DEEP LEARNING

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COMPUTERONIC – TEHRAN – IRAN

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CHAPTER 7 : GET IN TO THE FIRST REAL PROBLEM

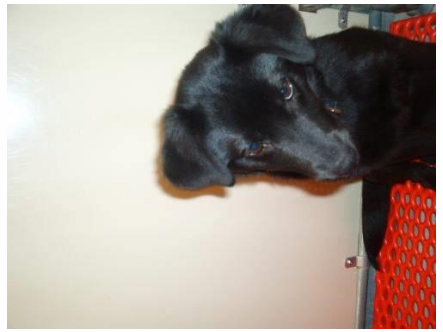
Dog-vs-cat dataset

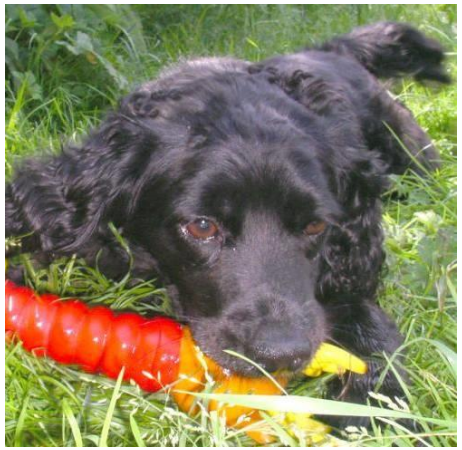
- Real Cats and dogs data set.
  - What's real mean ?
    - Different object's position, color & ...
    - Variety picture size and quality

- 12500 picture to train your network
- 12500 picture to test your network

- Work flow :

1. split data to 3 part (train / test / validation)
2. Make network and compile it
3. Train CNN network
4. Test CNN network





Lets get train, test and validation data ready

```
import os, shutil

original_dataset_dir = 'train'
base_dir = 'dog_vs_cat_dataset'
print("start to split data. please wait ...")
os.mkdir(base_dir)
train_dir = os.path.join(base_dir, 'train')
os.mkdir(train_dir)
validation_dir = os.path.join(base_dir, 'validation')
os.mkdir(validation_dir)
test_dir = os.path.join(base_dir, 'test')
os.mkdir(test_dir)
train_cats_dir = os.path.join(train_dir, 'cats')
os.mkdir(train_cats_dir)
train_dogs_dir = os.path.join(train_dir, 'dogs')
os.mkdir(train_dogs_dir)
validation_cats_dir = os.path.join(validation_dir, 'cats')
os.mkdir(validation_cats_dir)
validation_dogs_dir = os.path.join(validation_dir, 'dogs')
os.mkdir(validation_dogs_dir)
test_cats_dir = os.path.join(test_dir, 'cats')
os.mkdir(test_cats_dir)
test_dogs_dir = os.path.join(test_dir, 'dogs')
os.mkdir(test_dogs_dir)
```

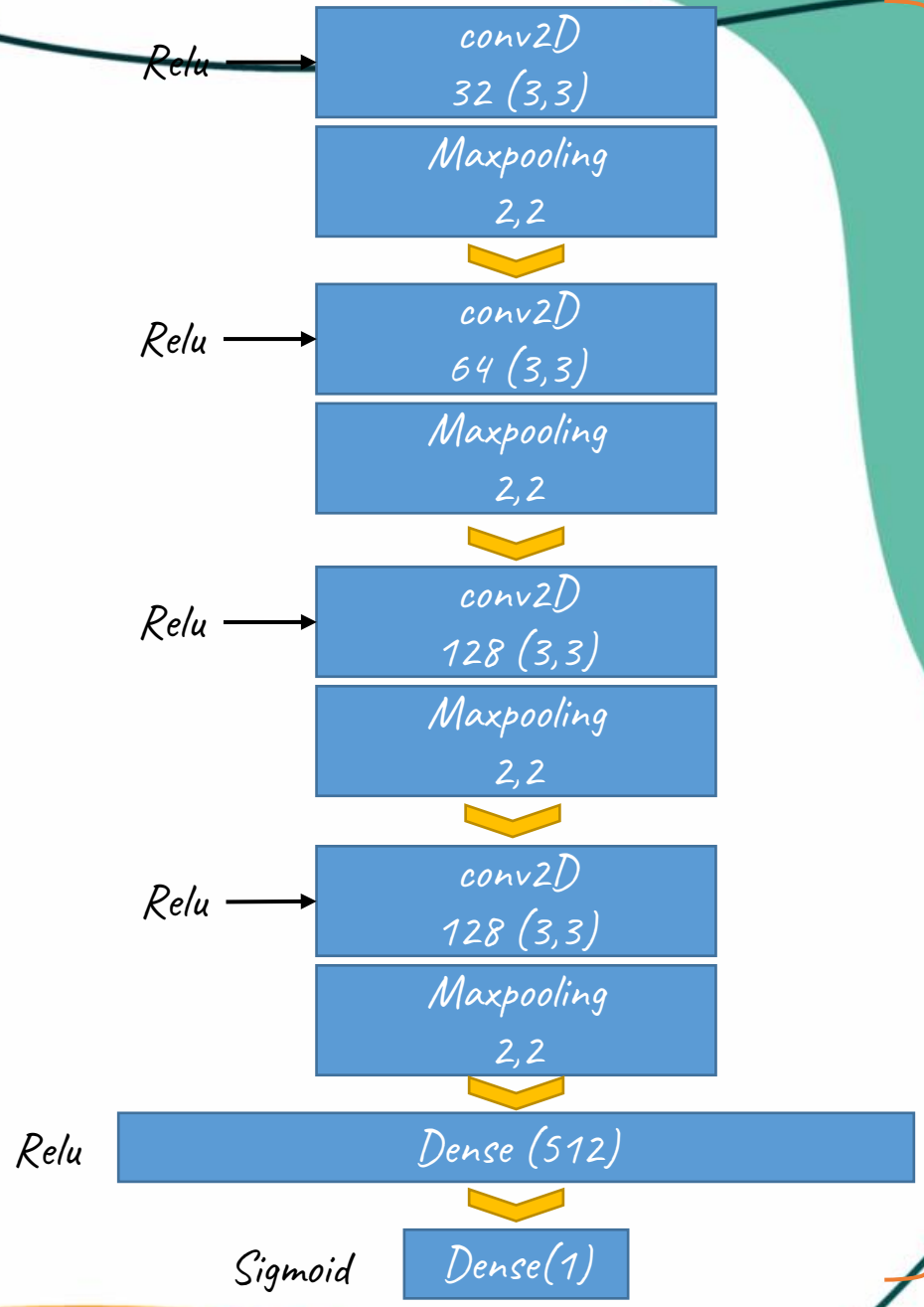
Make new directories

```
fnames = ['cat.{}.jpg'.format(i) for i in range(1000)]
for fname in fnames:
    src = os.path.join(original_dataset_dir, fname)
    dst = os.path.join(train_cats_dir, fname)
    shutil.copyfile(src, dst)
fnames = ['cat.{}.jpg'.format(i) for i in range(1000, 1500)]
for fname in fnames:
    src = os.path.join(original_dataset_dir, fname)
    dst = os.path.join(validation_cats_dir, fname)
    shutil.copyfile(src, dst)
fnames = ['cat.{}.jpg'.format(i) for i in range(1500, 2000)]
for fname in fnames:
    src = os.path.join(original_dataset_dir, fname)
    dst = os.path.join(test_cats_dir, fname)
    shutil.copyfile(src, dst)
fnames = ['dog.{}.jpg'.format(i) for i in range(1000)]
for fname in fnames:
    src = os.path.join(original_dataset_dir, fname)
    dst = os.path.join(train_dogs_dir, fname)
    shutil.copyfile(src, dst)
fnames = ['dog.{}.jpg'.format(i) for i in range(1000, 1500)]
for fname in fnames:
    src = os.path.join(original_dataset_dir, fname)
    dst = os.path.join(validation_dogs_dir, fname)
    shutil.copyfile(src, dst)
fnames = ['dog.{}.jpg'.format(i) for i in range(1500, 2000)]
for fname in fnames:
    src = os.path.join(original_dataset_dir, fname)
    dst = os.path.join(test_dogs_dir, fname)
    shutil.copyfile(src, dst)
```

copy and rename images

Build your network

```
from keras import layers
from keras import models
model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu',
input_shape=(150, 150, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Flatten())
model.add(layers.Dense(512, activation='relu'))
model.add(layers.Dense(1, activation='sigmoid'))

print(model.summary())

from keras import optimizers
model.compile(loss='binary_crossentropy',
optimizer=optimizers.RMSprop(lr=1e-4),
metrics=['acc'])
```



Train and test your CNN network

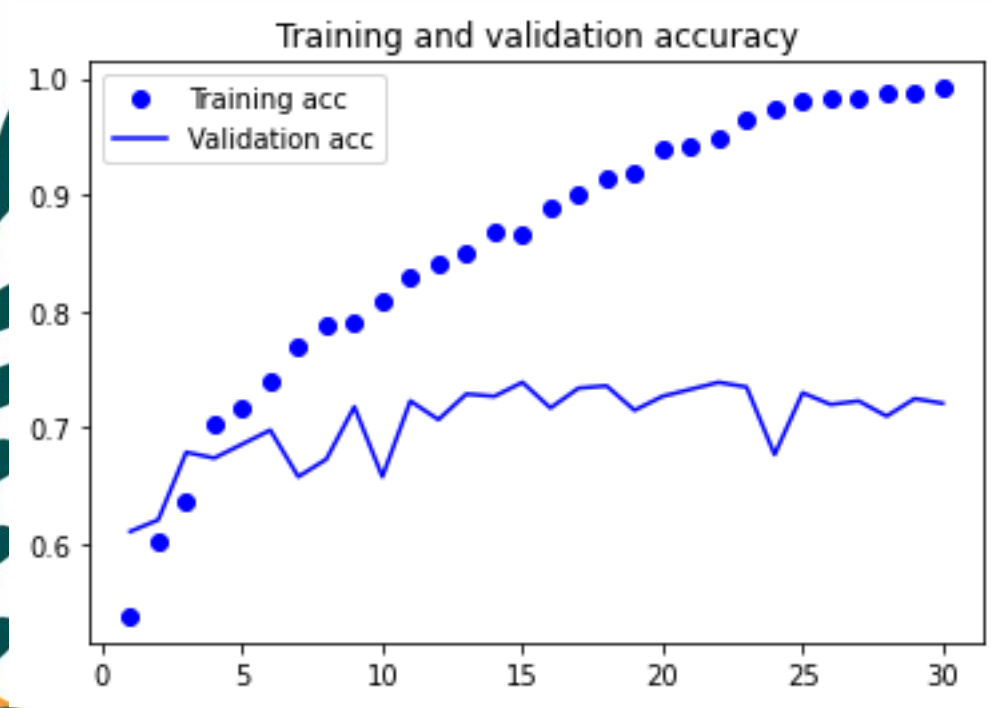
```
from keras.preprocessing.image import ImageDataGenerator
train_datagen = ImageDataGenerator(rescale=1./255)
test_datagen = ImageDataGenerator(rescale=1./255)
train_generator = train_datagen.flow_from_directory(
                                                    train_dir,
                                                    target_size=(150, 150),
                                                    batch_size=20,
                                                    class_mode='binary')
validation_generator = test_datagen.flow_from_directory(
                                                    validation_dir,
                                                    target_size=(150, 150),
                                                    batch_size=20,
                                                    class_mode='binary')
history = model.fit_generator(
                              train_generator,
                              steps_per_epoch=100,
                              epochs=30,
                              validation_data=validation_generator,
                              validation_steps=50)

model.save('cats_and_dogs_small_1.h5')
import matplotlib.pyplot as plt
acc = history.history['acc']
val_acc = history.history['val_acc']
loss = history.history['loss']
val_loss = history.history['val_loss']
epochs = range(1, len(acc) + 1)
plt.plot(epochs, acc, 'bo', label='Training acc')
plt.plot(epochs, val_acc, 'b', label='Validation acc')
plt.title('Training and validation accuracy')
plt.legend()
plt.figure()
plt.plot(epochs, loss, 'bo', label='Training loss')
plt.plot(epochs, val_loss, 'b', label='Validation loss')
plt.title('Training and validation loss')
plt.legend()
plt.show()
```

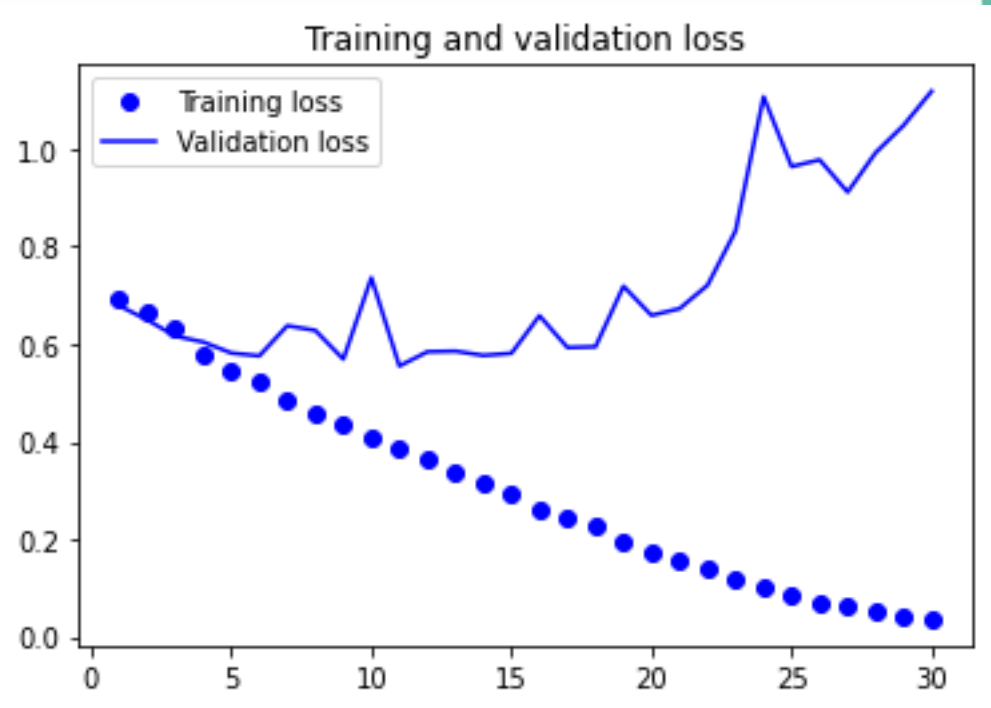
Arrange data in tensor

Train, test and save networks

Plot the result

Result (V1)



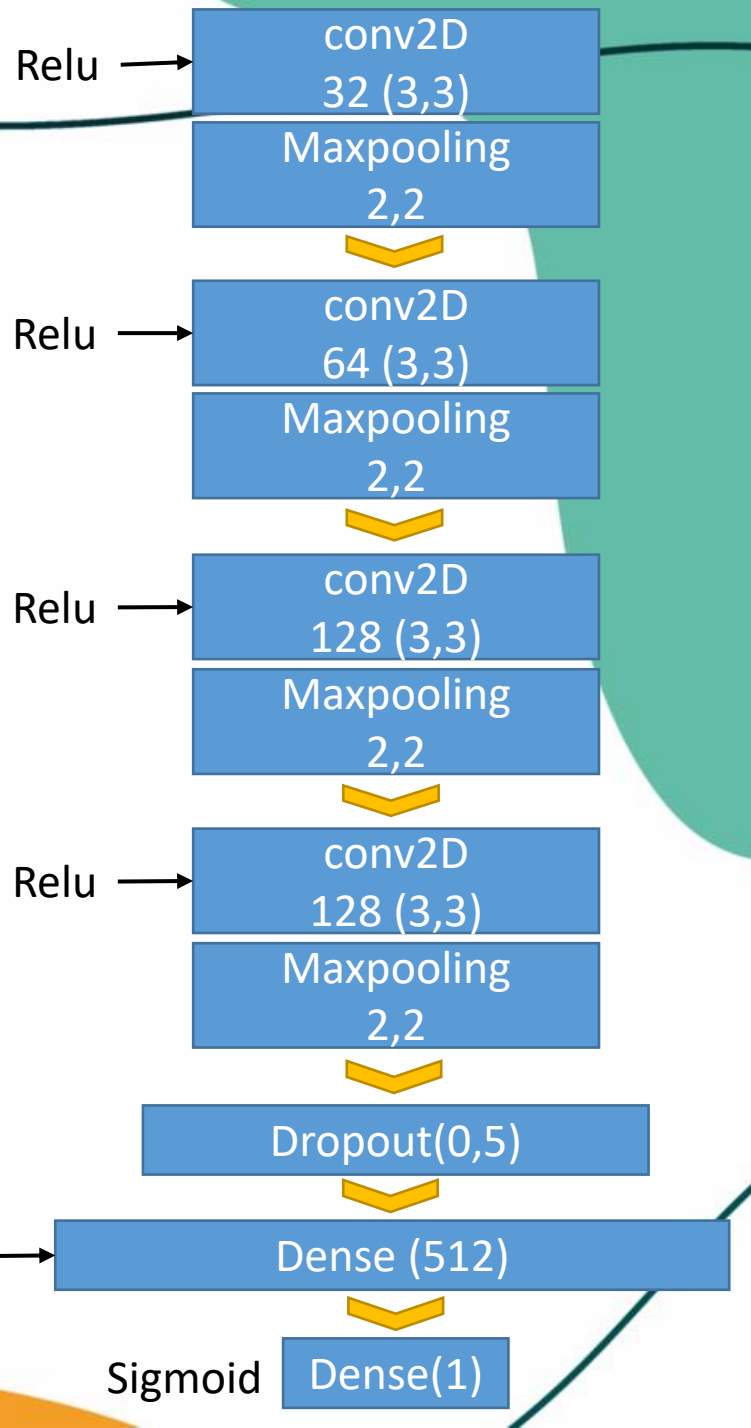


Time to execute : 43m/53s/10ms (in CPU mode) -> result : overfitting
What's your solution for that ?

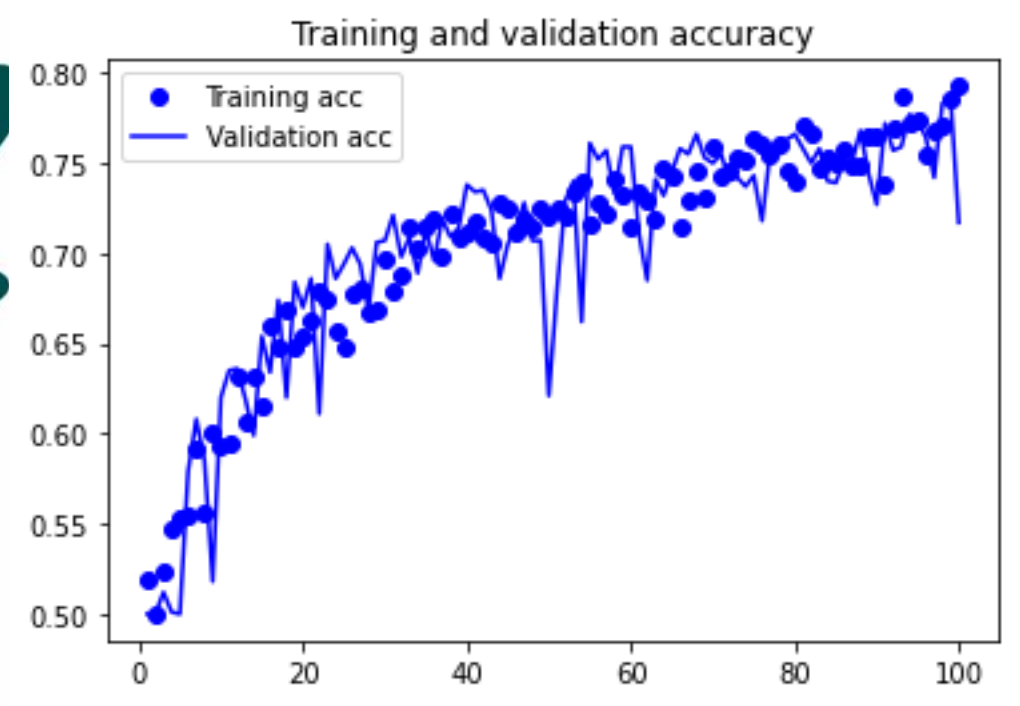
Let's try dropout layer

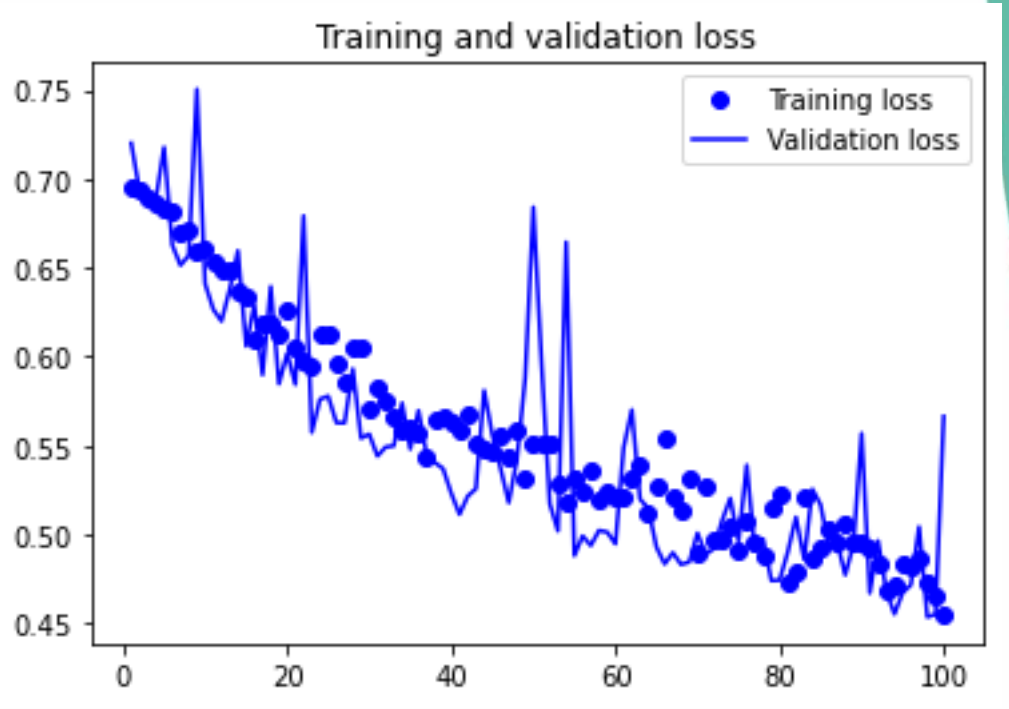
Add dropout layer to CNN network

```
from keras import layers
from keras import models

model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu',
input_shape=(150, 150, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(128, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Flatten())
model.add(layers.Dropout(0.5))
model.add(layers.Dense(512, activation='relu'))
model.add(layers.Dense(1, activation='sigmoid'))

print(model.summary())
```



Result (V2)

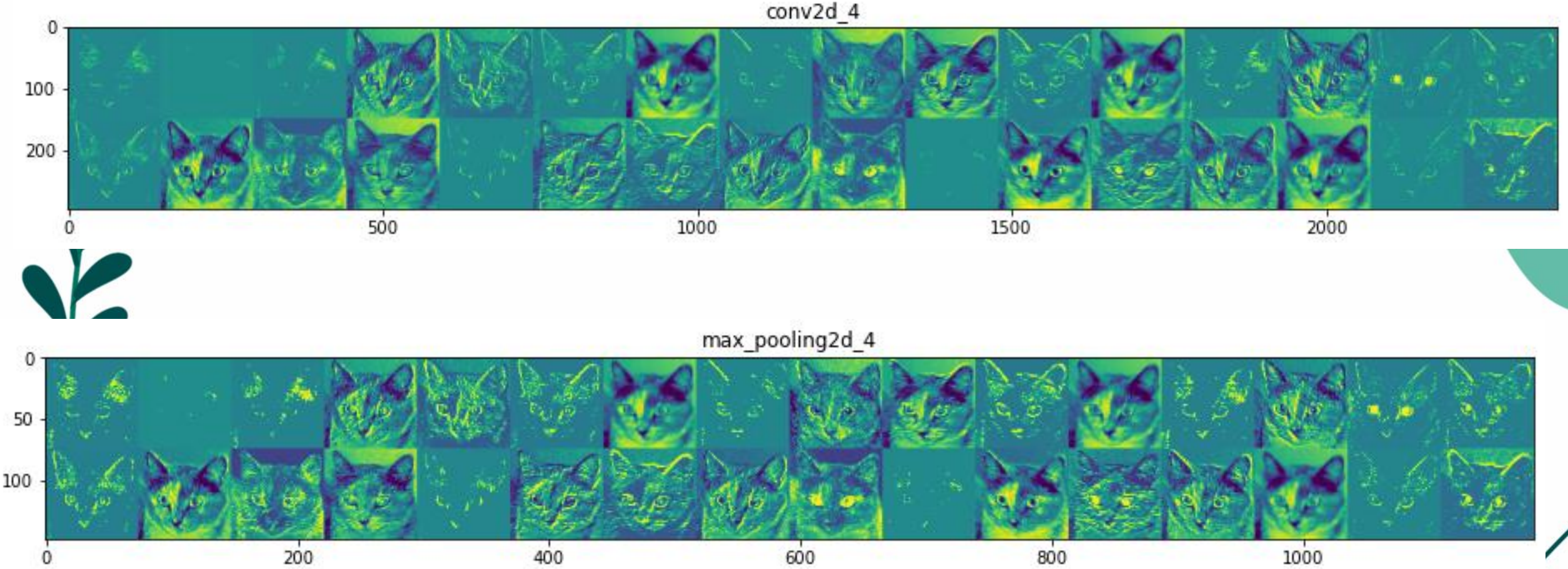


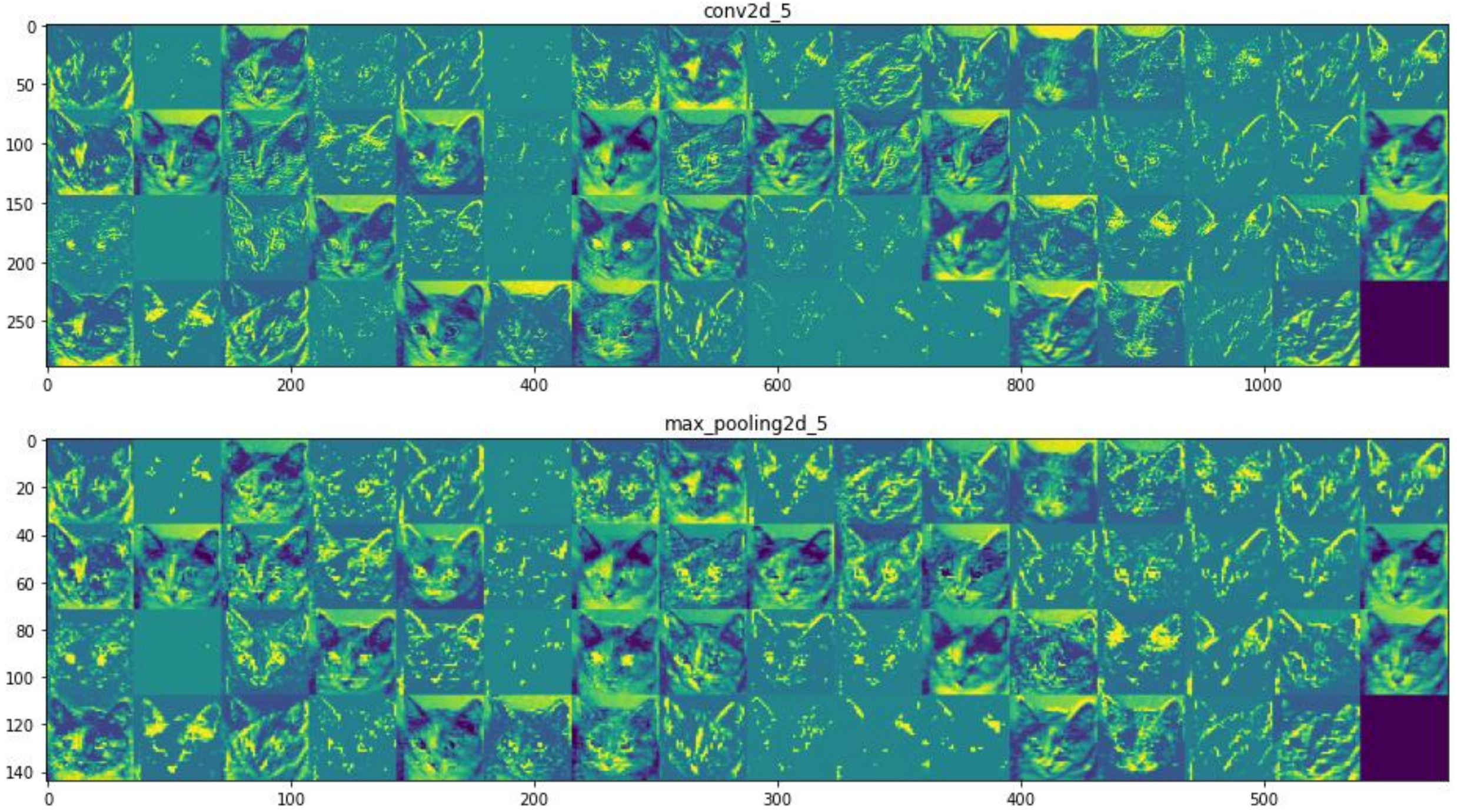


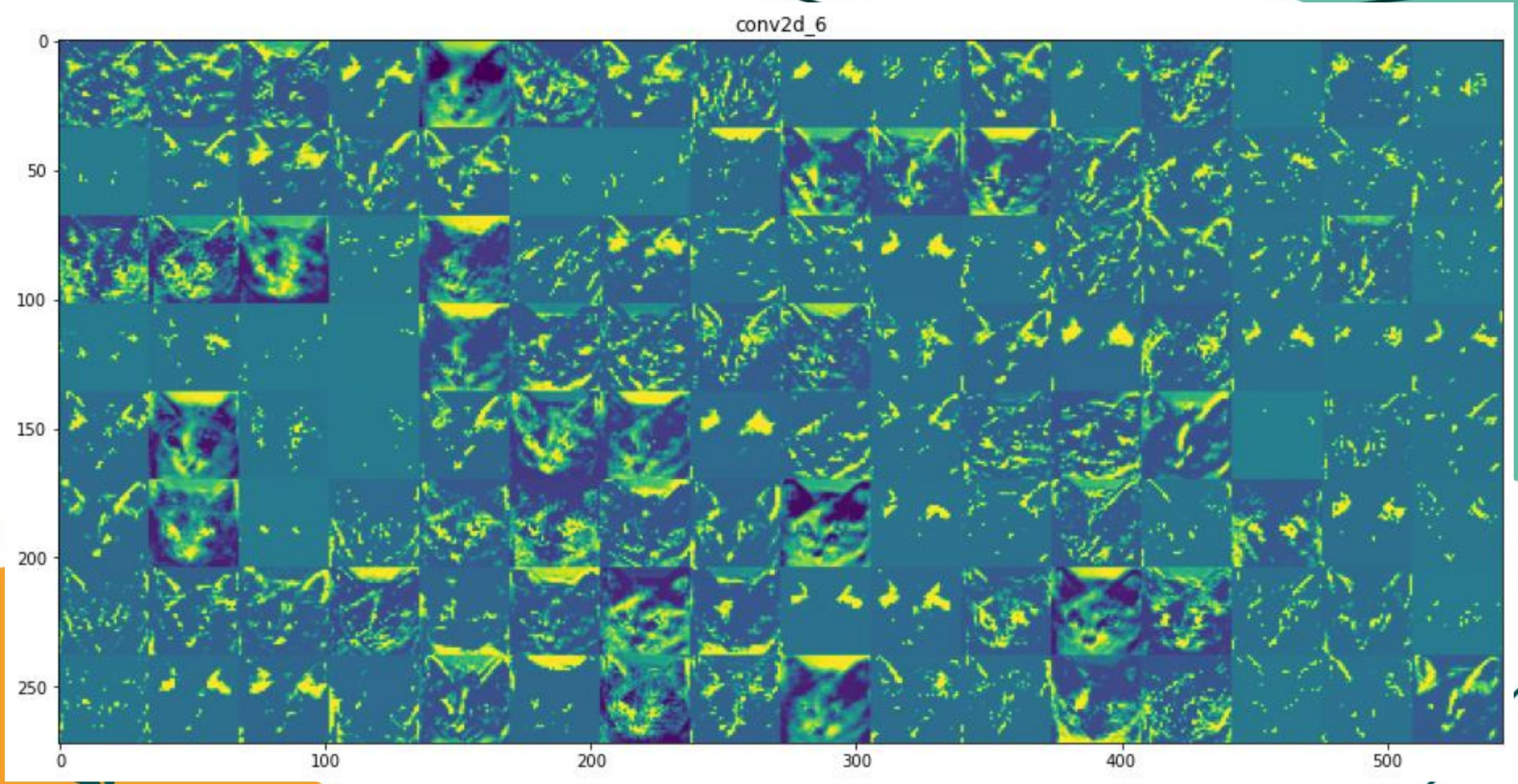
Time to execute : 50m/10s/50ms (in CPU mode) -> result :

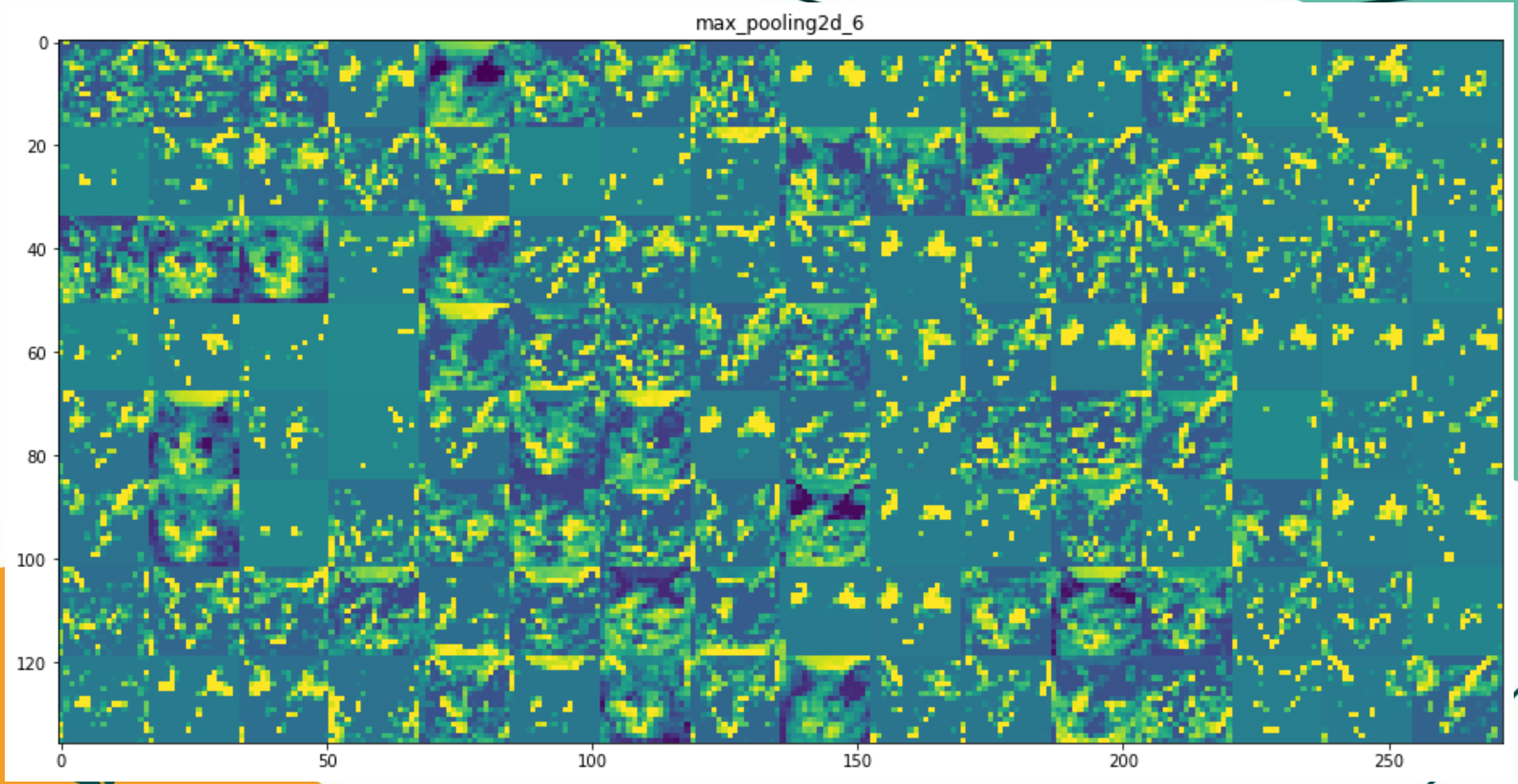
Loss < 80% | Accuracy < 45%

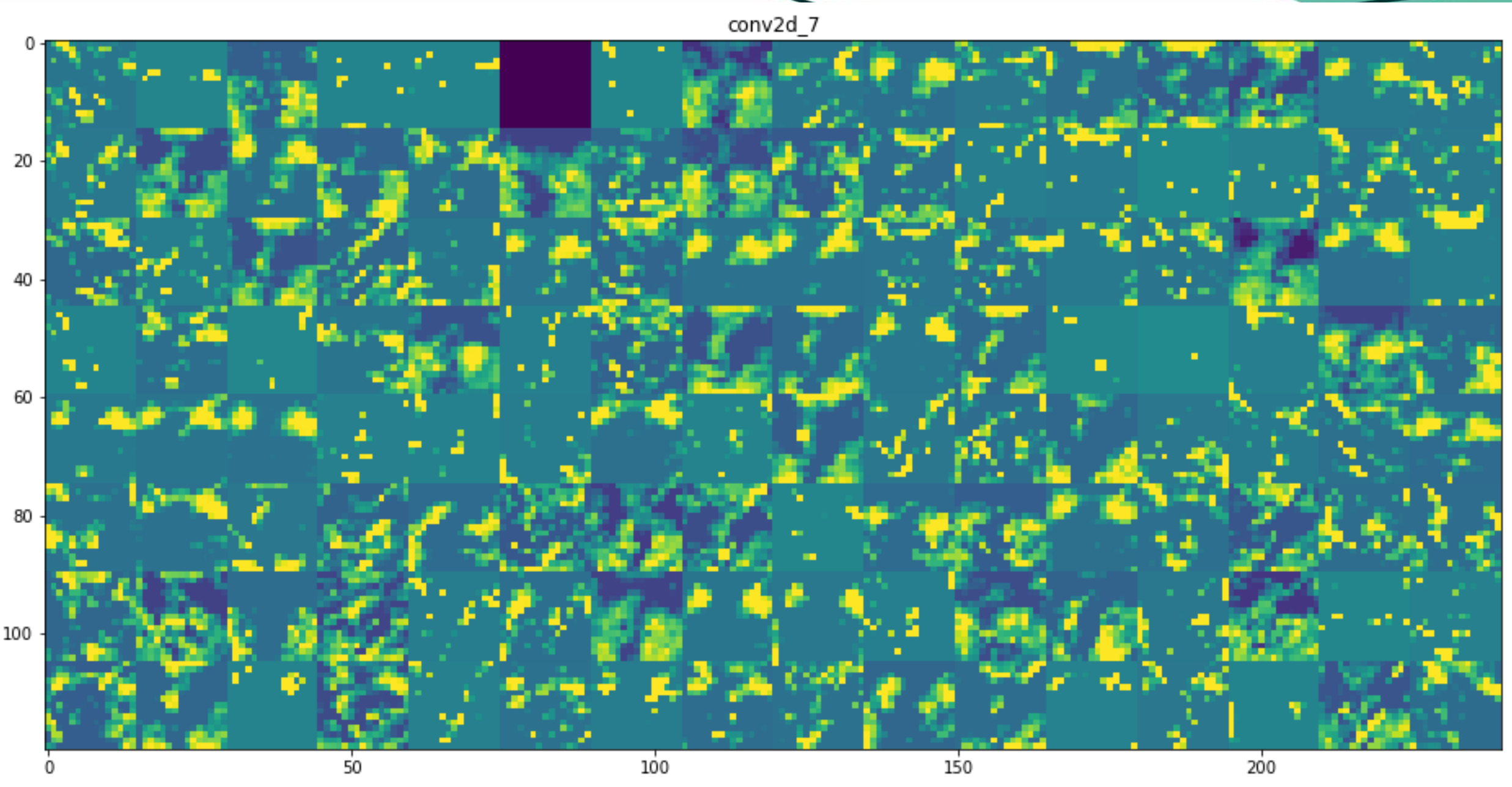
What's going on in the CNN ?

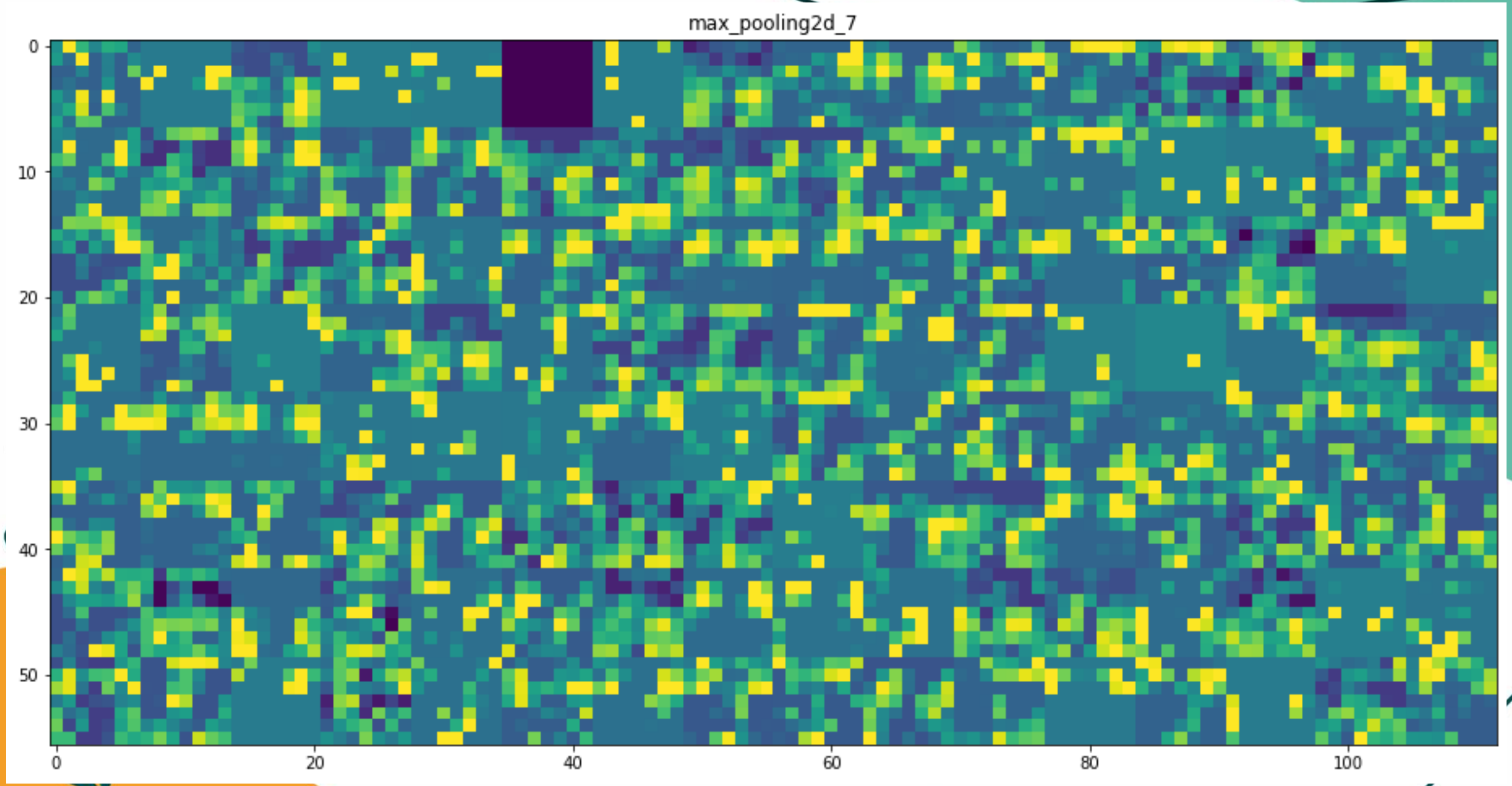



conv2d_5
0
50
100
150
200
250
0
200
400
600
800
1000
max_pooling2d_5
0
20
40
60
80
100
120
140
0
100
200
300
400
500


conv2d_6
0
50
100
150
200
250
0
100
200
300
400
500


max_pooling2d_6
0
20
40
60
80
100
120
0
50
100
150
200
250


conv2d_7
0
20
40
60
80
100
0
50
100
150
200


max_pooling2d_7
0
10
20
30
40
50
0
20
40
60
80
100