

1.structure

Layer (type)	Output Shape	Param #
input_1 (InputLayer)	(None, 512, 512, 3)	0
block1_conv1 (Conv2D)	(None, 512, 512, 64)	1792
block1_conv2 (Conv2D)	(None, 512, 512, 64)	36928
block1_pool (MaxPooling2D)	(None, 256, 256, 64)	0
block2_conv1 (Conv2D)	(None, 256, 256, 128)	73856
block2_conv2 (Conv2D)	(None, 256, 256, 128)	147584
block2_pool (MaxPooling2D)	(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
block3_pool (MaxPooling2D)	(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
block4_pool (MaxPooling2D)	(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
block5_pool (MaxPooling2D)	(None, 16, 16, 512)	0
conv2d_1 (Conv2D)	(None, 16, 16, 4096)	102764544
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)	200704


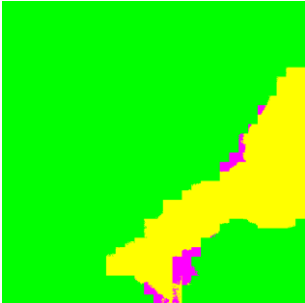
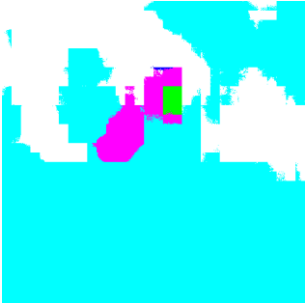

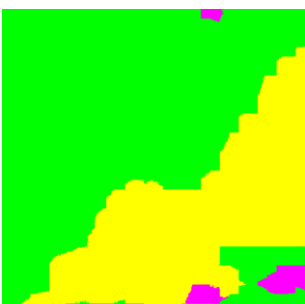
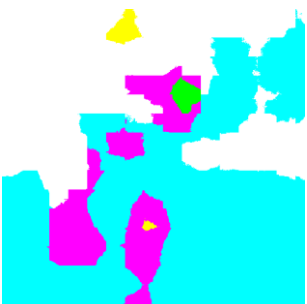

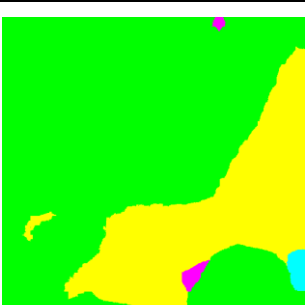
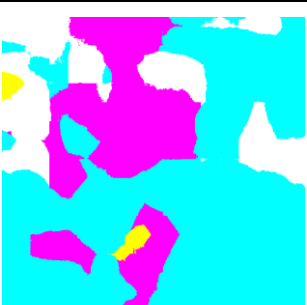
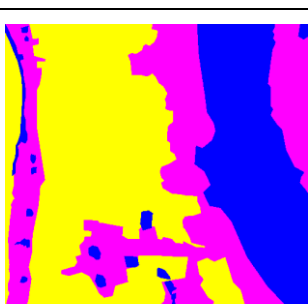
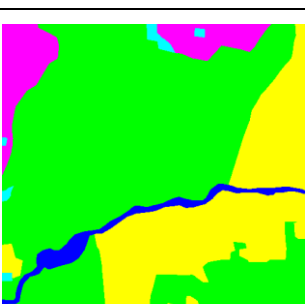
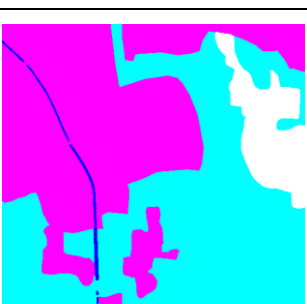
2.

 A map showing the predicted region for class 1 (blue) using FCN 2. The prediction is mostly correct but shows some noise and artifacts, particularly along the boundaries of the water body.	 A map showing the predicted region for class 2 (green) using FCN 2. The prediction is mostly correct but shows some noise and artifacts, particularly along the boundaries of the forest area.	 A map showing the predicted region for class 3 (red) using FCN 2. The prediction is mostly correct but shows some noise and artifacts, particularly along the boundaries of the urban area.	FCN 2
 A map showing the predicted region for class 1 (blue) using FCN 15. The prediction is more accurate than FCN 2, with smoother boundaries and less noise.	 A map showing the predicted region for class 2 (green) using FCN 15. The prediction is more accurate than FCN 2, with smoother boundaries and less noise.	 A map showing the predicted region for class 3 (red) using FCN 15. The prediction is more accurate than FCN 2, with smoother boundaries and less noise.	FCN 15
 A map showing the predicted region for class 1 (blue) using FCN 22. The prediction is very accurate, closely matching the ground truth, with very smooth boundaries and minimal noise.	 A map showing the predicted region for class 2 (green) using FCN 22. The prediction is very accurate, closely matching the ground truth, with very smooth boundaries and minimal noise.	 A map showing the predicted region for class 3 (red) using FCN 22. The prediction is very accurate, closely matching the ground truth, with very smooth boundaries and minimal noise.	FCN 22
 A map showing the ground truth prediction for class 1 (blue). The prediction is very accurate, closely matching the ground truth, with very smooth boundaries and minimal noise.	 A map showing the ground truth prediction for class 2 (green). The prediction is very accurate, closely matching the ground truth, with very smooth boundaries and minimal noise.	 A map showing the ground truth prediction for class 3 (red). The prediction is very accurate, closely matching the ground truth, with very smooth boundaries and minimal noise.	GT

3. Improved model

在本次作業中，我嘗試過了 Unet，不過效果不彰。後來我發現在本身 FCN32s 的架構上，引入 $\text{loss} = \text{weighted_categorical_crossentropy}$ 會有部分改善，mIoU 可以加高到 0.637，故架構同 1。

4.

			FCN32w 3
			FCN32w 11
			FCN32w 25
			GT

5. 我的 weight 計算方式是：

1. 統計 0~7 各類的 pixel 總和
2. 將上值取倒數（加權少的）再取 log，得到 weight
3. 將原本架構中的 categorical_crossentropy 換成

Weighted_categorical_crossentropy(weight)（自行改寫）

我會這樣做的原因，是因為發現很經常出現 class2 的 IoU 相對偏低，並猜測這種情況是由於資料不均衡所致（黃色太多）。因此，我嘗試引入 weighted 的 loss function，並取得了較好的結果，使 FCN32 突破了原本的限制，能繼續增長。

Bonus

$$\begin{aligned}
 x(z^{(n)}; w) &= \frac{1}{1 + \exp(-w \cdot z^{(n)})} \\
 \frac{d}{dw} G(w) &= \sum_n \frac{dG(w)}{dx^{(n)}} \frac{dx^{(n)}}{dw} \\
 &= - \sum_n \frac{d}{dx^{(n)}} \left[t^{(n)} \log x(z^{(n)}; w) + (1 - t^{(n)}) \log(1 - x(z^{(n)}; w)) \right] \\
 &= - \sum_n \left[t^{(n)} \times \frac{1}{x^{(n)}} + (1 - t^{(n)}) \left(-\frac{1}{1 - x^{(n)}} \right) \right] \frac{dx^{(n)}}{dw} \\
 &= - \sum_n \left[t^{(n)} \left(\frac{1}{x^{(n)}} + \frac{1}{1 - x^{(n)}} \right) - \frac{1}{1 - x^{(n)}} \right] \frac{dx^{(n)}}{dw} \\
 &= - \sum_n \left[\frac{t^{(n)} - x^{(n)}}{x^{(n)}(1 - x^{(n)})} \right] \cdot \frac{dx^{(n)}}{dw} \\
 &= - \sum_n (t^{(n)} - x^{(n)}) \cdot \frac{[1 + \exp(-w z^{(n)})]^2}{\exp(-w z^{(n)})} \cdot \frac{(-1) \cdot (-z^{(n)}) \cdot \exp(-w z^{(n)})}{[1 + \exp(-w z^{(n)})]^2} \\
 &= - \sum_n (t^{(n)} - x^{(n)}) \cdot z^{(n)} \quad \#
 \end{aligned}$$