

PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA
MINISTRY OF HIGHER EDUCATION AND
SCIENTIFIC RESEARCH

UNIVERSITE MOHAMED BOUDIAF - OF M'SILA



FACULTY OF MATHEMATICS AND
COMPUTER SCIENCE



DEPARTEMENT OF COMPUTER SCIENCE

Master thesis

Presented for the graduation of MASTER

Faculty: Mathematics and Computer

science

Department: Computer science

Field: Information System and Software Engineering

By: Ferhati Khadidja

SUBJECT

**Applying Deep Learning Approach In Real
Object Recognition to Assist Visual Perception for
Robots**

Supervised by: Mr. Said GADRI

2020 /2021

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List of abbreviations

R2-D2 : A type of robot

AI : Artificial intelligence

ML: Machine Learning

DL: Deep Learning

CNN: Convolutional Neural Network

NN: Neural Networks

ANN : Artificial Neural Network

RNN : Recurrent Neural Network

DNN : Deep Neural Network

GPU : graphical user Interface

SVM : Support Victor Machine

IDLE : integrated development and learning environment

GPU: processeur graphique

General Introduction

General introduction:

Nowadays, technology has become one of the most important areas of human interest, effectively many factors of human civilization, technologies are playing a fundamental role in directing where businesses are going and, to some extent, in determining how the future is shaping up.

One of the most important technologies of our time is artificial intelligence, AI is a branch of computer science, and the term artificial intelligence can be defined as the ability of machines and digital computers to do certain tasks as smart objects do, such as the ability to think or to learn. After the development of artificial intelligence, many terms and branches appeared, including machine learning and deep learning.

AI relies on deep learning because it makes it more human. Where deep learning is a subfield of machine learning. But both fall under the broad category of artificial intelligence. In another meaning, all machine learning is AI, but not all AI is machine learning and all deep learning is machine learning but not all machine learning is deep learning. Deep learning known as deep neural learning or deep neural network.

Insights about deep learning & neural networks:

- Neural networks, a beautiful biologically-inspired programming paradigm which enables a computer to learn from observational data
- Deep learning, a powerful set of techniques for learning in neural networks

Neural networks and deep learning currently provide the best solutions to many problems in image recognition and classification, speech recognition, and natural language processing. [1]

Briefly, machine learning and deep learning are subfields of AI area which are used to perform much more sophisticated algorithms allowing high performance pattern recognition and image classification than classic approaches. Deep learning is recently created as a branch of ml. Among the most used methods in DL, CNNs are for a special interest. The main idea in this project is to build a deep neural architecture and use it to recognize a collection of real images representing different objects. The advantage of using multiple layers here is that they can learn features at various levels of abstraction. For example, if you train a deep CNN on some images, you will find

that the first layer will train itself to recognize very basic things like edges, the next layer will train itself to recognize collections of edges such as shapes, the next layer will train itself to recognize collections of shapes like wheels, legs, tails, faces and the next layer will learn even higher-order features like objects (truck, ships, dog, frog... Etc.). So, the principal task in this project is to develop an automatic classifier that permits to classify some given color images representing real objects into one of 10 classes which are: airplane, automobile, bird, cat, deer, dog, frog, horse, ship, truck. The classes are completely mutually exclusive. To accomplish this work, we will proceed to the classification task using many ml algorithms including: IDA, KNN, cart, NB, and SVM. Then we will propose in second stage a CNN model composed of many layers (convolutional layers, Maxpooling layers and one full-connected layer). Finally, we established a comparison between different algorithms. As programming tools, we have used python, tensorflow, and keras which are the most used in the field.

In that, many people do not have a good idea of how to start learning AI and how to deal with the various techniques and algorithms related to it, but they are eager to learn more.

Deep learning has allowed a paradigm shift in pattern recognition, from using handcrafted features to using general-purpose learning procedures to learning together data-driven representations, features, and classifiers. The application of this new paradigm has been particularly successful in computer vision, where the development of deep learning methods for vision applications has become a hot research topic. We will provide a comprehensive overview of deep learning and its use in computer vision, which includes a description of the most commonly, used neural models and their main areas of application. Next, the methodology and programs used in the vision based on deep learning are introduced . Next, a review of the main work using deep learning in robot vision is presented, as well as current and future trends regarding the use of deep learning in robotics. This work is intended to be a guide for developers of robot vision systems. [2]

We have divided our work into several chapters, which are:

- Starting with a general introduction
- In chapter 1 we described briefly the field of our project which real objection recognition to assist visual perception for robots.
- In chapter 2, we presented some important concepts and definitions, including: Artificial Intelligence, Machine Learning and Deep Learning.
- Chapter 3 describes the programming environment.
- In the last chapter we presented the realized work.
- Finally we concluded our work by a general conclusion.

Chapter 1:

Visual Perception for

Robot

1.1 Introduction:

This chapter is an introduction to the project field, we discuss what a machine vision system is? And what tasks it is suited for? We also explore the relationship of machine vision to other fields that provide techniques for processing images or symbolic descriptions of images. We also talk about robotics, their definition, history some companies, and different types of robots.

1.2. What Is Robotics?

Robotics is the intersection of science, engineering and technology that produces machines, called robots, that substitute for (or replicate) human actions. Pop culture has always been fascinated with robots. R2-D2. Optimus prime. Wall-e. These over-exaggerated, humanoid concepts of robots usually seem like a caricature of the real thing...or are they more forward thinking than we realize? Robots are gaining intellectual and mechanical capabilities that do not put the possibility of an r2-d2-like machine out of reach in the future. [3]

1.3. What Is Robot?

A robot is a machine that functions automatically and can adapt to changes in its environment. Human beings have been tinkering with machines that run without human guidance since the time of the pharaohs. A staple of science fiction, robots are an increasingly important segment of our society, performing many jobs that are too dangerous or tedious for human beings. [4]

1.4. Types of Robots:

Mechanical bots come in a variety of forms and sizes to do the work for which they were created .The design, functioning, and level of autonomy of all robots differ. Robots are evolving to perform jobs that humans just cannot, from the 0.2 millimeter-long "robobee" to the 200-meter-long robotic freight vessel "vindskip." there are five sorts of robots.

1.4.1 Pre-Programmed Robots:

Pre-programmed robots operate in a controlled environment where they do simple, monotonous tasks. And its job is to perform that task longer, faster and more efficiently than a human. An example of a pre-programmed robot would be a mechanical arm on an automotive assembly line. The arm serves one function to weld a door on, to insert a certain part into the engine, etc. They cannot change their behavior while they are working, and no human is guiding their actions. [3] [5]



Fig 1. 1: Pre-Programmed Robots

1.4.2. Humanoïde Robots :

Humanoid robots are robots that look like and/or mimic human behavior. These robots usually perform human-like activities (like running, jumping and carrying objects), and are sometimes designed to look like us, even having human faces and expressions. Two of the most prominent examples of humanoid robots are Hanson robotics' Sophia (in the video above) and Boston dynamics' atlas. [3]



Fig 1. 2: Humanoid Robots

1.4.3. Autonomous Robots:

Autonomous robots operate independently of human operators. These robots are usually designed to carry out tasks in open environments that do not require human supervision. Is a robot that performs behaviors or tasks with a high degree of autonomy .They are quite unique because they use sensors to perceive the world around them, and then employ decision-making structures (usually a computer) to take the optimal next step based on their data and mission. An example of an autonomous robot would be the Roomba vacuum cleaner, which uses sensors to roam freely throughout a home. [3] [6]



Fig 1. 3: Autonomous Robots

1.4.4. Tele operated Robots:

Tele operated robots are semi-autonomous bots that use a wireless network to enable human control from a safe distance. These robots usually work in extreme geographical conditions, weather, circumstances, etc. Examples of tele operated robots are the human-controlled submarines used to fix underwater pipe leaks during the oil spill or drones used to detect landmines on a battlefield. Tele-robotic devices are finding acceptance by surgeons and might soon be regarded as key surgical tools for certain procedures [3][7]



Fig 1. 4: Tele operated Robots

1.3.5. Augmenting Robots :

Augmenting robots either enhance current human capabilities or replace the capabilities a human may have lost. The field of robotics for human augmentation is a field where science fiction could become reality very soon, with bots that have the ability to redefine the definition of humanity by making humans faster and stronger. Some examples of current augmenting robots are robotic prosthetic limbs or exoskeletons used to lift hefty weights. [3]



Fig 1. 5: Augmenting Robots

1.5. Uses of Robots:

1.5.1. Manufacturing :

Today most robots are used in manufacturing operations .The industrial industry is likely the most well-known and oldest user of robots. These robots and co-bots (bots that operate with people) test and assemble things such as automobiles and industrial machinery. More than three million industrial robots are currently in operation, according to estimates. [8][3]



Fig 1. 6: Manufacturing

1.5.2. Logistics:

Robots for shipping, handling, and quality control are quickly becoming a need for most merchants and logistics firms. Logistics businesses utilize robots in warehouses and even on the road to assist increase time efficiency since we now demand our products to arrive at lightning speed. At the moment, robots are removing your things from shelves, carrying them across the warehouse floor, and packing them. Furthermore, the emergence of last-mile robots (robots that will bring your product to your door autonomously) ensures that you will have a face-to-metal meeting with a logistics bot in the not-too-distant future. [3]



Fig 1. 7: Logistics

1.5.3. Domestique robots:

It is no longer science fiction. Robots may be seen in our homes, assisting with household duties, reminding us of our routines, and even amusing our children. Roomba, the self-driving vacuum cleaner, is the most well-known example of a household robot. Furthermore, robots have advanced to the point that they can now perform anything from mow grass independently to clean pools. [3]



Fig 1. 8: Domestique robots

1.5.4. Travel:

Is there anything more science fiction than self-driving cars? These self-driving cars are not simply a pipe dream anymore. Self-driving vehicles are taking the globe by storm, thanks to a mix of data science and robotics. Tesla, Ford, Waymo, Volkswagen, and BMW are all working on the next generation of transportation, which will allow us to sit back, relax, and enjoy the journey. Uber and Lyft, 2 ridesharing businesses, are developing autonomous rideshare vehicles that do not require people to operate. [3]



Fig 1. 9: travel

1.5.5. Healthcare :

In the healthcare business, robots have made huge achievements. From robot-assisted operations to bots that help people recover from injuries in physical therapy, these mechanical wonders are used in almost every facet of healthcare. Toyota's healthcare assistants, who help individuals regain their ability to walk, are an example of robots at work in healthcare. And "tug," a robot that can go around a hospital on its own and carry everything from medication to clean linens. Pharmaceutical firms have recently used robots to assist speed up the fight against covid-19. These bots are currently utilized to fill and seal covid-19 testing swabs, and some firms are now using them to make PPE and respirators. [3]



Fig 1. 10: healthcare

1.6. The Seven Biggest Challenges in Robotics:

- ✓ Manufacturing Procedures.
- ✓ Facilitating Human-Robot Collaboration.
- ✓ Creating Better Power Sources.
- ✓ Mapping Environments.
- ✓ Minimizing Privacy and Security Risks.
- ✓ Developing Reliable Artificial Intelligence.
- ✓ Building multi-functional robots.

1.7. Machine Vision:

Our most powerful sense is vision. It offers us with a significant quantity of information. It gives us access to a wealth of information about our environment and allows us to engage intelligently. All without making direct physical touch with the surroundings. We learn the locations and identities of things, as well as the relationships that exist between them, through it, and we are at a significant disadvantage if we are deprived of it, in this way it's no surprise that attempts have been made to give robots intelligence, a sensation of vision nearly since the beginning of digital computing generally accessible.

Our most difficult sense is vision. The knowledge we have about how biological vision systems work is still incomplete, confined largely to the steps of processing immediately related to signals collected from the sensors what we do know is that biological vision systems work in a similar way to computer vision systems.[5]

1.8. Image Processing:

Image processing is largely concerned with the generation of new images from existing images. Most of the techniques used come from linear systems theory. The new image may have noise suppressed, blurring removed, or edges accentuated. The result is, however, still an image, usually meant to be interpreted by a person. As we shall see, some of the techniques of image processing are useful for understanding the limitations of image-forming systems and for designing preprocessing modules for machine vision.

1.9. Our Problematic:

Robot controllers are frequently developed via simulation in evolutionary robotics since utilizing a physical robot to assess fitness takes too long. Simulators make it simple to assess the fitness of a controller. The task of a simulator is to provide the controller with the necessary sensor data. A virtual visual environment is required if the robot has an on-board camera.

If the robot has an on-board camera, a virtual visual environment to imitate the camera's signal is required. These visual landscapes were formerly created by hand, which necessitated the use of handcrafted models, texturing, and lighting, which was a difficult and time-consuming procedure. We developed a deep neural network-based architecture for mimicking visual environments in our proposed study. Without employing handcrafted models, texturing, or lighting, the neural networks are trained purely using images recorded from a camera, visual surroundings. Because all training data is recorded in the physical world, it does not rely on any external domain-specific datasets. Without employing handcrafted models, texturing, or lighting, the neural networks are trained purely using images recorded from a camera, visual surroundings. Robot controllers were developed in simulation to distinguish between objects of various colors and forms, and they accomplished the task well in the actual world. [9]

1.10. Designing Deep-Learning Based Vision Applications:

For designers of a deep-learning based vision system, it is important to know which learning frameworks and databases are available to be used in the design process, which DNN models are best suited for their application, whether an already trained DNN can be adapted to the new application, and how to approach the learning process. All these issues are addressed, in this section. These guidelines can be used in, the design process of any kind of vision system, including robot vision systems. [2]

1.10.1. The Visual Perception:

The capacity to see our environment through the light that enters our eyes is known as visual perception. Because graphical user interfaces (GUIs) are only seen through vision, the visual perception of colors, patterns, and structures has piqued researchers' attention. As a result, designers may build more effective user interfaces by understanding visual perception.

In GUI design, many visual perception characteristics are extensively employed. Many designers utilize gestalt concepts (i.e., how humans arrange visual stimuli) in the design of GUIs in order to build user interfaces that are simple to perceive and comprehend.

The visual perception of affordances (action possibilities in the environment) is another example of how the understanding of visual perception is a critical item in any designer's toolkit. [10]

1.11. Conclusion:

Machine vision is a paradigm of robotics and represents an ambitious project, which requires the fusion of many technologies like electronics, communications, mechatronics, software engineering and artificial intelligence. Therefore, in this chapter we presented generalities about vision of robots and some of the most important uses of. In the next chapter, we will explain the various branches of AI, and their relationship to the vision of robots.

Chapter 2:
Artificial Intelligence,
Machine Learning and Deep
Learning

2.1. Introduction:

Today Deep learning approach DL becomes the new tendency of machine learning approach ML which is used since it gives much more sophisticated pattern recognition and image classification than classic machine learning approach. Among the most used methods in DL, CNNs are for a special interest. [11]

First, when we talk about AI, we need to be clear about what we're talking about. What are artificial intelligence (AI), machine learning (ML), and deep learning (DL)? What is their relationship like?

So in this chapter we will separate in the team between the AI, ML and DL , the various algorithms related to them and talk about the different areas in which they are used.

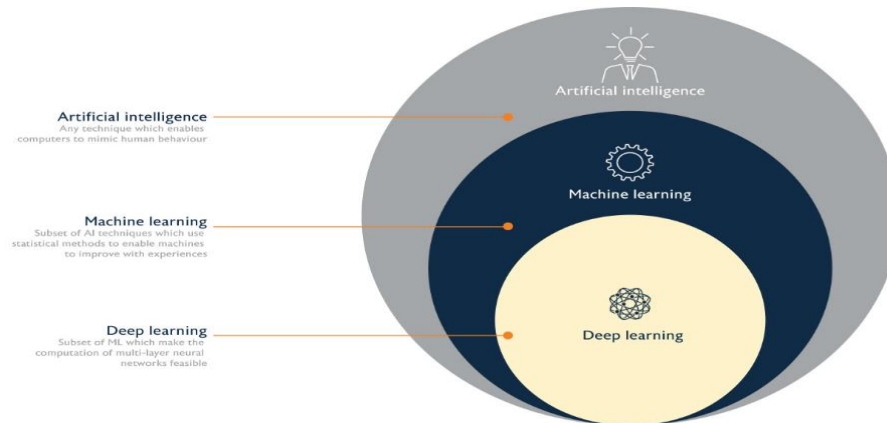


Fig 2. 1: Artificial Intelligence paradigms

2.2. Artificial Intelligence:

Artificial intelligence commonly known as AI ,it is "*The science and engineering of making intelligent machines, especially intelligent computer programs*", Humans are the most intelligent species on planet earth. And the secret sauce behind this powerful brain is Neocortex.

“AI is , a ability of computer program to work like a human brain” AI has three different levels:

- a) Narrow AI: when the machine can perform a specific task better than a human. [12]
- b) General AI: When it can perform any intellectual task with the same accuracy level as a human would. [12]
- C) Active AI: when it can beat humans in many tasks. [12][13]

2.3. Machine Learning:

2.3.1. Definition:

Machine learning ML is a branch of computer science that arose from the study of natural language processing, In artificial intelligence, pattern analysis and computational learning theory are used. A robot Predictive analytics on data is another term for learning processes. In 1959, Arthur Samuel defined ML as “a field of study that gives computers the ability to learn without being explicitly programmed”. Is concerned with designing algorithms that allow computers to have the property of learning without programming the rules for each problem. [12][14][15][16]

Personally, I liken ML to a young child from birth to gradually getting acquainted with objects and sounds by training him, correcting his information and repeating the process until good learning .The child learns either through supervised learning from his parents or through direct learning, where he gains experience, There are two important points in ML, which are training and expectation, that is, we train it to expect and then try it in order to expect the answers.

2.3.2 . Types Of Machine Learning:

There are three types of ML:

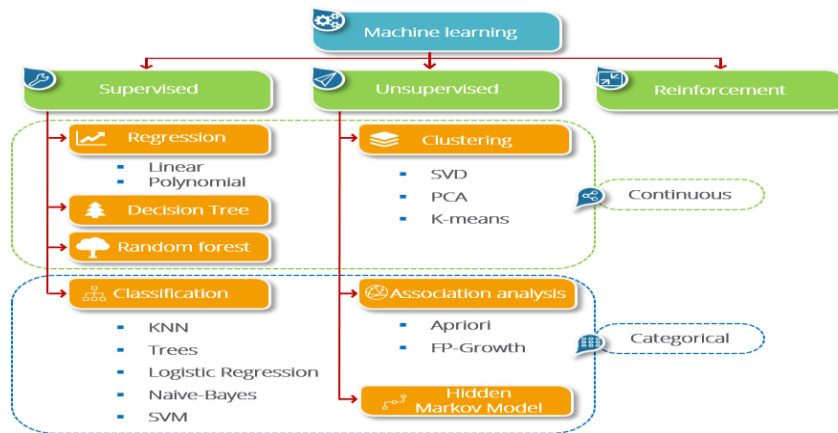


Fig 2. 2: Machine-Learning techniques.

2.3.2.1. Supervised Learning :

❖ **Definition:**

The computer is trained by giving it data and data outputs, so it is called supervised learning (SL), where we supervise learning ...Through training, the computer builds relationships and patterns between data and outputs so that it can later predict new data outputs.

✓ **Regression:**

Regression methods are used for training supervised ML. The goal of regression techniques is typically to explain or predict a specific numerical value while using a previous data set. For example, regression methods can take historical pricing data, and then predict the price of a similar property to retail demand forecasting.

Linear regression is considered the simplest and most basic method. In this case, a dataset is modeled using the following equation:

$$Y = M * X + B.....(1)$$

It is possible to train a regression model with multiple pairs of data, such as x, y. To do this, you need to define a position, as well as the slope of the line, with a minimal distance from all known data points. This is the line that best approximates the observations in the data, and can help make predictions for new unseen data. [17]

✓ **classification:**

Classification algorithms can explain or predict a class value. And is an essential component for many AI applications, but it is especially useful for ecommerce applications. For example, classification algorithms can help predict if a customer will purchase a product, or not. The two classes in this case are “yes” and “no”. Classification algorithms are not limited to two classes and can be used to classify items into a large number of categories.

Logistic regression is considered the simplest and most basic classification algorithm. A logistic regression algorithm can take more than one input, and use the data to estimate the probability of an event occurring. An interesting use of this algorithm can be seen in predicting university admittance results. The algorithm, in this case, analyzes two test scores to estimate the university admittance probability.

The output is a probable number between zero and one. The number 'one' represents absolute certainty in the admittance of the student, but any number greater than 0.5 predicts the student will be accepted by the university. [17]

❖ **Application of Supervised Machine Learning :**

- Bioinformatics
- Quantitative structure
- Database marketing
- Handwriting recognition
- Information retrieval
- Information extraction
- Object recognition in computer vision

2.3.2.2. Unsupervised Learning:

❖ **Definition:**

The computer is trained by giving it the data only so that we do not supervise the learning and we do not give the outputs to these data and through training the computer builds relationships and patterns between the data itself to be able to predict the output of the new data.

Unsupervised learning problems can be further grouped into clustering and association problems:

✓ **Clustering:**

A clustering problem is one in which you wish to uncover the data's intrinsic groups, such as categorizing consumers based on their purchases. [18]

✓ **Association:**

When you are working on an association rule learning challenge, you are trying to find rules that describe big chunks of data, like, as People who buy X are more likely to buy Y. [18]

❖ **Application of Unsupervised Machine Learning :**

1. Human Behavior Analysis
2. Social Network Analysis to define groups of friends.

3. Market Segmentation of companies by location, industry, and vertical.
4. Organizing computing clusters based on similar event patterns and processes.

2.3.2.3. Reinforcement Learning(RL) :

❖ Definition:

We have a data input layer that goes through some hidden neural network layer and delivers the result as an output. The machine is exposed to an environment where it trains itself continually using trial and error. And the machine is rewarded with a point for a correct answer or penalized with a point for a wrong answer. On the basis of reward points Which Acquired by the machine it gets ready to predict the new data presented to it. [19][12][20]

Reinforcement learning is a special type of learning scenario where the teacher only provides performance feedback to the learning system, not full input-output examples as for the learning from demonstration case. Learning is in general slower as the learning system may have to try several actions before making progress. After a solution is found, there is a trade-off between using the found solution and searching for a better solution, known as the exploration-exploitation dilemma. One possible scenario of reinforcement learning for autonomous navigation is a teacher providing feedback on how far from the desired path the vehicle is going. This possibility has not been explored in any of the included publications.

❖ Application of Reinforcement Machine Learning:

- ✓ Resources management in computer clusters
- ✓ Traffic Light Control
- ✓ Web System Configuration
- ✓ Personalized Recommendations
- ✓ Deep Learning
- ✓ Robotics

❖ Robotique:

DL is heavily used for building robots to perform human-like tasks. Robots powered by Deep Learning use real-time updates to sense obstacles in their path and pre-plan their journey instantly. It can be used to carry goods in hospitals, factories, warehouses, inventory management,

manufacturing products, etc. Boston Dynamics robots react to people when someone pushes them around, they can unload a dishwasher, get up when they fall, and do other tasks as well.

2.3.3. Machine Learning Algorithms:

2.3.3.1. Logistic Regression (LR):

It is a supervised classification algorithm used to classify data to corresponding classes by using the sigmoid/logit function to return probability values (between 0 and 1), thereby classifying the data into a set of discrete classes (identified classes). If there are many classes to be assigned, Logistic regression will use the one vs all method to classify the data. [21][22]

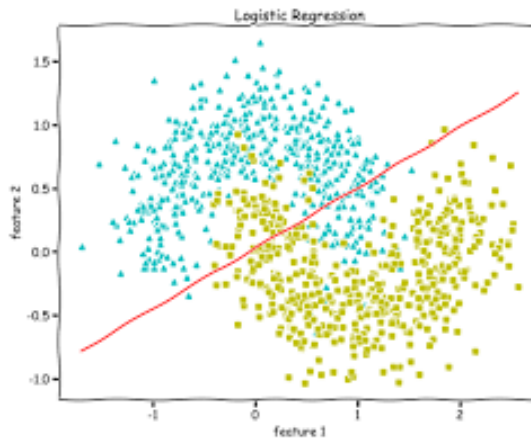


Fig 2. 3:Logistic Regression Example

2.3.3.2. Support Vector Machine (SVM) :

Encouragement Vector Machines are one of the most well-known and discussed machine learning techniques. It is essentially a more refined approach. Constructs and performs classification tasks hyperplanes are planes in a multidimensional space that are parallel to each other. Cases with various class designations are separated. SVM (Systematic Variable Modeling). [18]

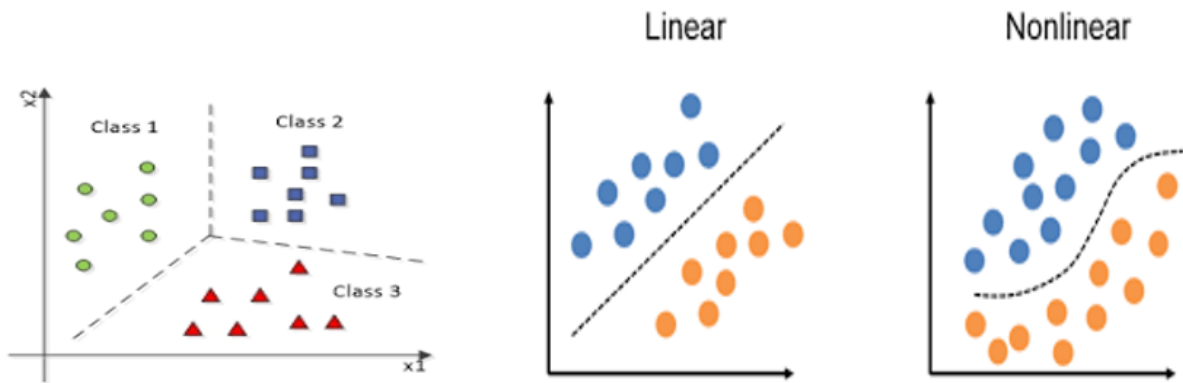


Fig 2. 4: examples of a two-class problem with two separating hyperplanes

2.3.3.3. Naïve Bayes (Nb) :

A naive Bayes classifier is not a single algorithm, but a family of machine learning algorithms which use probability theory to classify data with an assumption of independence between predictors. It is easy to build and particularly useful for very large data sets. Along with simplicity, Naive Bayes is known to outperform even highly sophisticated classification methods. [18]

the Fourmle is : $P(A/B) = P\left(\frac{B}{A}\right) * P(A) / P(B).....(2)$

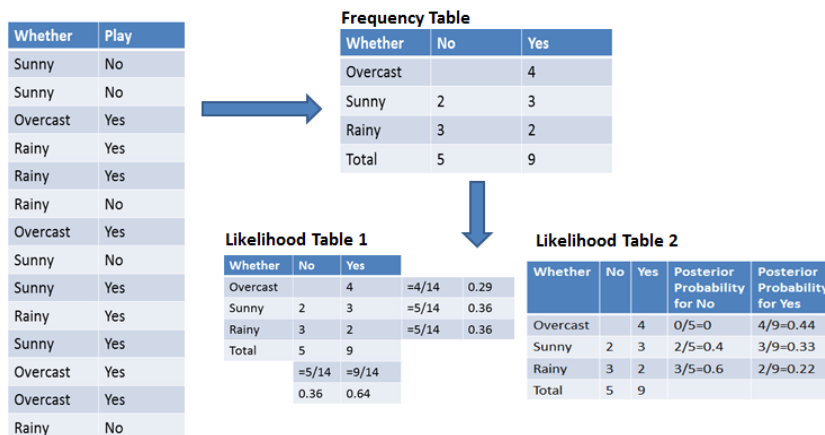


Fig 2. 5: Naïve Bayes Classification Example.

2.3.3.4. Decision Tree:

The decision tree algorithm classifies objects by answering “questions” about their attributes located at the nodal points. Depending on the answer, one of the branches is selected, and at the next junction, another question is posed, until the algorithm reaches the tree’s “leaf”, which indicates the final answer. Decision tree applications include knowledge management platforms for customer service, predictive pricing, and product planning. A typical example of decision trees is identifying the insurance premium that should be charged based on an individual’s situation. The decision tree can define a complex map of criteria such as location, types of insured events, environmental conditions, etc., and determine risk categories based on claims submitted and amounts spent. The system can then evaluate new claims for insurance coverage, categorizing them by risk category and potential financial damage. [17]

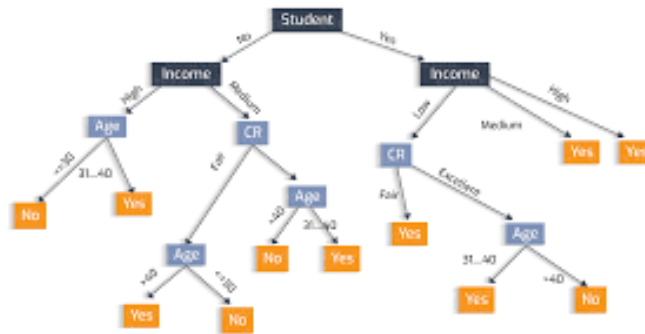


Fig 2. 6:Decision Tree

2.3.3.5. Neural Networks:

Neural networks (NN) mimic the structure of the brain: each artificial neuron connects to several other neurons, and together millions of neurons create a complex cognitive structure. NNs have a multilayer structure: neurons in one layer transmit data to several neurons on the next, and so on. Ultimately, the data reaches the output layer, where the network makes a decision about how to solve a problem, classify an object, etc. Due to the multi-layer nature of neural networks, their field of study is known as “DL”.

NNs are used for a wide variety of business applications. In healthcare, they are used in the analysis of medical images, to speed up diagnostic procedures and search for drugs. In the

telecommunications and media industries, neural networks can be used for machine translation, fraud detection, and virtual assistant services. The financial industry uses them for fraud detection, portfolio management and risk analysis. [17]

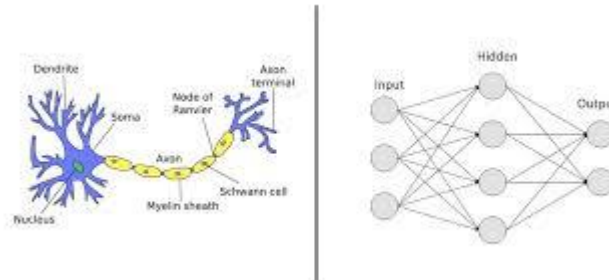


Fig 2. 7: Neural Networks

2.4. Deep learning:

2.4.1. Definition:

Deep learning, as a new field of machine learning research, is a procedure that makes it possible to Computers will be trained to execute activities that are inherent in the brain. Such as image re cognition. DL deals with many NNs, the most important of which is the convolution neural network and is most important algorithm to classification. [23]

A number of deep learning architectures, such as deep neural networks, deep convolutional neural networks and deep belief networks, have been applied to fields such as computer vision, automatic speech recognition, and audio and music signal recognition and these have been shown to produce cutting-edge results in various tasks.[24][25][26]

2.4.2. Deep Learning méthodes:

Dropout: is used for a technique, which drops out some nodes of the network. This technique is applied in the training phase to reduce overfitting effects. [27]

Max-Pooling : We start by defining the filter, and then we use the maximum assembly to minimize the size. By employing the maximum assembly, the dimensions can be minimized. [28]

- ✓ **Batch Normalization:** It stabilizes and accelerates the deep neural network, by normalizing the output from layer.[28]

2.4.3. Some examples of the uses of deep learning

- ❖ As traditional methods of feature extraction used in personal authentication systems are not able to yield interesting results, they suggested using a deep learning method called Sparse Autoencoder (SAE) to improve features extracted from several descriptors.[29]
- ❖ ClusterOne is a deep learning platform for AI and machine language development that's able to run multiple concurrent experiments while managing runtime environment, data and networking.[30]

2.5. Deep Neural Network:

2.5.1. Artificial Neural Network :

An artificial neural network (ANN) is a component of a computing system that mimics how the human brain analyzes and processes data. Artificial intelligence (AI) is built on this basis, and it solves issues that would be impossible or difficult to solve by human or statistical criteria. ANNs have self-learning characteristics, allowing them to improve their performance as more data becomes available. [31]

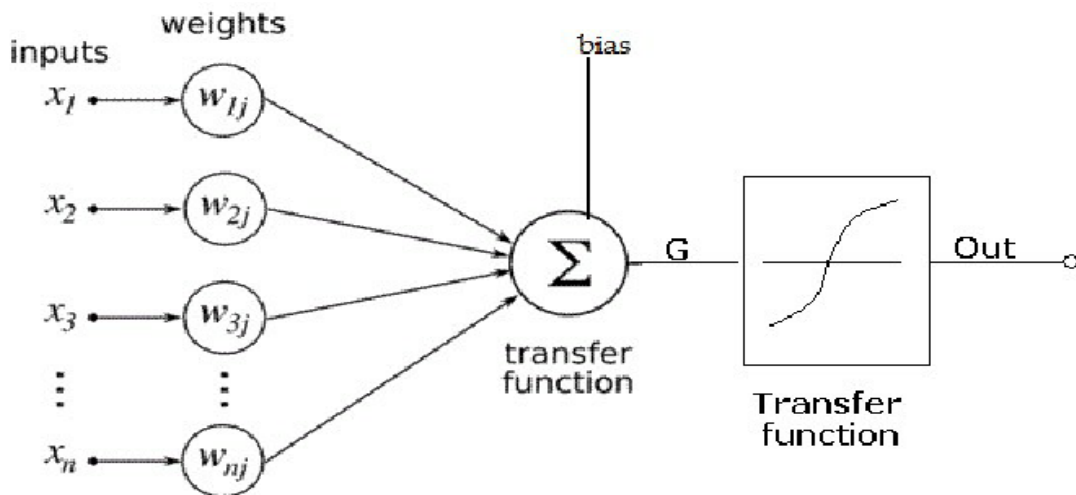


Fig 2. 8: Schematic of an artificial neural network

2.5.2. Recurrent Neural Network (RNN) :

RNN is based on the usage of sequential information. In classic neural networks, all inputs (and outputs) are assumed to be independent of one another. However, for many projects, this may not be the best option. It's easiest to guess the following word in a phrase if you know what came before it. There are two main variants of RNN, bidirectional RNN (BRNN) and long short-term memory (LSTM). [32]

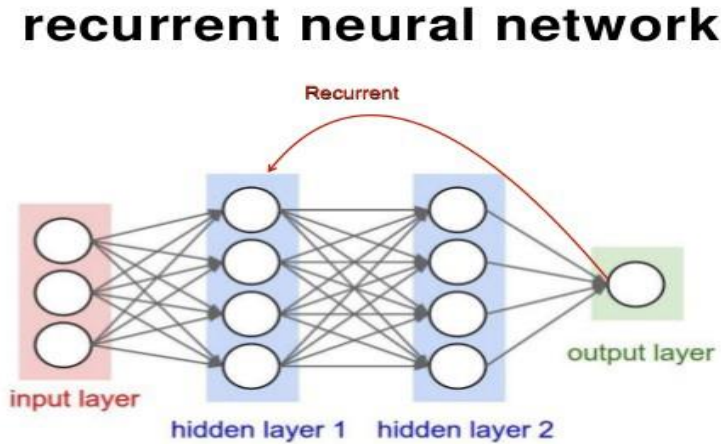


Fig 2. 9: A Typical Architecture of Recurrent Neural Network

2.5.3. Deep Neural Networks (DNNs) :

Deep Neural Network are the are the transport of data from the input layer to the output layer without return backward. Although this formula has been effective in many applications, however, the training process is long and tiring. The DNN was inspired by the brain's way of digesting multiple-level inputs in the brain. However, because he has no memory, you will have to start again the following time. It does not work in the same manner as the human brain. [33]

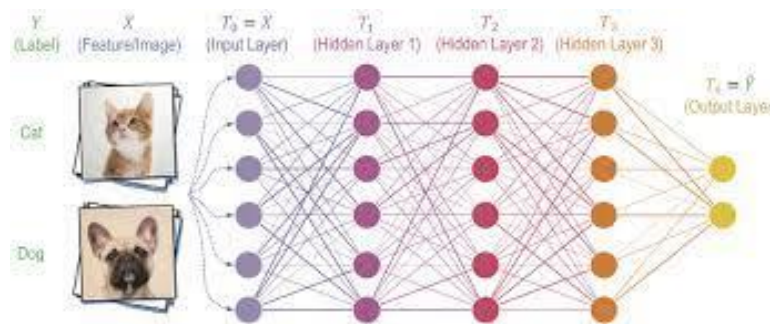


Fig 2. 10: Deep Neural Networks

2.6. Convolution Neural Network (CNN) :

2.6.1. Definition:

Convolutional Neural Networks (CNN) correspond to a family of DNN architectures whose main goal is analyzing natural signals by taking advantage of their properties, the main properties of CNNs are local connections, shared weights, pooling, and the use of many layers. The main reason for this is that the structure of CNNs is inspired by the processing pipeline of the mammalian visual system. Hence, the behavior of a given layer of CNN neurons can be modeled as a linear filtering operation, a convolution, followed by a non-linear operation (activation function). After the convolution layer, the application of a pooling operation permits modeling the increase of the receptive size of the neurons. After several convolutions and pooling operations are applied (the network has several layers), a decision needs to be made about the input stimuli. This is implemented using fully connected layers of neurons. Thus, CNNs are composed of three kinds of processing layers: convolutional layers, pooling layers, and fully-connected layers, as is shown in Figure 1.

The number of layers in a CNN and their type will depend on the specific network structure, but normally the number of convolution and pooling layers is much larger than the number of fully-connected layers. A very important side effect of this is that a CNN can have a smaller number of weights to be adapted than a shallow network, given that the number of free parameters

in the convolutional layers is very small, and proportional to the size of the implemented filters. If several output channels must be computed. One important aspect to highlight is that most of the operations that need to be computed in a CNN are local, and therefore can be mapped easily to GPUs.

The designing of a convolutional layer basically consists of selecting the number of filters that a given layer will have, and its size.

The parameters of the filters, the weights of the neurons, will be adapted during training.

In the case of the design of a pooling layer, the pooling operation needs to be selected.

The most frequently used pooling operations are average pooling and max pooling; however, The fully-connected layers are the ones in charge of converting the 2D feature maps into a 1D feature vector, in addition to being in charge of the classification.

The fully-connected layers have a similar structure to a traditional shallow network, and they normally contain a large percentage of the parameters of a CNN (about 90% according to).

In some cases the fully-connected layers in charge of the final classification are replaced by a softmax unit, or a different statistical classifier (e.g. An SVM).

Softmax has been shown to achieve better accuracy than SVM, because it can be trained end-to-end inside the network . [34] [35] [36] [37]

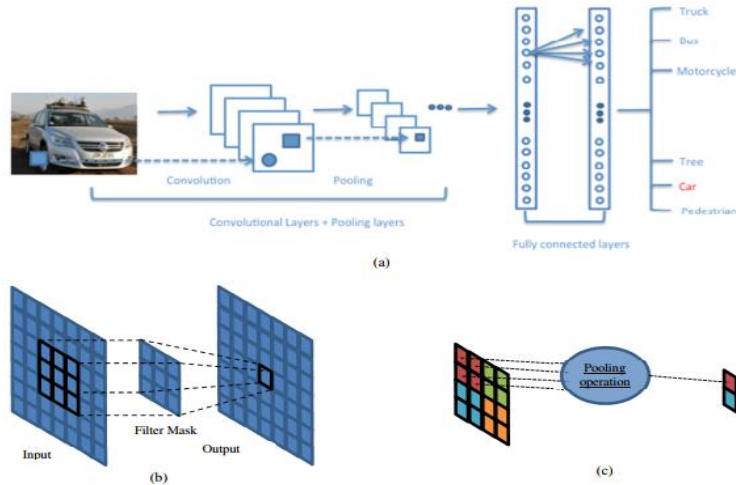


Fig 2. 11: Exemple Of CNN Model

2.6.2. Examples of Uses of Convolutional Neural Networks:

Convolutional neural networks are a broad area of research and a recent focus of researchers:

- ❖ They proposed a CNN model consisting of: many convolutional layers as automatic classifier that allows you to categorize a large number of clothes[38]
- ❖ They developed an automated system that allows detection and classification of traffic signals[39]

2.7. Activation function:

2.7.1. Definition:

Activation Functions are specially used in artificial neural networks to transform an input signal into an output signal which in turn is fed as input to the next layer in the stack. In an artificial neural network, we calculate the sum of products of inputs and their corresponding weights and finally apply an activation function to it to get the output of that particular layer and supply it as the input to the next layer. [40]

2.7.2. Types Of Activation Functions:

- A. Sigmoid
- B. Tanh
- C. ReLU
- D. SoftMax

A. Sigmoid:

It is the most widely used activation function as it is a non-linear function. The sigmoid function is used to manipulate data. a number between 0 and 1 It may be summed up as follows:

$$f(x) = 1 / (1 + e^{-x}) \dots\dots(3)$$

sigmoid function is not symmetric about zero. [40]

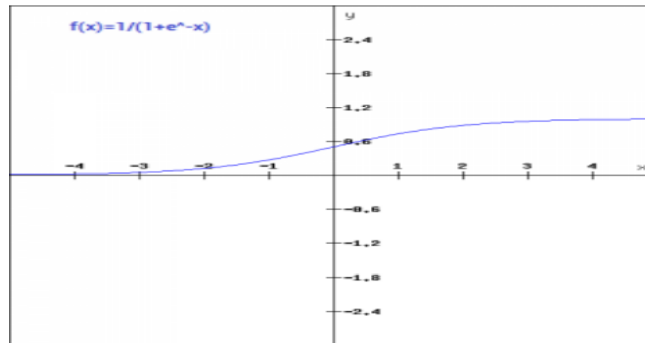


Fig 2. 12: Sigmoid Function

B. Tanh :

The Hyperbolic Tangent function is what it's called. Tanh function is similar to the sigmoid function, however it is symmetric around the origin. As a result, the outputs have various signs, previous levels that will be passed into the following layer as input, Tanh function is continuous and differentiable, the values lies in the range -1 to 1.It may be summed up as follows: [40]

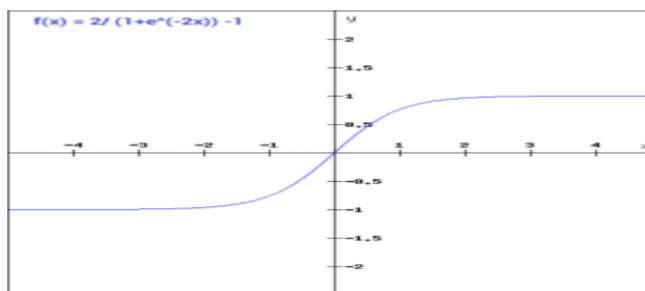


Fig 2. 13: Tanh Function

C. ReLU:

Relu stands for rectified liner unit and is a non-linear activation function which is widely used in neural network. The upper hand of using Relu function is that all the neurons are not activated at the same time. This implies that a neuron will be deactivated only when the output of linear transformation is zero. [40]

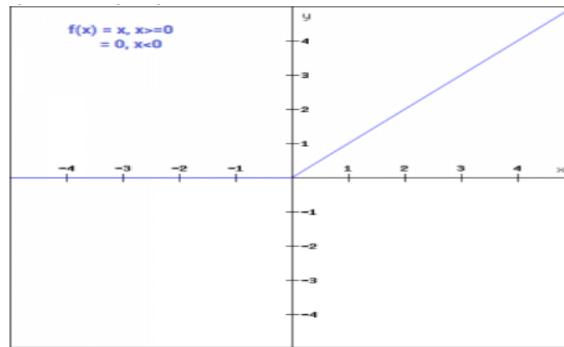


Fig 2. 14: ReLU Activation Function plot

D. Softmax:

The Softmax function is a sigmoid function that has been combined with other sigmoid functions. Because a sigmoid function gives numbers in the range of 0 to 1, we may regard these as data points of a specific class's probability. [40]

2.7.3 Choosing The Right Activation Function:

For better performance and less erroneous results, a lot of things have to be considered like the number of hidden layers in a network, training methods, hyperparameter tuning etc, and activation function is one of the most important parameters to consider. Choosing the right activation function for any particular task may be a te For classification problems, a combination of sigmoid functions gives better results.If there are dead neurons in our network, then we can use the leaky Relu function. Relu function has to be used only in the hidden layers and not in the outer layer. [40]

2.8. Machine Learning Vs Deep Learning:

Fig 2. 15:Machine Learning Vs Deep Learning

	Deep Learning	Machine Learning
Data	Needs a big dataset	Performs well with a small to a medium dataset
Hardware requirements	Requires machines with GPU	Works with low-end machines
Engineering peculiarities	Needs to understand the basic functionality of the data	Understands the features and how they represent the data
Training time	Long	Short
Processing time	A few hours or weeks	A few seconds or hours
Number of algorithms	Few	Many
Data interpretation	Difficult	Some ML algorithms are easy to interpret, whereas some are hardly possible

2.9. How Does Convolutional Neural Network Work?

Convolutional Neural Network architecture consists of four layers:

1. **Convolutional layer** :where the action starts. The convolutional layer is designed to identify the features of an image. Usually, it goes from the general (i.e., shapes) to specific (i.e., identifying elements of an object, the face of a certain man, etc.).
2. **Rectified Linear Unit layer (aka Relu)** : This layer is an extension of a convolutional layer. The purpose of Relu is to increase the non-linearity of the image. It is the process of stripping an image of excessive fat to provide a better feature extraction.
3. **The pooling layer:** is designed to reduce the number of parameters of the input i.e., perform regression.
4. **The connected layer** : It is a final straight line before the finish line where all the things are already evident. And it is only a matter of time when the results are confirmed.

Let us explain how CNN works in the case of image recognition:

- CNN perceives an image as a volume, a three-dimensional object. Usually, digital color images contain Red-Blue-Green, aka RGB encoding. What it means is that convolutional networks understand images as three distinct channels of color stacked on top of each other.
- CNN groups pixels and processes them through a set of filters designed to get certain kinds of results. For example, to recognize geometrical shapes on an image). The number of filters applied usually depends on the complexity of an image and the purpose of recognition.
- The pooling layer is designed to reduce the number of parameters of the input, i.e., perform regression.

As a result, you can a recognized image by identifying credentials and data layout that represents a blueprint of a picture of a specified kind.

Now let's take a look at the most prominent business applications of CNNs. [41]

2.10. Conclusion:

In this chapter, we talked about deep learning DL, which is a part of machine learning ML, which is contained in artificial intelligence AI, their respective techniques, their types, and concepts related to each one. Where we dealt with the most important algorithms and the various types of machine learning, and we have known the CNN, which we will detail in the next chapter.

CHAPTER 3:
PROGRAMMING ENVIRONMENT

3.1. Introduction:

In this chapter, we will talk about the Python language, which is considered one of the most important languages of the Area ,Many Python machine learning and Artificial Intelligence projects are developed today as it is used in many areas, including web and game programming, and what matters to us is artificial intelligence, as we find that these impose themselves strongly in the field of machine learning ... Where we will address the most important libraries and functions for learning The machine and deep learning, including Keras and Tensorflow, and how to work with it.

3.2. Anaconda Environment:

2.3.1. Definition:

Anaconda is a Python package that includes a number of different packages. Libraries, including key libraries used extensively in data science. The biggest benefit This version has the advantage of not requiring sophisticated settings and being able to operate on a variety of platforms. Operating systems and platforms (particularly Windows), which are prone to failure. While attempting to install specified Python packages[42]

Anaconda includes a fantastic integrated development environment (IDE), Spyder (Scientific Python Development Environment), as well as other useful tools like jupyter notebooks, the python console, and the excellent package management tool, conda, which allows us to install, remove, or upgrade any Anaconda package with a single command in Anaconda Prompt. Anaconda 5.2.0, which is compatible with Python 3.6, is used in our research. [43]

2.3.2. Anaconda downloading:

- *Ferst Click to this link* <https://repo.anaconda.com/archive/>.

File Name	Size	Date	Time	Hash
Anaconda3-4.4.0-Linux-ppc64le.sh	290.7M	2017-05-17	15:45:50	8c663e2056c7c57ac0075774b1f790be
Anaconda3-4.4.0-Linux-x86.sh	428.7M	2017-05-26	18:23:45	8556e85f81206c08ee2a30b67d1bb707
Anaconda3-4.4.0-Linux-x86_64.sh	499.0M	2017-05-26	18:23:04	50f19b935dae7361978a04d9c7c355cd
Anaconda3-4.4.0-MacOSX-x86_64.pkg	442.5M	2017-05-26	18:36:17	c6cd9c30b94c2ba2a5449e6f234d15f5
Anaconda3-4.4.0-MacOSX-x86_64.sh	380.4M	2017-05-26	18:35:59	3958ac6cb9a731e560dd83256aa5b15
Anaconda3-4.4.0-Windows-x86.exe	362.2M	2017-05-26	17:54:21	a7a663570b95a773dabbbef65a3af
Anaconda3-4.4.0-Windows-x86_64.exe	437.6M	2017-05-26	17:55:34	aa200a1c059a551e0ba9a5314a9554a5
Anaconda3-4.4.0-Linux-ppc64le.sh	285.6M	2017-07-26	16:08:42	fe7c87abd9fd70dc0cb4f83cc22d336f
Anaconda3-5.0.0-Linux-x86.sh	296.3M	2017-09-25	14:39:31	8fe5b29ca5be3ff11411621f79babfc2
Anaconda3-5.0.0-Linux-x86_64.sh	429.3M	2017-09-26	14:48:02	8120fcd072916e4a28d0179be8d29053
Anaconda3-5.0.0-Linux-x86_64.pkg	523.4M	2017-09-26	14:37:22	bb2656314d22aee6af243d8bbfb32c
Anaconda3-5.0.0-MacOSX-x86_64.pkg	567.2M	2017-09-26	16:25:10	de004893c4d5714e06d4003e0780aabd
Anaconda3-5.0.0-MacOSX-x86_64.sh	489.9M	2017-09-26	16:25:11	a72e7022c29f04e0559c8b453f89fa
Anaconda3-5.0.0-Windows-x86.exe	415.8M	2017-09-26	16:25:12	4a48ded89f15b4a2e39ffa69f3532df2
Anaconda3-5.0.0-Windows-x86_64.exe	510.0M	2017-09-26	14:14:53	fee3fad608d0006afa5c7bca44e3d02b
Anaconda3-5.0.0-Linux-x86.sh	429.8M	2017-10-02	10:50:15	8b6902d20063e6c3b98ebe70060f3131
Anaconda3-5.0.0-Linux-x86_64.sh	524.0M	2017-10-02	10:50:14	614cc8f244e956b41c75417dd1ec96fd
Anaconda3-5.0.1-Linux-x86.sh	431.0M	2017-10-23	18:07:51	d967f023a23698109fe213103a2c07bf
Anaconda3-5.0.1-Linux-x86_64.sh	525.3M	2017-10-23	17:52:55	c989ecc8b648ab8a64731aaee9ed2e7e
Anaconda3-5.0.1-MacOSX-x86_64.pkg	568.9M	2017-10-23	20:01:19	eeef112a1b8cbe854e189ee1969f699
Anaconda3-5.0.1-MacOSX-x86_64.sh	491.0M	2017-10-23	19:51:10	3c0fabfd9a68d91f6da65051046e106
Anaconda3-5.0.1-Windows-x86.exe	420.4M	2017-10-24	12:37:10	9d2ffb0aac1f8a72ef4a5c535f3891f2
Anaconda3-5.0.1-Windows-x86_64.exe	514.8M	2017-10-24	12:37:59	3dde7dbbef158db6dc44fce495671c92
Anaconda3-5.1.0-Linux-ppc64le.sh	285.7M	2018-02-15	09:08:56	47b5b2b17b7dbac0dad0f0a4653f5b1c
Anaconda3-5.1.0-Linux-x86.sh	449.7M	2018-02-15	09:08:58	793a94ee85baf64d0ebb67a0c49af4d7
Anaconda3-5.1.0-Linux-x86_64.sh	551.2M	2018-02-15	09:08:57	966406059cf7ed89cc82eb475ba506e5
Anaconda3-5.1.0-MacOSX-x86_64.pkg	594.7M	2018-02-15	09:09:06	6ed962218a3d115f83463d13136be49
Anaconda3-5.1.0-MacOSX-x86_64.sh	511.3M	2018-02-15	09:10:24	047e12523fd287149ecd80c803598429
Anaconda3-5.1.0-Windows-x86.exe	435.5M	2018-02-15	09:10:28	7a2291ab99178a4cdec530861494531f
Anaconda3-5.1.0-Windows-x86_64.exe	537.1M	2018-02-15	09:10:26	83a8b1edcb21fa0ac481b23f65b604c6
Anaconda3-5.2.0-Linux-ppc64le.sh	288.3M	2018-05-30	13:05:40	cbd1d5435ead2b0b97dba5b3cf45d694
Anaconda3-5.2.0-Linux-x86.sh	507.3M	2018-05-30	13:05:46	81d5a1648e3aca4843f88ca3769c0830
Anaconda3-5.2.0-Linux-x86_64.sh	621.6M	2018-05-30	13:05:43	3e58f494ab9fbc12db4460dc152377b5
Anaconda3-5.2.0-MacOSX-x86_64.pkg	613.1M	2018-05-30	13:07:00	9c35b2f2e9986701f7d80241516c665f
Anaconda3-5.2.0-MacOSX-x86_64.sh	673.3M	2018-05-30	13:07:03	hcb780-d1-1007d4c5e4a01764-31044

Fig 3. 1: Anaconda downloading

- Choose the anaconda3-5.2.0 from the list as indicated in Fig 3.1.

3.2.3. Installation of Anaconda (Python 3.6):

Anaconda is easy to install just download Anaconda 64-bits, execute the installer and follow the instruction:

- Search Google for “Anaconda Python” → Python V 3.6 for Windows 64 bits
- Install the Anaconda 64-bit installation file for Windows
- Install for → option: Just for me
- Modify anaconda packages by typing the two commands:
 - > conda update conda
 - > conda update –all

3.3. Python language:

3.3.1. Definition:

The Python programming language is one of the most widely used languages, with a wide range of applications. It's an interpreted, interactive, object-oriented programming language that's becoming more popular in academia and industry. [44]

Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program

modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed. [45]

Python for ML and DL Applications is a set of libraries that allow developers to quickly extract and convert data, execute data wrangling operations, apply existing robust ML algorithms, and create bespoke algorithms. These are the libraries that are available. Numpy, scipy, Pandas, Scikit-Learn, tensorflow, Keras, and more Python libraries. [46]

3.3.2. Brief History :

Python was developed at the Dutch Mathematics and Informatics Institute (CWI)

- It was first announced in 1991
- Python 2.0 was released on 16 October 2000
- Python 3.0 was released on 3 December 2008

3.3.3. Installing Python :

First, we need to download Python, the version that is compatible with your device, you need to try ... For myself, I used Python3.6 because it is compatible with my device and contains the libraries that I need in my project ...just Go to (www.python.org) and download.

❖ Installing Python packages with Conda:

- C:\>conda install jupyter → jupyter 1.0
- C:\>conda install scipy → la bibliothèque des tableau Scipy
- C:\>pip install sklearn → la bibliothèque de machine learning
- C:\>pip install pandas → la bibliothèque de machine learning
- C:\>pip install pandas-datareader → outils de lecture de la bibliothèque ML pandas
- C:\>pip install matplotlib → installer l’outil de traçage de courbes
- C:\>pip install pillow → Outils complémentaire de ML
- C:\>pip install requests → Outils complémentaire de ML
- C:\>pip install h5py → Outils complémentaire de ML
- C:\>pip install tensorflow/tensorflow ==1.2.1 → Installer la bibliothèque de machine learning et l’interface google tensorflow.

- C:\>pip install keras/keras==2.0.6 → Installer la bibliothèque de machine learning et l'interface keras.

3.4. IDLE:

3.4.1. Definition:

IDLE it's a an open source program that allows you to type your programs and run them. IDLE has two main window types, the shell window and the editor window. It is possible to have multiple editor windows simultaneously. on windows and Linux, each has its own top menu. each menu documented below indicates which window type it is associated with. [47]

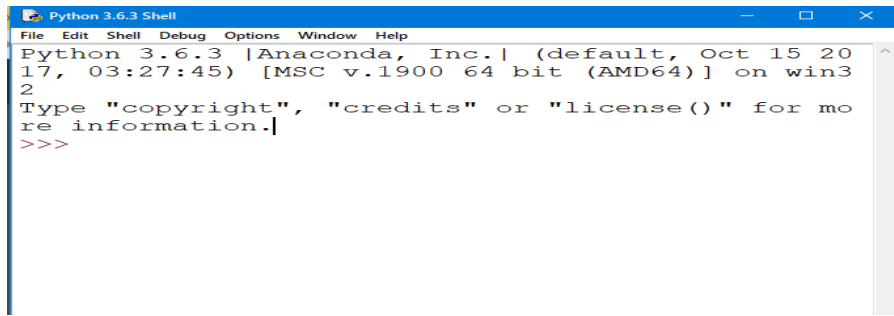


Fig 3. 2: IDIE Home Page

3.5. Python Libraries:

3.5.1. Numpy:

Numpy is the fundamental package for scientific computing in Python. It is a Python library that provides a multidimensional array object, various derived objects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation and much more.[48]

3.5.2. Scipy:

Scipy (pronounced “Sigh Pie”) is a Python-based ecosystem of open-source software for mathematics, science, and engineering. [49]

Scipy is a very popular library among Machine Learning enthusiasts as it contains different modules for optimization, linear algebra, integration and statistics. There is a difference between

the scipy library and the scipy stack. The scipy is one of the core packages that make up the scipy stack. Scipy is also very useful for image manipulation. [50]

3.5.3. Pandas:

Pandas is a well-known Python-based data analysis package that offers a wide range of functions, from parsing numerous file formats to transforming an entire data table into a numpy matrix array. As a result, pandas is a reliable partner in data science and machine learning. We used pandas : 0.20.3 for this project.[51]

3.5.4. Matplotlib:

Matplotlib is a Python library that provides interactive and non-interactive 2D charting, as well as the ability to save pictures in a variety of formats. It has a wide range of plots to choose from (lines, bars, pie charts, histograms...etc.). Furthermore, It is adaptable and simple to use. We used Matplotlib 2.2.2 in our project. [52]

3.5.5. TensorFlow:

TensorFlow is a Brain API and machine-learning library that works with Python machines. In 2015, Google created a team. Python programmers may now take advantage of this library with ease .Because AI and machine learning are supposed to make usage easier .And Tensor Flow is built on c, C++ making it very fast. It provides primitives for defining functions on tensors and automatically computing their derivatives in domains like physics and engineering, tensors are basic mathematical constructions. Tensors, on the other hand, have historically made less gain in computer science, which has generally been dominated by vectors. Logic and discrete mathematics are more closely related. This situation is beginning to shift. With the invention of the machine, this has changed dramatically. [53][54]

❖ Installation of Tensorflow:

- pip install tensorflow / tensorflow == 1.2.1
- pip install --ignore-installed --upgrade

3.5.6. Keras:

Keras is a Python-based deep learning API whose goal is to make constructing deep learning models as simple and quick as feasible. Tensorflow and Theano are utilized as the backend. We utilized Keras 2.2.4 with the tensorflow backend in the implementation phase of this project.[55]

❖ How to install Keras

Keras can be installed easily using PyPI, as follows:

```
pip install keras
```

3.5.7. TkInter:

Tkinter, or “Tk interface”, is a module of python that provides an interface GUI (Graphical User Interface). It is famous for its simplicity and it is open-source. The tkinter module is part of the Python standard, as it ships with the interpreter, and the Python documentation documents tkinter as if it were a built-in module. [56]

3.6. Dataset:

3.6.1. CIFAR10 description:

The CIFAR-10 dataset consists of 60000 32x32-color images in 10 classes, with 6000 images per class. There are 50000 training images and 10000 test images.

The dataset is divided into five training batches and one test batch, each with 10000 images. The test batch contains exactly 1000 randomly selected images from each class. The training batches contain the remaining images in random order, but some training batches may contain more images from one class than another. Between them, the training batches contain exactly 5000 images from each class. [57]

Here are the classes in the dataset, as well as 10 random images from each:

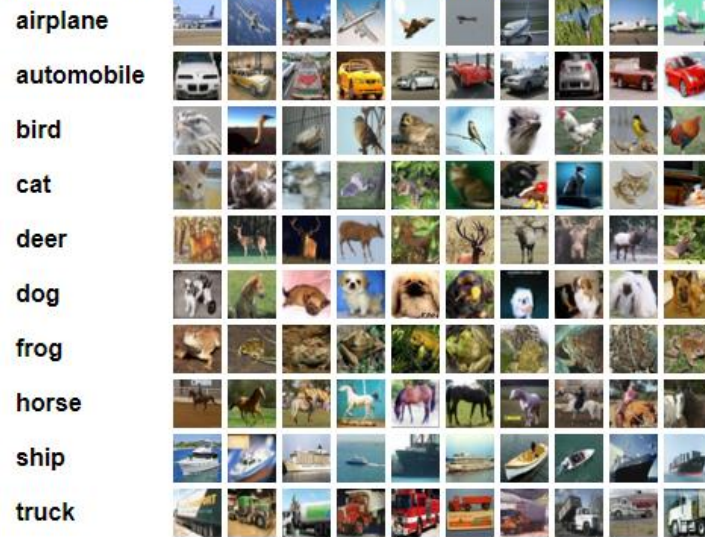


Fig 3. 3: Datasets Description

3.6.2. CIFAR10 Classes:

The label classes in the dataset are:

Table 3. 1: CIFAR-10 classes

❖ Airplane 	❖ Automobile 
❖ Bird 	❖ Cat 
❖ Deer 	❖ Dog 
❖ Frog 	❖ Horse 
❖ Ship 	❖ Truck 

3.7. Conclusion:

In this chapter, we have presented our project development environment and the most important libraries that we used. We chose them for the strength and accuracy of their results. In the next chapter, we will explain how to work on them with some of the used code.

**Chapter 4: Realized
Work And
Obtained Results**

4.1. Introduction:

In this chapter, I will work on explaining the content of my project and detailing the proposed CNN model, in which I tried to reach the greatest accuracy. I will also touch on some details about the graphical user interface (GUI) that I developed in order to facilitate the DL process and make experiments in a practical and easy way.

4.2. Preprocessing of the used dataset:

- Import the required layers and modules to create our convolution neural net architecture

#1. Load the dataset from keras datasets module

#6. Create the sequential model and add the layers

#7. Configure the optimizer and compile the model

#9. Train the model

```
model.fit(train_X,train_Y,
validation_data=(test_X,test_Y),
epochs=200,batch_size
```

Fig 4. 1 :Application of fit function source code

#10. Calculate its accuracy on testing data

```
scores = model.evaluate(x_test, y_test, batch_size=128, verbose=1)
```

Fig 4. 2:Application of evaluate function source code

#11. Save the model

```
model.save_weights('model4.h5')
```

Fig 4. 3:Application of save function source code

4.3. Convolutional Neural Network Model:

4.3.1. The Proposed Model:

In our work, we have developed an automatic classifier that allows to classify some given images ,It represents a group of objects such as animals, cars and planes... and it is one of 10 categories, . We proposed a CNN model, it consists of several convolutional layers, Max-Pooling layers and one full continuous layer.

Based on the two approaches, in order to improve the performance of the classification task, Figure 4.4 provides an outline of the proposed CNN model :

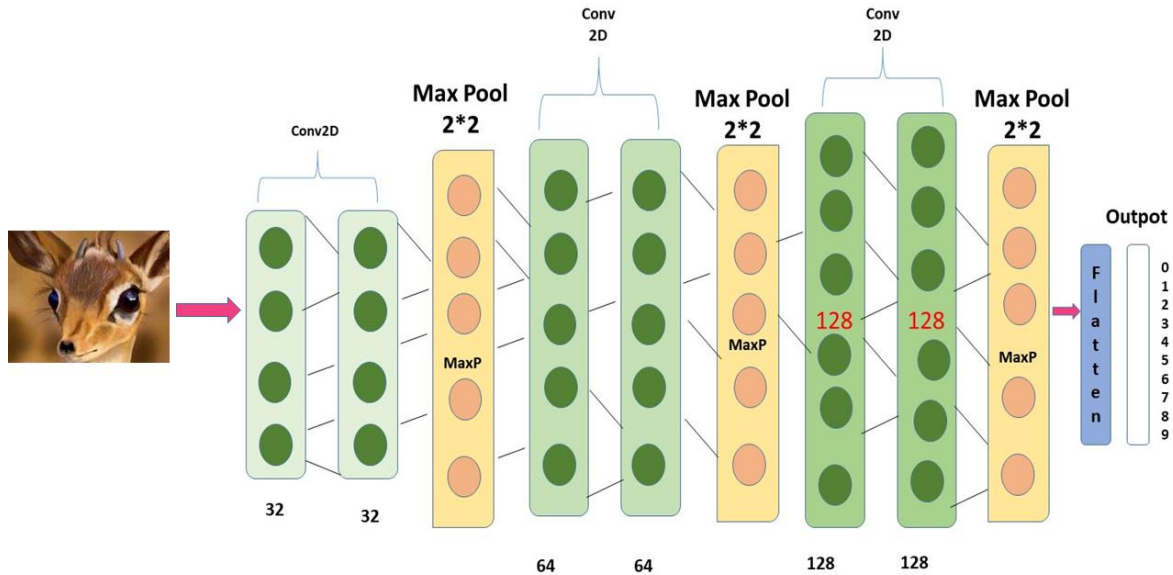


Fig 4. 4:The Proposed Model

The main task of our project was to design a CNN (Convolutional Neural Network) to get a highest accuracy and little time.

Model composed of many layers as it is presented in Fig 4. 4

- A first convolutional layer Conv1 constituted of 32 filters of size (3x3).
- A second convolutional layer Conv2 constituted of 32 filters of size (3x3).
- A MaxPooling MaxPool of size (2x2) allowing to reduce dimensions (weigh, high) of images issued of the previous layer after applying the different filters of Conv2
- A third convolutional layer Conv3 constituted of 64 filters of size (3x3).
- The fourth convolutional layer Conv4 constituted of 64 filters of size (3x3).
- A MaxPooling MaxPool of size (2x2) allowing to reduce dimensions (weigh, high) of images issued of the previous layer after applying the different filters of Conv4
- A Fifth convolutional layer Conv3 Conv5 constituted of 128 filters of size (3x3).
- A Sixth convolutional layer Conv3 Conv6 constituted of 128 filters of size (3x3).
- A MaxPooling MaxPool of size (2x2) allowing to reduce dimensions (weigh, high) of images issued of the previous layer after applying the different filters of Conv6.
- A flatten layer

4.3.2. Architecture of the Proposed Model:

Model: "sequential_12"

Table 4. 1: Architecture of the Proposed Model

Layer (type)	Output Shape	Param #
conv2d_108 (Conv2D)	(None, 32, 32, 32)	896
batch_normalization_108	(None, 32, 32, 32)	128
conv2d_109 (Conv2D)	(None, 32, 32, 64)	18496
batch_normalization_109	(None, 32, 32, 64)	256
max_pooling2d_48	(None, 16, 16, 64)	0
conv2d_110 (Conv2D)	(None, 16, 16, 64)	36928
batch_normalization_110	(None, 16, 16, 64)	256
conv2d_111 (Conv2D)	(None, 16, 16, 128)	73856
max_pooling2d_49	(None, 8, 8, 128)	0
conv2d_112 (Conv2D)	(None, 8, 8, 150)	172950
batch_normalization_112	(None, 8, 8, 150)	600
max_pooling2d_50	(None, 2, 2, 150)	0
conv2d_113 (Conv2D)	(None, 2, 2, 247)	148447
batch_normalization_113	(None, 2, 2, 247)	988
conv2d_114 (Conv2D)	(None, 2, 2, 270)	600480
batch_normalization_114	(Bat (None, 2, 2, 270)	1080
dense_12 (Dense)	(None, 10)	10810

Table 4.1 bellow summarizes the Architecture of the proposed CNN model

4.4. Model evaluation concepts:

➤ Accuracy:

The accuracy of a machine learning classification algorithm is one way to measure how often the algorithm classifies a data point correctly.

And it's one metric for evaluating classification models. Informally, **accuracy** is the fraction of predictions our model got right. Formally, accuracy has the following definition. [58]

$$accuracy = \frac{\text{Number of correct prediction}}{\text{Total nuber of preduction}} \dots \dots (4)$$

➤ **Loss:**

In mathematical optimization and decision theory, a loss function or cost function is a function that maps an event or values of one or more variables onto a real number intuitively representing some "cost" associated with the event. An optimization problem seeks to minimize a loss function. [59]

➤ **Optimizer:**

Optimizers are algorithms or methods used to change the attributes of the neural network such as weights and learning rate to reduce the losses. Optimizers are used to solve optimization problems by minimizing the function. [60]

➤ **Batch size:**

The batch size is a hyper parameter that defines the number of samples to work through before updating the internal model parameters.

➤ **Epochs:**

The number of epochs is a hyper parameter that defines the number times that the learning algorithm will work through the entire training dataset.

➤ **Batch normalization:**

Is a technique for training deep neural networks that standardizes the inputs to a layer for each mini-batch. This has the effect of stabilizing the learning process and dramatically reducing the number of training epochs required to train deep networks. [61]

4.5.Accuracy:

Table 4.2 bellow summarizes the obtained results after applying the proposed CNN model :

Table 4. 2 :AccuracyNo table of figures entries found.

	Loss value	Accuracy value
Training set	0.48%	0.93%
Test set	0.48%	0.89%

4.6. Application interface:

❖ Home Page:

This application contains five buttons, each of them has a separate page:

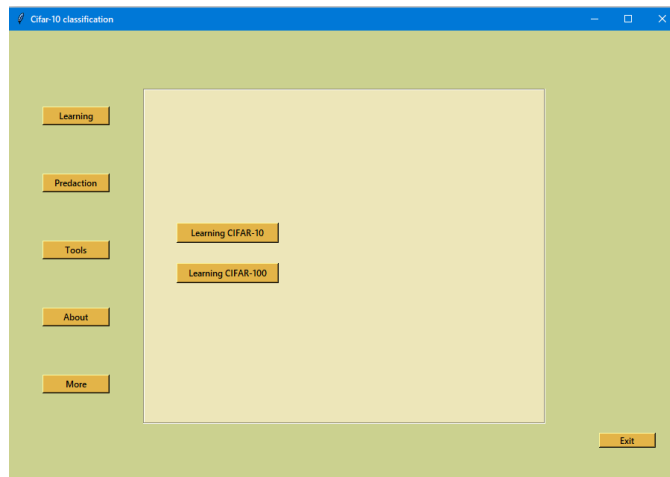


Fig 4. 5: Home Page of application

❖ Learning page:

This page contains two buttons, each with its own function

- ✓ Learning CIFAR-10 Button is to release The Learning Method of CIFAR-10
- ✓ Learning CIFAR-100 Button is to release The Learning Method of CIFAR-100

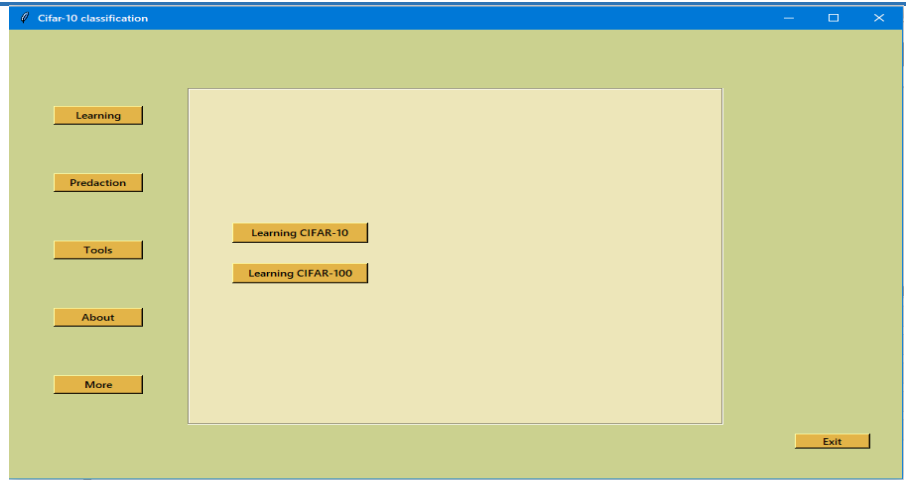


Fig 4. 6: Learning page of application

❖ **prediction Page:**

It is the most important page in the application ... where we find the prediction function:

- ✓ UploadPIC Button: To select an image that you want to rate
- ✓ ClassifyPIC Button: To classify your picture
- ✓ Clear Button: to clear the screen

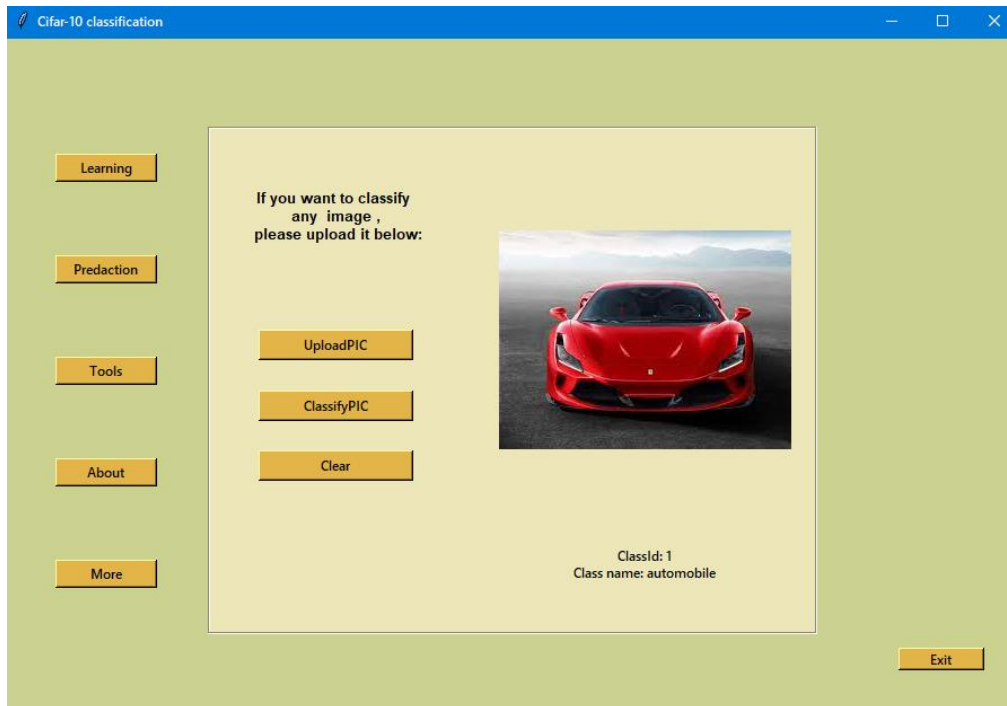


Fig 4. 7: prediction Page of application

❖ **Tools Page:**

Here are some tools to help you learn more about the field of deep learning, including the environment used to create this application

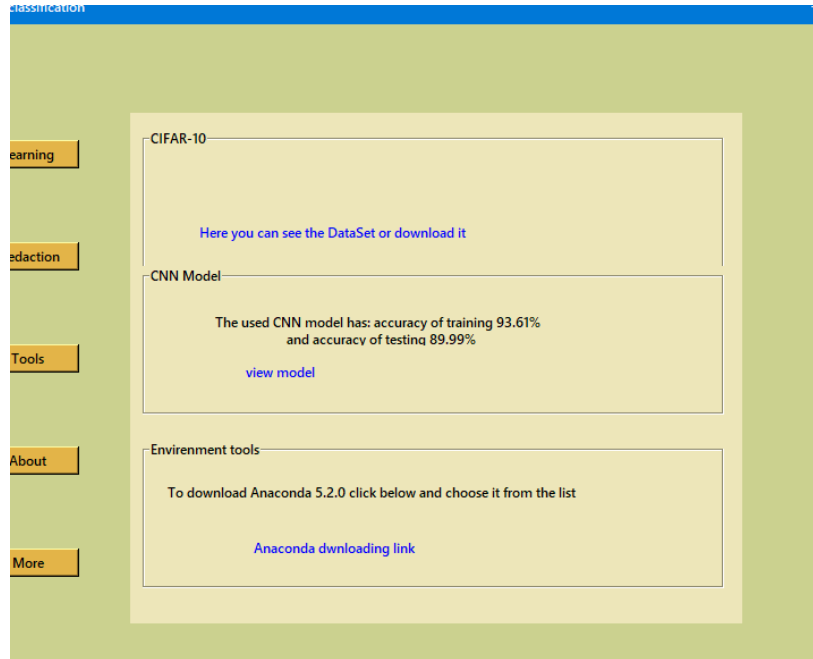


Fig 4. 8:Tools page of application

❖ **About Page:**

This page contains some explanations regarding the application

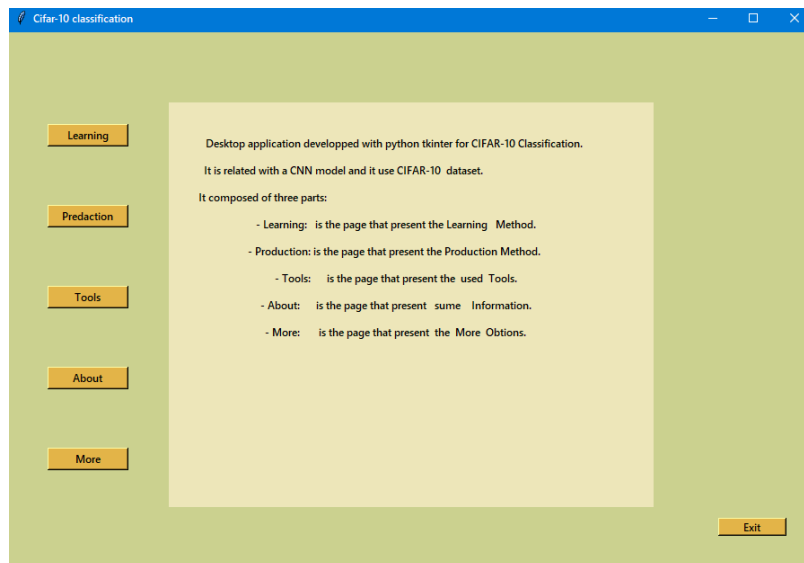


Fig 4. 9: About Page of application

❖ **More Page:**

This page contains two buttons, which are specifically for making a test on CIFAR-100

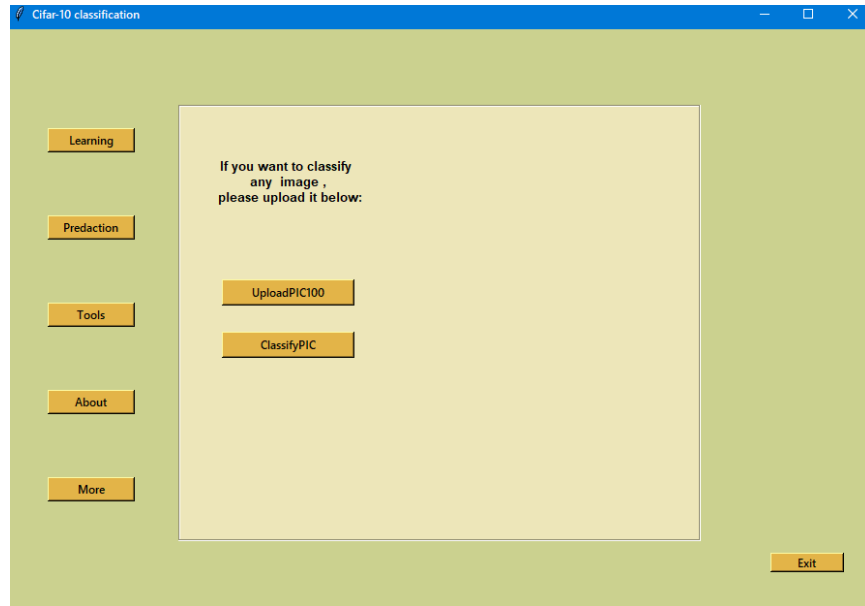


Fig 4. 10: More Page of application

4.7. Conclusion:

The general idea of deep learning using convolutional layers depends on two parts: building and developing the model, improving its Accuracsy, and working on developing the graphical interface that complies with this proposal and that helps to understand it and ease of use, and this is what is explained in this chapter.

General Conclusion

General Conclusion

During the past years, some important advances have been made in the field of image recognition and vision systems for robots. It mainly depends on the use of many neural networks. Therefore, classification on images is mainly based on the ML approach that provides high performance.

Our work focuses on identifying images classified into (10) classes. Classification is one of the most important Basic research topics to achieve vision in robotics a few years in the past. Classification on images was mainly based on machine learning methods that provide high performance. Over the past decade, some significant progress has been made in the field of machine learning, especially after the emergence of a new subfield called deep learning. It is mainly based on a neural network that uses many simple interconnected units to extract meaning patterns from large amounts of data to solve this kind of complex problem.

CIFAR-10 is one of the most important databases available currently and the most common one that many developers around the world work on, so that they are racing to get the highest accuracy rate as the greatest percentage reached 99.70% that a group of researchers had reached (*Pierre Foret, Ariel Kleiner, Hossein Mobahi, Behnam Neyshabur*)

As experimental results, the approach gives good accuracy compared to the data volume 0.5% Training error rate and 6% in the misclassification rate on test set. It is worth mentioning here that the CNN architecture consists of (7) convolutional layers, experimental results show that the proposed model gives promising classification accuracy.

The CNN framework for the CIFAR-10 dataset exhibits high performance in terms of time and accuracy, Compared to previously proposed systems. Thus, the elements in the images are easily recognized.

I would like to develop my application and include in it a lot of different Datasets. I would like to increase the learning rate to 99%.

It is worth noting that we have encountered many problems and difficulties (in installing the development environment and its affiliated libraries) to finish this study because the field of deep learning needs powerful hardware to reach satisfactory results and it consumes time while learning, so I suggest that centers and universities interested in developing this field provide GPU cards, which Make it easy for us to apply and get good results..

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Abstract: The work presented in this manuscript treats the problem of computer vision and image classification, recognition of objects and objects in images. Among the most used methods in the field of deep learning DL, we find Convolutional Neural Networks (CNNs) which can be considered as the best techniques currently used in the field and on which scientists are currently working.

Within this framework, we have developed an automated classifier that allows the classification of some high resolution images that represent a grouping of images from 10 categories (a combination of objects including animals and transportation). We proposed a new CNN model, consisting of several convolutional layers. We also explained and interpreted the obtained results.

Keywords: machine learning, deep learning , neural networks, image classification.

المخلص : يتمحور العمل المعروض في هذه المذكرة حول الرؤية بواسطة الكمبيوتر وتصنيف الصور، التعرف على المجسمات والعناصر في الصور، ومن بين الطرق الأكثر استخداماً في DL مجال التعلم العميق، نجد (CNNs) الشبكات العصبية التلافيفية وهي من أهم التقنيات التي يعمل على تطويرها المختصون في مجال هندسة الحاسوب حالياً. وفي هذا الإطار، قمنا بتطوير مصنف آلي يسمح بتصنيف بعض الصور الطبيعية ذات الجودة العالية والمنتظمة في مجموعة مكونة من 10 فئات (مزيج من الأشياء من بينها حيوانات ووسائل نقل). اقترحنا نموذجاً جديداً للشبكة، CNN يتكون من طبقات إنفافية عديدة. كما قمنا بشرح وتفسير النتائج التي تم الحصول عليها.

الكلمات المفتاحية: التعلم الآلي، التعلم العميق، الشبكات العصبية، تصنيف الصور.

Résumé : Le travail présenté dans ce manuscrit s'articule autour le probleme de la vision par ordinateur et de la classification d'images, de la reconnaissance d'objets et d'objets dans les images, et parmi les méthodes les plus utilisées en DL dans le domaine de l'apprentissage profond, on trouve les réseaux de neurones convolutifs (CNN) qui peuvent être considéré comme les meilleures techniques utilisées ctuellement, et sur lesquelles les scientifiques travaillent depuis longtemps.

Dans ce cadre la, nous avons développé un classifieur automatique qui permet la classification de certaines images de haute resolution qui représentent un regroupement d'images de 10 catégories (une combinaison d'objets incluant des animaux et des transports). Nous avons proposé un nouveau modèle CNN, composé de plusieurs couches convolutives. Nous avons également expliqué et interprété les résultats obtenus.

Mots-clés : apprentissage automatique, apprentissage profond, réseaux de neurones, classification d'images.