



UNIVERSITÀ
DEGLI STUDI
DE L'AQUILA



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BLENDDED INTENSIVE PROGRAMME (B.I.P) IN MATHEMATICAL MODELLING

L'AQUILA, JUNE - JULY 2024

Face Recognition
based on Facenet neural network



Presented by Mohamed Amine Harbaoui & Oussama Bersellou



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OUR TEAM



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Introduction

Face detection and recognition is one of the biggest areas of research in computer vision.

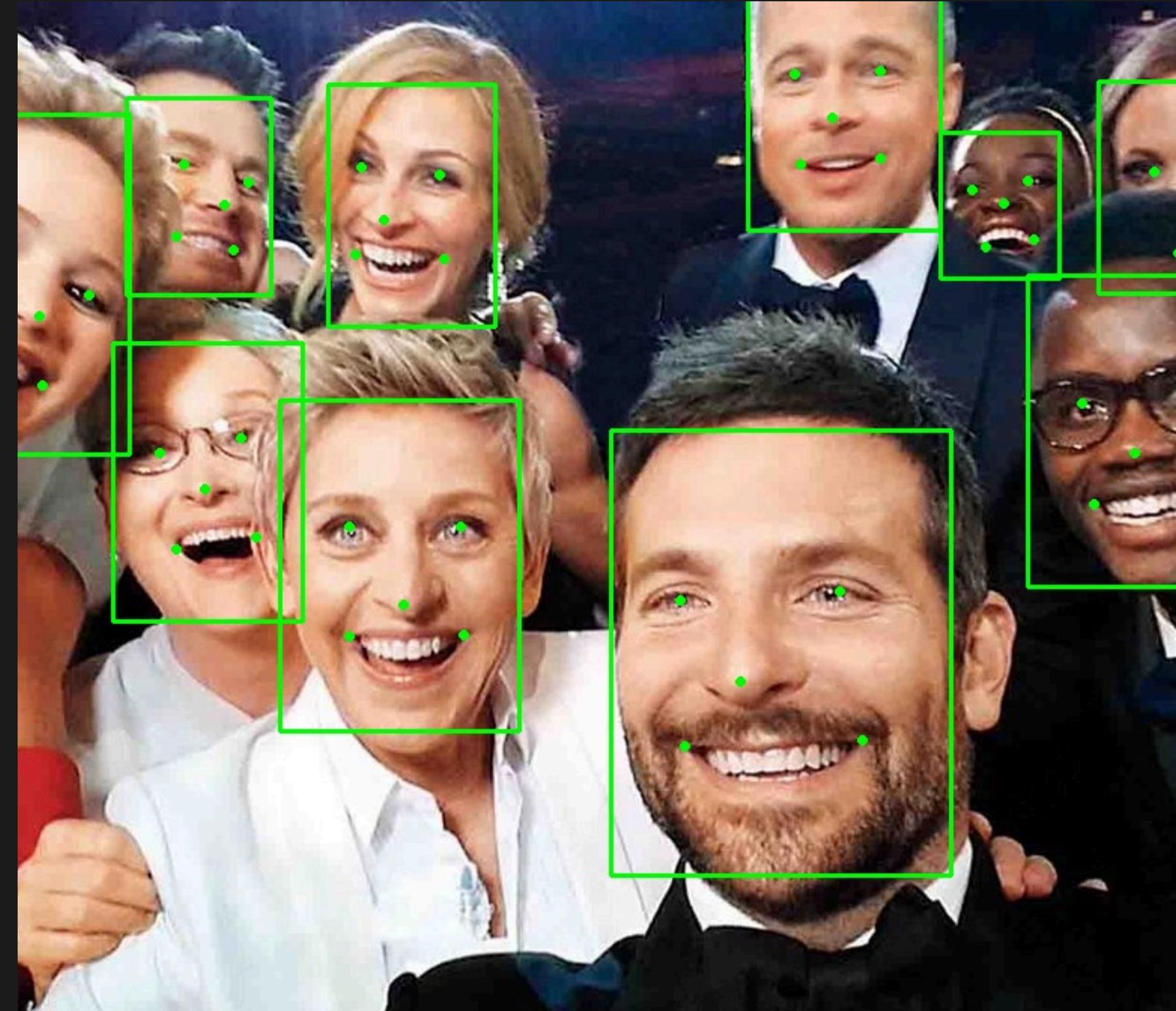
This is becoming increasingly important with many real-world applications such as unlocking the phone.

- 01 • Face detection
- 02 • CNN
- 03 • MTCNN
- 04 • Facial Recognition
- 05 • Facenet

Face detection

Face detection is the process of finding the face from the image, it consists in identifying all image regions that contain a face regardless of its position, orientation, and three-dimensional lighting states.

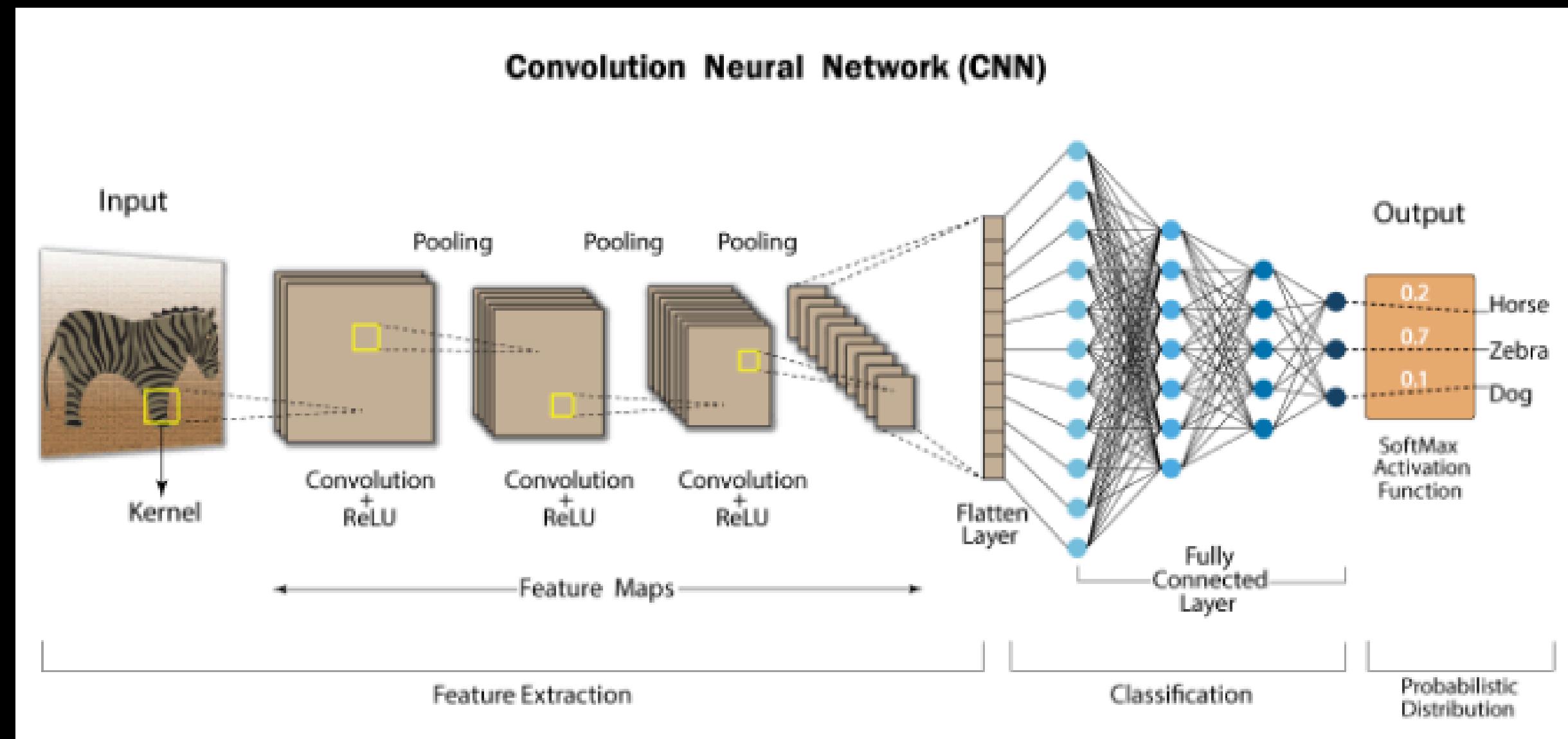
Face detection is the treatment performed just before the facial recognition phase, the identification process is not automatic and complete without effective detection phase.





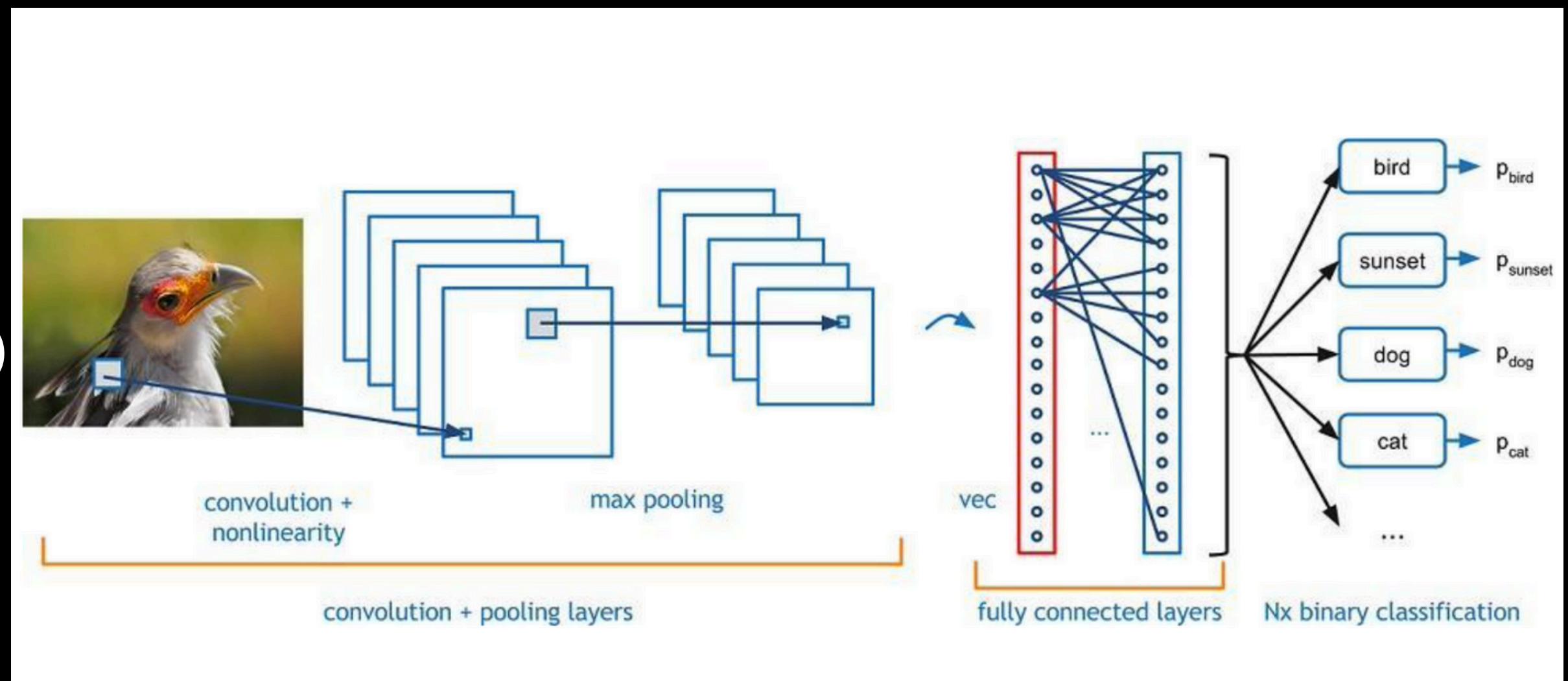
Convolutional Neural Network "CNN"

Convolutional neural networks (CNN) are a category of neural networks that have been shown to be very effective in areas such as image recognition and classification.

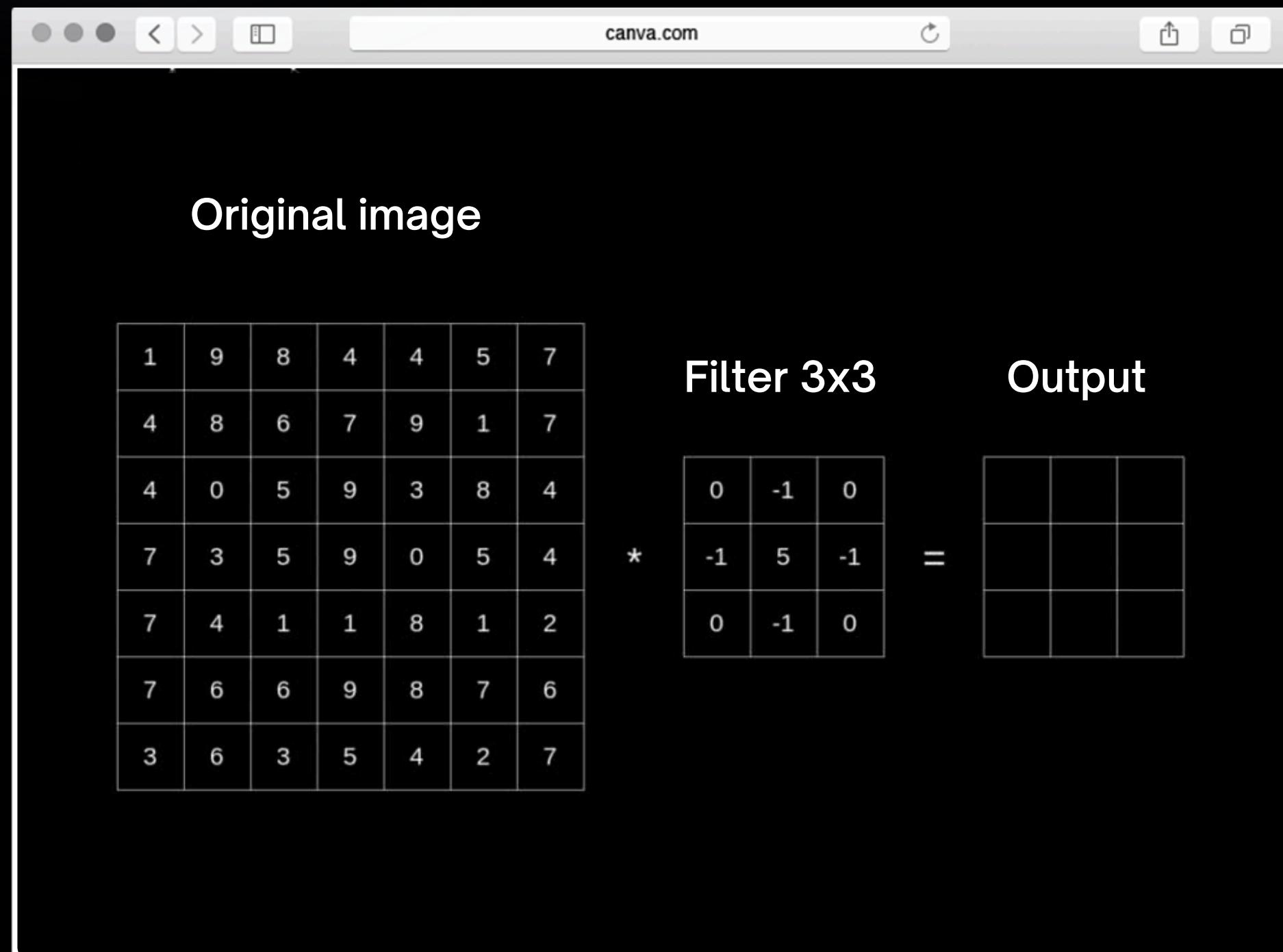


CNN Network Layers

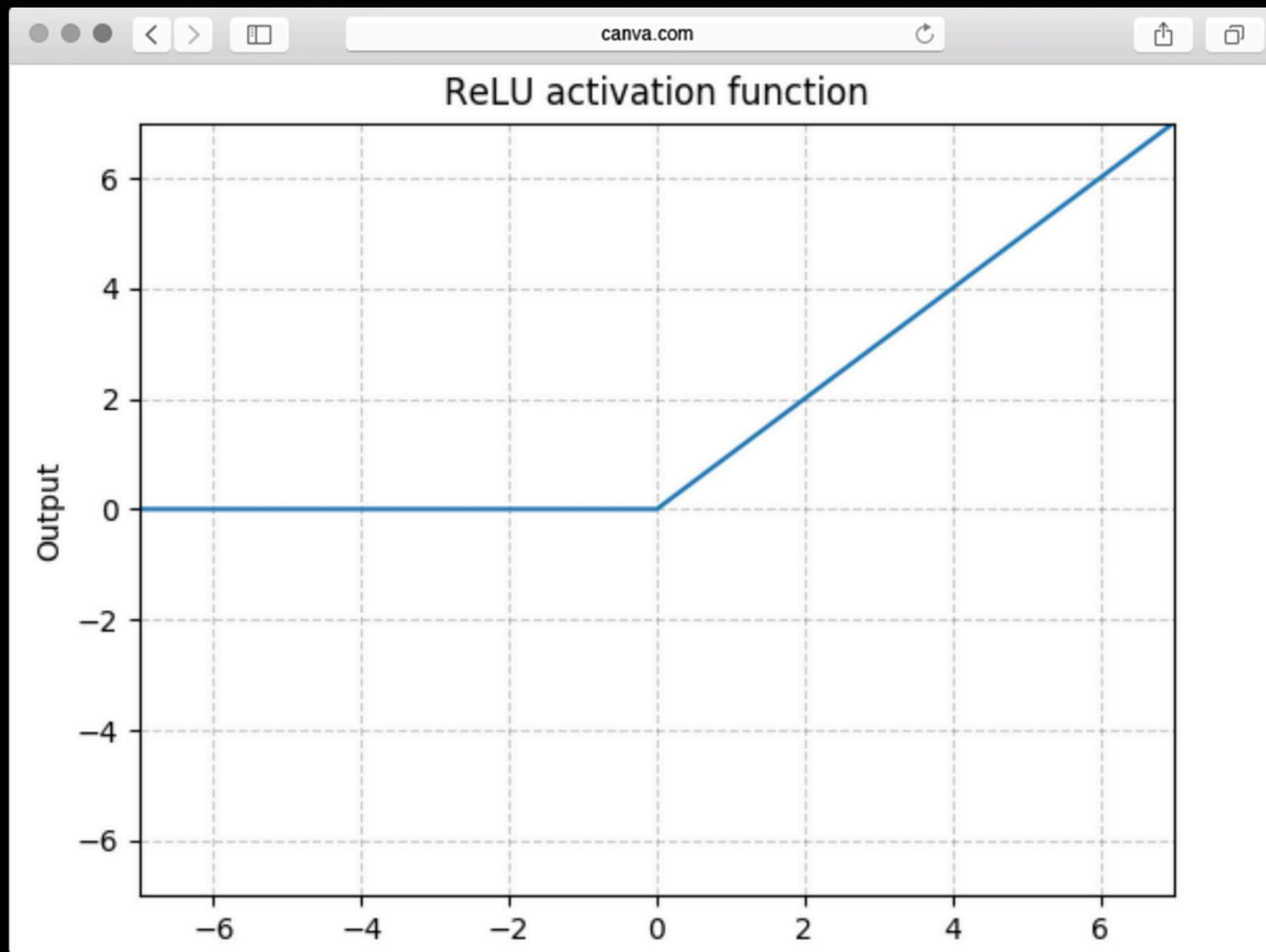
- Convolutional Layer
- Pooling layer
- ReLu (Rectifier Linear Unit)
- Fully Connected Layer
- Softmax



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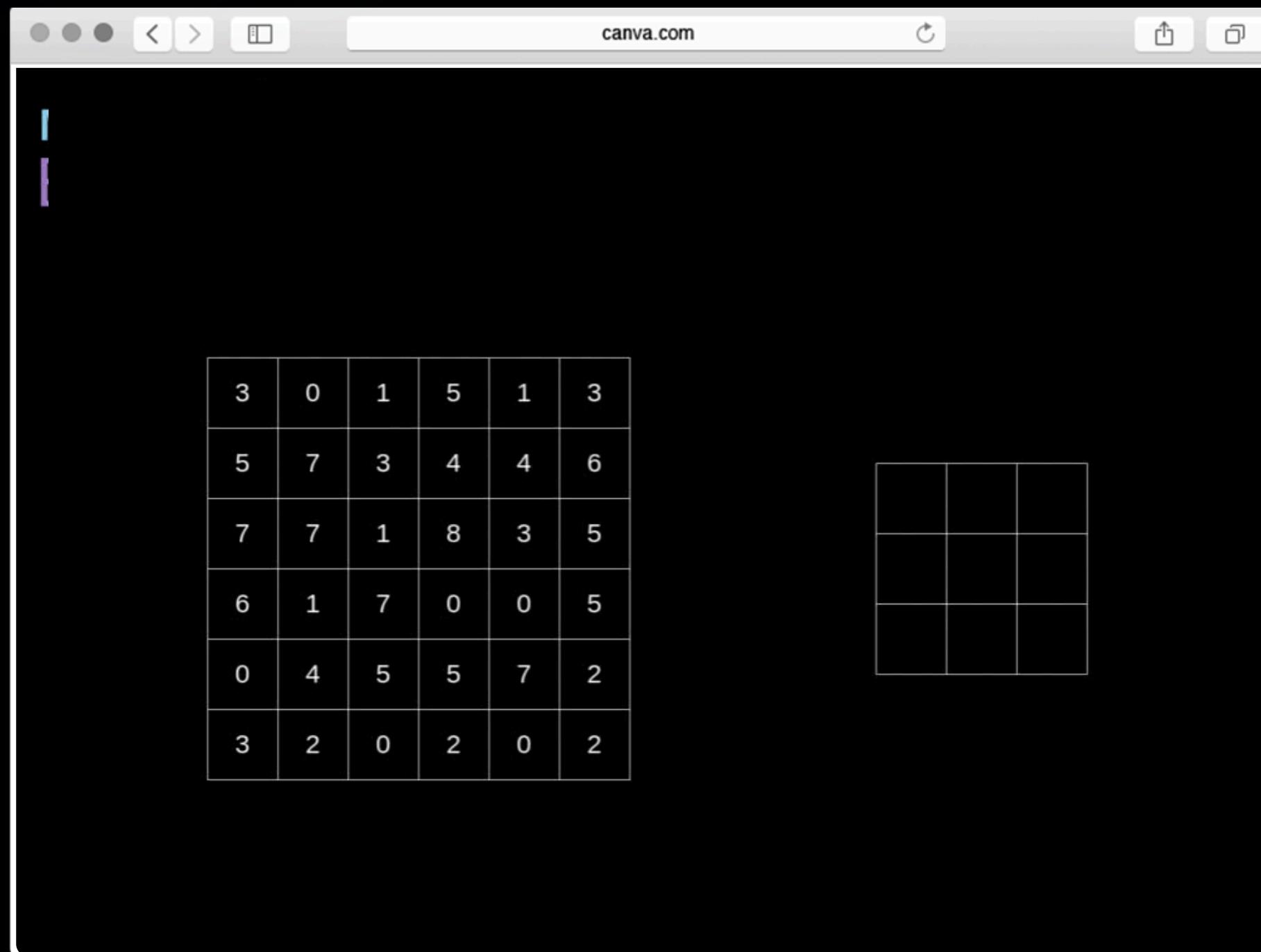


Convolutional Layer



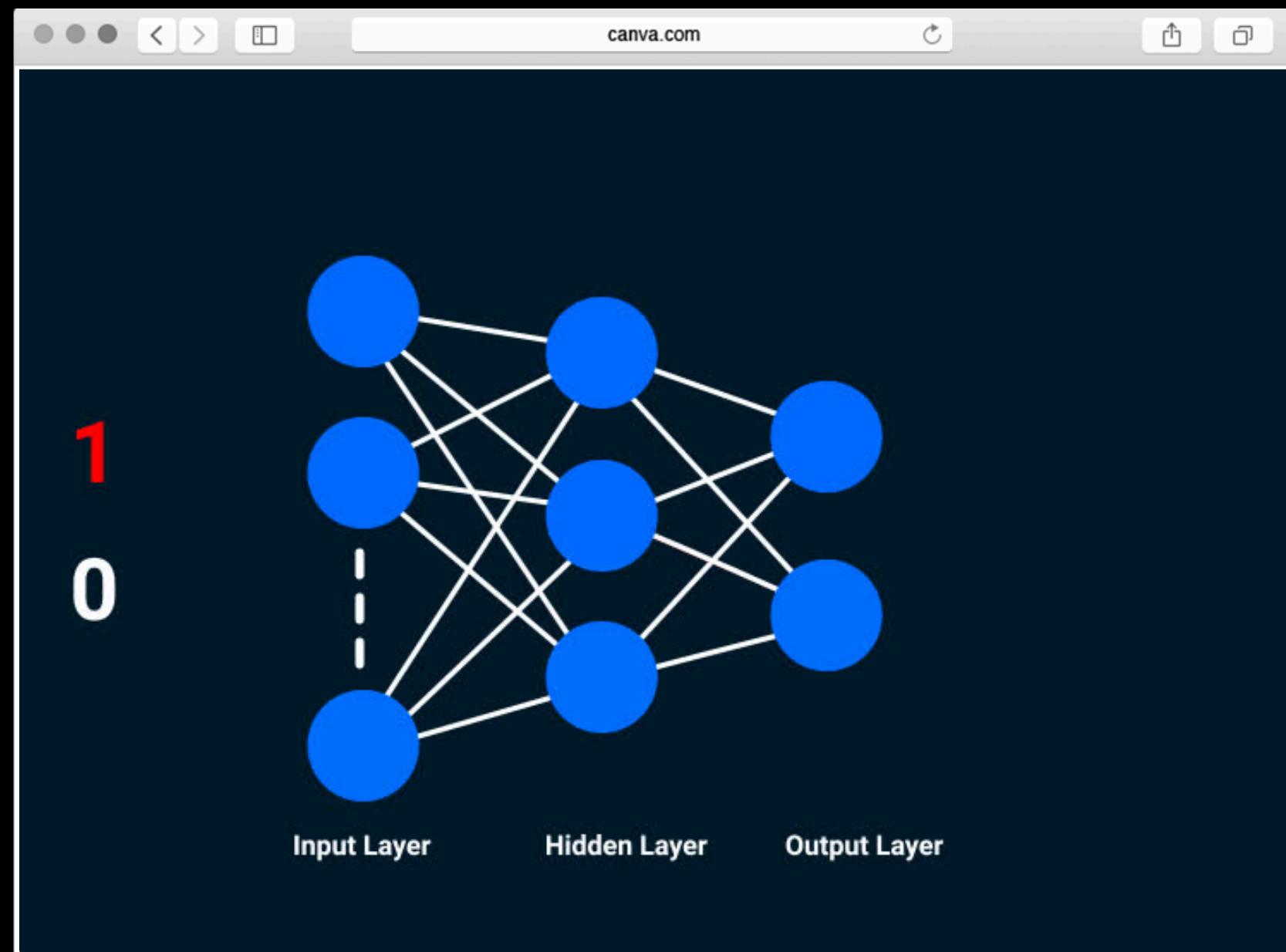
Correction Layer (Relu)

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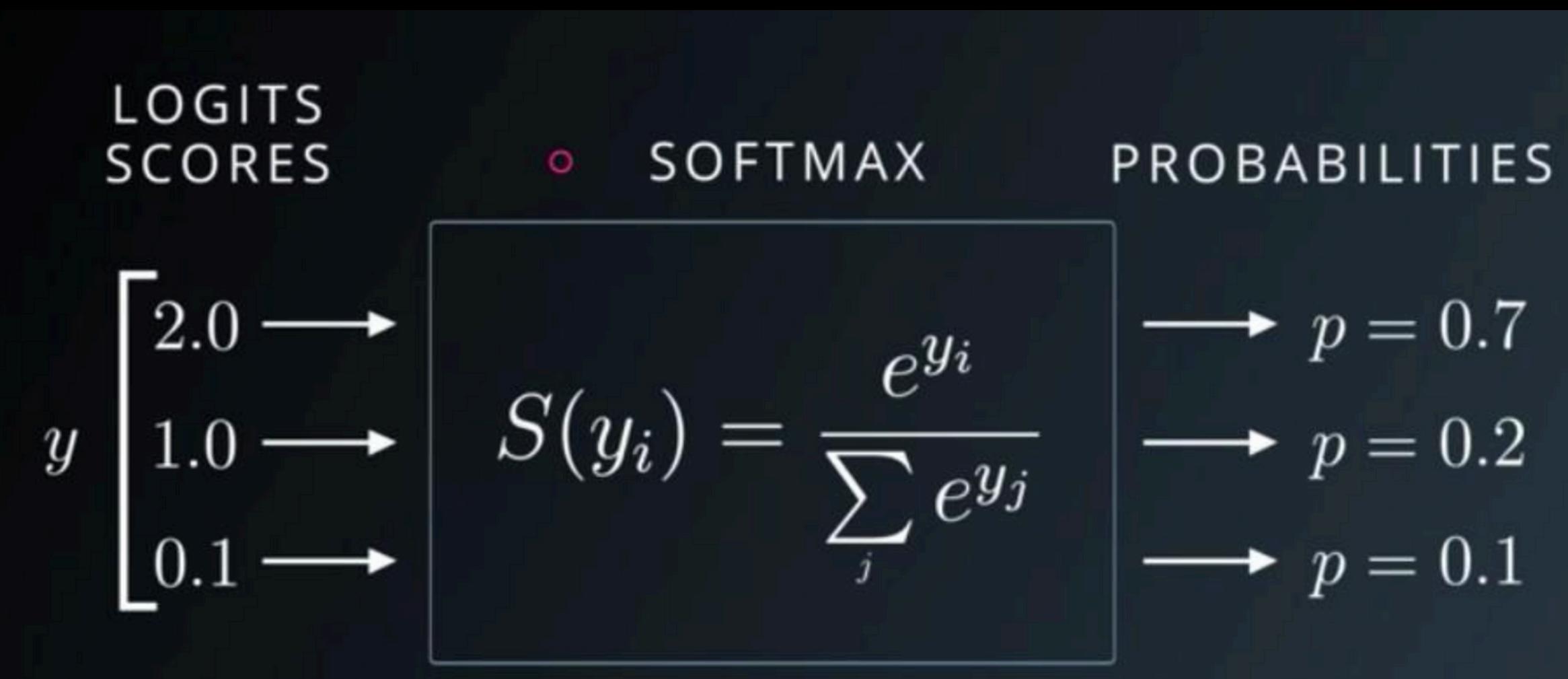
Pooling Layer

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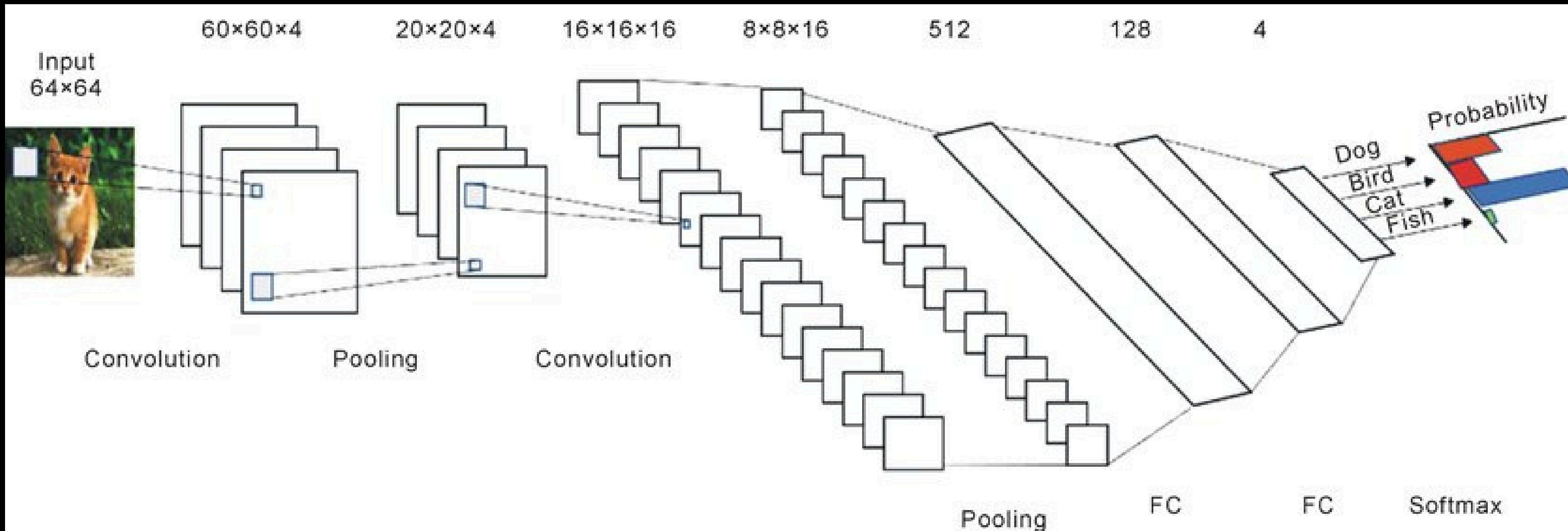
Fully Connected Layer

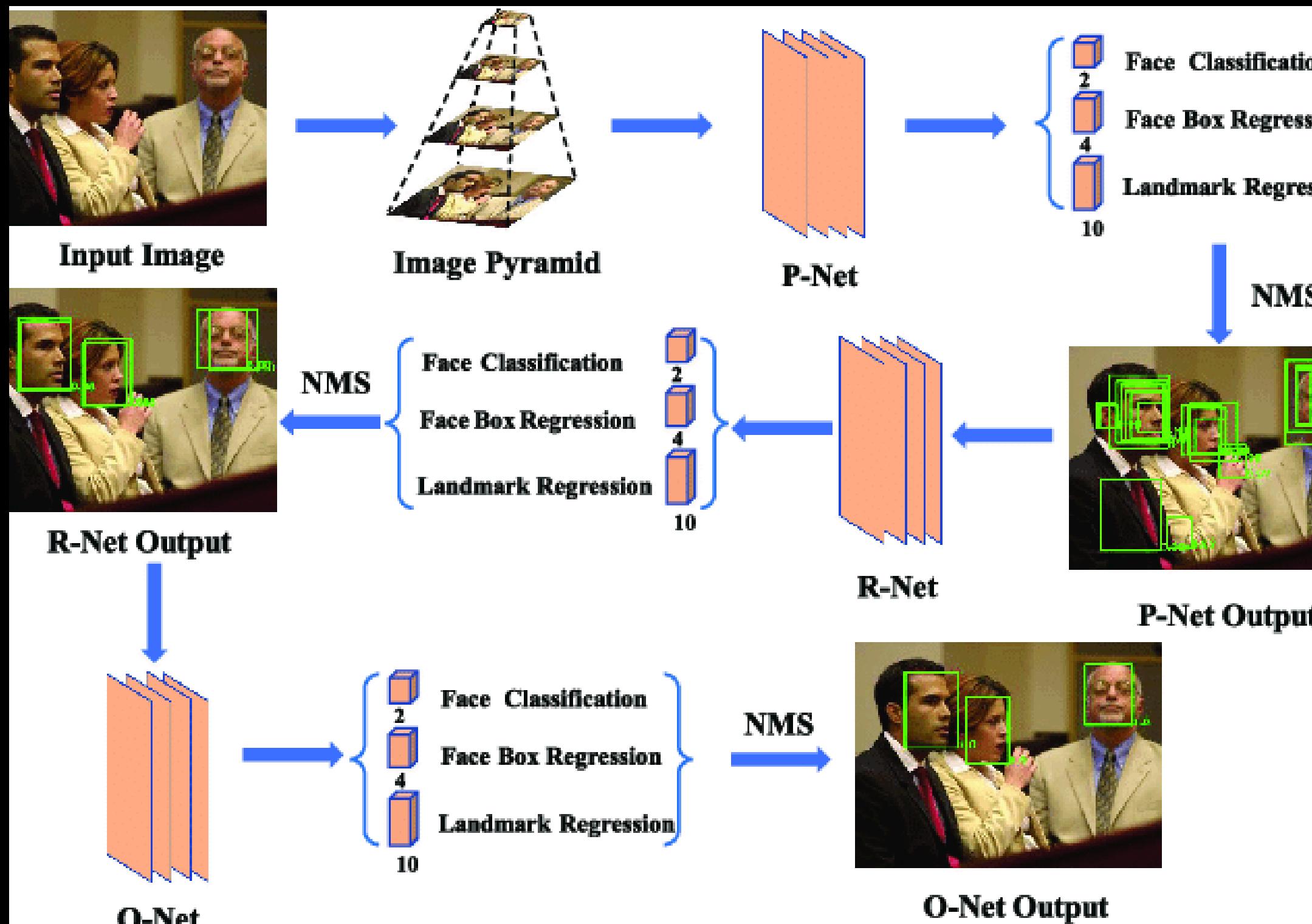
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Classification Output Layer (Softmax)

Convolutional Neural Network "CNN"





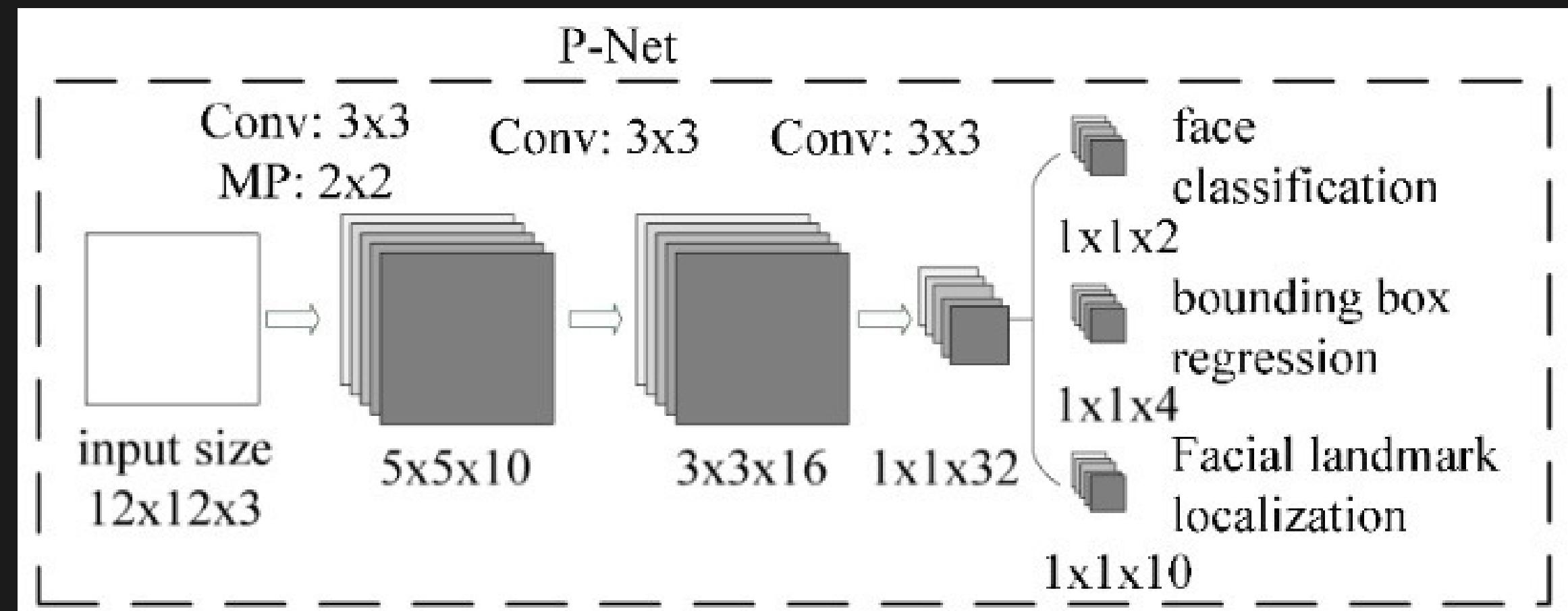
MTCNN

MTCNN is a cascading multi-task convolutional network that uses the inherent correlation between detection and alignment to improve its performance.

The Proposal Network (P-Net)

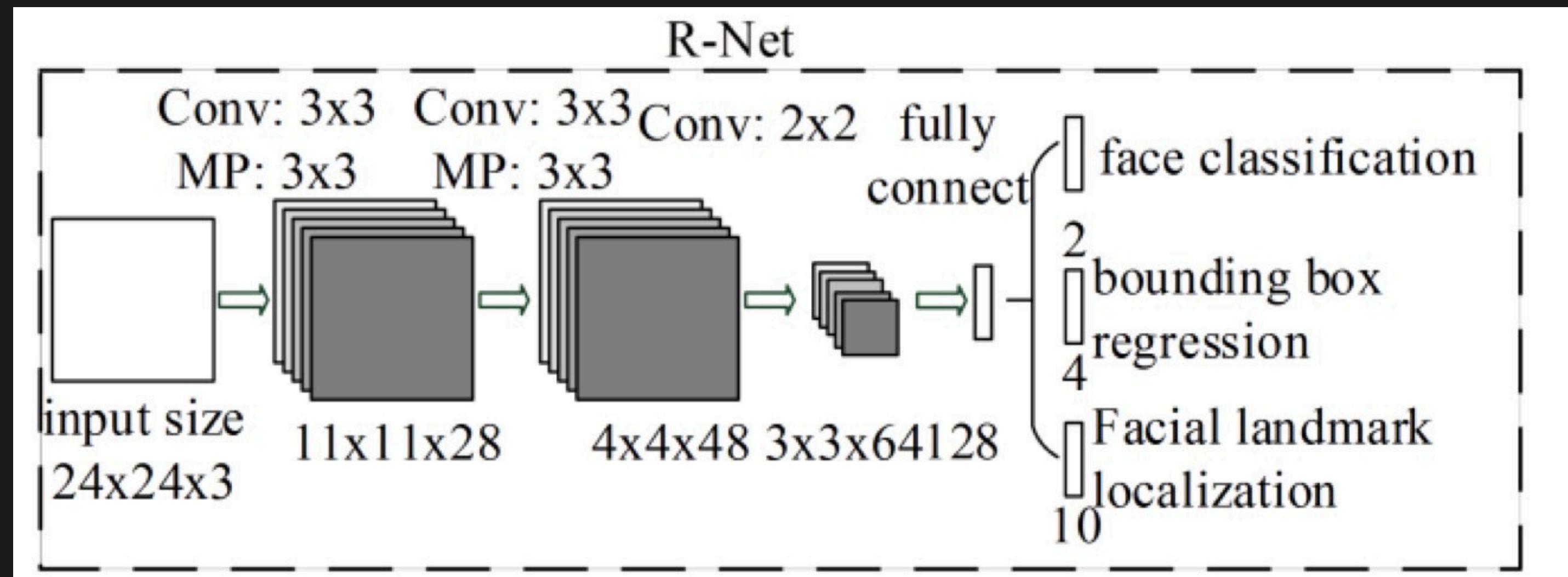
This first step is a fully convolutional network (FCN).

This proposal network is used to obtain candidate windows and their bounding box regression vectors.



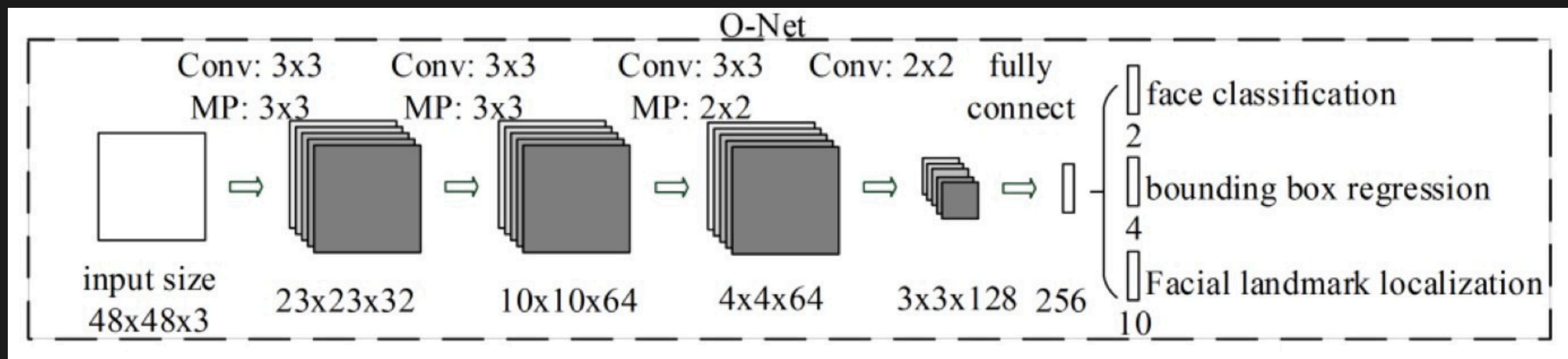
The Refining Network (R-Net)

The R-Net further reduces the number of candidates, performs a calibration with an encompassing box regression, and uses Non-Maximum Suppression (NMS) to merge overlapping candidates.

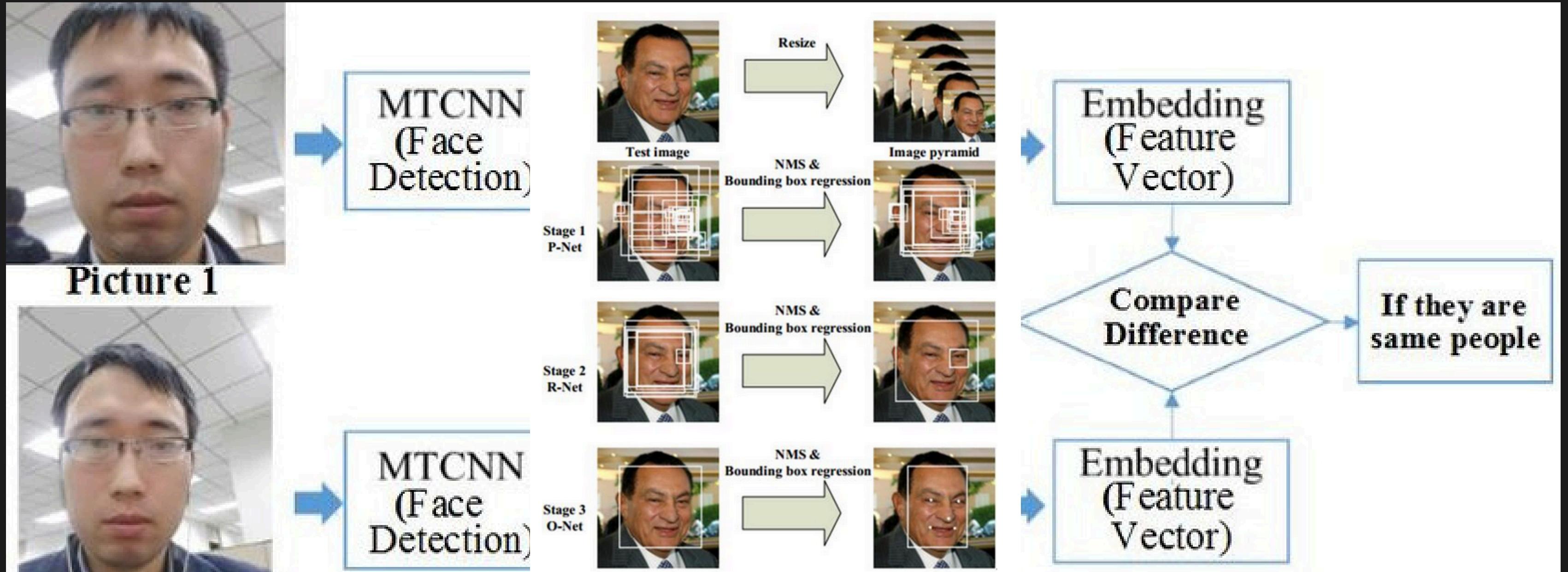


The Output Network (O-Net)

This output network aims to describe the face in more details and provides the positions of the five facial landmarks for the eyes, nose and mouth.



Architecture



Facial recognition

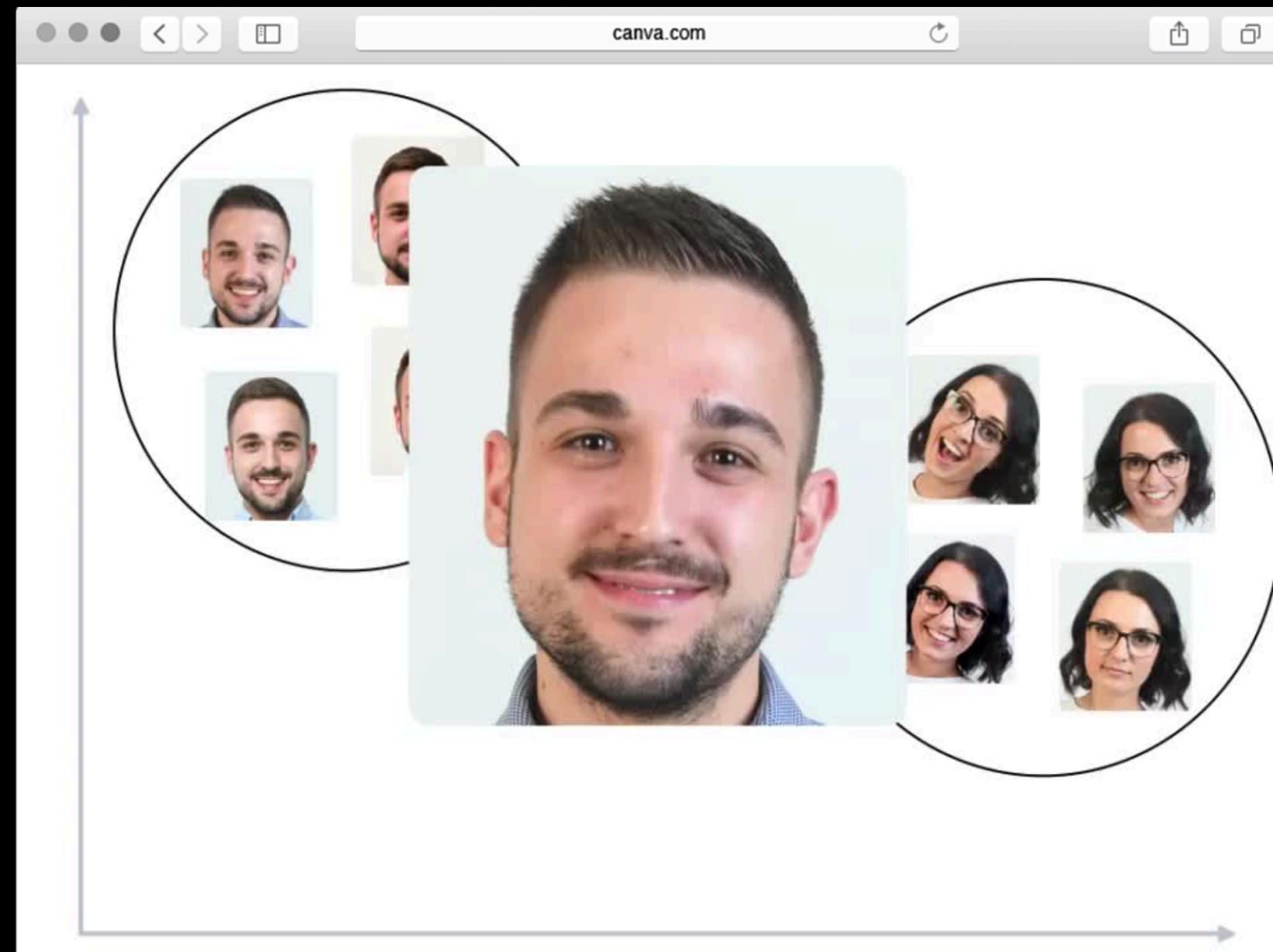
Face recognition

A biometric process that consists in determining the identity of a person through his face automatically.

Several recognition approaches have been developed, classified into three categories.



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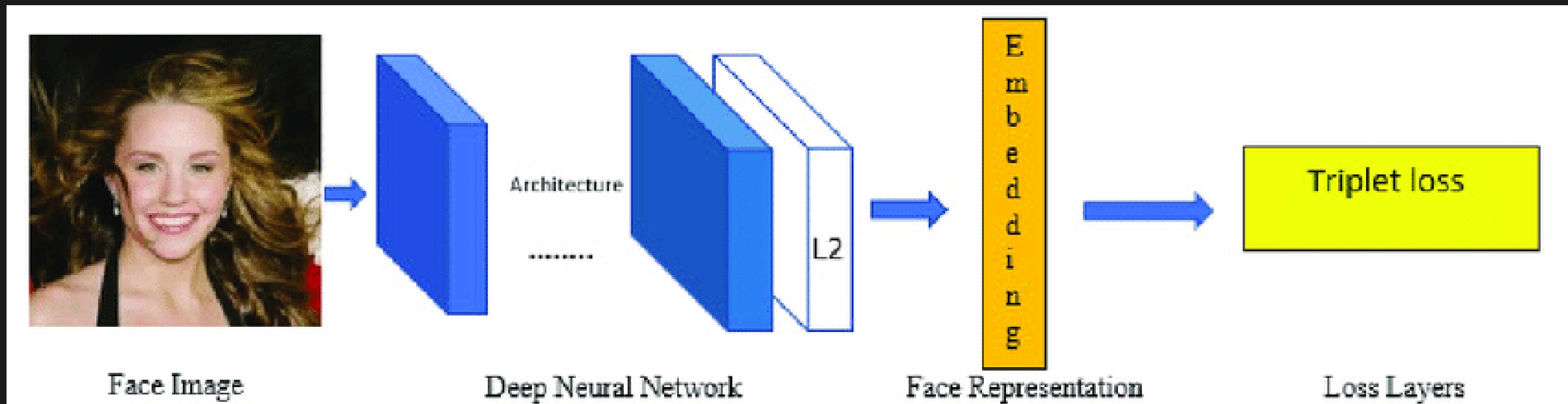


FaceNet

FACENET IS A DEEP LEARNING FRAMEWORK USED IN FACE RECOGNITION.

FACENET USES THE GOOGLENET MODEL, WHICH HAS HIGH ACCURACY IN FACE RECOGNITION.

FaceNet



Embedding

FaceNet takes as input an image of a person's face and produces a vector of 128 numbers that represent the most important features of a face

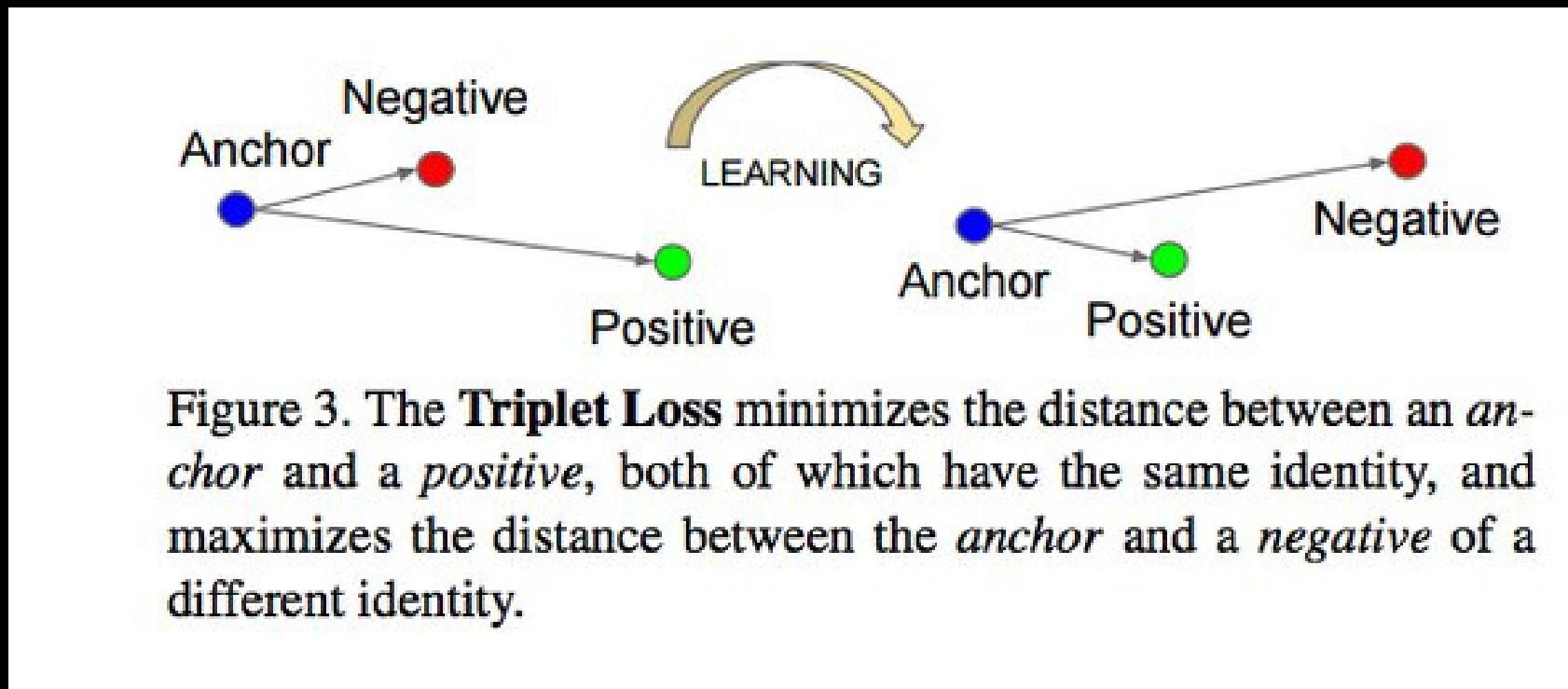
$$f(\text{face}) = \begin{pmatrix} 0.112 \\ 0.067 \\ 0.091 \\ 0.129 \\ 0.002 \\ 0.012 \\ 0.175 \\ \vdots \\ 0.023 \end{pmatrix}$$





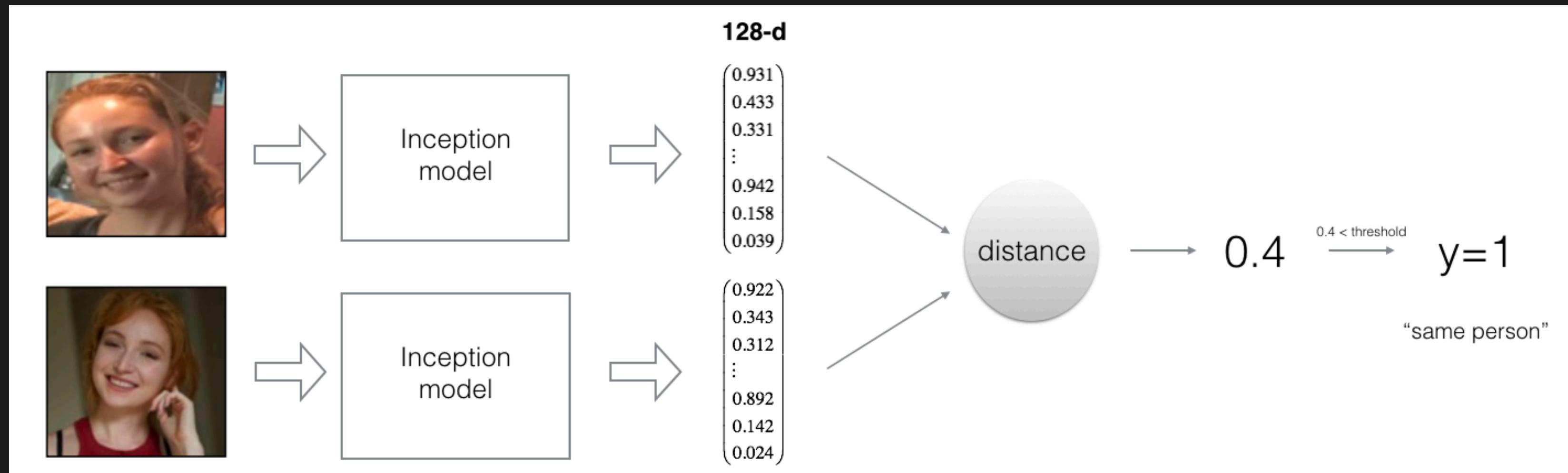

Triplet loss

For FaceNet to learn how to generate face embeds, it uses the Triplet loss function:

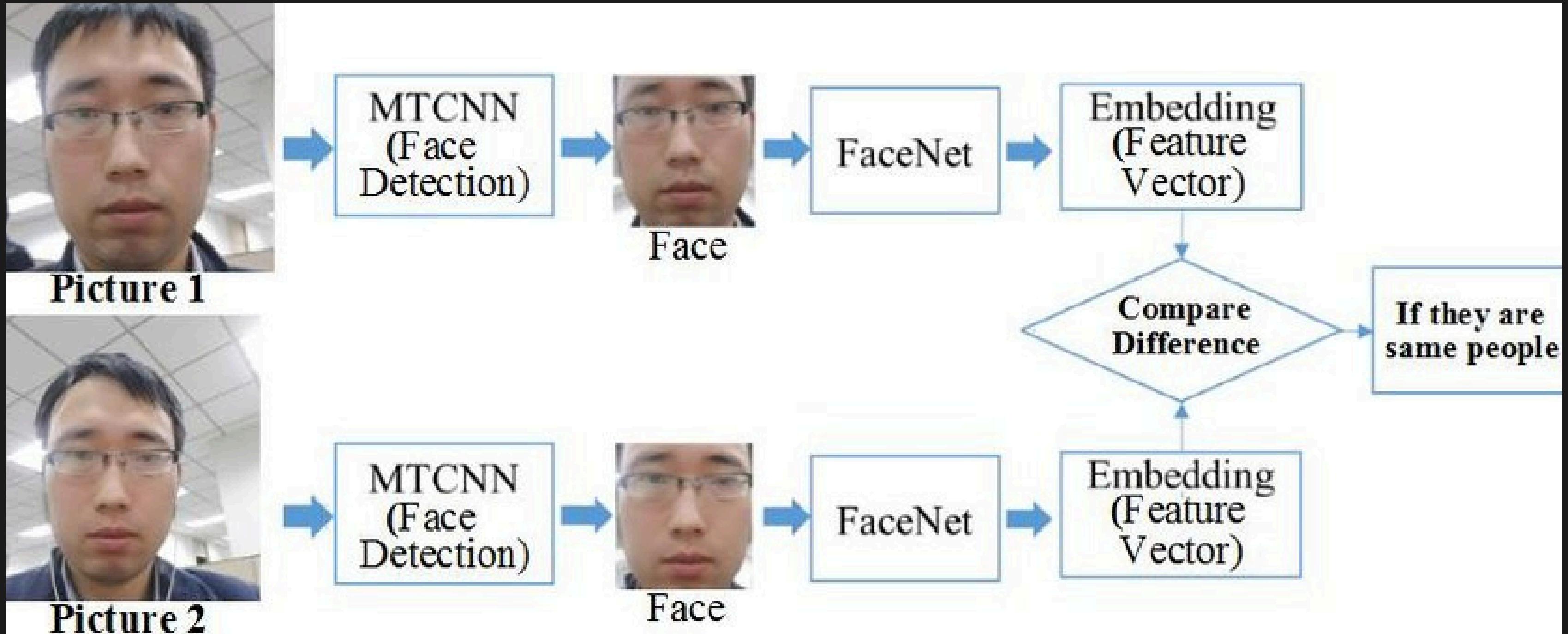


1. Randomly selects an anchor image.
2. Randomly selects an image of the same person as the cracked image (positive example).
3. Randomly selects an image of a different person from the anchor image (negative example).
4. Adjusts FaceNet network settings so that the positive example is closer to the anchor than the negative example.

Triplet loss

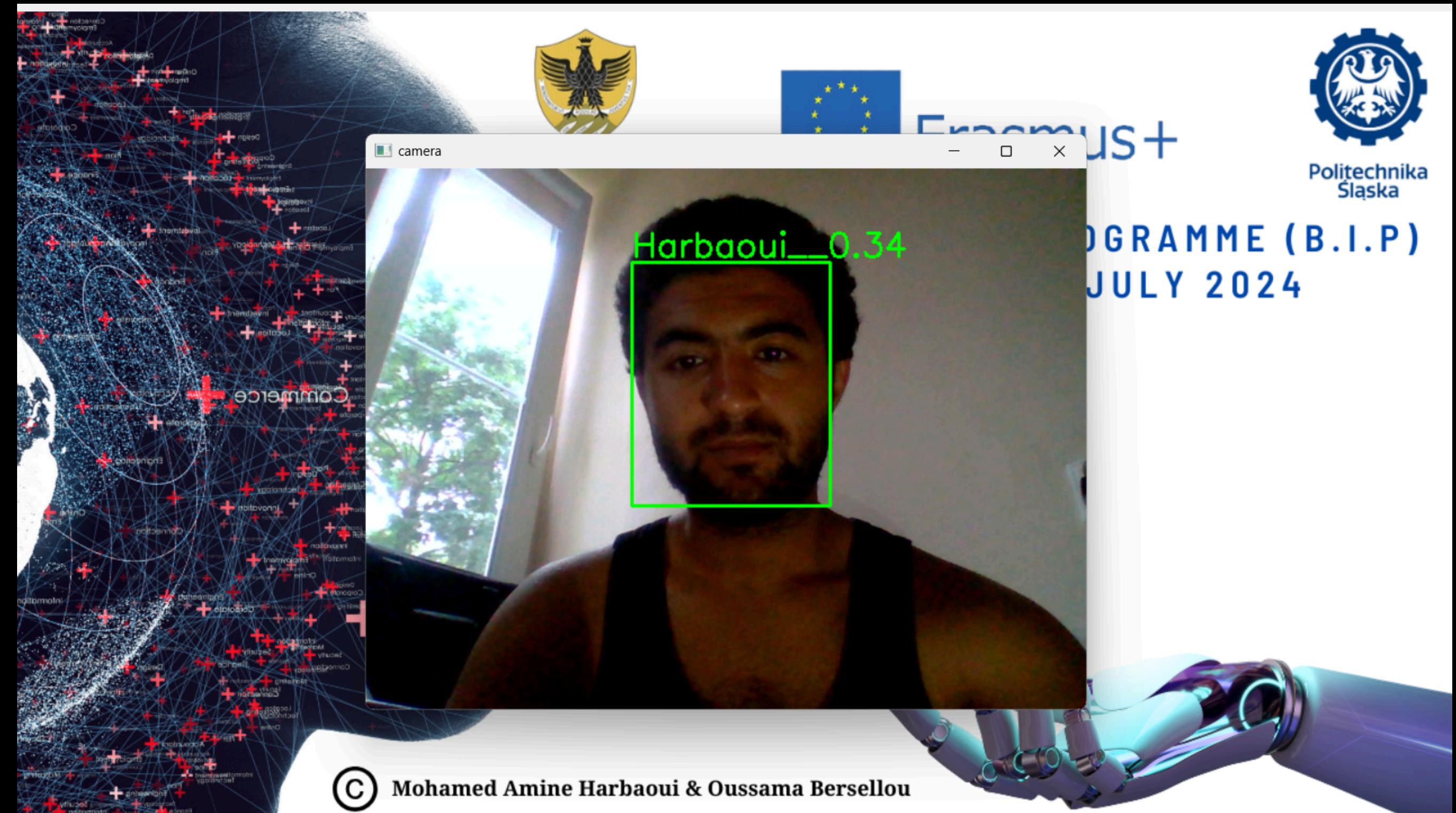


Architecture



Results

- The app's input is a real-time image taken from the user's camera.
- The output is the name of the person recognized in the image or a message indicating that the person was not found in the database.



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FINISH !

