Individual Studies in Medical Image Analysis

Image Segmentation with OD and Fovea

Advisor: Dr. Wei-Yang Lin

Name:	ID number:
Jia-Cheng, Syu	611410013
Yu-Ting, Liu	611410083
Wei-Chieh, Tseng	611410146
Cheng-You, Gao	611410166

Outline

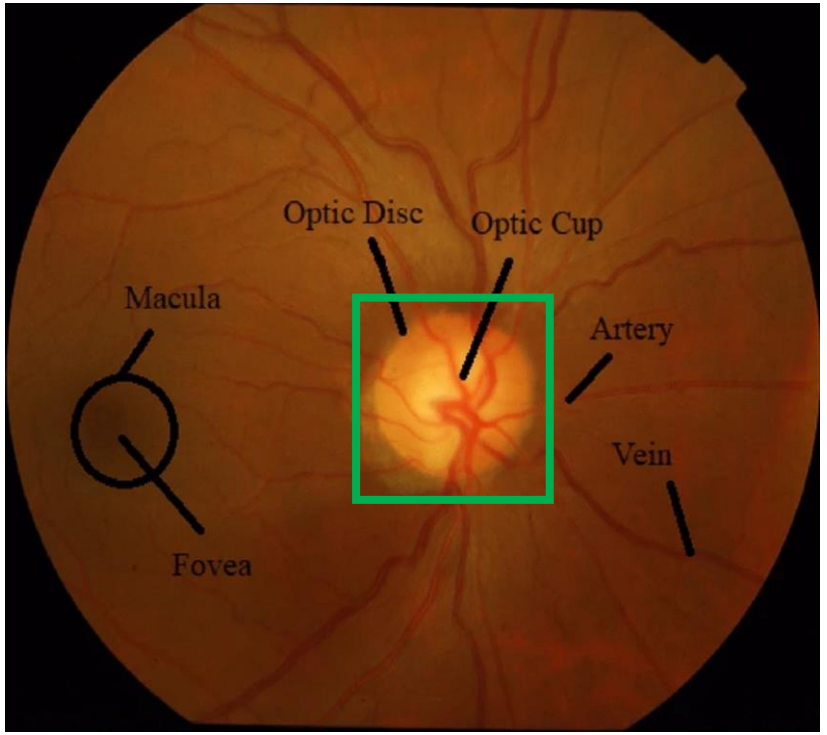
I. INTRODUCTION
II. PROPOSED METHOD
III. EXPERIMENTAL RESULTS
IV. DISCUSSION AND FUTURE RESEARCH
V. CONCLUTION

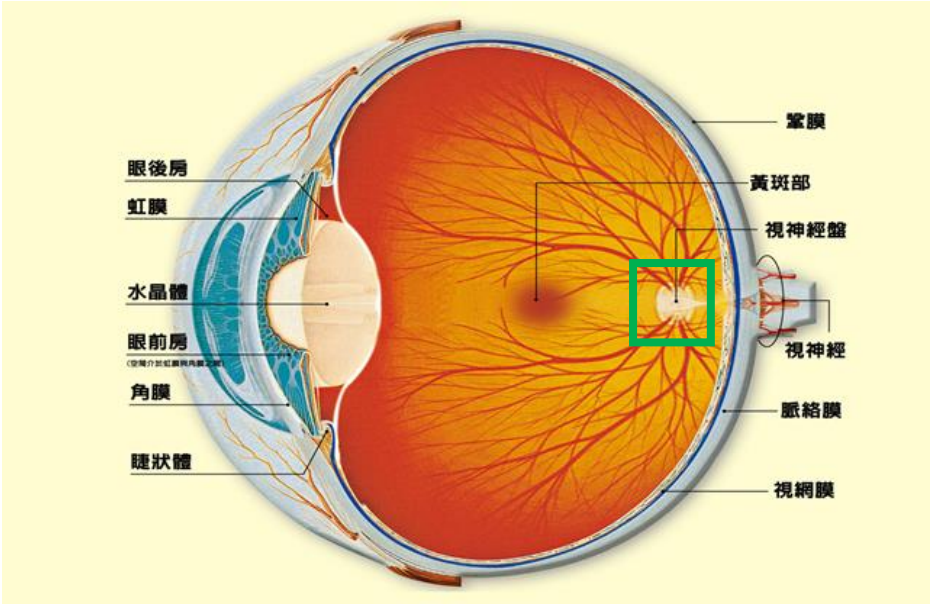
Outline

Optic Disc

視神經的根部有一處類似圓盤的構造，醫學名稱為「**視神經盤**」（Optic Disc），是視神經纖維最後**聚集**的地方，因此從視神經盤可看出包括許多視神經病變，包括**視神經發炎**或者是**青光眼**。

此外也可當做為**定位**標誌的特徵。

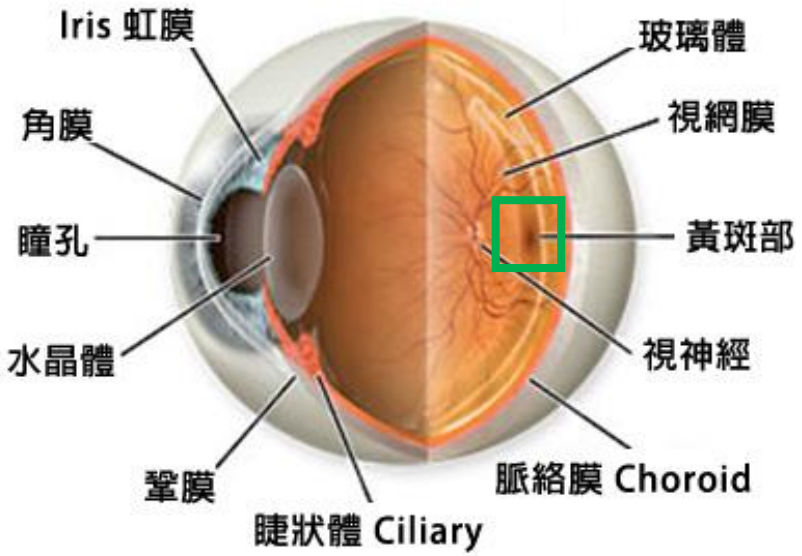


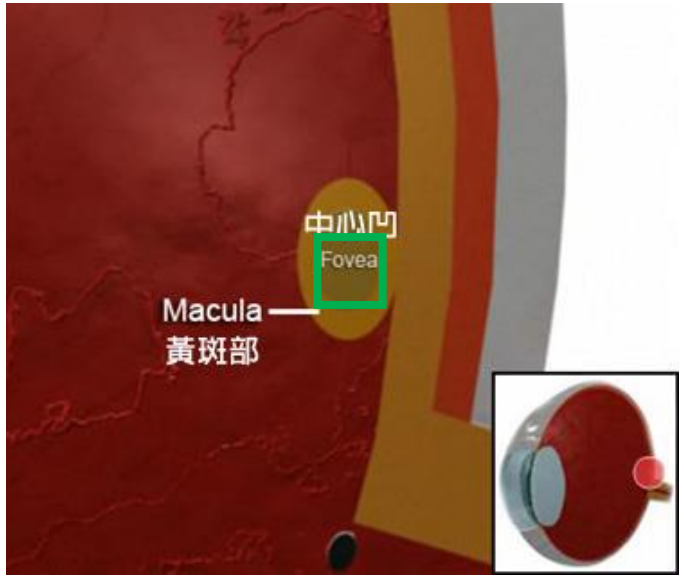


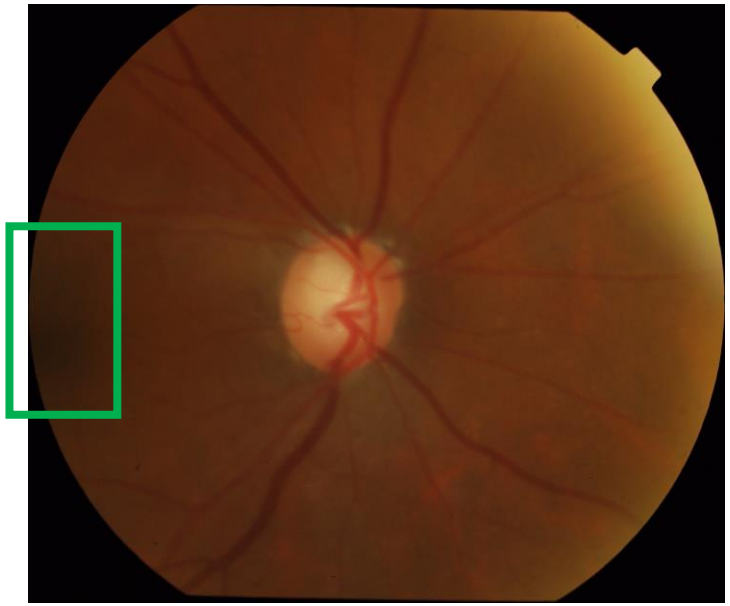
https://medicalinspire.com/posts/27168/%E3%80%90%E9%9D%88%E9%AD%82%E4%B9%8B%E7%AA%97%E3%80%91%E9%9D%92%E5%85%89%E7%9C%BC%E7%82%BA%E9%A6%99%E6%B8%AF%E9%A0%AD%E8%99%9F%E8%87%B4%E7%9B%B2%E7%9C%BC%E7%96%BE%EF%BC%8C%E4%BA%86%E8%A7%A3%E6%88%90/

Fovea

黃斑部(macula)位於眼球後部，屬於視網膜內部構造，方位正對瞳孔。黃斑部大小約0.5公分，其最中央部分稱為中心窩(fovea)，是眼睛感光最靈敏的部分。







http://ftp.healthhonk.com/doctor/lee04.htm

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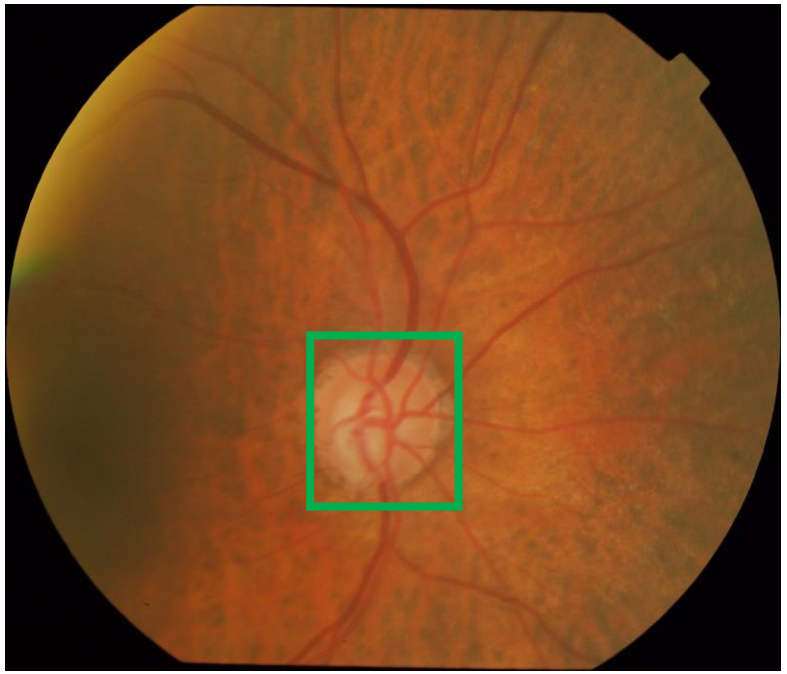
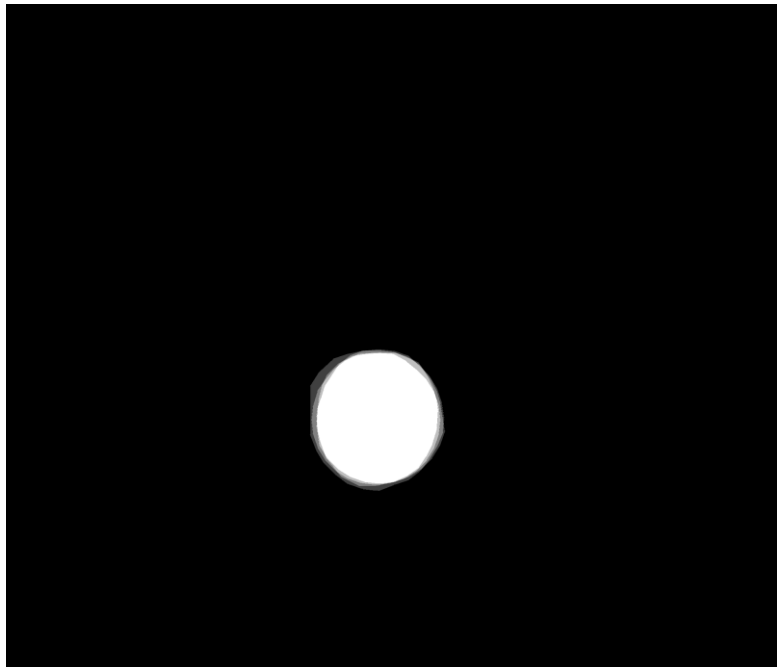
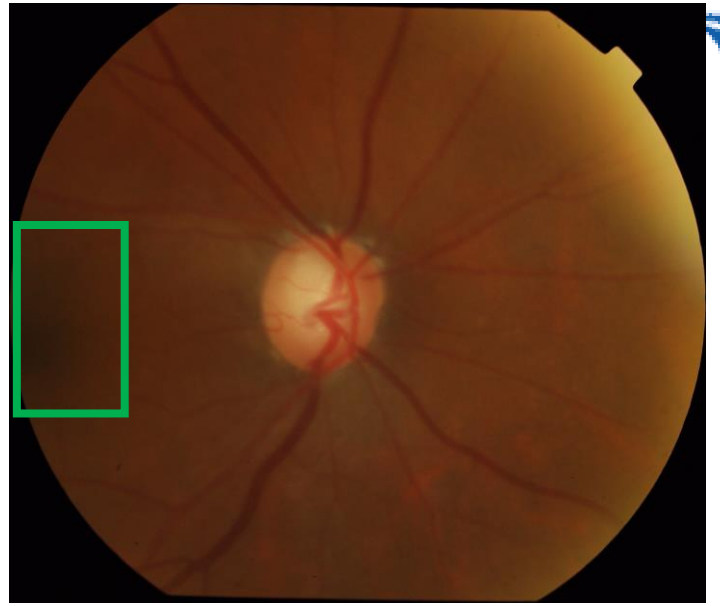
Optic Disc Segmentation

Fovea Segmentation





Optic Disc Ground Truth



Fovea Ground Truth

資料集

Different datasets 助教提供	Resolution	FoV	Bit depth	OD center localization	Fovea center localization	OD mask segmentation	Fovea mask segmentation
Drishti-GS	2896 x 1944	30°	24-bits	No	No	80 張	136 張
EURECOM AML 2021-Challenge 2	2124 x 2056	–	24-bits	Yes	**Yes**	400 張	0 張 此部分人工標記 共 400 張
DRIONS-DB	600 x 400	–	8-bits	Yes	No	110 張	0 張
IDRiD	4288 x 2848	50°	24-bits	Yes	No	54 張	0張

額外尋找

資料集

Optic disc

- Drishti-GS – **80 張**
- EURECOM AML 2021- Challenge 2 – **400 張**
- DRIONS-DB – **110 張**
- IDRiD – **54 張**

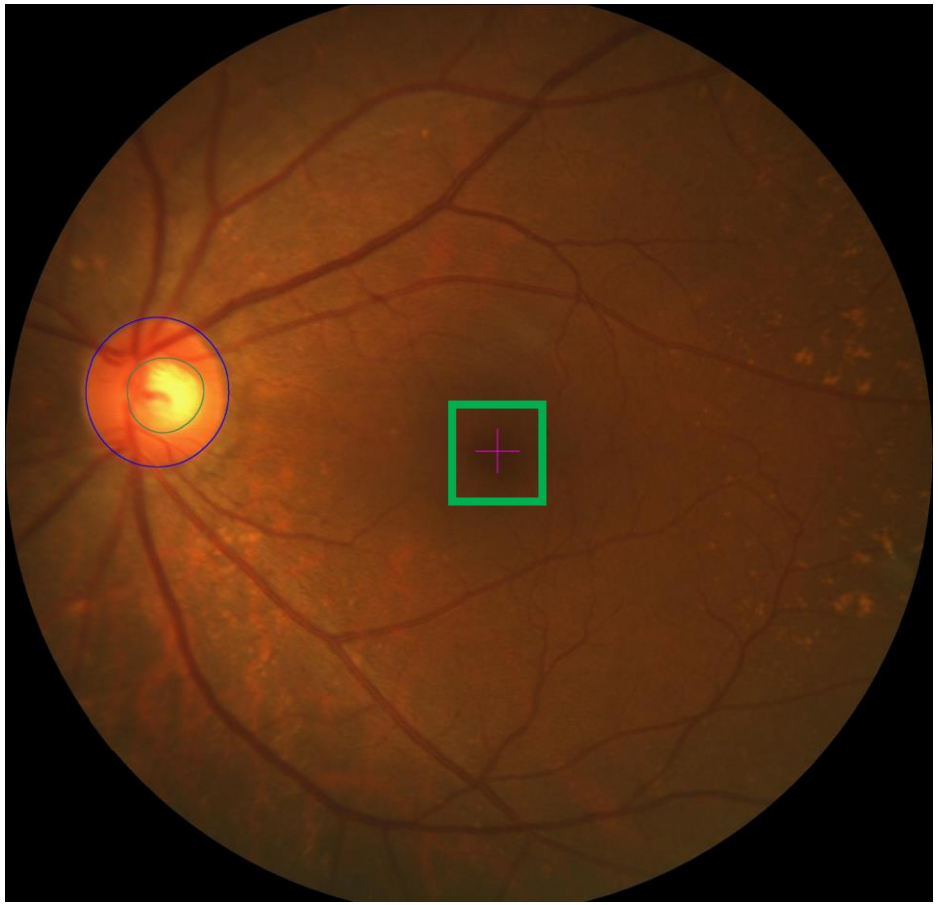
Fovea

- Drishti-GS – **136 張**
- EURECOM AML 2021- Challenge 2 – **400 張**

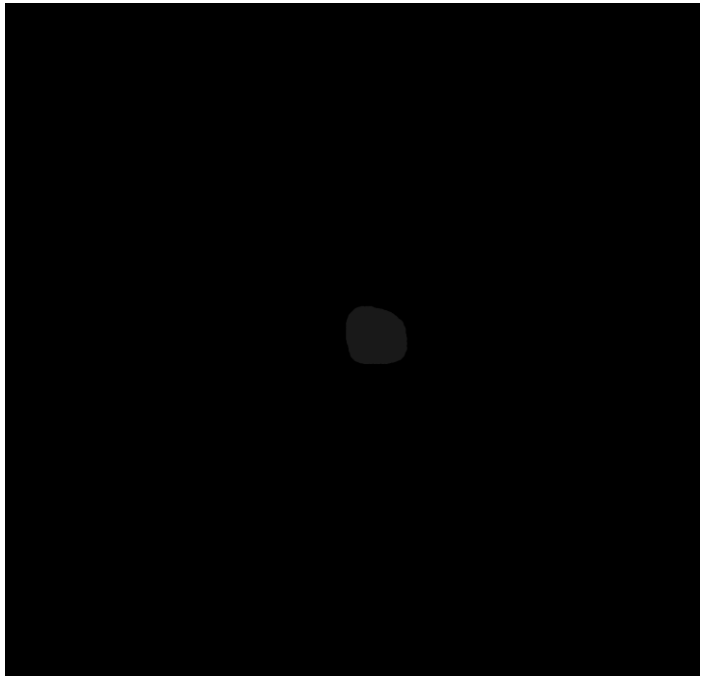
額外使用的資料集

- **Fovea Ground Truth (mask) 標記**

使用 PixelAnnotationTool



EURECOM AML 2021- Challenge 2



Fovea mask

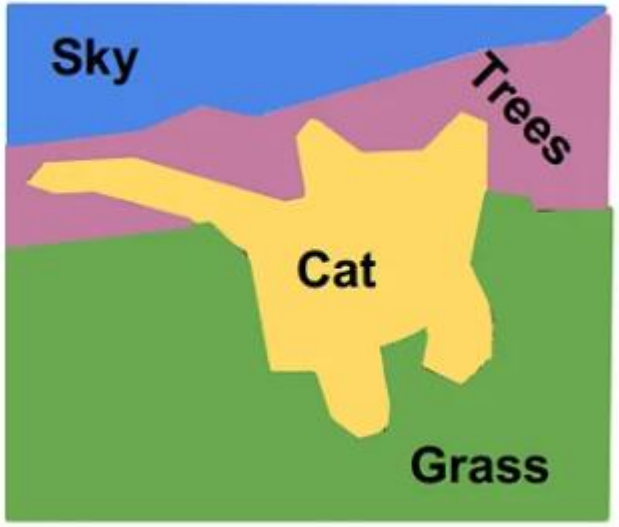
https://github.com/abreheret/PixelAnnotationTool

Outline

Semantic Segmentation

- Assign each pixel a class label

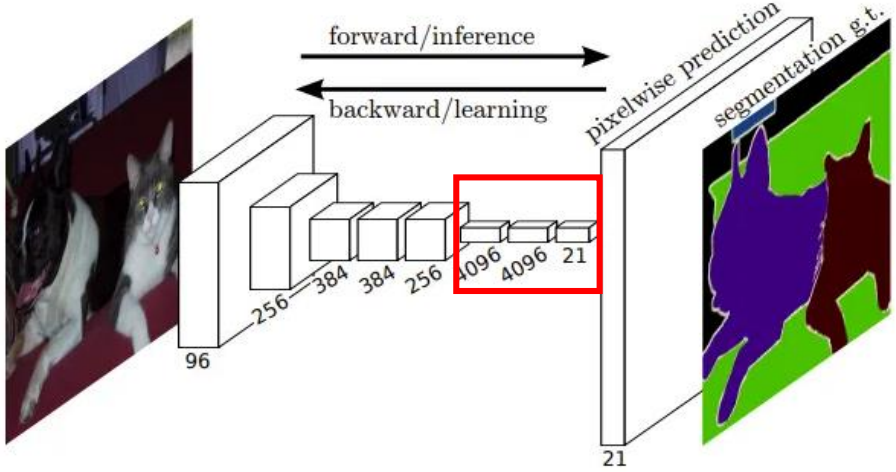
predict

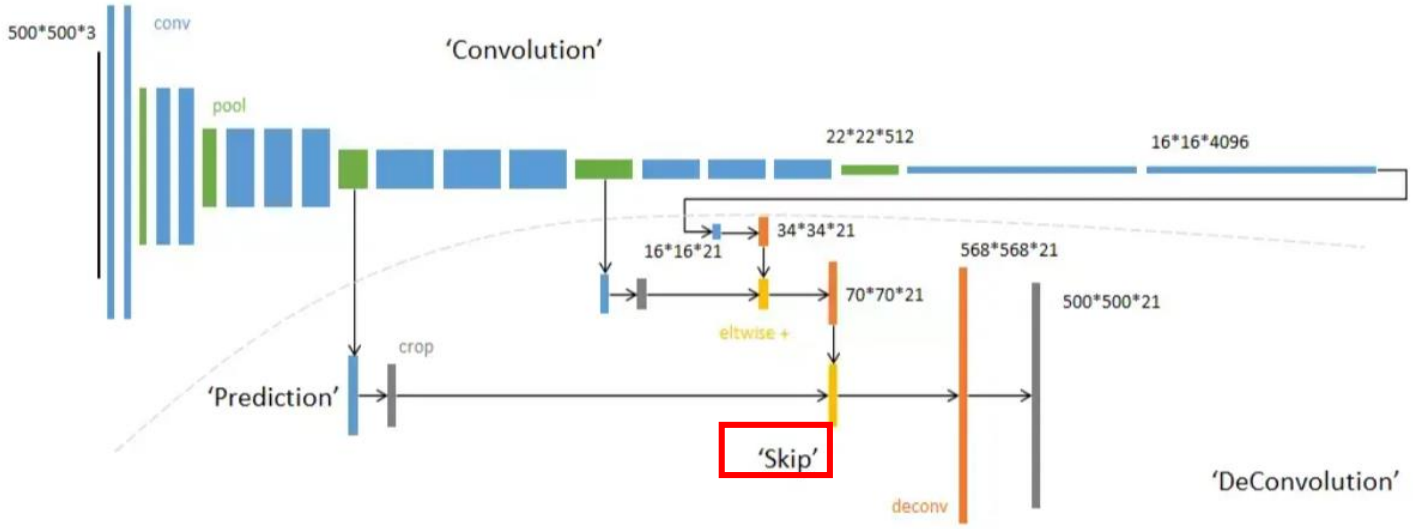


Cat
Sky
Tree
Grass

FCN (fully convolutional network)

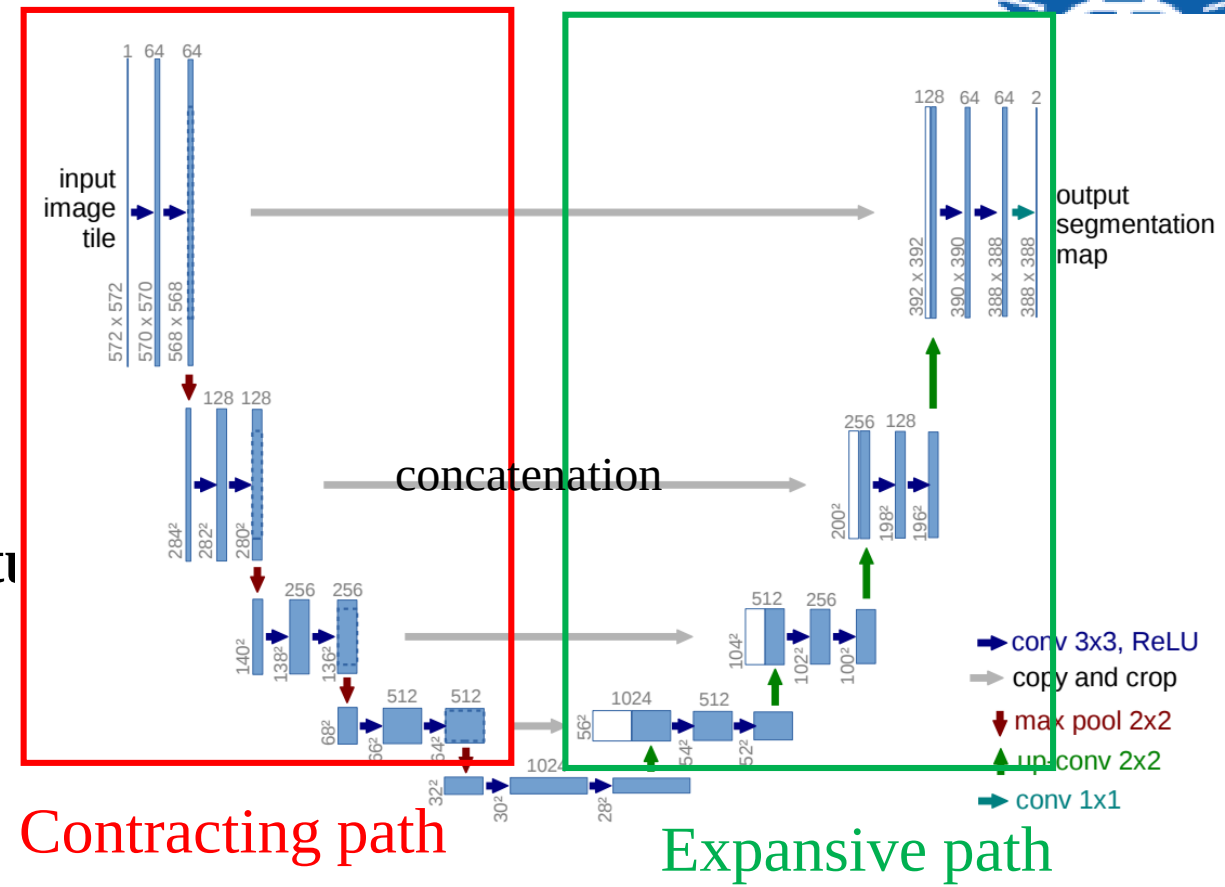
- 全連接層替換成卷積層，可輸入任意尺寸影像，輸出會得到每個像素所屬的類別。
- Gradually generate higher-level feature maps as the network gets deeper
- Transposed Convolution to generate segmentation map
- Model Variations-Utilize “Skip-connection”





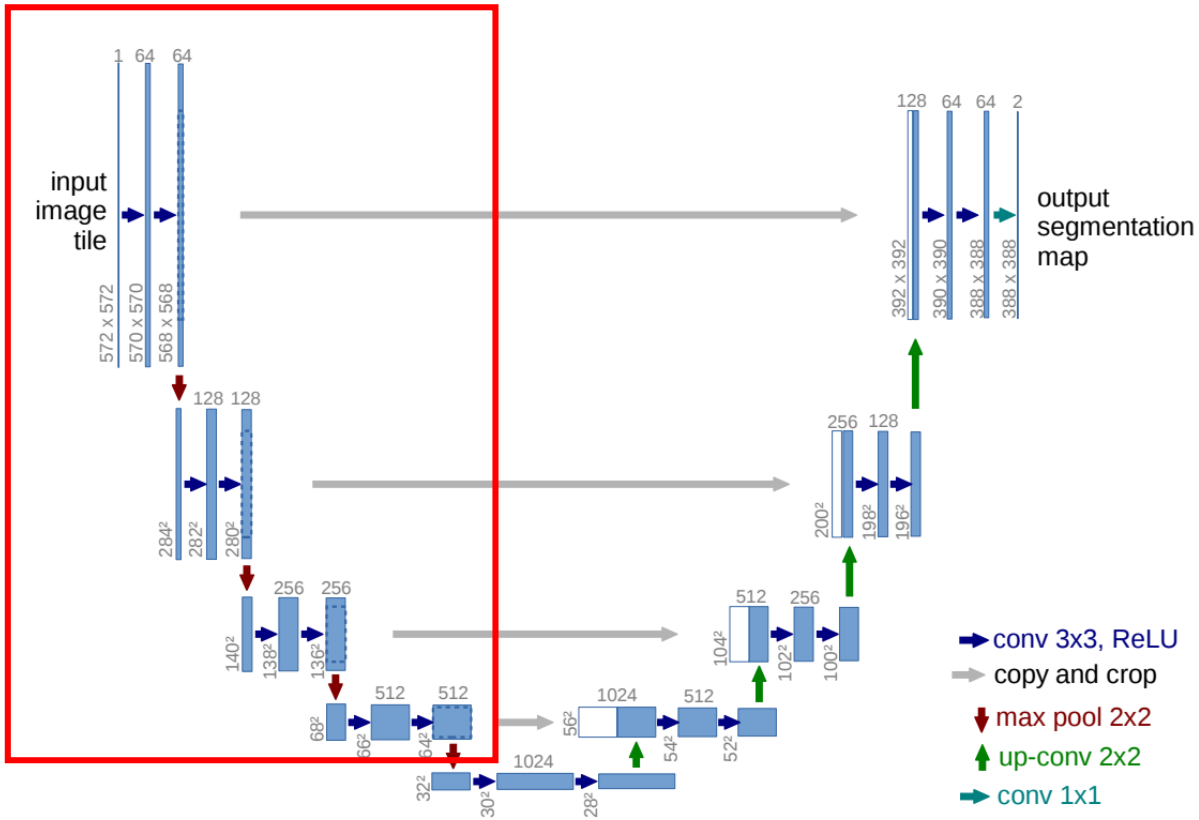
U-Net

- Contracting path (下採樣)
  - Channels increase
  - Resolution decreases
  - **Gradually generate higher-level featu**
- Expansive path (上採樣)
  - Transpose convolution
  - Channels decrease
  - Resolution increase
  - **More precise localization**
- Skip-connection by concatenation
  - Unlike FCN, U-Net "concatenates" the feature maps from the contracting path with the expansive path

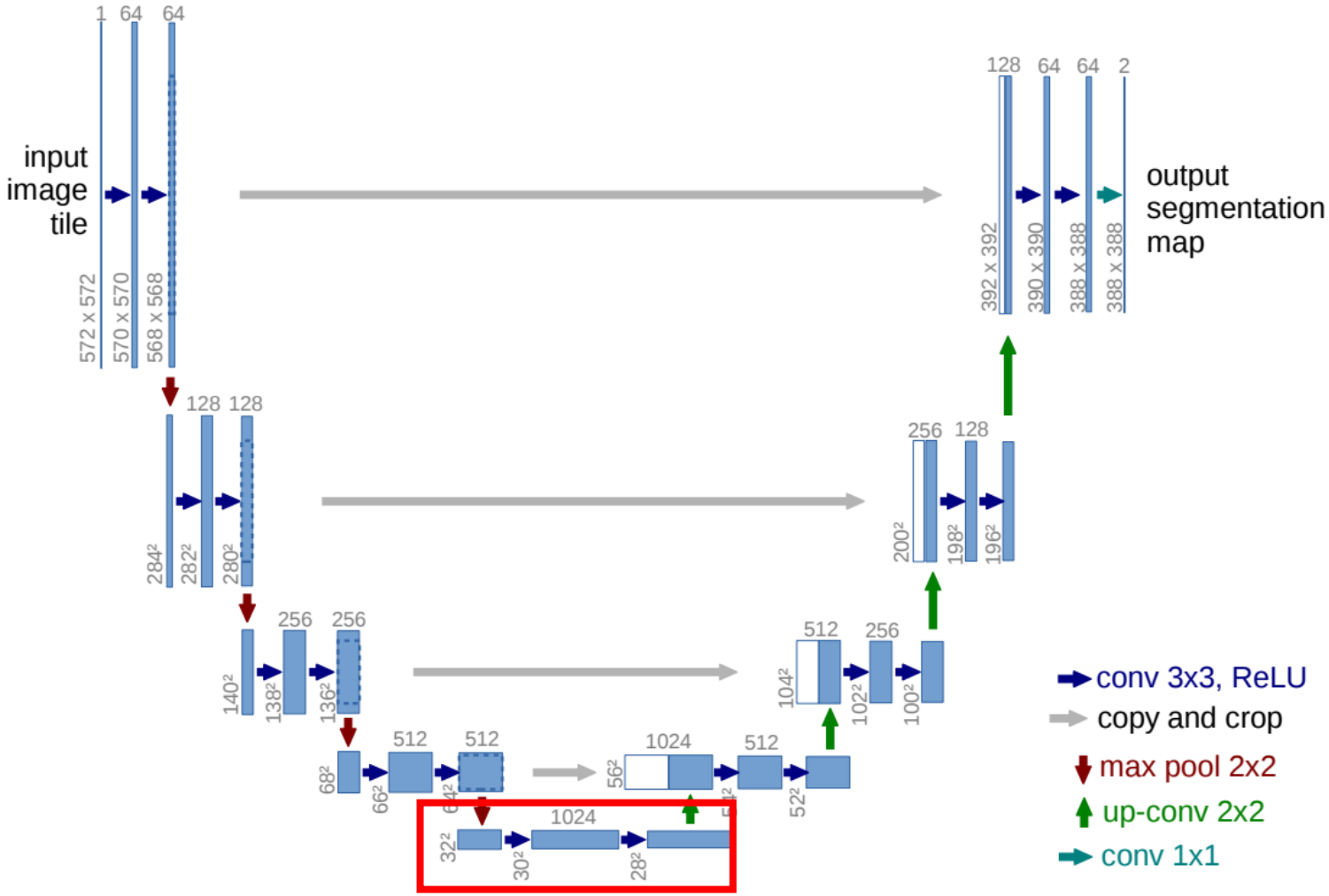


Contracting path

- Double Conv
  - 3*3 filter
  - No padding –resolution decreases after each conv layer
- ReLU
- 2*2 Max pooling,stride 2

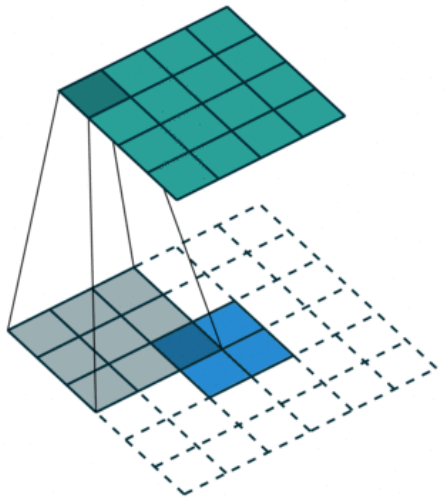


Bottleneck Layer

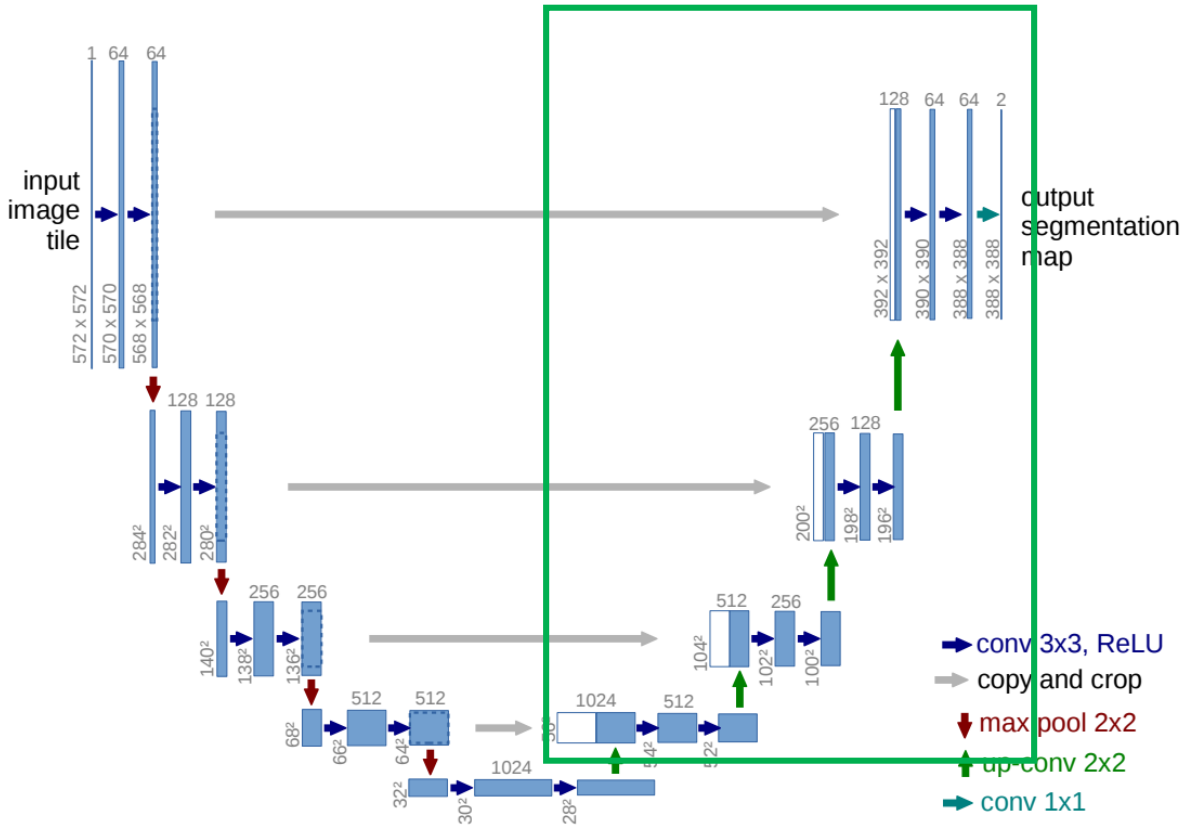


Expansive path

- 2*2 Transpose Convolution
- Skip Connection –Concatenation
  - Feature map from the contracting path is cropped to match the dimension for concatenation
- Double Conv
- ReLU

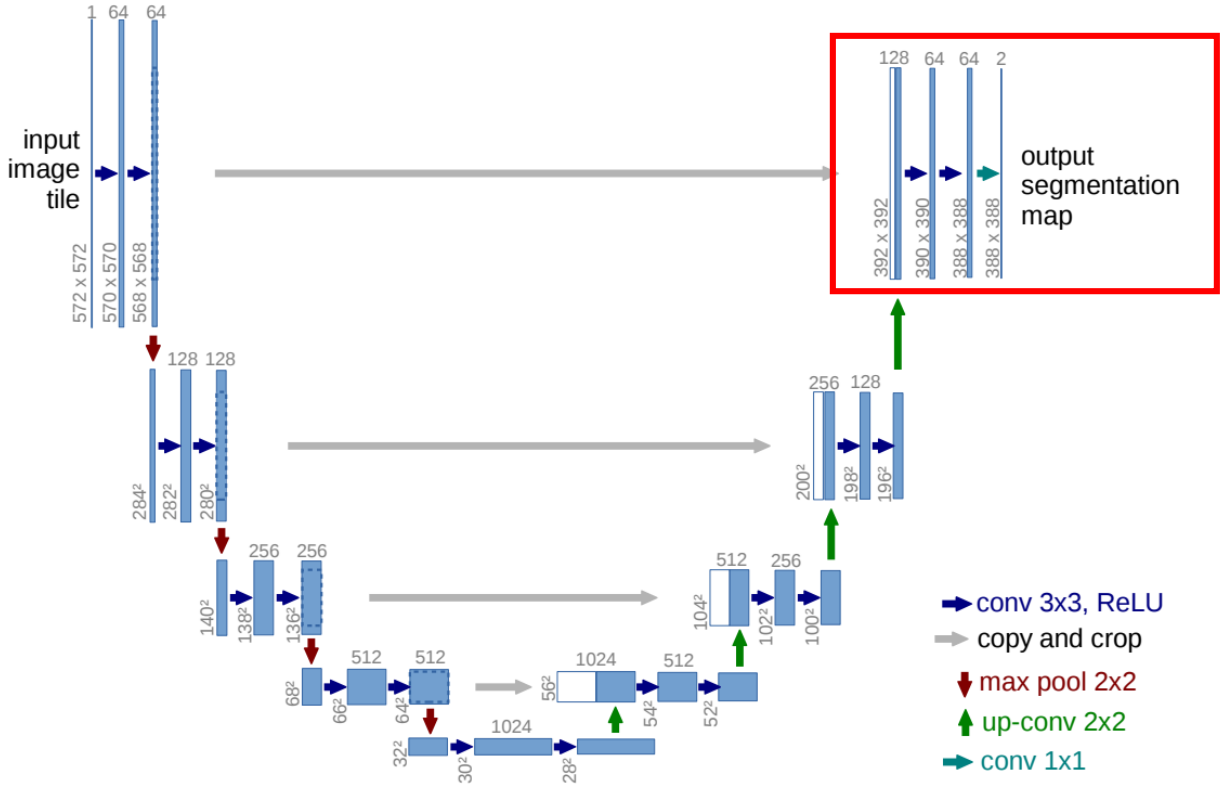


Transpose Convolution



Final Layer

- Assign a class label to each pixel value
- **1*1 conv filter** (n filters)where n is the number of classes
- Final Output:(B,n,H,W),n= #classes
- **Softmax** to produce segmentation map



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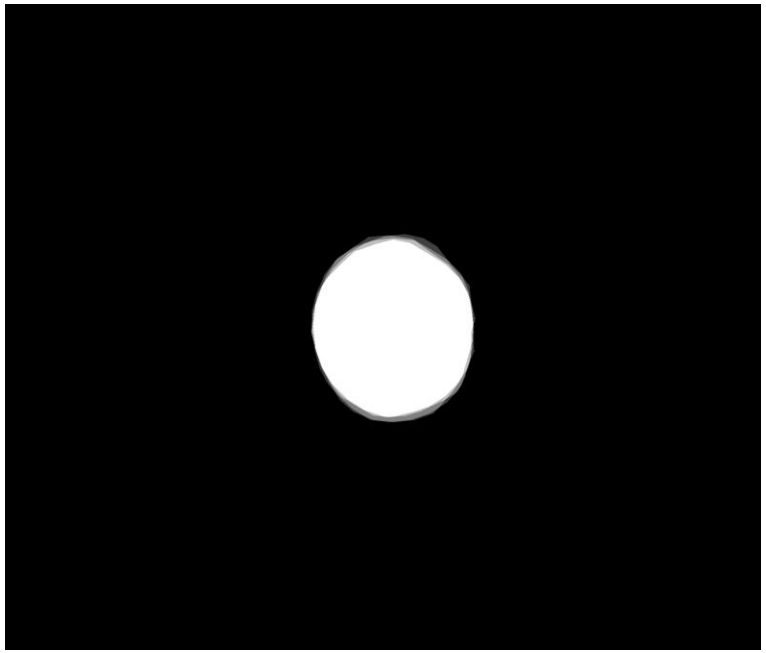
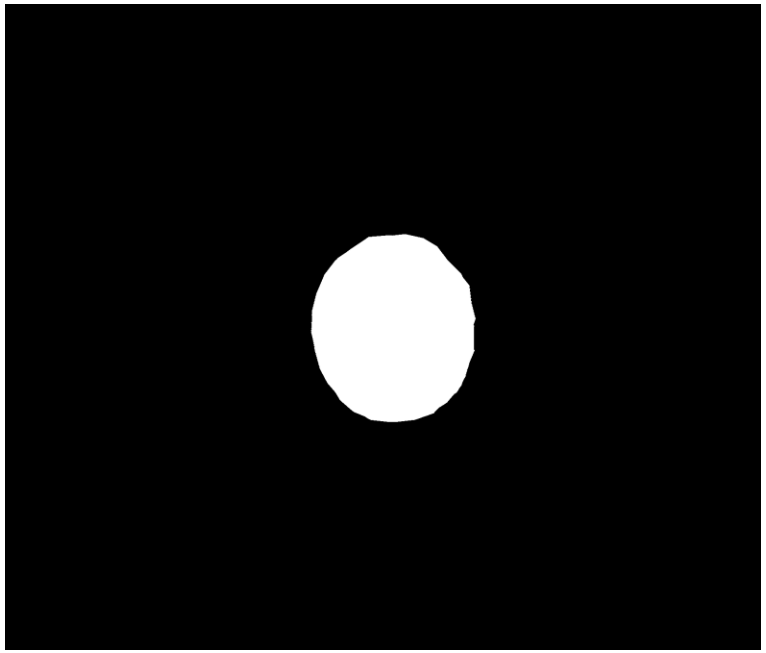
Pre-Processing



Binarization



[0, 64, 128, 191, 255]

Unique values

[0, 255]

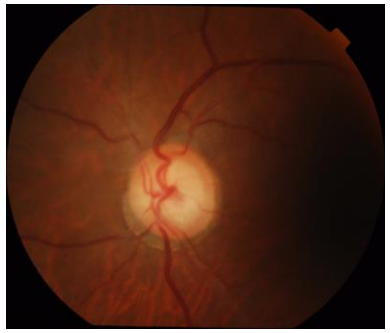
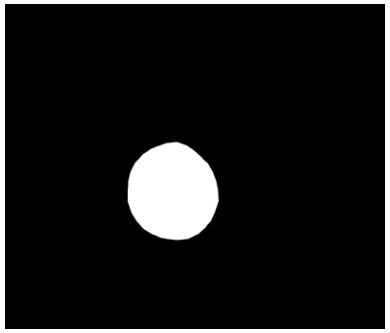
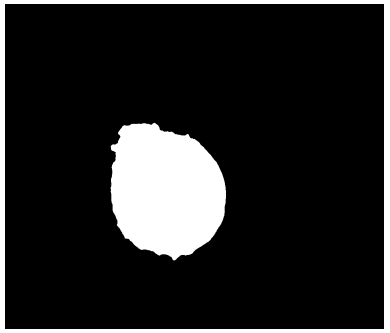
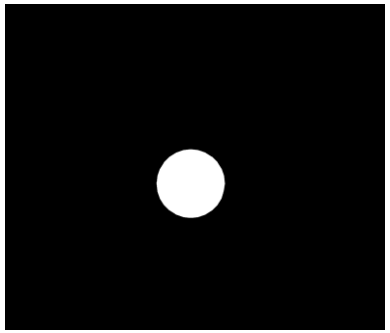
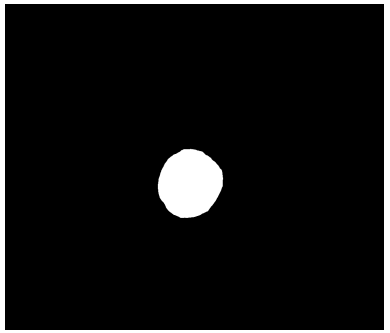
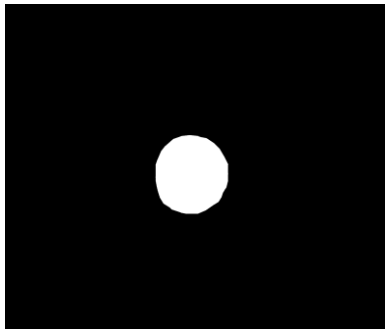
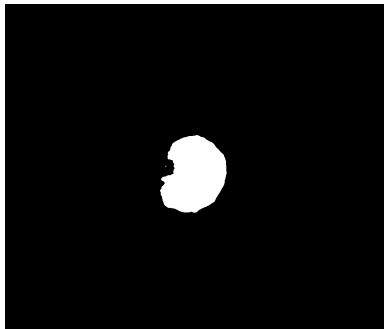
Optic Disk

Model	Dataset	Train_DSC	Test_DSC
Unet	Drishti-GS	0.96	0.94
	EURECOM	0.92	0.75
	DRIONS-DB	0.90	0.76
	IDRiD	0.91	0.76

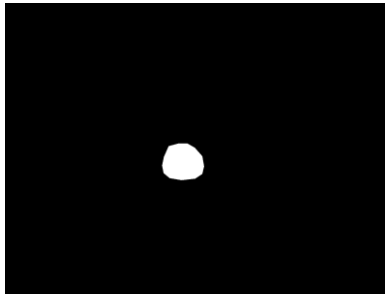
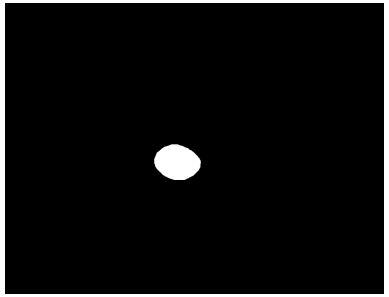
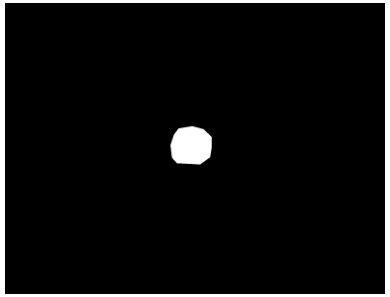
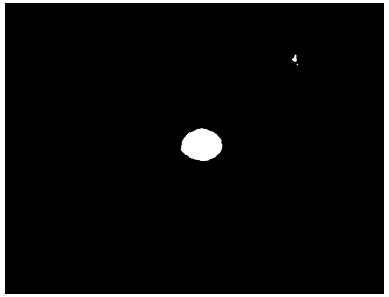
Fovea

Model	Dataset	Train_DSC	Test_DSC
Unet	Drishti-GS	0.83	0.82
	EURECOM	0.88	0.83

Optic Disk

Input	Ground Truth	Unet
		
		
		

Fovea

Input	Ground Truth	Unet
		
		
		

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DISCUSSION AND FUTURE RESEARCH

In the future, we can increase the dataset (color, angle), train with different models (Unet++, Unet3+), and adjust various hyperparameters to achieve 100% accuracy for our model.

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CONCLUSION

We used different dataset to compare and adjusted the color of mask.

Afterward, we adjusted the hyperparameters, epoch to 30, and scale to 0.25.

Finally, our OD dice score reached 0.94 and Fovea dice score reached 0.83.