**Project Deep Learning**

**Mask detection :**

**“Are you wearing mask?”**



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# Abstract

This work is an academic group project for the course of *Deep Learning*, Master in Data Science and Advanced Analytics at *Nova Ims*.

The idea that gave birth to this project comes from a particular situation that is generated by the Coronavirus pandemic. The virus has changed our daily lives and habits, and one of the symbol of this new reality is for sure represented by this new “cloth” that all of us should wear in public spaces: face mask.

The face-detection is a problem that Machine Learning and in general AI has developed, and the machines have already achieved very significant results, with high probabilities of recognition.

But what about half of the face covered? Are we able to help the authorities to discover if people is actually wearing the mask in public spaces, as the social restrictions require?

In easier terms: are people actually wearing masks?

With these questions and inspirations, we start the creation of our model.

# Problem Statement

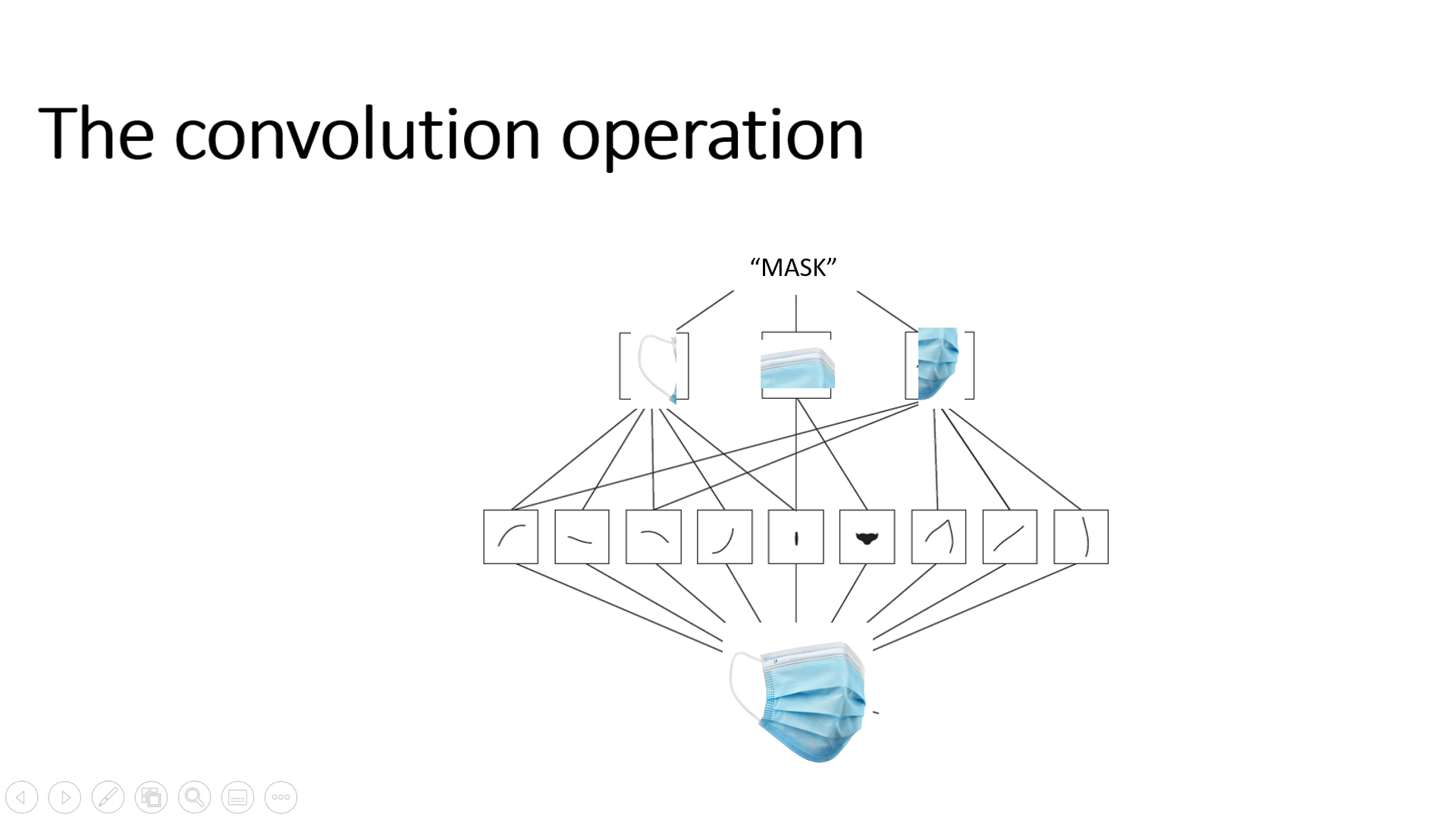
The idea of the CNN is that we provide the computer images that are read as array of numbers and it will output numbers that describe the probability of the image being a certain class (.80 for cat, .15 for dog, .05 for bird, etc).

In order to achieve the desired results, we build a Convolutional Neural Network.

We want to deal with a binary classification problem, in which we have 2 classes for the output: “mask” or “no mask”.

**Objective:**

The challenge we want to complete is the creation of a model able to detect automatically if, given an image-input, the person represented in that picture is wearing or not the mask.



One of key points for the success of this classification problem is that we would be achieve a successful creation of filters in the convolutional process that will be able to detect the key characteristic that identify the 2 classes: the presence of the mask.

# Sources and data

**Images MASK**

Source website : <https://www.kaggle.com/andrewmvd/face-mask-detection/metadata>

This dataset contains images of a single person with a mask and group of people with masks, with different background and position of the person / people in the image.

1411 images of people with mask are considered for this project.

**Images NO MASK**

For images of people with no mask, we select images from 2 different datasets. The reason is simple; in the first one there images of profiles of people with mask, instead in the second one there are group of people with mask in different context and with different backgrounds.

The choice is due to achieve the similar level of noise and good profile of people without mask, in order to have the images of the 2 classes as similar as possible.

The dataset with group of people without masks is the following.

Source: <http://chenlab.ece.cornell.edu/people/Andy/ImagesOfGroups.html>

From this dataset, 753 images are taken into consideration.

From the second dataset, there are close-up faces of people without mask, and only one person for each picture.

Source: <https://www.kaggle.com/ashwingupta3012/human-faces?select=Humans>

Form this dataset, 658 images are taken into consideration.

The total number of images are 1411 images for mask class and 1411 images for no mask class, with a total of 2822 pictures in the dataset.

Furthermore, in order to complete our analysis properly we split the dataset in train, validation and test sets. We chose the following percentages for the splitting:

* Train: 70 % 🡪 1978 images
* Validation: 15 % 🡪 422 images
* Test: 15 % 🡪 422 images

The final dataset already divided in the train, validation and test folders can be found [here](https://github.com/LorenzoPigozzi/Deep_Learning_Exercises/tree/main/Project).

# Further steps

1. Hyper-parameters tuning
2. Understand the behavior of the model using Heatmaps
   1. <https://glassboxmedicine.com/2019/06/11/cnn-heat-maps-class-activation-mapping-cam/>
   2. <https://colab.research.google.com/drive/1D_ChNp-XR4Xh8BNG-ZqacL2ShaH34SCc>
3. Test the model comparing the model created from scratch with a pre-trained NN
4. Develop an object localization of the mask
   1. <https://medium.com/analytics-vidhya/object-localization-using-keras-d78d6810d0be>