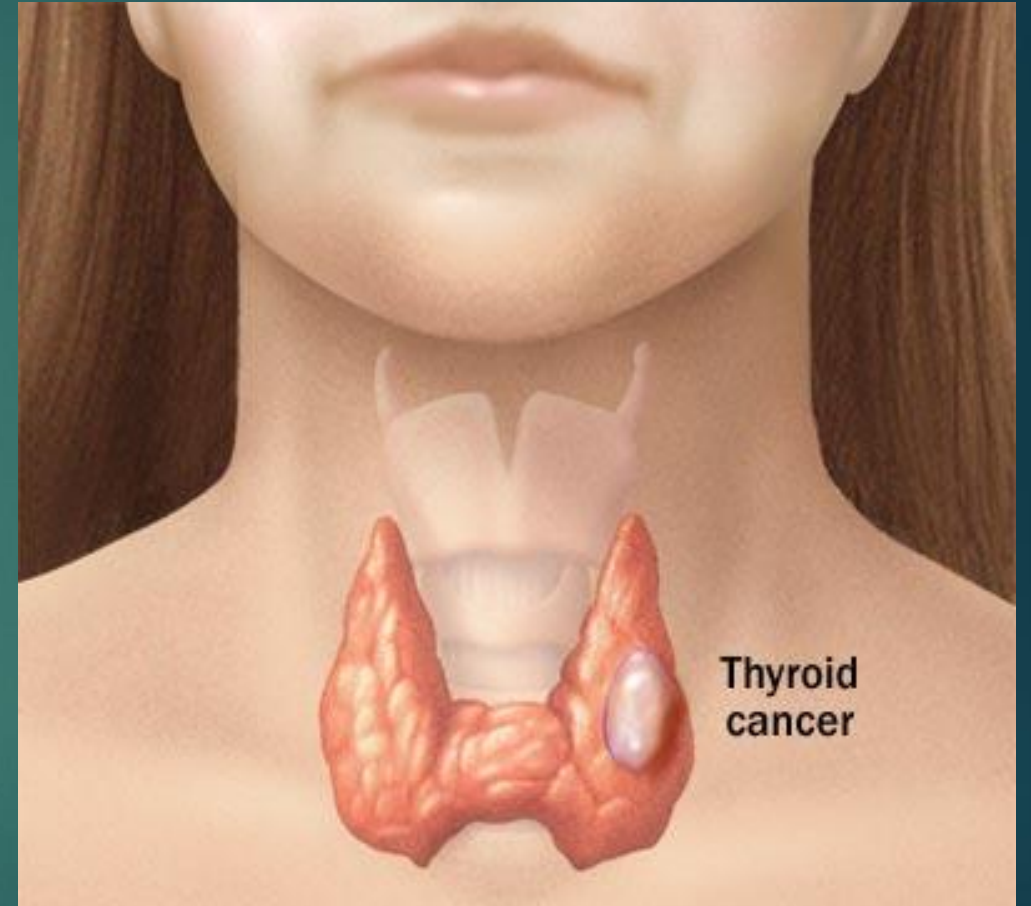# A CNN (CONVOLUTIONAL NEURAL NETWORK) MODEL PREDICTING DIFFERENT TYPES OF THYROID CANCER

Thyroid cancer

INTRODUCTION

▶ The model detects three types of thyroid cancer using convolutional neural network that works with ultrasound images data we used

▶ The types of the thyroid cancer that the model predict is: Follicular Thyroid cancer(FTC), Medullary Thyroid Cancer(MTC), Papillary Thyroid cancer(PTC)

▶ We used 298 ultra sound labelled images (FTC-100, MTC-99, PTC-99) to train the model which is split to 80%(238) for training and 20% (60) for validation test

▶ The link of the data set used is here below:

https://huggingface.co/datasets/FangDai/Thyroid_Ultrasound_Images

MODEL ARCHITECTURE

▶ Step 1: To Load the Dataset : We used a public dataset from Hugging Face with thyroid ultrasound images. We logged in with our Hugging Face token to access . Then Loaded all the images and Split them into 80% for training and 20% for testing

▶ Step 2: Preparing the Images: Converted images to color (RGB). Resized them to 224x224 pixels (same size). Divided pixel values by 255 so the values are between 0 and 1 (normalization).

▶ Step 3: Converting Data for Tensor Flow: We changed the dataset format to Tensor Flow so that we could use it for training the model.

MODEL ARCHITECTURE(continuation)

▶ Step 4: Building the Model: we created a simple CNN (Convolutional Neural Network) with 3 layers that learn image features. And a final layer that predict one of the 3 cancer types.

1. Conv2D Layer 1 Function: Learns basic features (edges, color changes).

2. Conv2D Layer 2 Function: Learns more complex features (shapes, corners).

3. Conv2D Layer 3 Function: Learns high-level features (tumor structure, texture).

▶ Each of these is followed by a pooling layer: max_pooling2d, max_pooling2d_1, and global_average_pooling2d respectively.

MODEL ARCHITECTURE(continuation)

► MaxPooling2D: Reduces the spatial size of the image while keeping important features. This helps speed up learning and reduce noise.

► GlobalAveragePooling2D: Greatly reduces the number of parameters by averaging each feature map, which helps prevent overfitting.

► The final layer is Dense layer with softmax activation. This layer has 3 neurons (one for each class: FTC, MTC, and PTC) and uses the softmax activation function to output a probability distribution across the 3 classes. The class with the highest probability is the predicted class.

MODEL ARCHITECTURE(continuation)

► Step 5: Training the Model, we trained the model on the training data. We used: Early stopping (to stop training if it stops improving). Model saving (to keep the best version). Learning rate control (to slow down learning if needed).

► Step 6: Testing the Model After training: we tested the model on the 20% validation set, we checked how many images it predicted correctly. We printed a report showing how good the predictions were and we printed a confusion matrix to see where it made mistakes.

PREDICTION RESULT

▶ The results the model predicted out of the 20% for the validation set is here below:

▶ Predicted FTC : 18 images were correctly classified as FTC, 3 were wrongly predicted as MTC, 1 was wrongly predicted as PTC.

▶ Predicted MTC : 15 correctly classified as MTC, 1 wrongly classified as FTC.

▶ Predicted PTC : All 22 were correctly classified. No errors here.

MODEL PERFORMANCE METRICS

- ▶ Precision: Of the samples predicted as a certain class, how many were actually correct? High precision means few false positives.

- ▶ Recall: Of the actual instances of a class, how many were correctly predicted? High recall means few false negatives.

- ▶ F1-Score : Harmonic mean of precision and recall. Balances both false positives and false negatives.

- ▶ Support : The number of true instances for each class in the test set

- ▶ Macro Avg (treats all classes equally)

- ▶ Weighted Avg (accounts for class imbalance)

- ▶ Overall Performance: Accuracy : 0.92 → **The model correctly classified 92% of all 60 validation set.**

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Classification Report:

              precision  recall  f1-score  support

        FTC      0.95      0.82     0.88        22

        MTC      0.83      0.94     0.88        16

        PTC      0.96      1.00     0.98        22


   accuracy                        0.92        60

  macro avg      0.91      0.92     0.91        60

weighted avg     0.92      0.92     0.92        60
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