**Summary of Unet model building:**

What is Unet Architecture?

**UNet** is a convolutional neural network architecture that expanded with few changes in the CNN architecture. It was invented to deal with biomedical images where the target is not only to classify whether there is an infection or not but also to identify the area of infection.

The Image shows a typical architecture of the UNET model.

The advantage of this architecture is

1. Input image size and output size of the model will be same
2. Reduced number of computations

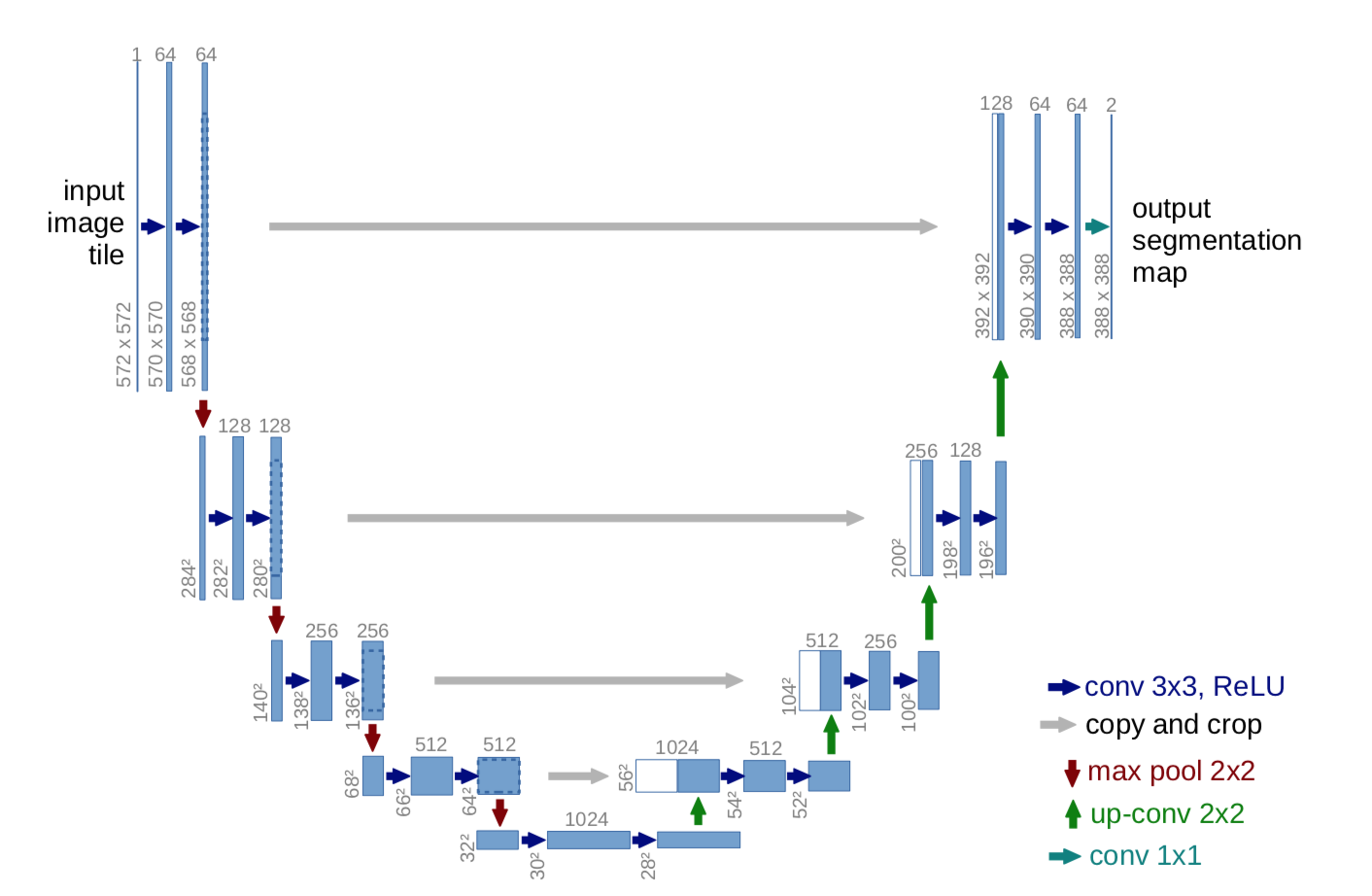
Basically the model follows a **“U”** shaped pattern where the input on the left hand side is first downsampled by decreasing the length and width of the image and increasing the depth making it a low resolution image, then upsample it to bring back the image to the same dimensions as input.

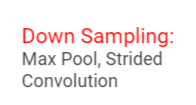
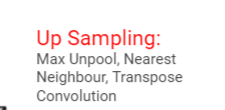
For our model the input size will be 128x128x3

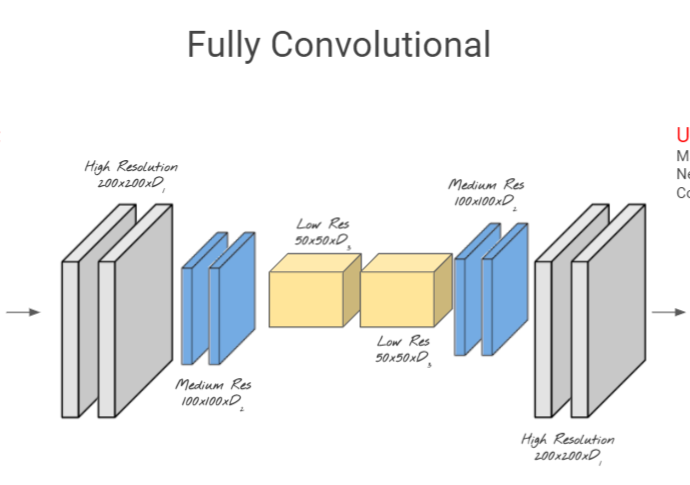
We downsample it till 8x8x64 using keras api **conv2d and maxpooling2d**

Updample till 128x128x3

The upsample is done using the special keras api **conv2d\_transpose**





**INPUT:**

* The Input for our model will be an image array of 128x128x3

**Output:**

* Same as for Our vgg model

**Loss Function:**

* Same as for Our vgg model

**Metrics:**

* Same as for Our vgg model

**Train and Validation sets:**

* Same as for Our vgg model

**Image Augmentation:**

* Same as for Our vgg model

**Model Summary:**

**From the summary we can see it has only 2 million weights compared to 50 million weights in VGG model**

Model: "model"

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Layer (type) Output Shape Param # Connected to

==================================================================================================

input\_img (InputLayer) [(None, 128, 128, 3) 0

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conv2d (Conv2D) (None, 128, 128, 16) 448 input\_img[0][0]

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batch\_normalization (BatchNorma (None, 128, 128, 16) 64 conv2d[0][0]

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activation (Activation) (None, 128, 128, 16) 0 batch\_normalization[0][0]

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conv2d\_1 (Conv2D) (None, 128, 128, 16) 2320 activation[0][0]

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batch\_normalization\_1 (BatchNor (None, 128, 128, 16) 64 conv2d\_1[0][0]

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activation\_1 (Activation) (None, 128, 128, 16) 0 batch\_normalization\_1[0][0]

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max\_pooling2d (MaxPooling2D) (None, 64, 64, 16) 0 activation\_1[0][0]

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dropout (Dropout) (None, 64, 64, 16) 0 max\_pooling2d[0][0]

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conv2d\_2 (Conv2D) (None, 64, 64, 32) 4640 dropout[0][0]

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batch\_normalization\_2 (BatchNor (None, 64, 64, 32) 128 conv2d\_2[0][0]

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activation\_2 (Activation) (None, 64, 64, 32) 0 batch\_normalization\_2[0][0]

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conv2d\_3 (Conv2D) (None, 64, 64, 32) 9248 activation\_2[0][0]

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batch\_normalization\_3 (BatchNor (None, 64, 64, 32) 128 conv2d\_3[0][0]

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activation\_3 (Activation) (None, 64, 64, 32) 0 batch\_normalization\_3[0][0]

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max\_pooling2d\_1 (MaxPooling2D) (None, 32, 32, 32) 0 activation\_3[0][0]

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dropout\_1 (Dropout) (None, 32, 32, 32) 0 max\_pooling2d\_1[0][0]

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conv2d\_4 (Conv2D) (None, 32, 32, 64) 18496 dropout\_1[0][0]

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batch\_normalization\_4 (BatchNor (None, 32, 32, 64) 256 conv2d\_4[0][0]

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activation\_4 (Activation) (None, 32, 32, 64) 0 batch\_normalization\_4[0][0]

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conv2d\_5 (Conv2D) (None, 32, 32, 64) 36928 activation\_4[0][0]

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batch\_normalization\_5 (BatchNor (None, 32, 32, 64) 256 conv2d\_5[0][0]

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activation\_5 (Activation) (None, 32, 32, 64) 0 batch\_normalization\_5[0][0]

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max\_pooling2d\_2 (MaxPooling2D) (None, 16, 16, 64) 0 activation\_5[0][0]

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dropout\_2 (Dropout) (None, 16, 16, 64) 0 max\_pooling2d\_2[0][0]

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conv2d\_6 (Conv2D) (None, 16, 16, 128) 73856 dropout\_2[0][0]

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batch\_normalization\_6 (BatchNor (None, 16, 16, 128) 512 conv2d\_6[0][0]

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activation\_6 (Activation) (None, 16, 16, 128) 0 batch\_normalization\_6[0][0]

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conv2d\_7 (Conv2D) (None, 16, 16, 128) 147584 activation\_6[0][0]

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batch\_normalization\_7 (BatchNor (None, 16, 16, 128) 512 conv2d\_7[0][0]

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activation\_7 (Activation) (None, 16, 16, 128) 0 batch\_normalization\_7[0][0]

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max\_pooling2d\_3 (MaxPooling2D) (None, 8, 8, 128) 0 activation\_7[0][0]

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dropout\_3 (Dropout) (None, 8, 8, 128) 0 max\_pooling2d\_3[0][0]

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conv2d\_8 (Conv2D) (None, 8, 8, 256) 295168 dropout\_3[0][0]

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batch\_normalization\_8 (BatchNor (None, 8, 8, 256) 1024 conv2d\_8[0][0]

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activation\_8 (Activation) (None, 8, 8, 256) 0 batch\_normalization\_8[0][0]

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conv2d\_9 (Conv2D) (None, 8, 8, 256) 590080 activation\_8[0][0]

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batch\_normalization\_9 (BatchNor (None, 8, 8, 256) 1024 conv2d\_9[0][0]

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activation\_9 (Activation) (None, 8, 8, 256) 0 batch\_normalization\_9[0][0]

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conv2d\_transpose (Conv2DTranspo (None, 16, 16, 128) 295040 activation\_9[0][0]

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concatenate (Concatenate) (None, 16, 16, 256) 0 conv2d\_transpose[0][0]

activation\_7[0][0]

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dropout\_4 (Dropout) (None, 16, 16, 256) 0 concatenate[0][0]

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conv2d\_10 (Conv2D) (None, 16, 16, 128) 295040 dropout\_4[0][0]

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batch\_normalization\_10 (BatchNo (None, 16, 16, 128) 512 conv2d\_10[0][0]

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activation\_10 (Activation) (None, 16, 16, 128) 0 batch\_normalization\_10[0][0]

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conv2d\_11 (Conv2D) (None, 16, 16, 128) 147584 activation\_10[0][0]

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batch\_normalization\_11 (BatchNo (None, 16, 16, 128) 512 conv2d\_11[0][0]

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activation\_11 (Activation) (None, 16, 16, 128) 0 batch\_normalization\_11[0][0]

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conv2d\_transpose\_1 (Conv2DTrans (None, 32, 32, 64) 73792 activation\_11[0][0]

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concatenate\_1 (Concatenate) (None, 32, 32, 128) 0 conv2d\_transpose\_1[0][0]

activation\_5[0][0]

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dropout\_5 (Dropout) (None, 32, 32, 128) 0 concatenate\_1[0][0]

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conv2d\_12 (Conv2D) (None, 32, 32, 64) 73792 dropout\_5[0][0]

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batch\_normalization\_12 (BatchNo (None, 32, 32, 64) 256 conv2d\_12[0][0]

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activation\_12 (Activation) (None, 32, 32, 64) 0 batch\_normalization\_12[0][0]

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conv2d\_13 (Conv2D) (None, 32, 32, 64) 36928 activation\_12[0][0]

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batch\_normalization\_13 (BatchNo (None, 32, 32, 64) 256 conv2d\_13[0][0]

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activation\_13 (Activation) (None, 32, 32, 64) 0 batch\_normalization\_13[0][0]

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conv2d\_transpose\_2 (Conv2DTrans (None, 64, 64, 32) 18464 activation\_13[0][0]

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concatenate\_2 (Concatenate) (None, 64, 64, 64) 0 conv2d\_transpose\_2[0][0]

activation\_3[0][0]

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dropout\_6 (Dropout) (None, 64, 64, 64) 0 concatenate\_2[0][0]

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conv2d\_14 (Conv2D) (None, 64, 64, 32) 18464 dropout\_6[0][0]

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batch\_normalization\_14 (BatchNo (None, 64, 64, 32) 128 conv2d\_14[0][0]

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activation\_14 (Activation) (None, 64, 64, 32) 0 batch\_normalization\_14[0][0]

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conv2d\_15 (Conv2D) (None, 64, 64, 32) 9248 activation\_14[0][0]

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batch\_normalization\_15 (BatchNo (None, 64, 64, 32) 128 conv2d\_15[0][0]

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activation\_15 (Activation) (None, 64, 64, 32) 0 batch\_normalization\_15[0][0]

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conv2d\_transpose\_3 (Conv2DTrans (None, 128, 128, 16) 4624 activation\_15[0][0]

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concatenate\_3 (Concatenate) (None, 128, 128, 32) 0 conv2d\_transpose\_3[0][0]

activation\_1[0][0]

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dropout\_7 (Dropout) (None, 128, 128, 32) 0 concatenate\_3[0][0]

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conv2d\_16 (Conv2D) (None, 128, 128, 16) 4624 dropout\_7[0][0]

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batch\_normalization\_16 (BatchNo (None, 128, 128, 16) 64 conv2d\_16[0][0]

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activation\_16 (Activation) (None, 128, 128, 16) 0 batch\_normalization\_16[0][0]

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conv2d\_17 (Conv2D) (None, 128, 128, 16) 2320 activation\_16[0][0]

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batch\_normalization\_17 (BatchNo (None, 128, 128, 16) 64 conv2d\_17[0][0]

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activation\_17 (Activation) (None, 128, 128, 16) 0 batch\_normalization\_17[0][0]

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global\_average\_pooling2d (Globa (None, 16) 0 activation\_17[0][0]

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class\_op (Dense) (None, 1) 17 global\_average\_pooling2d[0][0]

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reg\_op (Dense) (None, 4) 68 global\_average\_pooling2d[0][0]

==================================================================================================

Total params: 2,164,661

Trainable params: 2,161,717

Non-trainable params: 2,944

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**Result**:

* With all these steps we fit the model and ran it for 20 epochs and obtained the below accuracy for classification and regression.
  + Train Iou => 0.28 , Validation Iou => 0.35
  + Train\_accuracy => 86% , Validation accuracy => 84%

**Prediction:**