**Bailey Nguyen Assignment 3 Report Deep Learning**

**A Basic CNN**

64×64 grayscale image ->  
Conv2D (1 -> 32 filters, 3×3 kernel, ReLU) [Introduces non-linearity, allowing the network to learn complex patterns]->   
MaxPooling (32×32) ->  
Conv2D (32 → 64 filters, 3×3 kernel, ReLU) ->  
MaxPooling (16×16) ->  
Flatten (16×16×64 = 16,384) ->  
Fully Connected (16,384 -> 128, ReLU) [Acts as a high-level feature extraction layer]->  
Fully Connected (128 -> 10 output logits)

Overall a small CNN, but accuracy isn’t that great

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| train\_loss\_step=0.167,  train\_accuracy\_step=0.959,  val\_loss=1.750,  val\_accuracy=0.930,  train\_loss\_epoch=0.146,  train\_accuracy\_epoch=0.970 |
| 'test\_accuracy': 0.5385987162590027,  'test\_loss': 1.884461760520935 |

**ResNet 18**

self.estimator = models.resnet18(weights=ResNet18\_Weights.DEFAULT)

Simply used existing ResNet18 weights as model

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| train\_loss\_step=0.151,  train\_accuracy\_step=0.959,  val\_loss=0.782,  val\_accuracy=0.953,  train\_loss\_epoch=0.0903,  train\_accuracy\_epoch=0.969 |
| 'test\_accuracy': 0.7931210398674011,  'test\_loss': 0.7959476113319397 |

**Regularization**

Took the model from ‘A Basic CNN’ and added drop out

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| CNN no dropout | CNN with dropout |
| train\_loss\_step=0.167,  train\_accuracy\_step=0.959,  val\_loss=1.750,  val\_accuracy=0.930,  train\_loss\_epoch=0.146,  train\_accuracy\_epoch=0.970 | train\_loss\_step=0.519, train\_accuracy\_step=0.838,  val\_loss=1.520,  val\_accuracy=0.855,  train\_loss\_epoch=0.367, train\_accuracy\_epoch=0.885 |
| 'test\_accuracy': 0.5385987162590027, 'test\_loss': 1.884461760520935 | 'test\_accuracy': 0.5477706789970398,  'test\_loss': 1.6634222269058228 |

Looks like dropout made things slightly better with a slightly better test accuracy and smaller loss!

**Transfer Learning**

Used ResNet18 to do transfer learning

A comparison of a bar graph

AI-generated content may be incorrect.

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| train\_loss\_step=0.0064,  train\_accuracy\_step=1.000,  val\_loss=0.259,  val\_accuracy=0.922,  train\_loss\_epoch=0.0507,  train\_accuracy\_epoch=0.984 |
| 'test\_loss': 0.8595882654190063,  'test\_accuracy': 0.8133999705314636 |