Please use this report template, and upload it in the PDF format. Reports in other forms/formats will result in ZERO point. Reports written in either Chinese or English is acceptable. The length of your report should NOT exceed 6 pages (**excluding bonus**).

Name: 林志皓　Dep.: 電機系大三　Student ID:B0491069

1. (5%) Print the network architecture of your VGG16-FCN32s model.

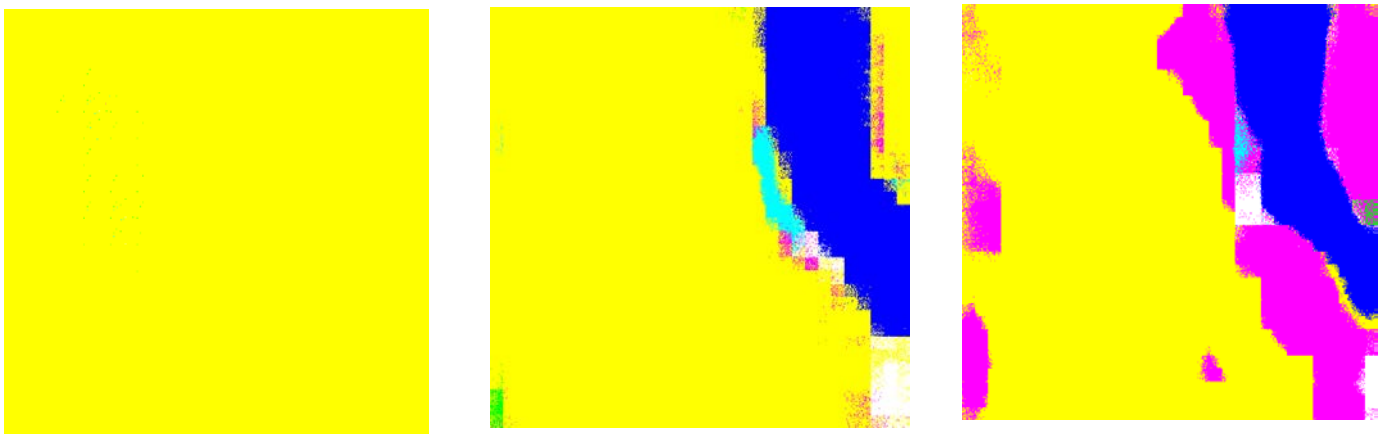
Layer (type)	Output Shape	Param #
block1_conv1 (Conv2D)	(None, 512, 512, 64)	1792
block1_conv2 (Conv2D)	(None, 512, 512, 64)	36928
max_pooling2d_1 (MaxPooling2	(None, 256, 256, 64)	0
block2_conv1 (Conv2D)	(None, 256, 256, 128)	73856
block2_conv2 (Conv2D)	(None, 256, 256, 128)	147584
max_pooling2d_2 (MaxPooling2	(None, 128, 128, 128)	0
block3_conv1 (Conv2D)	(None, 128, 128, 256)	295168
block3_conv2 (Conv2D)	(None, 128, 128, 256)	590080
block3_conv3 (Conv2D)	(None, 128, 128, 256)	590080
max_pooling2d_3 (MaxPooling2	(None, 64, 64, 256)	0
block4_conv1 (Conv2D)	(None, 64, 64, 512)	1180160
block4_conv2 (Conv2D)	(None, 64, 64, 512)	2359808
block4_conv3 (Conv2D)	(None, 64, 64, 512)	2359808
max_pooling2d_4 (MaxPooling2	(None, 32, 32, 512)	0
block5_conv1 (Conv2D)	(None, 32, 32, 512)	2359808
block5_conv2 (Conv2D)	(None, 32, 32, 512)	2359808
block5_conv3 (Conv2D)	(None, 32, 32, 512)	2359808
max_pooling2d_5 (MaxPooling2	(None, 16, 16, 512)	0
conv2d_1 (Conv2D)	(None, 16, 16, 4096)	8392704
dropout_1 (Dropout)	(None, 16, 16, 4096)	0
conv2d_2 (Conv2D)	(None, 16, 16, 4096)	16781312
dropout_2 (Dropout)	(None, 16, 16, 4096)	0
conv2d_3 (Conv2D)	(None, 16, 16, 7)	28679
conv2d_transpose_1 (Conv2DTr	(None, 512, 512, 7)	200711

Total params: 40,118,094
Trainable params: 40,118,094
Non-trainable params: 0

2. (10%) Show the predicted segmentation mask of validation/0008_sat.jpg, validation/0097_sat.jpg, validation/0107_sat.jpg during the early, middle, and the final stage during the training stage. (For example, results of 1st, 10th, 20th epoch)

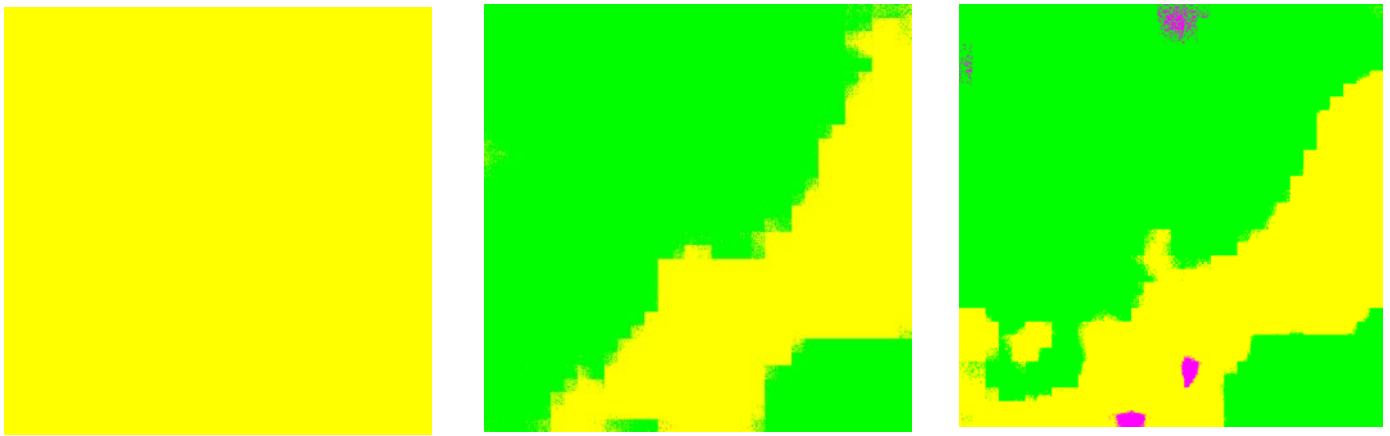
validation/0008_sat.jpg

1st epoch | 10th epoch | 15th epoch



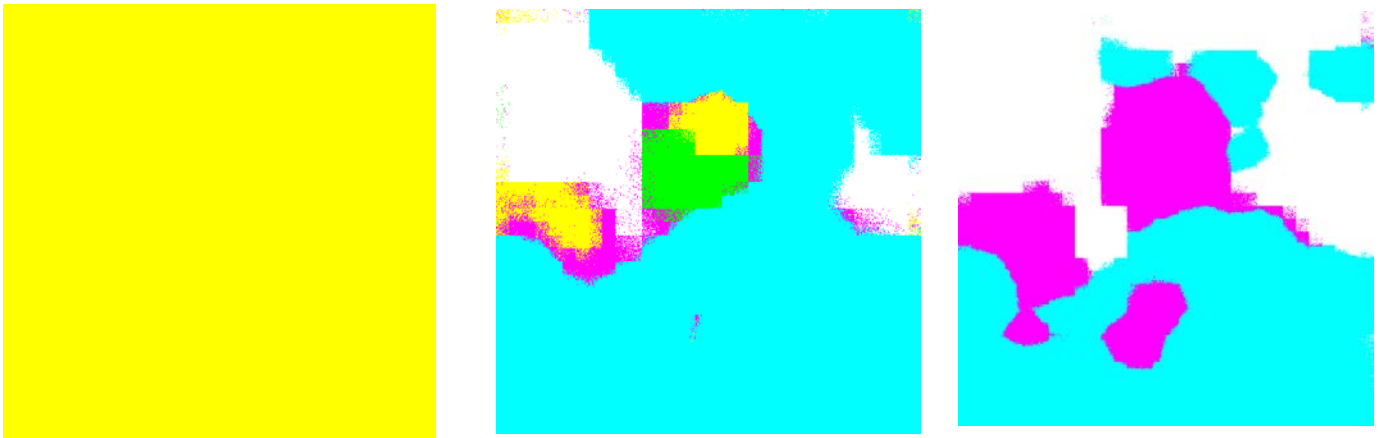
validation/0097_sat.jpg,

1st epoch | 10th epoch | 15th epoch



validation/0107_sat.jpg,

1st epoch | 10th epoch | 15th epoch



3. (15%) Implement an improved model which performs better than your baseline model. Print the network architecture of this model.

4. (10%) Show the predicted segmentation mask of validation/0008_sat.jpg, validation/0097_sat.jpg, validation/0107_sat.jpg during the early, middle, and the final stage during the training process of this improved model.

5. (15%) Report mIoU score of both models on the validation set. Discuss the reason why the improved model performs better than the baseline one. You may conduct some experiments and show some evidences to support your discussion.

mIoU score of my VGG16FCN is about 65% (in validation set). I'm sorry that I spent too much time to implement VGG16FCN so that I didn't implement a better model. But I had tried a great number of worse models…

6. (5%) [bonus] Calculate the result of d/dw G(w):

objective function:

$$G(\boldsymbol{w}) = -\sum_n \left[t^{(n)} \log \mathrm{x}(\boldsymbol{z}^{(n)}; \boldsymbol{w}) + (1 - t^n) \log\left(1 - \mathrm{x}(\boldsymbol{z}^{(n)}; \boldsymbol{w})\right)\right] \geq 0$$

$$\boldsymbol{w}^* = \arg\min_{\boldsymbol{w}} G(\boldsymbol{w})$$ choose the weights that minimise the network's surprise about the training data

$$\frac{\mathrm{d}}{\mathrm{d}\boldsymbol{w}} G(\boldsymbol{w}) = \sum_n \frac{\mathrm{d}G(\boldsymbol{w})}{\mathrm{d}x^{(n)}} \frac{\mathrm{d}x^{(n)}}{\mathrm{d}\boldsymbol{w}} = -\sum_n (t^{(n)} - x^{(n)}) \boldsymbol{z}^{(n)}$$ = prediction error x feature

$$\boldsymbol{w} \leftarrow \boldsymbol{w} - \eta \frac{\mathrm{d}}{\mathrm{d}\boldsymbol{w}} G(\boldsymbol{w})$$ iteratively step down the objective (gradient points up hill) 39