Dog breed identification

using

Convolutional Neural Network

MYP Personal Project 2019-2020

Name: Arjun Menon
Grade: MYP 5C
Supervisor: Rekha Mamgain
School name: Victorious Kidss Educares, Pune
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Criterion A: Investigating

Personal Interest

For my personal project, I wanted to work on Artificial Intelligence, Deep Learning to be precise. I have been very curious about this field of study for a long time. Artificial Intelligence has made huge strides in connecting humans and machines and making life easier and simpler.

Deep Learning is a subfield of Artificial Intelligence concerned with algorithms inspired by the system and structure of the human brain. It tries to mimic the way the human brain learns. This is called Artificial Neural Networks. Neural networks are basically a collection of Neurons. These Neurons take in an Input and provide and Output. This is very similar to the Neural Network in our Brain. The inputs of the neurons in our brain are the different senses (touch, smell, sight, taste and hearing).

Convolutional Neural Networks (CNNs) are a branch of neural networks which deal with image processing and detection. In Convolutional Neural Network you need to input an image, which is processed with multiple Hidden Layers and then it gives the desired Output.

I love dogs and I have a dog which I walk every day in my society and many people notice me doing so and ask what breed is my dog and they ask about how tall will she grow till. For this reason, I want to create an artificial intelligence model using **Convolutional Neural Network** which can identify a **Dog's Breed** using a single picture of a dog.

Thus, I want to learn and implement a neural network on my own. Hence this Project!

Goal/Product

My goal was to **"To Research and Learn about the Concepts of Convolutional Neural Network and develop an application program that identifies the Breed of the Dog using Neural Network."**. I have chosen this goal because of my interest which was about helping the Dog Veterinarian, Dog Lovers and people who want a Dog Database. I am also interested in the field of Artificial Intelligence for which I want to create a Convolutional Neural Network. I have created a Software Program of the Neural Network and its working was displayed on the Web. My Target Audience were Dog Lovers, a Dog Veterinary who can have a Dog Database in which they can input whichever medicines are needed for Dogs; for Dog Registers to identify which type of dog has been lost and what it looks like; for the people who want to know more about Dog Breeds can use my Program and the people who want to adopt a dog, they can use my Program to decide which dog they want to adopt. I have focused on Object Recognition using Convolutional Neural Network, which means that when I Input an Image it was then processed by Hidden Layers, it then gives the desired Output.

My goal was **highly challenging** because it contains multiple challenges, like: Research that was to Investigate into Convolutional Neural Network and about how to Create a

Convolutional Neural Network which can identify whether an Image is a Dog, Human or neither of them and also classify a Dog into Dog Breed. I have to also research on the Python Language, because I am going to be using it to create my Convolutional Neural Network. I needed to research on different Dog Breeds which was used in my Program. In Learning, I had to acquire the Knowledge of all Concepts (Analysis of Image and Classification of Image using Hidden Layer) of Convolutional Neural Network, that I have researched about. I have done research on different types of Dog Breed which I have Inputted into my Program so that it gives the desired Output. I have learned a **technology and concept that is emerging and trending**. I have then used all the Information that I have acquired about Convolutional Neural Network, Python Language and Dog Breeds to create my Convolutional Neural Network which can identify whether an Image is a Dog, Human or neither of them and also classify a Dog into Dog Breed.

See Appendix A (Topic Selection)
See Appendix B (Reason for choosing this Topic)

Global Context

Identifying the global context for the project
Global context guides my project. It provides a context for inquiry and research. I need to identify one of the following global contexts **relevant to my goal** and explain why it matters.

Global context of my Project was Scientific and Technical Innovation

Strands:
- The impact of scientific and technological advances on communities and environments.

I chose 'Scientific and Technical Innovation' as my global context for my personal project with the above strands.

The reason why I chose Scientific and Technical Innovation as the Global Context was since it was related to my Personal Interest since it was related to my Goal. I created a Program using Neural Network model to identify dog's breed with its picture. I had explored the concepts of Neural network, how it works, how it identifies an image and how it gives the required output.

My guiding/Inquiry question is "How can a technology be used identify a dog's breed?"

Learning resources have helped me to achieve my goal and it was also the evidence of my research and documentation of Convolutional Neural Network. I can display the research that I have collected & learned and can show my program as a working software model of a Convolutional Neural Network which can identify dog's breed from its picture as input in my Laptop by the end of the project. It had all the information I learned about my research and the process in making my project.

See Appendix C (Mind Map of Global Context)

Prior Knowledge

I understand that Personal Project was an opportunity for me to take charge of my own learning and be independent to do an innovation in the area of my interest which also allowed me to follow my passion. It was very important to choose a topic that inspired me to remain focused and involved throughout the Project work. Personal Project was an excellent way of demonstrating the skills learnt in IB which enable me to engage in practical explorations through a cycle of inquiry, action and reflection.

For my Personal Project, I have decided to choose the topic *"Dog breed identification using Convolutional Neural Network".*

Subject Specific Knowledge:

Science Behind Convolutional Neural Networks:
In Biology, I had learned about Human brain and structure of neurons.
 In the brain, a typical neuron collects signals from others through a host of fine structures called dendrites. The neuron sends out spikes of electrical activity through the axon which is the output and conducting structure. It can split into thousands of branches. At the end of each branch, a synapse converts the activity from the axon into electrical effects that inhibit or excite activity on the contacted (target) neuron. When a neuron receives excitatory input that is sufficiently large compared with its inhibitory input, it sends a spike of electrical activity (an action potential) down its axon.

Learning occurs by changing the effectiveness of the synapses so that the influence of one neuron on another changes.

Math Behind Convolutional Neural Networks:
Understanding of Linear algebra
Neural networks can adapt to changing input; so the network generates the best possible result without needing to redesign the output criteria. For correlation of input and output, understanding of linear algebra is required. I had learned basics of linear algebra in MYP4.
In CNN, Math is a very prominent subject because of the formulas present, all the numbers present in the hidden layers, etc.

Digital Design Behind Convolutional Neural Networks:
Basic understanding of Programming
An Artificial neural network is a series of algorithms that endeavours to recognise underlying relationships in a set of data through a process that mimics the way the human brain operates. I had learning basics of Python Programming in MYP3 through Khan Academy. This knowledge helped me in my Personal Project.

Digital Design and Math go hand in hand with each other.

English:

I have good proficiency in English language. This does help me a lot in doing the research on this subject. I watch many You Tube videos with similar applications, I go through various online learning courses in Convolutional Neural Network. All these are possible due to my proficiency in English language.

Personal experience: -
I have always had a love for dogs. I often observe dogs when I am going about my day and have an innate ability to identify which breed they belong to, at a glance.

Demonstrate Research Skills

What I researched about:

Throughout the project I explored the concept of Programming in depth (I used a Course from Udemy which is Deep Learning A-Z™: Hands-On Artificial Neural Networks), I joined the course and learned until I finished Convolutional Neural Network. During the Course I had to learn about how to use Jupyter Notebook, Keras Library, TensorFlow and Theano for creating my Program. I began my research work by creating research questions and figuring out the areas of research in my topic. While exploring my topic I used different resources that include Software Engineering, Course, websites and videos. The exploration of such diverse sources I developed a better understanding of my topic.

I organized my research into two – exploring software's that would help me designing the Program and exploring the elements and principles of Convolutional Neural Network to create my own designs.

I began my research for different Programming software to select the one suitable for my project. I tested the software on different parameters such as the capabilities, user interface, rendering, ease of use- and then decided to select Jupyter Notebook's iPython for my Convolutional Neural Network. I visited official website to extract information about the software and the tools within the software. The advantage in this software was that it had catalog feature which allowed me to choose among various different methods to be ran. I explored various tools and features in the software to create the CNN from my finished designs/ideas.

My personal interview with Akshay a professional software engineer who emphasized on using Jupyter Notebook as designing software for beginners. I also interviewed Mr. Vineet a Senior Product Leader. Through the interview I expanded my knowledge about the elements of coding and Programming and the way a Programmer works. I understood the importance of measurements while creating and that I should take my clients requirements into consideration while creating. Further into my research work, I surveyed my family members and a few neighbors of my gated community approaching towards their needs and requirements.

I needed to have dog images for training my Program, so I had to browse the Internet for websites which had Dog Images. After browsing I found 2 websites that had the Images they were
https://www.justdogbreeds.com/dog-breeds.html and
https://www.dogbreedslist.info/all-dog-breeds/.

See Appendix D (Subject Specific) [More about it]
See Appendix E (Different Functions and Classifications)

Criteria B: Planning

<u>Success Criteria</u>:

In order to ensure that I could create a successful Product that is of high quality, I developed a number of criteria which helped me to define the degree of excellence to which the product should reach, and later judge the product's success through the criteria. I developed these criteria, based on the information that I obtained from conducting research, and they helped guide me design to achieve my goal. They were also set, based on my strengths and weaknesses, which made the design process more manageable for me. For instance, when practicing I found that my weakest skill was organizing the code/giving explanation of each step and the strongest was creating it, so I decided that the product I had to complete each step with excellence and then only move on. Playing to my strengths helped to make the goal more feasible and made the process a lot more efficient.

Design Specifications and Success Criteria:

Specification	Description	Testing	1 – 2 Satisfactory	3 – 4 Good	5 – 6 Excellent
Aesthetics	It includes dark colours between the content + images and features of the Product itself (Headings, titles, Explanations for each step/images etc.) The font family of Century Gotham, "Helvetica Neue", Helvetica Arial, "sans serif". There are multiple steps in the Product which breaks down my Product. It gives justification for each step – what was done in this step, which new functions are used and from where. Also there are Images in some steps to make it look a little presentable. There should be 8 different steps which breaks down my Product. The First Step – Step 0 (Import Datasets). Then Second Step – Step 1 (Detect Humans). After which in the Third Step – Step 2 (Detect Dogs). In the Fourth Step – Step 3 (Create a CNN to Classify Dog Breeds (from Scratch)).	A Visual Check will be conducted by checking the Product about the Font Size, Font Style and also about the different Steps and the Explanation of each of them.	The Colour of the Product doesn't appeals to, the User's eyes and the Colour of the Product is Black and is not according to the Theme of the Project. There were no Steps in the Product and there is no Explanation for them.	The Colour of the Product appeals to, the User's eyes, but the Colour of the Product is Black and is not according to the Theme of the Project. There were 8 Steps in the Product, but there is no Explanation for them.	The Colour of the Product, appeals with the User's eyes and the Colour of the Product is White and is according to the Theme of the Project. There were 8 Steps in the Product and there is Explanation for each of them.

	In the Fifth Step – Step 4 (Use a CNN to Classify Dog Breeds). In the Sixth Step – Step 5 (Create a CNN to Classify Dog Breeds (using Transfer Learning)). In the Seventh Step – Step 6 (Writing the Algorithm). In the Eighth Step – Step 7 (Testing the Product).				
Target Audience	The Target Audience for my Project were Dog Veterinary – who can have a Database of Dogs which consist of the Information about the Dog Breed, Dog Owners and Lovers – Who want to know more about Dog Breeds and the people who want a Dog can use my Product for them to choose.		The Product doesn't engage the Target Audience not does it make them use them Project.	The Product engages the Target Audience, but it doesn't make them use the Project because of the Tedious Process to use it.	The Product engages the Target Audience and also makes them use it.
Environmental Considerations	This photo Program was made and created on Jupyter Notebook, which is an offline web development tool. There was no use of other disposable resources. The main physical resource for the project is my laptop.		There are no Environmental Considerations for the Product.	There are no Environmental Considerations for the Product.	There are no Environmental Considerations for the Product.
Function	This aim of the Program was to reach the Dog Veterinary who can have a Dog Database in which they can input whichever medicines are needed for Dogs; for Dog Registers to identify which type of dog has been lost and what it looks like; for the people who	I will check if my Product can function according to the description.	There is no Function for the Product.	The Function of the Product is that it could identify only Dogs.	The Function of the Product was that when an Image of a Dog was inputted it returns with the output as Dog identified and the subsequent Dog Breed, if a Human image was

|					
	want to know more about Dog Breeds can use my Program and the people who want to adopt a dog, they can use my Program to decide which dog they want to adopt. The Program had a high accuracy. Whenever an Image is inputted, the Program could identify the image accurately. It also depends on the configuration set up of the Laptop to run the Program faster.				detected the desired output was Human detected and if an image of neither Dog nor Human was inputted the desired output was neither Human nor Dog detected.
Resources	It's a Python code written on Jupyter Notebook which is an open-source web application that allowed me to create my Convolutional Neural Network. It is written with the help of Keras library. Keras library is an open-source library written on Python to make deep learning modelling and implementation easier on Python. In our project, this code is run on TensorFlow and Theano backend. TensorFlow and Theano is a math library used for machine learning and deep learning purposes.	The Testing for the Resources is to document the Process.	There are no Resources used in making the Product.	The Resources used in the Product is a Notebook and a Database. Keras library within Python was used. It ran on TensorFlow backend.	The Resources used in making the Product are Jupyter Notebook as a Platform or Medium to input the Images and receive the desired Output. It is written with the. help of Keras Library. The Code ran on TensorFlow and Theano backend.
Platforms	I have also uploaded my Project on GitHub and Reddit for people to access it and use it.		I am not uploading the Project on any Platforms.	I am uploading the Project on a Reddit Platforms.	I am uploading the Project on a Reddit and GitHub Platforms.

| Make up of Product | This Program was made using Jupyter Notebook's iPython and Terminal, Mac's Command Prompt was used for displaying content on the notebook and it was implemented to describe the presentation of a document written in Jupyter Notebook. There are no Java interfaces used. In this code Python language was used. After. importing TensorFlow and Theano and using Keras library, the creation of the neural network model begun. The different functions and methods used are: ReLU stands for rectified linear unit and is a type of activation function. Mathematically, it is defined as y = max (0, x). ReLU is the most commonly used activation function in neural networks, especially in CNNs. categorical_crossentropy cost function is a loss function which measures the performance of the model. The neural network changes its internal values in order to get the minimal loss (high performance) while training. This method trains the model with 20 epochs which are the times the algorithm sees the entire data set. | Document Process | There is no Make-up of Program. | This Program was made using Jupyter Notebook's iPython. | This Program was made using Jupyter Notebook's iPython and Terminal, Mac's Command Prompt. It used Python Language. categorical_crossentropy cost function, Relu activation function are used as the functions and methods for creating the Convolutional Neural Network. There are 20 epochs used to train the Project. |

Requirement	Hardware Requirement: Central Processing Unit (CPU) — Intel Core i5 6th Generation processor or higher. An AMD equivalent processor will also be optimal. RAM — 8 GB minimum, 16 GB or higher is recommended. Graphics Processing Unit (GPU) — NVIDIA GeForce GTX 960 or higher. AMD GPUs are not able to perform deep learning regardless. Operating System — Ubuntu or Microsoft Windows 10 or MacOs Software Requirements: 1. Anaconda Python should be installed. 2. Jupyter installed within Anaconda Python suite. 2. Tensor Flow and Theano backend with Keras in Python should be imported.	Check if the Project runs with the according Requirements.	Hardware Requirement: Graphics Processing Unit (GPU) — Nvidia GEForce 1060 graphics card. AMD Ryzen 3200 processor. RAM —16GB. Software Requirements: 1. Anaconda Python should be installed. 2. Jupyter installed within Anaconda Python suite. 2. Tensor Flow and Theano backend with Keras in Python should be imported.	Hardware Requirement: Intel Core i7-8750H, GeForce GTX 1070 Overclockable Graphics, 17.3" Full HD 144Hz G-Sync Display, 16GB DDR4, 256GB PCIe NVMe SSD, 1TB HDD. Software Requirements: 1. Anaconda Python should be installed. 2. Jupyter installed within Anaconda Python suite. 2. Tensor Flow and Theano backend with Keras in Python should be imported.	Hardware Requirement: Central Processing Unit (CPU) — Intel Core i5 6th Generation processor or higher. An AMD equivalent processor will also be optimal. RAM — 8 GB minimum, 16 GB or higher is recommended. Graphics Processing Unit (GPU) — NVIDIA GeForce GTX 960 or higher. AMD GPUs are not able to perform deep learning regardless. Operating System — Ubuntu or Microsoft Windows 10 or MacOs Software Requirements: 1. Anaconda Python should be installed. 2. Jupyter installed within Anaconda Python suite. 2. Tensor Flow and Theano backend with Keras in Python should be imported.

See Appendix F (Success Criteria)

Development Plan:

The goal of my Program was to create a working model of Dog Breed detection that meets every success criteria I have set. Creating the Program required me to make use of the knowledge that I acquired from my research and apply it to design a Program of good quality. I started the process by learning how to use Terminal. I started learning to use the software at the same time as I started creating the Program because it wasn't until I started the process that I realized how inefficient it was to create the model using Anaconda's Spyder. Akshay who is a Software Engineer advised me to create the whole Program on Jupyter Notebook – iPython (see Appendix : Changes), so I decided to create the Program on Jupyter Notebook – iPython. I took notes while he explained to me what tools to use to create the model.
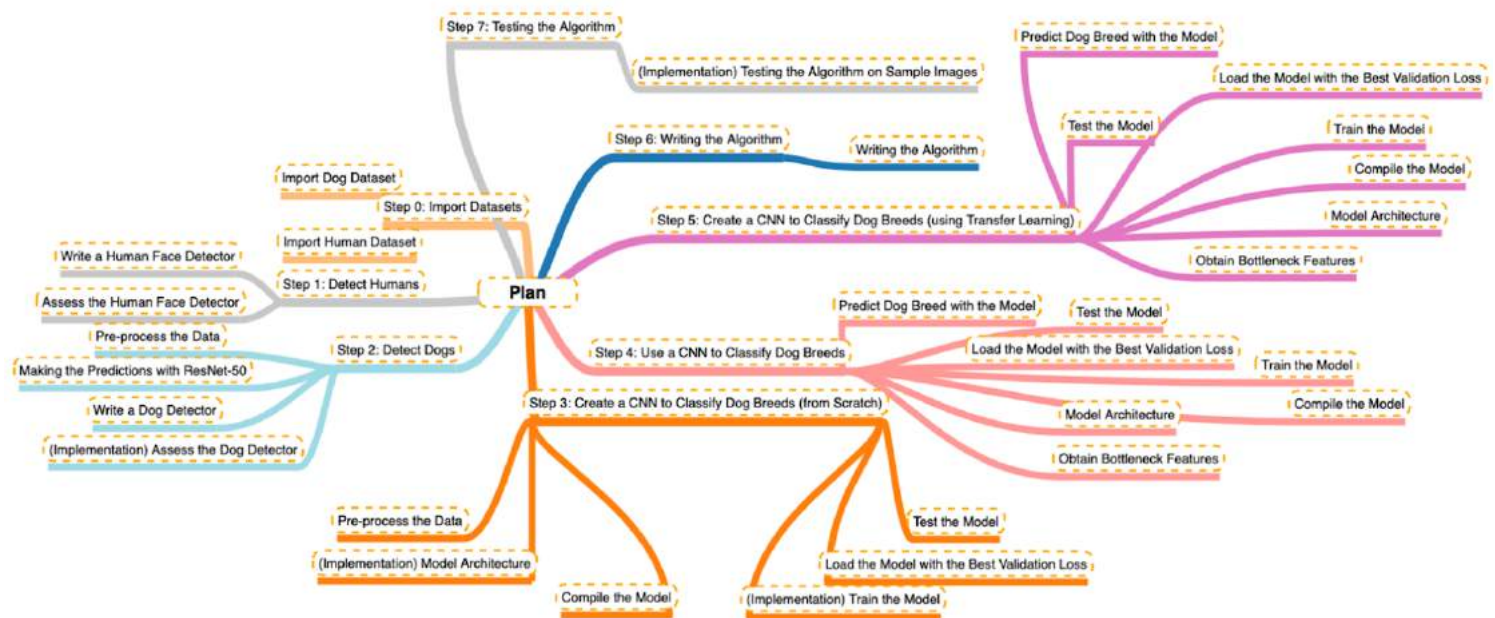
Jupyter Notebook: Jupyter Notebook which is a spin-off of Python which is created to "develop open-source software, open-standards, and services for interactive computing across dozens of Programming languages."
Terminal: Terminal is the terminal emulator included in the macOS operating system by Apple.
Keras Library: Keras is an open-source neural-network library written in Python.
TensorFlow: TensorFlow is a free and open-source software library for dataflow and differentiable Programming across a range of tasks.
Theano: Theano is a Python library and optimizing compiler for manipulating and evaluating mathematical expressions, especially matrix-valued ones.
Dataset: Dataset is a collection of data.
NumPy: NumPy is a library for the Python Programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays.

Scikit-learn Library: Scikit-learn is a free software machine learning library for the Python Programming language.
OpenCV: OpenCV is a library of Programming functions mainly aimed at real-time computer vision.
XML: Extensible Markup Language is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.
Haar cascades: Haar Cascade is basically a classifier which is used to detect the object for which it has been trained for, from the source.
Github: The Place where Software Programmers store their codes and access it using Internet.
ResNet-50: ResNet-50 is a convolutional neural network that is trained on more than a million images from the ImageNet database.
ImageNet: The ImageNet project is a large visual database designed for use in visual object recognition software research.
Train the Model: Training my model in the code cell. Use model checkpointing to save the model that attains the best validation loss.
VGG-19: VGG-19 is a convolutional neural network that is trained on more than a million images from the ImageNet database
ResNet-50: ResNet-50 is a convolutional neural network that is trained on more than a million images from the ImageNet database.
Inception: Inception is a technique originally used in LeNet, this was a successful convolutional neural network or CNN for identifying patterns in images.
LeNet: LeNet-5 is our latest convolutional network designed for handwritten and machine-printed character recognition.
Xception: Xception is a convolutional neural network that is trained on more than a million images from the ImageNet database.
Human Face Detector – A Function that returns True if a Human Face is Detected in an Image and False Otherwise.
Dog Face Detector – A Function which returns True if a dog is detected in an image (and False if not).

<u>Self-management skills:</u>

During my MYP years I had to manage my time effectively, because it was affecting my various Projects and my academics. For this I needed to come up with a plan, something which can organize my work and my day, which can help me to manage my time effectively. With this I came up with a 'To Do List', which means I can list down what I want to do. I can act on it and accordingly I can give a 'tick mark' for displaying that I have completed the task and a 'cross mark' for displaying that I haven't completed the task. But this wasn't effective as I was still wasting time since it didn't include any dates for when I would start the task and when I would finish it. Due to which I needed to move on and I decided to create a timeline which I can use as a plan that can be used that had due dates so that I would not procrastinate and so that I had sufficient time to complete the task. To visualize this I created the timeline in both Tabular Format and as a Gantt Chart.

With the Timeline and Gantt Chart I was able to use my time effectively and I wasn't procrastinating. I was setting deadlines which helped me in Studying too.

Date	Stage	Objective/Task	
6th May 2019	Investigating	Explore Personal Interest.	Online Research.
11th May 2019	Investigating	Research on Chosen Topic – Create a Chatbot.	Online Research.
15th May 2019	Investigating	Frame the Goal Statement and select the Global Context.	
30th May 2019	Investigating	Fill the Proposal Form.	
1st July 2019	Investigating	Topic Change to Dog Breed Identification using Convolutional Neural Network.	
4th July 2019	Investigating	Frame the Goal Statement and select the Global Context for Chosen Topic.	
7th July	Investigating	Identify the Subject Specific Knowledge and Prior Learning.	
9th July 2019	Investigating	Fill the Proposal Form.	
10th July 2019	Investigating	Take a Survey with the Target Audience about the need of creating a Program of Dog Breed Identification.	
12th July 2019	Investigating	Create Research Questions.	Online Research.
13th July 2019	Investigating	Research and Learn about how Convolutional Neural Network and How to Create it.	Online Research.
23rd July 2019	Investigating	Evaluate Sources on Convolutional Neural Network.	
28th July 2019	Investigating	Visit Mr. Akshay about which Applications and Software I need to use for creating the Program.	Akshay.
2nd August 2019	Investigating	Decide on which Applications and Software I need to use for creating the Program.	
8th August 2019	Planning	Create Specifications for Program based on Research.	
14th August 2019	Planning	Create Success Criteria for Program.	

Date		Description	
22th August 2019	Planning	Create a Development Plan.	
30th August 2019	Planning	Make a To Do List.	
5th September 2019	Planning	Use Gantt Chart to help in using Time Effectively.	
8th September 2019	Taking Action	Find different Human and Dog Images.	Online Research.
11th September 2019	Taking Action	Import Dog Datasets and populate variables using scikit-learn library's 'load_files' for creating File Paths to the Images, Classification Labels and List of String-Valued Dog Breed Names for Translating Labels.	Scikit-Learn Library and Python.
13th September 2019	Taking Action	Import Human Datasets and use NumPy Array to store the File Paths.	NumPy and Python.
15th September 2019	Taking Action	Detect Humans by using OpenCV's Haar feature-based cascade classifiers.	OpenCV and Python.
19th September 2019	Taking Action	Write a Human Face Detector by using Function 'face_detector'.	OpenCV and Python.
21th September 2019	Taking Action	Assess the Human Face Detector by using Human Images.	Python.
24th September 2019	Taking Action	Detect Dogs by using ResNet-50 Model for detecting Dogs in Images.	ResNet-50 Model and Python.
26th September 2019	Taking Action	Pre-process the Data by TensorFlow and Keras Library.	TensorFlow, Keras Library and Python.
29th September 2019	Taking Action	Make Predictions using ResNet-50 Model.	ResNet-50 Model and Python.
3rd October 2019	Taking Action	Write a Dog Detector using Function 'dog_detector'.	Python.
6th October 2019	Taking Action	Assess the Dog Detector.	Python.
8th October 2019	Taking Action	Create a CNN to Classify Dog Breeds (from Scratch) by Pre-processing the Data.	Keras Library and Python.
10th October 2019	Taking Action	Model Architecture for creating the CNN to classify Dog Breed.	Keras Library and Python.

14th October 2019	Taking Action	Compile the Model.	Python.
17th October 2019	Taking Action	Train the Model for attaining the best Validation Loss.	Keras Library and Python.
18th October 2019	Taking Action	Load the Model with best Validation Loss.	Python.
20th October 2019	Taking Action	Test Model using Dataset of Dog Images.	TensorFlow and Python.
22th October 2019	Taking Action	Obtain Bottleneck Features for using a CNN to Classify Dog Breeds.	Python.
25th October 2019	Taking Action	Model Architecture using VGG-16 model.	Python.
29th October 2019	Taking Action	Compile Model using VGG-16 model.	Python.
2nd November 2019	Taking Action	Train Model using VGG-16 model.	Python.
4th November 2019	Taking Action	Load the Model with the Best Validation Loss using VGG-16 model.	Python.
6th November 2019	Taking Action	Test the Model to understand how well it identifies breed within the test dataset of dog images using VGG-16 model.	Python.
8th November 2019	Taking Action	Predict Dog Breed with the Model to using the Bottleneck Features Obtained.	Python.
11th November 2019	Taking Action	Obtain Bottleneck Features for Create a CNN to Classify Dog Breeds (using Transfer Learning) using ResNet-50 Model.	Keras Library and Python.
14th November 2019	Taking Action	Model Architecture using ResNet-50 Model.	Python.
16th November 2019	Taking Action	Compile the Model using ResNet-50 Model.	Python.
19th November 2019	Taking Action	Train the Model to Obtain the Best Validation Loss.	Python.
21th November 2019	Taking Action	Load the Model with the Best Validation Loss using ResNet-50 Model.	Python.
23th November 2019	Taking Action	Test the Model to understand how well it identifies breed within the test dataset of dog images using ResNet-50 model.	Python.

25th November 2019	Taking Action	Write an Algorithm that accepts a file path to an image and first determines whether the image contains a human, dog, or neither.	Python.
6th December 2019	Reflecting	Upload the Program on GitHub and Reddit.	GitHub and Reddit.
12th December 2019	Reflecting	Evaluating Quality of the Product against the Criteria using Expert Appraisal.	Akshay, Vineet
15th December 2019	Reflecting	Evaluating Quality of the Product against the Criteria using Target Audience.	Biju, Saila and Krishna.
18th December 2019	Reflecting	Personal Project Exhibition – Collect Feedback.	

See Appendix G (Timeline)

See Appendix H (To Do List)

Criterion C: Taking Action

Communication and Social Skills:

Even though a few parts of the process were solitary, such as independent research of Dog Breed and the actual creation of the product, the project tremendously helped develop my communication and social skills since I had to interact with different people of different expertise on a regular basis to help me develop and master the skills needed to create a successful CNN (Convolutional Neural Network) that achieves the goal. Since my skills in coding were very limited despite having a bit of experience in the past, it was important that I consulted people who were experienced in coding, who would help me to improve by giving guidance and provide me with the practical knowledge that I need. Coding was a very challenging skill that requires a lot of practice and guidance, so I referred to my Mother, who is skilled at it, to help me learn the basics . Additionally, I consulted Akshay, who's a Software Engineer, to help me learn how to use the software. By interacting and communicating, I've obtained a lot of tips and techniques that I've incorporated into the product's design. This helped me a lot because I was able to get individual, hands-on help that I wouldn't have been able to get otherwise. Furthermore, I also received feedback from my supervisor on how I could improve certain parts of the project. I made sure to review the feedback and edit my report based on the feedback, which helped remind me what aspects of the project I could improve on and what I could do to improve them.

Challenges in Product and Solutions:

```
Compile the Model

In [13]: model.compile(optimizer='rmsprop', loss='categorical_crossentropy', metrics=['accuracy'])

         W1114 23:20:57.124458 4518128960 deprecation_wrapper.py:119] From /Users/arjunmenon/anaconda3/envs/dog-project/lib/py
         thon3.7/site-packages/keras/optimizers.py:790: The name tf.train.Optimizer is deprecated. Please use tf.compat.v1.tra
         in.Optimizer instead.
```

I faced a Challenge of the tf.train. Optimizer is deprecated and it Solution for it was use tf.compat.v1.train.Optimizer instead.

I faced a Challenge of use add_dispatch_support.<locals>.wrapper (from tensorflow.python.ops.array_ops) is deprecated and will be removed in a future version, so instead I used Use tf.where in 2.0, which has the same broadcast rule as np.where.

Thinking Skills:

The product creation process posed numerous challenges that required thinking skills to overcome. I've exercised my critical thinking when deciding on where to create the model. While my creative thinking explored the endless possibilities of functions and codes generate detailed ideas. To tackle the problem, I used critical thinking to recognize any shortcuts or parts that I can skip through without ruining the end result. This helped me move along the process at a quicker pace and made the overall product a success.

Criteria D: Reflecting

Evaluating Quality of the Product against the Criteria:

Expert Appraisal:

I have taken an expert appraisal from members of the gated community where I live that consist of dog lovers and IT Professionals.

This was the End Result from the Expert Appraisal about the evaluation according to the quality against criteria.

Sr No.	Criteria	Grade	Justification
1	Aesthetics of the Website	5	The Colour of the Product, appeals with the User's eyes and the Colour of the Product is White and is according to the Theme of the Project.
2	Size	5	The Choice of Size is excellent as it has been well utilized in terms of space and Accommodation. The Project also matches with the specs for my laptop.
3	Development of the Code	6	There has been a higher level of complexity shown in the creation of designs as anti-aliasing, advanced coding, explanation of each step, editing, texturing tools for the Images have been used.
4	Target Audience	6	The Product engages the Target Audience and also makes them use it.
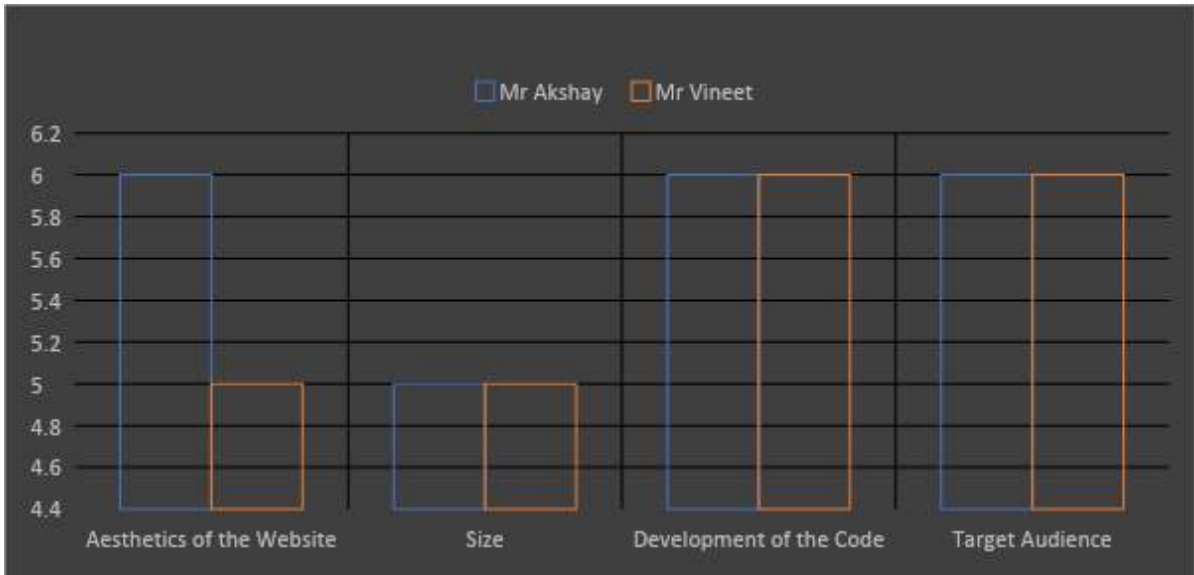
From the analysis of the graph given above, I can conclude that I have met a high level of achievement of my project as I have received a positive feedback from experts. Overall, I have reached outstanding results in the development of designs and meeting requirement of the expert and really good results with the Development of the Code, theme and

Aesthetics. However, the size was an aspect that can be worked on as I have received moderate results in those criteria.

Evaluation with Target Audience:

I was happy with the end result of the designs and evaluated the quality against criteria. As I interviewed three different age groups in which one of them is an IT Professional, one knows about dogs and one who loves dogs.

| Sr No.	Criteria	Grade	Justification
1	Aesthetics of the Website Plot Area	5	The Colour of the Product, appeals with the User's eyes and the Colour of the Product is White and is according to the Theme of the Project.
2	Size	6	The Choice of Size is excellent as it has been well utilized in terms of space and Accommodation. The Project also matches with the specs for my laptop.
3	Development of the Code	5	There has been a higher level of complexity shown in the creation of designs as anti-aliasing, advanced coding, explanation of each step, editing, texturing tools for Images have been used.
4	Target Audience	6	The Product engages the Target Audience and also makes them use it.
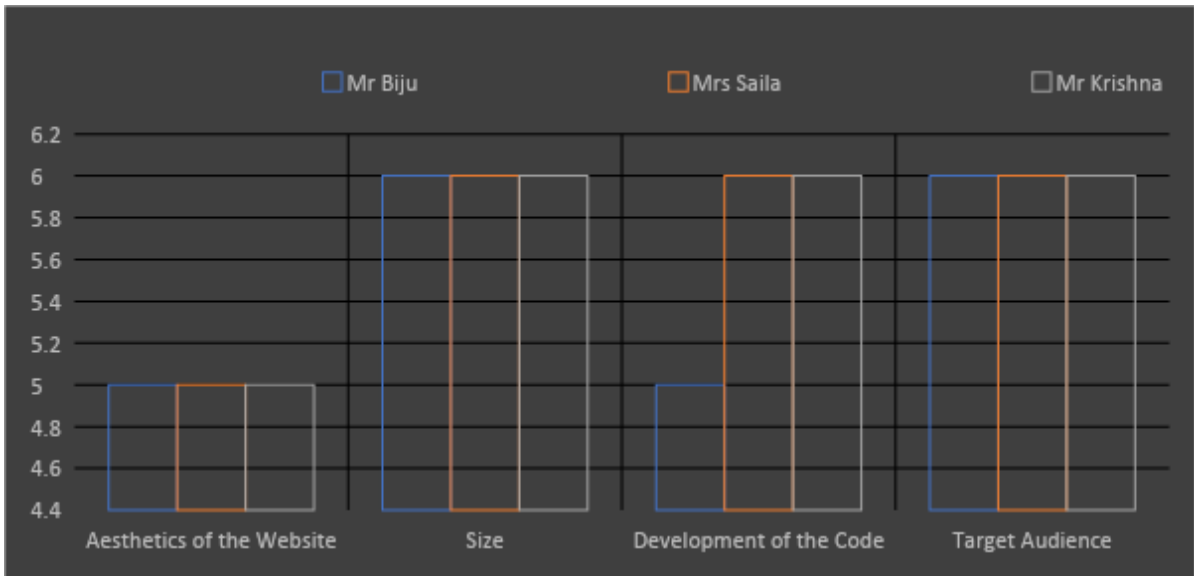
From the analysis of the graph given above, I can conclude that I have met a high level of achievement of my project as I have received a positive feedback from my target audience. Overall, I have reached outstanding results in the development of designs and meeting requirement of the target audience and really good results with the Development of the Code, theme and Size. However, the Aesthetics was an aspect that can be worked on as I have received moderate results in those criteria.

See Appendix I (Evidence for Expert Appraisal and the Target Audience)

Improvements Needed:

Even though my Project was creatively made, there are some improvements which are needed to enhance it and make it more successful. Like: The Software used for creating my Project was mainly on Python and Terminal, but if I used a more consistent and reliable Software, then it could have enhanced my Project. This program can be converted to a Python web application using Flask for the purposes of required personnel who would benefit from this like Vets or animal NGOs.

Strengths:

I started using my Time Effectively to complete tasks and it helped me in submitting my work on time.

Weakness:

A problem that I faced was that I couldn't do multi-tasking which added a lot of stress which caused a slight hiccup in my academic grades. I have now learnt and understood the importance of time management and I'm sure this would help me a lot in the future.

Challenges and Solutions:

One of the biggest challenges I faced before creating this project is to choose the study material to use to improve my knowledge and skills in neural network. I decided to use Python as the Programming language and used an online course on Udemy called 'Deep Learning A-Z' to learn Python for Neural Networks. I used the Keras library within Python to make the Programming easier. Keras library is an Open source library specially created for Deep Learning. It makes python coding for Neural networks much easier than that of native Python.

One other challenge I faced was the correct dataset to use for dogs. There are multiple dog datasets available on the internet. I had to choose and use the appropriate one for my neural network model. Even the size of each image matters.

One very important aspect of creating a neural network is the computer system being used. The computer should be able to handle the processor heavy operations especially while training the model. Having a graphics card on my laptop was a huge plus since that helped me distribute all the heavy processes evenly between the processor and the graphics card.

Reflection on Completing the Project had extended Knowledge and Understanding of the Topic and Global Context:

Due to the completion of my Project I had a deeper knowledge about Neural Networks which is a part of Deep Learning that is a part of the uprising. Field in Computer Science –

Artificial Intelligence, I understood about the need of using multiple Validation of the Product, since it makes sure the part of the Product which was just ran had all the necessary features, input data and the syntax. It also helps in telling if there are any errors and spots it out. By completing the Project I gained a deep understanding about the Global Context – Scientific and Technical Innovation. I also explored the Global Context by understanding 'How humans use their understanding of scientific principles', 'the impact of scientific and technological advances on communities and environments' and 'the interaction between the people and the natural world'. This helped me gaining a deeper understanding about the Global Context – Scientific and Technical Innovation.

Reflection on the Development as an IB Learner:

I developed my knowledge on Artificial Intelligence and Deep Learning, I got the opportunity to improve my skills as a coder in Python. The concept of Deep Learning and training a model is very interesting and it made me curious about what other types of products can be created in Artificial Intelligence. When I had to study for my Academic Assessments I had to manage my Time Effectively to obtain grades in both the Academic Assessments and in the Personal Project.

Conclusion:

Throughout my Personal Project I had learned a whole new branch of Computer Science and this helped in broadening my knowledge and it made me think of a new Career Plan – Coding.

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Appendix:

Appendix A (How I arrived at my Goal and Project topic from various Topics):

Chatbot
How does Siri work?
How does it identify the my voice?
Can I create my own Siri?

Create an Animation
Is it possible to create an
animation about Stars, Planets
and Satellites?

**Brainstorming of
Topics for
Personal Project**

Neural Network
I am hearing about AI and Neural
Network?
How does scientist/programmers
create Robots?
Can I create a Software Program
to identify various animals?

Travel Brochure
Which are the places that I
should travel to describe?
Will I get time travel to many
places?

Appendix B (Justification for choosing this goal):
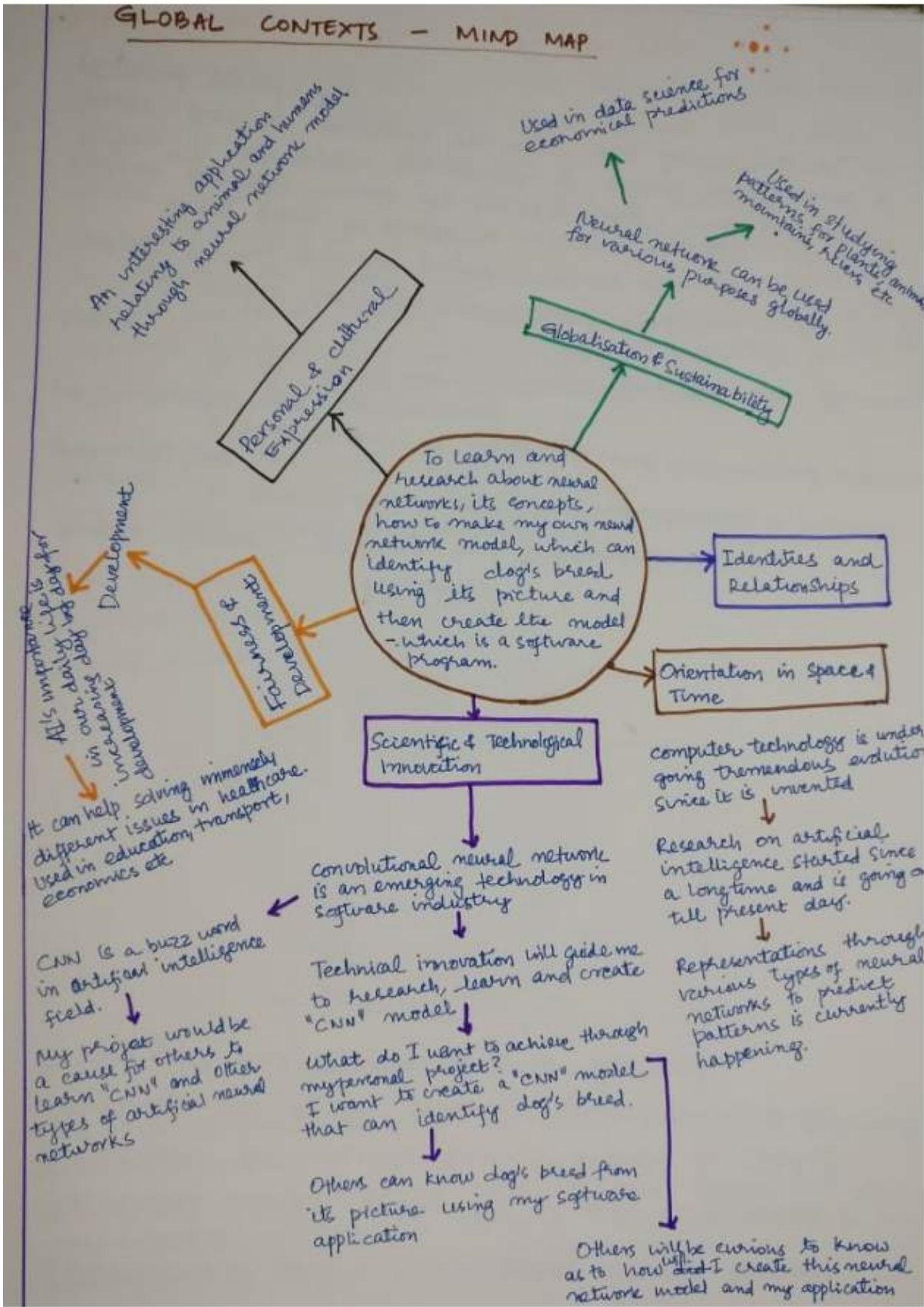
I chose this topic because I love dogs and I can identify many breeds. I have a dog at home and I take my pet outside for walking every day. I have seen many people struggle identifying various dog breeds existing around. Hence, I thought why don't I create a Product that would help others do the same?

Pomeranian   Poodle   Pug

Shih Tzu   Silky Terrier   Tibetan Spaniel

Appendix C (Mind map of Global Context):

GLOBAL CONTEXTS — MIND MAP

An interesting application relating to animal and humans through neural network model.

Used in data science for economical predictions

Used in studying patterns for plants, mountains, rivers etc.

Neural network can be used for various purposes globally.

Personal & cultural Expression

Globalisation & Sustainability

To learn and research about neural networks, its concepts, how to make my own neural network model, which can identify dog's breed using its picture and then create the model – which is a software program.

Identities and Relationships

Development

Fairness and Development

Orientation in Space & Time

AI's importance is increasing in our daily day by day.

It can help solving immensely different issues in healthcare. Used in education, transport, economics etc.

Scientific & Technological Innovation

computer technology is under going tremendous evolution since it is invented

Research on artificial intelligence started since a long time and is going on till present day.

convolutional neural network is an emerging technology in software industry

CNN is a buzz word in artificial intelligence field.

My project would be a cause for others to learn "CNN" and other types of artificial neural networks

Technical innovation will guide me to research, learn and create "CNN" model

What do I want to achieve through my personal project? I want to create a "CNN" model that can identify dog's breed.

Representations through various types of neural networks to predict patterns is currently happening.

Others can know dog's breed from its picture using my software application

Others will be curious to know as to how did I create this neural network model and my application

Appendix D (Subject Specific):
General awareness from Articles, Ted Talks & YouTube videos

i)   Study about simulating human brain system

General properties of neurons can be abstracted in order to study the dynamical behaviour of large ensembles of neuronal cells. Thus, there have been many interesting attempts to mimic the brains learning processes by creating networks of artificial neurons.

This approach consists in deducing the essential features of neurons and their interconnections and then, Programming a computer to simulate these features.

ii)   What is Artificial Neural Network?

Artificial neural networks are typically composed of inter connected units which serve as model neurons. The synapse is modelled by a modifiable weight associated with each particular connection. Most artificial networks do not reflect the detailed geometry of the dendrites and axons, and they express the electrical output of a neuron as a single number that represents the rate of firing.

Each unit converts the pattern of incoming activities that it receives into a single outgoing activity that it sends to other units. This conversion is performed in two steps:

First, it multiplies each incoming activity by the weight on the connection and adds together all these weighted inputs to get a total input.

Appendix E (Different Functions and Classifications):
'AI and Neural network '.
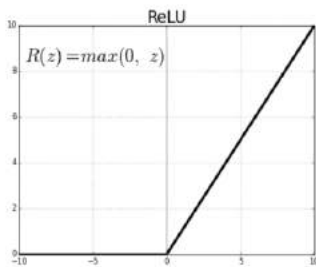https://towardsdatascience.com
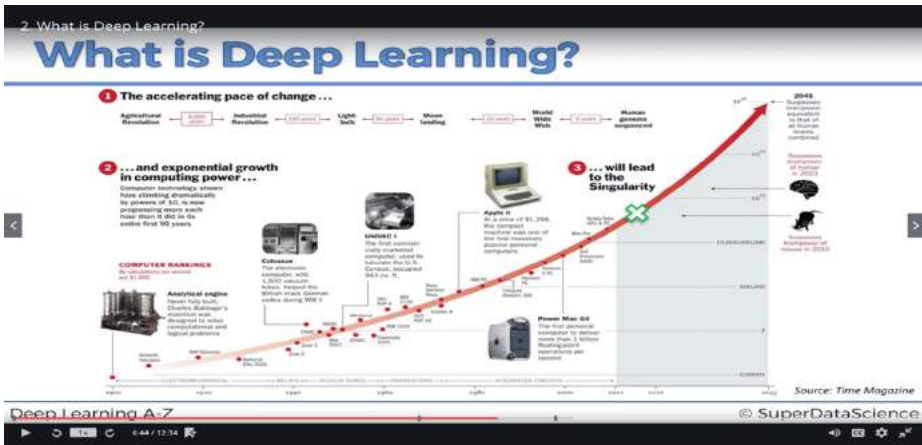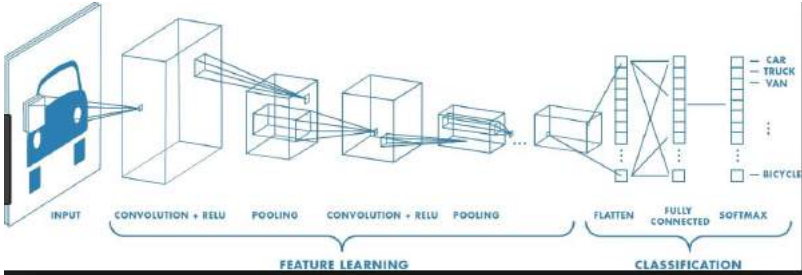
As the name suggests, neural networks were inspired by the neural architecture of a human brain, and like in a human brain the basic building block is called a Neuron. Its functionality is similar to a human neuron, i.e. it takes in some inputs and fires an output. In purely mathematical terms, a neuron in the machine learning world is a placeholder for a mathematical function, and its only job is to provide an output by applying the function on the inputs provided.

Activation functions

I researched on Activation functions like
- **Step function**
- **Sigmoid functions**
- **Rectifier Function**

Eg. Rectifier Function

Appendix F (Success Criteria):

Aesthetics of the Website		
1 – 2 Satisfactory	3 – 4 Good	5 – 6 Excellent
The Colour of the Product doesn't appeals to, the User's eyes and the Colour of the Product is Black and is not according to the Theme of the Project.	The Colour of the Product appeals to, the User's eyes, but the Colour of the Product is Black and is not according to the Theme of the Project.	The Colour of the Product, appeals with the User's eyes and the Colour of the Product is White and is according to the Theme of the Project.

Size		
1-2 Satisfactory	3-4 Good	5-6 Excellent
The size of the CNN is not suitable for the project as it takes a lot of space.	There has been a standard and moderate choice for the Size that is suitable and can be used in the given circumstances.	The choice of Size is excellent as it has been well utilized in terms of space and accommodation. The project also matches with the specs for my laptop.

Development of the Code		
1-2 Satisfactory	3-4 Good	5-6 Excellent
There has been no complexity shown in the creation of these codes.	There has been complexity shown in the creation of the designs as explanation of each step, editing and texturizing tools for the Images have been used.	There has been a higher level of complexity shown in the creation of the designs as anti-aliasing, advanced coding, explanation of each step, editing, texturizing tools for the Images have been used.

Target Audience		
1 – 2 Satisfactory	3 – 4 Good	5 – 6 Excellent
The Product doesn't engage the Target Audience not does it make them use them Project.	The Product engages the Target Audience, but it doesn't make them use the Project because of the Tedious Process to use it.	The Product engages the Target Audience and also makes them use it.

Appendix G (Timeline):

Appendix H (To Do List):

To Do List:-

Equipment Needed - Checklist

Done ✓
Not Done ✗

Get Jupyter Note book ✓
Get Terminal ✓

Photos of Humans ✓
Like: celebrities - Donald Trump, Vladimir Putin etc

Photos of Dogs ✓
Most of the Dog Breeds' images

Photos of cats ✗
Most of the cat's images

✓

To Do List

Design a notebook to walk anyone through my project which is of machine learning and artificial intelligence programs. Also of course my project.

Add steps to the notebook which is broken down into seperate steps:

Step 0: Import datasets
Step 1: Detect Humans
Step 2: Detect Dogs
Step 3: Create a CNN to classify Dog breeds (From scratch)
Step 4: Use a CNN to classify Dog Breeds (using Transfer Learning)
Step 5: Create a CNN to classify Dog Breeds (using Transfer Learning)
Step 6: write your Algorithm
Step 7: Test your Algorithm

Appendix I (CRAAP Test):

I used CRAAP test to evaluate the sources and displayed research skills:

Eremenko, Kirill, et al. "Deep Learning A-Z™ : Hands-On Artificial Neural Networks." *Udemy*, Udemy, 28 June 2017, www.udemy.com/course/deeplearning/.

Currency: 9
The date when the information was published is not given.
The date of when the Udemy Course had been updated is 1 January 2020.
Since the date of when the Udemy Course is updated is recent it is a reliable source.
The links in the Udemy Course are still functional.

Relevance: 10
The information relates to my topic and answers my question which is 'what a Neural Network is, what is needed to create a Neural Network and how to create a Neural Network?'
The intended audience for this website is a Teenager.
The information is in an appropriate level and its intended audience for this website is a Teenager.
I have looked at a variety of resources before choosing this one.
I would be comfortable using this Source for a research paper.

Authority: 9
The creator of the Udemy Course is Kirill Eremenko.
The publisher is Udemy.
The author's credentials and organizational affiliations are:
  ● He is a data science management consultant with over five years of experience in finance, retail, transport and other industries. He was trained by the best analytics mentors at Deloitte Australia and today he leverages Big Data to drive business strategy, revamp customer experience and revolutionize existing operational processes.
The creator's qualifications are not written.
The creator's Facebook, LinkedIn and Twitter as contact information.

Accuracy: 10
The source for where the information comes from is written.
The information is supported by evidence.
I can verify the information with another source.
The language or tone doesn't seem biased and is emotion free.
There are no spelling, grammar or typographical errors.

Purpose: 10
The purpose of the information is to explain 'what is a Neural Network, what is needed to create a Neural Network and how to create a Neural Network?'
The information is fact and not opinion or propaganda.
The point of view appears objective and impartial.
There are no political, ideological, cultural, religious, institutional, or personal biases.

Total:
48 – Excellent

Chen, James. "Neural Network Definition." *Investopedia*, Investopedia, 13 Sept. 2019, www.investopedia.com/terms/n/neuralnetwork.asp.

Currency: 9
The information was posted on 13 September 2019.
It had been updated on 13 October 2019.
Since the information had been updated recently it is a reliable source.
The links in the website are still functional.

Relevance: 8
The information relates to my topic and answers my question which is 'What is Neural Network?'
The intended audience for this website is a Teenager.
The information is in an appropriate level and its intended audience for this website is a Teenager.
I have looked at a variety of resources before choosing this one.
I would be comfortable using this source for a research paper.

Authority: 9
The author of the website is James Chen.
The publisher is Investopedia.
Author's credentials and organizational affiliations:

- Director of Trading & Investing Content at Investopedia
- Former head of research at Gain Capital
- Two decades of experience in the financial markets as a trader, investor, author, investment adviser, and global market strategist.

The Author's Qualifications:

- A graduate of Tufts University, James is a chartered market technician (CMT), certified financial technician (CFTe), and registered investment adviser (RIA), as well as a former commodity trading advisor (CTA). He had extensive market expertise in stocks, ETFs, options, commodities, fixed income, and currencies.

The Author had given his Twitter and LinkedIn Profile as his contact information.

Accuracy: 9
The source for where the information comes from is not written.
The Information is supported by evidence.
I can verify the Information with another source.
The language or tone do not seem biased and is free of emotion.
There are no spelling, grammar or typographical errors.

Purpose: 9
Purpose of the information is to explain what Neural Network and its application.
The information is fact and not opinion or propaganda.
The point of view appears objective and impartial.
There are no political, ideological, cultural, religious, institutional, or personal biases.

Total:
44 – Good

Appendix J (Deep Learning Workshop):

Deep Learning Workshop

to matrixdatascience ▾   Sun, 21 Jul 2019, 17:32

Hi ma'am or sir,

I came to know about the workshop on Deep Learning, Artificial Intelligence and Data Science.

I would Like to attend this workshop but please let me know about the Age Limit as I am 15 years old.

Registration:
Name -
Mobile Number -
Email id -

Thank You

Feedback from audience/users:

Transcripts of the Interview with Experts:

Transcript of Interview with Expert – Mr. Vineet

Transcript of Interview with Expert – Mr. Akshay

Question 1:

Which Software Application should I use for creating the Dog Breed Identifier using Convolutional Neural Network?

Question 1:

Which Software Application should I use for creating the Dog Breed Identifier using Convolutional Neural Network?

Answer 1:

You should use Jupyter Notebook for creating your Dog Breed Identifier and 3 different Libraries – TensorFlow, Keras Library and Theano.

Answer 1:

To Create a Dog Breed Identifier, you need to use a couple of Software Application and Library. They are Terminal which is the Command Prompt for Mac, Jupyter Notebook and 3 Libraries which are Keras Library, Theano and TensorFlow.

Question 2:

How does Jupyter Notebook help me create my Dog Breed Identifier?

Question 2:

How does Jupyter Notebook help me create my Dog Breed Identifier?

Answer 2:

It is an Open-Source Software which allows you to create your Dog Breed Identifier using Equations and Text.

Answer 2:

For Dog Breed Identifier Jupyter Notebook is a Platform or Medium to Write the Program in which the Input is the Dog Image and the Output is the Dog Breed.

Question 3:

Is it easy to create a Convolutional Neural Network Program on iPython?

Question 3:

Is it easy to create a Convolutional Neural Network Program on iPython?

Answer 3:

iPython is a command shell for interactive computing in multiple programming languages which was developed for the Programming Language – Python. iPython is a kernel for Jupyter Notebook which can help you create your Convolutional Neural Network using the features of Jupyter Notebook and of iPython.

Answer 3:

iPython Notebook is now known as Jupyter Notebook and iPython is the Interactive Command Line Terminal for Python. Python is the most common Programming Language for Convolutional Neural Network Program used by Programmers.

Question 4:

What Sources do you suggest I should refer to for creating my Dog Breed Identifier?

Answer 4:

I suggest you go through a Udemy Course for Convolutional Neural Network as it can help you build an in-depth understanding about Convolutional Neural Network and also teach you about how to create a Dog Breed Identifier.

Question 4:

What Sources do you suggest I should refer to for creating my Dog Breed Identifier?

Answer 4:

Use a Udemy Course called Deep Learning A-Z™: Hands-On Artificial Neural Networks which has Convolutional Neural Network and it can also teach you to create a Dog Breed Identifier.

Question 5:

Where should I obtain Dog Images from?

Survey with Target Audience:

4 responses

Accepting responses

| Summary | Question | Individual |

What is your Name?
4 responses

Sarada Bojja

Bharat Wankhede

Biju Bhuvenendran

Anushree Ghaisas

How do you Identify a Dog's Breed?
4 responses

I use the Internet to Identify a Dog's Breed.

By looking at Internet.

I have a Textbook which contains all the Dog Breeds and I also have a Laminated Chart which contains all Dog Breeds.

Do you own a Dog?
4 responses

- Yes
- No

Do you know about different Dog Breeds?
4 responses

- Yes
- No

Will you prefer a Software Program to Identify Dog Breed?
4 responses

- Yes
- No

75% / 25%

Responses cannot be edited

Survey
*Required

What is your Name? *
Anushree Ghaisas

Do you own a Dog? *
○ Yes
◉ No

Do you know about different Dog Breeds? *
◉ Yes
○ No

How do you Identify a Dog's Breed? *
I have a Textbook which contains all the Dog Breeds and I also have a Laminated Chart which contains all Dog Breeds.

Will you prefer a Software Program to Identify Dog Breed? *
◉ Yes
○ No

Survey

*Required

What is your Name? *
Biju Bhuvanendran

Do you own a Dog? *

(●) Yes
(○) No

Do you know about different Dog Breeds? *

(○) Yes
(●) No

How do you Identify a Dog's Breed? *
I use the Internet to identify a Dog's Breed.

Will you prefer a Software Program to Identify Dog Breed? *

(●) Yes
(○) No

Survey

*Required

What is your Name? *
Bharat Wankhede

Do you own a Dog? *

(○) Yes
(●) No

Do you know about different Dog Breeds? *

(○) Yes
(●) No

How do you Identify a Dog's Breed? *
By looking at Internet;

Will you prefer a Software Program to Identify Dog Breed? *

(●) Yes
(○) No

Survey

*Required

What is your Name? *
Sarada Bojja

Do you own a Dog? *

(●) Yes
(○) No

Do you know about different Dog Breeds? *

(●) Yes
(○) No

How do you Identify a Dog's Breed? *
I use the Internet to identify a Dog's Breed.

Will you prefer a Software Program to Identify Dog Breed? *

(○) Yes
(●) No