Computational Analysis

Let's calculate the total number of computations and parameters in our network:

**Number of Computations**

For a convolutional layer with:

* Input size: H×W×C\_in
* Filter size: k×k
* Number of filters: m
* Output size: H×W×m

The number of computations (multiply-adds) for one convolutional layer is:  
H × W × m × k × k × C\_in

For our network with 5 convolutional layers, assuming input image size of 224×224:

1. Layer 1: 224 × 224 × m × k × k × 3
2. Layer 2: 112 × 112 × m × k × k × m (after max pooling)
3. Layer 3: 56 × 56 × m × k × k × m
4. Layer 4: 28 × 28 × m × k × k × m
5. Layer 5: 14 × 14 × m × k × k × m

For the dense layer:  
(7 × 7 × m) × n

For the output layer:  
n × 10

Total computations = Sum of all layer computations

**Number of Parameters**

For a convolutional layer with k×k filters, m filters, and C\_in input channels:  
Parameters = m × (k × k × C\_in + 1) # +1 for bias

For our network:

1. Layer 1: m × (k × k × 3 + 1)
2. Layer 2: m × (k × k × m + 1)
3. Layer 3: m × (k × k × m + 1)
4. Layer 4: m × (k × k × m + 1)
5. Layer 5: m × (k × k × m + 1)

For the dense layer:  
(7 × 7 × m) × n + n # weights + biases

For the output layer:  
n × 10 + 10 # weights + biases

Total parameters = Sum of all layer parameters

**General Formula**

Given m filters in each layer of size k×k and n neurons in the dense layer:

**Total number of computations:**

* Conv layers: (224×224×3 + 112×112×m + 56×56×m + 28×28×m + 14×14×m) × m × k × k
* Dense layer: (7×7×m) × n
* Output layer: n × 10

**Total number of parameters:**

* Conv layers: m × (k×k×3 + 1) + 4 × m × (k×k×m + 1)
* Dense layer: (7×7×m) × n + n
* Output layer: n × 10 + 10

Simplifying the parameter count:  
Parameters = m × (k×k×3 + 1) + 4m × (k×k×m + 1) + (7×7×m) × n + n + 10n + 10  
= m(k×k×3 + 1) + 4m(k×k×m + 1) + 49mn + n + 10n + 10  
= m(k×k×3 + 1) + 4mk×k×m + 4m + 49mn + 11n + 10  
= 3mk² + m + 4m²k² + 4m + 49mn + 11n + 10  
= 3mk² + 4m²k² + 5m + 49mn + 11n + 10