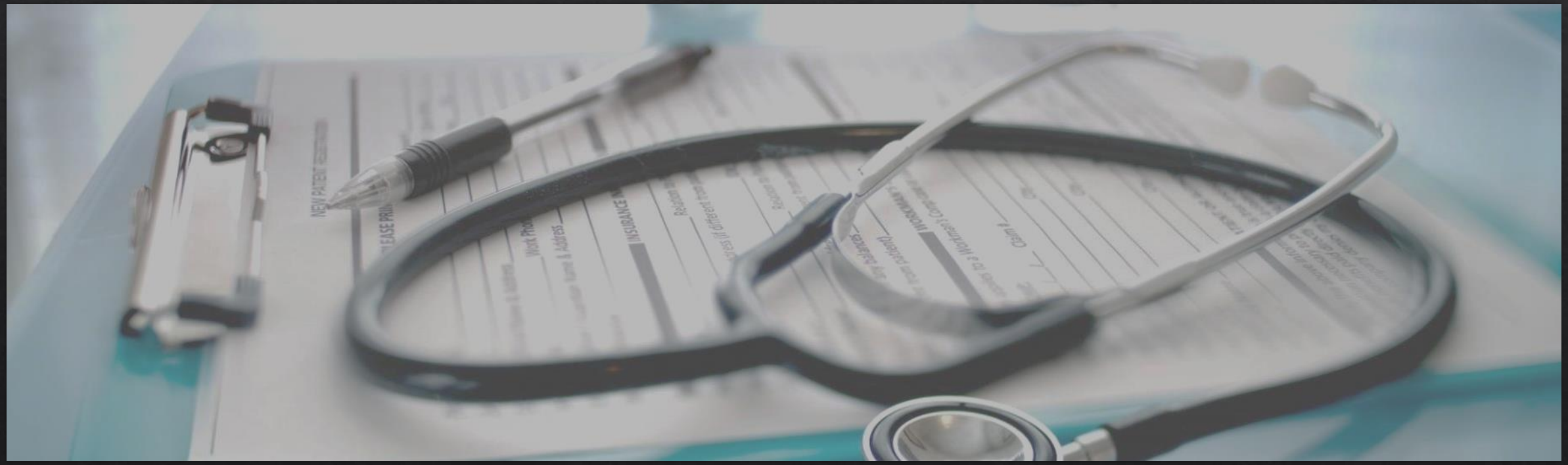
“IMPROVING HEALTHCARE OUTCOMES: UNVEILING THYROID DISEASE PATTERNS WITH MACHINE LEARNING ANALYTICS”

Gringo R. Velasco



BACKGROUND

Did you know?

In the Philippines, the prevalence of thyroid function abnormalities is 8.53% among the adult population *(2012 Philippine Thyroid Diseases Study (PhilTiDes-1))*

The 2013 National Nutrition Survey revealed that about 5.8 million Filipinos were afflicted with thyroid disorders in different clinical presentations

Overall, this medical condition can have a significant impact on public health and can even shorten the lifespan of individuals of any age.

Why use Machine Learning?

❑ Early Detection and Prevention

ML models can analyze large datasets, including patient demographics, medical history, laboratory test results, and imaging data, to identify early signs of thyroid disease. Early detection allows for timely intervention and treatment, which can prevent the condition from progressing to a more severe stage and potentially avoid complications.

❑ Enhanced Accuracy

Machine learning algorithms can process and identify patterns that may be challenging for human experts to recognize. By analyzing multiple variables and complex relationships, ML models can provide more accurate predictions and diagnoses, reducing the likelihood of misdiagnosis or overlooking subtle patterns indicative of thyroid disease.

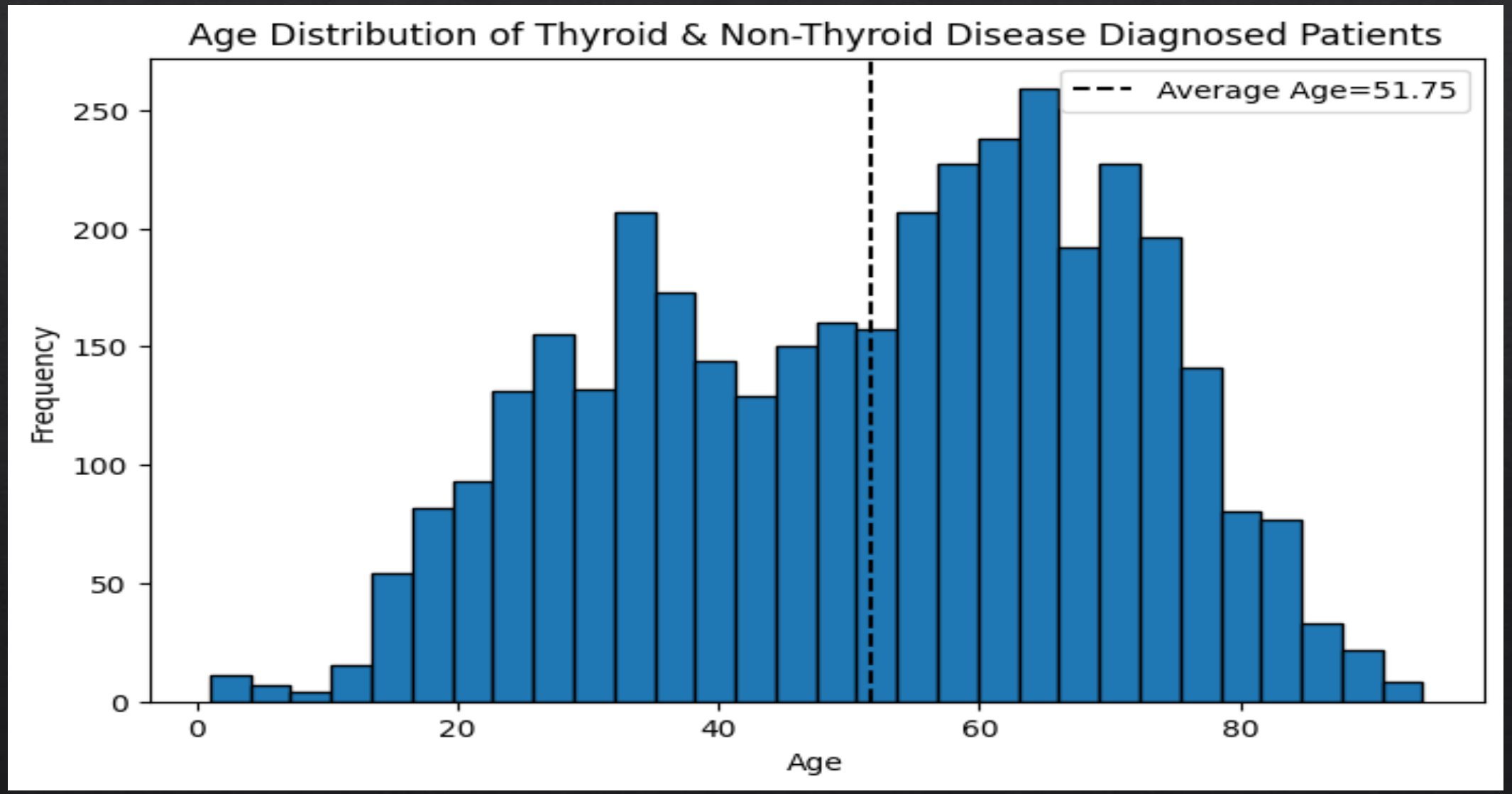
❑ Decision Support for Healthcare Professionals

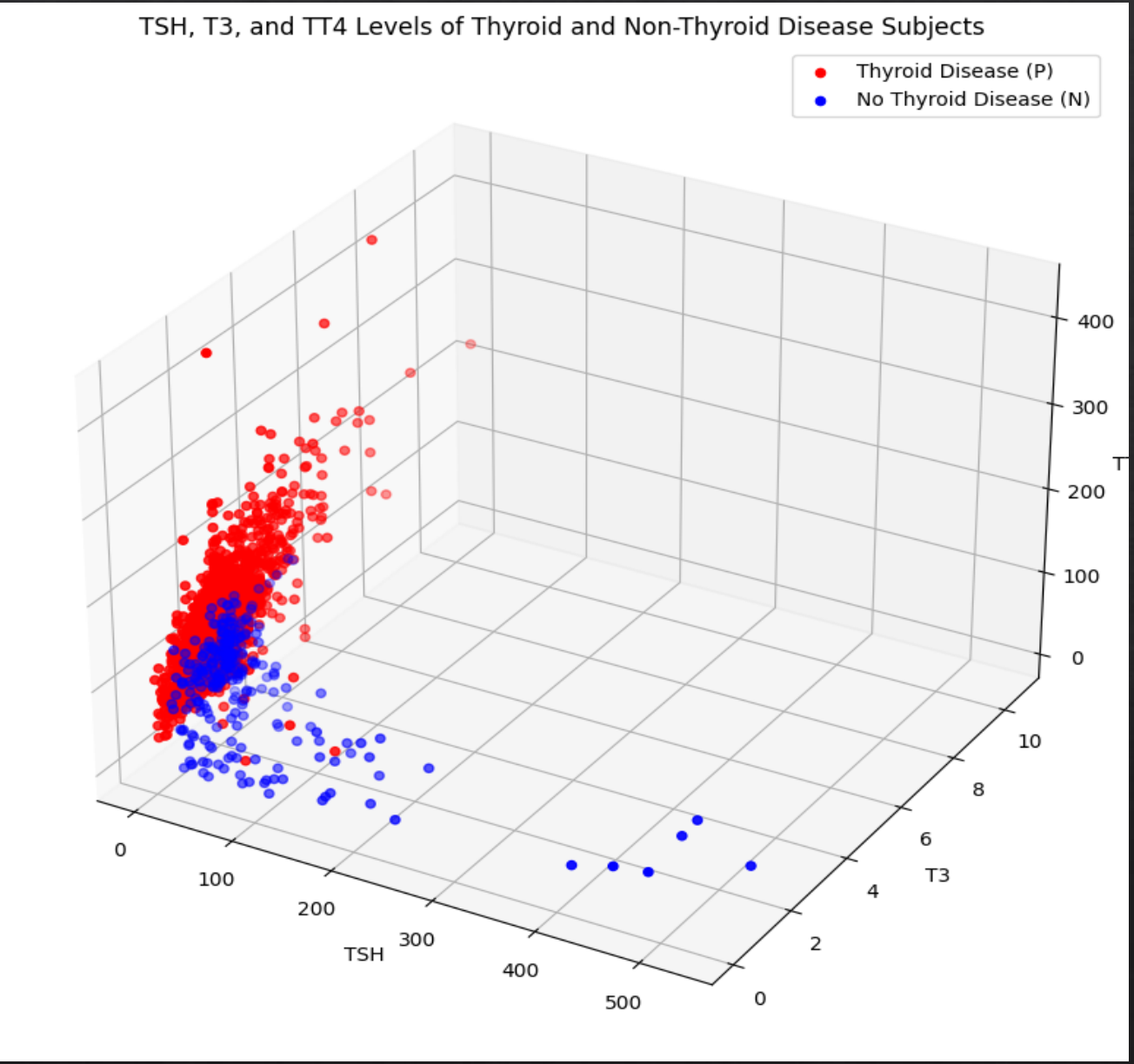
ML algo provides additional insights and predictions, that can assist doctors in making more informed and data-driven decisions, leading to better patient management.

The DATASET

Source: Thyroid Disease Data Set | Kaggle

(6 databases from the Garavan Institute in Sydney, Australia)


Age Distribution of Thyroid & Non-Thyroid Disease Diagnosed Patients
Average Age=51.75
Frequency
Age
0
50
100
150
200
250
0
20
40
60
80



Graphical presentation of the levels of the 3 primary hormone used in diagnosing thyroid disease (**TSH, T3 & TT4**)

https://www.mayoclinic.org/diseases-conditions/hyperthyroidism/diagnosis-treatment/drc-20373665#:~:text=Diagnosis%201%20Medical%20history%20and%20physical%20exam.%20During,TSH%20is%20common%20in%20people%20with%20hyperthyroidism.%20

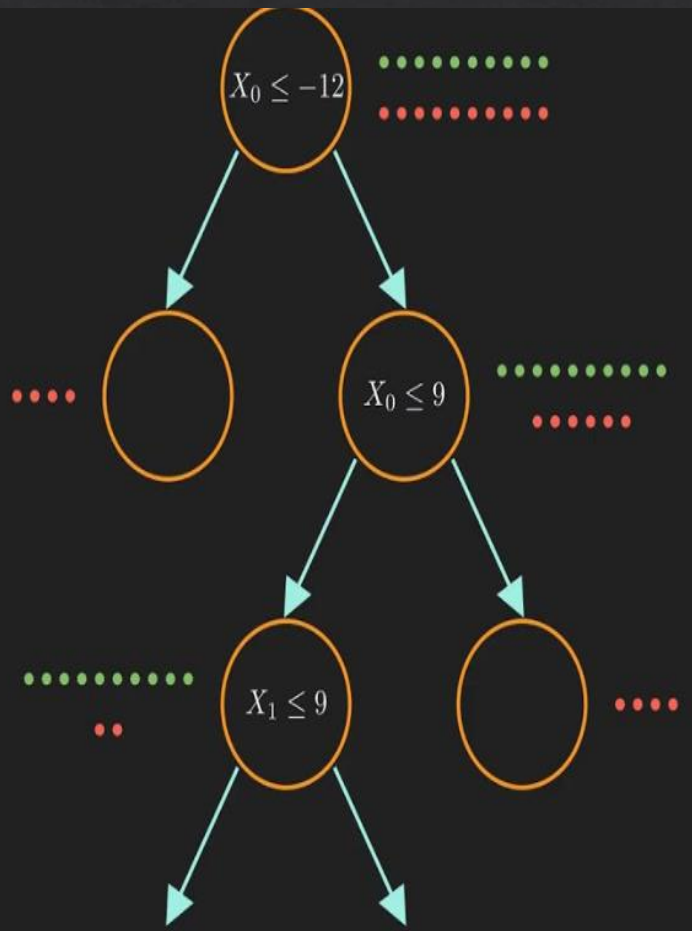
The way to get started is to quit talking and begin doing.

-Walt Disney-

Lets to dive to our ML MODELS

FIRST MODEL

Decision Tree Classifier



BASE MODEL

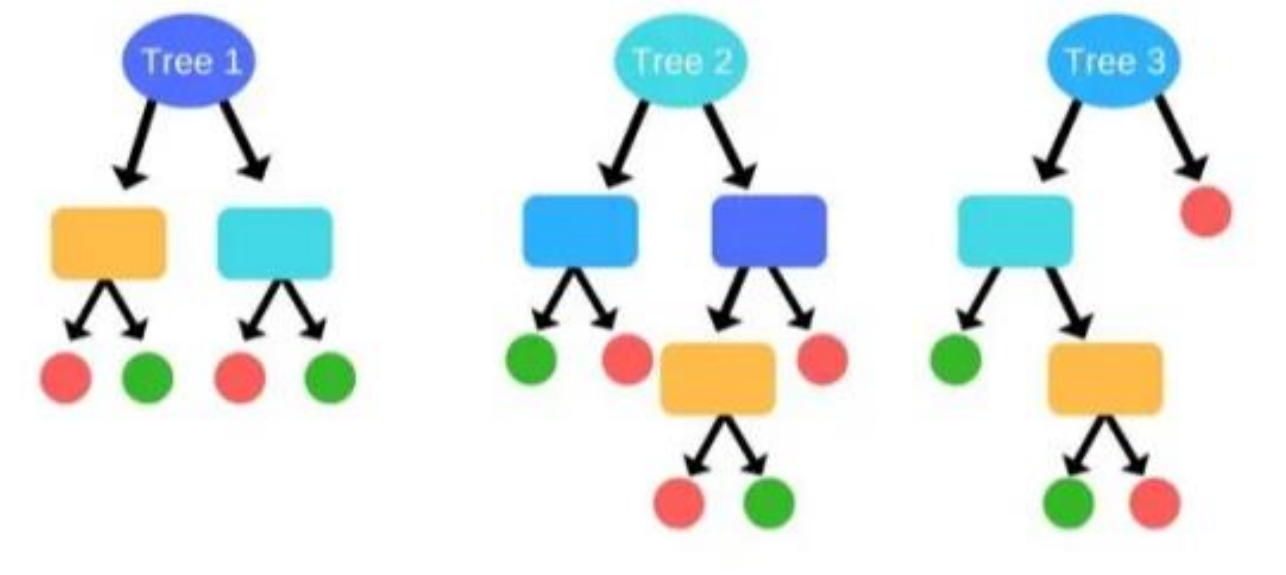
Run time:	62 ms
Precision:	82% / 82%
Recall:	82% / 82%
Accuracy:	81.91%

TUNED MODEL

Run time:	2 mins 1 sec
Precision:	80% / 87%
Recall:	89% / 77%
Accuracy:	82.03%

SECOND MODEL

RANDOM FOREST CLASSIFIER



BASE MODEL

Run time: 1.44 s

Precision: 92% / 92%

Recall: 92% / 92%

Accuracy: 91.94%

TUNED MODEL

Run time: 1min 2s

Precision: 91% / 93%

Recall: 94% / 91%

Accuracy: 91.25%

THIRD MODEL

K NEAREST NEIGHBOR

KNN WITH PCA APPLIED MODEL

Run time: 26.9 ms

Precision: 76% / 93%

Recall: 95% / 70%

Accuracy: 82.50%

KNN WITHOUT PCA APPLIED MODEL

Run time: 1min 2s

Precision: 77% / 94%

Recall: 96% / 70%

Accuracy: 83.02%

THIRD MODEL

K NEAREST NEIGHBOR

KNN WITH PCA APPLIED MODEL

Run time: 26.9 ms

Precision: 76% / 93%

Recall: 95% / 70%

Accuracy: 82.50%

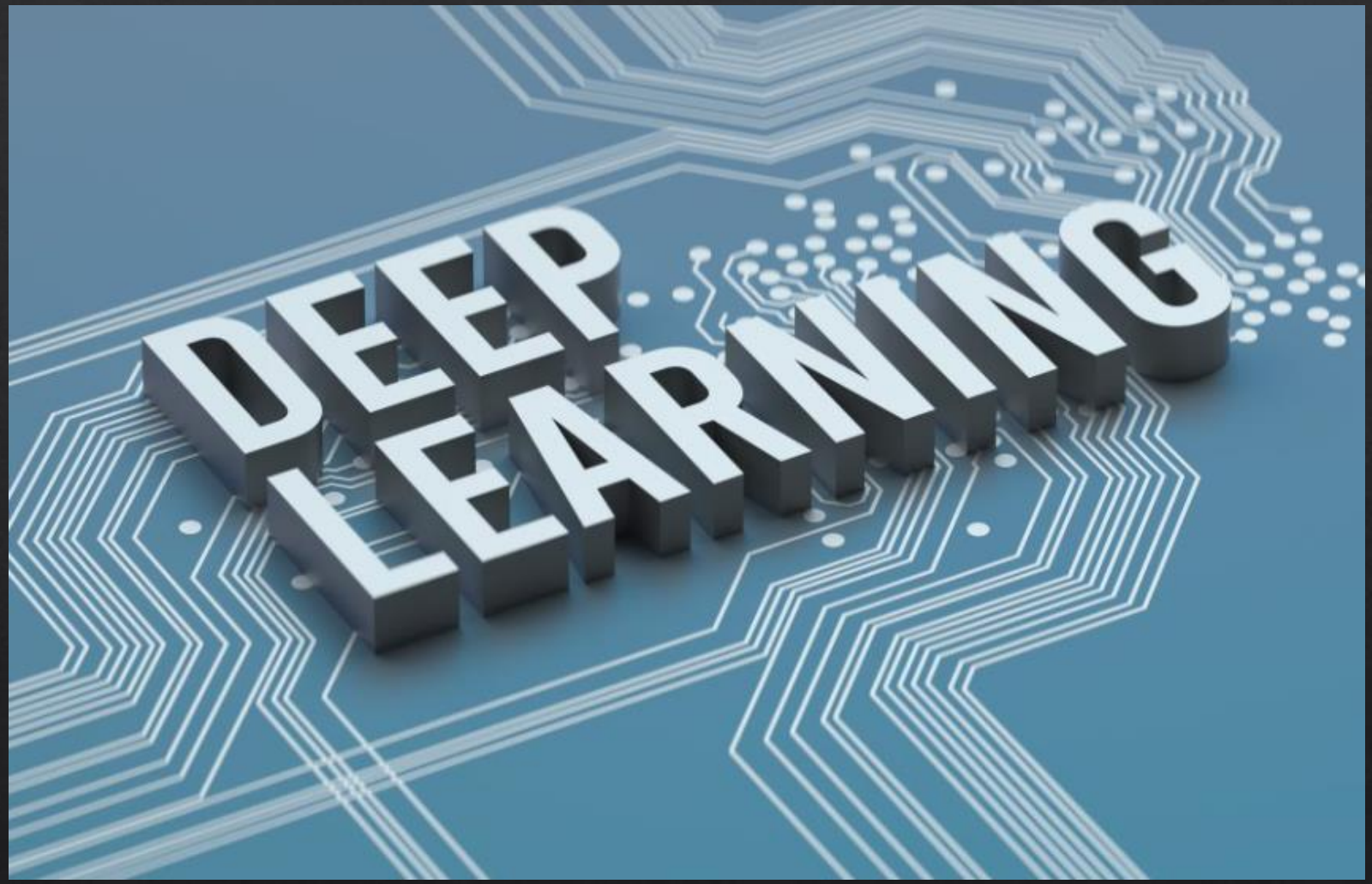
KNN WITHOUT PCA APPLIED MODEL

Run time: 1min 2s

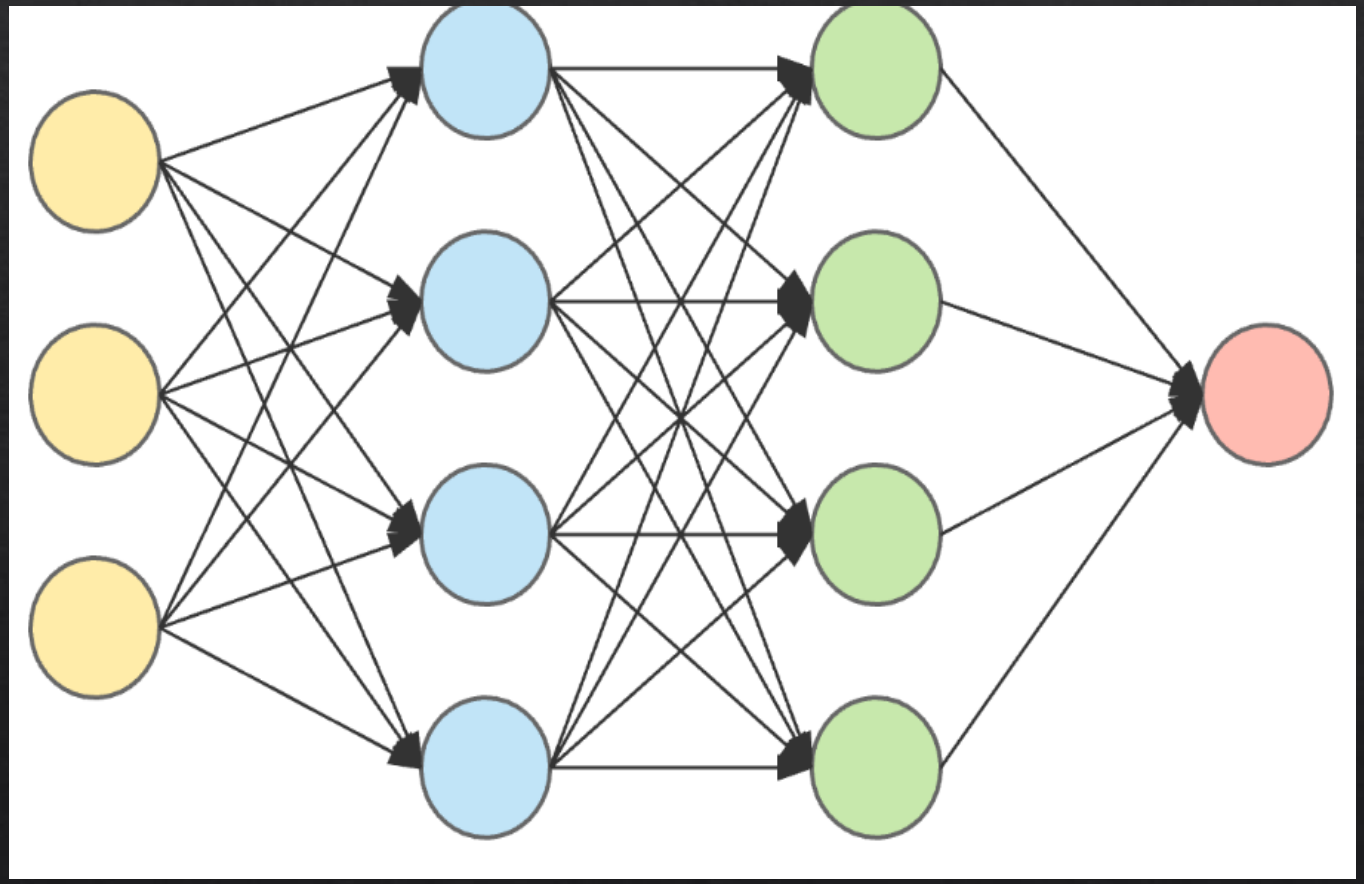
Precision: 77% / 94%

Recall: 96% / 70%

Accuracy: 83.02%


DEEP
LEARNING

SEQUENTIAL MODEL



2 LAYERS

Run time: 17.1 s

Precision: 83% / 81%

Recall: 81% / 83%

Accuracy: 82%

3 LAYERS

Run time: 53 s

Precision: 83% / 91%

Recall: 93% / 81%

Accuracy: 87%

3 LAYERS - WITH EARLY STOPPING

Run time: 34.6 s

Precision: 86% / 92%

Recall: 92% / 85%

Accuracy: 89%

MODEL RESULTS SUMMARY AND COMPARISON
TRAINING AND TESTING SCORES

DECISION TREE MODEL
Training Score: 1.0000
Testing Score: 0.8191

DECISION TREE MODEL-TUNED
Training Score: 0.9716
Testing Score: 0.8203

RANDOM FOREST MODEL
Training Score: 1.0000
Testing Score: 0.9195

RANDOM FOREST MODEL-TUNED
Training Score: 0.9893
Testing Score: 0.9125

KNN MODEL-WITH PCA
Training Score: 0.8802
Testing Score: 0.8250

KNN MODEL-WITHOUT PCA
Training Score: 0.8868
Testing Score: 0.8302

SEQUENTIAL MODEL-2 LAYERS
Training Score: 0.8746
Testing Score: 0.8221

SEQUENTIAL MODEL-3 LAYERS
Training Score: 0.9166
Testing Score: 0.8664

SEQUENTIAL MODEL-3 LAYERS-WITH EARLY STOPPING
Training Score: 0.8893
Testing Score: 0.8396

The Random Forest Model and its tuned version achieved the highest testing scores of 0.9195 and 0.9125, respectively. These models demonstrated strong predictive capabilities and performed well on unseen data, indicating good generalization. However, they also achieved perfect training scores, suggesting potential overfitting.

The Decision Tree models showed slightly lower testing scores compared to the Random Forest models, but they exhibited better generalization, especially the tuned version.

The KNN models provided moderate performance, with the KNN model without PCA achieving a slightly higher testing score (0.8302) compared to the one with PCA (0.8250).

The Sequential Neural Network models had varying results, with the 3-layer Sequential Model achieving the best testing score (0.8664).

Combining the strengths of different machine learning models and continually refining the model's performance can lead to accurate and robust thyroid disease prediction. In order to achieve this, additional steps must be taken including **DATA COLLECTION** and **REAL WORLD TESTING.**

Regular updates and additional relevant data can help keep the model up-to-date and ensure its continued effectiveness in predicting thyroid disease. We must ensure a comprehensive and high-quality dataset for training and evaluation.

After finalizing the model, conduct real-world testing on independent datasets or integrate it into a healthcare setting for further validation. Regular performance monitoring and updates based on real-world feedback will help maintain the model's effectiveness over time.

QUESTIONS

Thank you