Bansilal Ramnath Agarwal Charitable Trust's
Vishwakarma Institute of Information Technology, Pune-48
(An Autonomous Institute affiliated to Savitribai Phule Pune University)

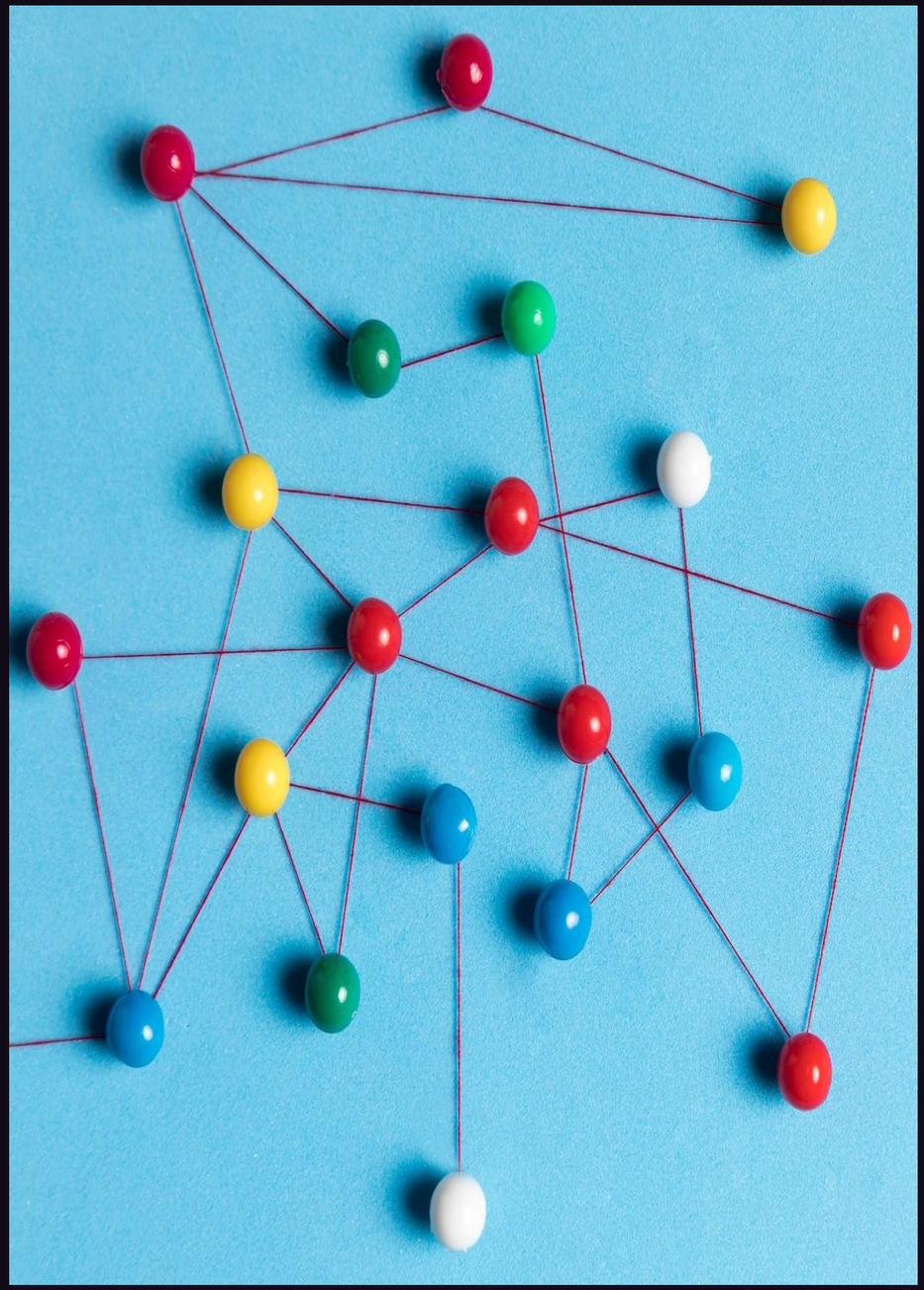
Department of Computer Engineering

Advanced Machine Learning

Flip Classroom

Topic :

Understanding Google Net: An In-depth Exploration



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GoogLeNet

- GoogleNet, also known as Inception v1, is a convolutional neural network (CNN) architecture developed by researchers at Google. It was introduced in the paper "Going Deeper with Convolutions" by Szegedy et al. and won the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) in 2014.

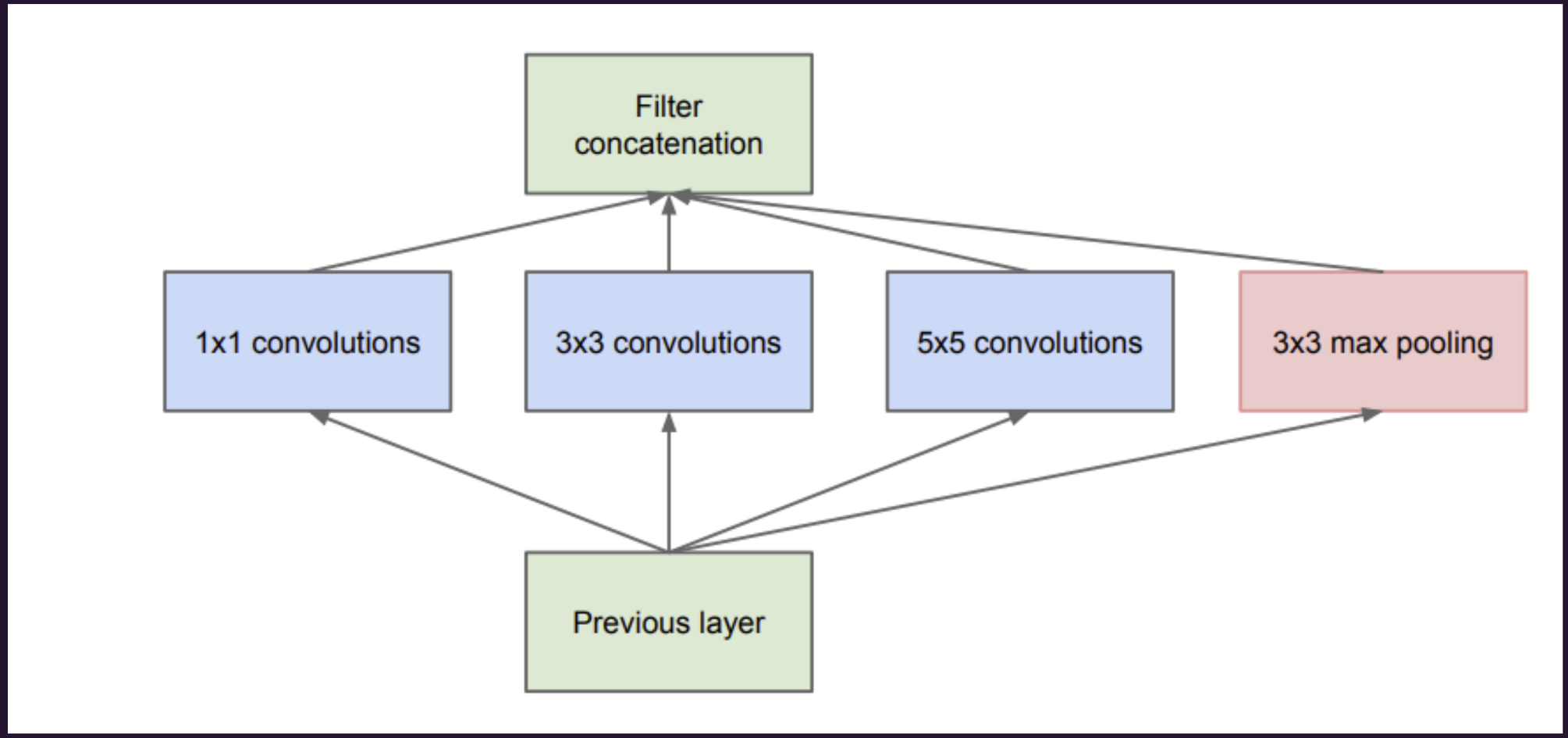
- The main hallmark of this architecture is the improved utilization of the computing resources inside the network. By a carefully crafted design, the depth and width of the network is increased while keeping the computational budget constant.

- To optimize quality, the architectural decisions were based on the Hebbian principle ("neurons that fire together, wire together") and the intuition of multi-scale processing.

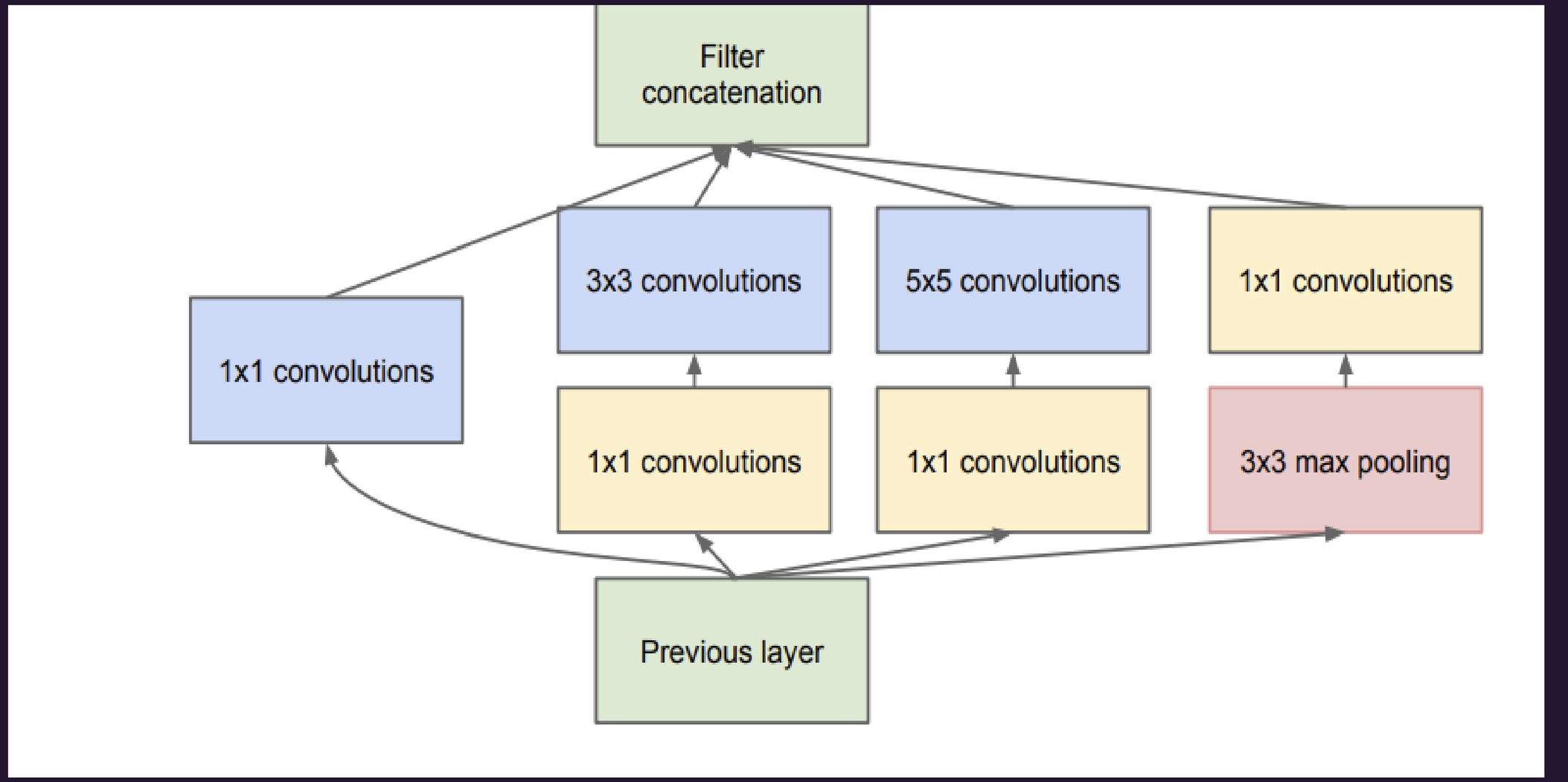
Architecture Overview

Google Net

One fun fact about Google Net is that its name "Inception" comes from the movie "Inception" because of the network's use of inception modules, which are like layers within layers, much like the dreams within dreams concept portrayed in the film.



Inception module, na¨ıve version



Inception module with dimensionality reduction

Architecture Overview

- Deep and Complex Structure: **Google Net's** architecture is notably deep and intricate, consisting of multiple layers that enable it to learn increasingly complex features from raw input data.

- Introduction of Inception Modules: A key innovation of Google Net is the inception module. These modules facilitate parallel processing at different scales within the network, allowing for the simultaneous extraction of features at various levels of granularity.

- Stacking of Inception Modules: Google Net utilizes a stack of these inception modules, creating a hierarchical structure that enables the network to capture information at multiple levels of abstraction. This stacking enhances the network's ability to recognize patterns and objects in images with varying complexities.

GoogleNet Architecture Insights:

1

Innovative Design Principles::

By incorporating inception modules, which utilize parallel convolutional layers, it can capture features at different scales simultaneously, fostering a richer representation of the input data.

2

Efficiency Considerations:

Despite its depth, Google Net maintains a low computational cost, making it viable for deployment in resource-constrained environments like mobile devices.

3

Scalability and Adaptability:

Google Net's modular architecture enables easy scalability and adaptation to diverse tasks and datasets. Researchers can adjust the network's depth and width to meet specific requirements, enhancing its applicability across various computer vision tasks.

Comparison between CNN and GoogleNet

Feature	Convolution Neural Network	Google Net
Architecture	Generally deep, sequential layers	Repeated Inception modules
Computation complexity	High due to depth	Lower due to fewer parameters
Local connectivity	CNN typically have local connectivity, where each neuron is connected to small region of the input volume	GoogleNet utilizes max pooling and global average pooling to encourage the network to learn more discriminative features
Reducing Overfitting	For training it require techniques like dropout and batch normalization to prevent overfitting	GoogleNet's inception modules help mitigate overfitting by promoting sparsity in the activations.

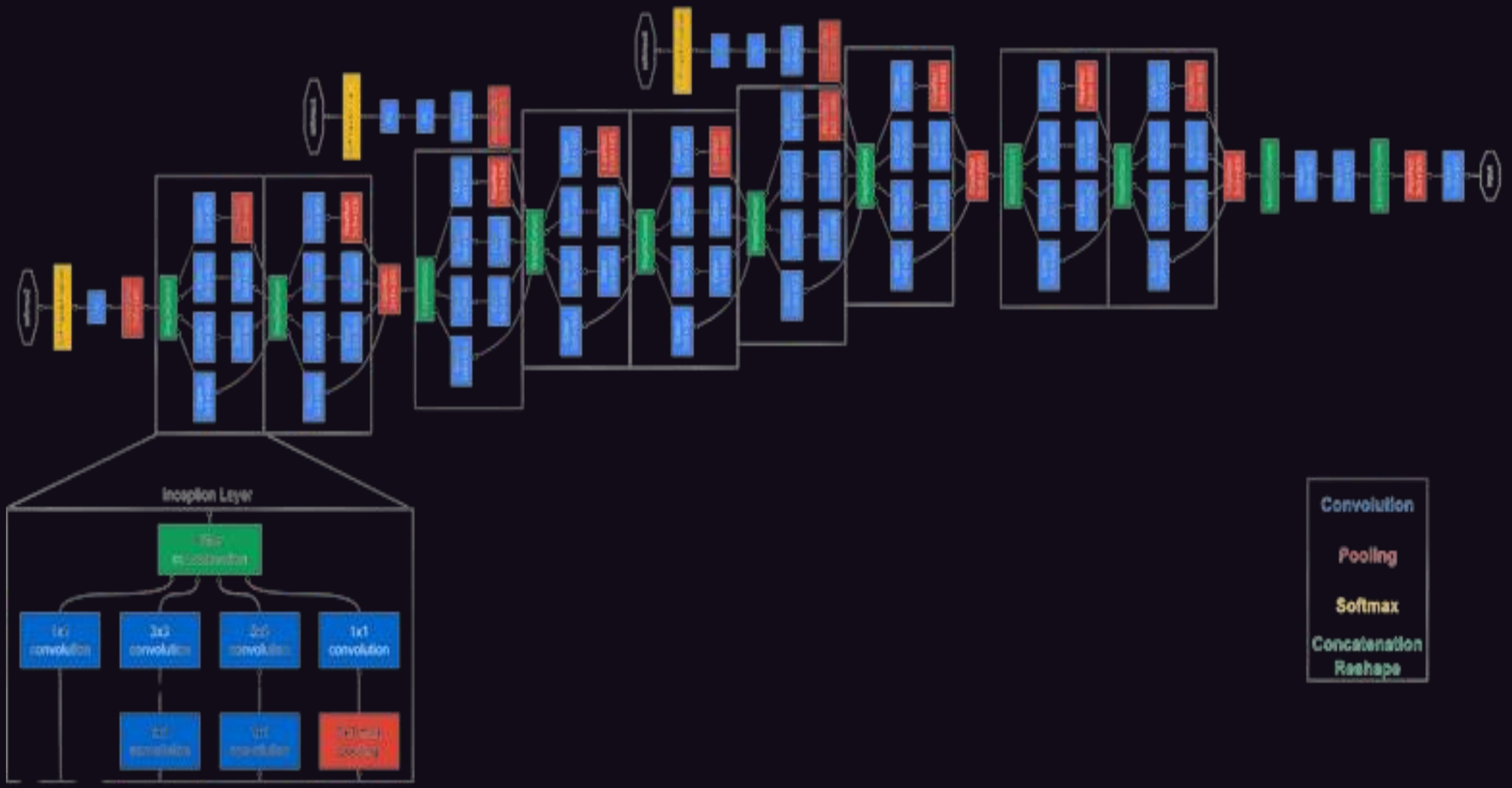
Applications of Google Net:

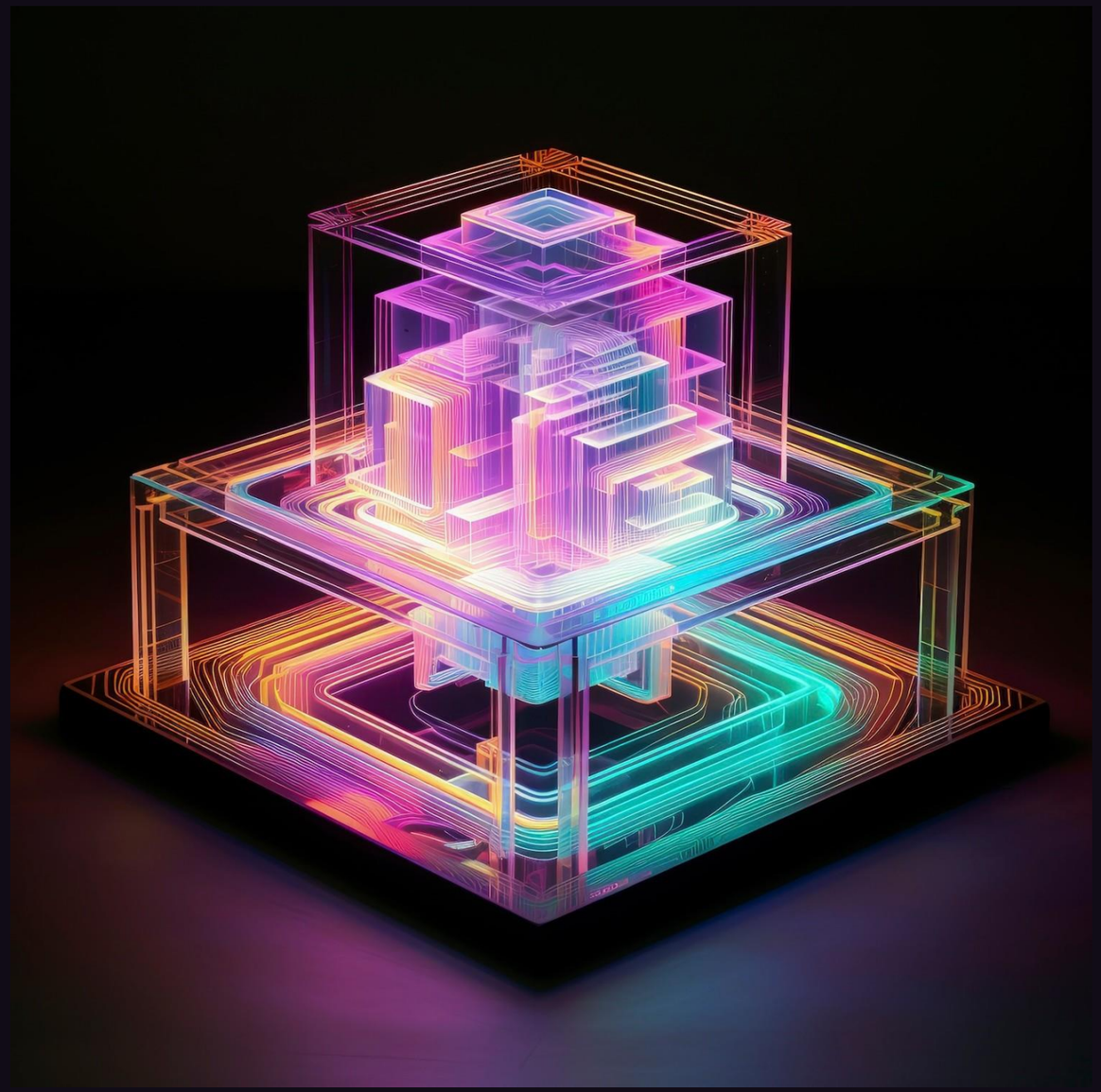
1. Image Classification: Google Net is utilized extensively for accurate classification of images into predefined categories or labels.

2. Object Detection: Its architecture enables precise identification and localization of objects within images, crucial for tasks like autonomous driving and surveillance.

3. Image Segmentation: Google Net's capabilities extend to segmenting images into meaningful regions, facilitating tasks such as medical image analysis and scene understanding.

4. Real-World Implementations: Its deployment in smartphones for image recognition and in autonomous vehicles for real-time scene analysis demonstrates its practical utility and impact across diverse domains.

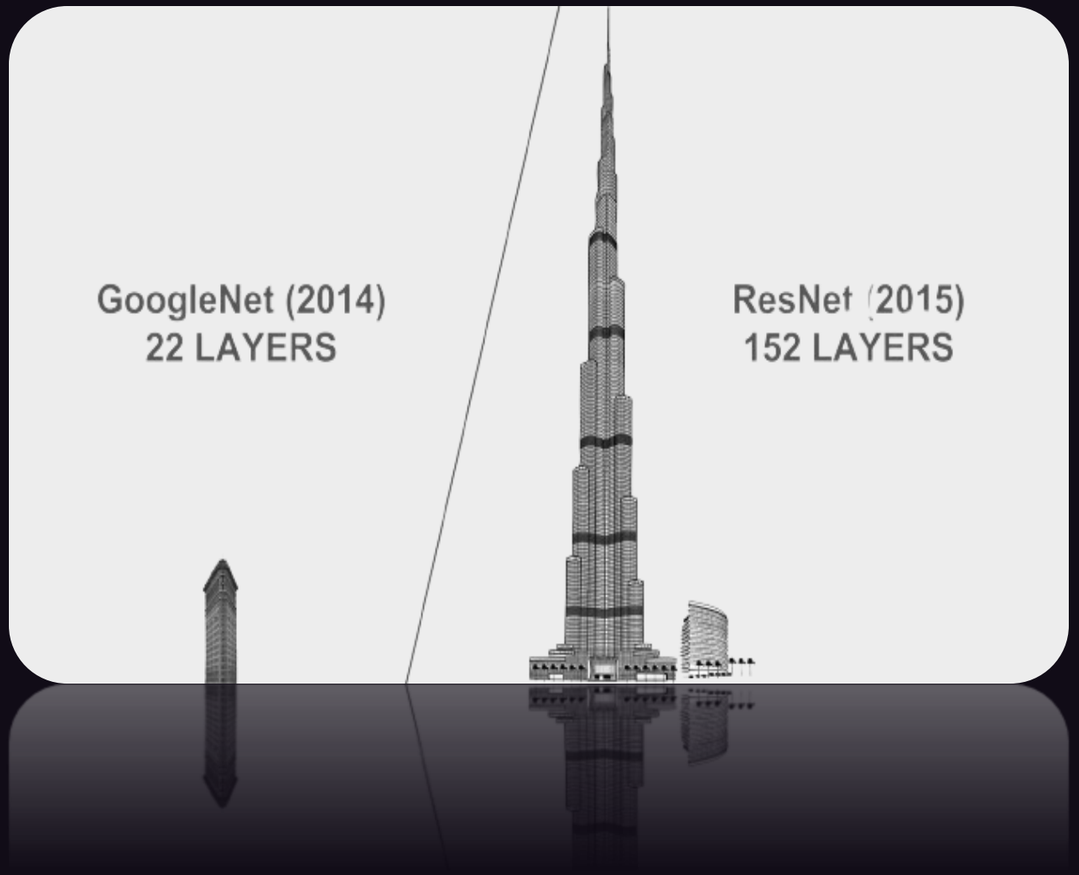

Inception Layer
1x1 convolution
3x3 convolution
1x1 convolution
Convolution
Pooling
Softmax
Concatenation
Reshape



Challenges and Limitations

- Computational Intensity: Google Net's high computational requirements pose challenges for deployment on hardware with limited resources.
- Training Complexity: Training deep networks like Google Net demands substantial computational power and time due to the complex architecture and large datasets.

Challenges and Limitations



- Optimization Challenges: Optimizing Google Net for resource-constrained devices requires balancing model complexity and efficiency.
- Deployment Considerations: Implementing Google Net in real-world applications requires careful consideration of factors like model size and computational efficiency.

Evolution and Successors

- Google Net revolutionized neural network design, inspiring research into deeper and more efficient architectures.
- Its success prompted the development of successors like Inception-v2, Inception-v3, and Inception-ResNet, which aimed to improve performance and efficiency.
- These models built upon Google Net's innovations, further advancing the field of deep learning.
- The evolution of Google Net and its successors continues to drive innovation, pushing the boundaries of neural network capabilities in various applications.

References:

•C. Szegedy et al., "Going deeper with convolutions," 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Boston, MA, USA, 2015.

•https://imagenet.org/challenges/LSVRC/#:~:text=The%20ImageNet%20Large%20Scale%20Visual,image%20classification%20at%20large%20scale.

•https://pytorch.org/hub/pytorch_vision_googlenet/

Thank you!