# ANTICIPATING MENSTRUAL MIGRAINE USING DEEP LEARNING

**Final Year Project**

*TEAM – 12*


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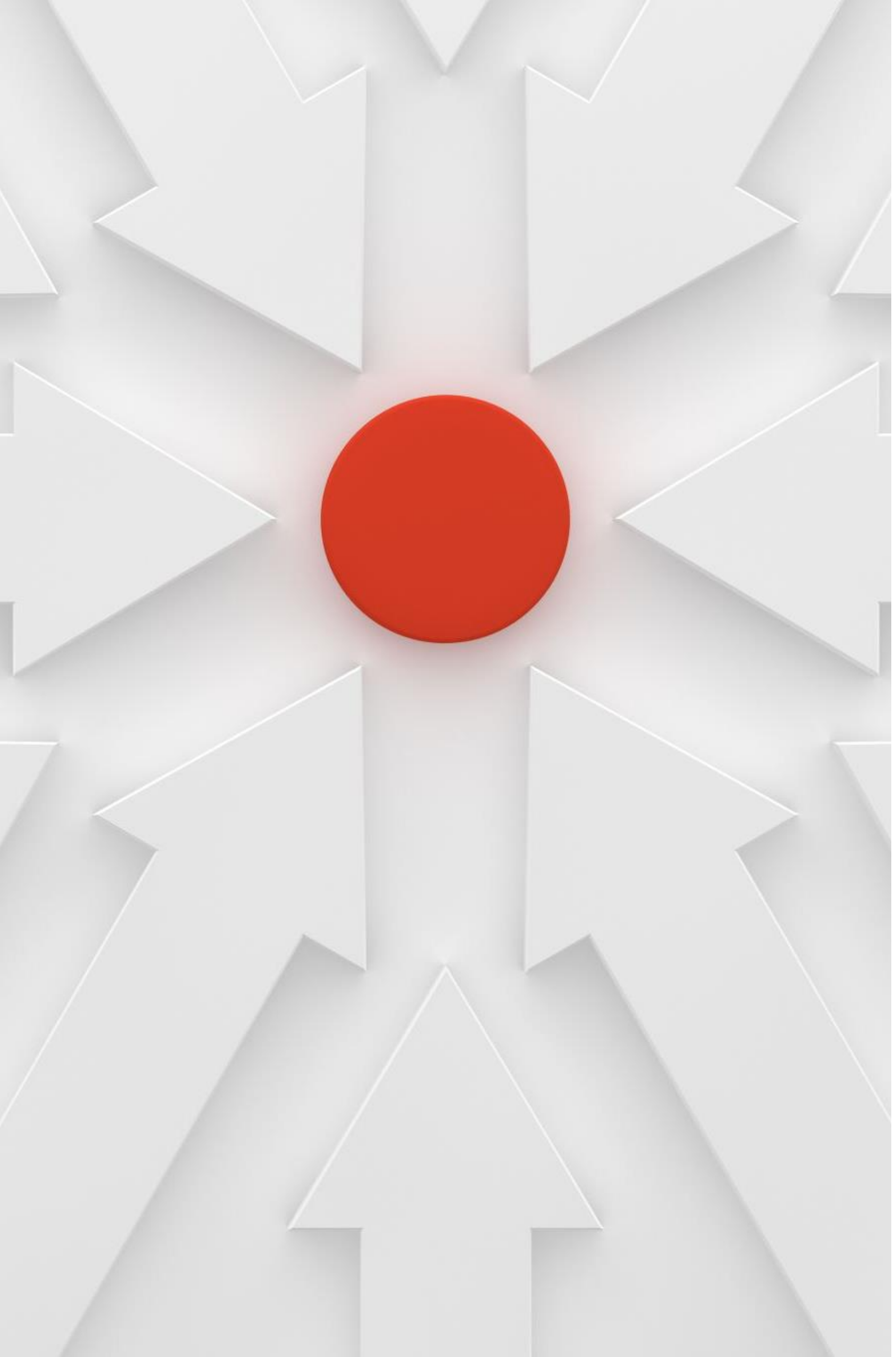
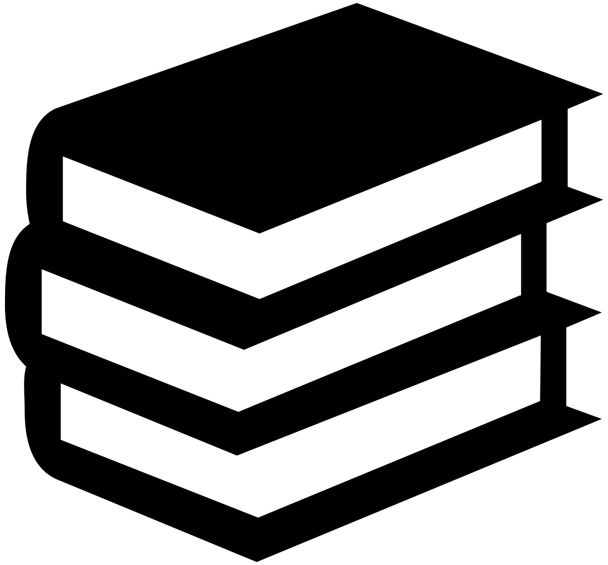


# OBJECTIVES

- This project aims to build an automated system that identifies, classifies, and anticipates an occurrence of Menstrual Migraine in women. This is based on the severity of symptoms that a woman experiences – like *throbbing, periods, Nausea, visual disturbances, intensity, & many more.*
- The data collected from a woman is cleaned & modeled into the *Deep Learning Classification system* that identifies the type of migraine occurring (Menstrual | Non-Menstrual | Others)
- This classification system can be integrated with period-tracking applications and cloud-based systems to scale up the impact created on a woman's health.
- The project enables women to consider prior precautions & medication in cases of menstrual-related migraines.

# ABSTRACT

**Menstrual Migraines** are headaches that occur without any typical aura or sensory disturbances. They can be labeled as '**Migraine without Aura**'. A woman could undergo menstrual migraine just before or during her period starts. This is majorly due to the drop in **estrogen** levels in the body. Menstrual migraines can be intense, & they must be identified accurately & treated separately from regular ones. Anticipating Menstrual Migraines using Deep Learning methodology can help women in taking precautions beforehand and aid in improving their health.

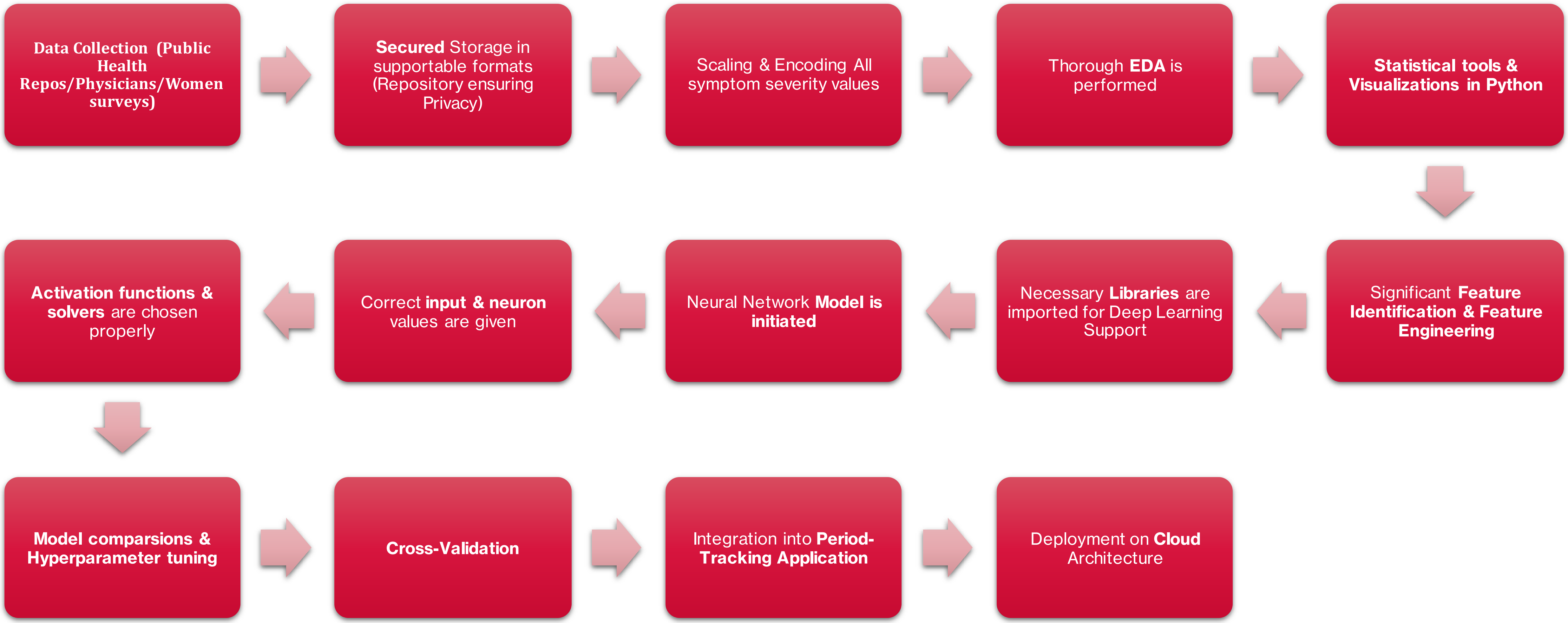


# LITERATURE REVIEW

| No. (Author) | Name | Methodology | Drawbacks |
|---|---|---|---|
| **1** (Alkan A) | Use of K-means clustering in migraine detection by using EEG records under flash stimulation | EEG signals are pre-processed & analysed using Histograms. Features are set to K-means algorithm for detecting migraine. | Based upon analysing brain wave signals. Requires resources and is inefficient. |
| **2** (Subasi A, Tuncel D) | Analysis of repetitive flash stimulation frequencies and record periods to detect migraine using ANN | Flash stimulation is based on frequency analysis in EEGs. Frequency ranges in Hz are used to determine migraine at beta-bands | Complex process of analysing frequencies over time. Requires long duration and equipment to just detect migraine. |
| **3** (Akben SB, Subasi A, Kiymik MK) | Comparison of artificial neural network and support vector machine classification methods in diagnosis of migraine by using EEG | Frequency spectrums are classified using ANN & SVMs. Detecting migraine among headache symptoms, using triggering factors. | Similar to the previous ones |
| **4** (Andrew Charles) | The Migraine Aura | Basic mechanisms of migraine aura and its clinical significance based upon evidence from human studies and animal models. | Only intended to identify migraine with Aura (unrelated to non-aura migraines) |
| **5** (Catherine, Nathan) | Migraine classification using magnetic resonance imaging resting | Used ML techniques to develop biomarkers for rs-fMRI data | Just provided insights upon pain circuits in the brain that acted as biomarkers to identify migraine patients |

| | | | |
|---|---|---|---|
| **6** (Wei-Ta Chen, Cing-Yan) | Migraine classification by ML with functional near-infrared spectroscopy during the mental arithmetic task | Subjects' haemoglobin in the brain was measured using fNIRS during mental attacks | fNIRS & haemoglobin analysis is not quite the easy or standard way to quickly identify the types of migraine. |
| **7** (Yolanda Garcia-Chimeno, Juan Carlos) | Automatic migraine classification via feature selection committee and ML techniques over imaging and questionnaire data | Diffusion tensor Images & questionnaires like IQ were used to enable feature selection & Multiple ML techniques. | DTI images & IQ questionnaires are a complex process to create classification models. Lot of scope for optimization |
| **8** (Konrad Jackowski) | Migraine Diagnosis Support System Based on Classifier Ensemble | Ensemble pool of elementary classifiers are combined to increase accuracy in identifying migraine from regular headaches | Does not provide any insights into types of migraines based on aura, and null on menstrual-related migraines |
| **9** (Paola Sanchez)<br><br>**[ Existing System – Base Paper ]** | Automatic migraine classification using artificial neural networks | Designs & tests an early classification system to classify 7 different types of migraines using ANN | No significant EDA performed. Increased dimensions and incomprehensible correlations among the variables. Leaves scope for efficient system to be built over neural networks (other than old MLP Classifier) |
| **10** (Stephen D Silverstein) | Diagnosis and Treatment of the Menstrual Migraine Patient | Provides medical diagnostic criteria for women having migraine without Aura. | Provides a perspective into post-identification procedures & treatments for women with menstrual migraine. |

# PROPOSED SYSTEM



# METHODOLOGY

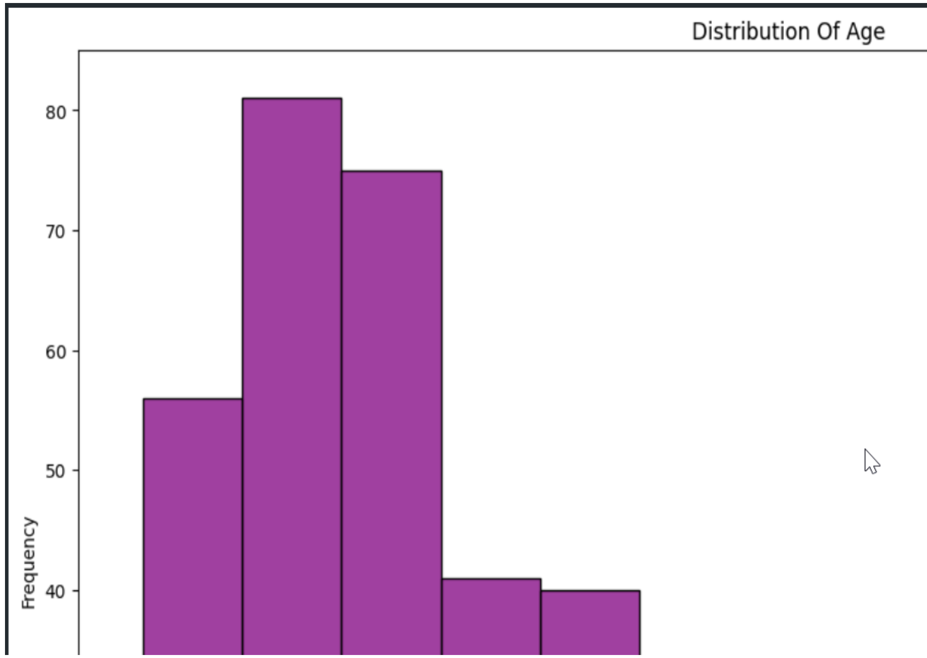
- We propose an efficient methodology to accurately classify the headaches into 3 major types. Our primary focus would be on identifying menstrual migraines from regular migraines so that one can anticipate its occurrence for prior treatment properly.
- Data shall be collected from public health repositories, physicians, and women who are experiencing a variety of symptoms relating to headaches or migraines. This data is pre-processed and maintained neatly in a comprehensible format.
- The data is comprised of numerous quantifiable and simple but important symptoms that a woman would experience. Ex – Nausea, Visual aura, Intensity level, Frequency, Period status, etc.
- All the symptoms and severities are scaled and encoded into simpler values for efficient processing by the models.
- Data undergoes thorough Exploratory Analysis to identify correlations, impacts and insignificances of the variables present at hand. This is done in a visual manner for better understanding of the data.
- Finally, the important features are identified, and they are ready to be fed into a Deep Learning- based Neural network Classifier.

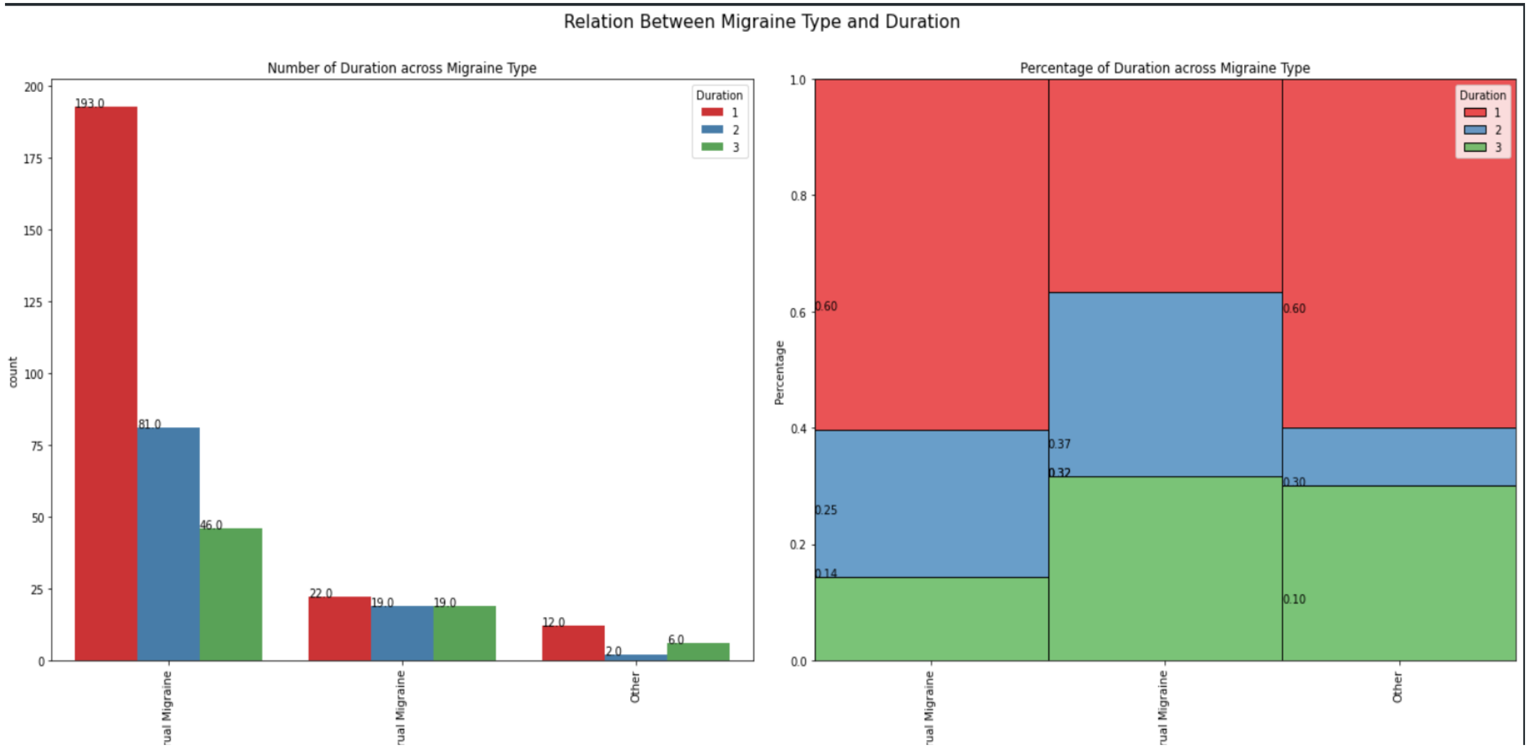
- The classifier system is built using Neural Networks for categorizing multiple classes effectively. Each layer is added in a sequential format, with the correct parameters relating to the shape of the input & output data.
- Right activations and loss functions are chosen for productive multi-class classification.
- Final set of model and its hyperparameters are tuned using methods like cross validation.
- This system is intended to be integrated into a period-tracking system for efficient User-Interface and easy healthcare.

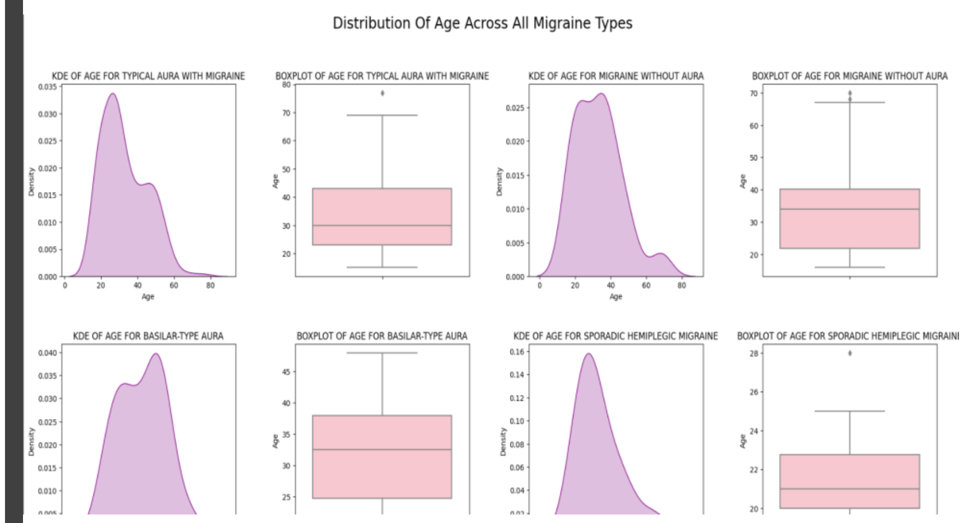
# Work done so for

- Clear Problem Statement definition
- Thorough review of multiple related papers was done & Base paper was identified.
- Collected medically-valid data from a public health repository that comprises numerous significant symptoms for migraines.
- Designed a methodology architecture for implementing the system
- Symptom severities - Scaled, Encoded, Simplified through preprocessing
- Comprehensive EDA performed using statistical visualizations & comparing correlations of variables
- Model building & Comparision Stage (multiple algorithms being tested for accuracy - Like RFC, KerasClassifier, KNN, etc;

| | Age | Duration | Frequency | Location | Character | Intensity | Nausea | Vomit | Phonophobia | Photophobia | ... | Hypoacusis | Diplopia | Visual_defect |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 30 | 1 | 5 | 1 | 1 | 2 | 1 | 0 | 1 | 1 | ... | 0 | 0 | 0 |
| 1 | 50 | 3 | 5 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | ... | 0 | 0 | 0 |
| 2 | 53 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | ... | 0 | 0 | 0 |
| 3 | 45 | 3 | 5 | 1 | 1 | 3 | 1 | 0 | 1 | 1 | ... | 0 | 0 | 0 |
| 4 | 53 | 1 | 1 | 1 | 1 | 2 | 1 | 0 | 1 | 1 | ... | 0 | 0 | 0 |



# EXPERIMENTAL RESULTS

```
[ ]
    #Defining our Base Model
    def baseline_model():
        # Create model here
        model = Sequential()
        model.add(Dense(14, input_dim = 24, activation = 'relu')) # Rectified Linear Unit Activation Function
        model.add(Dense(14, activation = 'relu'))
        model.add(Dense(3, activation = 'softmax')) # Softmax for multi-class classification
        # Compile model here
        model.compile(loss = 'categorical_crossentropy', optimizer = 'adam', metrics = ['accuracy'])
        return model

[ ]  #Create Keras Classifier to use predefined base model
    estimator = KerasClassifier(build_fn = baseline_model, epochs = 100, batch_size = 10, verbose = 0)

    /usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:2: DeprecationWarning: KerasClassifier is depreca

[ ] # KFold Cross Validation
    kfold = KFold(n_splits = 5, shuffle = True, random_state = seed)

[ ] # Object to describe the result
    results = cross_val_score(estimator, x, y, cv = kfold)
    # Result
    print("Result: %.2f%% (%.2f%%)" % (results.mean()*100, results.std()*100))

    Result: 99.75% (0.50%)
```

```
[ ] # Create a model
    rfc = RandomForestClassifier(max_depth=23,
                                 max_features='sqrt',
                                 min_samples_split=10,
                                 n_estimators=40)

    # Fit the model
    rfc.fit(X_train, Y_train)

    RandomForestClassifier(max_depth=23, max_features='sqrt', min_samples_split=10,
                           n_estimators=40)

    # Print metrics of the model
    model_metrics(rfc)

    ***** Model Fit *****

    FIT ON TRAIN DATA   --> 1.0
    FIT ON TEST DATA    --> 0.9916666666666667
```

```
] # Adding the input layer and the first hidden layer...
  classifier.add(Dense(units=13, kernel_initializer='uniform', activation='relu', input_dim=24))

] # Adding the second hidden layer...
  classifier.add(Dense(units=13, kernel_initializer='uniform', activation='relu'))

] # Adding the last and final output layer...
  classifier.add(Dense(units=1, kernel_initializer='uniform', activation='softmax'))

] # Compiling the ANN...
  classifier.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])

  # Fitting the ANN to the Training set...
  classifier.fit(X_train, y_train, batch_size=10, epochs=100)
  30/30 [==============================] - 0s 1ms/step - loss: 0.0000e+00 - accuracy: 0.1533
  Epoch 33/100
  30/30 [==============================] - 0s 1ms/step - loss: 0.0000e+00 - accuracy: 0.1533
  Epoch 34/100
  30/30 [==============================] - 0s 1ms/step - loss: 0.0000e+00 - accuracy: 0.1533
  Epoch 35/100
  30/30 [==============================] - 0s 1ms/step - loss: 0.0000e+00 - accuracy: 0.1533
  Epoch 36/100
  30/30 [==============================] - 0s 2ms/step - loss: 0.0000e+00 - accuracy: 0.1533
  Epoch 37/100
  30/30 [==============================] - 0s 1ms/step - loss: 0.0000e+00 - accuracy: 0.1533
```

# REFERENCES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# Thank You!