

U-Net Models

3 models for the segmentation task:

- **Classic U-Net:** *baseline U-Net model architecture*

U-Net Models

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- **Improved U-Net**: *small improvements, fewer parameters*

U-Net Models

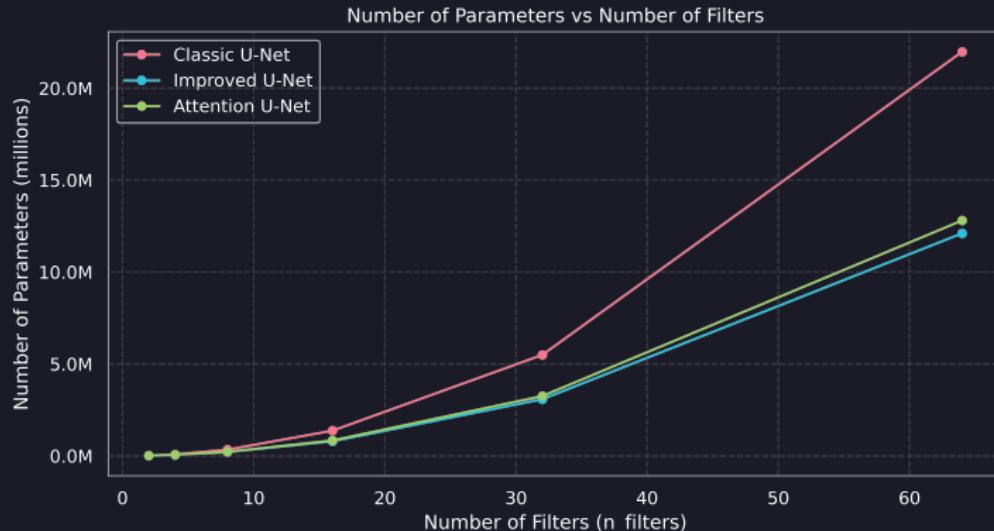
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- **Attention U-Net**: *attention mechanism added*

U-Net Models

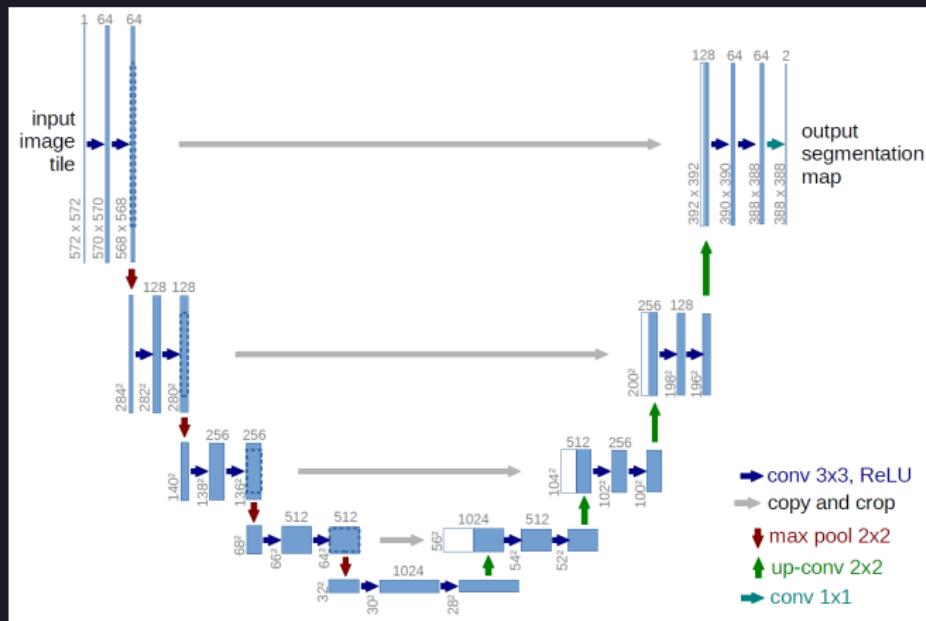
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Segmentation Models

Classic U-Net



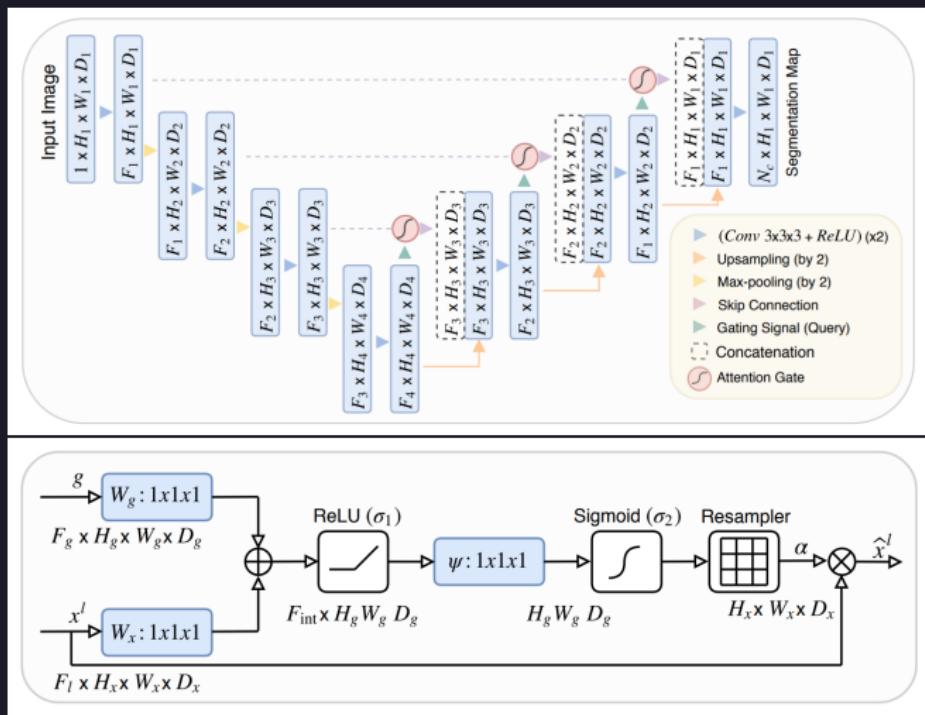
Improved U-Net

Small improvements from previous → to reduce n^o of parameters and improve performance:

- **Separable Convolutions:** depthwise + pointwise convolutions
- **Batch Normalization:** to improve training and generalization
- **Larger Kernel Size:** 7×7 kernels instead of 3×3
- **Inverse Bottleneck:** expands + compresses channels
- **Additive Skip Connections:** instead of concatenated ones

Segmentation Models

Attention U-Net



Training Details

U-Net Models training parameters:

- **epochs:** 20
- **Optimizer:** Adam (with weight decay (1×10^{-2}))
- **Scheduler:** Exponential Decay ($\gamma = 0.9$)
- **Loss Function:** BCE with Logits Loss
- **learning rate:** 2×10^{-3}
- **batch size:** 32 (both training and validation)
- **image size:** 240×240
- **first encoder filters:** 32

Segmentation Models

Visualizing a prediction

Predicted Mask Channels [RGB]



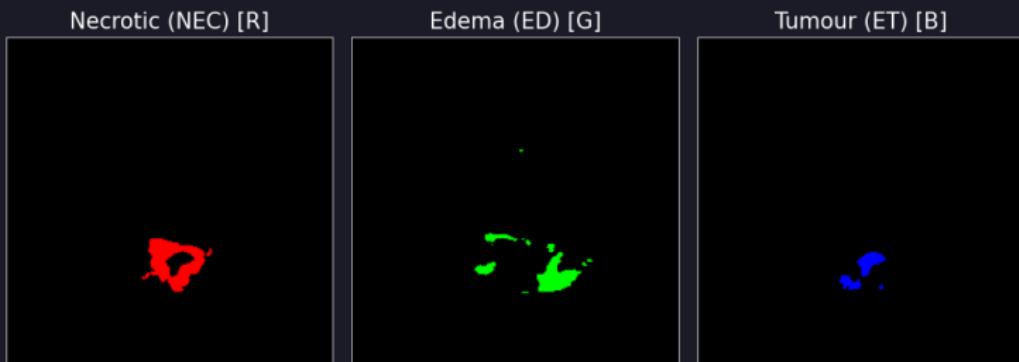
Ground Truth Mask Channels [RGB]



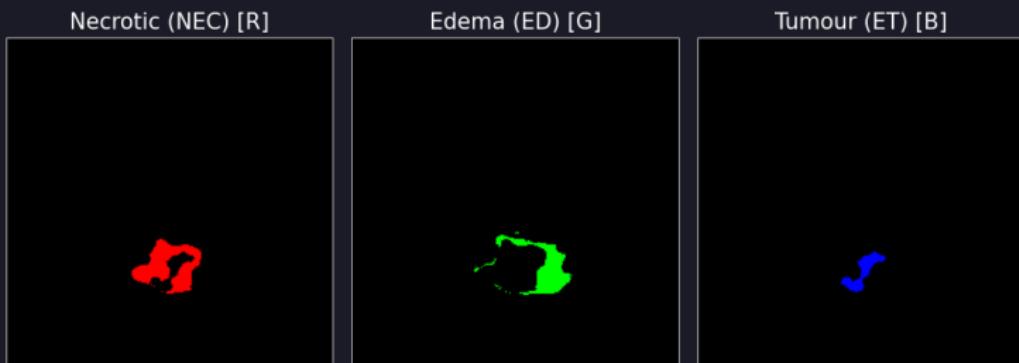
Segmentation Models

Visualizing a prediction

Binarized Predicted Mask Channels [RGB]



Ground Truth Mask Channels [RGB]



Segmentation Models

Performance Assessment

$$\text{Dice} = \frac{2 \times |X \cap Y|}{|X| + |Y|}$$

Dice Coefficient

"overlap" metric

$$\text{Precision} = \frac{TP}{TP + FP}$$

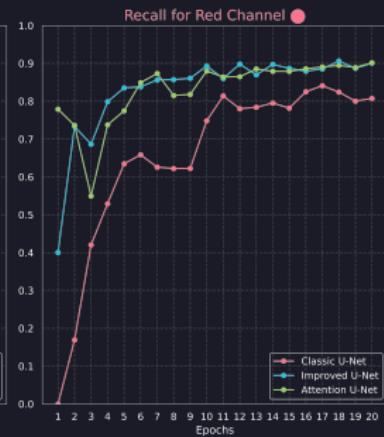
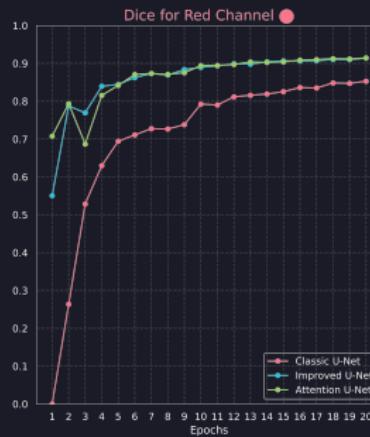
Precision

prediction quality

$$\text{Recall} = \frac{TP}{TP + FN}$$

Recall

prediction quantity



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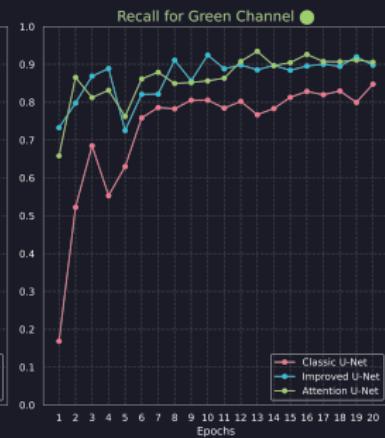
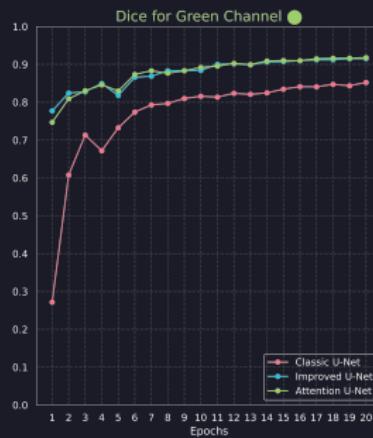
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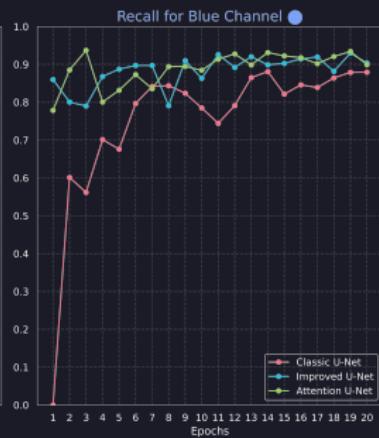
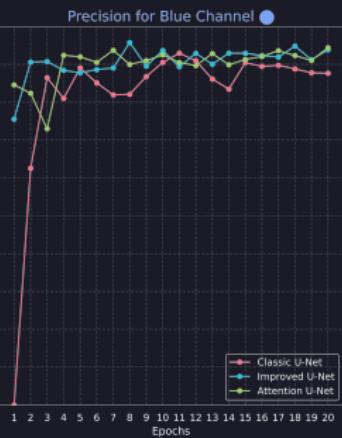
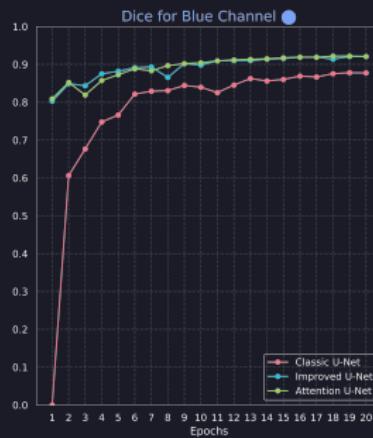
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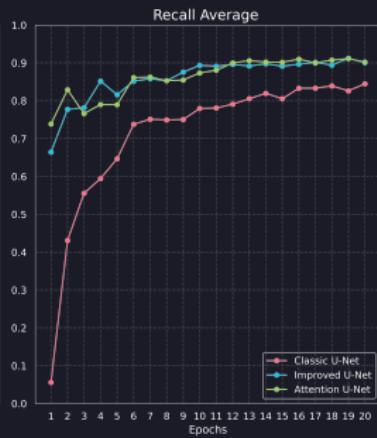
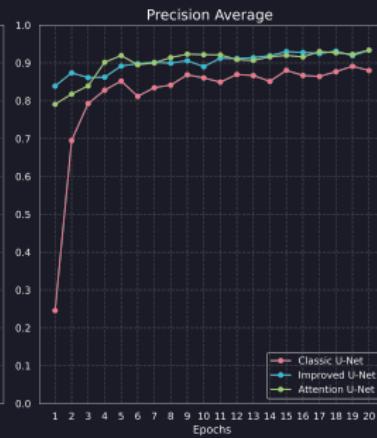
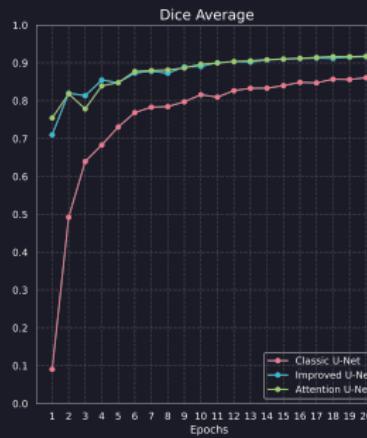
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Segmentation Models

Visualizing Attention Maps

