CONTENTS

INTRODUCTION

A facial expression is the visible manifestation of the affective state, cognitive activity, intention, personality and psychopathology of a person and plays a communicative role in interpersonal relations.

Facial expression, as the most expensive and direct way to communicate emotion in humans, draws a lot of attraction. However, although facial expression can be easily recognized by human beings, reliable facial expression recognition by machine is still a great challenge.

Contd…

Automatic recognition of facial expressions can be an important component of natural human-machine interfaces. It needs to perform:

- detection and location of faces in a cluttered scene
- facial feature extraction
- facial expression classification.

IMPORTANCE AND NEED

Facial expressions convey non-verbal cues, which play an important role in interpersonal relations.

- Automatic recognition of facial expressions can be an important component of natural human-machine interfaces;
- It may also be used in behavioural science and in clinical practice.

OBJECTIVES AND SCOPE

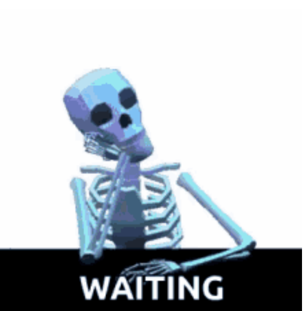
- Our aim is to **propose an approach that can achieve the desired goal of face expression identification** effectively.
- Facial expression recognition system will be implemented using Convolution Neural Network (CNN) to classify images of human faces into discrete expression categories and compare the result of different datasets.
- CNN model of the project is based on **LeNet** Architecture.

WORKING PRINCIPLE AND METHODOLOGY

TRAINING PHASE

STEPS:

I. The training step takes as input an image with a face.
II. Normalization is applied to the image.
III. Normalized images are used to train the Convolutional Network.
IV. The output of the training step is a set of weights that achieve the best result with the training data



Time consuming Process

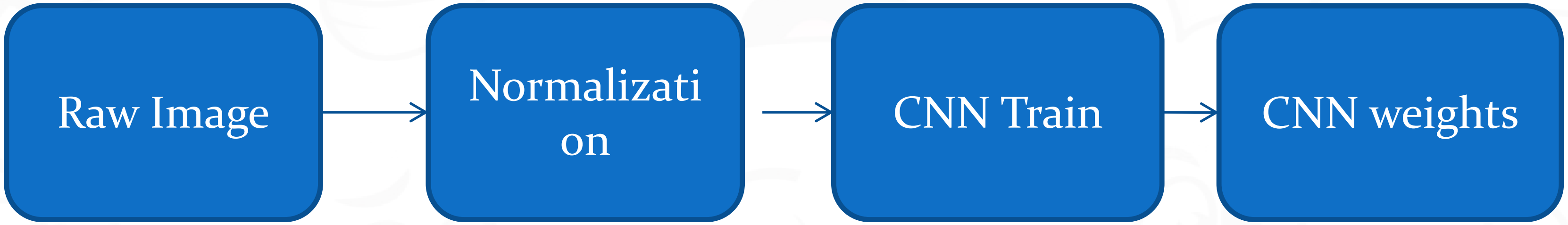


Fig. 1

Training Phase

TESTING PHASE

- During test, the system receives a grayscale image of a face from test dataset, and outputs the predicted expression by using the final network weights learned during training.

- Output is to be a single number that represents one of the seven basic expressions.

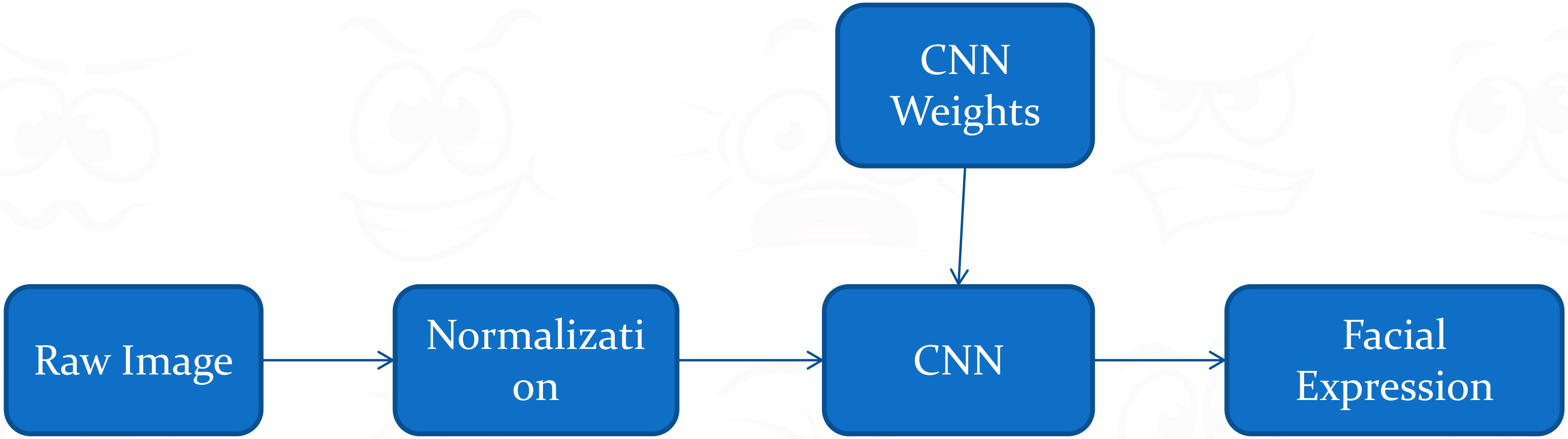


Fig. 2

Testing Phase

Normalization

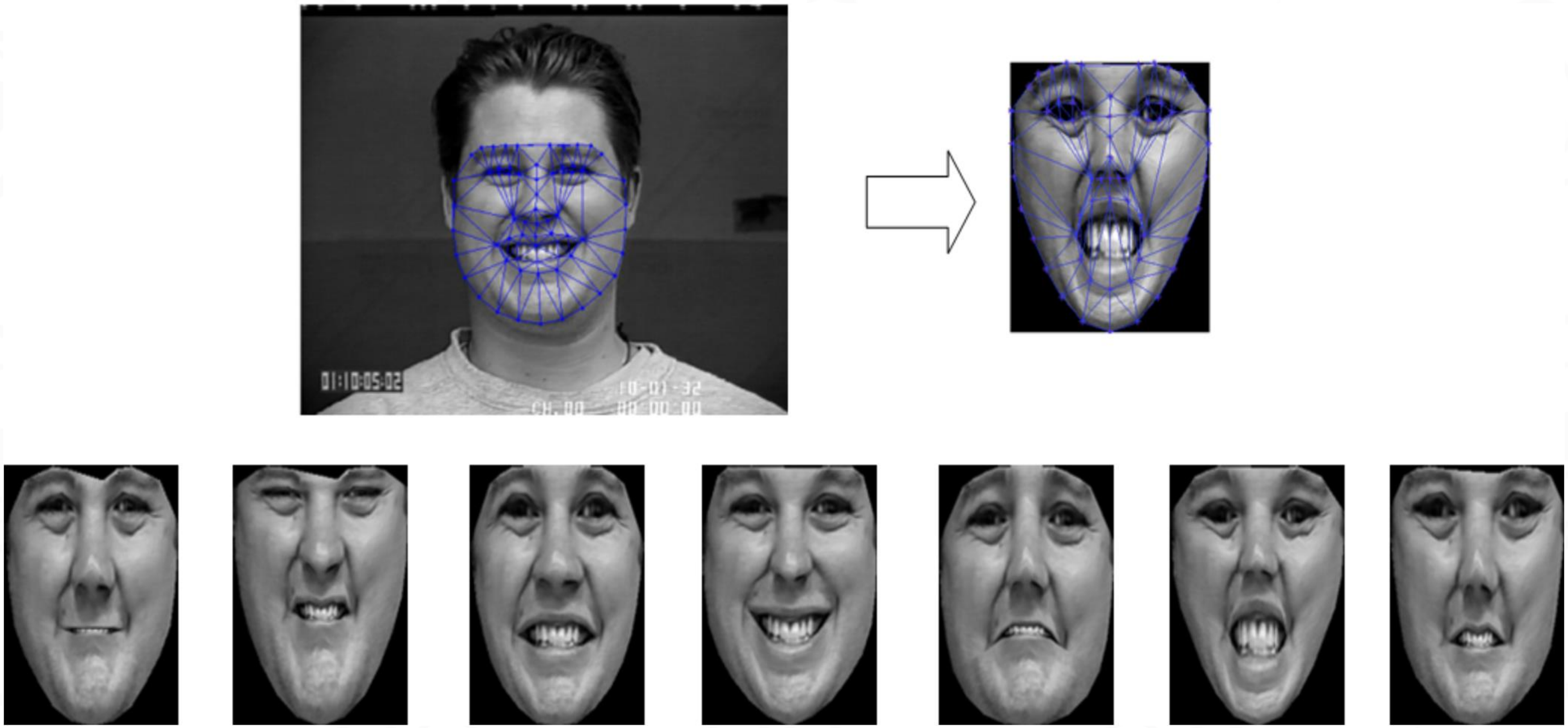


Fig. 3

Convolutional Neural Network (CNN)

In machine learning, a convolutional neural network (CNN, or ConvNet) is a type of feedforward artificial neural network in which the connectivity pattern between its neurons is inspired by the organization of the animal visual cortex.

A typical architecture of a convolutional neural network contains an input layer, some convolutional layers, some fully-connected layers, and an output layer. Here, **CNN is to be designed with some modification on LeNet Architecture.**

Classic Architectures:

Year	CNN	Developed by	Place	Top-5 error rate	No. of parameters
1998	LeNet(8)	Yann LeCun et al			60 thousand
2012	AlexNet(7)	Alex Krizhevsky, Geoffrey Hinton, Ilya Sutskever	1st	15.3%	60 million
2013	ZFNet()	Matthew Zeiler and Rob Fergus	1st	14.8%	
2014	GoogLeNet(19)	Google	1st	6.67%	4 million
2014	VGG Net(16)	Simonyan, Zisserman	2nd	7.3%	138 million
2015	ResNet(152)	Kaiming He	1st	3.6%	

Fig.4

LeNet Architecture

LeNet is one of the very first convolutional neural networks which helped propel the field of Deep Learning.

It has 6 layers without considering input and output.

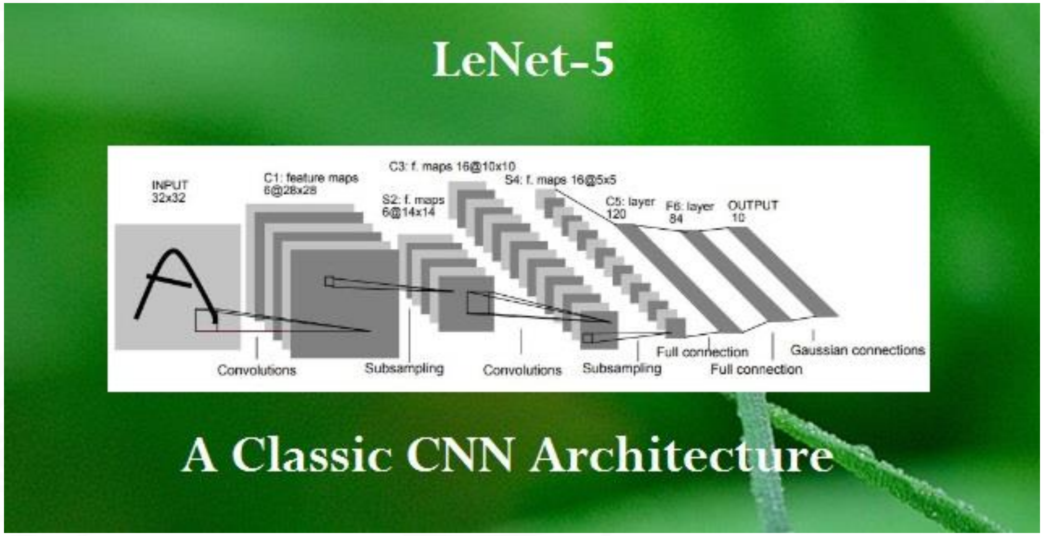


Fig. 5

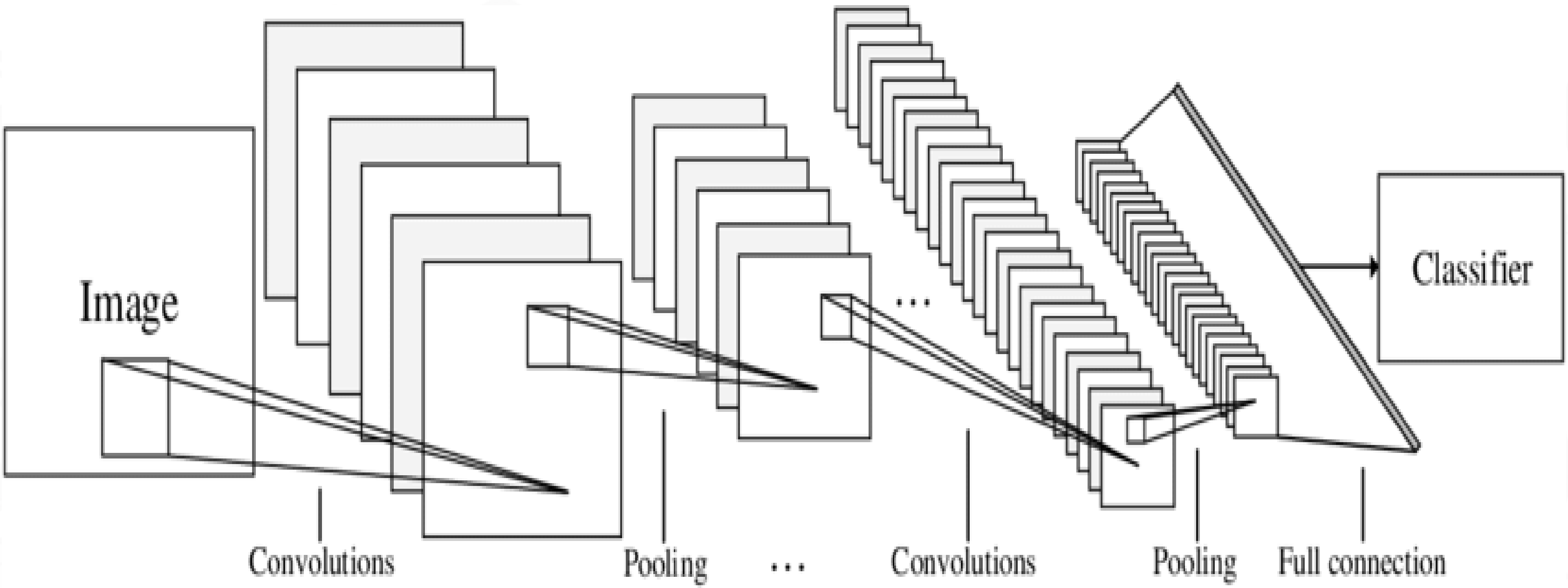


Fig. 6

Example: LeNet Architecture (Broad View)

Step 1. Convolution

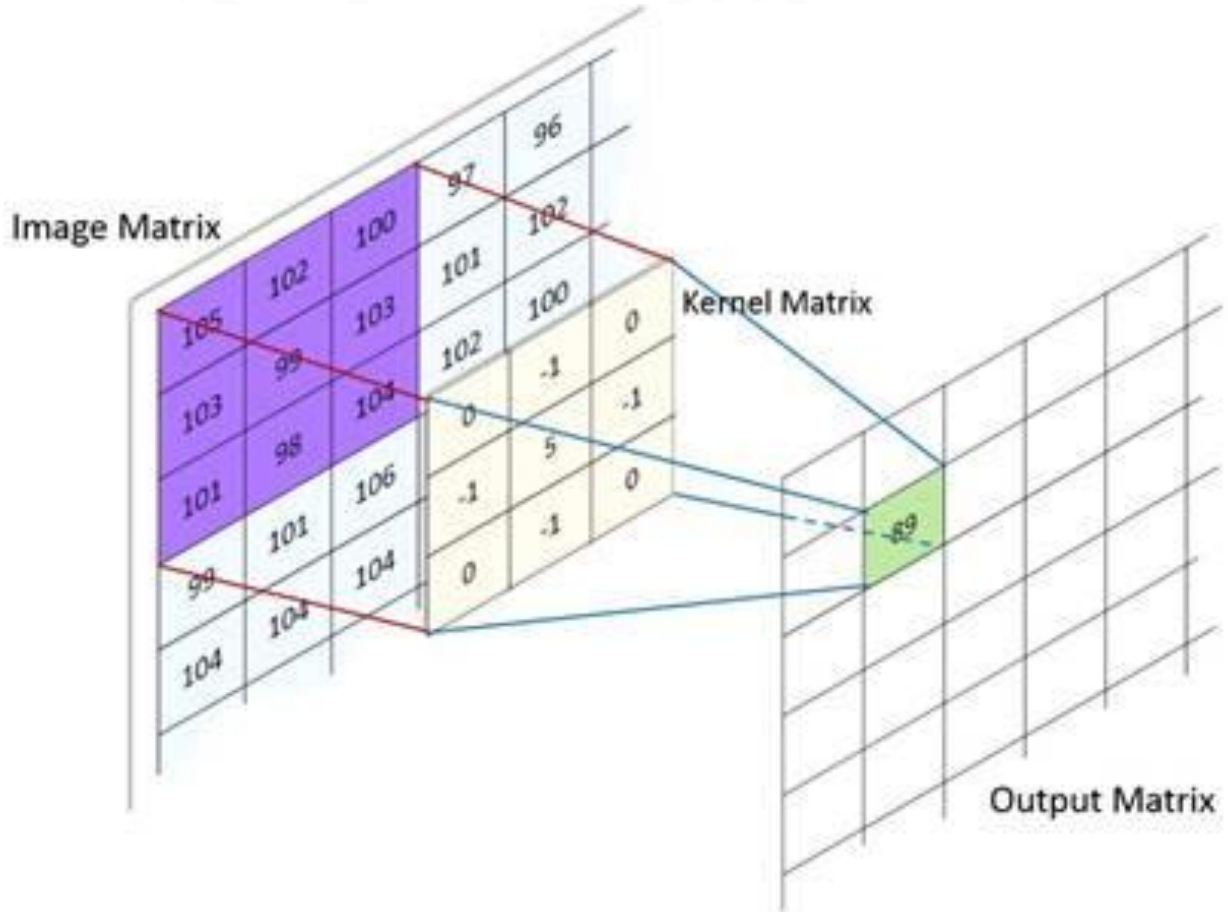


Fig. 7

Image Padding

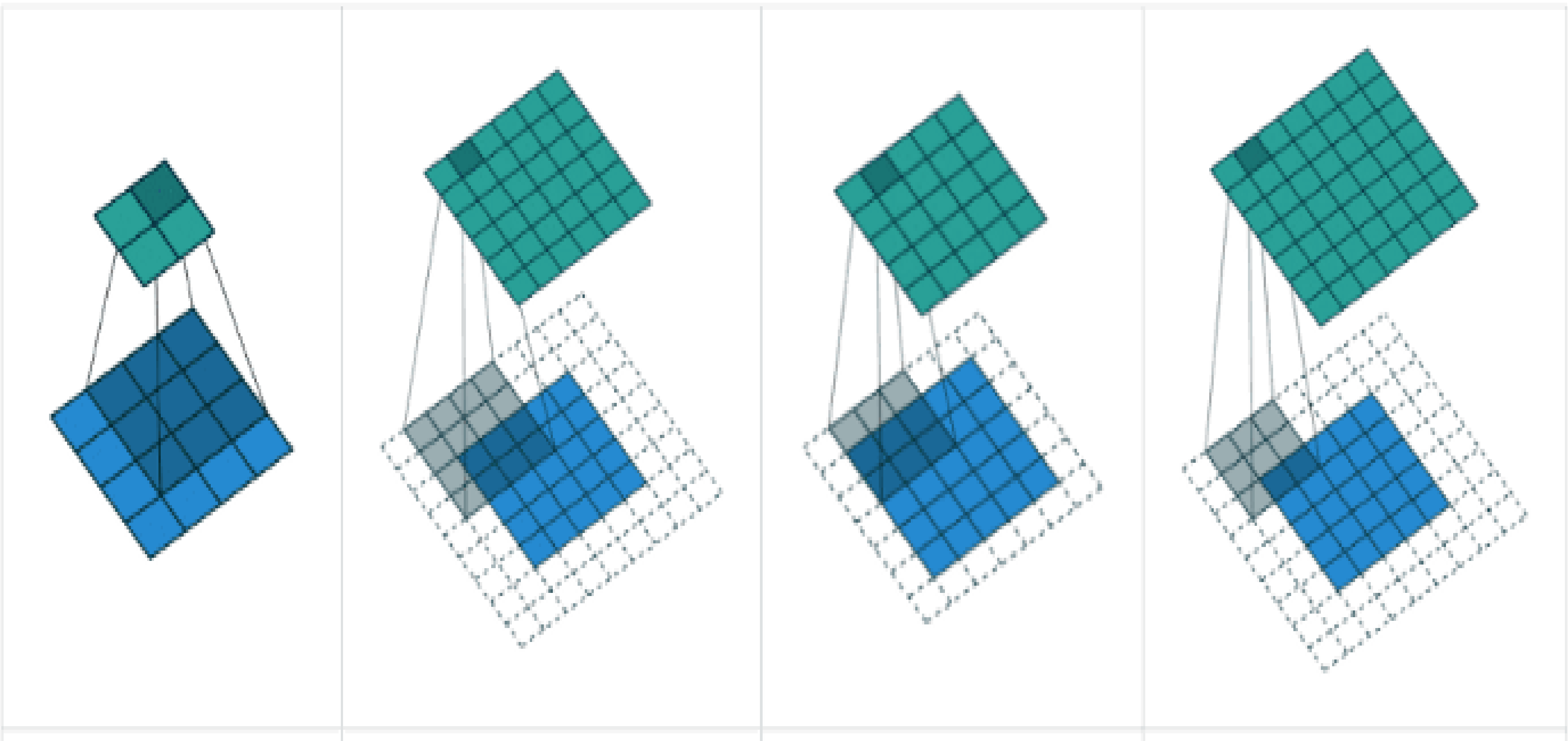


Fig. 8

Step 2. Max Pooling

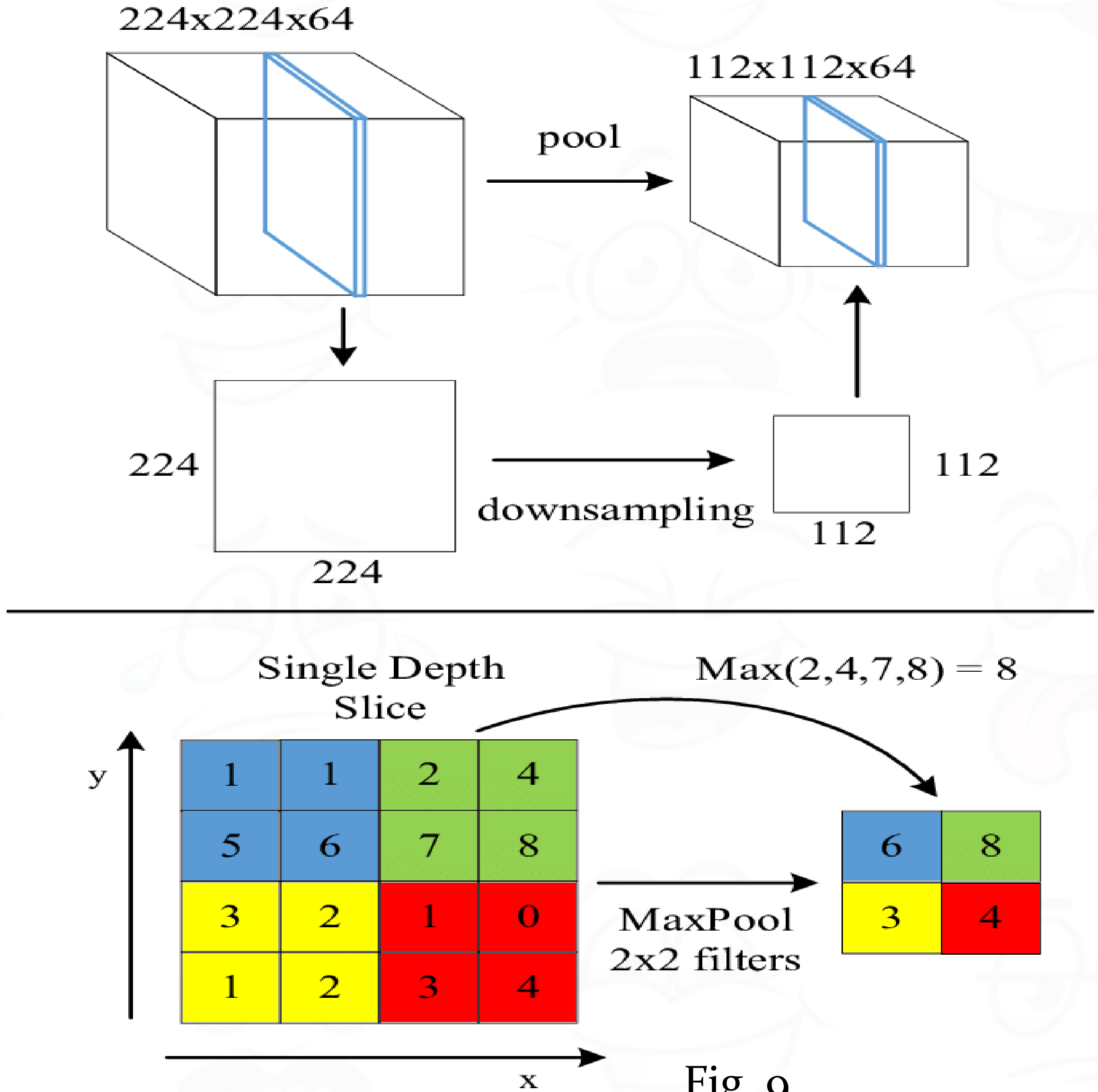


Fig. 9

Fully Connected and Output Predictions

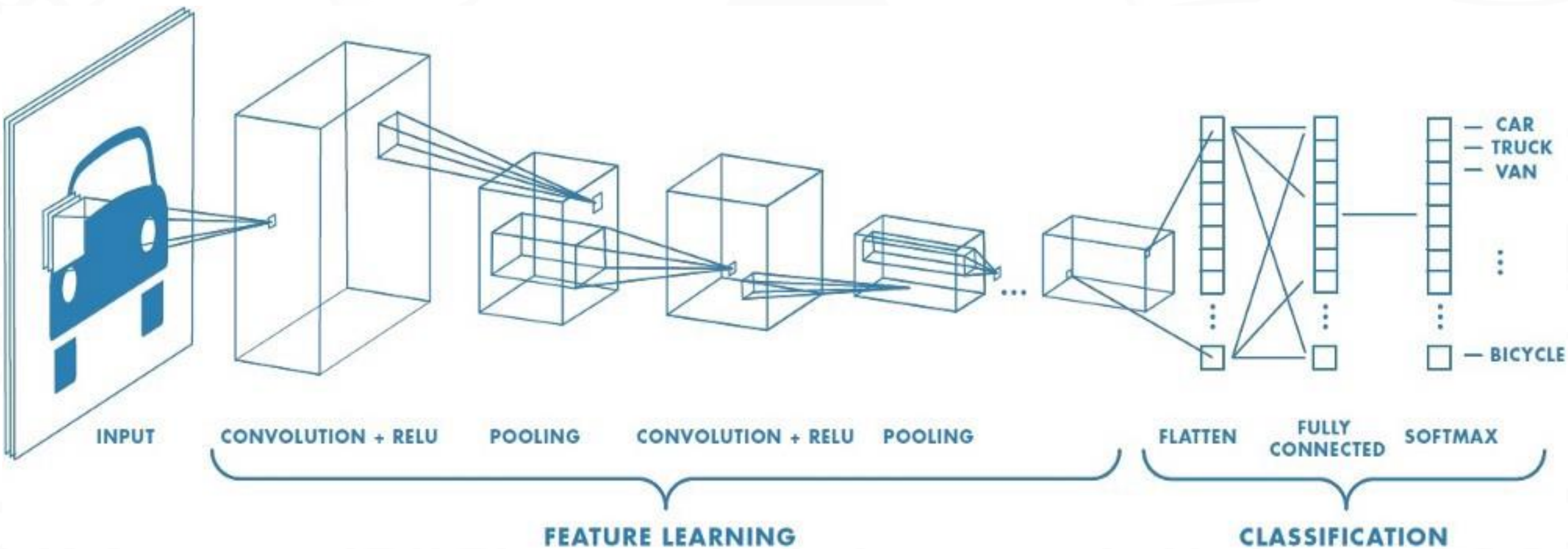


Fig. 10

Relu Activation Function

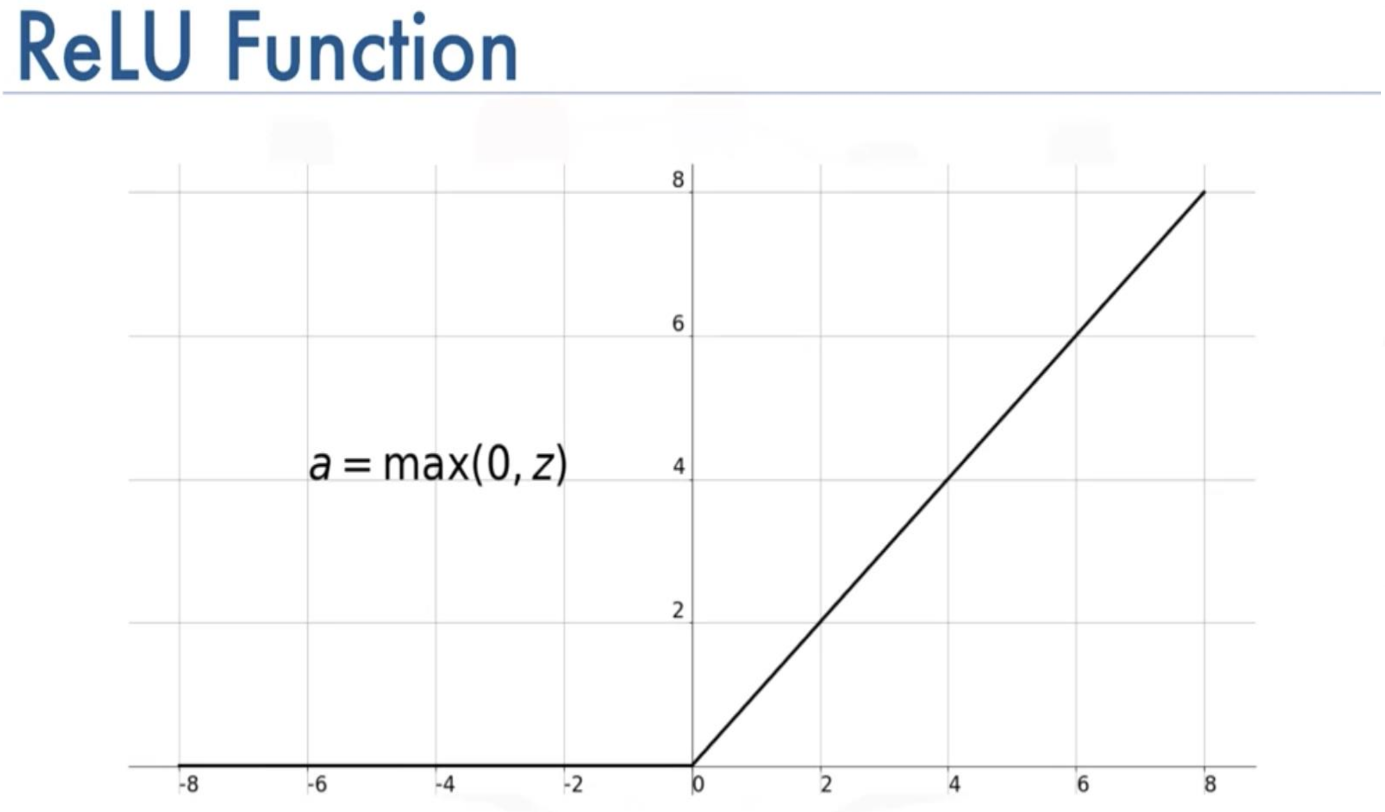


Fig. 11

ReLU Layer

Filter 1 Feature Map

9	3	5	-8
-6	2	-3	1
1	3	4	1
3	-4	5	1

9	3	5	0
0	2	0	1
1	3	4	1
3	0	5	1

Fig. 12

Flattening of Image

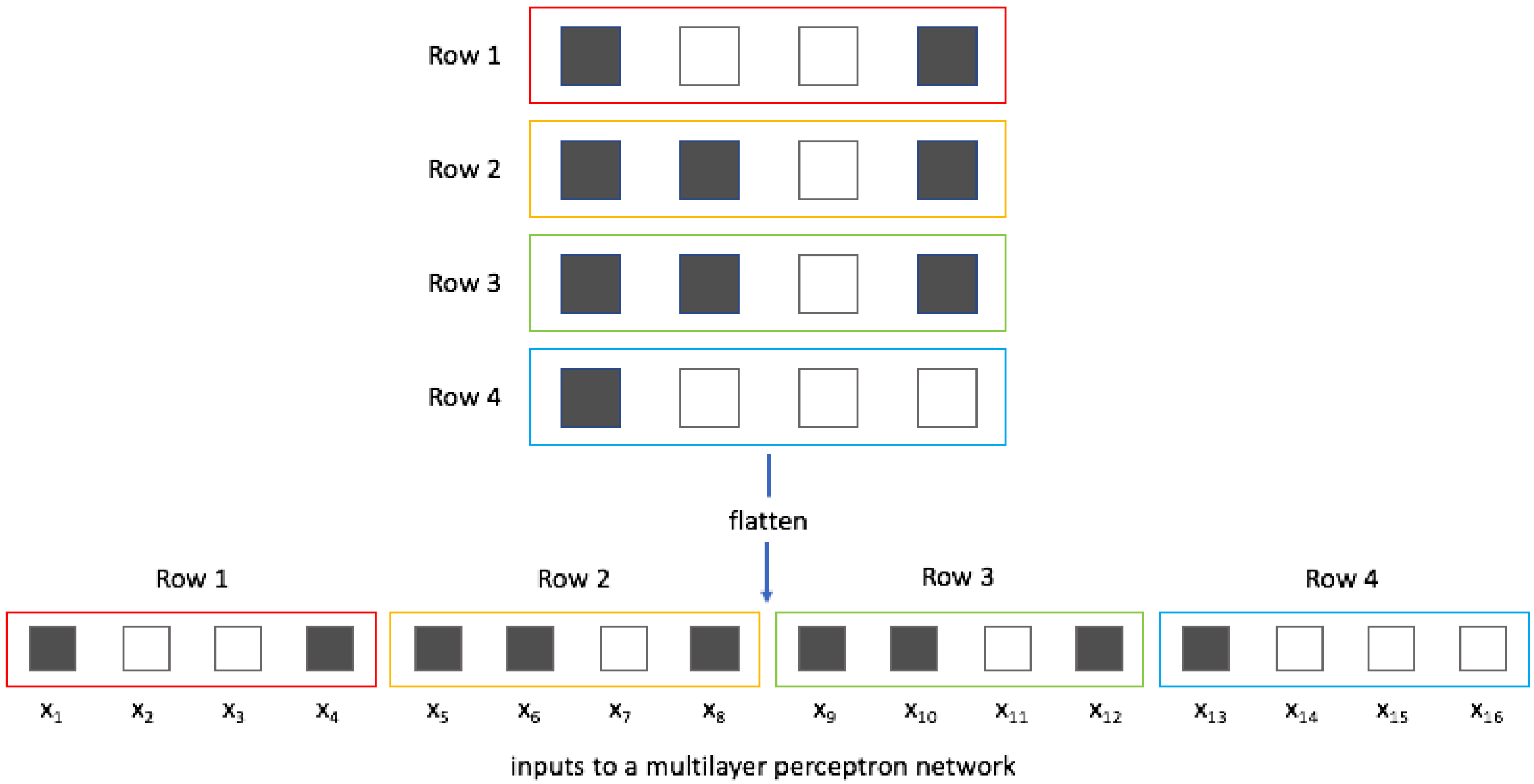


Fig. 13

Connected Layers

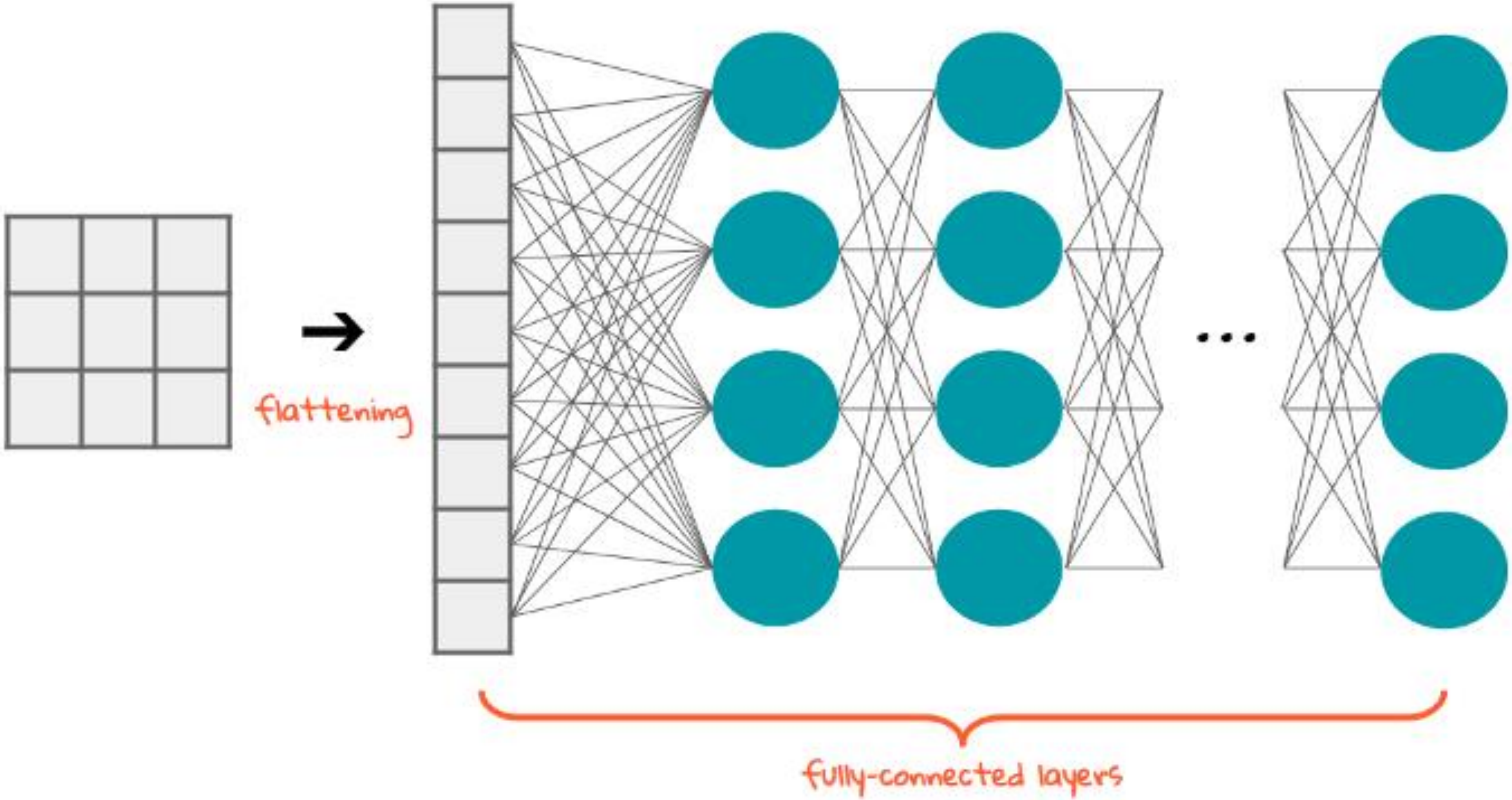


Fig. 14

Softmax and Probability connection

$$\mathbf{z} = \begin{bmatrix} z_1 \\ z_2 \\ z_3 \\ \vdots \\ z_K \end{bmatrix} = \begin{bmatrix} \mathbf{w}_1^\top \\ \mathbf{w}_2^\top \\ \mathbf{w}_3^\top \\ \vdots \\ \mathbf{w}_K^\top \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ \vdots \\ x_n \end{bmatrix}$$

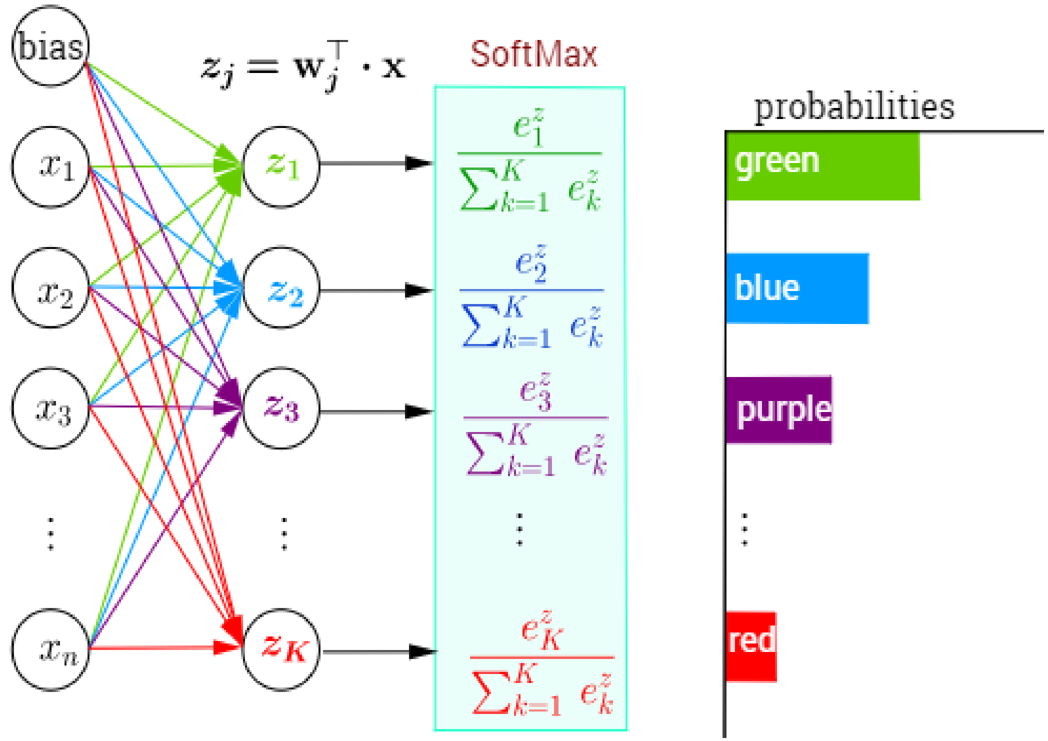


Fig. 15

Insights to datasets

- This dataset was prepared by ***Pierre-Luc Carrier and Aaron Courville***. The dataset is collected from Kaggle website.
- The data consists of 48x48 pixel grayscale images of faces.
- The training set consists of 28,821 examples and validation set consist of 7,066 examples.
- The faces have been automatically registered so that the face is more or less centered and occupies about the same amount of space in each image.
- The task is to categorize each face based on the emotion shown in the facial expression in to one of seven categories (0=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral).

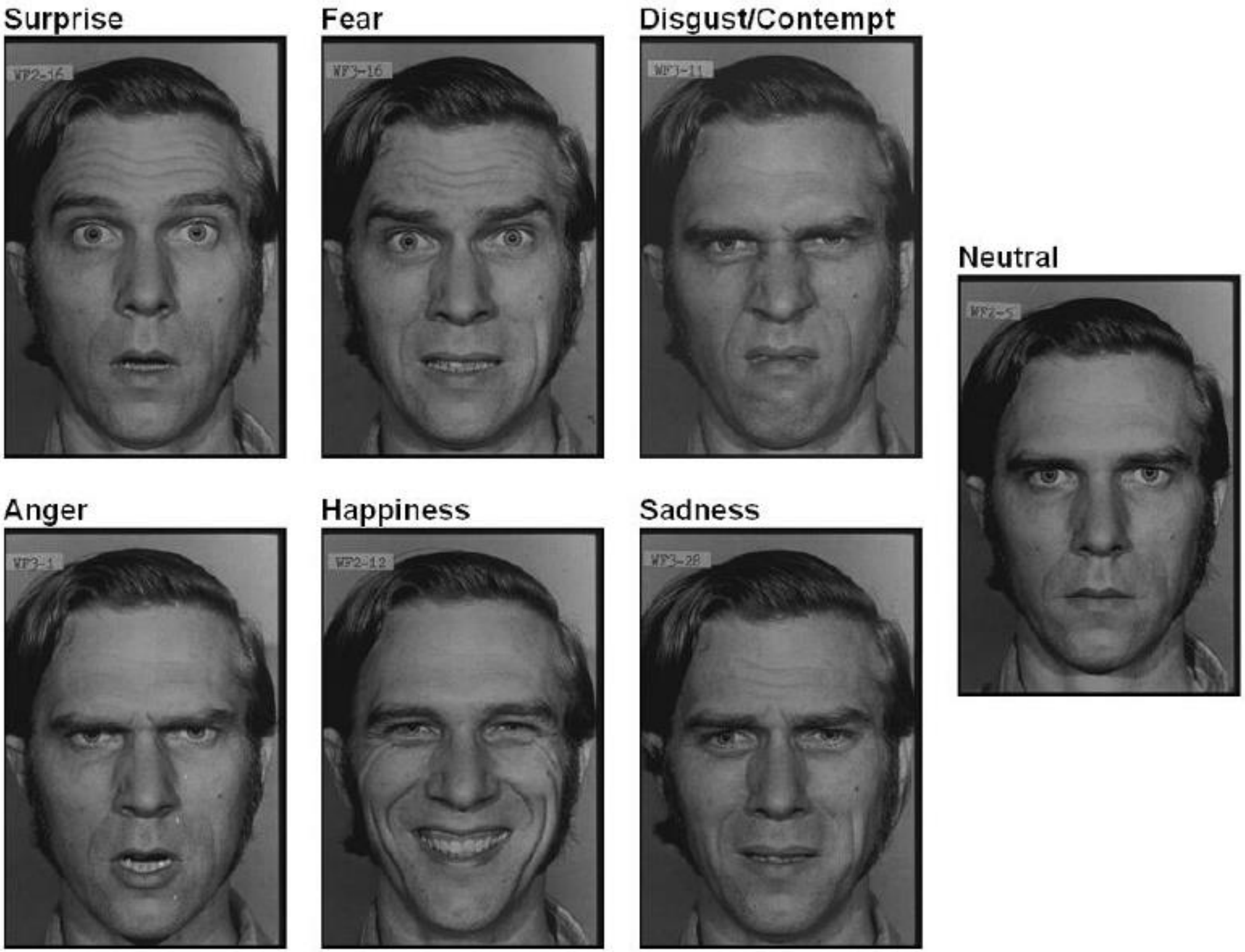

Surprise
Fear
Disgust/Contempt
Neutral
Anger
Happiness
Sadness

Fig. 16

SOFTWARE AND HARDWARE REQUIREMENTS

Software Requirements:-

1. Opencv 2.0
2. Python 3.0

Hardware Requirements:-

1. Web camera

CONCLUSION

In this project, we have used **LeNet architecture** based on convolution neural network to recognize human facial expressions i.e. **happy, sad, surprise, fear, anger, disgust, and neutral** from grayscale pictures.

After using different optimizing techniques and proper training, our model will able to predict the outcome from the datasets.

REFERENCES

- *Shan, C., Gong, S., & McOwan, P. W. (2005, September). Robust facial expression recognition using local binary patterns. In Image Processing, 2005. ICIP 2005. IEEE International Conference on (Vol. 2, pp. II-370). IEEE.*

- *Chibelushi, C. C., & Bourel, F. (2003). Facial expression recognition: A brief tutorial overview. CVonline: On-Line Compendium of Computer Vision, 9.*

- *"Convolutional Neural Networks (LeNet) – DeepLearning 0.1 documentation". DeepLearning 0.1. LISA Lab. Retrieved 31 August 2013.*

THANK YOU!