Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 16, 16, 32)	896
batch_normalization (BatchNormalization)	(None, 16, 16, 32)	128
conv2d_1 (Conv2D)	(None, 8, 8, 64)	18496
batch_normalization_1 (BatchNormalization)	(None, 8, 8, 64)	256
conv2d_2 (Conv2D)	(None, 4, 4, 128)	73856
batch_normalization_2 (BatchNormalization)	(None, 4, 4, 128)	512
conv2d_3 (Conv2D)	(None, 4, 4, 128)	147584
batch_normalization_3 (BatchNormalization)	(None, 4, 4, 128)	512
conv2d_4 (Conv2D)	(None, 4, 4, 128)	147584
batch_normalization_4 (BatchNormalization)	(None, 4, 4, 128)	512
conv2d_5 (Conv2D)	(None, 4, 4, 128)	147584
batch_normalization_5 (BatchNormalization)	(None, 4, 4, 128)	512
conv2d_6 (Conv2D)	(None, 4, 4, 128)	147584
batch_normalization_6 (BatchNormalization)	(None, 4, 4, 128)	512
max_pooling2d (MaxPooling2D)	(None, 1, 1, 128)	0
flatten (Flatten)	(None, 128)	0
dense (Dense)	(None, 128)	16512
batch_normalization_7 (BatchNormalization)	(None, 128)	512
dense_1 (Dense)	(None, 10)	1290

Total params: 704842 (2.69 MB)
Trainable params: 703114 (2.68 MB)
Non-trainable params: 1728 (6.75 KB)

1. **INCLUDE** ***Did you observe any overfitting? Should the model train for longer, shorter, or about that number of epochs.***

The first model may have had overfitting with the ending accuracy of .99. For the 32x32 images, the 50 epochs seemed to be enough. If the images were larger I would consider training the model longer.

2. **INCLUDE** *Does it correctly label the picture?*

Yes, all 3 models were able to label the pictures correctly.

3. **INCLUDE** For this model, *did you observe any overfitting? Should the model train for longer, shorter, or about that number of epochs.*

Similarly to before, did not notice overfitting, and for the image size and complexity, I think the 50 epochs were sufficient.

4. **INCLUDE** *How did the three models compare? Consider final accuracy, time per epoch to train, number of epochs needed to reach a given accuacy , overfitting.*

For the first model, it took around 17-18 seconds to complete an epoch, for the second model around 20 seconds, and for the third epoch also averaged around 20 seconds. The first model ended with an accuracy of .99, the second at .92, and the third finishing at .95. All models ran for 50 epochs, and the first model reached .9 accuracy within 10 epochs, the second model took the whole 50, and the third model in 24 epochs.