VGG19 Overview

- Proposed by **Visual Geometry Group (VGG), Oxford** in 2014.
- Extension of **VGG16**, but **deeper (19 layers)**.
- Famous for its **simplicity**: only **3×3 convolution filters** stacked with depth.
- Trained on **ImageNet** (1.2M images, 1000 classes).
- Despite being simple, it achieved **very high accuracy** in ImageNet classification.

Architecture of VGG19

- Total **19 weight layers**: **16 convolutional layers + 3 fully connected layers**.
- Uses **ReLU activation** and **max pooling**.
- Input: **224 × 224 × 3 RGB image**.

Layer-by-Layer Breakdown

1. Input Layer

- Image resized to **224×224×3**.
- Preprocessing: subtract mean RGB values computed on training set.

---

2. Convolution + Pooling Blocks

VGG19 has **5 blocks**, each with multiple convolutional layers and one max pooling.

- **Block 1**
  - 2 Conv layers: 64 filters, 3×3
  - MaxPooling (2×2, stride 2)
  - Output: 112×112×64
- **Block 2**
  - 2 Conv layers: 128 filters, 3×3
  - MaxPooling (2×2, stride 2)
  - Output: 56×56×128

- **Block 3**
  - 4 Conv layers: 256 filters, 3×3
  - MaxPooling (2×2, stride 2)
  - Output: 28×28×256
- **Block 4**
  - 4 Conv layers: 512 filters, 3×3
  - MaxPooling (2×2, stride 2)
  - Output: 14×14×512
- **Block 5**
  - 4 Conv layers: 512 filters, 3×3
  - MaxPooling (2×2, stride 2)
  - Output: 7×7×512

---

3. Fully Connected Layers

After flattening the **7×7×512 = 25088 features**:

- **FC1**: 4096 neurons, ReLU
- **FC2**: 4096 neurons, ReLU
- **FC3 (Output layer)**: 1000 neurons (ImageNet classes), Softmax

---

Summary Table of VGG19

Layer Type	Details	Output Size
Input	224×224×3	224×224×3
Conv + Conv	64 filters × 2 (3×3)	224×224×64
Max Pooling	2×2	112×112×64
Conv + Conv	128 filters × 2 (3×3)	112×112×128
Max Pooling	2×2	56×56×128
Conv ×4	256 filters (3×3)	56×56×256 → 28×28×256
Conv ×4	512 filters (3×3)	28×28×512 → 14×14×512
Conv ×4	512 filters (3×3)	14×14×512 → 7×7×512

Layer Type	Details	Output Size
FC1	4096 neurons, ReLU	1×4096
FC2	4096 neurons, ReLU	1×4096
FC3 (Output)	1000 neurons, Softmax	1×1000

Key Characteristics

- **Uniform filter size** → only **3×3 convolutions** throughout.
- **Depth** → very deep (19 layers) → learns highly complex features.
- **Parameter-heavy** → ~144 million parameters (huge model).
- **Transfer Learning** → widely used as pretrained backbone for tasks like detection, segmentation, style transfer.

 In short:
VGG19 = **5 convolutional blocks (16 conv layers) + 3 fully connected layers**, all with **3×3 filters** and **ReLU**, ending with **softmax**.

VGG -19 Architecture