ECE6524 Project # 1

CONVOLUTIONAL NEURAL NETWORKS

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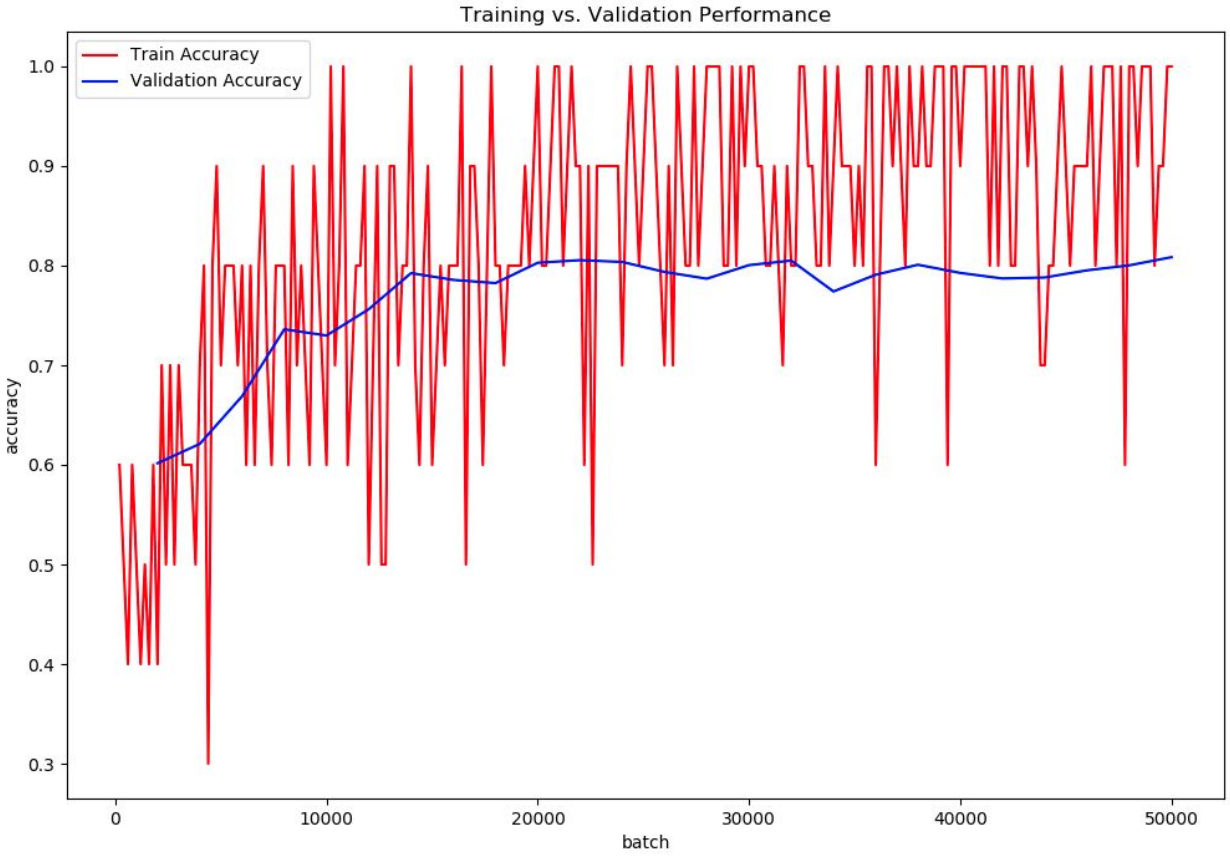
1. EXPERIMENTAL RESULTS

******* NOTE *******

******* The training and validation performance was logged in the LOGS.txt file. Please refer to the log file for detailed results of training and validation phases.***

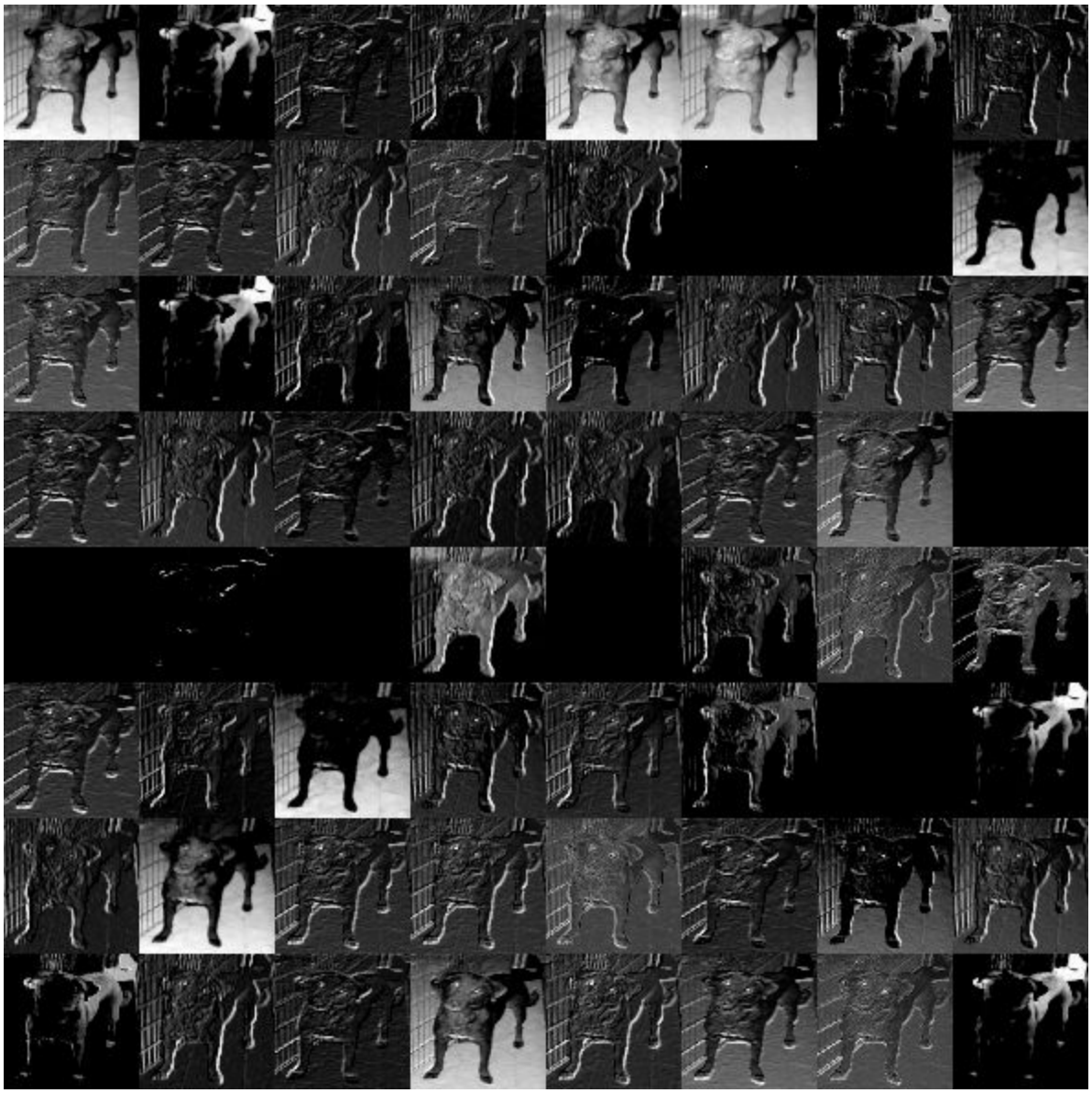
Model Training and Validation Performance:



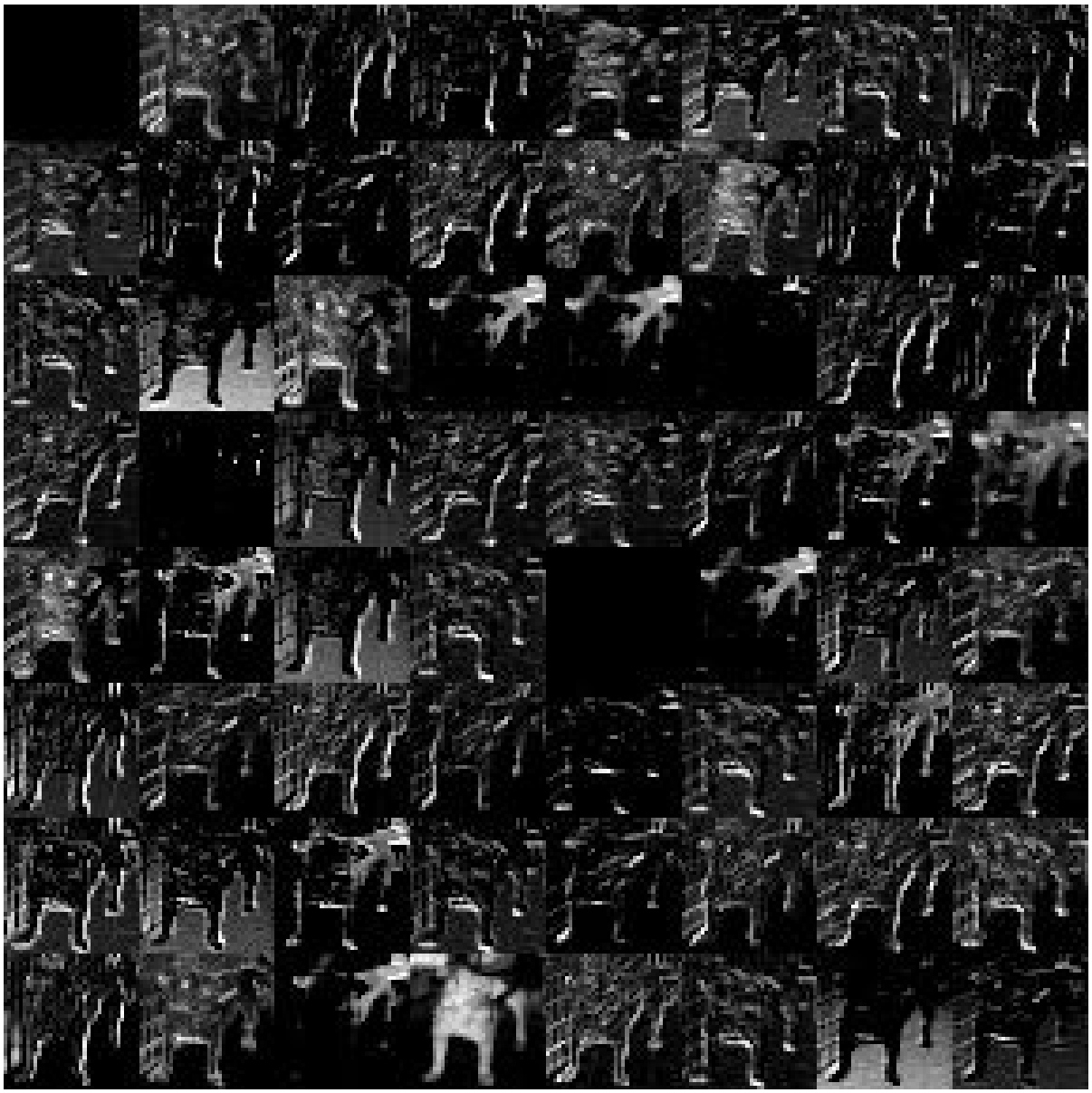
Following are the results for visualization of feature maps on example input images for both classes, i.e. Dog and Cat:

DOG

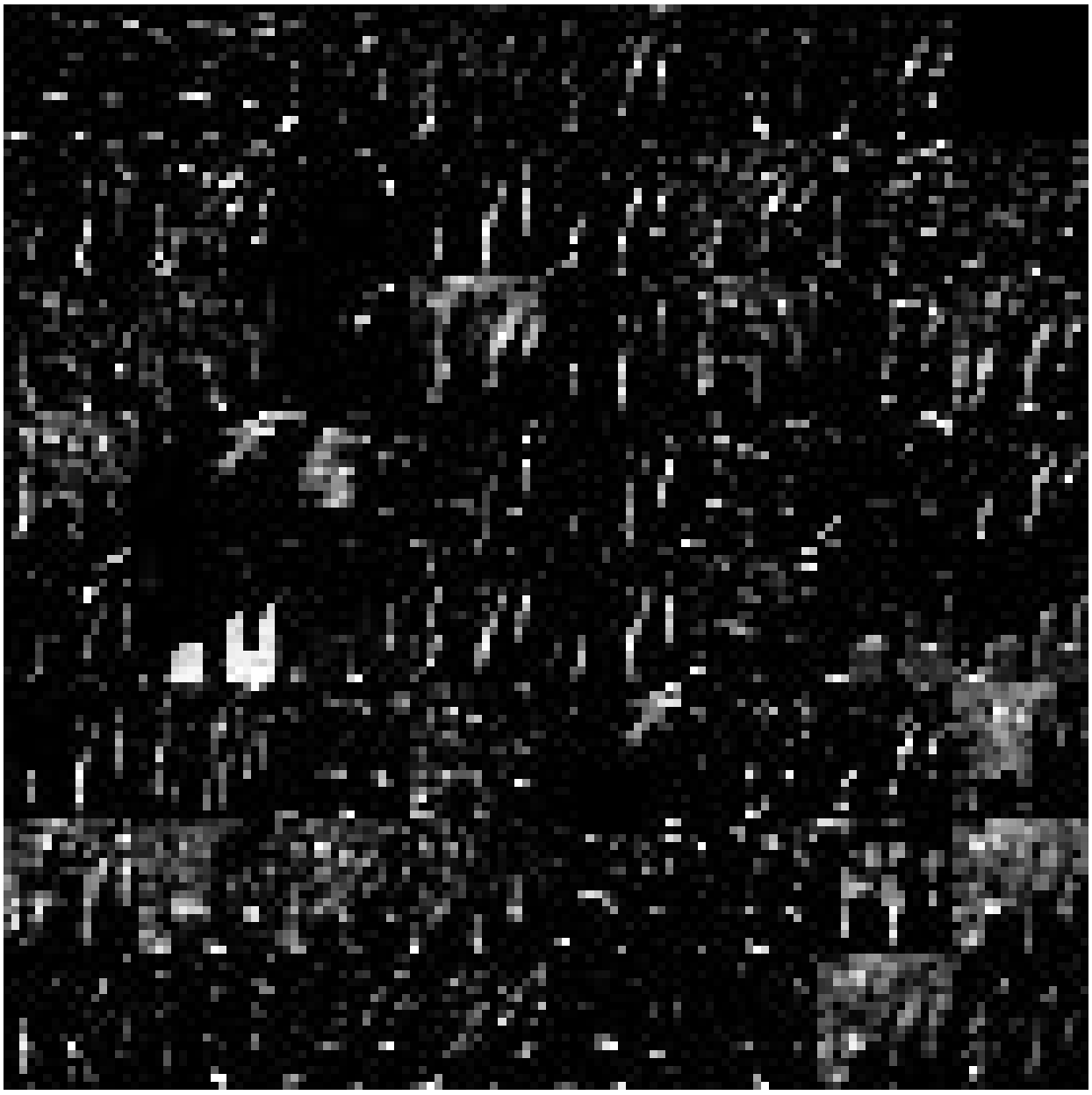
CONV1 Layer 74 x 74 x 64



CONV2 Layer 36 x 36 x 64

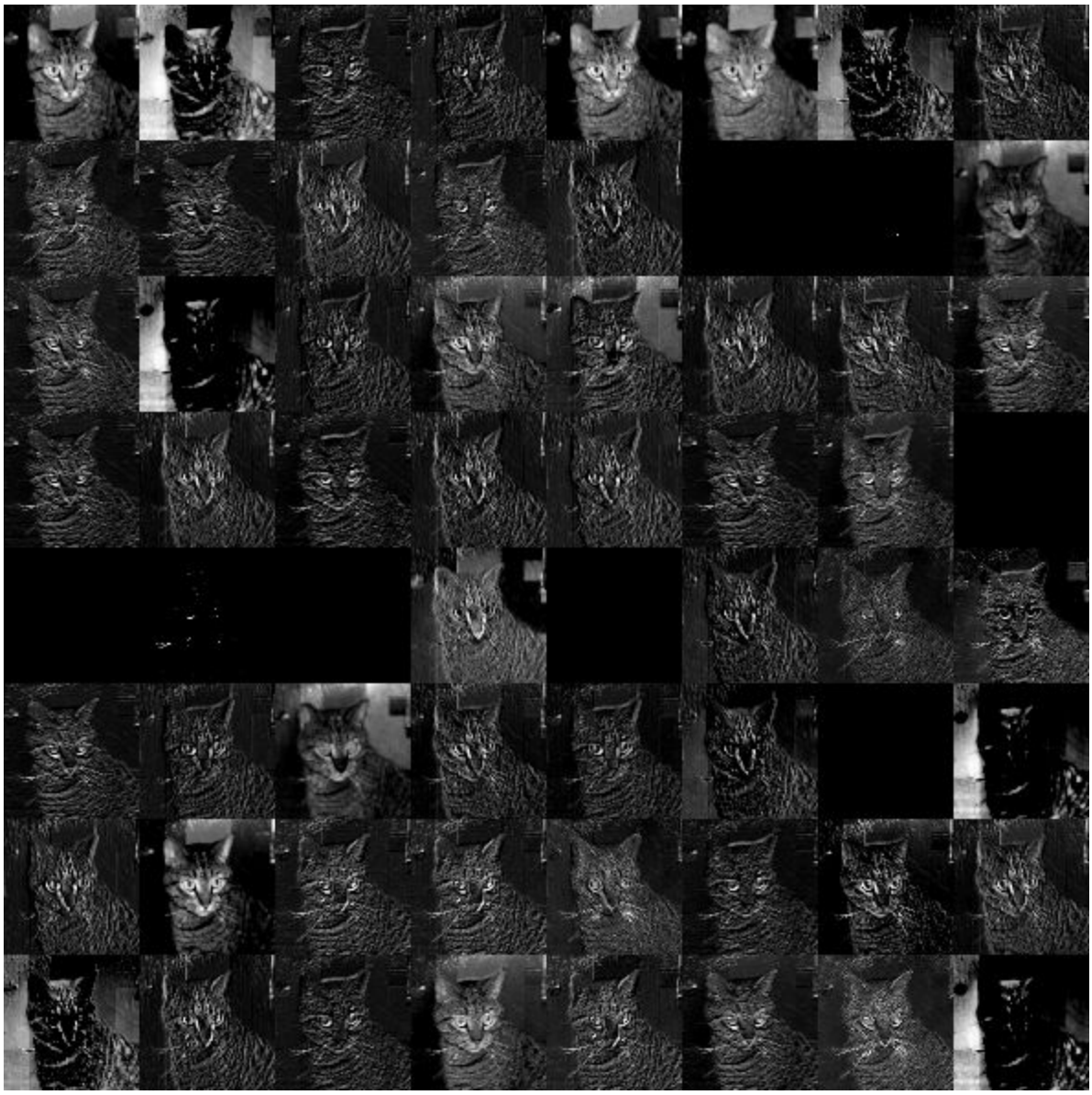


CONV3 Layer 17 x 17 x 64

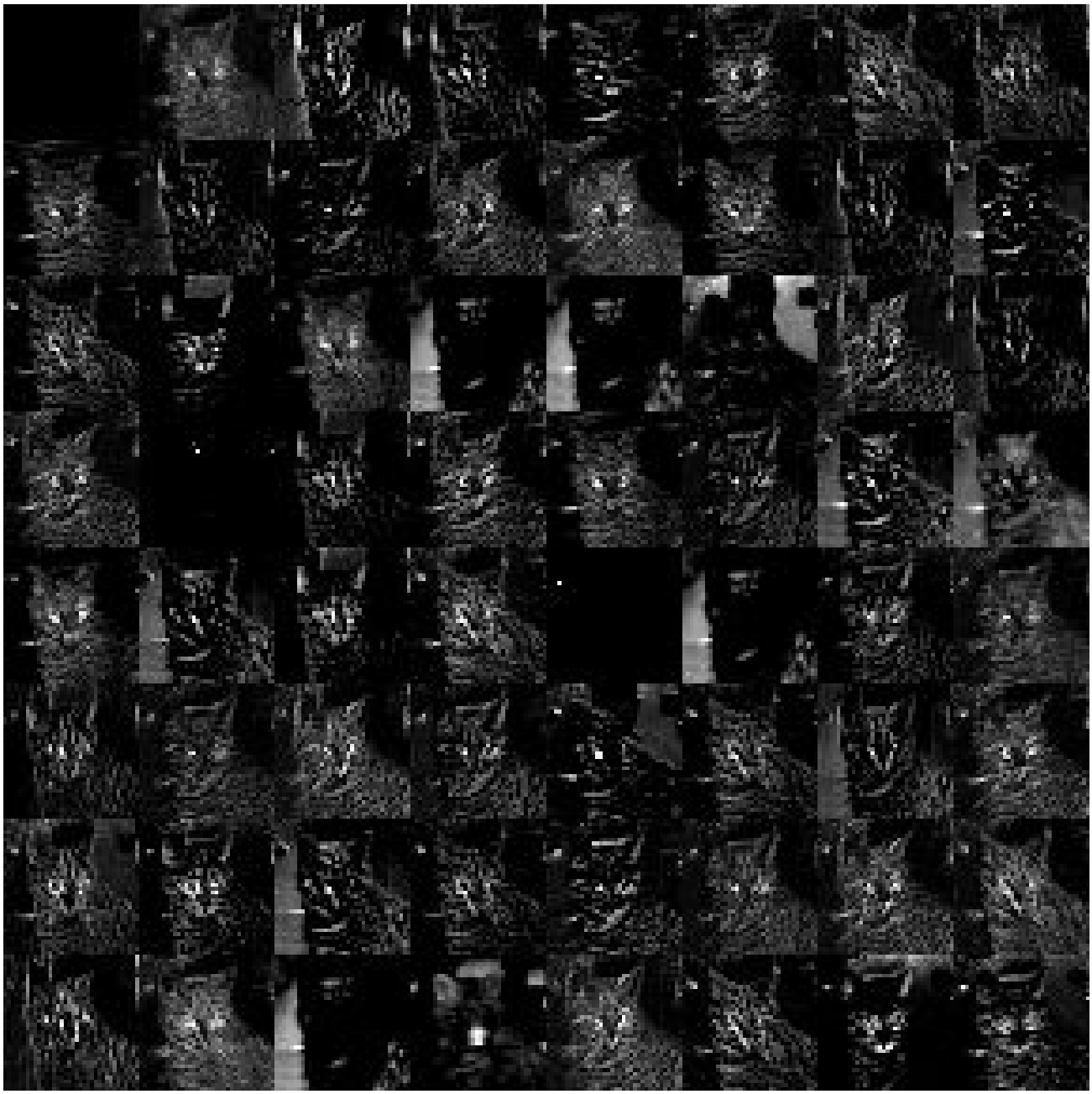


CAT

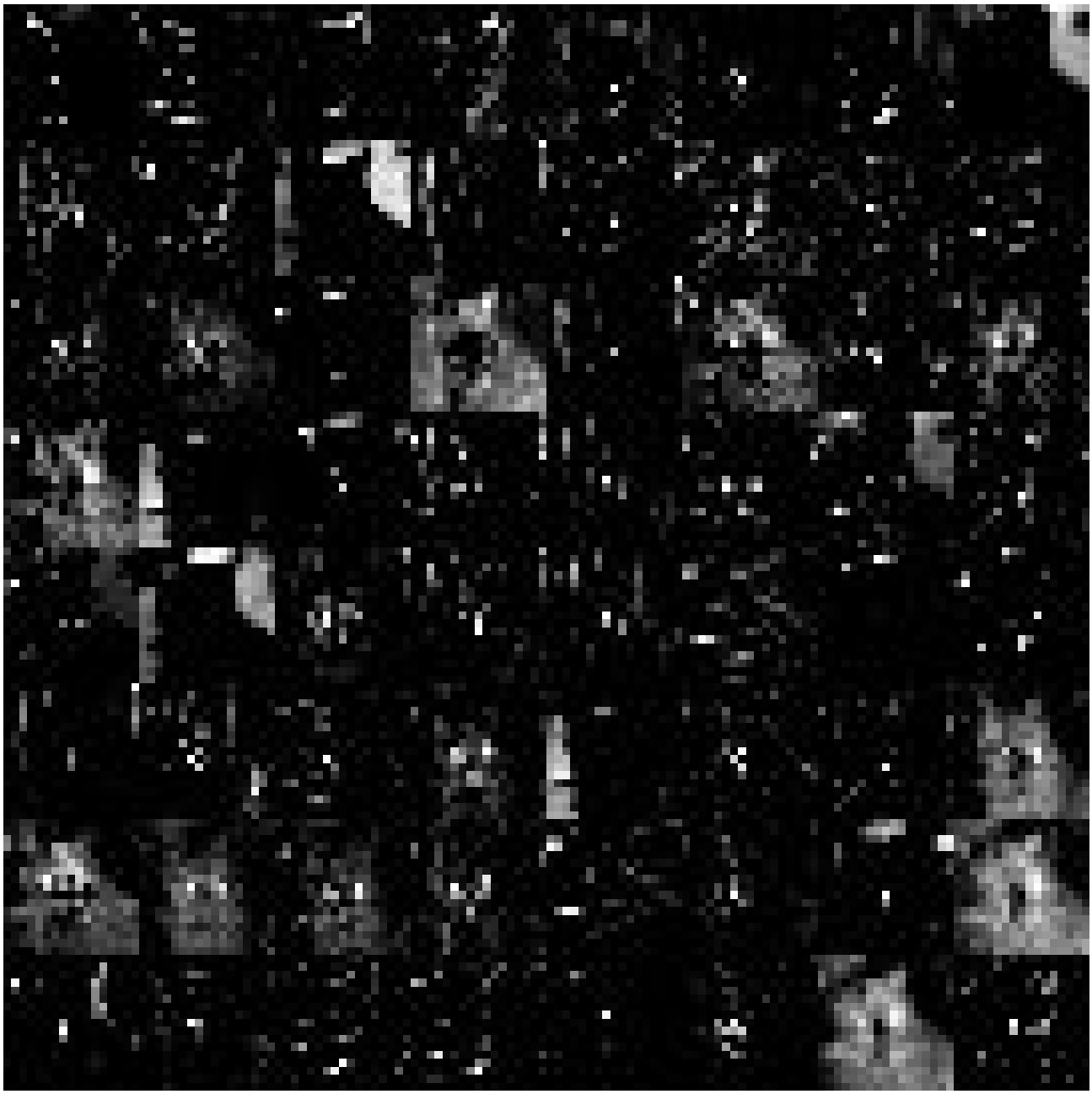
CONV1 Layer 74 x 74 x 64



CONV2 Layer 36 x 36 x 64

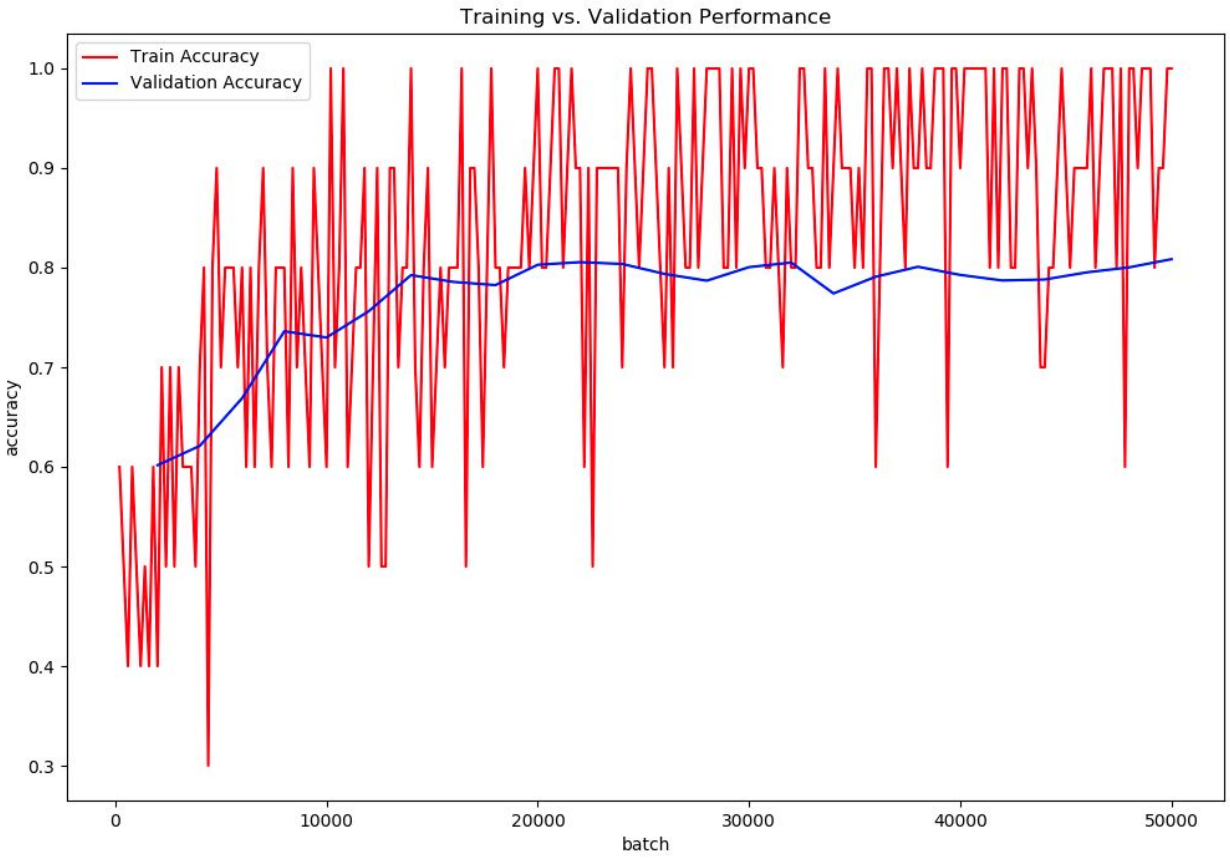


CONV3 Layer 17 x 17 x 64



2. DISCUSSION

PROBLEM of OVERFITTING



➔ In this section, we explore the overfitting problem by studying the model accuracies on training and validation data and observe a *significant gap* in the training and validation accuracies.

➔ In the figure shown above, we see that the training accuracy repeatedly achieves a perfect accuracy of 100%, but the validation accuracy starts to plateau as number of batches increase. This shows that the model does not generalize well to unseen data. Hence, this is a case of ***OVERFITTING***.

➔ A possible solution to this could be the use of regularization to make the model perform on both training as well as validation data. This might help solve the issue of overfitting since we rely highly on the validation accuracy metric, as

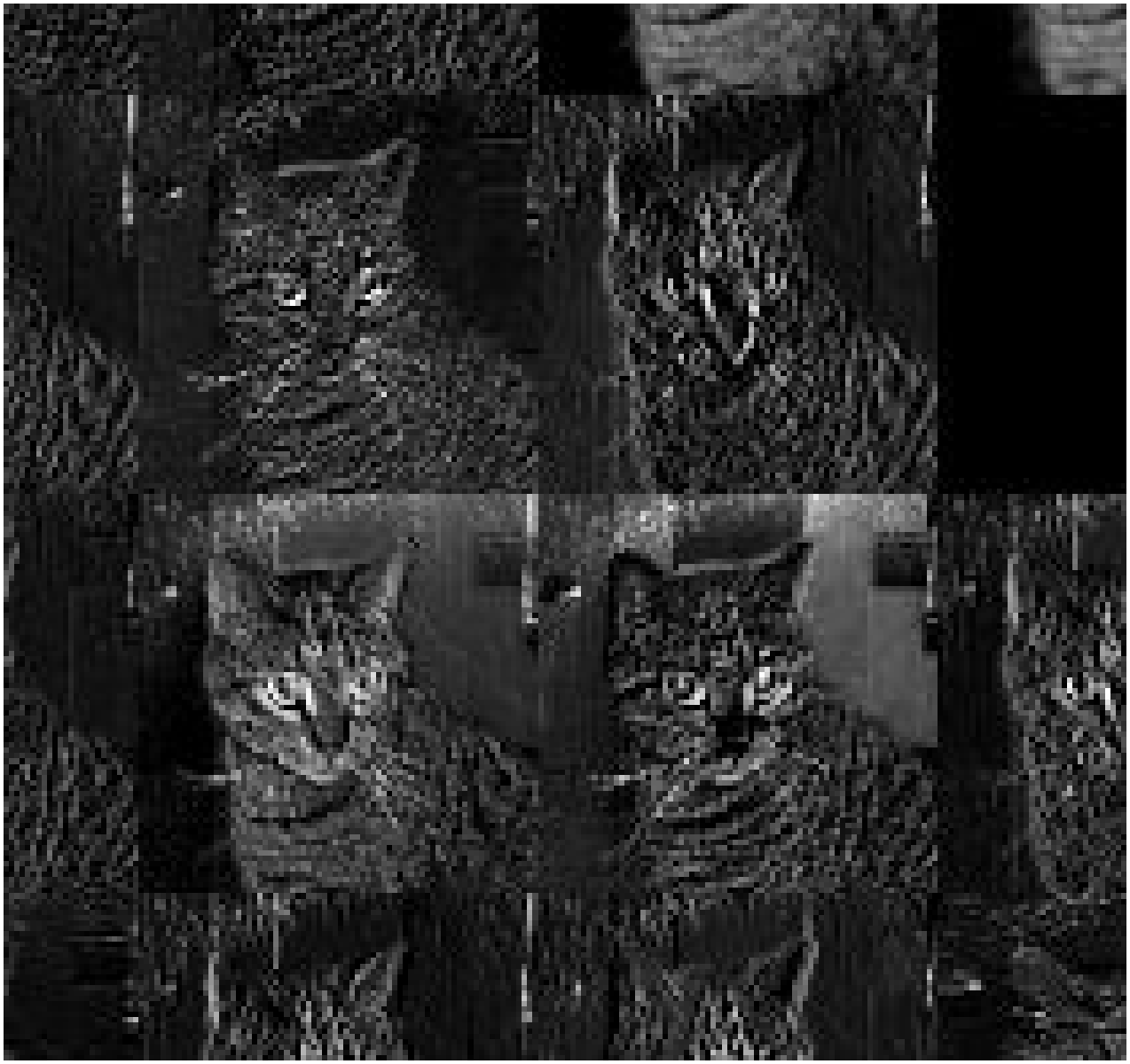
➔ Validation Accuracy tells us the true performance of a model on unseen data.

➔ In my implementation I introduced L2 regularization with a weight decay factor of 0.005. After trying a range of values for the decay factor, I found this value to be the most effective.

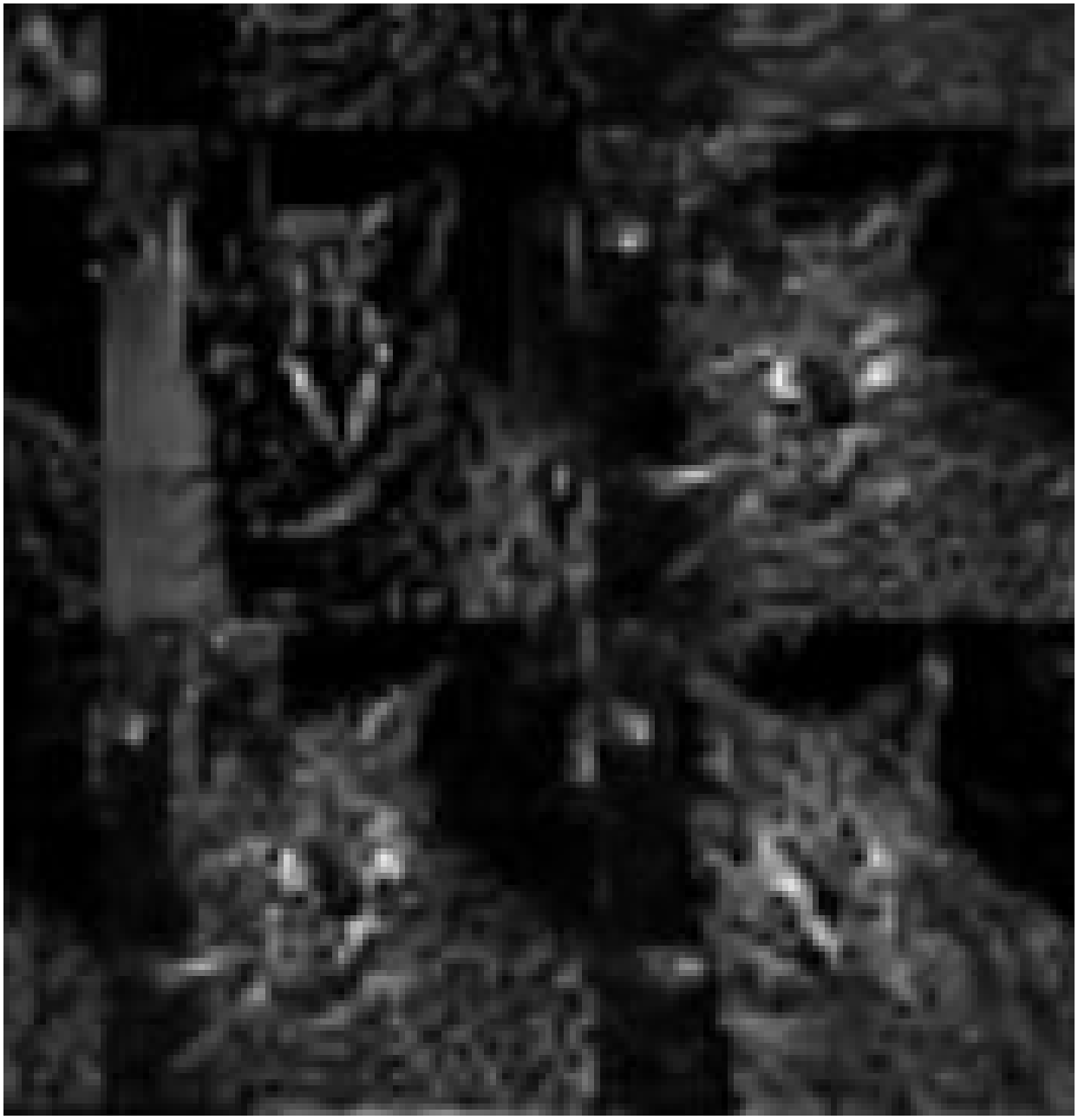
➔ Use of other regularization techniques such as Dropout, Early stopping was not done because the question did not specify if these techniques could be included or not.

VISUALIZING FEATURE MAPS OF CNNS

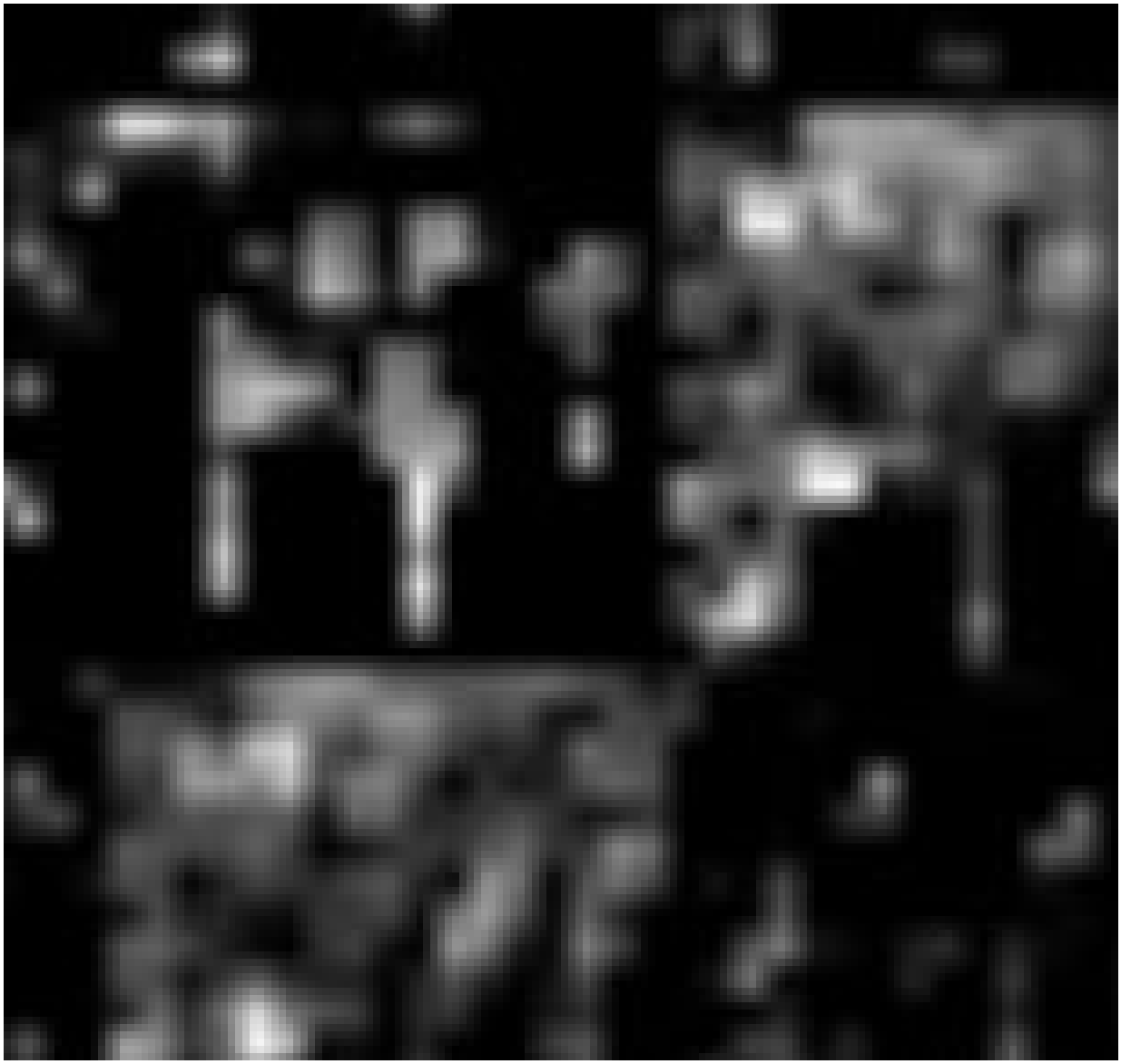
➔ The feature maps from the 3 convolutional layers are shown in the results section. I tested and visualized all 64 maps of each of the 3 CNN layers for both classes. This helps us understand what the layers extract for both types of input: Dog and Cat.



- ➔ The output of the first feature map shown above gives features similar to EDGE DETECTION, which tells us that the initial layers could be extracting lower level features from the input image.
- ➔ The following layer seems to be combining low level features from the first layer and forming patterns which show parts of the subject's body. This suggests a possible hierarchical structure learnt by the 3 CNN layers.



➔ We also see that for the CAT class, the CNN learns to identify the fur of the cat which may be able to tell us some separability between these two classes.



➔ In the final layer of the CNN module, we see that we have very high values for large parts of the feature map and low for the remaining parts. This shows that the final layer learns attributes specific to the types of animal shown in the image and combines all low level features as can be seen in the image above. The limbs and head of the dog are seen to have high scores.