MEDICAL IMAGE ANALYSIS-PROJECT

HIPPOCAMPUS REGION SEGMENTATION

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Introduction:

- The hippocampus is a vital and complex structure located within the medial temporal lobe of the brain. It plays a crucial role in various cognitive functions and is particularly associated with memory formation and spatial navigation.
- The hippocampus consists of two curved structures, one in each hemisphere of the brain, and is often divided into regions like the dentate gyrus, the hippocampal CA1, CA2, and CA3 subfields, and the subiculum.
- The hippocampus is primarily associated with the formation and consolidation of declarative memories, which include facts and events. It acts as a key player in the transition of short-term memory to long-term memory.

Importance of segmenting the hippocampus region:

- The hippocampus is one of the earliest and most affected regions in Alzheimer's disease. Accurate segmentation aids in early diagnosis and monitoring disease progression.
- In cases of epilepsy, the hippocampus is often involved. Precise segmentation helps identify abnormalities and plan surgical interventions.

DATA SET :

ADNI dataset

Images -260

Masks-260

Total files(NIFTI files to png files(transverse plane images))

Images-9270

Masks-9270

Proceedings of the project:

- **Rescaling**

- **Converting the (NIFTI) nii.giz files to png(transverse plane) format**

- **Data generator class**

- **Loading the image and mask files**

- **Defining the UNET model**

- **Train-Test data splitting**

- **Defining custom metrics and losses(IOU,Dice coefficient and IoU,Dice Loss)**

- **Compiling the model and Training the model**

- **Loading the best weights**

- **Evaluating and predicting the model**

- **Visual prediction of the model**

- **Intersection over Union (IoU):**
  - IoU is a measure of the overlap between the predicted and true segmentation masks. It is calculated as the ratio of the area of overlap (intersection) to the area of union between the predicted and true masks.
  - IoU=Area of Overlap/Area of Union
  - **Range:** The IoU score ranges from 0 to 1, where 0 indicates no overlap, and 1 indicates a perfect match between the predicted and true masks.
  - **Interpretation:** A higher IoU score indicates better segmentation performance.
- **Dice Loss:**
  - Dice Loss, also known as the Sørensen-Dice coefficient, is another metric used to assess the similarity between two sets. In the context of image segmentation, it measures the similarity between the predicted and true masks.
  - **Range:** The Dice coefficient ranges from 0 to 1.
  - Dice=2xarea of Overlap / (area of predicted mask + area of original mask)
  - **Interpretation:** A higher Dice coefficient indicates better segmentation performance. Dice Loss, which is commonly used as a loss function during model training, is calculated as 1-dice

Model used: Unet

- **Architecture:** It features a U-shaped structure with a contracting path (encoder) and an expansive path (decoder).

- **Encoder:** The encoder captures features and context through convolutional and pooling layers, reducing spatial resolution.

- **Decoder:** The decoder up samples the encoded features, recovering spatial details and generating a segmentation mask.

- **Skip Connections:** U-Net uses skip connections to preserve fine-grained details by connecting corresponding layers in the encoder and decoder.

- **Applications:** Commonly used for tasks like medical image segmentation, where precise localization of objects is crucial.
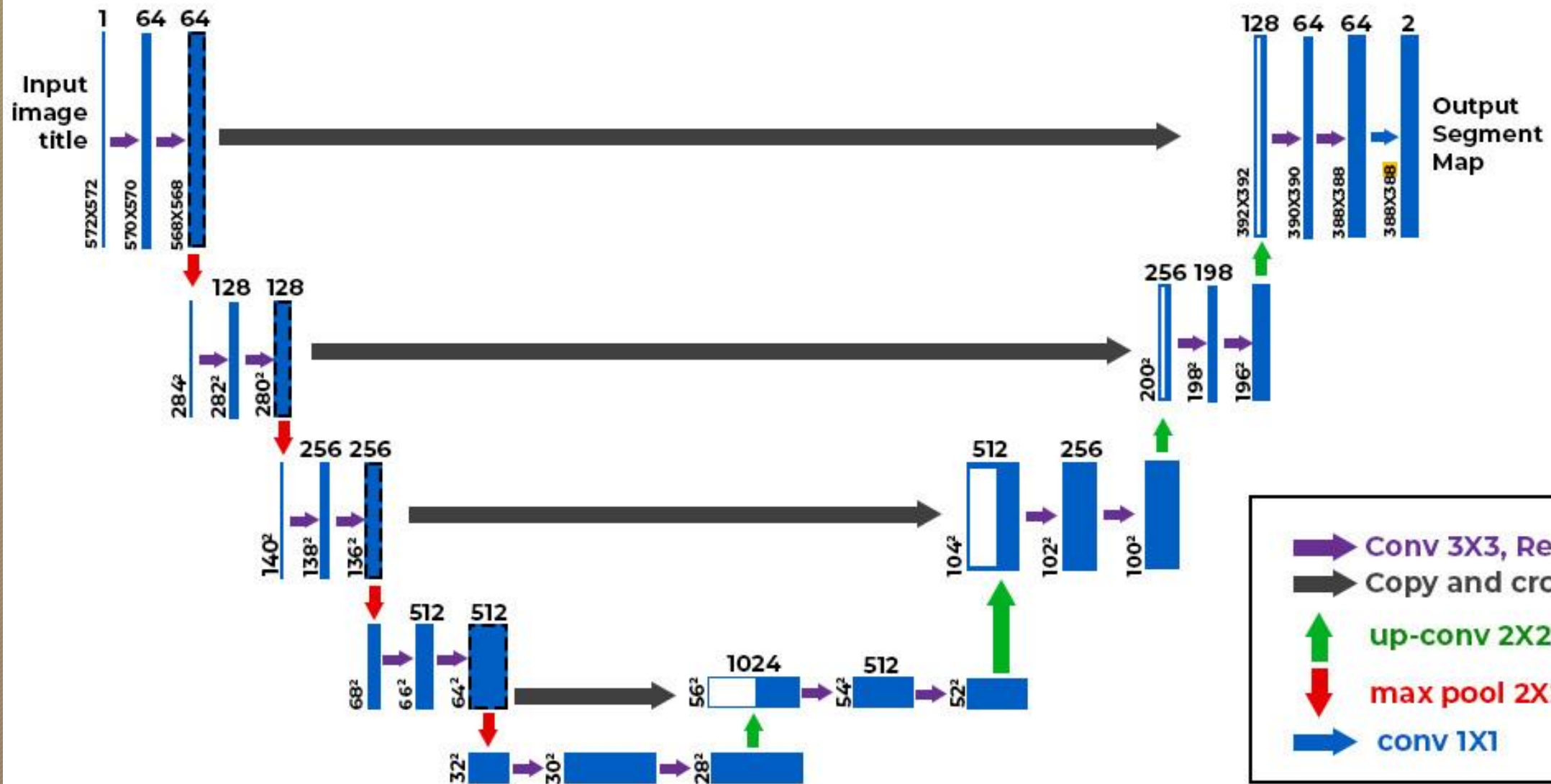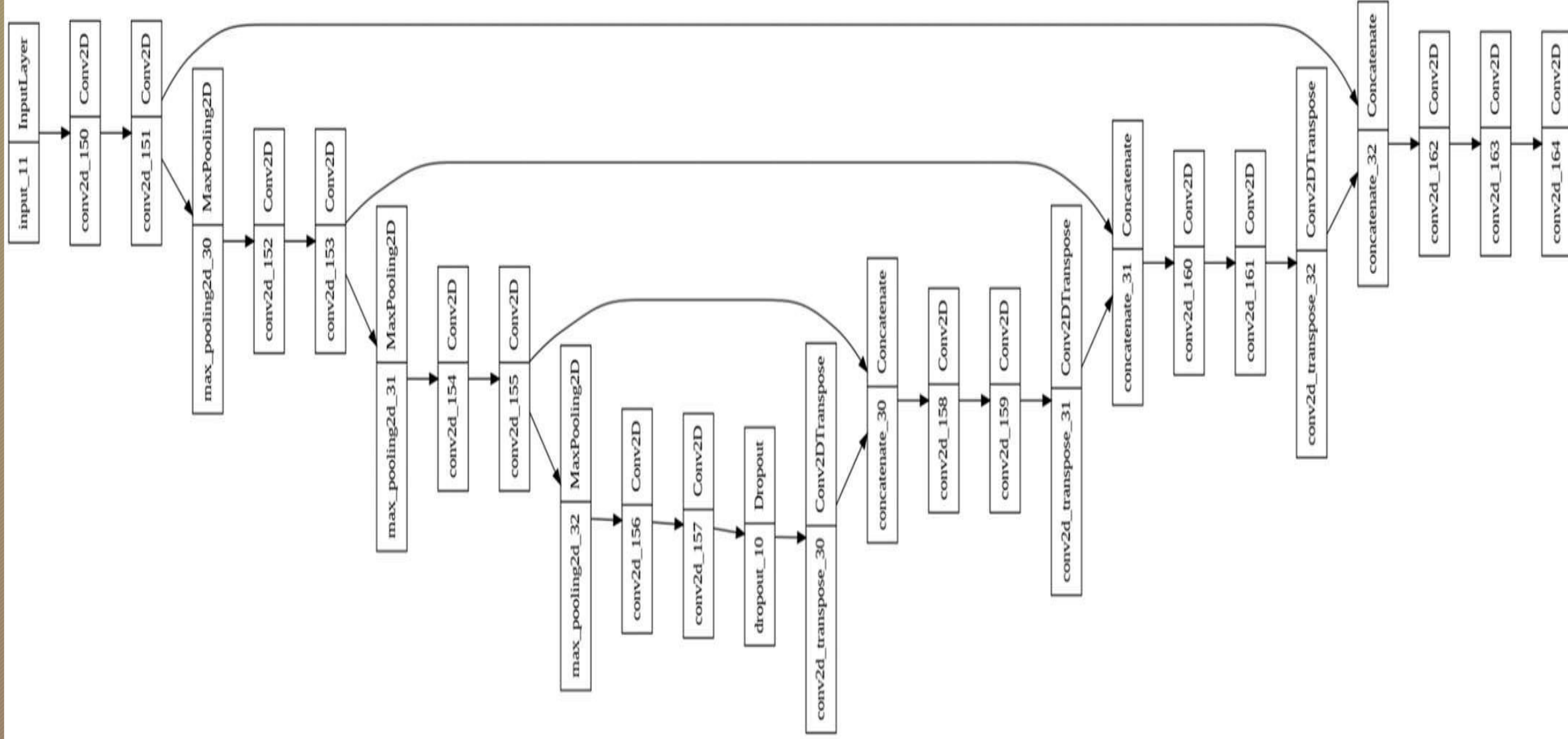
RESULTS

```
pred = model.evaluate(DataGenerator(image_test, mask_test))

28/28 [==============================] - 5s 170ms/step - loss: 0.1447 - iou: 0.7475 - dice_coefficient: 0.8553
```

Hippocampus region segmentation	
Loss function	Dice loss
Activation function	AdamW(with 0.0001 learning rate)
Epochs	20(given) after 11th epoch the loss and iou,dice coefficient stabilizes and then the loss increases from 13th epoch onwards
Batch size	32
Dice coeffiecient	0.8553
Intersection Over union(IoU)	0.7475
loss	0.1447

Prediction results

Original image original label predicted label