

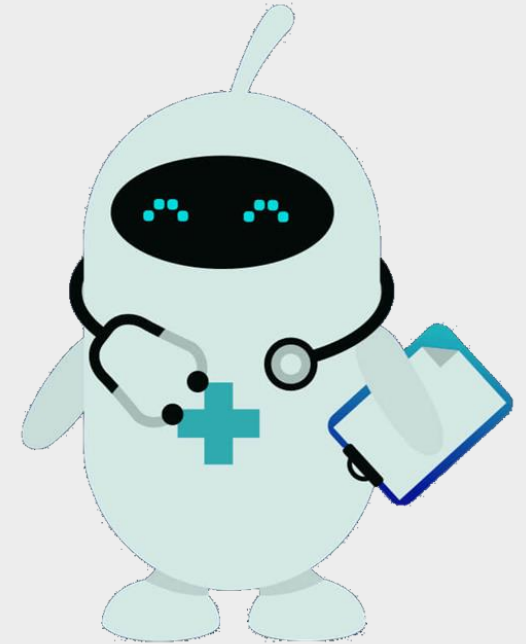
# **AI-based Chatbot For Skin Disease Prediction Using Customized CNN And Decision Tree**

Group -13

Team Members:

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**Under the guidance of  
Dr. P . Geetha**



# OVERALL OBJECTIVE

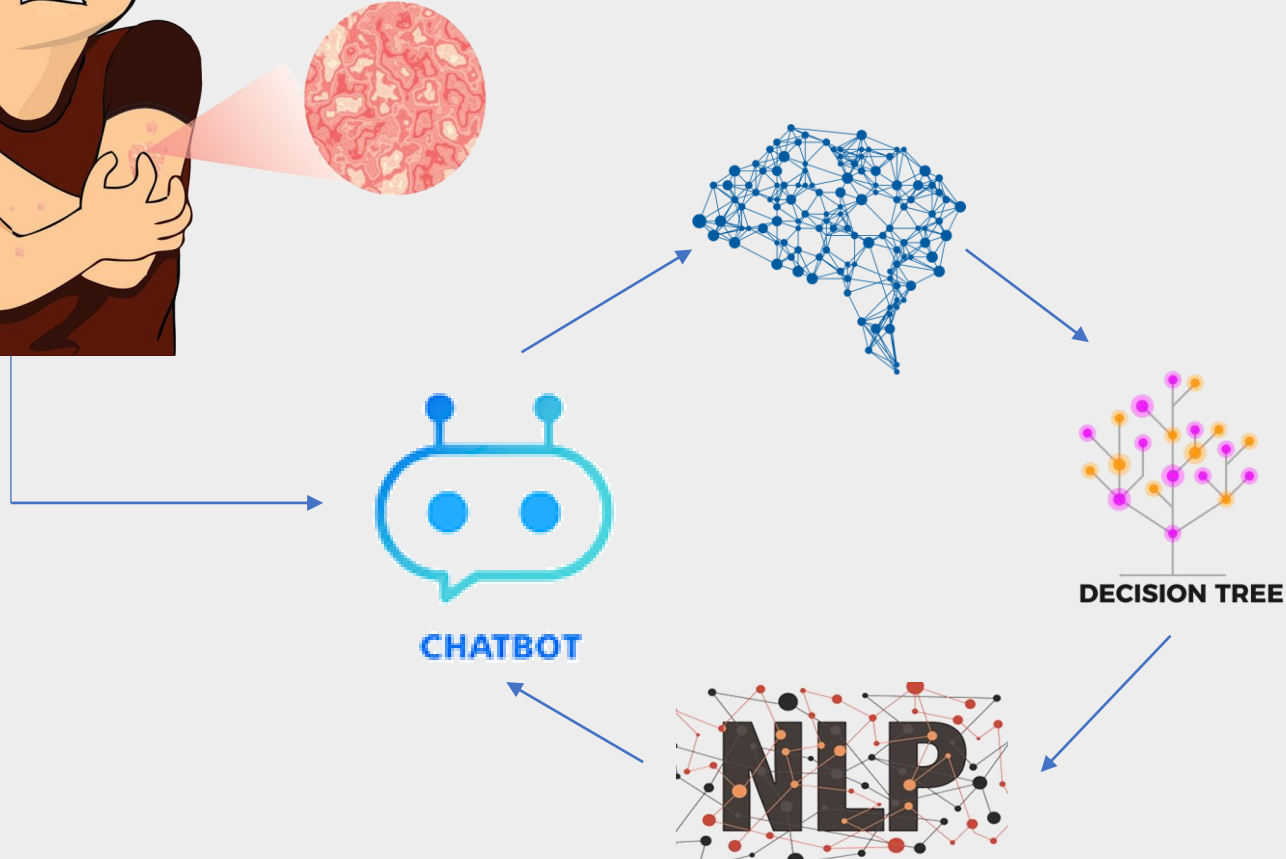
- To design Customised CNN model.
- To incorporate user lifestyles and external factors using Decision Tree.
- To develop a chatbot for user interrogation.
- To develop chatbot to answer general questions from the user using NLP.
- To ultimately build an AI dermatologist.

# Introduction:



Why?

- Poor hygiene and exposure to infections.
- Rapid and alarming spread of disease.
- Very few experts.



**ACCURACY : 91.557**



Pros:

- Accessible anywhere, anytime.
- Convenient user interface
- Timely replies and accurate results.
- Reduction in human labour.

# LITERATURE SURVEY

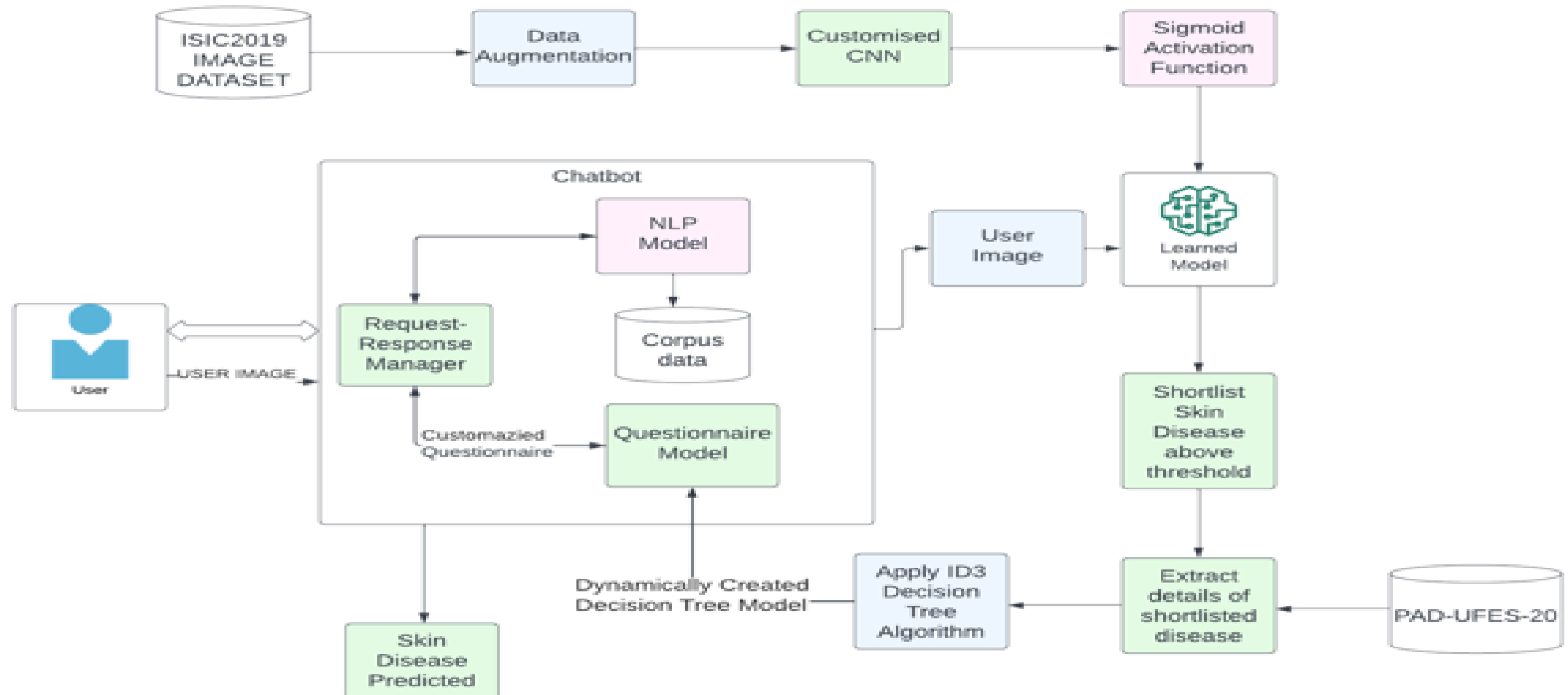
SNO	TITLE	METHODOLOGY	ADVANTAGES	DISADVANTAGES	IDEAS FOR ADOPTION
1	Single Model Deep Learning on Imbalanced Small Datasets for Skin Lesion Classification	<ul style="list-style-type: none"><li>• Modified DCNNs</li><li>• Regularization using DropOut and DropBlock</li></ul>	<ul style="list-style-type: none"><li>• Significant performance with less computing resources and shorter time.</li><li>• Class imbalance issue dealt.</li></ul>	<ul style="list-style-type: none"><li>• Symptoms too different than the trained model</li></ul>	<ul style="list-style-type: none"><li>• Class imbalance issue can be dealt</li><li>• Use of regularization techniques such as DropOut</li></ul>
2	An AI-Based Medical Chatbot Model for Infectious Disease Prediction	<ul style="list-style-type: none"><li>• Uses deep feedforward multilayer perceptron for Covid-19 dataset</li><li>• Utilizes DNN architecture.</li></ul>	<ul style="list-style-type: none"><li>• All around 24/7 support</li><li>• Provides necessary information about the availability of hospital beds in an area where the user wants the patient to be taken.</li></ul>	<ul style="list-style-type: none"><li>• Low accuracy</li></ul>	<ul style="list-style-type: none"><li>• Provide details regarding hospitals and doctors.</li></ul>
3	Skin Lesion Classification by Ensembles of Deep Convolutional Networks and Regularly Spaced Shifting	<ul style="list-style-type: none"><li>• Combines several convolutional deep classifiers which form an ensemble</li></ul>	<ul style="list-style-type: none"><li>• The nevi class scores were higher in most of the predictions.</li></ul>	<ul style="list-style-type: none"><li>• More deep networks and other topologies of the lattice can be tested.</li></ul>	<ul style="list-style-type: none"><li>• This method involve randomly transforming the training images during training to improve generalization.</li></ul>
4	Skin Disease Prediction	<ul style="list-style-type: none"><li>• Computer algorithm ResNet152V2 is used.</li></ul>	<ul style="list-style-type: none"><li>• An effective, low-cost solution.</li></ul>	<ul style="list-style-type: none"><li>• Can be trained on clusters of data rather than the whole dataset</li></ul>	<ul style="list-style-type: none"><li>• Training the algorithm on clusters of data rather than the entire dataset is also a good suggestion.</li></ul>
5	Targeted Ensemble Machine Classification Approach for Supporting IoT Enabled Skin Disease Detection	<ul style="list-style-type: none"><li>• A dynamic AI-model configuration and secured IoT-Fog-Cloud is used</li></ul>	<ul style="list-style-type: none"><li>• A new classification process was provided to produce better classification results in skin disease detection.</li></ul>	<ul style="list-style-type: none"><li>• Classification can be done for a wider skin-related disease classification.</li></ul>	<ul style="list-style-type: none"><li>• Use of a two-phase classification process.</li></ul>

# LITERATURE SURVEY

SNO	TITLE	METHODOLOGY	ADVANTAGES	DISADVANTAGES	IDEAS FOR ADOPTION
6	Prediction of Skin Diseases Using Machine Learning	<ul style="list-style-type: none"> <li>Ensemble Algorithm and Data Mining Algorithms</li> </ul>	<ul style="list-style-type: none"> <li>Application developed is light-weight and can be used in machines with low system specifications.</li> </ul>	<ul style="list-style-type: none"> <li>It can be explored with recent advances in AI and the benefits of diagnosis assisted with AI.</li> </ul>	<ul style="list-style-type: none"> <li>Ensuring that the system is trained on diverse and representative data.</li> </ul>
7	Technical Aspects of Developing Chatbots for Medical Applications: Scoping Review	<ul style="list-style-type: none"> <li>Scoping review methodology, the PRISMA extension of scoping reviews</li> </ul>	<ul style="list-style-type: none"> <li>Results showed that the common language of communication between the user and chatbot is English</li> </ul>	<ul style="list-style-type: none"> <li>It is important to conduct more in-depth systematic reviews on the effectiveness of chatbots.</li> </ul>	<ul style="list-style-type: none"> <li>Question generation method to be dependent on the answers in a dynamic way.</li> </ul>
8	IntelliDoctor – AI based Medical Assistant	<ul style="list-style-type: none"> <li>The app utilizes predictive analytics to generate periodic health based on everyday activities and environment.</li> </ul>	<ul style="list-style-type: none"> <li>All the information is displayed into graphical interface.</li> <li>Periodic health reports are generated for the users to follow.</li> </ul>	<ul style="list-style-type: none"> <li>Not reliable or accurate compared to traditional methods.</li> </ul>	<ul style="list-style-type: none"> <li>A user friendly application is better.</li> <li>Focus on usability and simplicity</li> </ul>
9	A Convolutional Neural Network Model for Online Medical Guidance	<ul style="list-style-type: none"> <li>CNN is used for text classification</li> </ul>	<ul style="list-style-type: none"> <li>The variation of the system accuracy with varying number of returned answers</li> </ul>	<ul style="list-style-type: none"> <li>accuracy can be improved (70% accuracy).</li> </ul>	<ul style="list-style-type: none"> <li>With an addition of chatbot to know the other information.</li> </ul>
10	Healthcare Chatbot using Artificial Intelligence	<ul style="list-style-type: none"> <li>Ensemble Algorithm</li> <li>Data Mining Algorithms</li> </ul>	<ul style="list-style-type: none"> <li>Light-weight and can be used in machines with low system specifications.</li> </ul>	<ul style="list-style-type: none"> <li>It can be explored with recent advances in AI and the benefits of diagnosis assisted with AI.</li> </ul>	<ul style="list-style-type: none"> <li>It's important to ensure that the limited medical information is reliable and accurate.</li> </ul>

# OVERALL ARCHITECTURE

- Our Contribution
- Existing Algorithm/Code without modification
- Existing Algorithm/Code with modification



# MODULE DESIGN

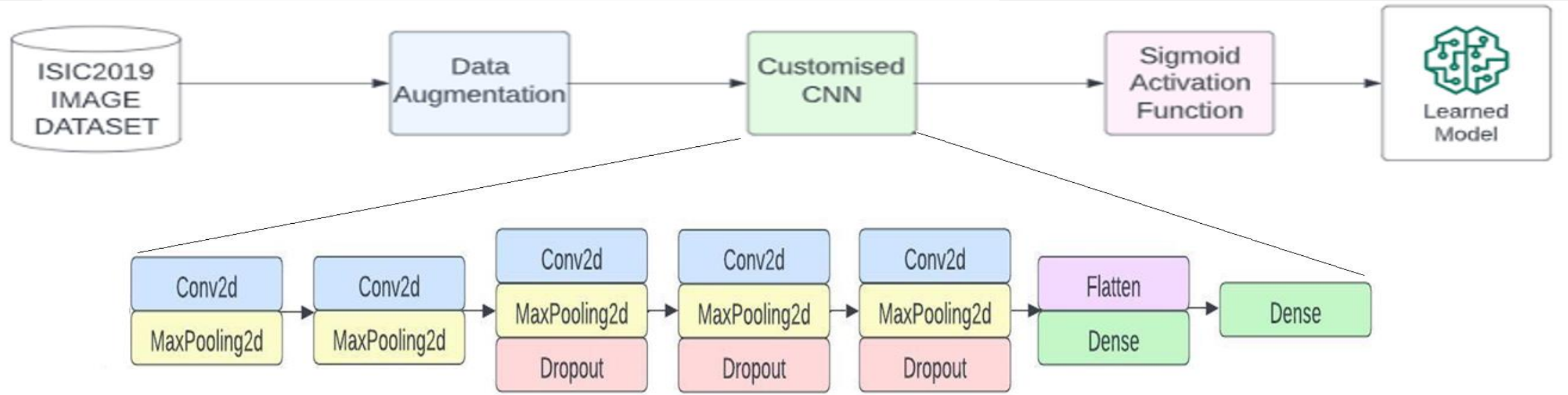
## Module 1: Customized CNN Model Creation on ISIC2019 Dataset

- Dataset: ISIC2019
- ISIC2019 skin diseases: actinic keratosis, basal cell carcinoma, melanoma, nevus, seborrheic keratosis, squamous cell carcinoma.
- 7 layer customised CNN model.

INPUT - ISIC2019 skin disease image data set.

OUTPUT - CNN model

### DETAILED DESIGN:



## ALGORITHM:

1. *Import all required libraries*
2. *Define path for train and test images of ISIC2019 dataset.*
3. *Perform data augmentation on train data set*
  - 4.1. *for each class:*
    - 4.1.1. *specify output directory*
    - 4.1.2. *image -> rotate with probability 0.7*
      - 4.1.2.1. *max\_left\_rotation = 10*
      - 4.1.2.2. *max\_right\_rotation = 10*
    - 4.1.3. *maintain images count as 1000*
5. *Spilt augmented data for train and validation*
6. *Create Sequential CNN Model*
  - 6.1. *Layer 1 ->add Conv2D() -> filters=32, size = 3, padding = 'same', activation = 'relu', add MaxPool2d()*
  - 6.2. *Layer 2 ->add Conv2D() -> filters=64, size = 3, padding = 'same', activation = 'relu', add MaxPool2d()*
  - 6.3. *Layer 3 -> add Conv2D()->filters=128, size =3, padding = 'same', activation = 'relu', add MaxPool2d(), add Dropout() -> rate = 0.15*
  - 6.4. *Layer 4 -> add Conv2D()->filters=256, size =3, padding = 'same', activation = 'relu', add MaxPool2d(), add Dropout() -> rate = 0.20*
  - 6.5. *Layer 5 -> add Conv2D()->filters=512, size =3, padding = 'same', activation = 'relu', add MaxPool2d(), add Dropout() -> rate = 0.25*
  - 6.6. *Layer 6 ->add Flatten() , add Dense() -> units = 1024, activation = 'rule'*
  - 6.7. *Layer 7 ->add Dense() -> units = 6, activation = 'sigmoid'*
7. *Compile CNN model*
  - 7.1. *Optimiser -> Adam, learning\_rate = 0.001*
  - 7.2. *Loss Function -> SparseCategoricalCrossentropy, from\_logits = True*
  - 7.3. *metrics -> accuracy*
8. *Model.fit(), epochs = 25*
9. *Print -> accuracy*
10. *Save the created Model and the learned weights*



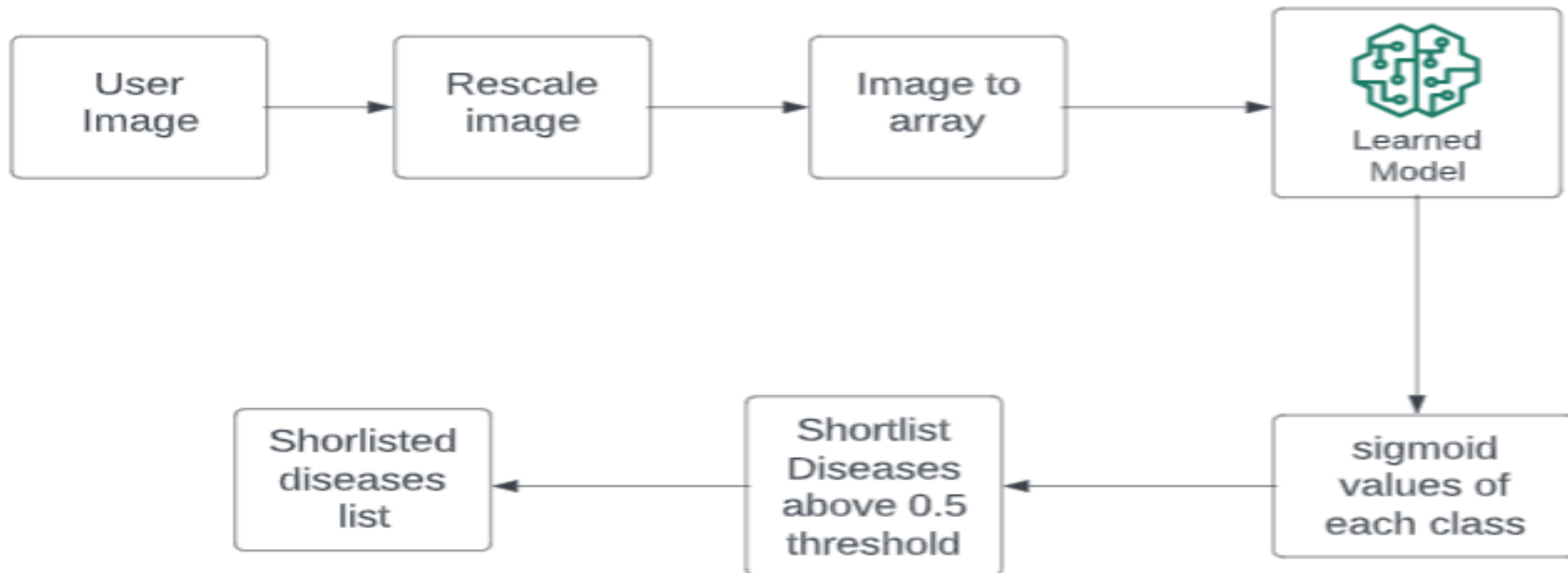
## Module 2: Shortlisting of skin diseases for given user image

- Shortlisting skin diseases for given user image is done using the CNN model which was created in module 1.
- The skin disease above the threshold 0.5 are shortlisted for the next process.

INPUT – CNN model and User Image

OUTPUT – Shortlisted skin diseases

### DETAILED DESIGN:



## ALGORITHM:

1. *Load the created CNN model*
2. *Threshold = 0.5*
3. *The diseases are mapped to short forms:*
  - ACK → Actinic Keratosis*
  - BCC → Basal Cell Carcinoma*
  - MEL → Melanoma*
  - NEV → Nevus*
  - SEK → Seborrheic Keratosis*
  - SCC → Squamous Cell Carcinoma*
4. *User image is collected*
5. *The image is rescaled to 180 X 180*
6. *Convert image to array*
7. *Apply the created CNN model*
8. *Predictions -> sigmoid values of each class*
9. *Find the shortlist using the predictions*
  - 9.1. *Initialise empty list 'shortlist'*
  - 9.2. *for i in each prediction*
    - 9.2.1. *if i > threshold*
      - 9.2.1.1. *Append to*  
*'shortlist'*
  - 9.3. *Return shortlist*

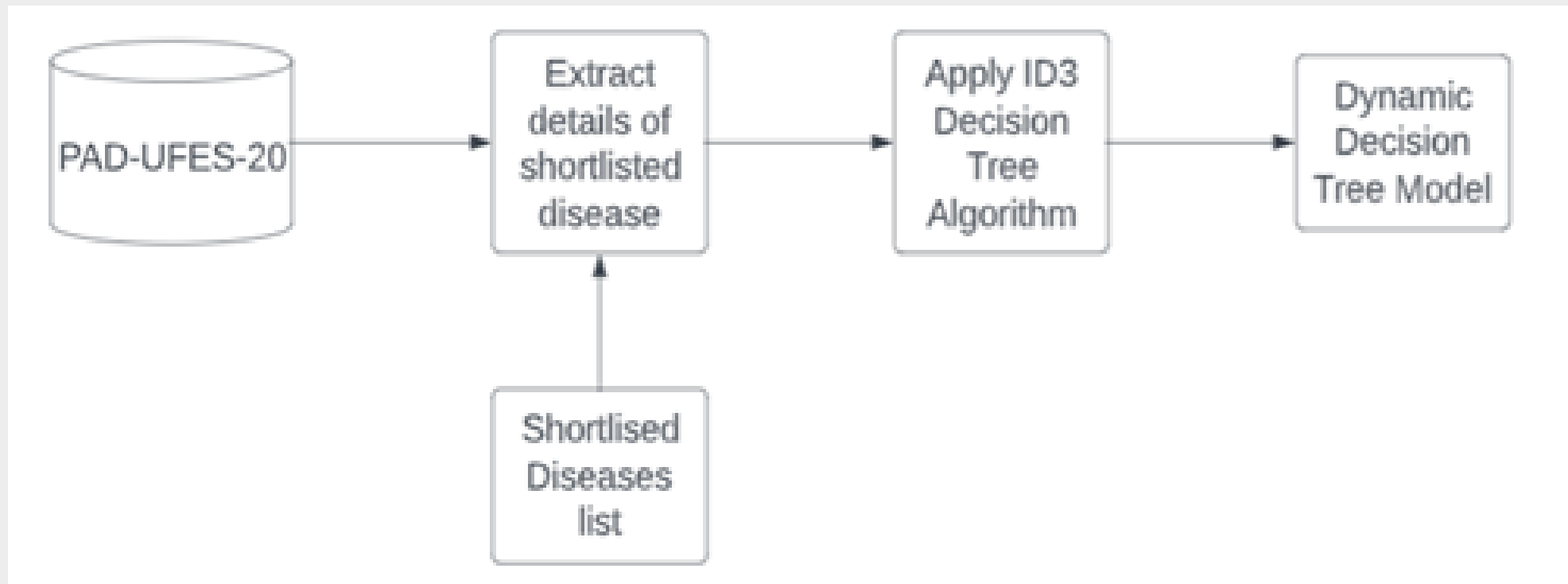
# Module 3: Dynamic ID3 Decision Tree Model

- PAD-UFES-20 dataset for external factors.
- Narrowed extraction of shortlisted diseases information from PAD-UFES-20.
- Creation of Decision tree model using ID3 algorithm.

INPUT – Shortlisted skin diseases

OUTPUT – ID3 Decision tree model

## DETAILED DESIGN:



## ALGORITHM:

1. *Extract only the data of shortlisted diseases from  
PAD-UFES-20 dataset*
  - 1.1 *Initialise empty data[]*
    - 1.1.1. *for i in dataset:*
      - 1.1.2. *if i[disease] in shortlisted\_diseases:*
        - 1.1.3. *append to data[]*
    - 1.2. *return data*
2. *Calculate entropy for whole data*
3. *For each attribute/feature*
  - 3.1. *Calculate entropy for all its categorical values*
  - 3.2. *Calculate information gain for the feature*
4. *Find the feature with maximum information gain*
5. *Add feature as node in the tree*
6. *Repeat steps 2 – 5 to get the decision tree*
7. *Dynamic Decision tree created*

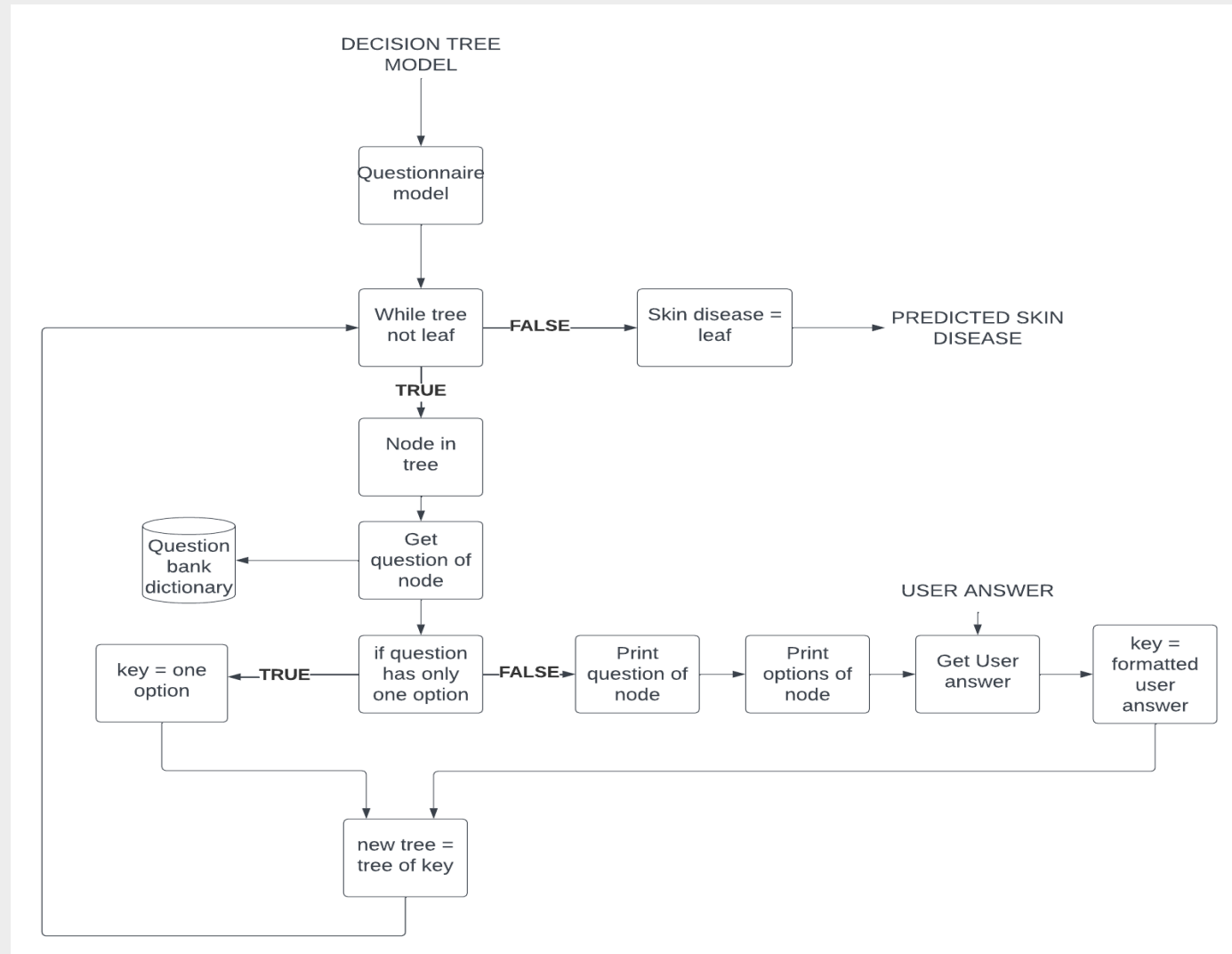
# Module 4: Creation Of Skin Disease Prediction Chat Bot- Questionnaire Model

- A chatbot asking counter question based on user images is created.

INPUT: ID3 Decision tree and user's Answers

OUTPUT: Predicted skin disease

## DETAILED DESIGN:



## **ALGORITHM:**

1. Define the question bank
2. While tree is not leaf:
  - 2.1 Flag = 1
  - 2.1. For node in tree:
    - 2.1.1. If len of options in node == 1:
      - 2.1.1.1. Flag=0
      - 2.1.1.2. Break out of for loop
    - 2.1.2. Print question of the node
    - 2.1.3. for options in node: print options
    - 2.1.4. Get ans(options list)
      - 2.1.4.1. Answer = input from user
      - 2.1.4.2. If Answer not in options list:
        - 2.1.4.2.1. Display error message
        - 2.1.4.2.2. Ask user to enter again
      - 2.1.4.3. Else: Return Answer
  - 2.2. If flag == 1: Next Tree = existing Tree [Answer]
  - 2.3. If flag == 0:
    - 2.3.1. Means that only one option is there
    - 2.3.2. Next Tree = existing Tree [only option]
  - 2.4. reset flag to 1
  - 2.5. If type(Tree) == string: reached leaf node -> Break out of while loop
3. Return node -> ie the predicted skin disease

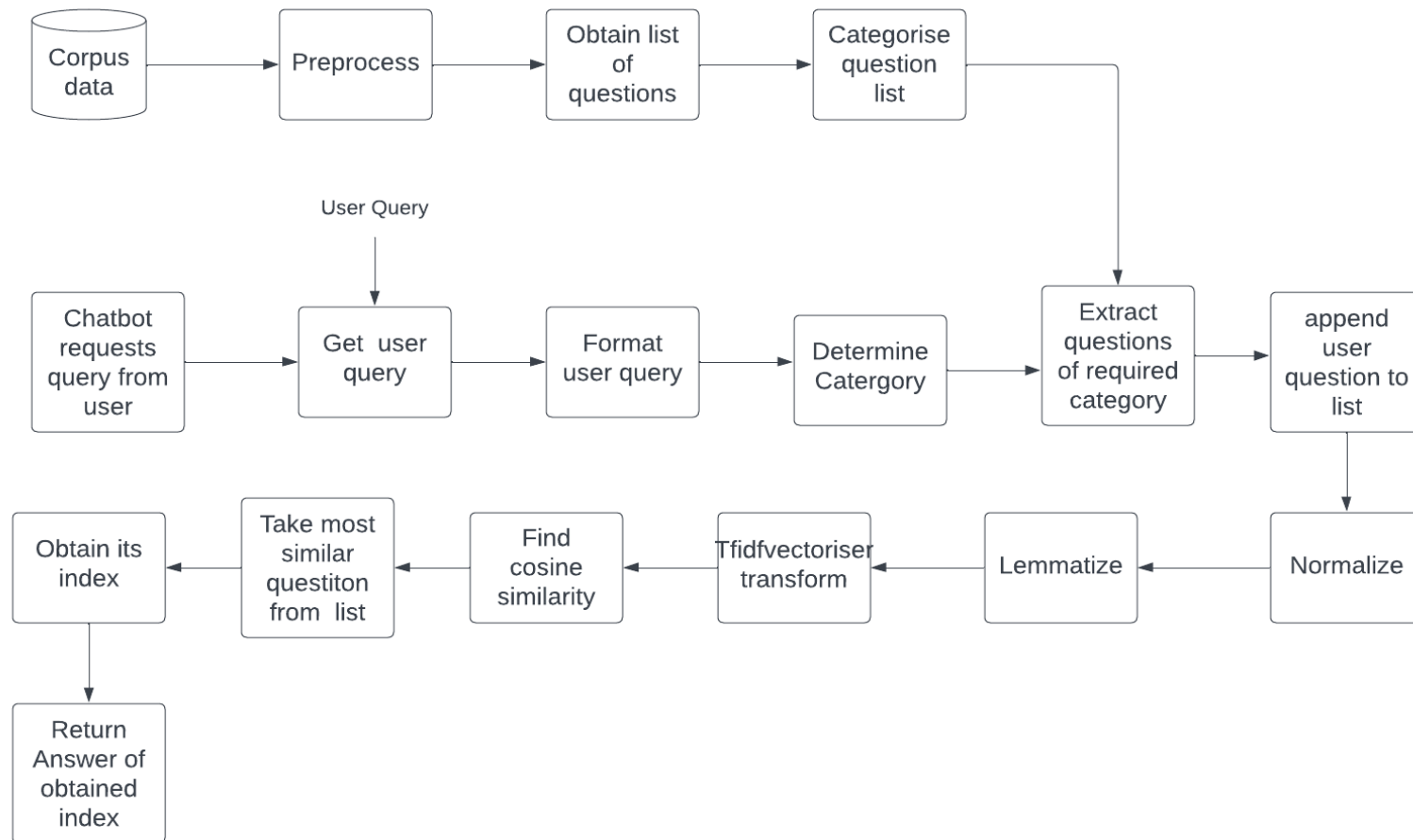
# MODULE 5: CHATBOT CREATION USING NLP

- Creation of corpus containing categories of questions and answers.
- Development of chatbot to answer the user queries with respect to the created corpus.

INPUT: User question

OUTPUT: Response to user's question

## DETAILED DESIGN:



## ALGORITHM:

1. Create corpus
2. Label each question according to its category.
3. Pre-process the corpus
  - 3.1. category = ['ACK', 'BCC', 'MEL', 'NEV', 'SEK', 'SCC', 'GEN']
  - 3.2. initialise an empty main\_list and index\_list
  - 3.3. for i in every category:
    - 3.3.1. m\_list=[], i\_list=[]
    - 3.3.2. for j in corpus\_data:  
if category of j is i:  
append question(j) to m\_list  
append j to i\_list
    - 3.3.3. append m\_list to main\_list
    - 3.3.4. append i\_list to index\_list
4. Declare greeting messages and respond for it
5. Main menu Chatbot:
  - 5.1. Predict skin disease
  - 5.2. Ask general queries
  - 5.3. Quit
6. Sub menu:
  - 6.1. Return to main menu
  - 6.2. Quit

### 7. Predict skin disease:

- 7.1. Ask user image
- 7.2. shortlist skin disease - Module 2
- 7.3. Create decision tree — Module 3
- 7.4 Questionnaire model - Module 4

### 8. Ask General queries related to Skin disease

- 8.1. Chatbot Requests query from user
- 8.2. format user response:
  - 8.2.1. if any shortforms present convert it to full forms
  - 8.2.2. Find out the category of user question
  - 8.2.3. return formatted user query and the category
- 8.3. generate response:
  - 8.3.1. take the list of questions for the obtained category  
from the main list -> sent\_tokens
  - 8.3.2. append user query to list
  - 8.3.3. Lemmatize
  - 8.3.4. Normalize
  - 8.3.3. TfidfVec.fit\_transform(sent\_tokens)
  - 8.3.4. find cosine similarity between user query and ques
  - 8.3.5. take the most similar from the ques list
  - 8.3.6. idx = index of the question which matched the most
  - 8.3.7. req\_tfidf = tf-idf value of the index that matched most
  - 8.3.8. if req\_tfidf == 0: return "No ans FOUND"
  - 8.3.9.else: Retur corpus\_data.ans[index\_list[category][jdx]]



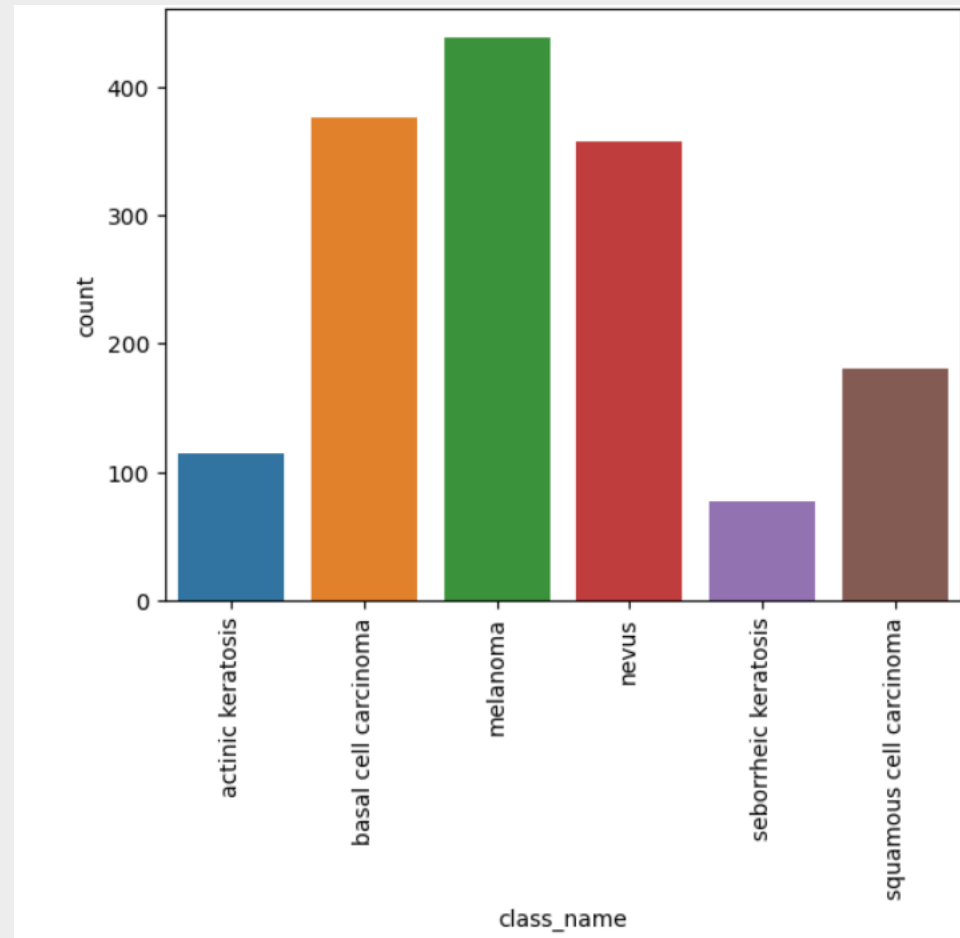
# Implementation Outputs

## MODULE 1- CNN MODEL CREATION FOR ISIC2019 SKIN DISEASES IMAGE DATA SET

Visualising training data before data augmentation

```
total training image count = 1543
```

```
-----  
Class name = actinic keratosis  
count      = 114  
proportion = 0.07388204795852236  
-----  
Class name = basal cell carcinoma  
count      = 376  
proportion = 0.2436811406351264  
-----  
Class name = melanoma  
count      = 438  
proportion = 0.2838626053143227  
-----  
Class name = nevus  
count      = 357  
proportion = 0.23136746597537264  
-----  
Class name = seborrheic keratosis  
count      = 77  
proportion = 0.049902786779001944  
-----  
Class name = squamous cell carcinoma  
count      = 181  
proportion = 0.11730395333765392  
-----
```



Visualising after data augmentation :

```
total training image count = 6000
```

```
-----  
Class name = actinic keratosis  
count      = 1000  
proportion = 0.16666666666666666  
-----
```

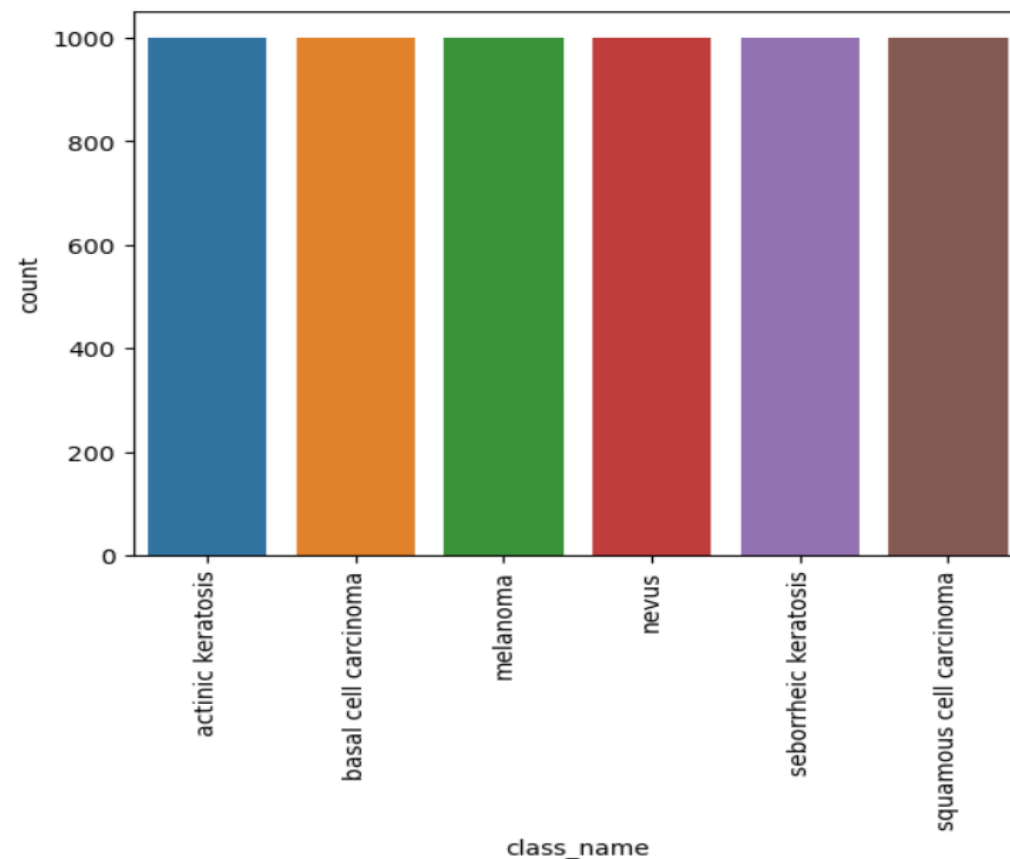
```
Class name = basal cell carcinoma  
count      = 1000  
proportion = 0.16666666666666666  
-----
```

```
Class name = melanoma  
count      = 1000  
proportion = 0.16666666666666666  
-----
```

```
Class name = nevus  
count      = 1000  
proportion = 0.16666666666666666  
-----
```

```
Class name = seborrheic keratosis  
count      = 1000  
proportion = 0.16666666666666666  
-----
```

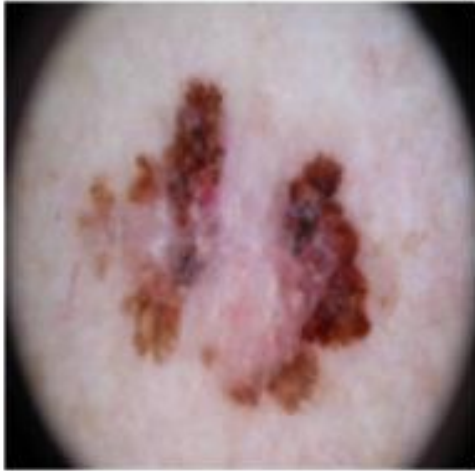
```
Class name = squamous cell carcinoma  
count      = 1000  
proportion = 0.16666666666666666  
-----
```



## MODULE 2- SHORTLISTING OF SKIN DISEASE

Shortlisting diseases for given user image:

input image 1 :



1/1 [=====] - 0s 38ms/step

Classes-

ACK : 0.03402483  
BCC : 0.0007034292  
MEL : 0.95889  
NEV : 0.93243307  
SEK : 0.60410833  
SCC : 0.944368

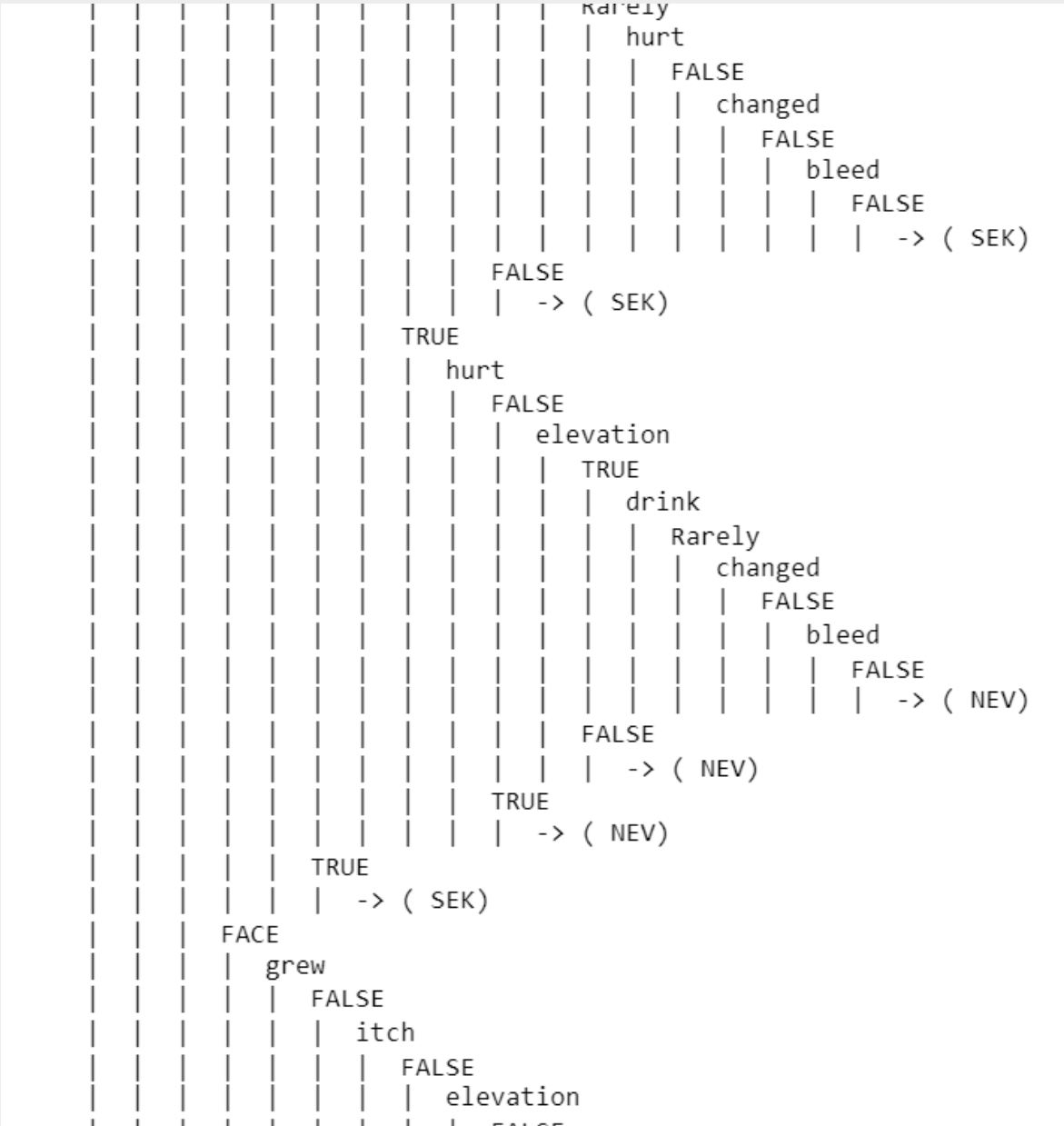
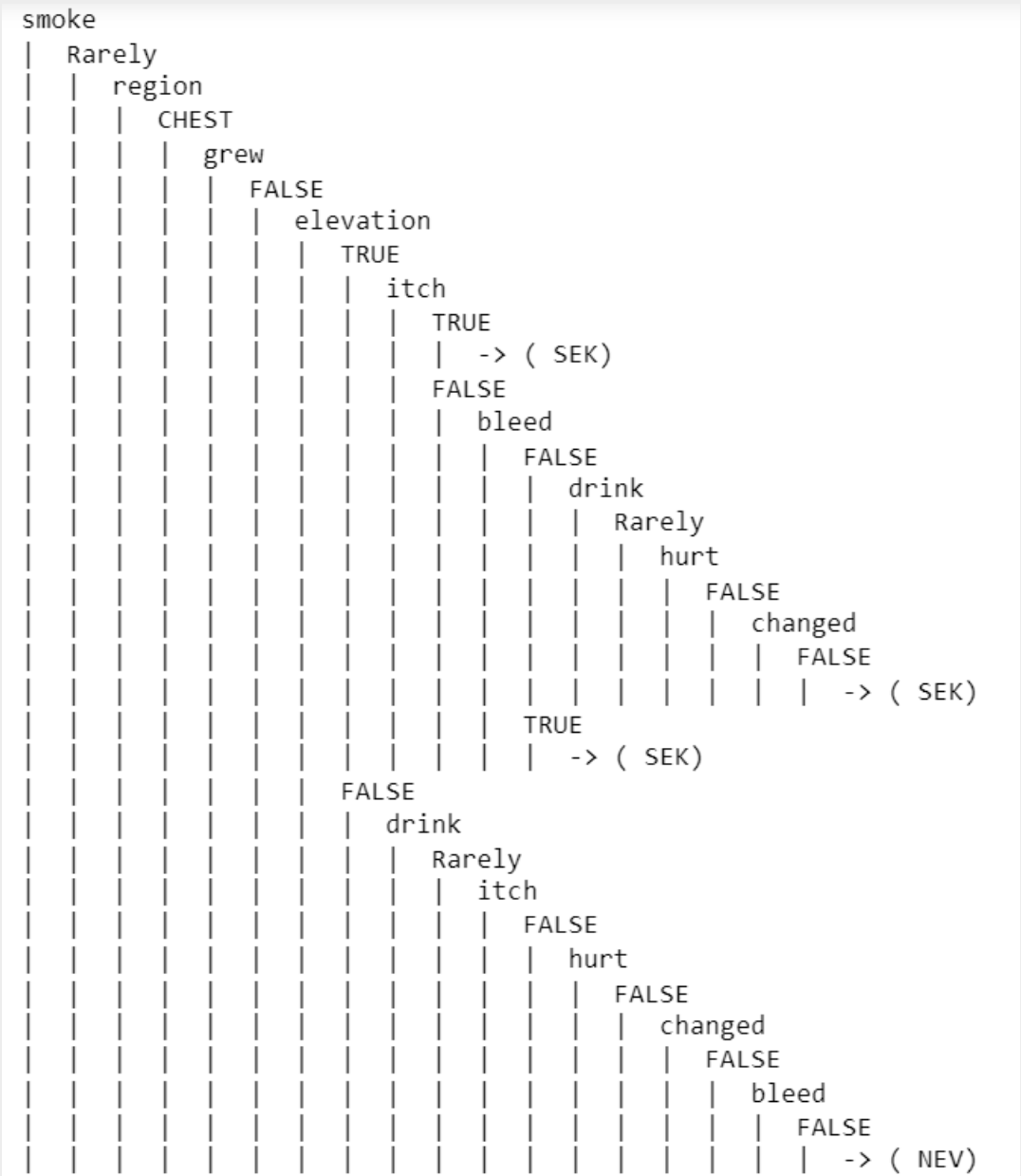
shortlisted diseases:

MEL  
NEV  
SEK  
SCC

SHORTLISTED DISEASES LIST FOR IMAGE 1:

['MEL', 'NEV', 'SEK', 'SCC']

# MODULE 3- Dynamic ID3 Decision Tree Model



## MODULE 4- Creation Of Skin Disease Prediction Chatbot – Questionnaire Model

```
BOT: HEY! I am the chatbot which will help you with skin related diseases
BOT: Please choose what you need:
```

```
--MAIN MENU--
```

```
Enter 1 for predicting your skin disease
Enter 2 for asking queries related to skin diseases
Enter 3 to quit
Enter your option:1
```

```
BOT :Hello,I will be predicting your skin disease..
Please provide an image of your skin disease
USER: PAD/IMAGES/PAT_46_881_939.png
1/1 [=====] - 0s 456ms/step
```

```
BOT : Your image has been analysed!
Please answer the further questions to make accurate predictions-
```

```
How often do you smoke?
opts:
Rarely
Never
Frequently
enter option:never
```

```
Does your skin disease keep growing?
opts:
Yes
Unknown
No
enter option:yes
```

```
Does it bleed?
opts:
Yes
No
enter option:yes
```

```
Is you skin itchy?
opts:
Yes
No
enter option:yes
```

```
Does it hurt?
opts:
No
Yes
enter option:no
```

```
How often do you drink?
opts:
Frequently
Never
enter option:never
```

```
Has ur skin disease changed?
opts:
No
Yes
enter option:no
```

```
Is there any elevation?
opts:
Yes
No
enter option:yes
```

```
THE SKIN DISEASE THAT YOU SEEM TO HAVE IS: BCC
```

```
ENTER 1 to go to the main menu
Enter 2 to exit
Enter your option:2
```

```
BOT: BYE! Take care
```

## Module 5: Chatbot Creation using NLP

BOT: HEY! I am the chatbot which will help you with skin related diseases

BOT: Please choose what you need:

--MAIN MENU--

Enter 1 for predicting your skin disease

Enter 2 for asking queries related to skin diseases

Enter 3 to quit

Enter your option:2

Hi. I will answer your queries. Please type in your questions here. If you want to exit, type Bye!

USER:what is melanoma

BOT: Melanoma is a type of skin cancer that begins in the melanocytes, the cells that produce pigment in the skin.

USER:causes of SEK

BOT: The exact cause of seborrheic keratosis is unknown, but it is believed to be related to genetics, sun exposure, and aging. People with a family history of seborrheic keratosis are more likely to develop the condition.

USER:symptoms of Nevus

BOT: Nevus symptoms can vary depending on the type of lesion, but may include changes in size, shape, or color, itching or bleeding, and an irregular border.

USER:different types of skin cancer

BOT: There are two main forms of skin cancer: melanoma and nonmelanoma.

Melanoma is a rare form of skin cancer. It is more likely to invade nearby tissues and spread to other parts of the body than other types of skin cancer. When melanoma starts in the skin, it is called cutaneous melanoma. Melanoma may also occur in mucous membranes (thin, moist layers of tissue that cover surfaces such as the lips). This PDQ summary is about cutaneous (skin) melanoma and melanoma that affects the mucous membranes.

The most common types of skin cancer are basal cell carcinoma and squamous cell carcinoma. They are nonmelanoma skin cancers. Nonmelanoma skin cancers rarely spread to other parts of the body.

USER:treatments for ACK

BOT: It is very important that actinic keratosis be treated right away before it can become cancerous. Different treatments include topical chemotherapy, immunotherapy, and nonsteroidal anti-inflammatory drugs, also known as NSAIDs. In addition to these, your dermatologist may recommend cryosurgery or photodynamic therapy to remove the spots.

USER:what is abcde

BOT: ABCDE stands for asymmetry, border, color, diameter and evolving. These are the characteristics of skin damage that doctors look for when diagnosing and classifying melanomas.

- Asymmetry: One half does not match the other half.
- Border: The edges are not smooth.
- Color: The color is mottled and uneven, with shades of brown, black, gray, red or white.
- Diameter: The spot is greater than the tip of a pencil eraser (6.0 mm).
- Evolving: The spot is new or changing in size, shape or color.

USER:bla bla

BOT: I am sorry! I don't have an answer for this

USER:what is universe

BOT: I am sorry! I don't have an answer for this

USER:is melanoma dangerous

BOT: Melanoma is the most invasive skin cancer with the highest risk of death. While it's a serious skin cancer, it's highly curable if caught early. Prevention and early treatment are critical, especially if you have fair skin, blonde or red hair and blue eyes.

USER:bye

BOT: Bye! take care..

ENTER 1 to go to the main menu

Enter 2 to exit

Enter your option:1

--MAIN MENU--

Enter 1 for predicting your skin disease

Enter 2 for asking queries related to skin diseases

Enter 3 to quit

# All Possible Test Cases

Test Case	Expected Output	Predicted Output
<b>Choosing Menu 1 -</b> BOT: HEY! I am the chatbot which will help you with skin related diseases BOT: Please choose what you need:  --MAIN MENU-- Enter 1 for predicting your skin disease Enter 2 for asking queries related to skin diseases Enter 3 to quit Enter your option:1	Redirecting to skin disease prediction menu and requesting user image.	BOT :Hello,I will be predicting your skin disease.. Please provide an image of your skin disease  USER: <input type="text"/>
<b>Providing invalid image path-</b>  BOT :Hello,I will be predicting your skin disease.. Please provide an image of your skin disease USER: imge2.jpg File not found Please provide an image of your skin disease  USER: <input type="text"/>	Display file not found and ask user to re-enter	File not found Please provide an image of your skin disease  USER: <input type="text"/>
<b>Providing valid image path-</b> File not found Please provide an image of your skin disease USER: PAD/IMAGES/PAT_1516_1765_530.png	Analyse the image and ask further questions	BOT : Your image has been analysed! Please answer the further questions to make accurate predictions-  Has ur skin disease changed? opts: No Yes Unknown enter option: <input type="text"/>



<p>Providing input other than the option-</p> <pre> Has ur skin disease changed? opts: No Yes Unknown enter option:hi </pre>	<p>Display error and ask user to enter again</p>	<pre> enter option:hi Invalid Input!Try again  enter option: </pre>
<p>Providing right option-</p> <pre> enter option:yes  How often do you drink? opts: Rarely Never Frequently  enter option: </pre>	<p>Ask follow up question</p>	<pre> How often do you drink? opts: Rarely Never Frequently  enter option: </pre>
<p>Giving all capital letter for input-</p> <pre> Has ur skin disease changed? opts: No Yes Unknown enter option:NO </pre>	<p>Code to still work</p>	<pre> enter option:NO  How often do you drink? opts: Rarely Never Frequently </pre>

<p>Skin disease prediction-</p> <p>Is there any elevation?  opts:  No  Yes  enter option:no</p>	<p>SEK</p>	<p>THE SKIN DISEASE THAT YOU SEEM TO HAVE IS: SEK</p> <p>ENTER 1 to go to the main menu  Enter 2 to exit</p>
<p>Quitting chatbot-</p> <p>ENTER 1 to go to the main menu  Enter 2 to exit  Enter your option:2</p>	<p>Exit chatbot</p>	<p>ENTER 1 to go to the main menu  Enter 2 to exit  Enter your option:2</p> <p>BOT: BYE! Take care</p>
<p>Going to main menu-</p> <p>ENTER 1 to go to the main menu  Enter 2 to exit  Enter your option:1</p>	<p>Redirecting back  to main menu</p>	<p>--MAIN MENU--  Enter 1 for predicting your skin disease  Enter 2 for asking queries related to skin diseases  Enter 3 to quit</p> <p>Enter your option: <input type="text"/></p>

# The Test Cases regarding the working of NLP chatbot

Test Case	Expected Output	Predicted Output
<b>Choosing Menu 2 -</b> --MAIN MENU-- Enter 1 for predicting your skin disease Enter 2 for asking queries related to skin diseases Enter 3 to quit Enter your option:2	Redirecting to placeholder for user to type in query.	Hi. I will answer your queries. Please type in your questions here. If you want to exit, type Bye!  USER: <input type="text"/>
<b>Different types of greetings -</b> <b>USER:Hi</b> <b>USER:Hello</b>	Greet the user differently every time	BOT: Hello, please type in your queries BOT: Hi, how can I help you
<b>In case of spelling mistake:</b> USER:Types of acinic keratosis instead of USER:Types of actinic keratosis	There are different types of actinic keratosis, including hypertrophic, atrophic, and pigmented. BOT: There are different types of actinic keratosis	BOT: During cryosurgery, your dermatologist freezes the AK. The To freeze the AK, your dermatologist will apply a very cold sub
<b>USER:What is nevus</b>	<b>Definition of nevus</b>	BOT: A nevus, also known as a mole, is a common skin growth that develops

USER:What are the symptoms melanoma	Symptoms of melanoma	BOT: Melanoma may appear as a new or changing mole or pigmented area on the s
USER:What can I apply to my skin to prevent any disease	Suggest methods	BOT: To prevent skin diseases, it's important to maintain good hyg 1. Washing your face and body daily with a mild, gentle cleanser t 2. Applying a broad-spectrum sunscreen with an SPF of at least 30 3. Using a moisturizer to keep your skin hydrated and protected fr 4. Avoiding harsh skincare products or excessive use of makeup tha 5. Drinking plenty of water and maintaining a healthy diet and lif 6. Seeing a dermatologist for regular skin checkups and to address
USER:What is best way to care for oily skin	Provide skincare advice	BOT: The best way to care for oily skin is to use gentle cleansers,
Short Forms of diseases are accepted in queries. It will be replaced and formatted before matching. USER:Symptoms of bcc	Correctly fetched answer from that disease category.	BOT: Symptoms of basal cell carcinoma include a small, waxy b
In singular and plural <u>terms</u> it works. Code helps with it. USER:What causes sek and USER:What can cause sek	Same results are produced, proving singular and plural terms are recognised.	BOT: The exact cause of seborrheic keratosis is unk and BOT: The exact cause of seborrheic keratosis is unk

# Performance Metrics

For the performance evaluation, calculate the accuracy of the model by the percentage ratio of the number of correct prediction to the total cases:

$$\text{Accuracy} = \frac{\text{Correct prediction}}{\text{Total cases}} * 100 \%$$



```
In [143]: print('ACCURACY : ',acc[-1])  
          print('VALIDATION ACCURACY : ',val_acc[-1])  
  
ACCURACY : 0.8924999833106995  
VALIDATION ACCURACY : 0.8733333349227905
```

CNN model accuracy: 87.34%.

- The full dataset has been passed into the CNN model.
- Total number of correct predictions = 2104
- Total number of cases = 2298
- Accuracy = 91.557

```
In [16]: ▶ print('NUMBER OF CORRECT PREDICTIONS:',correct_predictions)
```

```
NUMBER OF CORRECT PREDICTIONS: 2104
```

```
In [17]: ▶ print('TOTAL NUMBER OF CASES:',total_cases)
```

```
TOTAL NUMBER OF CASES: 2298
```

```
In [110]: ▶ print("ACCURACY = ",correct_predictions/total_cases*100)
```

```
ACCURACY = 91.55787641427328
```

# Comparative Analysis

In the previous works only image data has been used.

Maximum accuracy: **85.8%**

MODEL	ACCURACY
PROPOSED MODEL	87.34%
RegNetY-3.2G	85.8%
EfficientNet-b7	84.7%
DenseNet-161	83.7%
ResNet-152	83.5%
VGG-19	75.0%

Proposed system –

Accuracy only using image: **87.34%**

After incorporating external factors- Accuracy: **91.557%.**

# Conclusion

- CNN model has been improved by using optimum number of layers hence attaining a high accuracy.
- External factors and user's lifestyle activities have been considered.
- Lively interactive chatbot options have been created.
- User friendly AI dermatologist with an accuracy of 91.557 % is created.



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