CONVOLUTIONAL NEURUAL NETWORK

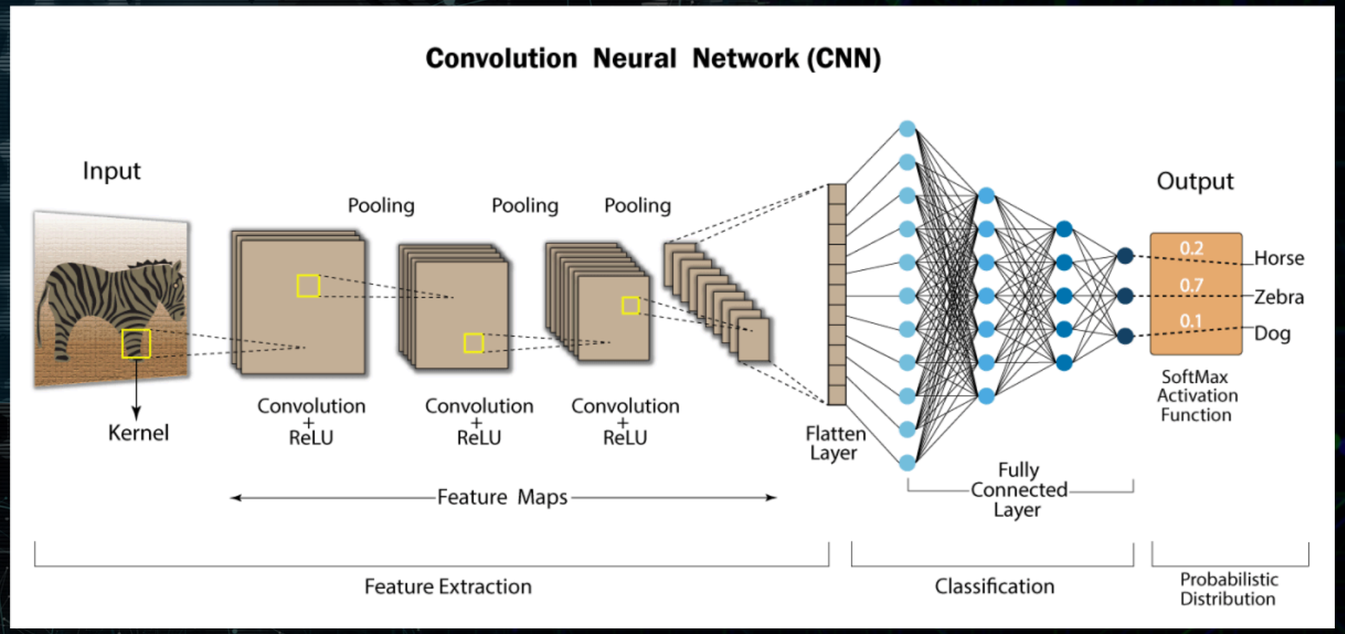
By: Dale Faubion and Henry Johnson

WHAT IS A CNN?

Deep Learning Model Developed by Yann LeCun in 1989

3 Layers:

- Convolution
  - Featurizes
- Pooling
  - Summarizes
- Fully Connected
  - Classifies



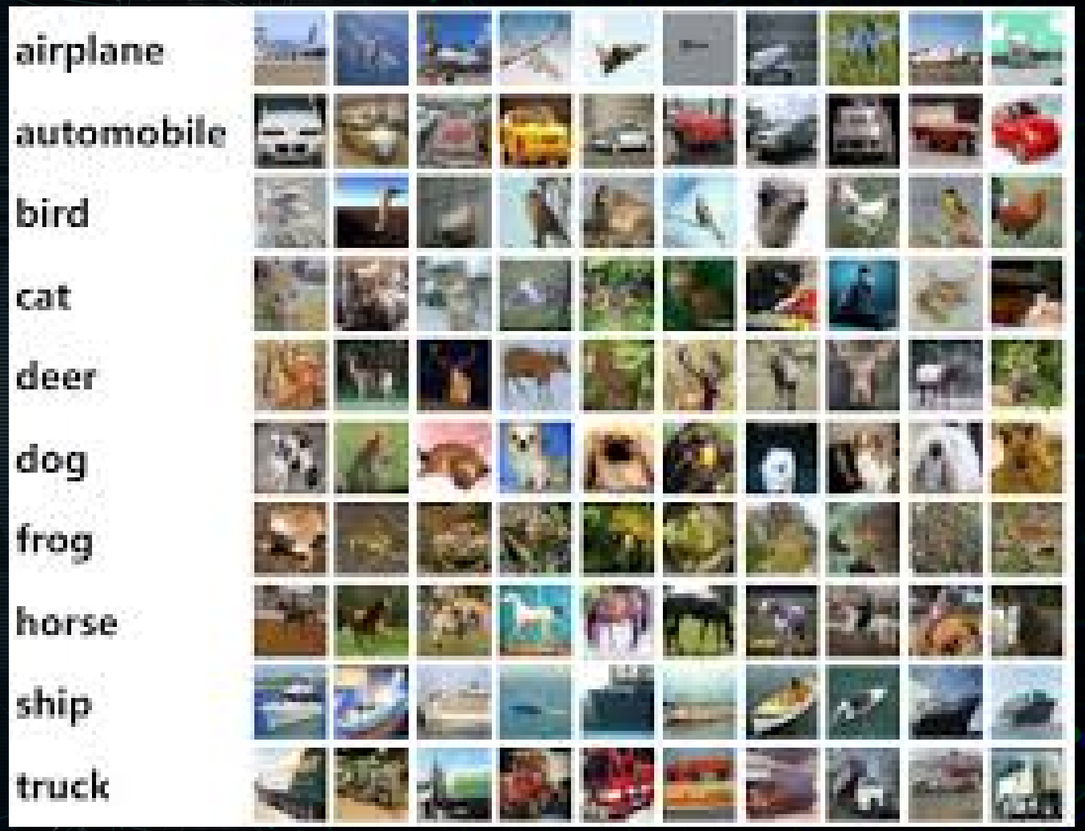
DATA - CIFAR10

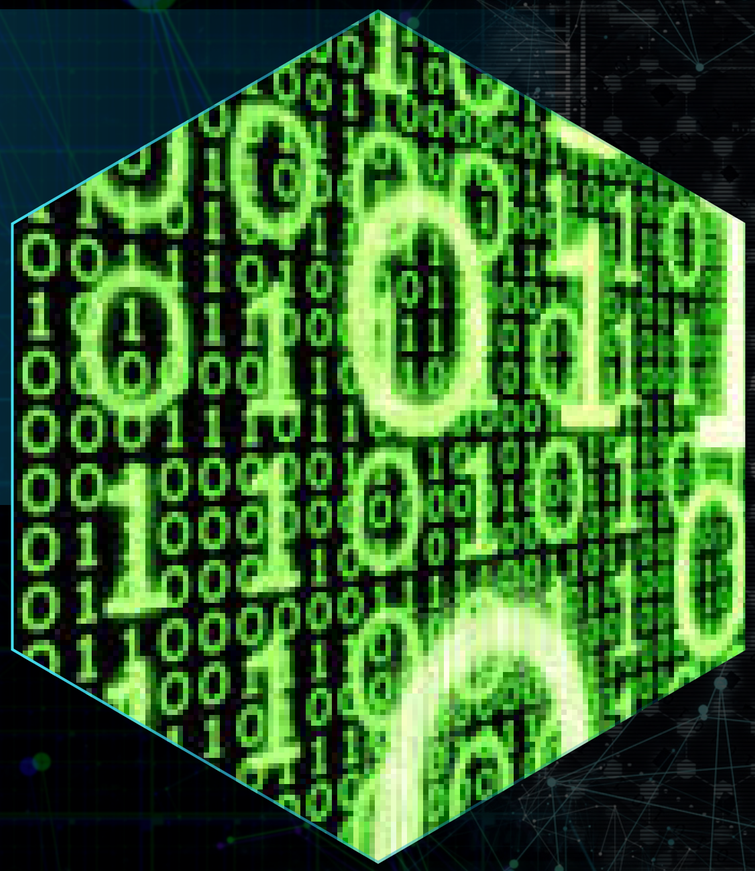
What is the the CIFAR10:

- Consists of 60,000 32x32 bit images
- Split into 10 categories evenly

The categories:

- airplane, automobile, bird, cat, deer, dog, frog, horse, ship, and truck

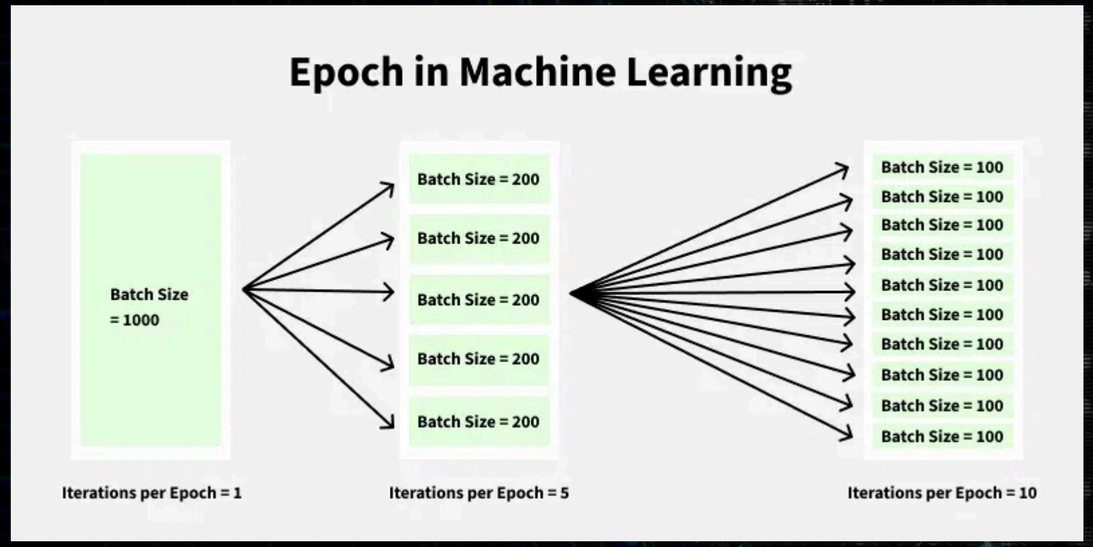




OUR PROCESS

Given the set code, we altered the various hyperparameters to see how it affected the resuls of the cnn

EPOCHS

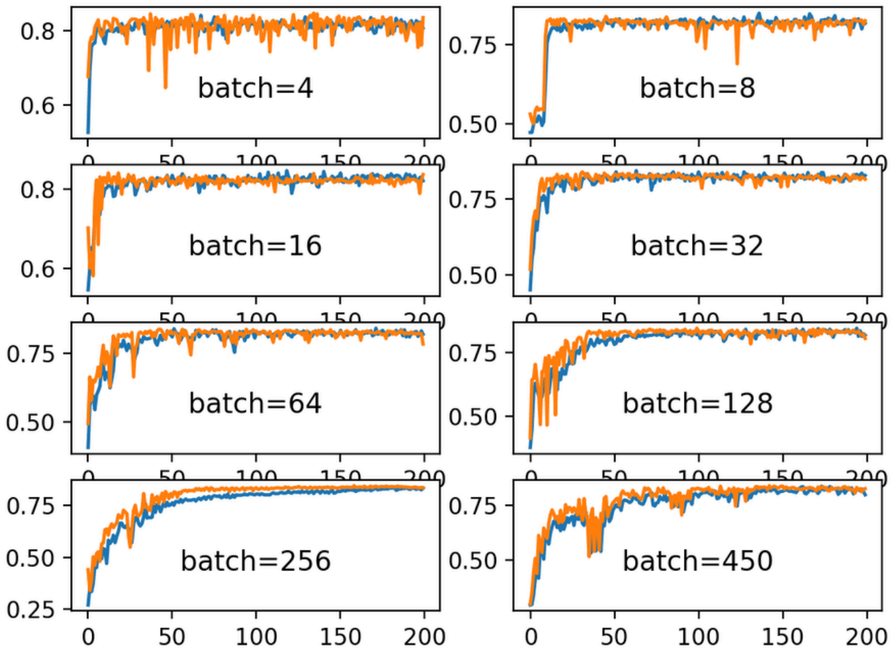


1. WHAT IS AN EPOCH:

- An epoch refers to one complete pass of the entire training dataset through a learning algorithm
- The number of epochs is a hyperparameter that determines how many times the algorithm works through the entire dataset,

2. OPTIONS FOR THE EPOCH

- 5
- 10
- 15
- 20
- 30
- Best Option Overall: 30 - more training time



BATCH SIZE

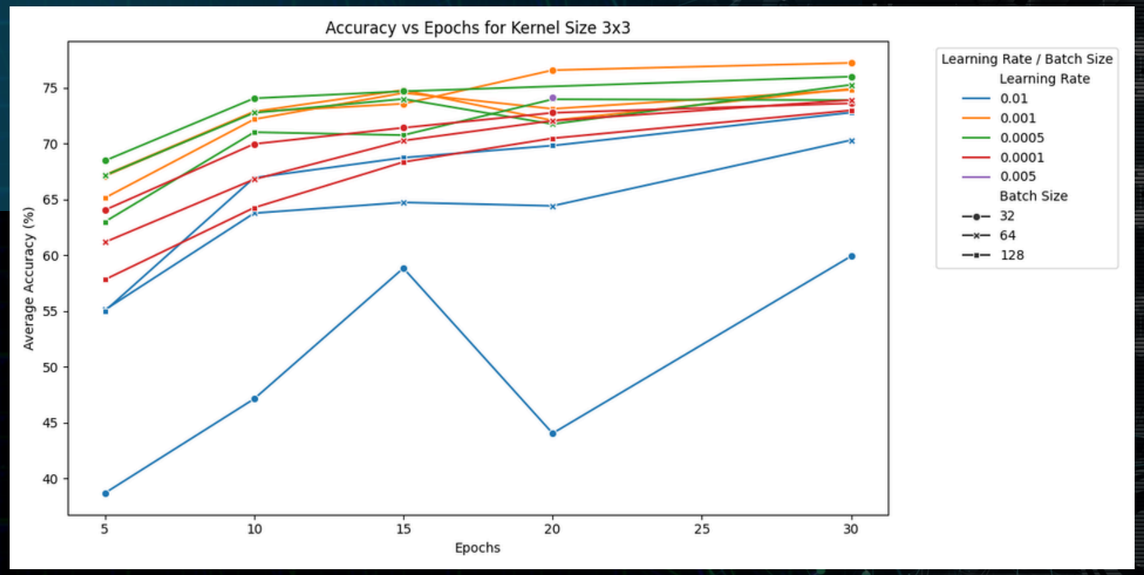
1. WHAT IS THE BATCH SIZE:

Batch size refers to the number of training examples used in one iteration during model training
Smaller Batch Sizes: Can lead to more robust learning with noisier gradients and potentially better generalization
Larger Batch Sizes: Can speed up training by leveraging parallel processing on hardware like GPUs

OPTIONS FOR THE BATCH SIZE:

- 32
- 64
- 128
- Best Batch Size - 32

LEARNING RATE



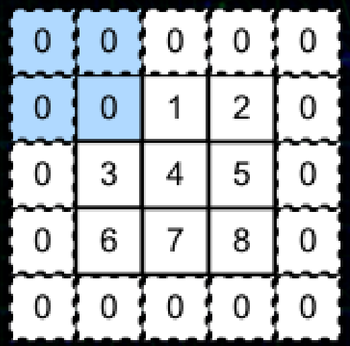
1. WHAT IS LEARNING RATE:

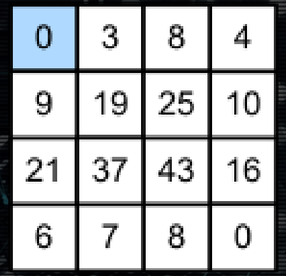
- The Learning Rate refers to how much the weights are updated to minimize loss.
- Too large: overshoot convergence
- Too small: Takes forever to converge

2. OPTIONS FOR LEARNING RATE

- 0.01
- 0.001
- 0.005
- 0.0001
- 0.0005
- Best Learning Rate = 0.001

KERNEL SIZE





1. WHAT IS THE KERNEL SIZE:

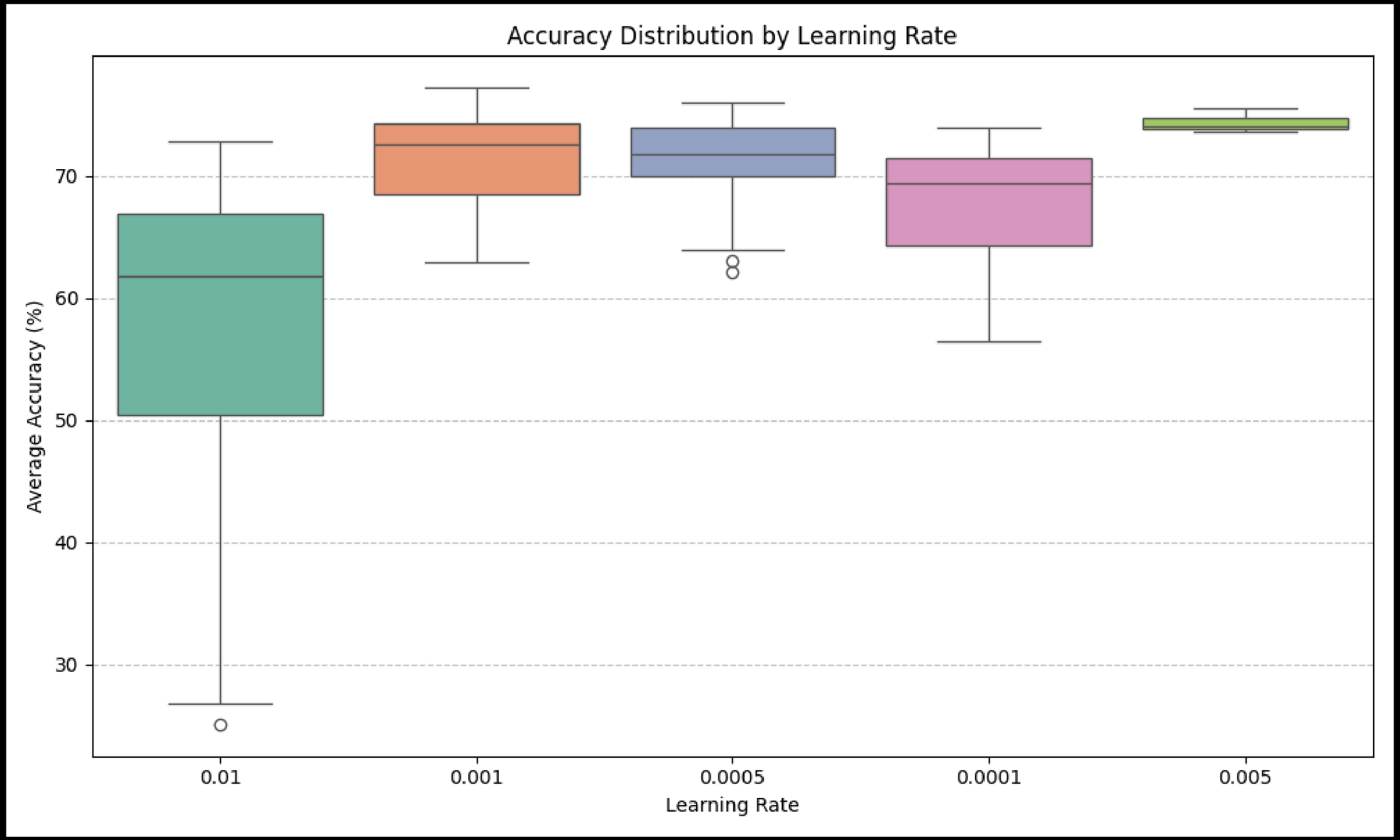
kernel size refers to the dimensions of the small matrix used to extract features from an image. The kernel can be thought of as a small, movable window that examines a specific region of the image

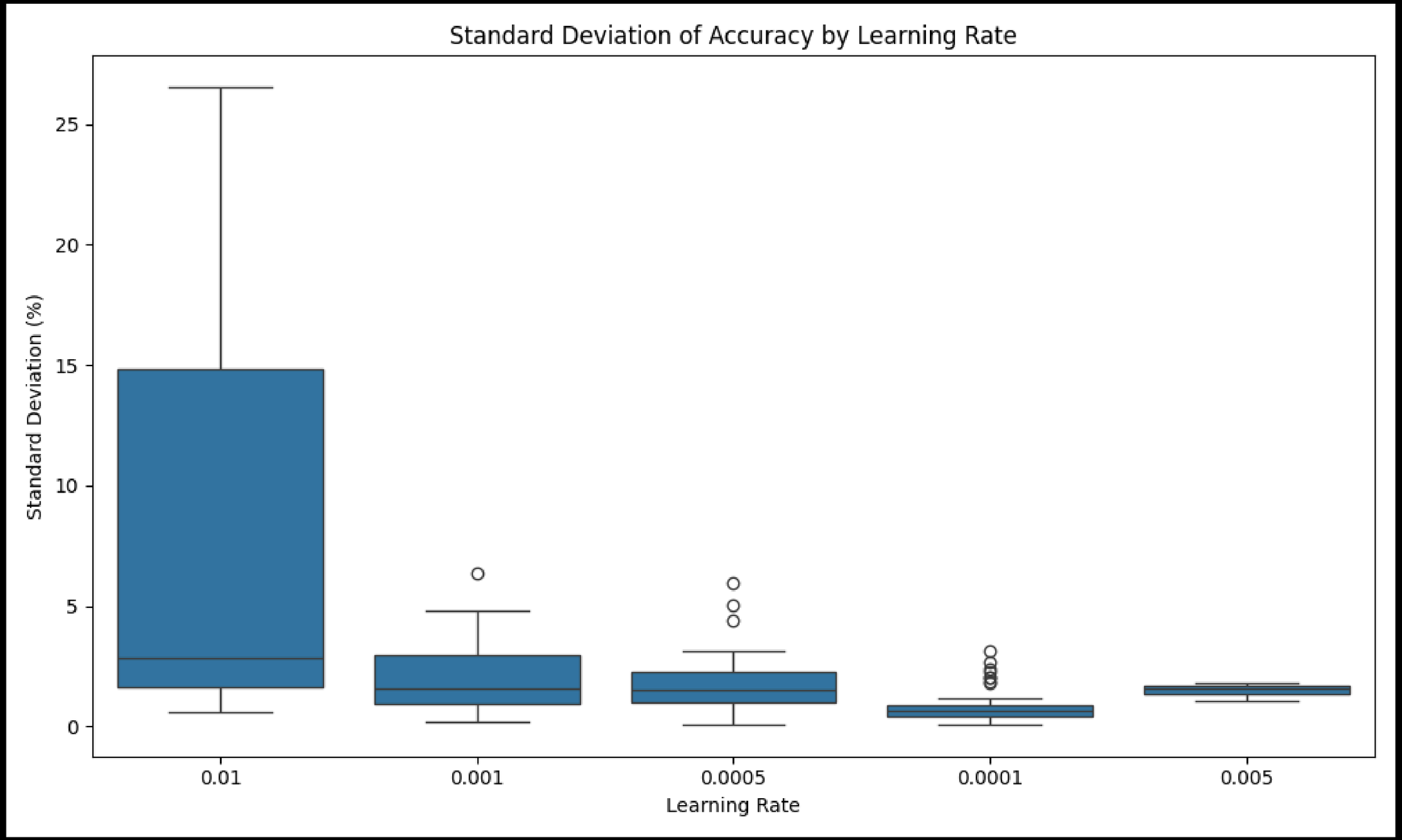
2. OPTIONS FOR THE KERNEL SIZE:

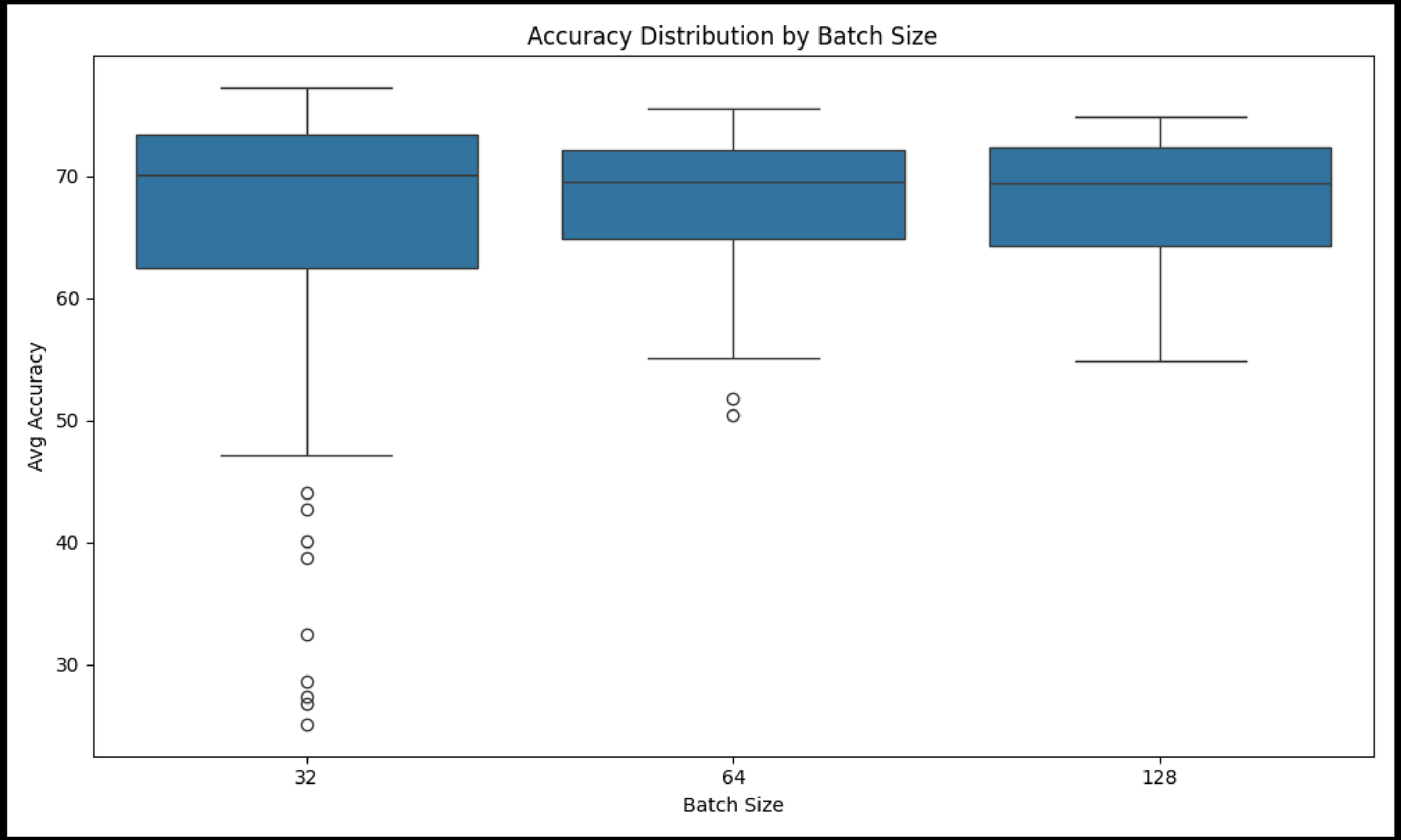
- 2x2
- 3x3
- 5x5
- Best Kernel Size: 3x3

TOP TEN RESULTS

Trial	Epochs	Batch Size	Learning Rate	Kernel Size	Average Accuracy	Standard Deviation
148	30	32	0.001	3x3	77.24%	0.65%
112	20	32	0.001	3x3	76.59%	1.11%
151	30	32	0.0005	3x3	76.01%	0.10%
159	30	64	0.001	2x2	75.52%	1.25%
116	20	32	0.005	5x5	75.51%	1.59%
149	30	32	0.001	5x5	75.42%	0.17%
161	30	64	0.001	5x5	75.40%	0.53%
152	30	32	0.0005	5x5	75.37%	0.78%
163	30	64	0.0005	3x3	75.28%	0.45%
113	20	32	0.001	5x5	75.26%	0.51%


Accuracy Distribution by Learning Rate
Average Accuracy (%)
70
60
50
40
30
0.01
0.001
0.0005
0.0001
0.005
Learning Rate


Standard Deviation of Accuracy by Learning Rate
Standard Deviation (%)
25
20
15
10
5
0
0.01
0.001
0.0005
0.0001
0.005
Learning Rate


Accuracy Distribution by Batch Size
Avg Accuracy
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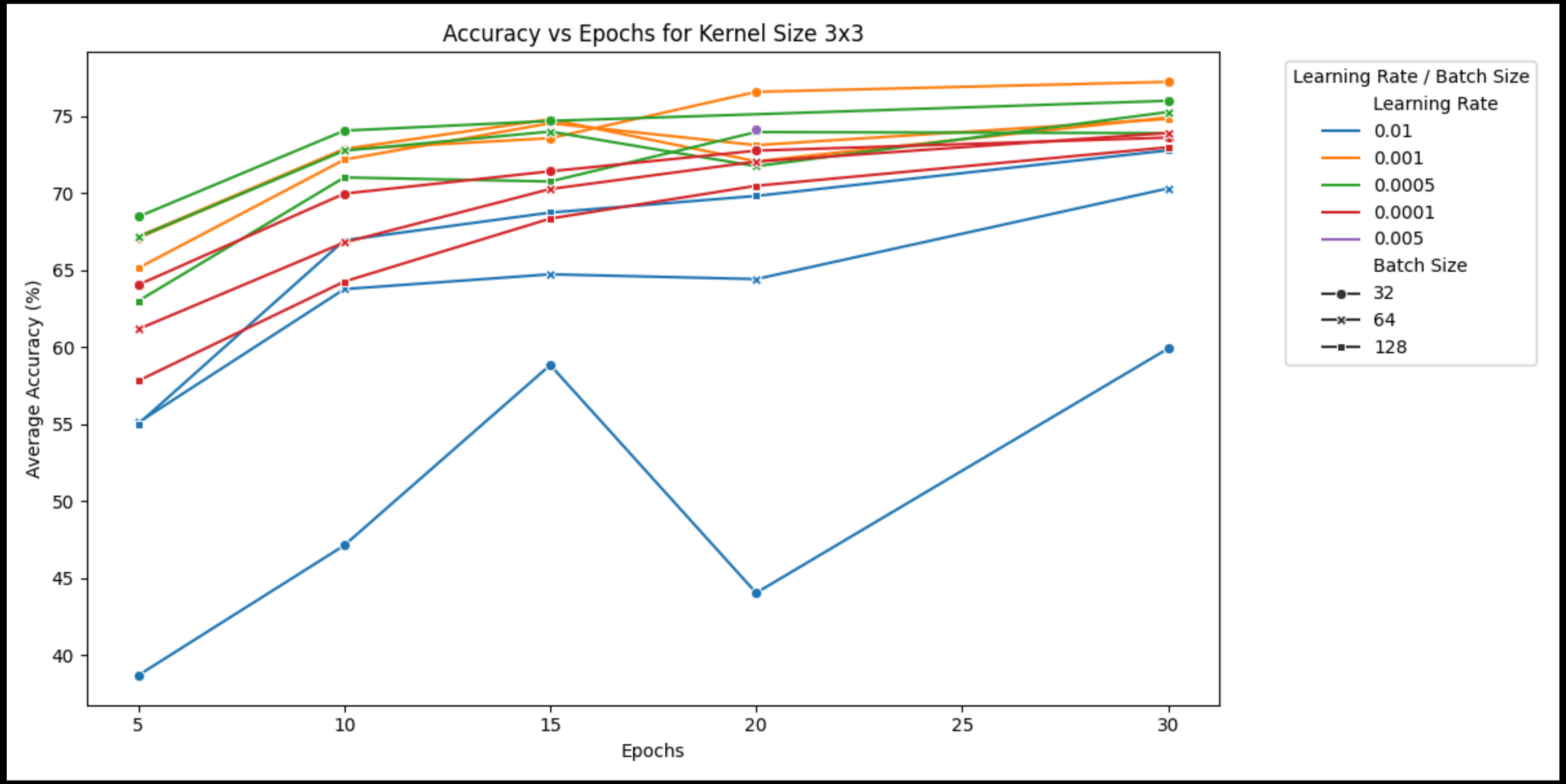
128
Batch Size


Accuracy vs Epochs for Kernel Size 3x3
Average Accuracy (%)
Epochs
75
70
65
60
55
50
45
40
5
10
15
20
25
30
Learning Rate / Batch Size
Learning Rate
0.01
0.001
0.0005
0.0001
0.005
Batch Size
32
64
128

FUTURE PLANS

1. MORE EXTENSIVE HYPERPARAMETERS

Test the true limits of all the hyperparameters such as:
Learning Rate of 0.1 or 0.00001
Kernel Size of 10x10 or 1x1
ect

2. DIFFERENT DATASET

- CIFAR 100
- Facial Recognition

3. DIFFERENT HYPERPARAMTERS

- Activiation Functions
  - Current: ReLu
  - Leaky ReLu
  - Softmax
- Optimizers
  - Current: Adam
  - SGD with momentum
  - RMSprop
  - Adagrad

Predictions for: jorr-picasso.png

Model 1: frog

Model 2: cat

Model 3: frog

Predictions for: Walker1.png

Model 1: bird

Model 2: bird

Model 3: bird

Predictions for: Walker3.png

Model 1: deer

Model 2: dog

Model 3: dog

Predictions for: Walker4.png

Model 1: frog

Model 2: frog

Model 3: frog

DEMO


Predictions for: Grass.png
Model 1: dog
Model 2: bird
Model 3: truck

THANK YOU

QUESTIONS?