Zhengming Wang

Part I

```
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=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] train accuracy: 0.9956, loss: 0.0166

[Epoch 100] eval accuracy: 0.9004, loss: 0.7200

Part II

AlexNetLargeKernel:

```
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] train accuracy: 0.9955, loss: 0.0122
[Epoch 100] eval accuracy: 0.8734, loss: 1.1481
```

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AlexNetTiny:

```
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] train accuracy: 0.9969, loss: 0.0107

[Epoch 100] eval accuracy: 0.9066, loss: 0.6590

AlexNetAvgPooling:

```
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] train accuracy: 0.9928, loss: 0.0226
[Epoch 100] eval accuracy: 0.8776, loss: 0.9795
```

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AlexNetDilation

```
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)
  )
)
```

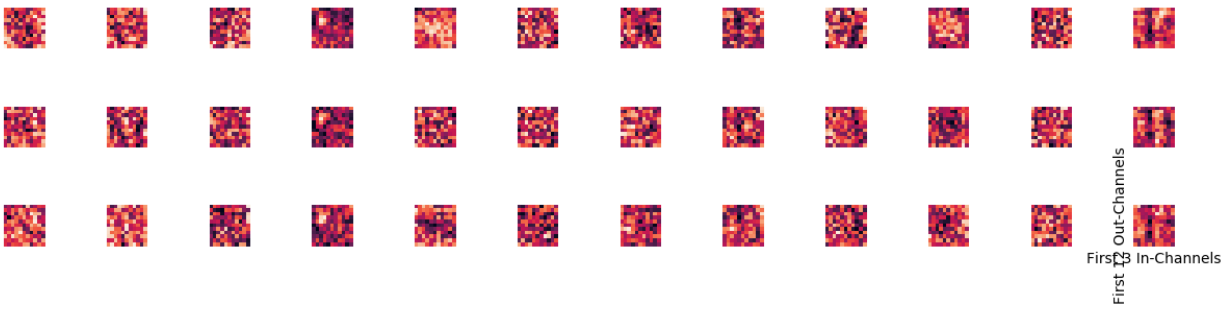
[Epoch 100] train accuracy: 0.9843, loss: 0.0511

[Epoch 100] eval accuracy: 0.8932, loss: 0.7845

Part III

<u>Domain Kernels:</u>

Conv2d-0



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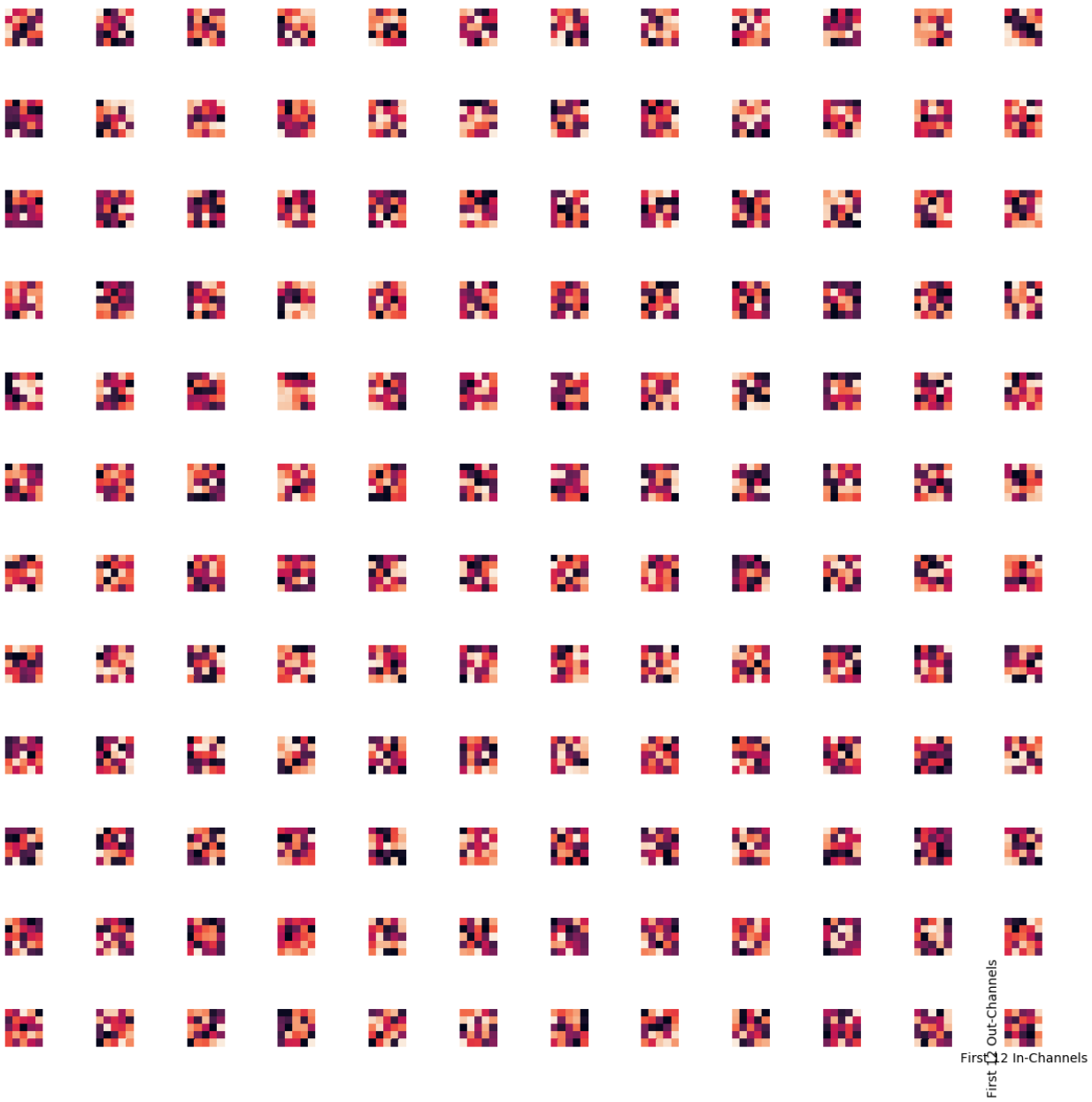
Conv2d-3



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Conv2d-6

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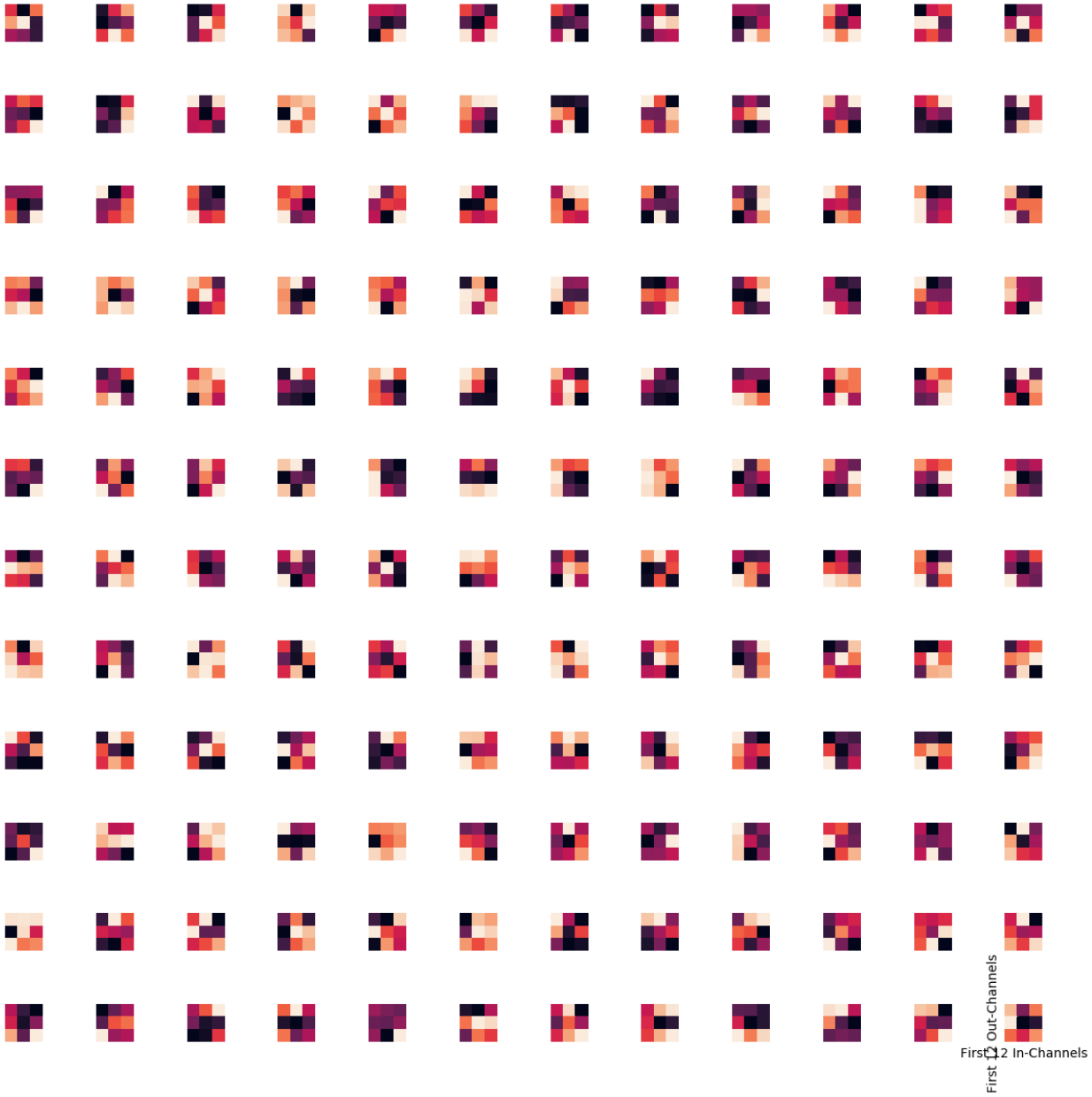
Conv2d-8



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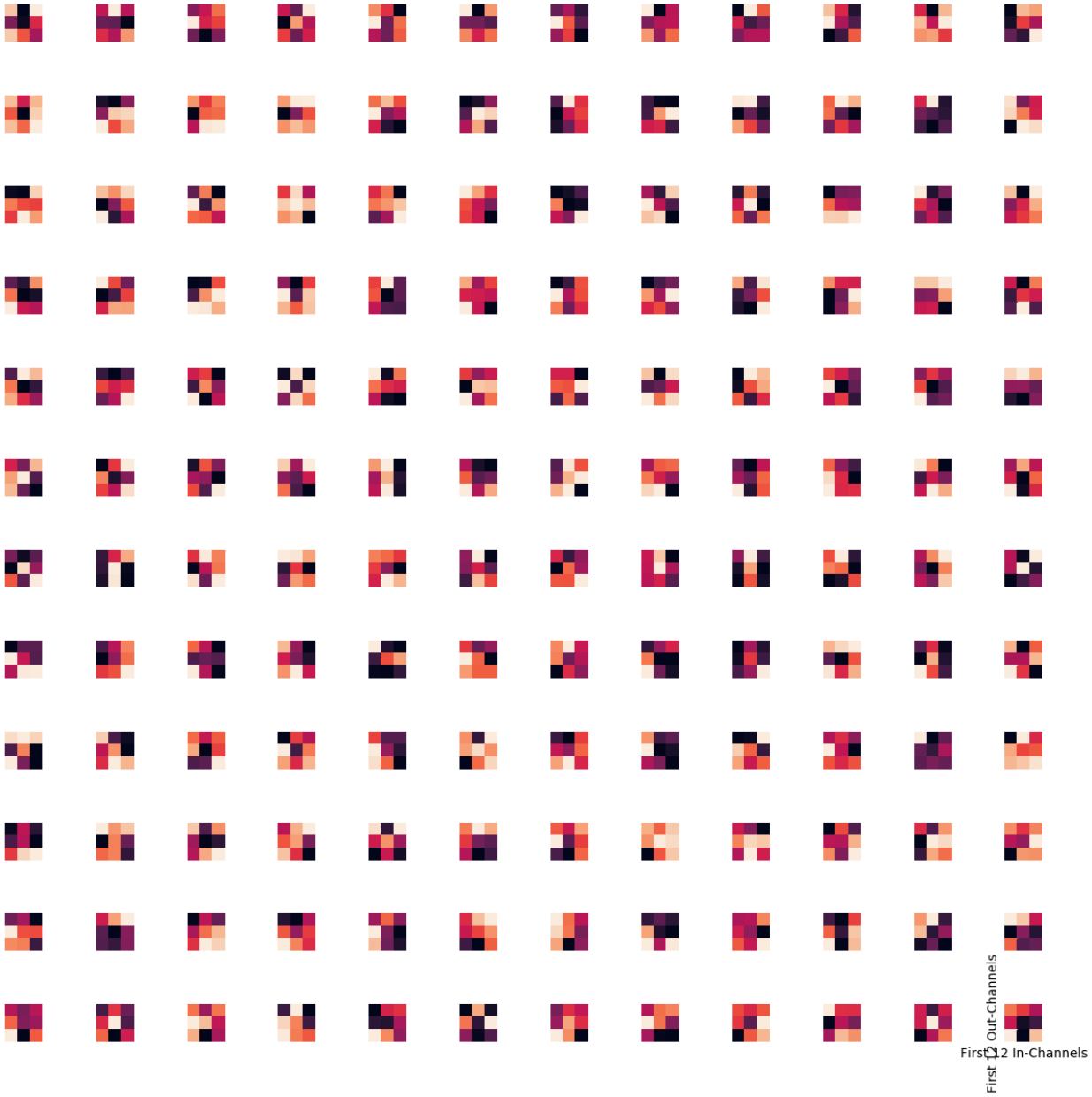
Conv2d-10



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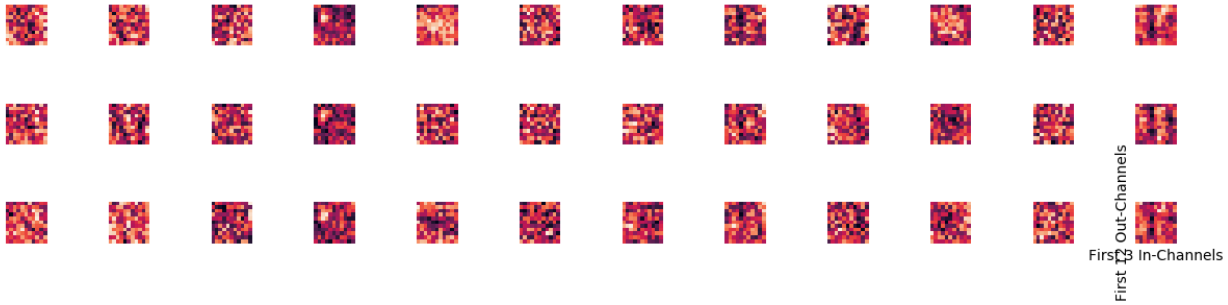
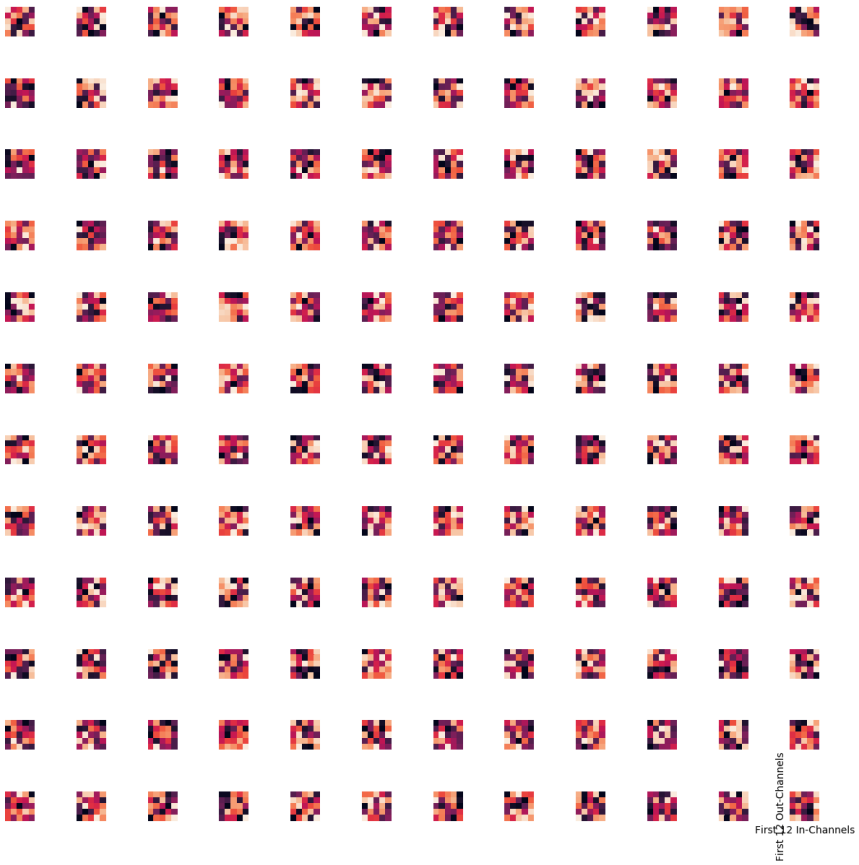
Category Kernels:

Conv2d-0



Conv2d-3



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Conv2d-6

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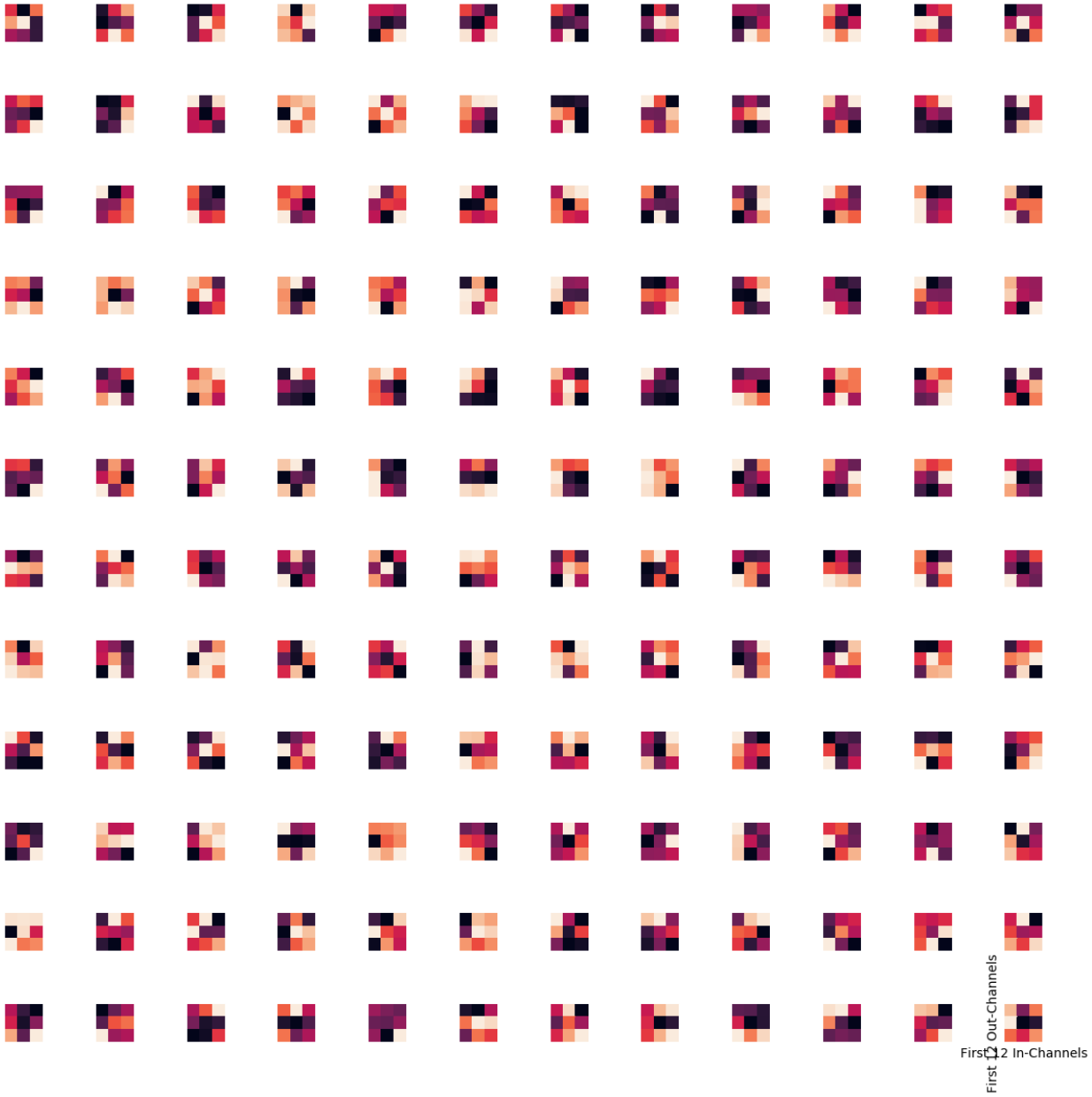
Conv2d-8



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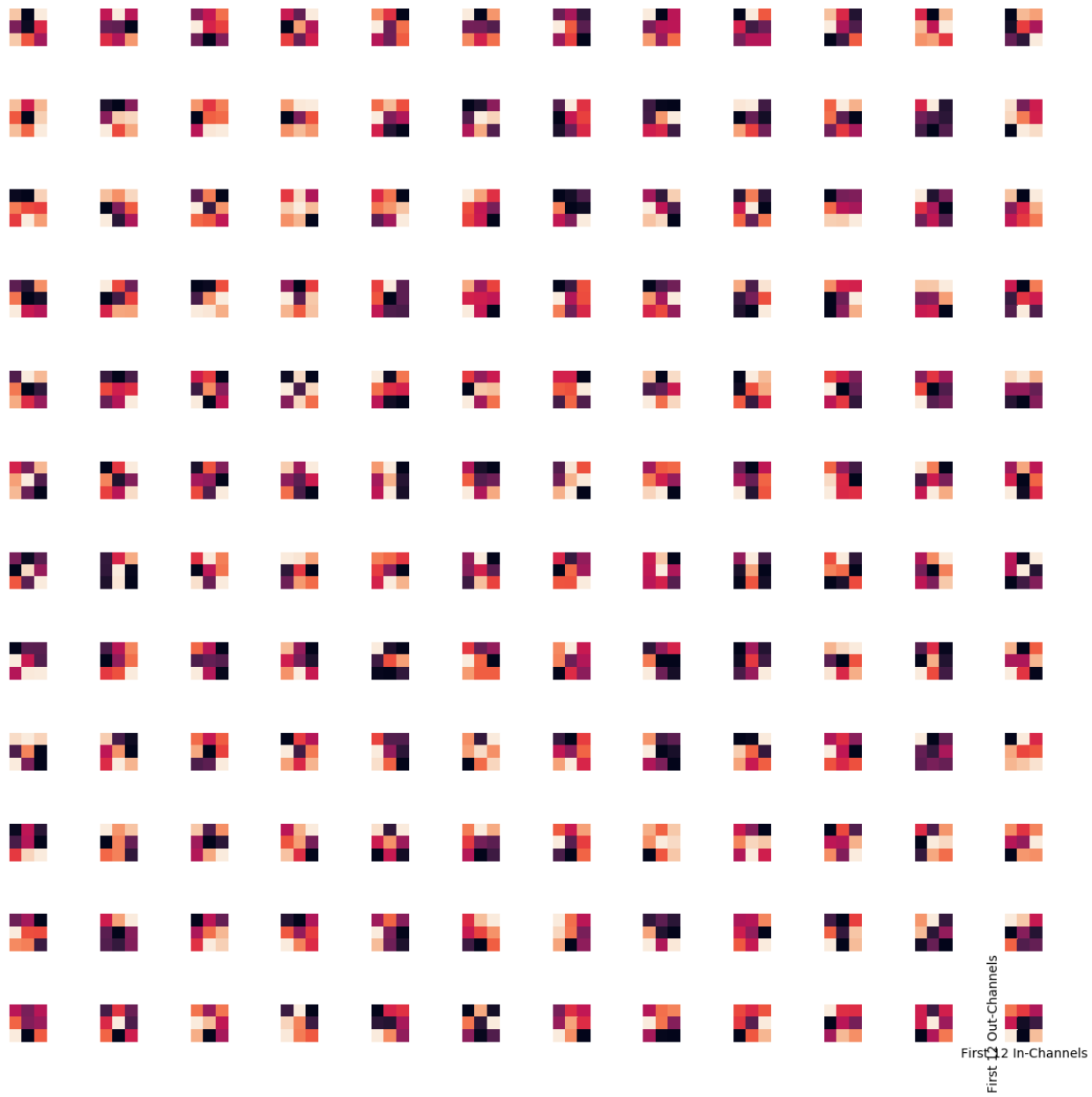
Conv2d-10



Summary:

As expected the kernels progress from simple to more advanced convolutions. Though domain and category classification are looking for different properties of the photos, some consistencies exist. For example, both have edge detection convolutions as shown on the right. Since domain classification looks to differentiate the mode of each photo, it is not surprising to see its kernels in the final layer to be based more on textures. Categorical classification is concerned with discerning the contents of each photo, so one would hope for various shapes to be convolved. On the left is a “shape” that was often see in the final layer of the categorical classifier.