

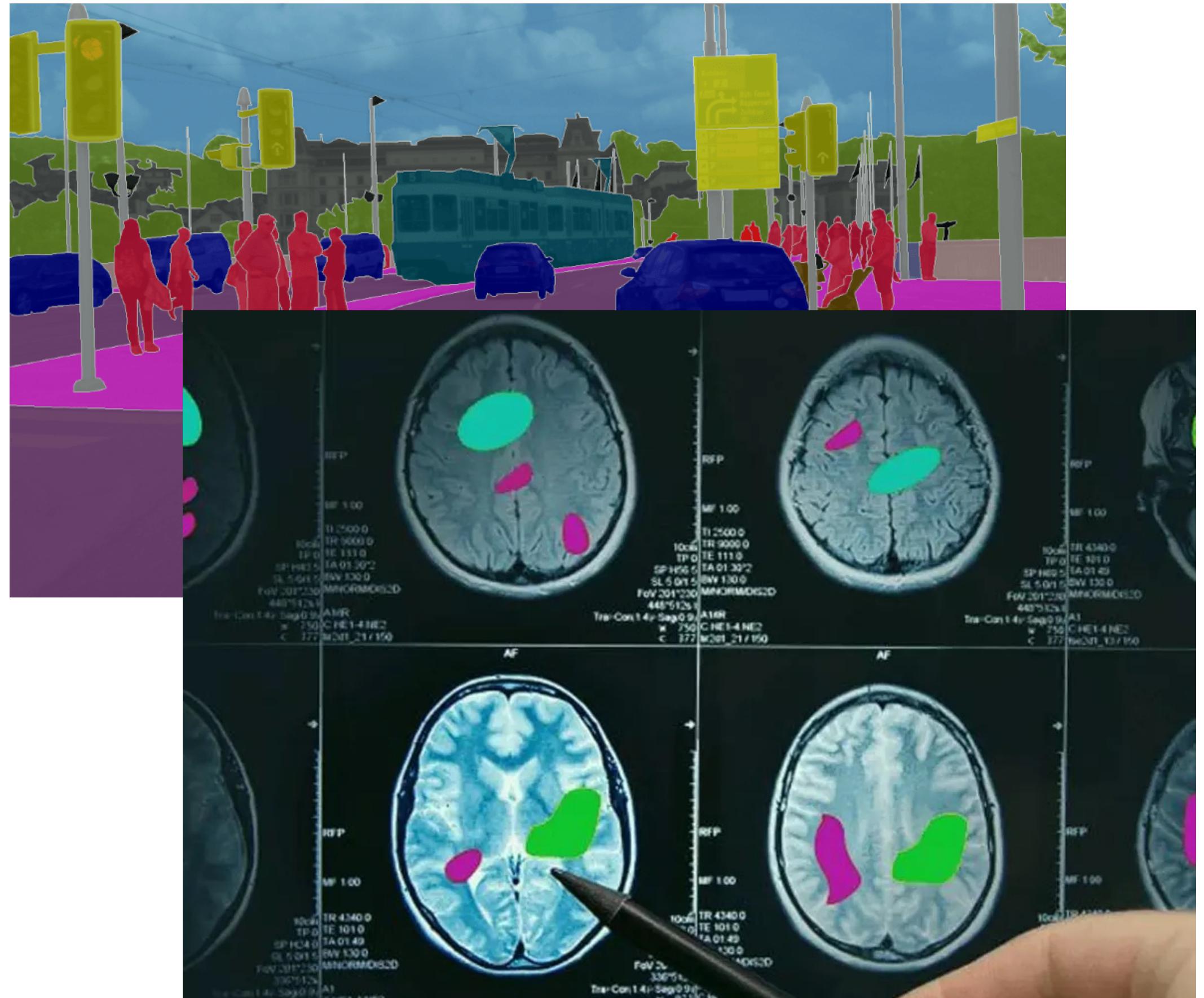
# Unet for image segmentation

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**Practical Deep Learning for Science**  
**27 June, 2023**

# Unet: Two main usage

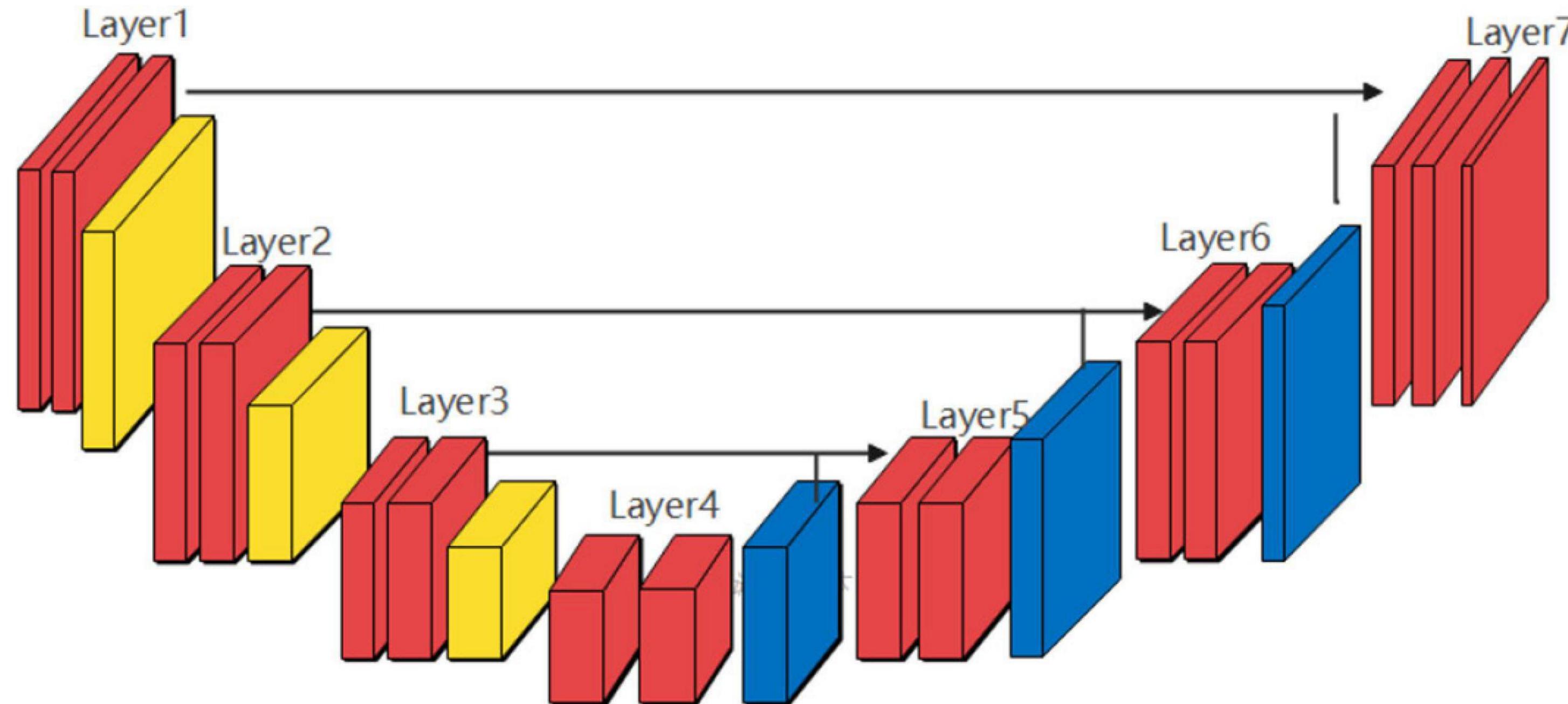


segmentation



Diffusion (next lecture)

# Unet



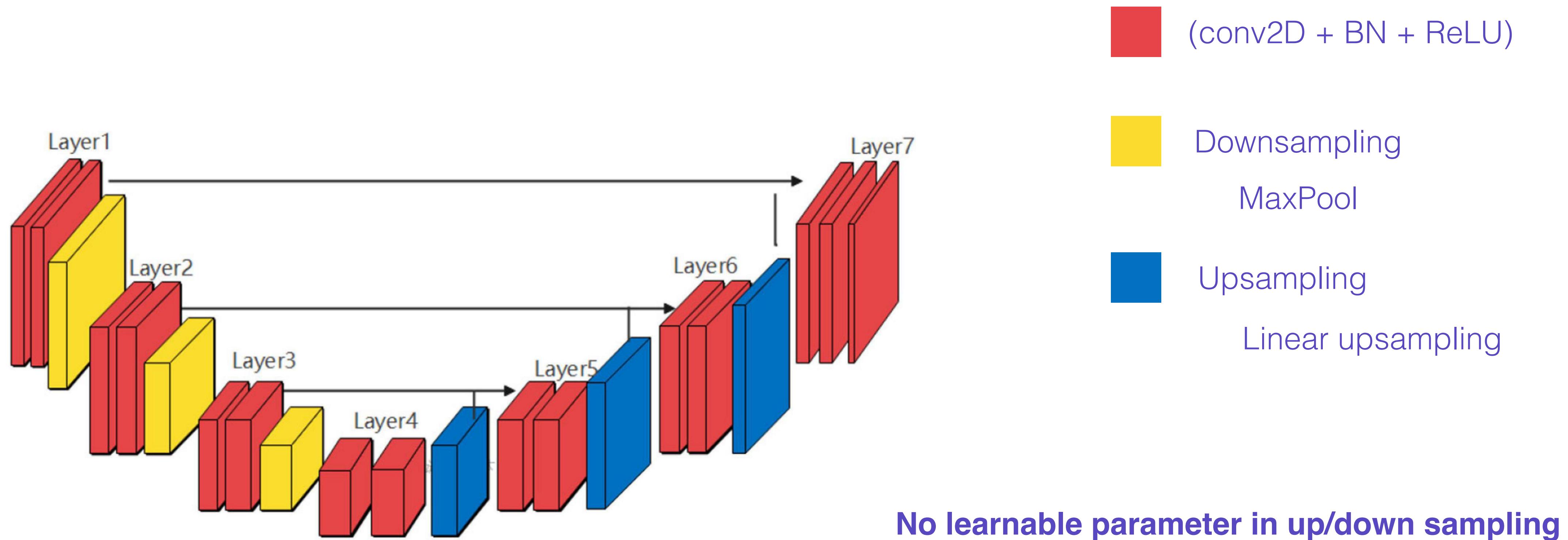
- U-shaped
- Very similar to the VAE
- Differences
  - Input is not the target
  - We won't be sampling.  
(No KLD in the middle)
  - Skip connections
  - Helps upsampling

# Upsampling

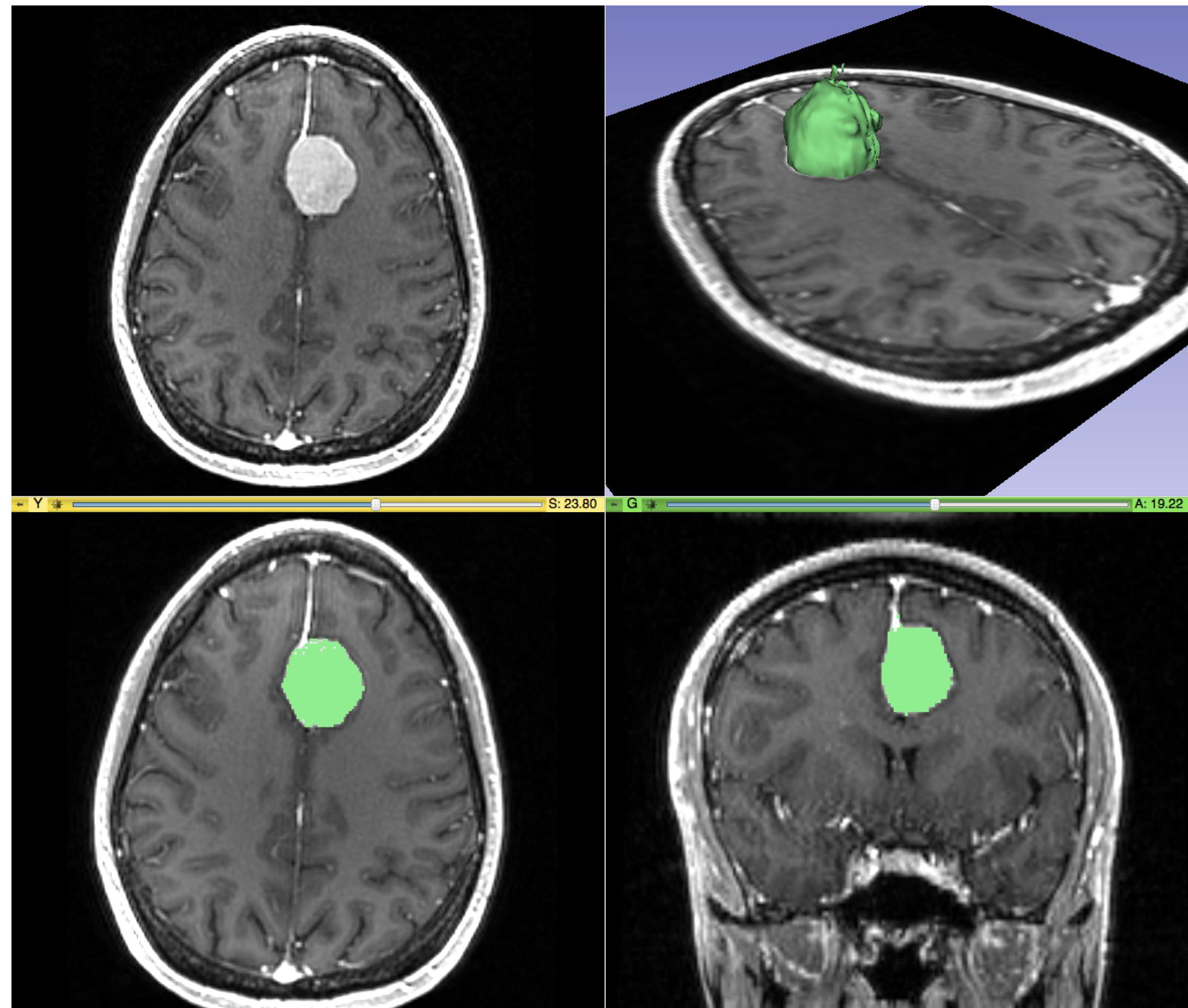
- For VAE, we used transposeConv2D
- Today we'll try (linear upsampling + conv2D)
  - Conceptually easier
- Linear upsampling => insert new pixel between already existing pixel
  - The new pixel value can be computed using different types of interpolation
  - Eg. Bilinear interpolation: new pixel value is the weighted average of the surrounding pixels

# DoubleConv

- (conv2D + batchNorm + ReLU) x2 + upsampling/downsampling



# Dice loss: why?

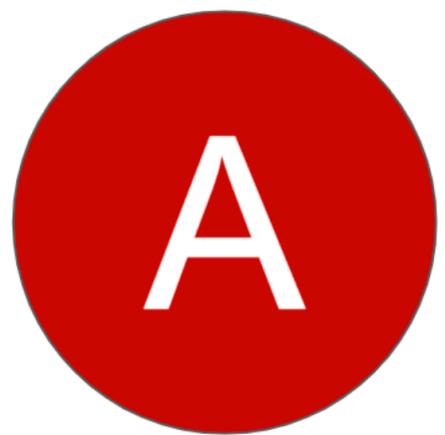


- Classification on each pixel
- Way more background (0) pixels than signal (1)
- Class imbalance!
- Network will biased to predict 0

[https://mphy0026.readthedocs.io/en/latest/segmentation/segmentation\\_methods.html](https://mphy0026.readthedocs.io/en/latest/segmentation/segmentation_methods.html)

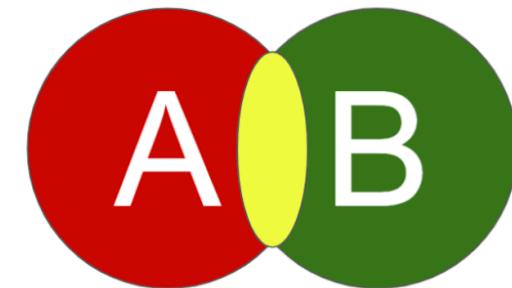
# Dice loss

Traget mask



Pred mask

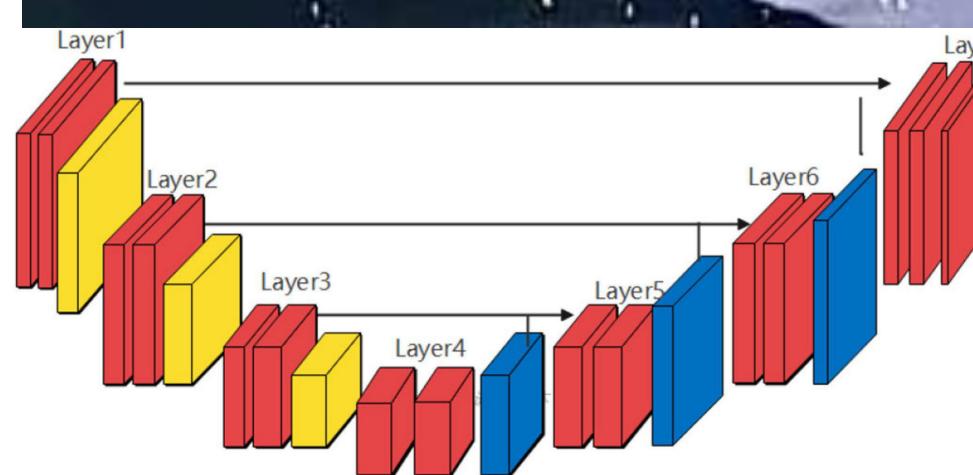


$$\text{Dice coeff} = \frac{2 \times \text{A} \cap \text{B}}{\text{A} + \text{B}}$$
A Venn diagram consisting of two overlapping circles, one red labeled 'A' and one green labeled 'B'. The overlapping region is yellow, representing the intersection of sets A and B.

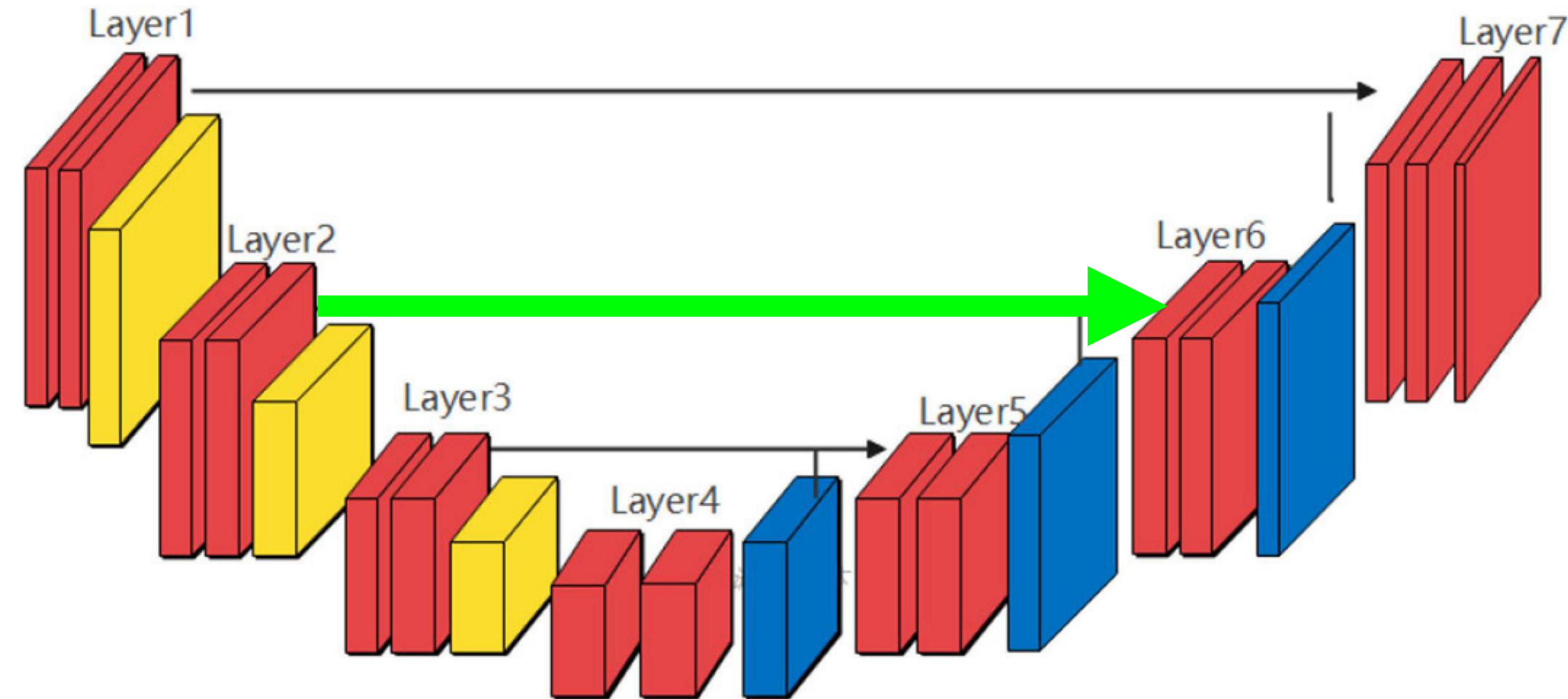
A and B have zero overlap => 0 (minimum)

A and B are same => 1 (maximum)

Dice loss = 1 - dice coefficient

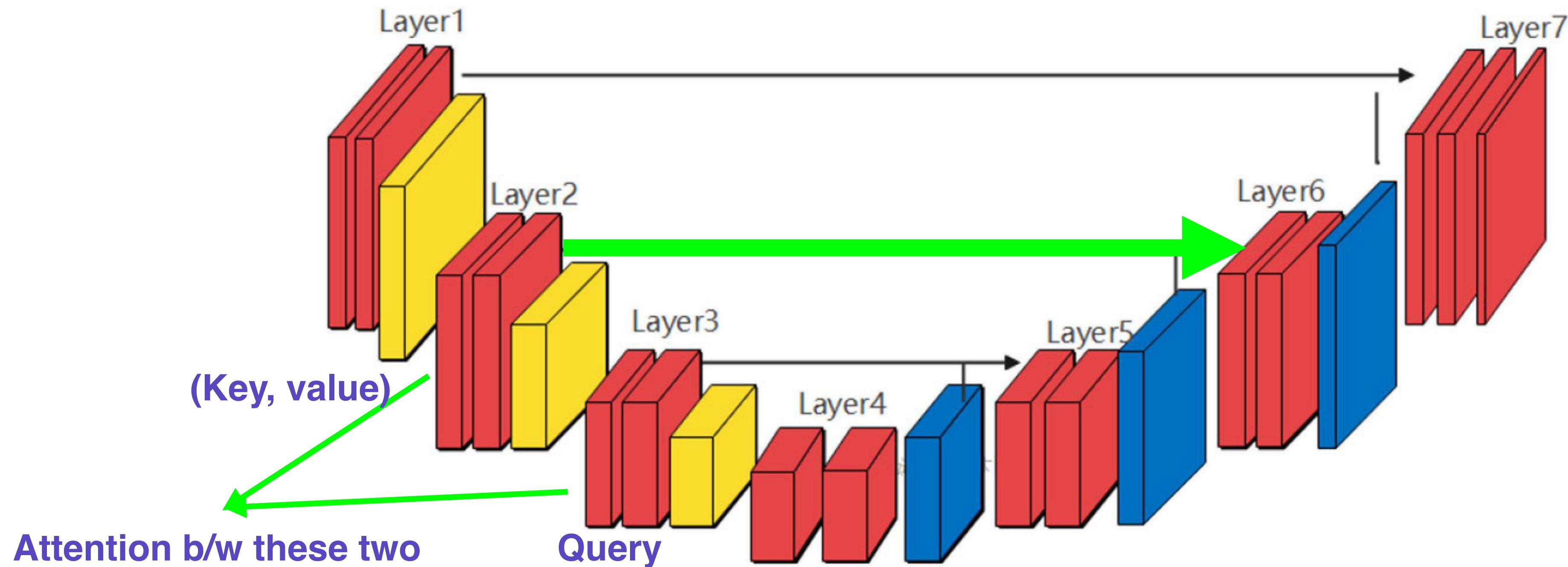


# Attention Unet



- Skip connection helps with upsampling
- But also can bring redundant information
  - Counterproductive considering we wanted to extract important information

# Attention Unet



- Skipconnect only the information that was useful when downsampling

# COCO data format

- Common Objects in COntext
- Pretty common in object detection, instance segmentation...
- Contains - images, annotations, categories