Homework 4
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Part 1: Implement AlexNet

Model Architecture:

```
AlexNet(
  (features): Sequential(
    (0): Conv2d(3, 96, kernel_size=(11, 11), stride=(4, 4))
    (1): ReLU(inplace=True)
    (2): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (3): Conv2d(96, 256, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
    (4): ReLU(inplace=True)
    (5): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (6): Conv2d(256, 384, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (7): ReLU(inplace=True)
    (8): Conv2d(384, 384, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (9): ReLU(inplace=True)
    (10): Conv2d(384, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (11): ReLU(inplace=True)
    (12): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
  )
  (classifier): Sequential(
    (0): Dropout(p=0.5, inplace=False)
    (1): Linear(in_features=9216, out_features=9216, bias=True)
    (2): ReLU(inplace=True)
    (3): Dropout(p=0.5, inplace=False)
    (4): Linear(in_features=9216, out_features=4096, bias=True)
    (5): ReLU(inplace=True)
    (6): Linear(in_features=4096, out_features=4, bias=True)
  )
)
```

Epoch 100: eval accuracy: 0.9118

Part 2: Enhancing AlexNet

1.

Model Architecture:

```
AlexNetLargeKernel(
  (features): Sequential(
    (0): Conv2d(3, 96, kernel_size=(21, 21), stride=(8, 8), padding=(1, 1))
    (1): ReLU(inplace=True)
    (2): Conv2d(96, 256, kernel_size=(7, 7), stride=(2, 2), padding=(2, 2))
    (3): ReLU(inplace=True)
    (4): Conv2d(256, 384, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (5): ReLU(inplace=True)
    (6): Conv2d(384, 384, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (7): ReLU(inplace=True)
    (8): Conv2d(384, 256, kernel_size=(3, 3), stride=(2, 2))
    (9): ReLU(inplace=True)
  )
  (classifier): Sequential(
    (0): Dropout(p=0.5, inplace=False)
    (1): Linear(in_features=9216, out_features=4096, bias=True)
    (2): ReLU(inplace=True)
    (3): Dropout(p=0.5, inplace=False)
    (4): Linear(in_features=4096, out_features=4096, bias=True)
    (5): ReLU(inplace=True)
    (6): Linear(in_features=4096, out_features=4, bias=True)
  )
)
```

Epoch 100: eval accuracy: 0.8610

2.

Model Architecture:

```
AlexNetTiny(
  (features): Sequential(
    (0): Conv2d(3, 48, kernel_size=(11, 11), stride=(4, 4))
    (1): ReLU(inplace=True)
    (2): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (3): Conv2d(48, 128, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
    (4): ReLU(inplace=True)
    (5): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (6): Conv2d(128, 192, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (7): ReLU(inplace=True)
    (8): Conv2d(192, 192, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (9): ReLU(inplace=True)
    (10): Conv2d(192, 128, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (11): ReLU(inplace=True)
    (12): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
  )
  (classifier): Sequential(
    (0): Dropout(p=0.5, inplace=False)
    (1): Linear(in_features=4608, out_features=2048, bias=True)
    (2): ReLU(inplace=True)
    (3): Dropout(p=0.5, inplace=False)
    (4): Linear(in_features=2048, out_features=1024, bias=True)
    (5): ReLU(inplace=True)
    (6): Linear(in_features=1024, out_features=4, bias=True)
  )
)
```

Epoch 100: eval accuracy: 0.8952

3.

Model Architecture:

```
AlexNetAvgPooling(
  (features): Sequential(
    (0): Conv2d(3, 96, kernel_size=(11, 11), stride=(4, 4))
    (1): ReLU(inplace=True)
    (2): AvgPool2d(kernel_size=3, stride=2, padding=0)
    (3): Conv2d(96, 256, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
    (4): ReLU(inplace=True)
    (5): AvgPool2d(kernel_size=3, stride=2, padding=0)
    (6): Conv2d(256, 384, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (7): ReLU(inplace=True)
    (8): Conv2d(384, 384, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (9): ReLU(inplace=True)
    (10): Conv2d(384, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (11): ReLU(inplace=True)
    (12): AvgPool2d(kernel_size=3, stride=2, padding=0)
  )
  (classifier): Sequential(
    (0): Dropout(p=0.5, inplace=False)
    (1): Linear(in_features=9216, out_features=4096, bias=True)
    (2): ReLU(inplace=True)
    (3): Dropout(p=0.5, inplace=False)
    (4): Linear(in_features=4096, out_features=4096, bias=True)
    (5): ReLU(inplace=True)
    (6): Linear(in_features=4096, out_features=4, bias=True)
  )
)
```

Epoch 100: eval accuracy: 0.8734

4.

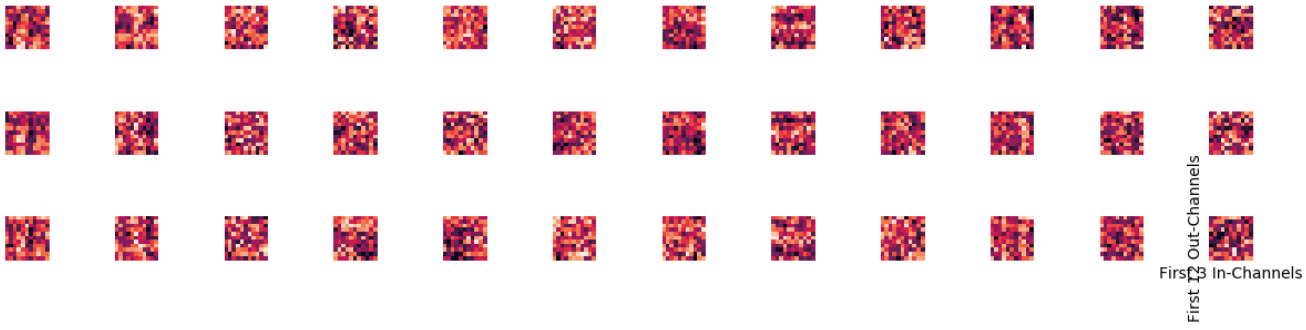
Model Architecture:
AlexNetDilation(
  (features): Sequential(
    (0): Conv2d(3, 96, kernel_size=(11, 11), stride=(4, 4), padding=(5, 5), dilation=(2, 2))
    (1): ReLU(inplace=True)
    (2): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (3): Conv2d(96, 256, kernel_size=(5, 5), stride=(1, 1), padding=(4, 4), dilation=(2, 2))
    (4): ReLU(inplace=True)
    (5): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (6): Conv2d(256, 384, kernel_size=(3, 3), stride=(1, 1), padding=(2, 2), dilation=(2, 2))
    (7): ReLU(inplace=True)
    (8): Conv2d(384, 384, kernel_size=(3, 3), stride=(1, 1), padding=(2, 2), dilation=(2, 2))
    (9): ReLU(inplace=True)
    (10): Conv2d(384, 256, kernel_size=(3, 3), stride=(1, 1), padding=(2, 2), dilation=(2, 2))
    (11): ReLU(inplace=True)
    (12): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
)
  (classifier): Sequential(
    (0): Dropout(p=0.5, inplace=False)
    (1): Linear(in_features=9216, out_features=4096, bias=True)
    (2): ReLU(inplace=True)
    (3): Dropout(p=0.5, inplace=False)
    (4): Linear(in_features=4096, out_features=4096, bias=True)
    (5): ReLU(inplace=True)
    (6): Linear(in_features=4096, out_features=4, bias=True)
)
)

Epoch 100: eval accuracy: 0.8880

Part 3: Visualizing Learned Filters

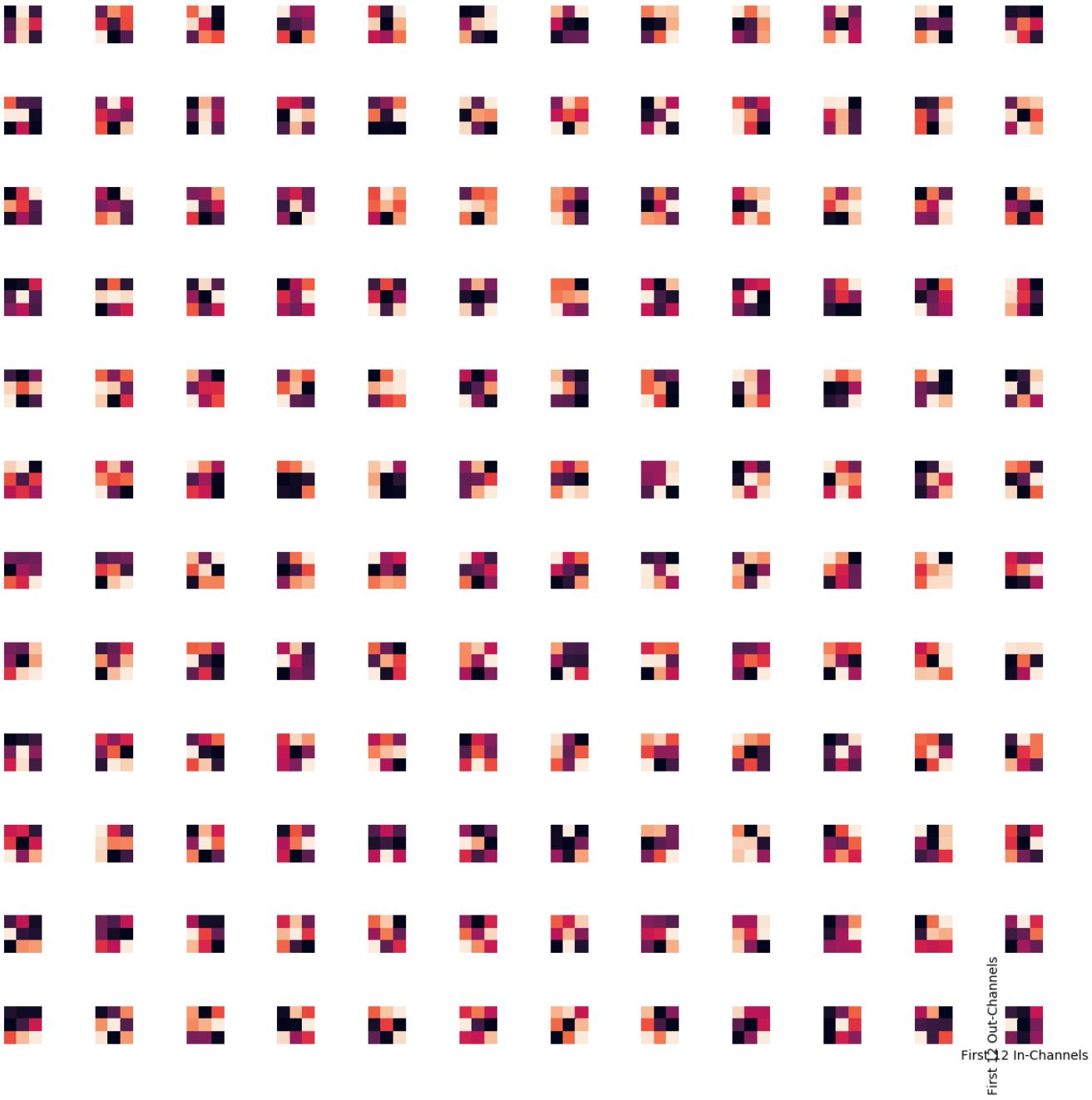
Category Conv2d Visualizations:

Conv2d-1

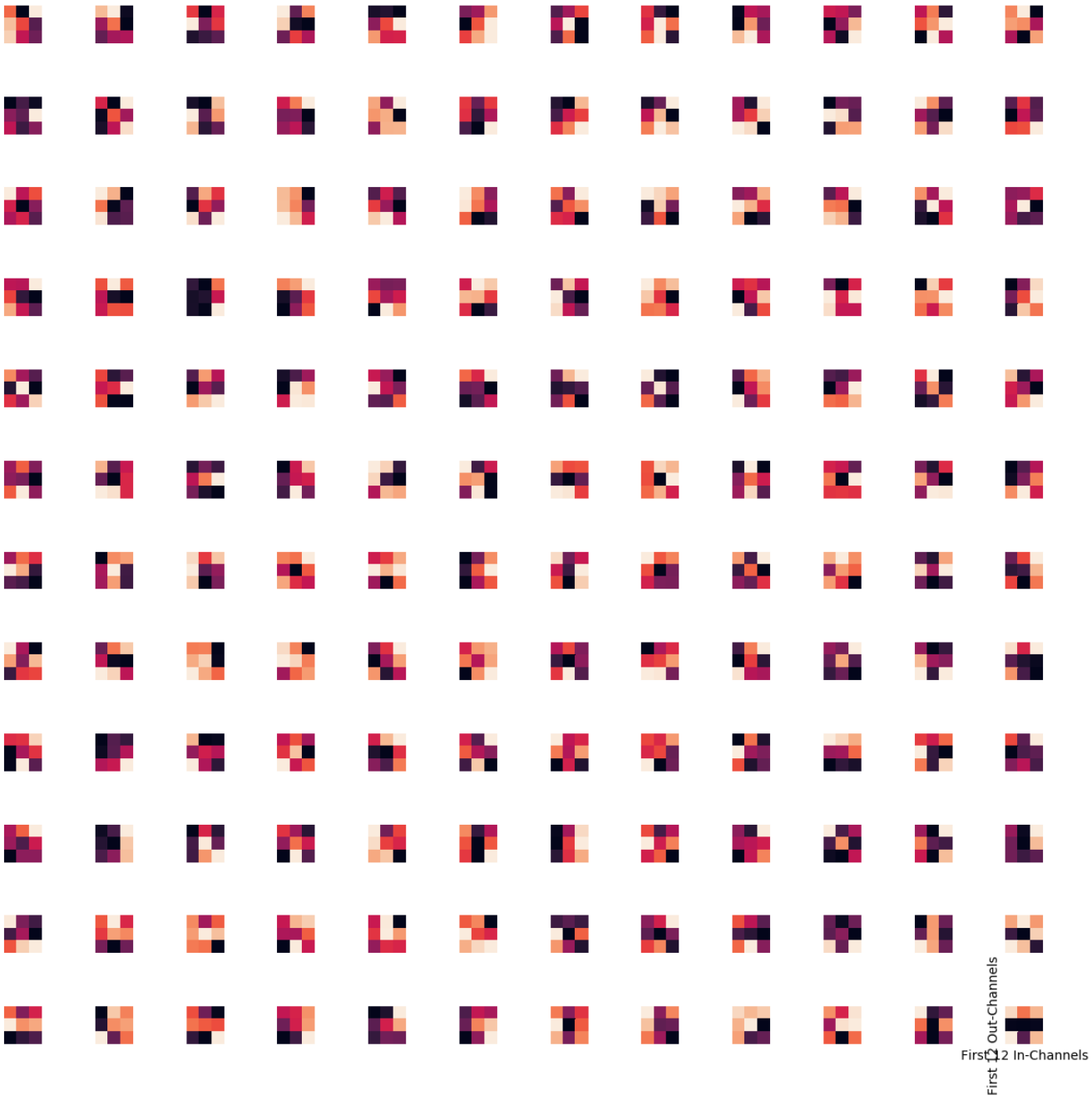


Conv2d-4

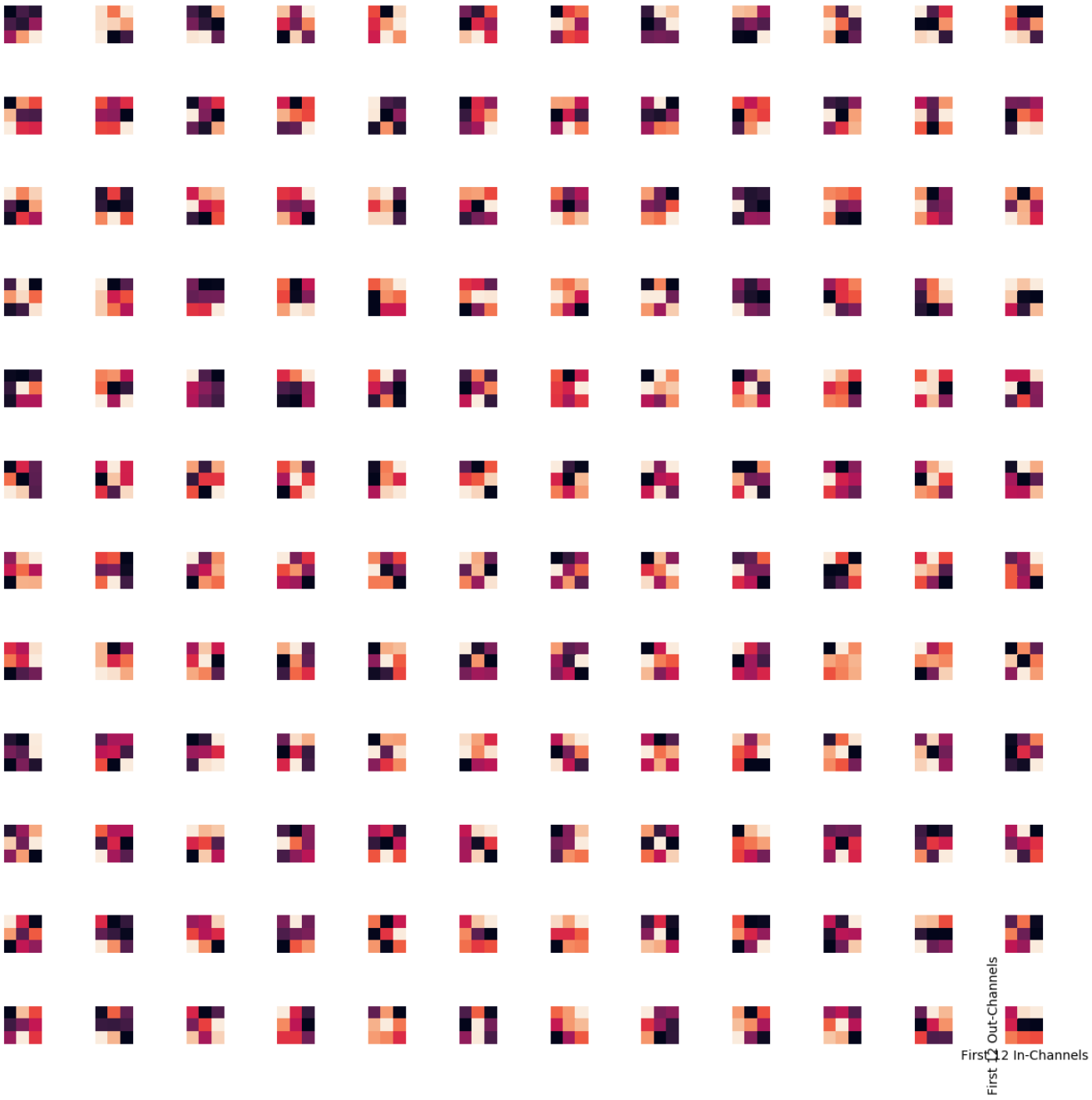
Conv2d-7



Conv2d-9

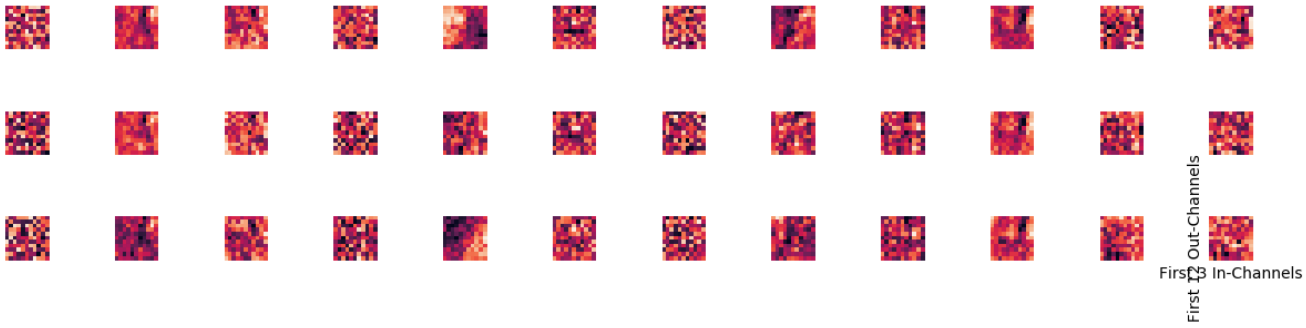


Conv2d-11

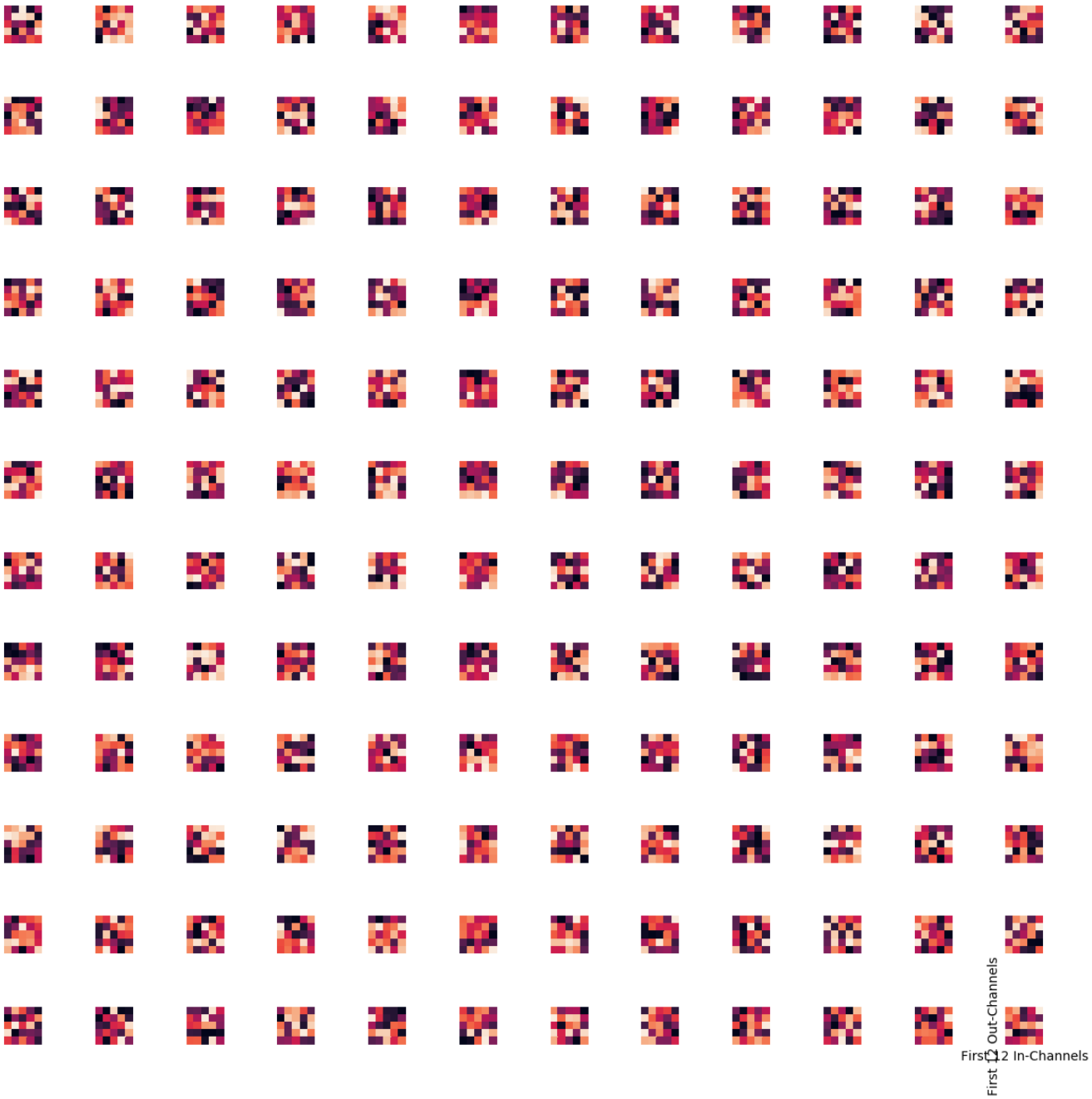


Domain Conv2d Visualizations:

Conv2d-1

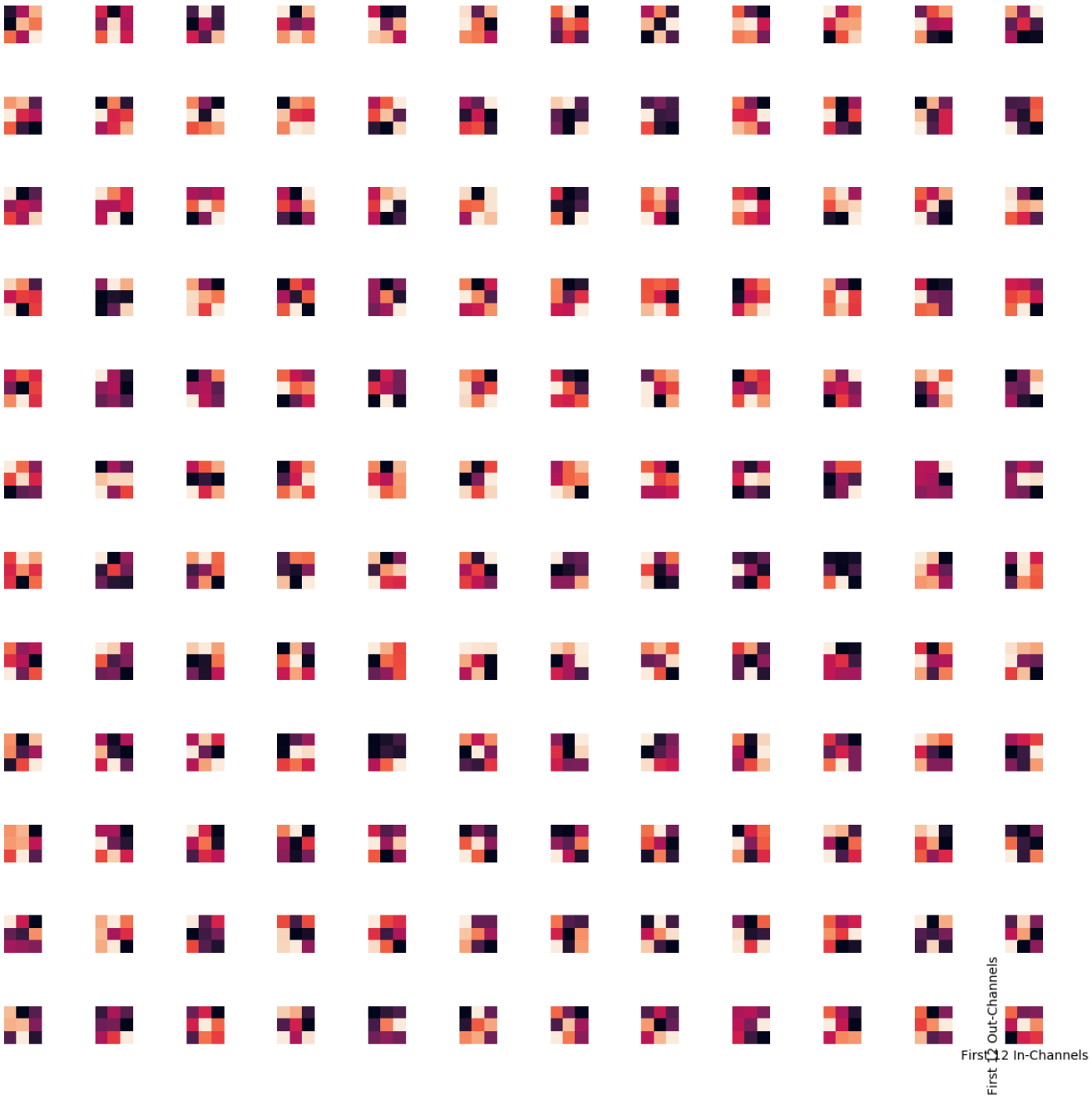


Conv2d-4

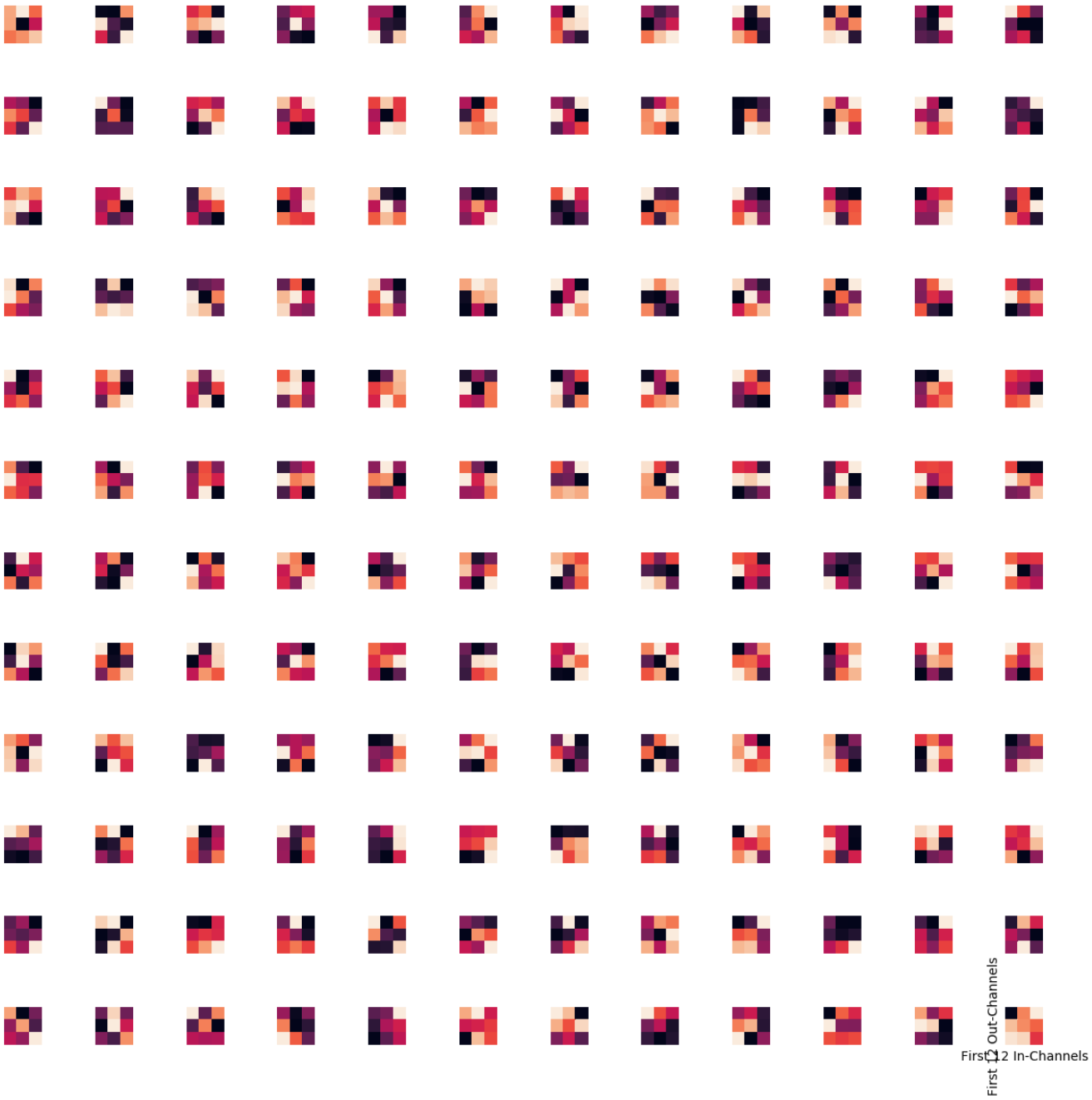


Conv2d-7

Conv2d-9



Conv2d-11



The kernels are much different from each other for the two sets.