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Pattern Recognition & Computer Vision

1. What is the primary difference between classic machine learning and deep network-based machine learning in computer vision?

Classic machine learning has people look at images and detect important features. It uses models like K-nearest neighbors for classification and accuracy is dependent on how well the data was labelled.

Deep network-based machine learning has neural networks to learn the features from the images. It does the extraction of features and classification all in one, and can learn more complex patterns.

2. What are the factors that enabled the deep network revolution?

Data availability and computing power have definitely been some of the most significant factors that enabled the deep network revolution. This is because, now that there is more data storage, we can have larger datasets to feed into the neural networks. With the greater compute power, we can scale up the networks and train larger models, with greater accuracy and performance overall.

3. Consider the architectures of GoogleNet, VGG-16, and ResNet52. Which network has more layers that are able to integrate information from the entire image?

ResNet52 has the most layers (52 as the name suggests) which allows it to integrate more information from the entire image than the other networks. VGG-16 has 16 layers and GoogleNet has 22 layers.

4. What is a residual connection and how does it change the function a particular layer of the network is learning?

A residual connection is a type of skip connection where the input to a layer of the network is added to the output of the layer. It changes what a layer learns by allowing it to focus on learning the residuals and refining features, as opposed to restarting at a new layer.

5. In Files::CV Papers, find the paper huang-DenseNet-CVPR17.pdf, which describes a network called DenseNet. Focus on the architecture diagram. DenseNet uses skip connections rather than residual connections. How does the DenseNet architecture combine filters from different layers of the block?

DenseNet exploits the network's potential through feature reuse, making it easier to train and highly parameter efficient. To combine filters from different layers of the block, the authors' propose a different connectivity pattern where "we introduce direct connections from any layer to all subsequent layers" and they call this 'dense connectivity'.

6. Within a DenseNet block, does DenseNet reduce the number of filters that need to be computed compared to an equivalent number of layers for a ResNet architecture? How does it do that?

It reduces the number of filters needed by concatenating the multiple inputs into a single tensor.

7. What is the difference between a residual connection and a skip connection?

Residual connection – input to a layer is added to the output of the layer, allowing the network to learn residual mappings

Skip connection – a connection where information skips one or more layers (this can involve addition, concatenation, etc)

8. Why do residual and skip connections facilitate much deeper networks?

Residual and skip connections facilitate much deeper networks because they enable networks to be more efficient, robust, and easier to train. They simplify learning for a network and allow features to be reused and refined.