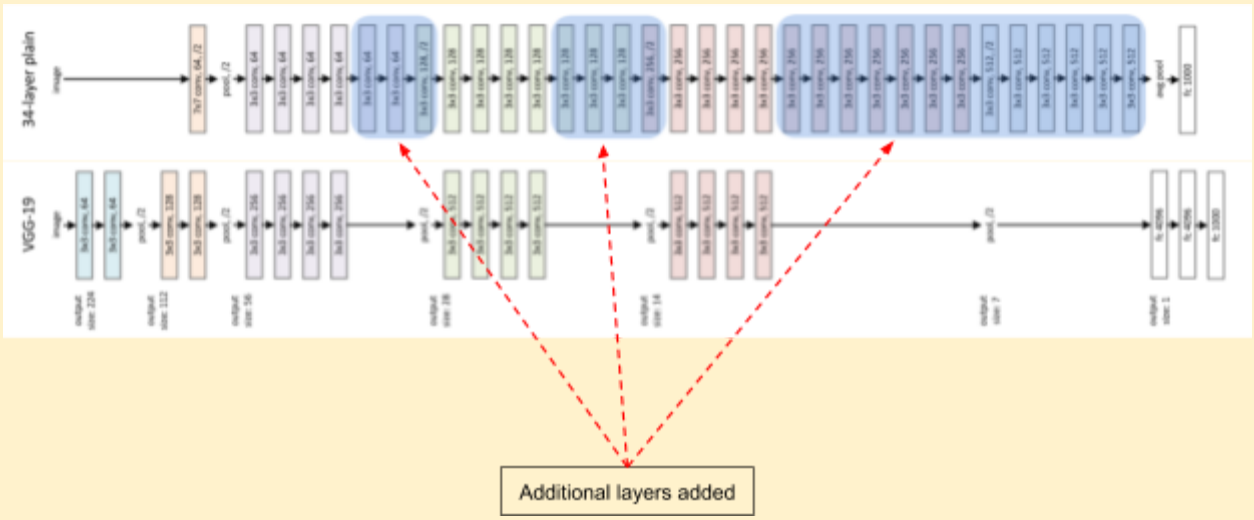
PadhAI: CNN Architectures

One Fourth Labs

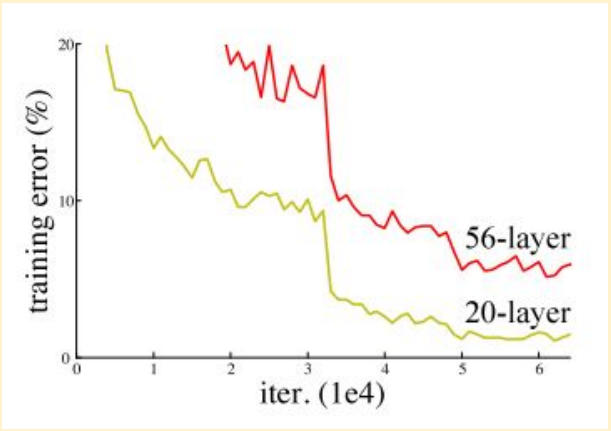
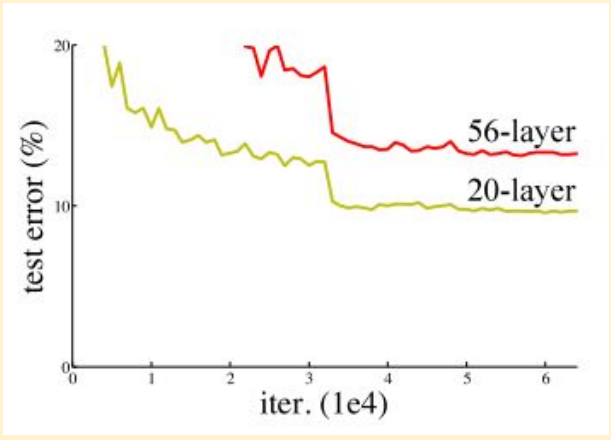
ResNet

What happens if you increase the depth of the network?

1. Let us consider the basic architecture of the VGG-19 network when compared to another 34 layer network architecture

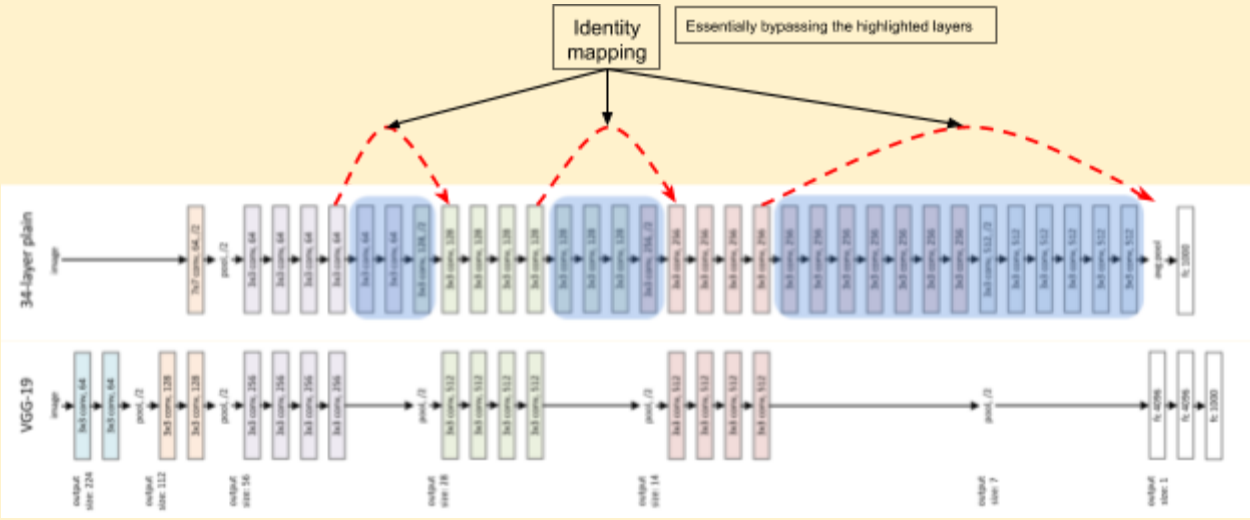


2. The train/test error curves were plotted for some other 20-layer and 56-layer networks

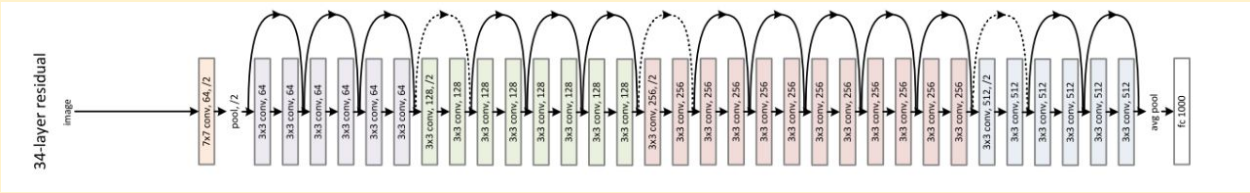
Training curves	Test Curves
	
Unexpectedly, the 56-layer had a higher train error than the 20-layer. It was expected to have overfit the training data, thereby having a lower training error. It was hypothesised that the gradients were not able to flow well through this deeper network.	Here, as predicted, the 56-layer performed worse than the 20-layer due to overfitting.

3. Now, when comparing the 19 and 34-layer networks, we see that at the very least, the 34-layer network should be able to match the performance of the 19-layer network.

4. Matching the performance could be done by bypassing the additional layers in the 34-layer network by using Identity Mapping.
5. Identity mapping refers to learning filter values such that the output is preserved identical across a finite number of layers, till it reaches the target layer. Basically cloning the layer output till required.



6. However, it wasn't able to match the 19-layer's error. This implies that the information from the input is getting highly morphed and by the time we reach the output, it is highly transformed.
7. A simple solution would be to keep passing the input information repeatedly in stages.
8. To attempt this, they tried the Residual Network or the ResNet



9. In the ResNet, **every two layers, we pass the input given to the first layer along with the output obtained at the second layer.**
   a. Input: x_1
   b. Output: $x_2 = f(x_1) + x_1$
   c. Output after two layers: $x_3 = f(x_2) + x_2$
10. This helped the gradients to flow back better and the training to improve
11. It is called a Residual Network because at every stage, there is a residue of the input which is passed once again with the output.
12. Using this technology, they were able to train very deep Neural networks of up to 151 layers.

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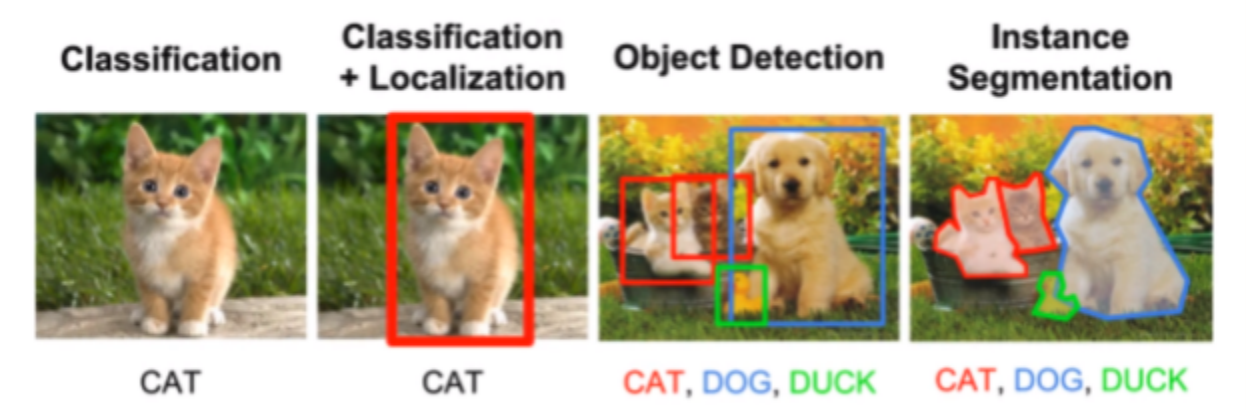
13. The ResNet showed remarkable performance among the various tasks



14. It was the winner among the 4 main tasks across the following datasets
    a. ImageNet Classification **(ResNet-151)**
    b. ImageNet Localization **(ResNet-101)**
    c. ImageNet Detection **(ResNet-101)**
    d. Coco Detection **(ResNet-101)**
    e. Coco Segmentation **(ResNet-101)**
15. Some of the popular ResNets are **(ResNet-51, ResNet-101 and ResNet-151)**