COMP6721 Applied Artificial Intelligence (Fall 2020)

Project Assignment Part I

Due date : Friday, November 20th

AI Face Mask Detector

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0. Introduction

In this project, we developed 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).

In this first phase of the project, we focused on a proper design of our datasets, collecting suitable training data, setting up the complete AI learning & evaluation process and gathering first results. We will further improve it in the second phase of the project.

1. Dataset

1.1 Create dataset

In this part we will describe how we built our dataset, the source of collected images and provide details on the dataset.

In order to get better performance for our project, we decided to build our own dataset by collecting images from existing several datasets rather than directly re-use existing datasets. We collected images from public datasets, CelebFaces Attributes Dataset (CelebA); from online community of data scientists and learning practitioners, Kaggle; from personal source code datasets, Git. More details about the source in the Reference Section.

Our dataset has two parts, train dataset part and test dataset part. Each part includes three classes.

* Person with a face mask,
* Person without a face mask, and
* Not a person (i.e., any other image).

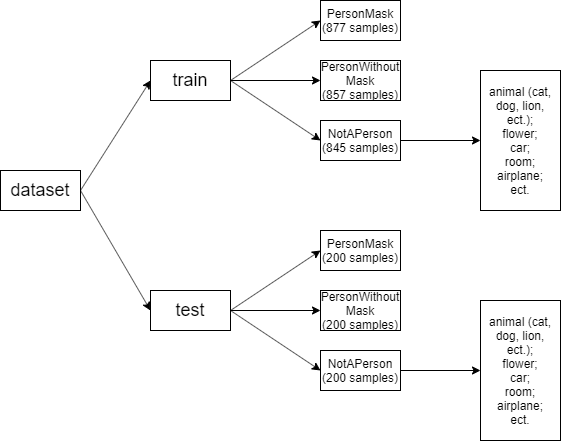


Fig.1 dataset’s size and structure

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

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, but again please make sure you properly reference the source of the images (name, author, source, license of the dataset). Also, note the additional evaluation task that will follow in Part II of the project mentioned below when setting up your dataset.

1.2 Pre-process datasets

When we install PyTorch, we also install torchvision library which contains models and transformation operations generally used in the image pre-processing.

For train dataset, we do image resize, center crop and transfer to tensor; while for test dataset, we do image resize and transfer to tensor, we do not need to do center crop.

1.3 Load datasets

We use DataLoader to provide API for loading datasets. We create a DataLoader object, then we load image and label information up to model for training by looping this object.

1.4 Analyse datasets

(I) Data Specialist, responsible for creating, pre-processing, loading & analyzing the datasets; （这两点你可以留着给我，你尽量写你能写的）

Deliverables:

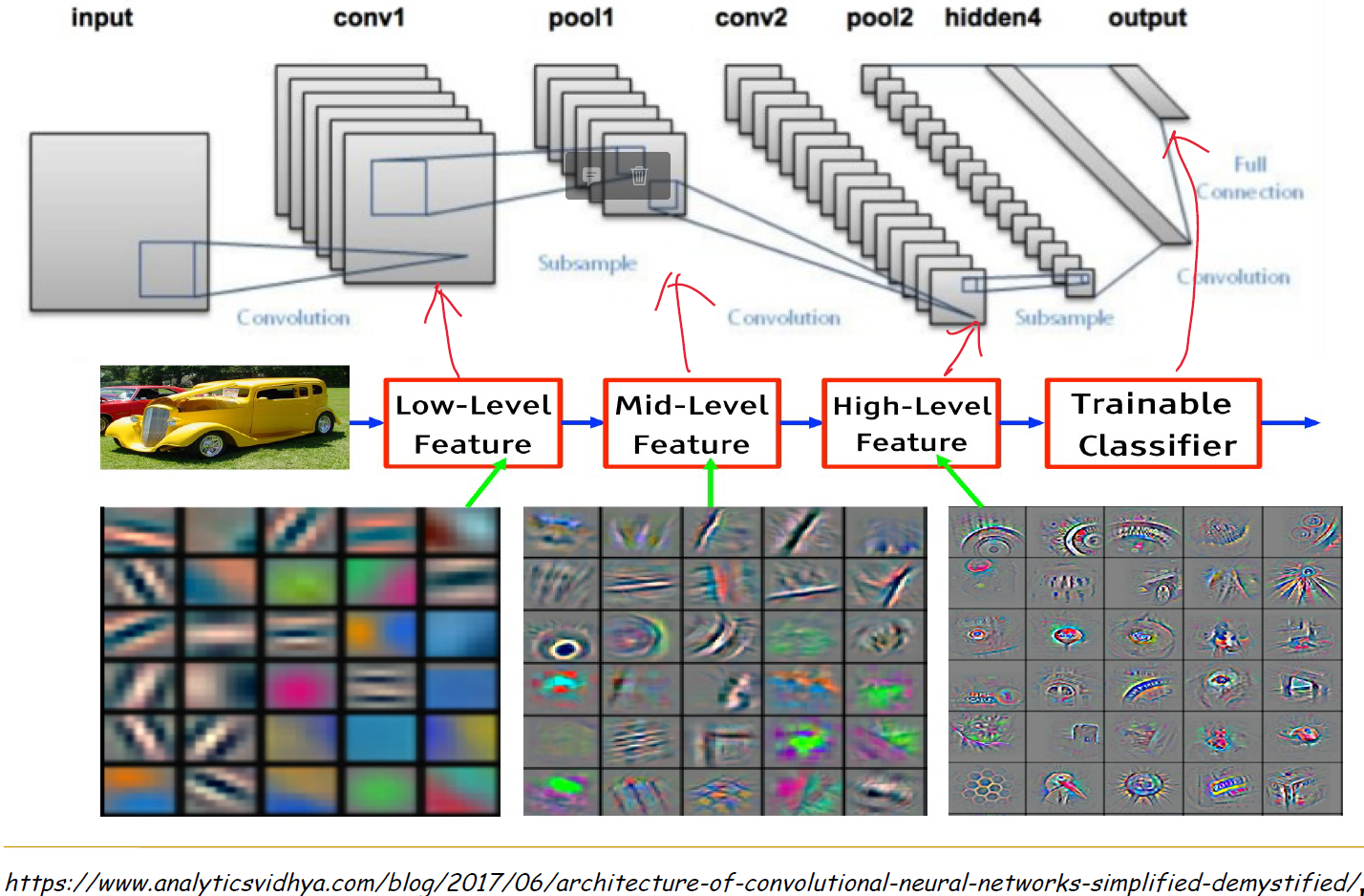
Dataset: The dataset you collected, as well as a fille detailing the source of each image.

2. CNN Architecture

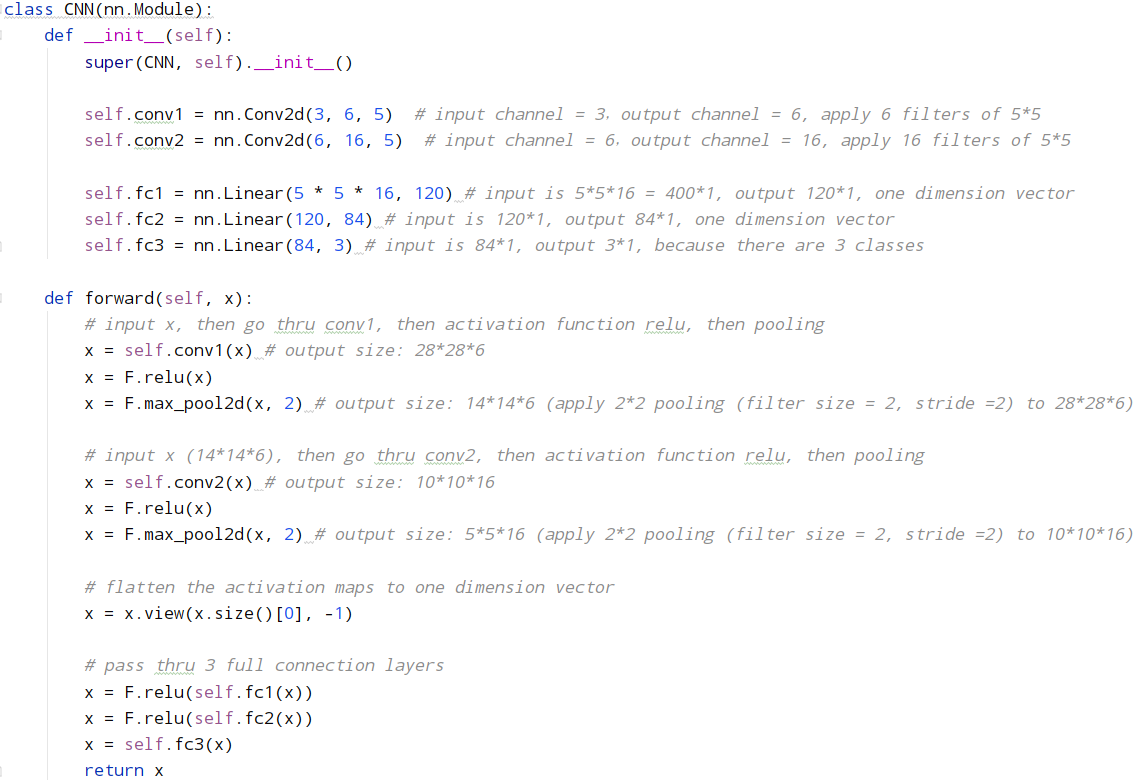
In this part we will describe the architecture of our CNN and provide details on the training.

In order to create a suitable Convolutional Neural Network (CNN) architecture, implement it in PyTorch, and train it using our dataset, we first create a class inheriting from the nn.Module to define different layers of the network based on provided network architecture above.

We set 2 Convolutional Layers with activation and max pooling, the flatten it to one-dimension vector, then pass it through 3 Full Connection layers, like shown in the teaching material:



In our code, we have provided comment for every step, as shown below:



In the training phase, we use “train\_loader” to load the images from given path, the images in each sub-folder is labeled with the sub-folder name.

Following what we learned from the lecture and lab, we create an instance of the Convolution class we defined in previous part, then define the optimizer and loss function.

We set the learning rate to be 0.001, this number is small so the weight won’t get changed violently.

We train the model for 10 epochs, for now we can get a final accuracy of 91.17%.

In second phase of the project we can increase this number to achieve better performance.

When training phase is completed, the parameters of our CNN are saved to 2 files:

*net.pkl*

*net\_params.pkl*

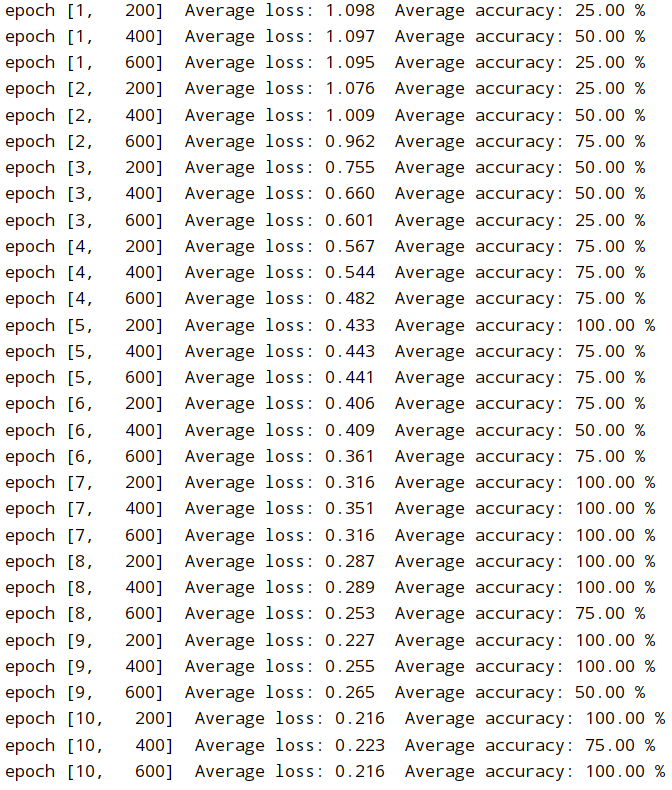
This will be read by the testing phase to evaluate our model.

3. Evaluation

We provide the data as below to analyze and evaluate our model:

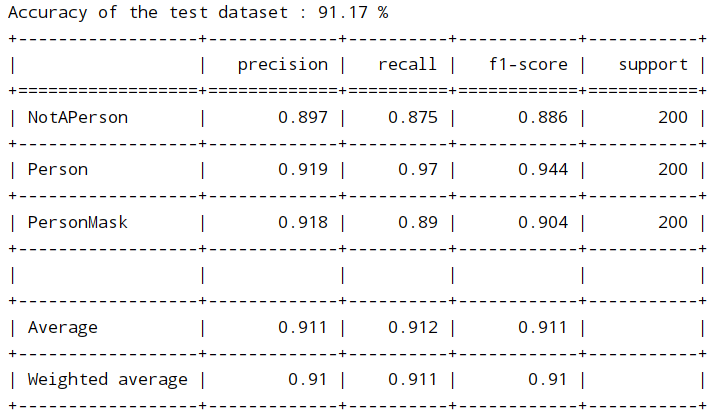
(1) Log for training our CNN:

Average loss and accuracy of each 200 images



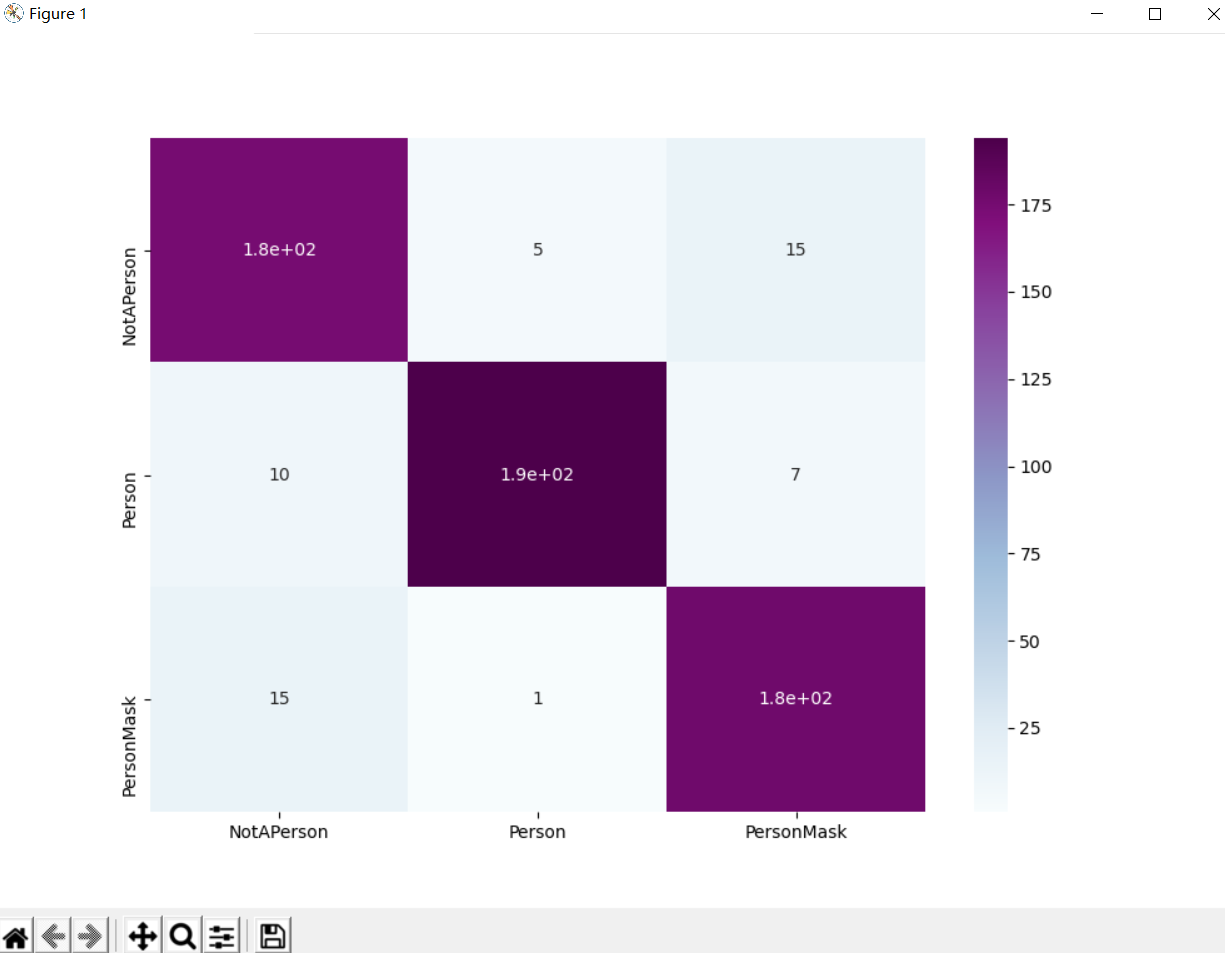
It is obvious that along with the process of training, the average loss decreases, while average accuracy is augmented.

(2) A table of results showing the accuracy, precision, recall and F1-measure



The results of accuracy, precision, recall and F1-measure are acceptable and promising, means we learned the knowledge and skill to build a CNN to do classification.

(3) Confusion matrix:



As we can see from the Confusion matrix, our CNN model successfully classified majority of the test data.

(4) Running time

Training phase takes: 0:03:02.110196

Testing phase takes: 0:00:41.731781

(5) Discuss the results and explain how and where we want to improve during the second phase of the project.

- We could improve on the structure of our CNN:

* For structure:
* We could increase the number of Convolutional Layers so that the accuracy will be further improved;
* We could add normalization to some steps in Convolutional Layers;
* We could add the step of “dropout random nodes” in Full Connection Layers to avoid certain feature has huge impact on the result;
* For parameters:
* We could change the kernel size of the Convolutional Layers (currently always 5\*5);
* We could add padding (currently no padding);
* We could try other activation functions (currently relu);
* For training phase:
* We could try different loss function (currently using CrossEntropyLoss());
* We could use other optimizer (currently using optim.SGD);
* We could change the learning rate to see if the performance can be further improved (current learning rate = 0.001)
* we could increase the number of images in training set, until it reaches the top of the learning curve (where accuracy hardly could be improved by increasing the size of the training set).
* Also We could increase the number of epochs to minimize the loss, and maximize accuracy, precision, recall and F1-measure.

4. Reference Section

This part contains citations to all relevant resources that we have consulted, even if it was just to inspire us.

Data part:

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[] 写完麻烦编一下号码（全部第4部分）~~

1. CelebFaces Attributes Dataset, by Ziwei Liu, Ping Luo, Xiaogang Wang, Xiaoou Tang, Multimedia Laboratory, The Chinese University of Hong Kong <http://mmlab.ie.cuhk.edu.hk/projects/CelebA.html>
2. Face Mask Detection, by Larxel, <https://www.kaggle.com/andrewmvd/face-mask-detection>
3. With/Without Mask, by Niharika Pandit, <https://www.kaggle.com/niharika41298/withwithout-mask>
4. Face Mask Classification, by Dhruv Makwana, <https://www.kaggle.com/dhruvmak/face-mask-detection>
5. Face Mask Detection, by Edward Zhang, <https://www.kaggle.com/sshikamaru/face-mask-detection>
6. Mask detection, by abdelatif, <https://www.kaggle.com/moussaid/mask-detection>
7. COVID-19 Mask Detector, by Niharika Pandit, <https://www.kaggle.com/niharika41298/covid-19-mask-detector>
8. LFW-People (Face Recognition), by Atul Anand{Jha}, <https://www.kaggle.com/atulanandjha/lfwpeople>
9. Real-World-Masked-Face-Dataset, by X-zhangyang, <https://github.com/X-zhangyang/Real-World-Masked-Face-Dataset>
10. Face-Mask-Detection, by chandrikadeb7, <https://github.com/chandrikadeb7/Face-Mask-Detection/tree/master/dataset/with_mask>
11. Documentation of pytorch, <https://pytorch.org/>
12. Build our own datasets and load to pytorch, <https://pytorch.org/docs/stable/torchvision/datasets.html>
13. Lab 7 of COMP6721, refer to moodle
14. https://www.youtube.com/watch?v=YRhxdVk\_sIs
15. Youtube video: How Convolutional Neural Networks work, <https://www.youtube.com/watch?v=FmpDIaiMIeA&ab_channel=BrandonRohrer>
16. “A Comprehensive Guide to Convolutional Neural Networks — the ELI5 way”, <https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks-the-eli5-way-3bd2b1164a53>
17. Precision, recall, and F1measure, From Wikipedia: <https://en.wikipedia.org/wiki/Precision_and_recall>
18. A Comprehensive Tutorial to learn Convolutional Neural Networks from Scratch (deeplearning.ai Course #4), <https://www.analyticsvidhya.com/blog/2018/12/guide-convolutional-neural-network-cnn/>
19. Documentation of pytorch: TRAINING A CLASSIFIER, <https://pytorch.org/tutorials/beginner/blitz/cifar10_tutorial.html>
20. Neural Network Programming - Deep Learning with PyTorch, <https://deeplizard.com/learn/video/0LhiS6yu2qQ>
21. Documentation of pytorch , <https://pytorch-lightning.readthedocs.io/en/latest/metrics.html>
22. Architecture of Convolutional Neural Networks (CNNs) demystified, <https://www.analyticsvidhya.com/blog/2017/06/architecture-of-convolutional-neural-networks-simplified-demystified/>