Note: All coding problems to be submited with Github Link. Do not Upload the files/folder. Use git commands only.

Note: this is the distribution of questions:

(a) Question 1 to Question2: Required for everyone.

(b) Question 3: Required only for Graduate Students

(c) Question 4: Bonus question for both Graduate Students and Undergraduate Students

Problem 1 (20 points)

You have a convolutional neural network that takes as an input image of size $512 \times 512 \times 3$ and passes it through a layer that convolves the image using 3 filters of dimensions $5 \times 5 \times 3$ with a valid padding.

(a) List all learnable parameters of this convolution layer.

(b) What if you want to replicate the behavior of this convolutional layer using a fully connected layer? How many parameters would that fully connected layer have?

Problem 2 (20 points)

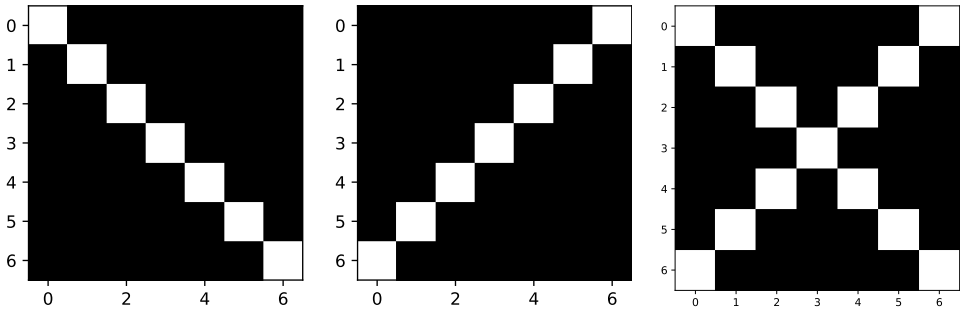
Given a binary input image of diagonal streaks (see example in Figure 2) and two filters (see Figure 1a) describe how would you build a detector for finding the location of pattern shown in Figure 1b on the input image. Allowed operations are convolution, summation, and argmax.

——————————— Bonus for undergraduates beyond this line

Problem 3 (20 points)

Demonstrate that convolution is translation invariant for 1D convolution (Note:this can be extended to N-D convolutions as well).

——————————— Bonus for both undergraduates and graduates beyond this line.



(a) Available fixed filters (b) Target shape to detect

Figure 1: Filters to use (1a) and pattern to find (1b).

Problem 4 (20 points)

You have to choose between two papers given below:

(a) Paper 1: High-Performance Neural Networks for Visual Object Classification:

(i) Give a short summary of the paper.

(ii) What were the parameter sizes for CIFAR-10 and MNIST? why do you think the paramtere size differed for CIFAR-10 vs MNIST?

(b) Paper 2: ImageNet Classification with Deep Convolutional Neural Networks:

(i) Give a short summary of the paper.

(ii) Why is there a big fluctuation of loss for the last epoch of training?

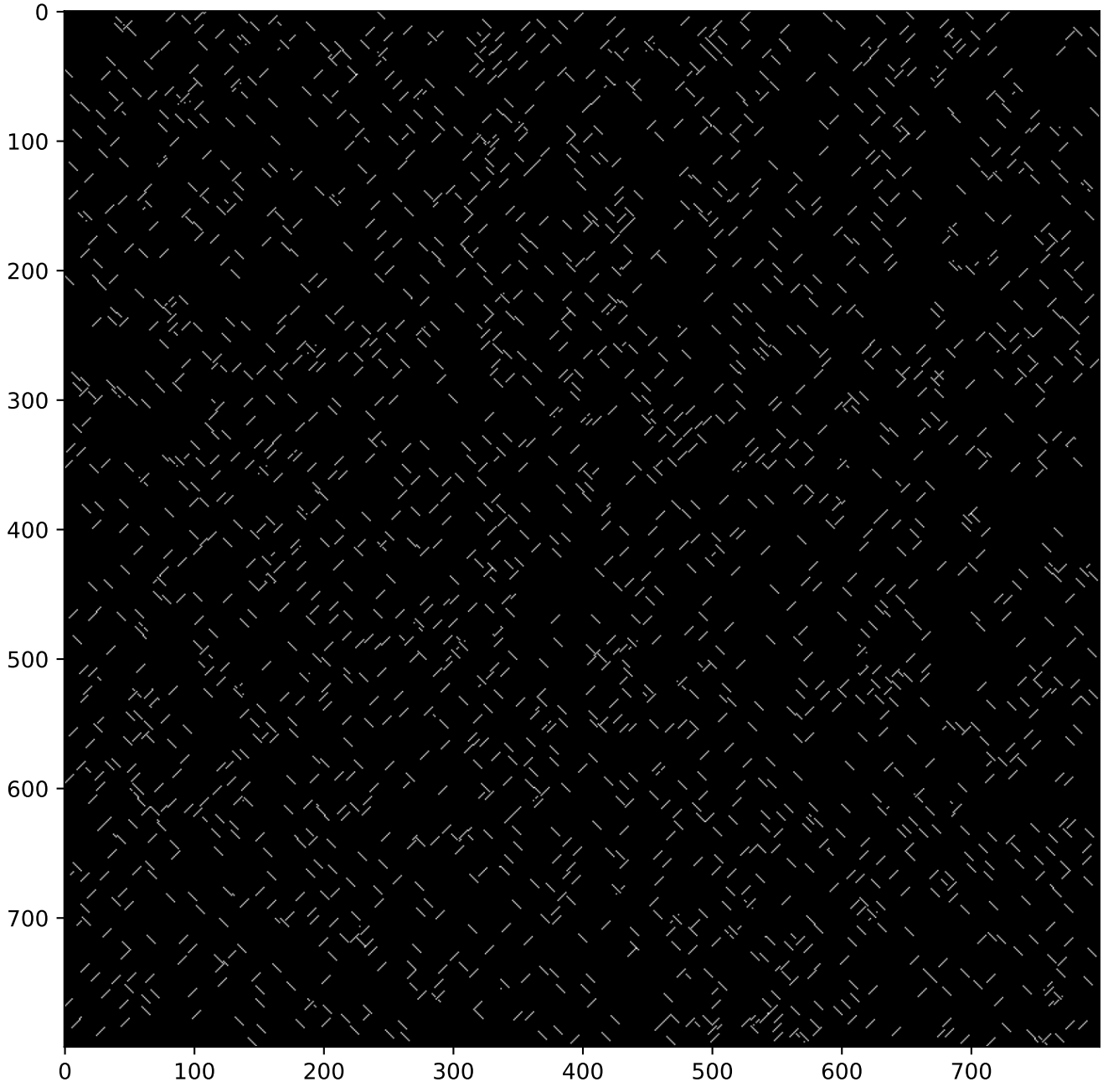


Figure 2: An example image for the architecture