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Neural Network and Deep Learning Assignment-2

[Code link]

(A) Effect of Different Types of Activation Functions


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==================== Accuracy Summary ====================
VGG16         | relu: 2.75% | softmax: 4.45% | tanh: 7.20% | sigmoid: 6.70% |
VGG19         | relu: 1.95% | softmax: 5.05% | tanh: 4.80% | sigmoid: 8.10% |
ResNet50      | relu: 3.90% | softmax: 4.70% | tanh: 5.90% | sigmoid: 6.25% |
InceptionV3   | relu: 5.15% | softmax: 5.80% | tanh: 6.75% | sigmoid: 5.80% |
Xception      | relu: 5.55% | softmax: 6.70% | tanh: 4.80% | sigmoid: 5.95% |
MobileNet     | relu: 3.00% | softmax: 3.45% | tanh: 7.20% | sigmoid: 5.35% |
DenseNet121   | relu: 6.55% | softmax: 4.95% | tanh: 6.55% | sigmoid: 2.80% |
EfficientNetB1| relu: 3.70% | softmax: 3.85% | tanh: 3.90% | sigmoid: 4.35% |
NASNetMobile  | relu: 4.50% | softmax: 7.35% | tanh: 6.85% | sigmoid: 4.20% |
NASNetLarge   | relu: 4.50% | softmax: 3.60% | tanh: 4.85% | sigmoid: 3.50% |
```

Figure 1: Output of effect on different types activation function

(B). Classification of CNN Architectures Based on Convolution Kernel Types

Model	Kernel Types Used
VGG16	Regular Kernel
VGG19	Regular Kernel
ResNet50	Regular Kernel, Pointwise Kernel (1×1 conv)
InceptionV3	Regular Kernel, Pointwise Kernel (1×1 conv)
Xception	Depthwise Separable Kernel, Pointwise Kernel
MobileNet	Depthwise Separable Kernel, Pointwise Kernel
DenseNet121	Regular Kernel, Pointwise Kernel (1×1 conv)
EfficientNetB1	Modified Depthwise Separable Kernel, Pointwise Kernel
NASNetMobile	Regular Kernel, Depthwise Separable Kernel, Pointwise Kernel
NASNetLarge	Regular Kernel, Depthwise Separable Kernel, Pointwise Kernel

Table 1: Kernel Types Used in Popular Pretrained CNN Models

(C). Understanding Layer-wise Feature Map Representation in ResNet50

Layer Name	Type	Input Shape	Output Shape	Description
conv1	Conv2D (7×7, stride 2)	224×224×3	112×112×64	Captures low-level features like edges and blobs
conv1_pool	MaxPool (3×3, stride 2)	112×112×64	56×56×64	Reduces resolution while preserving important edges
conv2_x	Residual block (3 layers)	56×56×64	56×56×256	Captures simple textures and color blobs
conv3_x	Residual block (4 layers)	56×56×256	28×28×512	Extracts more complex shapes and patterns
conv4_x	Residual block (6 layers)	28×28×512	14×14×1024	Encodes object parts and mid-level patterns
conv5_x	Residual block (3 layers)	14×14×1024	7×7×2048	High-level abstraction; object-like patterns
avg_pool	Global Average Pooling	7×7×2048	1×1×2048	Reduces to 1 vector per channel (global descriptor)
fc (classifier head)	Dense Layer	2048	20	Final classification layer

Table 2: Feature Map Summary of Key Layers in ResNet50