COMP 6721 Applied Artificial Intelligence (Winter 2021)

Project Assignment, Part I

Due date (Moodle Submission): Friday, March 19th
Counts for 50% the course project

AI Face Mask Detector. You have to develop an AI that can analyze face images and detect whether a person is wearing a face mask or not:

		
Person with Face Mask[1]	**Person without Face Mask**[2]	**Not a Person**[3]

Towards this end, you have to develop a Deep Learning *Convolutional Neural Network* (CNN) using *PyTorch* and train it to recognize three different classes: (1) Person without a face mask, (2) Person with a face mask, and (3) Not a person (i.e., any other image). You will have to collect suitable training data and evaluate the performance of your system:

Training Data. Create datasets for training and testing your AI. You have to provide provenance information, i.e., where you obtained each image in your dataset. You can re-use existing datasets,[4] but again please make sure you properly reference the source of the image datasets (name, author, source, license of the dataset). It is expected that you have a *minimum* of 1000 training images and 300 testing images (across all classes). Note that you will have to perform suitable pre-processing (such as size-normalization) on your datasets.

Also, note the additional evaluation task that will follow in Part II of the project, mentioned below, when setting up your dataset. For images showing a face, you can limit your dataset to single persons (i.e., not groups of people). For the third category, it can be anything not showing a person (imagine a street-facing camera as part of an AI entry control system).

Deep Learning. Create a suitable Convolutional Neural Network (CNN) architecture, implement it in PyTorch, and train it using your dataset. You must implement the complete workflow in your CNN, that is, you cannot use any external libraries (e.g., to check if an image contains a face before feeding it into your network).

Evaluation. Evaluate your model, creating a table of results showing the *accuracy, precision, recall* and F_1*-measure*, as well as a *confusion matrix*. You can use scikit-learn (including skorch[5]) for your evaluation process.

[4] E.g., from Kaggle, https://www.kaggle.com
[5] See https://github.com/skorch-dev/skorch

Team Member Specialization. While all team members have to contribute equally to the project, you should designate one person who is mainly responsible for each of the following three tasks in the project: A *(I) Data Specialist*, responsible for creating, pre-processing, loading & analyzing the datasets; a *(II) Training Specialist*, responsible for setting up and training the CNN; and a *(III) Evaluation Specialist*, responsible for analyzing, evaluating, and applying the generated model. Each specialist has to write the corresponding part in the project report, detailed below. Note: this does not mean the designated person has to do all the work for the given task, but rather is mainly responsible for and can define and distribute sub-tasks to the other team members.

Report. You have to write a report on your work with the following information:

Title page: showing your group information (team name, team members, ID numbers, team member specialization).
Length: 1 page

Dataset: Describe how you built your dataset and where you collected images (provide details on each image's source in a file). Provide statistics on the size and structure of your dataset, i.e., how many images you have in each class.
Length: ca. 1 page

CNN Architecture: Describe the architecture of your CNN and provide details on the training process (how many epochs you trained, etc.).
Length: ca. 1 page (excluding images/diagrams)

Evaluation: Evaluate your model and provide the tables mentioned above. Discuss the results and explain how and where you want improve during the second phase of the project (also see Phase II details below).
Length: ca. 1 page

Reference Section: containing citations to all relevant resources that you have consulted (books, Web sites, . . .), even if it was just to inspire you. Failure to properly cite your references constitutes plagiarism and will be reported.

Project Phases I and II. The goal of this first phase of the project is to set up the complete AI learning & evaluation process and gather first results. You can improve the design and collect further training data for the final submission. In other words, do not overly worry about the performance at this step, rather focus on a proper design of your datasets and evaluation process, so that you can further improve it in the second phase of the project.

Phase II Preview: In Part II of the project, you are expected to further improve the performance of your system. A new task will be an extended evaluation of your AI, where you have to determine if your model exhibits any kind of *bias*, i.e., whether it performs differently for faces depending on age, gender, or race; and subsequently remove the bias from your system.

Deliverables. Your submission must include the following deliverables within a single `.zip` or `.tgz` archive:

Python code: All the Python code that you developed for this project. You must have a complete CNN implemented using PyTorch.

Dataset: Information on the datasets you collected, as well as a file detailing the source of each dataset/image. For external, publicly available dataset, only include a reference to the source with the details mentioned above. Include images you created yourself, as well as any manually created metadata for the Phase II bias evaluation.

Trained Model: The trained model that you used in your evaluation, together with some sample data (ca. 100 images) and instructions on how to run your system on the provided data.

README: A `readme.txt` (or `readme.md`) file that lists all submitted files with an explanation of their content. It also must describe how to run your code for (a) training and (b) testing (including generating the evaluation results provided in the report). If your instructions are incomplete and your code cannot be run you might not receive any marks for your work.

Report: The project report, as detailed above, in PDF format.

Submission. You must submit your code electronically on Moodle by the due date (late submission will incur a penalty, see Moodle for details). Include an *Expectation of originality* form (see https://www.concordia.ca/encs/students/sas/expectation-originality.html), (electronically) signed by *all* team members.

Demo. We will schedule online demos sessions for your project using Zoom.

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