

Neural Network Laboratory Work – 5

Ravinthiran Partheepan

CNN USAGE

- ▶ Convolutional Neural Networks, or CNNs, were designed to map image data to an output variable.
- ▶ They have proven so effective that they are the go-to method for any type of prediction problem involving image data as an input.

CNN Layers

- ▶ A convolutional network ingests such images as three separate strata of color stacked one on top of the other.
- ▶ A normal color image is seen as a rectangular box whose width and height are measured by the number of pixels from those dimensions.
- ▶ Matrix Representation for Pixel Selection

1	0	1	2	0	0	0	1
1	0	-1	0	0	1	1	-1
1	0	0	0	0	0	0	0
1	0	1	0	0	1	0	1
1	1	0	1	-5	0	1	0
0	-2	-3	0	0	1	0	1

CNN – Parameters

- ▶ first set of CONV => RELU => POOL
- ▶ Conv2D - which is the core building block and does most of the computational heavy lifting. Data or image is convolved using filters or kernels.
- ▶ The output of a convolution that has a 3d filter with color would be a 2d matrix.
- ▶ RELU – Activation Layer -> the rectifier function to increase non-linearity in the CNN. Images are made of different objects that are not linear to each other.
- ▶ Pooling Layer -> **The dimension of spatial extent:** which is the value of n which we can take N cross and feature representation and map to a single value
- ▶ **Stride:** which is how many features the sliding window skips along the width and height

CNN Layers – Parameters, Output, Conv2D, Max_Pooling and Shape

Layer (type)	Output Shape	Param #
conv2d_7 (Conv2D)	(None, 148, 148, 32)	896
activation_11 (Activation)	(None, 148, 148, 32)	0
max_pooling2d_7 (MaxPooling2D)	(None, 74, 74, 32)	0
conv2d_8 (Conv2D)	(None, 72, 72, 32)	9248
activation_12 (Activation)	(None, 72, 72, 32)	0
max_pooling2d_8 (MaxPooling2D)	(None, 36, 36, 32)	0
conv2d_9 (Conv2D)	(None, 34, 34, 64)	18496
activation_13 (Activation)	(None, 34, 34, 64)	0

Loss per Epochs – 50 (Epochs)

max_pooling2d_9 (MaxPooling2)	(None, 17, 17, 64)	0
flatten_3 (Flatten)	(None, 18496)	0
dense_5 (Dense)	(None, 64)	1183808
activation_14 (Activation)	(None, 64)	0
dropout_3 (Dropout)	(None, 64)	0
dense_6 (Dense)	(None, 1)	65
activation_15 (Activation)	(None, 1)	0
=====		
Total params: 1,212,513		
Trainable params: 1,212,513		
Non-trainable params: 0		

Loss per Epochs – 50 (Epochs)

Found 24 images belonging to 2 classes.

Found 30 images belonging to 2 classes.

Epoch 1/50

2/2 [=====] - 3s 2s/step - loss: 0.9145 - acc: 0.4000 - val_loss: 0.7136 - val_acc: 0.5000

Epoch 2/50

2/2 [=====] - 1s 412ms/step - loss: 0.7544 - acc: 0.6000 - val_loss: 0.8284 - val_acc: 0.5000

Epoch 3/50

2/2 [=====] - 1s 382ms/step - loss: 0.9332 - acc: 0.3444 - val_loss: 0.7167 - val_acc: 0.5000

Epoch 4/50

2/2 [=====] - 1s 416ms/step - loss: 0.7662 - acc: 0.3000 - val_loss: 0.6979 - val_acc: 0.4000

Epoch 5/50

2/2 [=====] - 1s 418ms/step - loss: 0.7299 - acc: 0.4315 - val_loss: 0.6877 - val_acc: 0.7000

Epoch 6/50

2/2 [=====] - 1s 427ms/step - loss: 0.7008 - acc: 0.3000 - val_loss: 0.6925 - val_acc: 0.5000

Epoch 7/50

2/2 [=====] - 1s 410ms/step - loss: 0.7336 - acc: 0.2000 - val_loss: 0.6877 - val_acc: 0.6000

Epoch 8/50

2/2 [=====] - 1s 426ms/step - loss: 0.6959 - acc: 0.3611 - val_loss: 0.6915 - val_acc: 0.7000

Epoch 9/50

Loss Per EPOCHS

```
Epoch 10/50
2/2 [=====] - 1s 416ms/step - loss: 0.6900 - acc: 0.5685 - val_loss: 0.7088 - val_acc: 0.4000
Epoch 11/50
2/2 [=====] - 1s 426ms/step - loss: 0.7136 - acc: 0.4000 - val_loss: 0.6896 - val_acc: 0.7000
Epoch 12/50
2/2 [=====] - 1s 412ms/step - loss: 0.6983 - acc: 0.5000 - val_loss: 0.6861 - val_acc: 0.6000
Epoch 13/50
2/2 [=====] - 1s 378ms/step - loss: 0.6919 - acc: 0.4481 - val_loss: 0.6908 - val_acc: 0.5000
Epoch 14/50
2/2 [=====] - 1s 409ms/step - loss: 0.6856 - acc: 0.6000 - val_loss: 0.6461 - val_acc: 0.7000
Epoch 15/50
2/2 [=====] - 1s 374ms/step - loss: 0.7684 - acc: 0.3444 - val_loss: 0.6873 - val_acc: 0.8000
Epoch 16/50
2/2 [=====] - 1s 405ms/step - loss: 0.7435 - acc: 0.3000 - val_loss: 0.6996 - val_acc: 0.3000
Epoch 17/50
2/2 [=====] - 1s 409ms/step - loss: 0.7340 - acc: 0.3000 - val_loss: 0.6907 - val_acc: 0.7000
Epoch 18/50
2/2 [=====] - 1s 379ms/step - loss: 0.7351 - acc: 0.3611 - val_loss: 0.6835 - val_acc: 0.9000
Epoch 19/50
```


Loss Per Epochs

```
Epoch 25/50  
2/2 [=====] - 1s 375ms/step - loss: 0.6974 - acc: 0.4481 - val_loss: 0.6634 - val_acc: 0.7000  
Epoch 26/50  
2/2 [=====] - 1s 399ms/step - loss: 0.6810 - acc: 0.6000 - val_loss: 0.6699 - val_acc: 0.8000  
Epoch 27/50  
2/2 [=====] - 1s 417ms/step - loss: 0.6589 - acc: 0.8000 - val_loss: 0.7528 - val_acc: 0.4000  
Epoch 28/50  
2/2 [=====] - 1s 421ms/step - loss: 0.9021 - acc: 0.2241 - val_loss: 0.6675 - val_acc: 0.7000  
Epoch 29/50  
2/2 [=====] - 1s 459ms/step - loss: 0.6818 - acc: 0.6000 - val_loss: 0.7504 - val_acc: 0.4000  
Epoch 30/50  
2/2 [=====] - 1s 431ms/step - loss: 0.7489 - acc: 0.3444 - val_loss: 0.7308 - val_acc: 0.4000  
Epoch 31/50  
2/2 [=====] - 1s 416ms/step - loss: 0.6895 - acc: 0.4000 - val_loss: 0.6512 - val_acc: 0.9000  
Epoch 32/50  
2/2 [=====] - 1s 404ms/step - loss: 0.6823 - acc: 0.4000 - val_loss: 0.6789 - val_acc: 0.8000  
Epoch 33/50  
2/2 [=====] - 1s 378ms/step - loss: 0.6967 - acc: 0.5685 - val_loss: 0.6651 - val_acc: 0.8000  
Epoch 34/50
```

LOSS per EPOCHS

```
2/2 [=====] - 1s 354ms/step - loss: 0.6887 - acc: 0.5000 - val_loss: 0.6443 - val_acc: 0.8000
Epoch 42/50
2/2 [=====] - 1s 392ms/step - loss: 0.6461 - acc: 0.9000 - val_loss: 0.6600 - val_acc: 0.7000
Epoch 43/50
2/2 [=====] - 1s 372ms/step - loss: 0.6008 - acc: 0.6722 - val_loss: 0.5766 - val_acc: 0.9000
Epoch 44/50
2/2 [=====] - 1s 357ms/step - loss: 0.6979 - acc: 0.4000 - val_loss: 0.6185 - val_acc: 0.9000
Epoch 45/50
2/2 [=====] - 1s 339ms/step - loss: 0.6886 - acc: 0.6556 - val_loss: 0.7052 - val_acc: 0.3000
Epoch 46/50
2/2 [=====] - 1s 355ms/step - loss: 0.7564 - acc: 0.8000 - val_loss: 0.6654 - val_acc: 0.7000
Epoch 47/50
2/2 [=====] - 1s 356ms/step - loss: 0.6219 - acc: 0.6000 - val_loss: 0.5504 - val_acc: 0.9000
Epoch 48/50
2/2 [=====] - 1s 343ms/step - loss: 0.7946 - acc: 0.5852 - val_loss: 0.6050 - val_acc: 0.8000
Epoch 49/50
2/2 [=====] - 1s 399ms/step - loss: 0.6339 - acc: 0.4000 - val_loss: 0.5616 - val_acc: 0.8000
Epoch 50/50
2/2 [=====] - 1s 387ms/step - loss: 0.7155 - acc: 0.4481 - val_loss: 0.5845 - val_acc: 0.8000
```

outputs and predictions

```
2/2 [=====] - 1s 343ms/step - loss: 0.7946 - acc: 0.5852 - val_loss: 0.6050 - val_acc: 0.8000
Epoch 49/50
2/2 [=====] - 1s 399ms/step - loss: 0.6339 - acc: 0.4000 - val_loss: 0.5616 - val_acc: 0.8000
Epoch 50/50
2/2 [=====] - 1s 387ms/step - loss: 0.7155 - acc: 0.4481 - val_loss: 0.5845 - val_acc: 0.8000
```

Identification of the unknown object

```
cat10.jpg CNN decision - CAT: well done!
cat11.jpg CNN decision - CAT: well done!
cat12.jpg CNN decision - CAT: well done!
cat13.jpg CNN decision - CAT: well done!
cat14.jpg CNN decision - DOG: error!
cat15.jpg CNN decision - CAT: well done!
dog10.jpg CNN decision - CAT: error!
dog11.jpg CNN decision - CAT: error!
dog12.jpg CNN decision - DOG: well done!
dog13.jpg CNN decision - DOG: well done!
dog14.jpg CNN decision - DOG: well done!
dog15.jpg CNN decision - DOG: well done!
```

Thank You

