Assignment #4

Image Based Biometry
Faculty of Computer and Information Science
University of Ljubljana

Deep Face Recognition Pipeline

I. Introduction

You need to improve face recognition pipeline from the previous assignment #3 with deep-learning-based (DL) approaches and be amazed at how much better performance you get, where we're all headed as humanity and whether we should already start bowing to our robo overlords[1]:

- keep VJ in the comparison, but add at least two DL approaches. By default these are YOLO (https://docs.ultralytics.com/) and detection part of Insightface's model (https://github.com/deepinsight/insightface) – for both see the examples on Eučilnica, but feel free to use anything else,
- keep recognition of whole images you had, but add two DL approaches of your choosing, first one by default is Insightface's recognition model, the second (or more) you need to find on your own (use weights from face recognition, no need to train on your own),
- keep recognition of detected faces (this is face recognition pipeline evaluation) you had, but add the DL approaches.

Dataset: Same subset of CelebA-HQ and split from the previous assignment.

II. Installation and Preparation

Since it is up to you which approaches you will use, you have to install libraries as needed.

III. Tasks

You are required to implement a face recognition pipeline and evaluate it through the following steps:

1) **Face Detection:**
   - Use at least two pretrained face detection DL models.
   - By default these are YOLO and Insightface's face detection model (see Eučilnica for YOLO's weights and examples for both).
   - Report detection metrics using Intersection over Union (IoU) together with IoU's from the previous assignment.
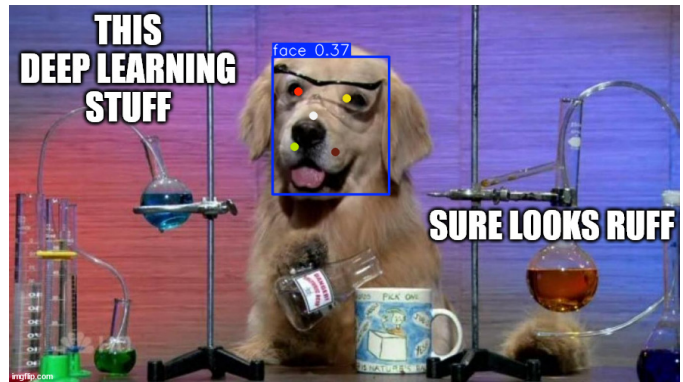
2) **Feature Extraction:**

Fig. 1. Example of a powerful deep-learning-based face detection.

- Select and implement at least two DL-based feature extraction methods for face recognition. You may use any face-pretrained models. Be careful, using only `pretrained=True` in e.g. Pytorch is not enough since this will load ImageNet weights and not for faces.
- An example of Faceinsight's recognition model is available on Eučilnica. But it is your task to find the second (or more) face recognition model. Make sure you have correct weights and that you take feature vector (embedding) as the output and not the final class-predictions that usually come after fully-connected layers in CNNs.
- Put your new approaches together with approaches form your previous assignment (no need to rerun those, you can simply copy the numbers if you have that stored).

3) **Evaluation** through the three experiments is the same as in the previous assignment, which means:
   - (I) Evaluate detection performances separately and report IoU metrics.
   - Evaluate recognition performance. Plot Cumulative Match Characteristic (CMC) curves and report Rank-1 and Rank-5 recognition accuracies:
     - (II) Whole images using each feature extractor,
     - (III) The full pipeline on **the best performing detection**, followed by each feature extractor.

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[1]All resistance is futile; we are mere inferior mortals.

4) **Report:**
   - Prepare a detailed report summarizing your methodology, experiments, results, and observations with the strict limit of **2 (two) pages**.
   - Include all plots (e.g., CMC curves) and tabulated performance metrics (IoU, Rank-1, and Rank-5).
   - Make sure the experimental section explains well what you did and also polish the reports. You can **omit** the first three sections: **Abstract, Intro and Related work**.

IV. Grading

Your submission will be evaluated as follows:

- **2.5pts**: The quality and of your solutions.
- **2.5pts**: Quality and clarity of the submitted report.

V. Submission

Submit the following on Eučilnica by the deadline:

- your scripts,
- a PDF report summarizing your approach, results, and key observations.

Oral defenses will follow. Have fun and be in awe!