University of Verona

A.Y. 2021-22

Machine Learning & Artificial Intelligence

Projects and Exam

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Final Evaluation

Project

1) Code shared by Github

2) Written Report (to be evaluated)

3) Oral Presentation

Theory

A few questions about the theory to be asked during the project presentation

Project – Rules

- The project can be carried out in groups of 2 people max

- Every group should propose a project.

- In May 30 (date to be confirmed), there is the possibility to present a *pitch* of 5 min describing the project (no more than 5 slides), and we'll give you feedback and suggestions.

- The students interested to present should send us a note (by email) no later than May 26, 2022

- Possibility to perform projects in collaboration with other courses, subject to agreement between the teachers («natural» companion course: Deep Learning – Prof. M. Cristani)

- Possibility to perform Master theses

Project – Rules

- When the project is concluded, each group should present:
    - A written technical report, to be evaluated by us.
    - Project code, shared by GitHub.
    - An oral presentation of about 10 min, to be done by all authors by preparing a PowerPoint presentation.
    - After the presentation, a few questions related to the theory will be asked.

- The official dates of the exams have been fixed to June 27 and July 12, 2022, **BUT** they are only indicative for the exam registration and the delivery of the report to us.

- The effective exam, that is, the project discussion + theory questions will be held in a date to be fixed, which is typically about a week later the official dates.

Typical project structure

- The typical project should be structured as follows:

  - **Problem or task definition**: classification, regression, clustering, etc.., and associated application
  - **Dataset selection**
  - **Feature extraction** from data and related analysis
  - **Model selection** to be utilized
  - Evaluation of **Results** and analysis

Dataset Selection

- Strongly constrained to the tackled problem.

- Classification or clustering:
  - MNIST , SVHN, etc.: handwritten digits
  - FashionMNIST: clothing
  - CIFAR-10/CIFAR-100: objects
  - LEGO Bricks
  - CelebA : celebrity faces
  - Many others …

- Other datasets and project ideas on Kaggle.com or https://paperswithcode.com/datasets

- Or you can google the task your want to address + the word «datasets», e.g., «face recognition datasets»

Feature extraction

- Once the dataset has been selected, reason about it and pick one of the methods described in the course for extracting features and reduce feature dimensionality.

- Examples:
  - Principal Component Analysis
  - Linear Discriminant Analysis (Fisher)

- Feature extraction from images can also be done by pre-trained ConvNets (a script will be made available on *Moodle*)

Model selection

- Utilize classification/clustering models seen during the lectures to solve the tackled task

- Make comparisons, at least 5 variants:
  - Same model with different (hyper-)parameters
  - Different models, e.g., SVM vs. KNN vs. ConvNets

- Examples:
  - SVM
  - K-NN
  - Neural Nets (shallow and deep)
  - K-Means
  - Mean-Shift
  - …

Result evaluation and analysis

- Every single variant should be endowed of :

    - Quantitative results:
        - Confusion matrix
        - Accuracy figures
        - Recall/Precision figures (whenever possible)

    - Qualitative results:
        - Images representing input, output/predictions, ground-truth

How to write a technical report

- No fixed number of pages, not too short, not too long, if you want numbers let's say within 8 and 20 pages, but it's not compulsory

- **COVER PAGE:** Project Title, Master degree, Course, Academic Year, Author(s)
- Index (structure of the report)
- Subdivision in the following **Sections**

- The following suggested subdivision in Sections is indicative of the logical structure of the report, but not necessarily the only possible one.

How to write a technical report

- **Section MOTIVATION AND RATIONALE**
  - Place the proposed project in context, possibly identifying a Research Theme(s) of interest. What is the problem addressed by your project? Why is it significant?

- **Section STATE OF THE ART** [optional, but at least a glance]
  - Describe the state of the art relevant for the project.
  - What results or techniques do you plan to exploit? Which are the weak points of the SoA methods, which ones need to be improved? Why? How?

- **Section OBJECTIVES**
  - Please, clearly state the general and specific objectives of your project.

How to write a technical report

- **Section METHODOLOGY**
  - Discuss method(s), algorithms, datasets, analytical and computational tools that will be necessary to pursue the project objectives.

- **Section EXPERIMENTS & RESULTS**
  - Describe the evaluation protocol, conditions, datasets used and metrics to measure the performance (accuracy, confusion matrix, recall & precision, etc.)

- **Section CONCLUSIONS**
  - Summarize the project (goals, methods, results) and sketch possible future works.

- **Section BIBLIOGRAPHY or REFERENCES**
  - Only list the bibliographic references that are strictly relevant for describing the research project. All references should correspond to a citation in the text.

Project example

- Hair color classification of every celebrity present in the CelebA dataset

- Features: extracted by a pre-trained ConvNet

- Dimensionality reduction : PCA

- 3 model variants to test:
 - K-NN (K=3,5,7)
  - SVM (3 diversi kernel)

Possible further themes

- Pedestrian detection (HOG features)
  - Other object detection problems: cars, bikes, …

- Face detection (and recognition)

- SIFT features: classification, recognition, detection
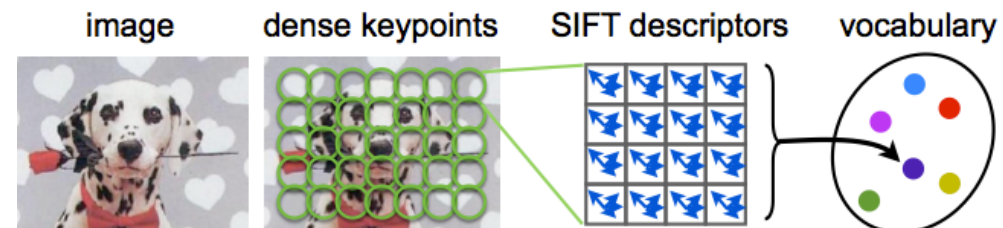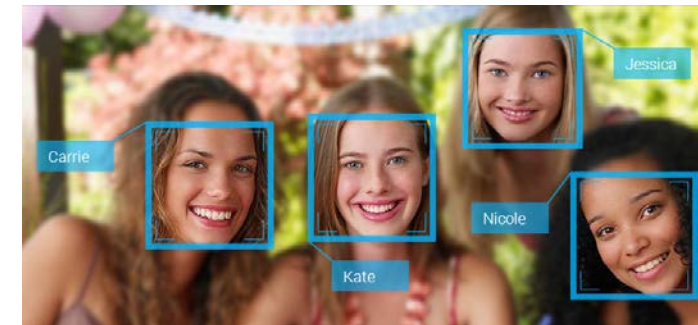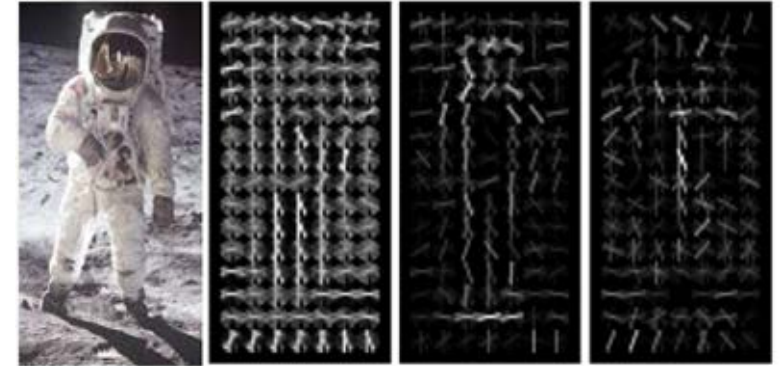
Possible further themes

- Sequence-like problems: estimate motion (e.g., optical flow) and classification

- Detection and tracking (keypoints)

- Image (semantic) segmentation

- Music classification, or other types of data, not necessarily images
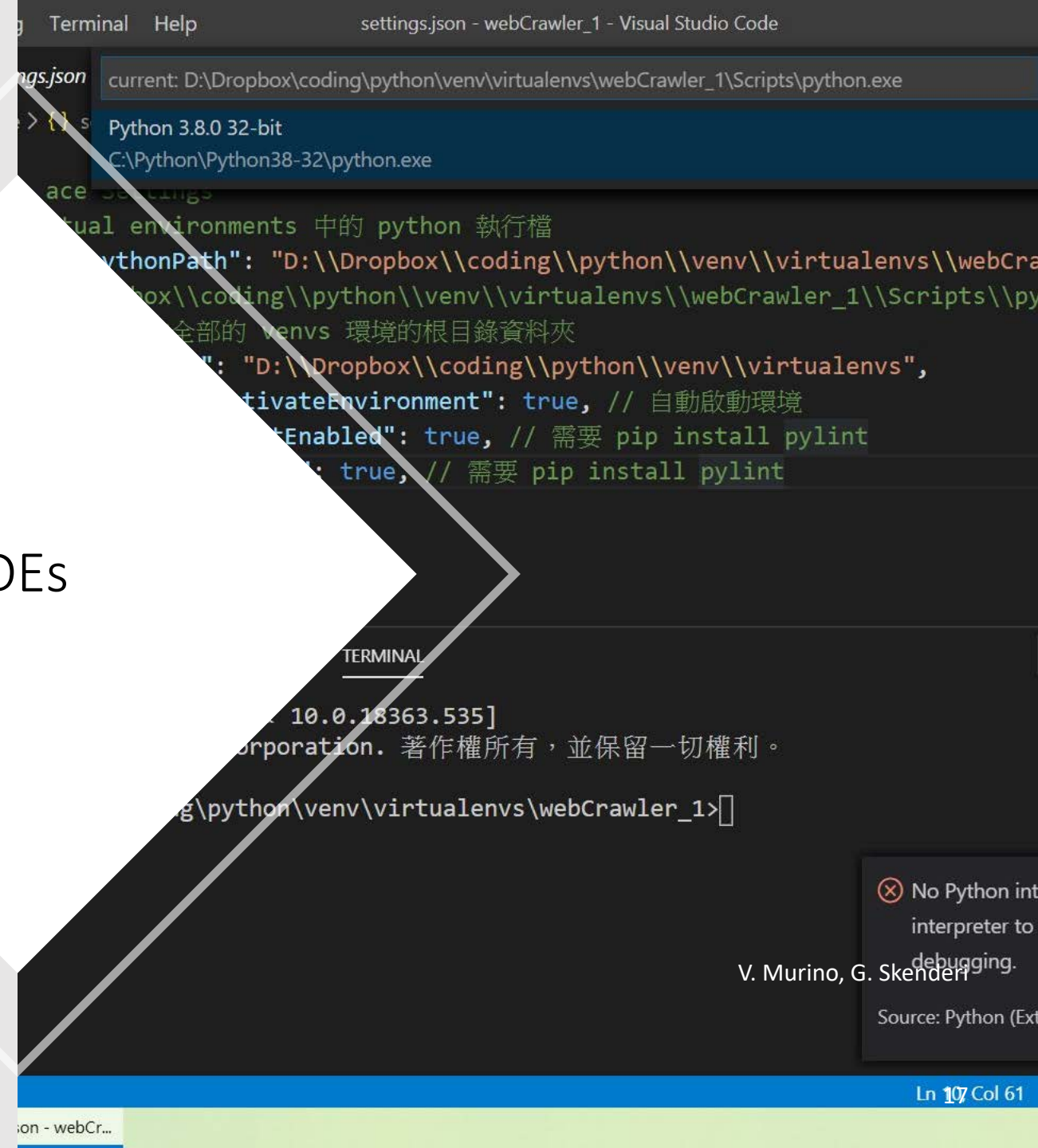
- ... your proposals

Input Image   Semantic Segmentation   Instance Segmentation
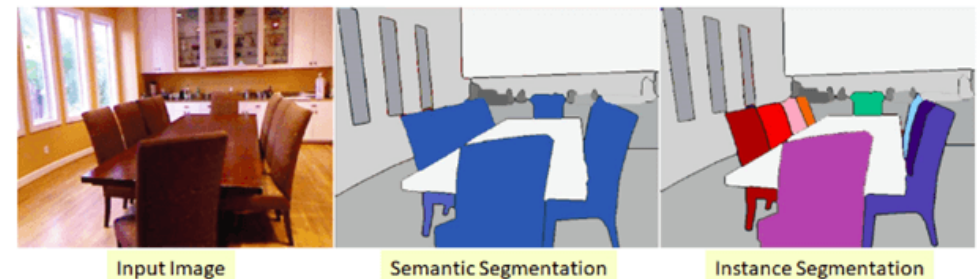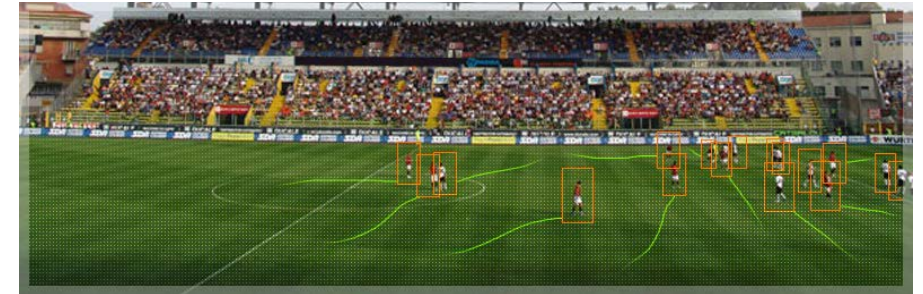
Development environment

IDEs

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