#Topic: segment the OASIS brain dataset with improved UNet Name: zhengzhao li student number: 45542976

#Description The segmentation of brain tumors is critical to the clinic, and manual segmentation is very cumbersome, so I have worked hard in developing segmentation algorithms form of Convolutional Neural Network My network architecture is inspired by the U-Net and has been carefully modified to maximize the performance of brain tumor segmentation. I use dice loss function Cope with class imbalance and use extensive data augmentation to successfully prevent overfitting.

#How it works I divided this project into five parts. The first part is to create a data loader to load the data and images I need. The second part is to create a model, I create convolutional layer according to the model given by the pdf, and the dice similarity coefficient with an accuracy of 0.9. The third part is model training, I plot the training and validation loss and accuracy. The fourth part is the visual prediction. I will first load the data and then print out the image/prediction/ground truth of the data. and the fifth part is Get the segmentation metrics, I randomly select an image and Print out his prediction and ground truth.

#here is the output

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Model: "functional_1"
_____
Layer (type)                    Output Shape           Param #    Connected to
===============================================================================
input_4 (InputLayer)            [(None, 256, 256, 1) 0
_____
conv2d_53 (Conv2D)              (None, 256, 256, 16) 160        input_4[0][0]
_____
conv2d_54 (Conv2D)              (None, 256, 256, 16) 2320       conv2d_53[0][0]
_____
dropout_12 (Dropout)            (None, 256, 256, 16) 0          conv2d_54[0][0]
_____
conv2d_55 (Conv2D)              (None, 256, 256, 16) 2320       dropout_12[0][0]
_____
tf_op_layer_AddV2_14 (TensorFlo [(None, 256, 256, 16 0          conv2d_53[0][0]
                                                                 conv2d_55[0][0]
_____
conv2d_56 (Conv2D)              (None, 128, 128, 32) 4640       tf_op_layer_AddV2_14[0][0]
_____
conv2d_57 (Conv2D)              (None, 128, 128, 32) 9248       conv2d_56[0][0]
_____
dropout_13 (Dropout)            (None, 128, 128, 32) 0          conv2d_57[0][0]
_____
conv2d_58 (Conv2D)              (None, 128, 128, 32) 9248       dropout_13[0][0]
_____
tf_op_layer_AddV2_15 (TensorFlo [(None, 128, 128, 32 0          conv2d_56[0][0]
                                                                 conv2d_58[0][0]
_____
conv2d_59 (Conv2D)              (None, 64, 64, 64)   18496      tf_op_layer_AddV2_15[0][0]
_____
conv2d_60 (Conv2D)              (None, 64, 64, 64)   36928      conv2d_59[0][0]
_____
dropout_14 (Dropout)            (None, 64, 64, 64)   0          conv2d_60[0][0]
_____
conv2d_61 (Conv2D)              (None, 64, 64, 64)   36928      dropout_14[0][0]
_____
tf_op_layer_AddV2_16 (TensorFlo [(None, 64, 64, 64)] 0          conv2d_59[0][0]
                                                                 conv2d_61[0][0]
_____
conv2d_62 (Conv2D)              (None, 32, 32, 128)  73856      tf_op_layer_AddV2_16[0][0]
_____
conv2d_63 (Conv2D)              (None, 32, 32, 128)  147584     conv2d_62[0][0]
_____
dropout_15 (Dropout)            (None, 32, 32, 128)  0          conv2d_63[0][0]
_____
conv2d_64 (Conv2D)              (None, 32, 32, 128)  147584     dropout_15[0][0]
_____
tf_op_layer_AddV2_17 (TensorFlo [(None, 32, 32, 128) 0          conv2d_62[0][0]
                                                                 conv2d_64[0][0]
_____
conv2d_65 (Conv2D)              (None, 16, 16, 256)  295168     tf_op_layer_AddV2_17[0][0]
_____
conv2d_66 (Conv2D)              (None, 16, 16, 256)  590080     conv2d_65[0][0]
_____
dropout_16 (Dropout)            (None, 16, 16, 256)  0          conv2d_66[0][0]
_____
conv2d_67 (Conv2D)              (None, 16, 16, 256)  590080     dropout_16[0][0]
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tf_op_layer_AddV2_18 (TensorFlo [(None, 16, 16, 256) 0          conv2d_65[0][0]
                                                                 conv2d_67[0][0]
_____
up_sampling2d_6 (UpSampling2D)  (None, 32, 32, 256)  0          tf_op_layer_AddV2_18[0][0]
_____
conv2d_68 (Conv2D)              (None, 32, 32, 128)  295040     up_sampling2d_6[0][0]
_____
concatenate_4 (Concatenate)     (None, 32, 32, 256)  0          tf_op_layer_AddV2_17[0][0]
                                                                 conv2d_68[0][0]
_____
conv2d_69 (Conv2D)              (None, 32, 32, 128)  295040     concatenate_4[0][0]
_____
conv2d_70 (Conv2D)              (None, 32, 32, 128)  16512      conv2d_69[0][0]
_____
up_sampling2d_7 (UpSampling2D)  (None, 64, 64, 128)  0          conv2d_70[0][0]
_____
conv2d_71 (Conv2D)              (None, 64, 64, 64)   73792      up_sampling2d_7[0][0]
_____
concatenate_5 (Concatenate)     (None, 64, 64, 128)  0          tf_op_layer_AddV2_16[0][0]
                                                                 conv2d_71[0][0]
_____
conv2d_72 (Conv2D)              (None, 64, 64, 64)   73792      concatenate_5[0][0]
_____
conv2d_73 (Conv2D)              (None, 64, 64, 64)   4160       conv2d_72[0][0]
_____
up_sampling2d_9 (UpSampling2D)  (None, 128, 128, 64) 0          conv2d_73[0][0]
_____
conv2d_75 (Conv2D)              (None, 128, 128, 32) 18464      up_sampling2d_9[0][0]
_____
concatenate_6 (Concatenate)     (None, 128, 128, 64) 0          tf_op_layer_AddV2_15[0][0]
                                                                 conv2d_75[0][0]
_____
conv2d_76 (Conv2D)              (None, 128, 128, 32) 18464      concatenate_6[0][0]
_____
conv2d_77 (Conv2D)              (None, 128, 128, 32) 1056       conv2d_76[0][0]
_____
up_sampling2d_10 (UpSampling2D) (None, 256, 256, 32) 0          conv2d_77[0][0]
_____
conv2d_79 (Conv2D)              (None, 256, 256, 16) 4624       up_sampling2d_10[0][0]
_____
conv2d_74 (Conv2D)              (None, 64, 64, 16)   1040       conv2d_73[0][0]
_____
concatenate_7 (Concatenate)     (None, 256, 256, 32) 0          tf_op_layer_AddV2_14[0][0]
                                                                 conv2d_79[0][0]
_____
up_sampling2d_8 (UpSampling2D)  (None, 128, 128, 16) 0          conv2d_74[0][0]
_____
conv2d_78 (Conv2D)              (None, 128, 128, 16) 528        conv2d_77[0][0]
_____
conv2d_80 (Conv2D)              (None, 256, 256, 32) 9248       concatenate_7[0][0]
_____
tf_op_layer_AddV2_19 (TensorFlo [(None, 128, 128, 16 0          up_sampling2d_8[0][0]
                                                                 conv2d_78[0][0]
_____
conv2d_81 (Conv2D)              (None, 256, 256, 16) 528        conv2d_80[0][0]

_____
up_sampling2d_11 (UpSampling2D) (None, 256, 256, 16) 0          tf_op_layer_AddV2_19[0][0]
_____
tf_op_layer_AddV2_20 (TensorFlo [(None, 256, 256, 16 0          conv2d_81[0][0]
                                                                 up_sampling2d_11[0][0]
_____
conv2d_82 (Conv2D)              (None, 256, 256, 16) 272        tf_op_layer_AddV2_20[0][0]
================================================================================================
Total params: 2,777,200
Trainable params: 2,777,200
Non-trainable params: 0
_____
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--------------------------------------------------------------------------------------
up_sampling2d_11 (UpSampling2D) (None, 256, 256, 16) 0          tf_op_layer_AddV2_19[0][0]
--------------------------------------------------------------------------------------
tf_op_layer_AddV2_20 (TensorFlo [(None, 256, 256, 16 0          conv2d_81[0][0]
                                                                up_sampling2d_11[0][0]
--------------------------------------------------------------------------------------
conv2d_82 (Conv2D)              (None, 256, 256, 16) 272        tf_op_layer_AddV2_20[0][0]
======================================================================================
Total params: 2,777,200
Trainable params: 2,777,200
Non-trainable params: 0
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