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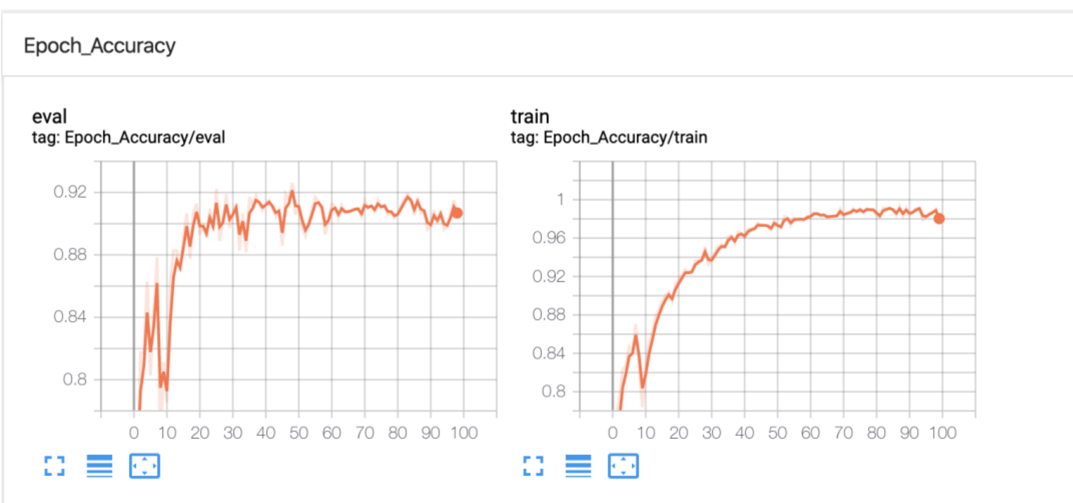
MAV120
CS 1699
HW 4

Part I – Implement AlexNet

```
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)
  )
  (flatten): Flatten()
  (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)
  )
)
```

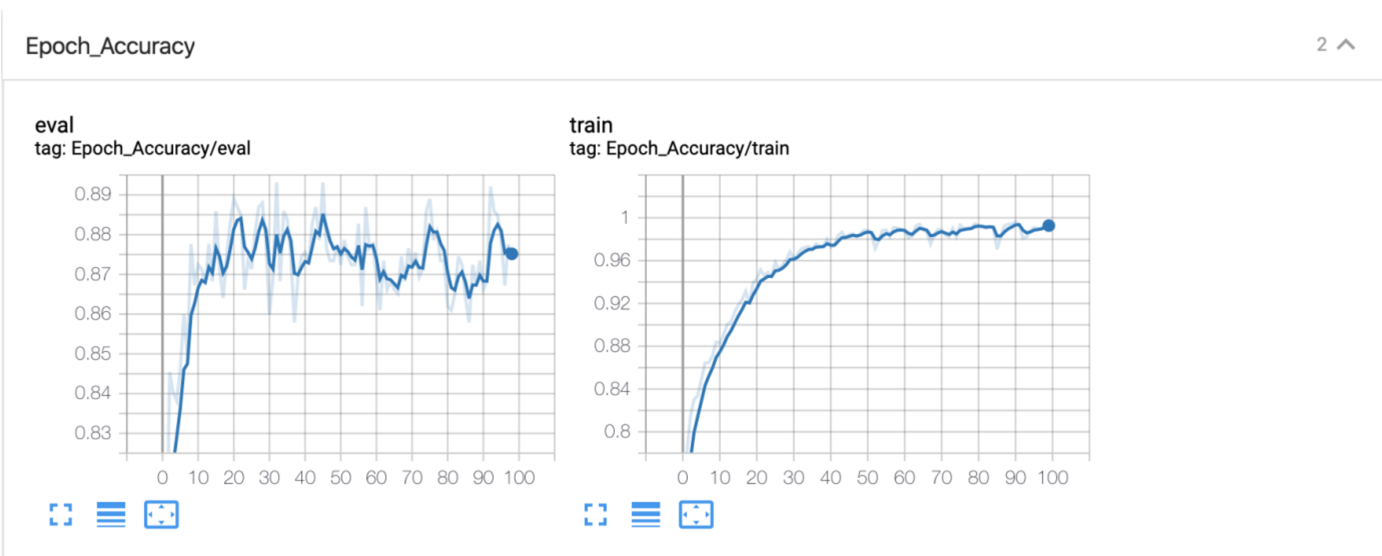
Validation Set Accuracy: 0.9046



Part II – Enhancing AlexNet

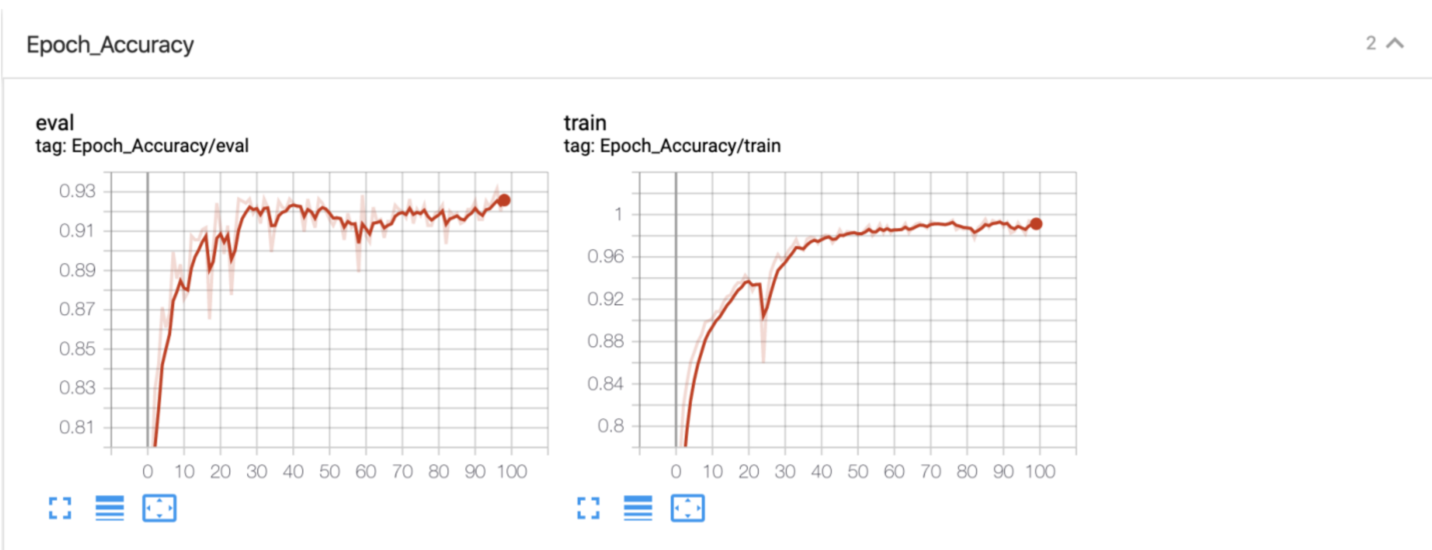
```
AlexNetLargeKernel(
  (features): Sequential(
    (0): Conv2d(3, 96, kernel_size=(21, 21), stride=(8, 8), padding=(1, 1))
    (1): ReLU(inplace=True)
    (2): Conv2d(96, 256, kernel_size=(7, 7), stride=(2, 2), padding=(2, 2))
    (3): ReLU(inplace=True)
    (4): Conv2d(256, 384, kernel_size=(3, 3), 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)
  )
  (flatten): Flatten()
  (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)
  )
)
```

Validation Set Accuracy: 0.8734



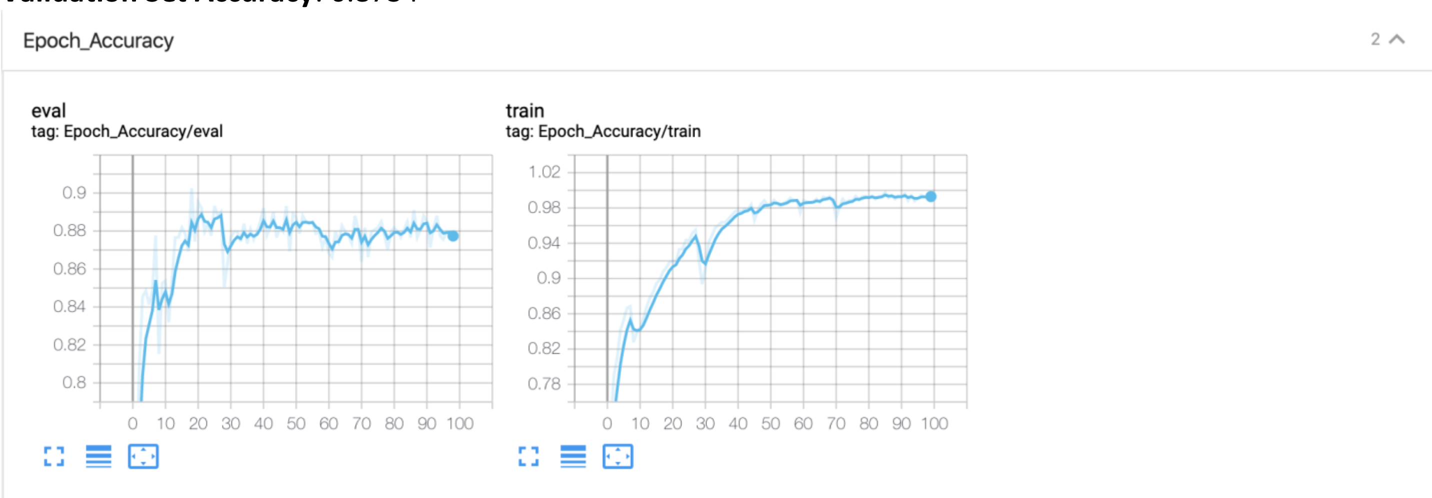
```
AlexNetTiny(
  (features): Sequential(
    (0): Conv2d(3, 48, kernel_size=(11, 11), stride=(4, 4))
    (1): ReLU(inplace=True)
    (2): MaxPool2d(kernel_size=3, stride=2, padding=0, dilation=1, ceil_mode=False)
    (3): Conv2d(48, 128, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
    (4): ReLU(inplace=True)
    (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)
  )
  (flatten): Flatten()
  (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)
  )
)
```

Validation Set Accuracy: 0.9295



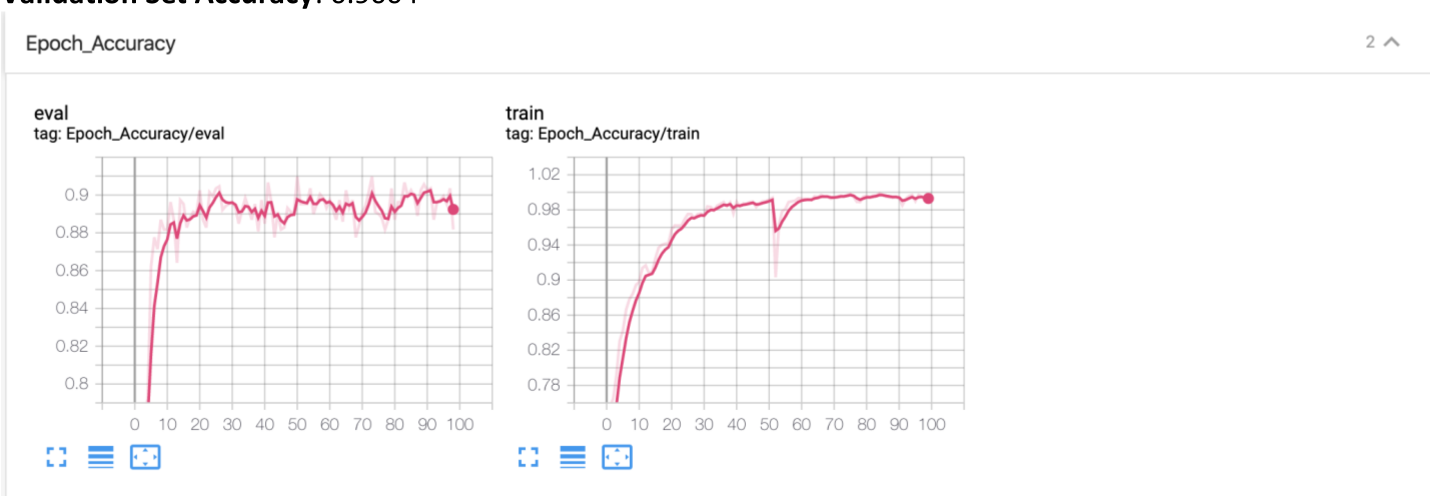
```
AlexNetAvgPooling(
  (features): Sequential(
    (0): Conv2d(3, 96, kernel_size=(11, 11), stride=(4, 4))
    (1): ReLU(inplace=True)
    (2): AvgPool2d(kernel_size=3, stride=2, padding=0)
    (3): Conv2d(96, 256, kernel_size=(5, 5), stride=(1, 1), padding=(2, 2))
    (4): ReLU(inplace=True)
    (5): 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)
  )
  (flatten): Flatten()
  (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)
  )
)
```

Validation Set Accuracy: 0.8734



```
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)
  )
  (flatten): Flatten()
  (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)
  )
)
```

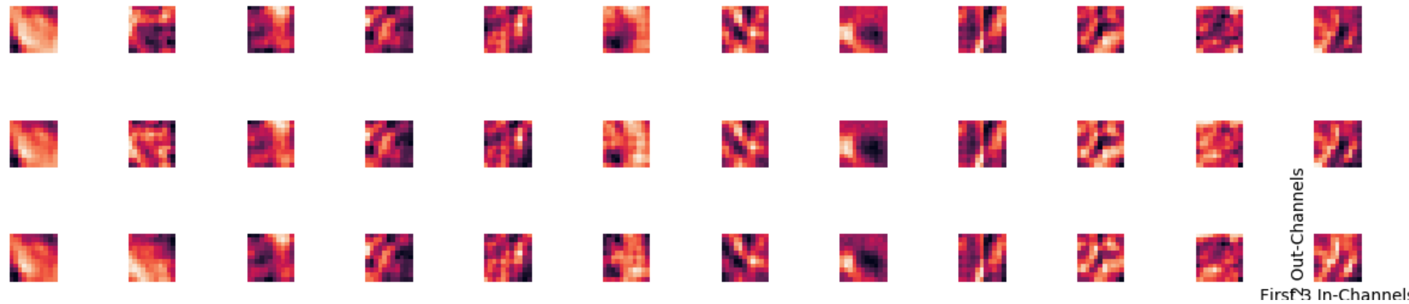
Validation Set Accuracy: 0.9004



Part III – Visualizing Learned Filters

AlexNet – Domain

Conv2d-1



Conv2d-4

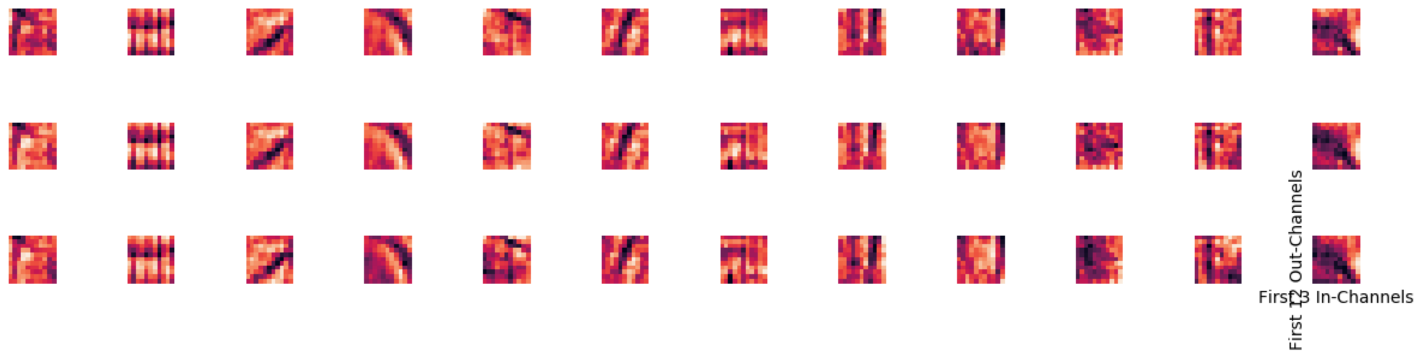
Conv2d-7

Conv2d-9

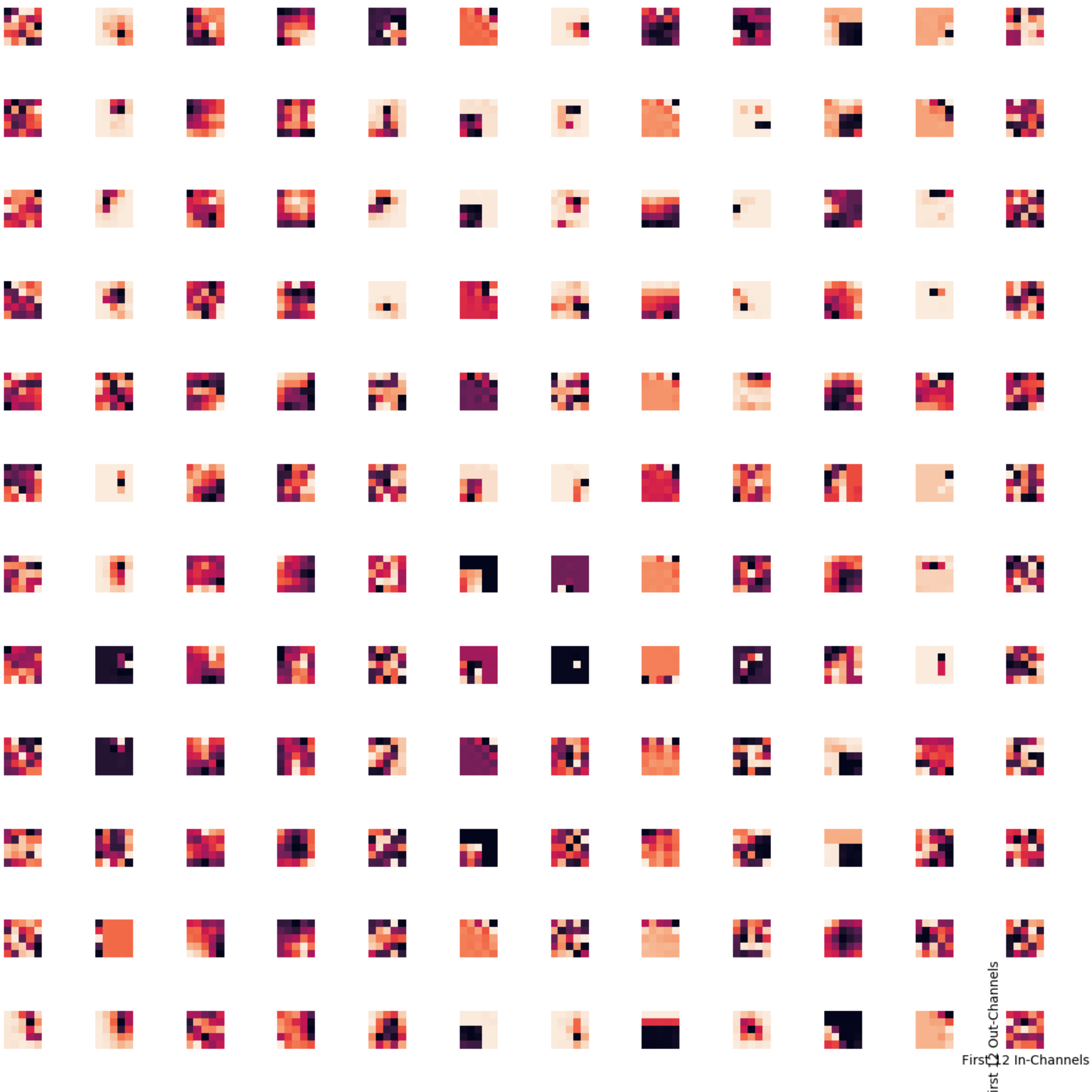
Conv2d-11

AlexNet - Class

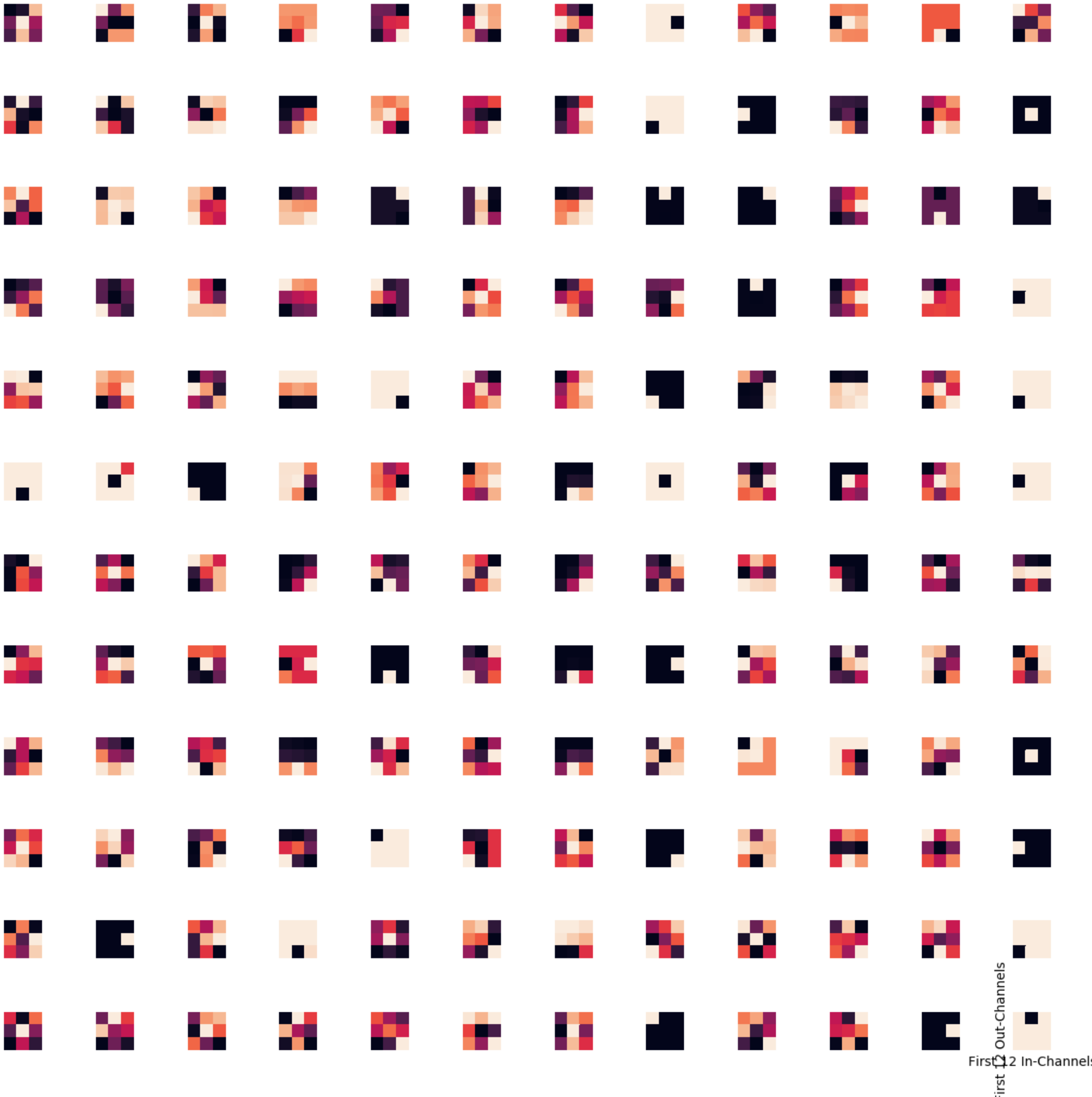
Conv2d-1



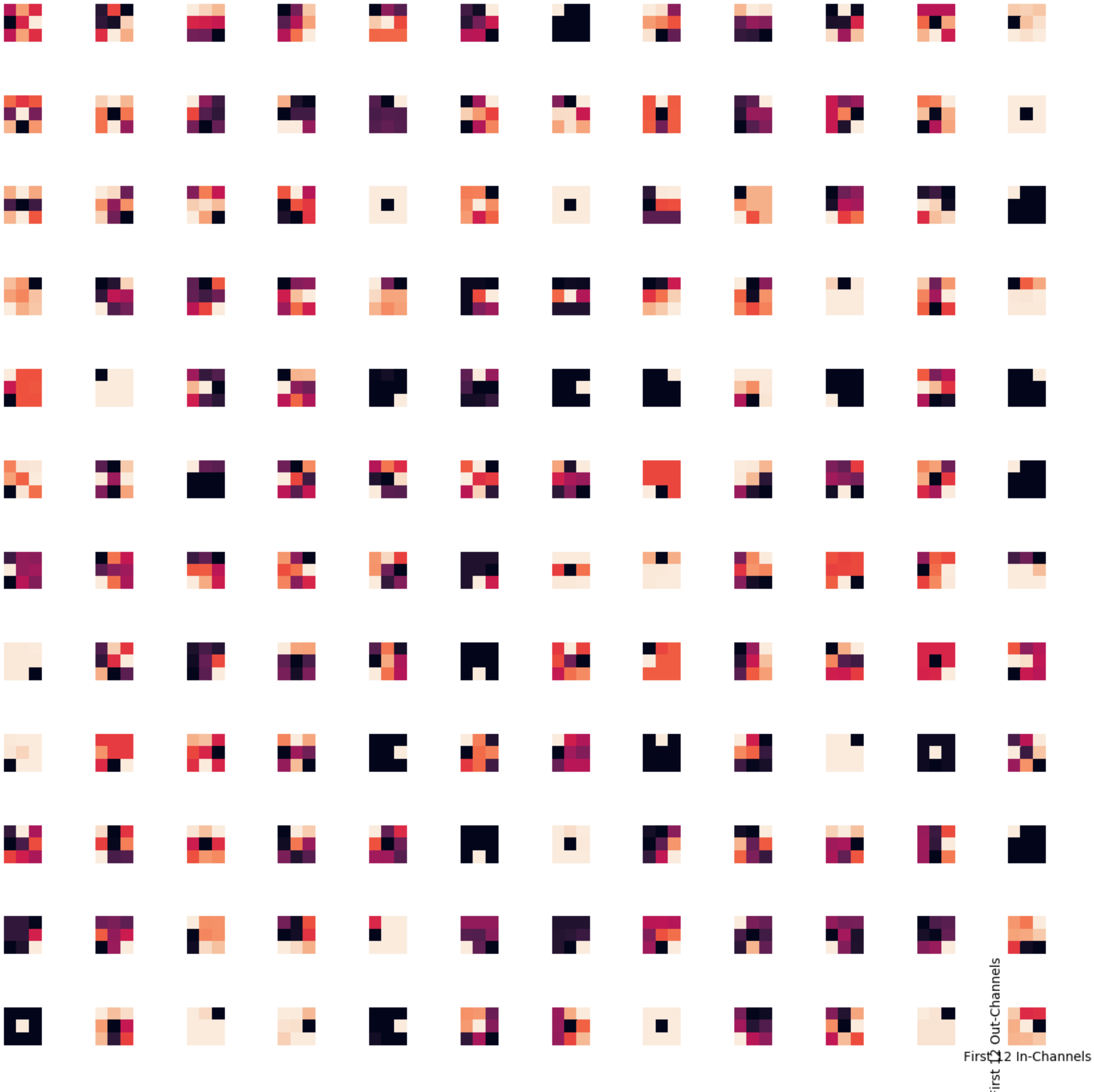
Conv2d-4



Conv2d-7



Conv2d-9



Conv2d-11

Findings

Domain classification is determining if an image is art, cartoon, photo, or a sketch. It seems that in both the domain and the category label type classification, there were kernels learned that seemed to be pretty standard edge detection and point detection kernels. The Conv2d-11 layer for both category and domain look similar. The domain kernel looks like it is finding some sort of bumps. It is really hard to tell. The category kernel looks like it is finding perhaps textures and different shapes. Maybe this is because it is finding different patterns in different categories.