Master in
Computer Vision
*Barcelona*

**Module:** M1 Introduction to human and computer vision

**Projects:** Museum painting retrieval

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# M1 – Content Based Image Retrieval

- **Main goal**
  - To learn the basic concepts and techniques to build a simple query by example retrieval system for finding paintings in a museum image collection.


Museum dataset

- **Scope**
  - Image retrieval based on color, texture, text information
  - Image retrieval based on keypoints and local descriptors
  - Denoising, orientation correction and picture cropping
  - Morphological filters to detect and remove overlying text from images
  - Evaluation of system performance
- **Applicability**
  - Almost any (small) query by example problem

# M1 – Content Based Image Retrieval

Apply the knowledge, tools and concepts from lectures.

The Objective is **apply and use** the knowledge learned, **not** to make a perfect system!

Images:

- Can Framis museum
- Alfred Figueres expo
- Kode Bergen museum

There will be different query sets

- Simple (no rotation, one painting per image, ...)
- Challenging (rotated painting, large background, noisy images, multiple paintings, …)

Dataset available at Virtual Campus

# Project Flowchart

- **Stages**

  - Image retrieval based on color histograms (1D, 2D, 3D, global, block and multiresolution)
  - Background removal by color
  - Detection and removal of overlaying text
  - Image denoising
  - Image retrieval based on color / textual / texture descriptors
  - Image retrieval based on keypoints and local descriptors
  - Orientation correction and picture cropping before retrieval
  - Image clustering

# Methodology

- **Groups of 4 students**
- Project organized in **6** sessions
- Before each follow-up session
  - teams submit their homework (code + slides + results)
  - each student submits intra-group evaluation
  - each team read other teams slides and submit two questions for other teams
- Every **follow-up session**
  - each team asks two questions to two different teams (one for each team)
  - teams answer questions in class
  - teachers give feedback
- One hour class
  ~40 min for discussions
  ~20 min to present next week's work
- **Final session**:
  - oral presentation (all members)
  - written report

# Timetable

| DATE | TIME | Lecture |
|---|---|---|
| Mon. Oct. 3rd | 16:00 -18:00 | Image processing assessment and pixel-based processing |
| Mon. Oct. 3rd | 18:00 - 19:00 | Project Introduction |
| Wed. Oct. 5th | 16:00 -18:00 | Morphological and nonlinear filtering |
| | | |
| Mon. Oct. 10th | 16:00 -18:00 | Space-frequency representation, Fourier transform and linear filtering (I) |
| Mon. Oct. 10th | 18:00 - 19:00 | Project follow-up |
| Wed. Oct. 12th | 16:00 -18:00 | HOLIDAY |
| | | |
| Mon. Oct. 17th | 16:00 -18:00 | Space-frequency representation, Fourier transform and linear filtering (II) |
| Mon. Oct. 17th | 18:00 - 19:00 | Project follow-up |
| Wed. Oct. 19th | 16:00 -18:00 | Space-frequency representation, Fourier transform and linear filtering (III) |
| | | |
| Mon. Oct. 24th | 16:00 -18:00 | Human Visual system and perception |
| Mon. Oct. 24th | 18:00 -19:00 | HOMEWORK |
| Wed. Oct. 26th | 16:00 -18:00 | Image formation and color representation |
| | | |
| Mon. Oct. 31st | 16:00 -18:00 | Feature extraction |
| Mon. Oct. 31st | 18:00 -19:00 | Project follow-up |
| Wed. Nov. 2nd | 16:00 -18:00 | HOMEWORK |
| | | |
| Mon. Nov. 7th | 16:00 -18:00 | Grouping, segmentation and classification (II) |
| Mon. Nov. 7th | 18:00 - 19:00 | Project follow-up |
| Wed. Nov. 9th | 16:00 -18:00 | Grouping, segmentation and classification (I) |
| | | |
| Mon. Nov. 14th | 16:00 -19:00 | Project Presentations |
| | | |
| Mon. Nov. 21st | | HOMEWORK |
| Wed. Nov. 23rd | | HOMEWORK |
| | | |
| Mon. Nov. 28th | 16:00 -19:00 | EXAM |
| | | |

→ Session1: October 3rd
Introduction

→ Session2: October 10th
Follow-up

→ Session3: October 17th
Follow-up

→ Session4: October 31th
Follow-up

→ Session7: November 8th
Follow-up

→ Session6: November 14th
Final presentations
Report

# Project evaluation

- The Project Development PD (70% of the final mark)
  - weeks 1-5 , 5x14%
  - delivered code + slides
  - completion of tasks (additional contributions increase the grades)
  - feedback and questions in class
  - penalization for late submissions (code / slides / questions / i-g eval)
- Intra-group evaluation
  - every week students quantize the % of workload done by each member of the team
- Final project presentation PP (20% of the final mark)
  - All the team members have to present.
  - Evaluated by professors and students

$$PP = 0.5 \ . \ \mathrm{PP}^{prof} + 0.5. \ \mathrm{PP}^{st}$$

- The final mark is $$V = \sum_{i=1}^{5} 0.14 \cdot Week + 0.2 \cdot PP + 0.1 \cdot Report$$

# Deliverables: what

- Progress slides (template provided):
  - A Google Slides presentation, with
    - Problem
    - Method / strategy
    - Results (good/bad cases, metrics, plots)
    - **Discussion (comments & conclusions)**
- Source code (GitHub):
  - A **working** version of the Python code developed along the blocks with a README.txt file explaining how to run it
  - Code must be
    - well structured / well commented / use relative paths / ready to be extended
- Like in a real CV challenge: provide results for the test set
  - We will compute performance metrics / ranking of teams
  - Position in the ranking does not influence the grades
- Questions for teams and intra-group evaluation

# Deliverables: where

- Progress slides:
  - Google Drive with slides per task
  - Share a link to slides in the ‘issues’ section of the ‘deliverables’ repository on GitHub
- Source code
  - Team repository on GitHub
- Test masks / results
  - Submit to Google Drive folder
- Two questions for other teams
  - Google docs, provided
- Intra-group evaluation
  - Fill the intra-group evaluation form (a link to be published)

# Material

- Dataset
  - Already available
- Code
  - GitHub repository in organization **MCV-2022-M1-Project**[1]
  - Python language

https://github.com/MCV-2022-M1-Project

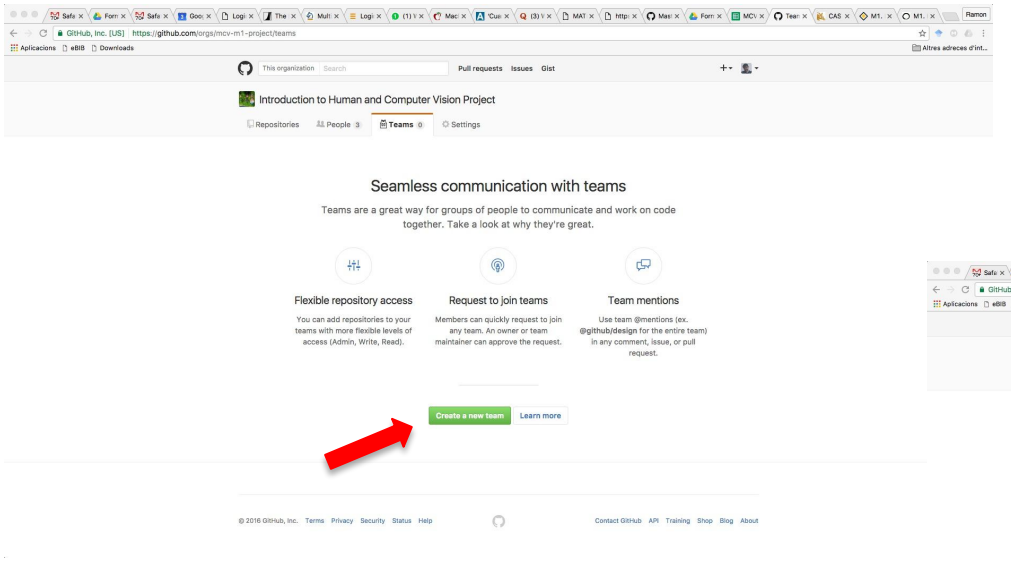
# GitHub repository

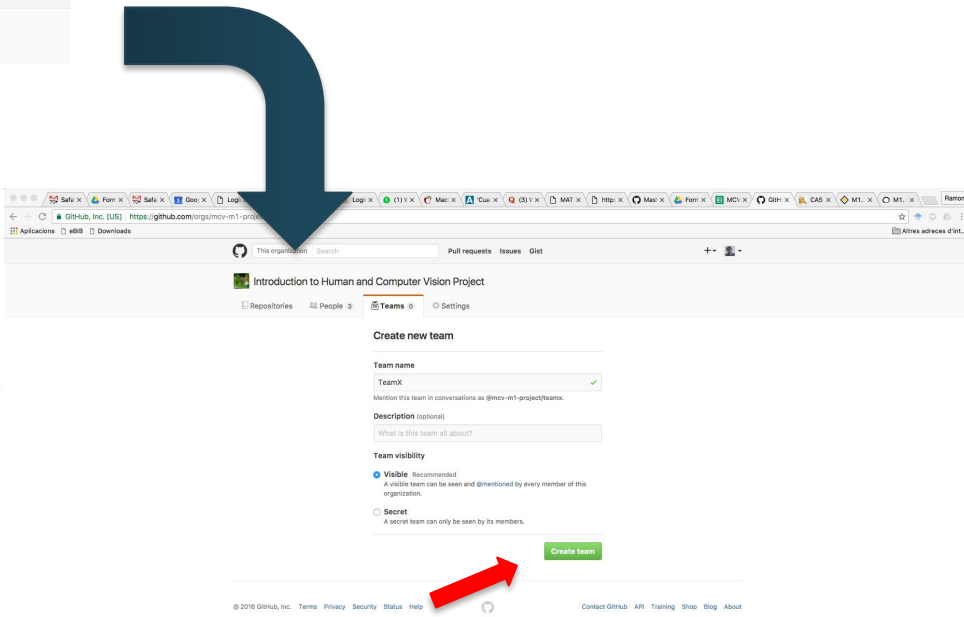
- Join GitHub by creating a personal account (all students). Enter account info in this spreadsheet
- We (lecturers) add you to the organization
- Set up a team & repository in the course organization **MCV-2022-M1-Project**[1] on GitHub (team admin)
  - Get your team ID by writing down the team members in this spreadsheet
  - Login into your GitHub personal account
  - Create a **team** in the GitHub organization with the ID assigned on the spreadsheet (just one person per team)
  - Add members to your team
  - Create a repository in **MCV-2022-M1-Project** with your ID to store your code
  - Give your team write permissions to this repository

https://github.com/MCV-2022-M1-Project

# GitHub repository

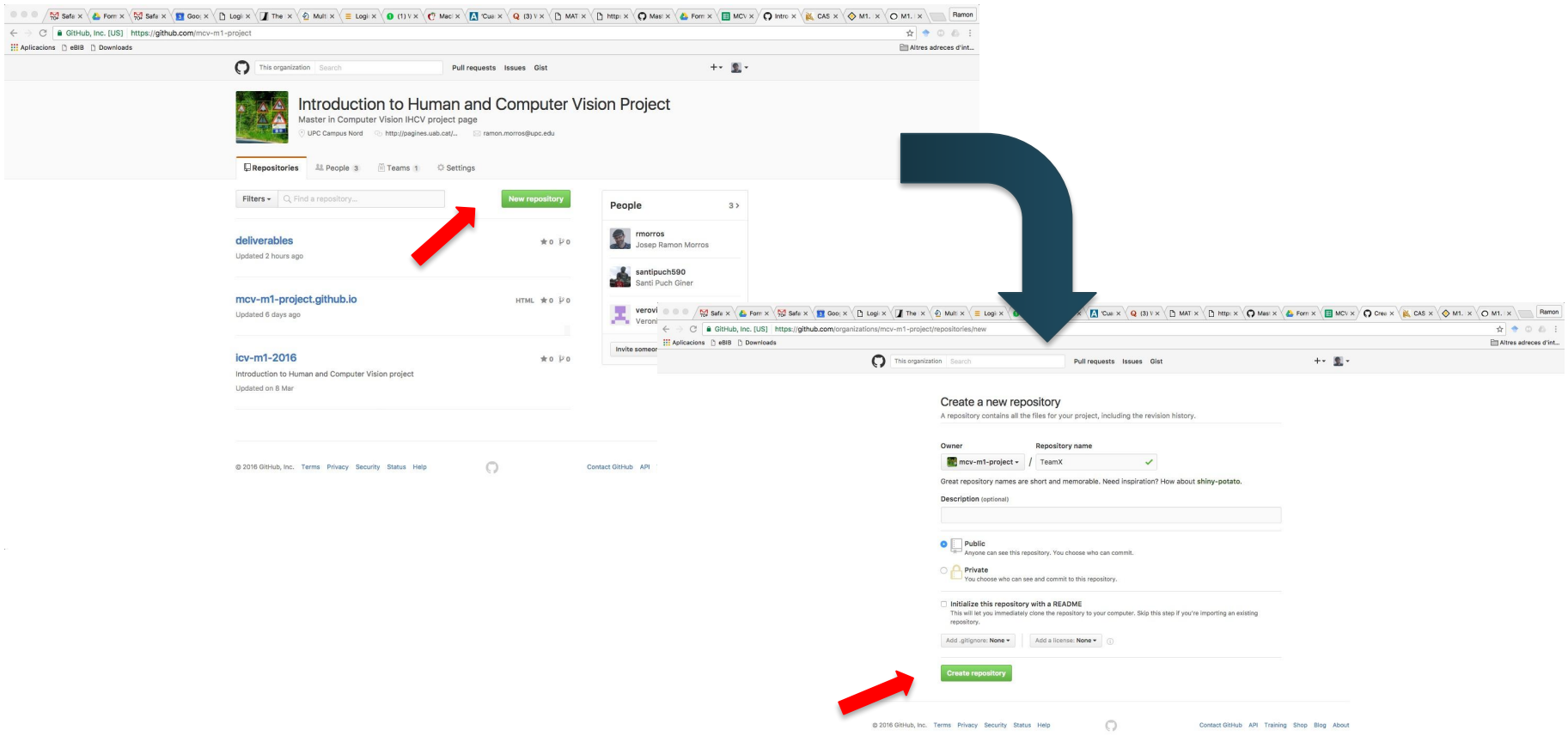
- Once we invited you into the organization …
- Create a **team** in the GitHub organization **MCV-2022-M1-Project**[1] with the ID assigned on the spreadsheet
- Add members to the team



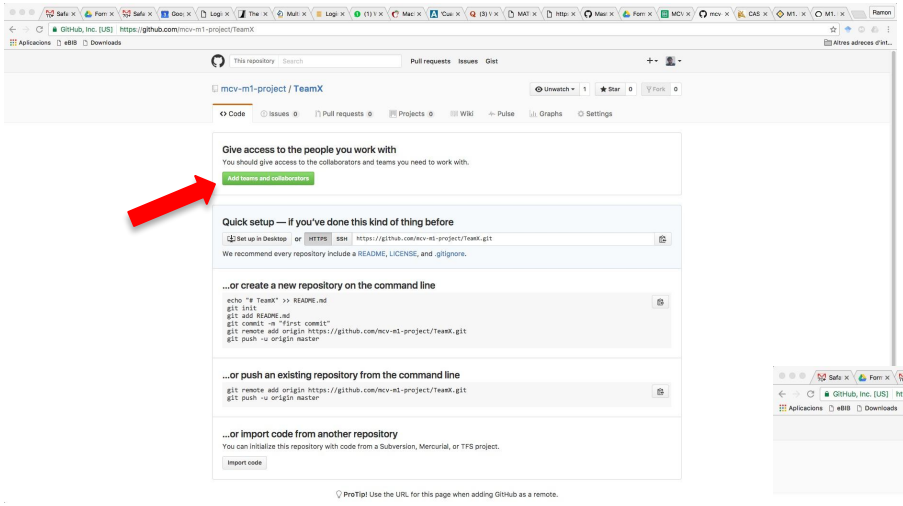
# GitHub repository

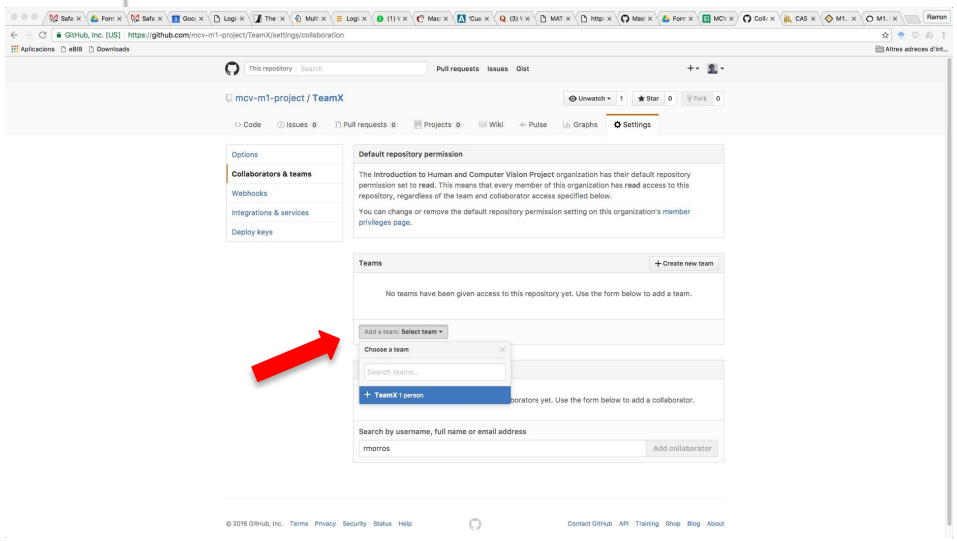
- Create a repository in **MCV-2022-M1-Project** with your ID to store your code



# GitHub repository

- Associate the repository with the team.

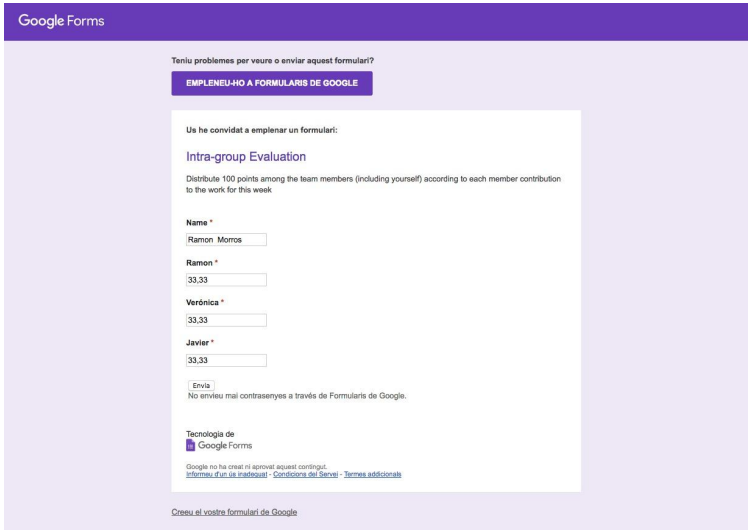


# Intra-group evaluation (IGE)

- Distribute 100 points among the team members (including yourself) according to each member contribution to the work for the week
- Consider quality & quantity of contribution
- Forms will be provided by us after each week submission

**Example 1**: I consider that all the team members have contributed the same




**Example 2**: I consider that Verónica did 2/3 of the total work, and Javier and me only 1/6 each