50 |

```
from Levenshtein import distance
for ii in range(len(text_lines)):
    current_dist = distance(text_lines[ii], hypo_text_lines[ii])
    total_dist = total_dist + current_dist
avg_dist = total_dist/len(text_lines)
```

Average Levenhstein distance. Only the valid lines (the fsubmitted iles wich contain text) are considered.

# W4 Datasets


## Museum datasets

- Can Framis Museum
- Figueres 120 years expo
- Kode Bergen

## Query dataset (development with GT and test without GT)

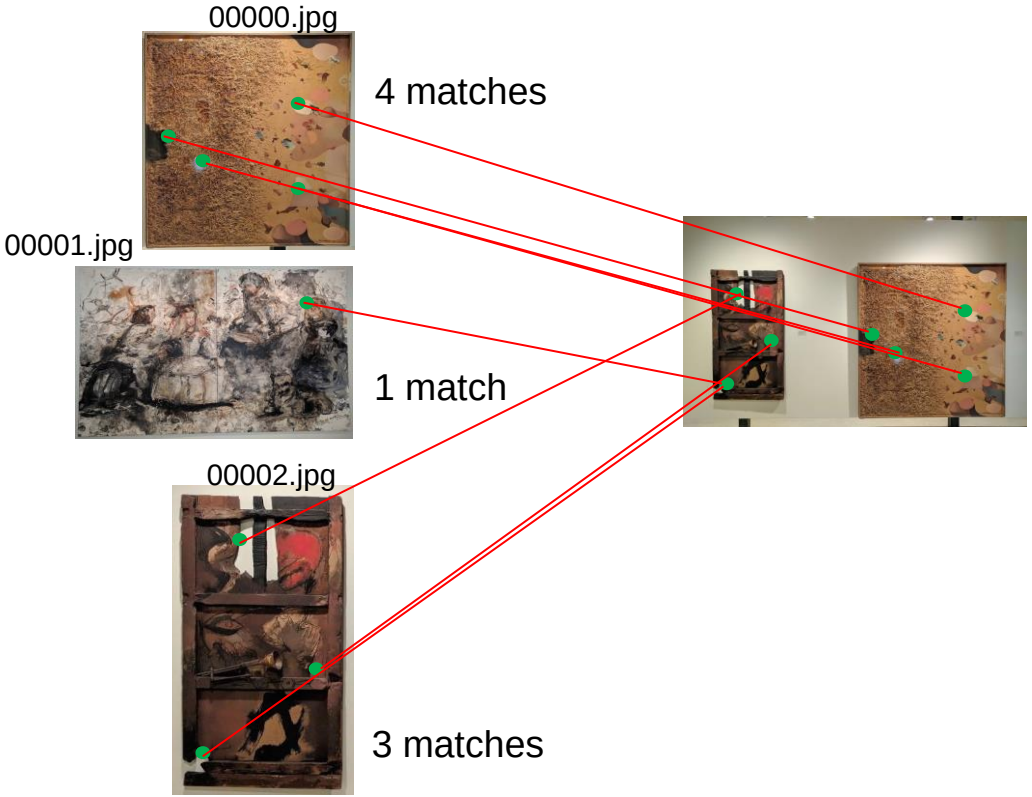
- Original and  paintings with
  - superimposed text on a **semitransparent** box (painter name, different fonts, sizes and positions)
  - noise (some random samples)
  - color changes (some random samples, random Hue changes)
  - double queries
  - **The query set can contain images not in the database**

- QSD1-W4 (30) / QST1-W4 (50)  pictures with background, with overlapping text (name of painter), **one, two or three** paintings per image, some paintings with noise, some paintings with changes in color, some paintings not in database

# W4 – Content based image retrieval

- **Goal:** search images from a large image database (DB) based on visual contents
- **Similarity:** based on number of matches between local descriptors
  - Match features. Discard false/ambiguous matches
  - Select DB images with larger number of matches
  - Discard images with ‘small’ number of matches
- **CBIR steps:**
  - Index the DB: generate keypoints, descriptors (e.g. SIFT) for all images
  - Extract keypoints, features from query image (e.g. SIFT)
  - Compute matches between descriptors of keypoints from the query image and each DB image descriptor, and order the DB images according the number of matches

# W4 – Query method




[[**2,**7,9,...],[**0**,23,44,...]]

# W4 – Query method

00000.jpg

1 matches

00001.jpg

0 match

00002.jpg

0 matches

[[**-1**]]

# W4 - Tasks

- Given the museum and the query dataset. For each image in the query dataset, retrieve the K most similar images in the Museum dataset, ordered by score

- Image descriptor: keypoints + local descriptors

**Task 1:** Detect keypoints and compute descriptors in Museum and query images

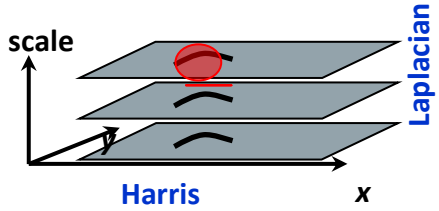
**Task 2:** Find tentative matches based on similarity of local appearance and verify matches

**Task 3:** Evaluate the system on QSD1-W4, map@k

**Task 4:** Evaluate best system from previous week on QSD1-W4

# W4 - Task1

- **Keypoint detection**



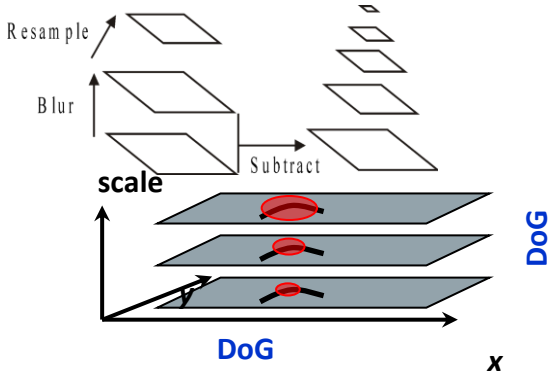

## Rotation, translation, intensity invariant

– **Harris corner detector:** uses the autocorrelation (second moment) matrix .
Important difference in all directions-> interest point [Harris ‘88]

## Scale invariant

– **Harris Laplacian** [Mikolajczyk & Schmid ‘01]
  - Find local maxima/minima of:
    – Harris corner detector in space (image coordinates)
    – Laplacian in scale

– **Difference of Gaussians (DoG or SIFT)** [Lowe’99]
  - Find local maxima/minima of
    – Difference of Gaussians in space and scale

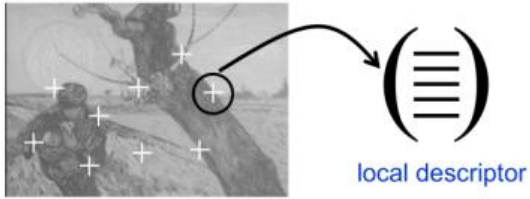


# W4 - Task 1

- **Local descriptors:**

  Tons of options!

  - SIFT
  - SURF
  - ORB (FAST+BRIEF)
  - LBP
  - HOG
  - PCA-SIFT
  - Color-SIFT
  - GLOH
  - DAISY
  - …



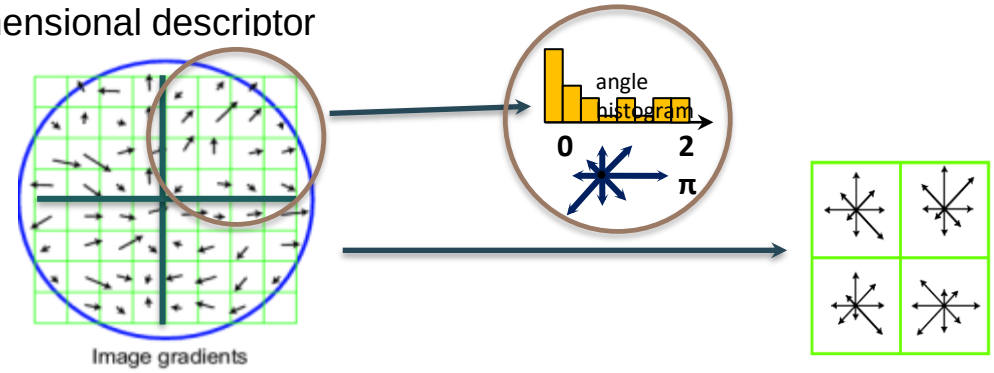

https://docs.opencv.org/master/db/d27/tutorial_py_table_of_contents_feature2d.html

# W4 - Task 1

- SIFT descriptor
  - Take 16x16 window around detected keypoint (8x8 shown below), rotated along keypoint direction
  - Compute edge orientation (angle of the gradient – 90°) for each pixel
  - Throw out weak edges (threshold gradient magnitude)
  - Divide the 16x16 window into a 4x4 grid of cells (2x2 case shown below)
  - Create histogram (8 bins) of surviving edge orientations for each cell
  - 16 cells * 8 orientations = 128 dimensional descriptor
  - Normalize vector

```
pip install opencv-contrib-python==4.4.0.46

import cv2
kp, desc = sift.detectAndCompute(gray,None)
```



# W4 - Task 2

- Find tentative matches based on similarity of local appearance and verify matches
  - consider different similarity metrics

- Implement a system to discard queries not in the data set (unknowns)
  - Usually, a threshold in the number of matches
  - Define the threshold by optimizing F1 measure on the development set

# W4 - Task 3

- Evaluate system based on keypoint descriptors on QSD1-W4

# W4 - Task 4

- Optional: Evaluate your best query system **from previous week** on QSD1-W4

# W4 - Submissions

- For each query, a list of the K best results (K=10).
  - **[[-1]] if ima not in dataset**
  - Only best method!
- For each query image, a text file with the text transcription (one line for each painting)

**Note**: Deliver files to:
/home/dlcv0X/m1-results/week4/QST1/**method1**/result.pkl
/home/dlcv0X/m1-results/week4/QST1/**method1**/text_boxes.pkl
/home/dlcv0X/m1-results/week4/QST1/**method1**/*.txt

- Tests sets delivered on Sunday 07 Nov 2021 at 14h
- Submit progress slides
  - Deadline slides: Sunday 07 Nov 2021 at 18:00
  - Deadline results: Sunday 07 Nov 2021 at 20:00
  - Deadline questions to teams: Monday 08 Nov 2021 at 14:00