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## 9. Convolutional Neural Networks

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Project due Apr 5, 2023 08:59 -03 Completed

Next, we are going to apply convolutional neural networks to the same task. These networks have demonstrated great performance on many deep learning tasks, especially in computer vision.

**You will be working in the files `part2-mnist/nnet_cnn.py` and `part2-mnist/train_cnn.py`.**

## Convolutional Neural Networks

3.0/3.0 points (graded)

We provide skeleton code `part2-mnist/nnet_cnn.py` which includes examples of some of the layers you will need in this part. Using the [PyTorch Documentation](#), complete the code to implement a convolutional neural network with following layers in order:

- A convolutional layer with 32 filters of size  $3 \times 3$
- A ReLU nonlinearity
- A max pooling layer with size  $2 \times 2$
- A convolutional layer with 64 filters of size  $3 \times 3$
- A ReLU nonlinearity
- A max pooling layer with size  $2 \times 2$
- A flatten layer
- A fully connected layer with 128 neurons
- A dropout layer with drop probability 0.5
- A fully-connected layer with 10 neurons

**Note:** We are not using a softmax layer because it is already present in the loss: `PyTorch nn.CrossEntropyLoss` combines `nn.LogSoftMax` with `nn.NLLLoss`.

Without GPU acceleration, you will likely find that this network takes quite a long time to train. However, we don't expect you to actually train this network until convergence. Implementing the network (which should take less than 10 minutes) is enough for this project. If you are curious, you can try training it longer; if implemented correctly, your model should achieve >99% **test accuracy** after training. If you have access to a CUDA compatible GPU, you could even try configuring PyTorch to use it.

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