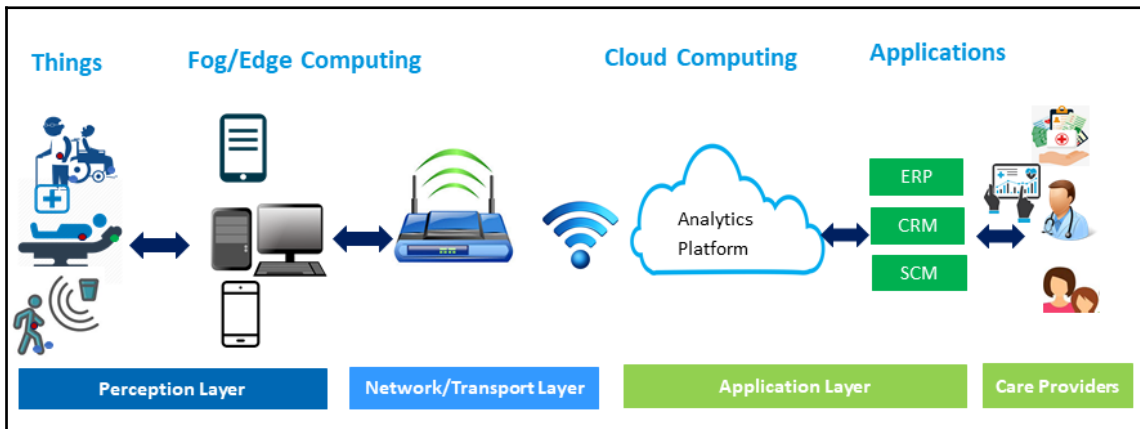
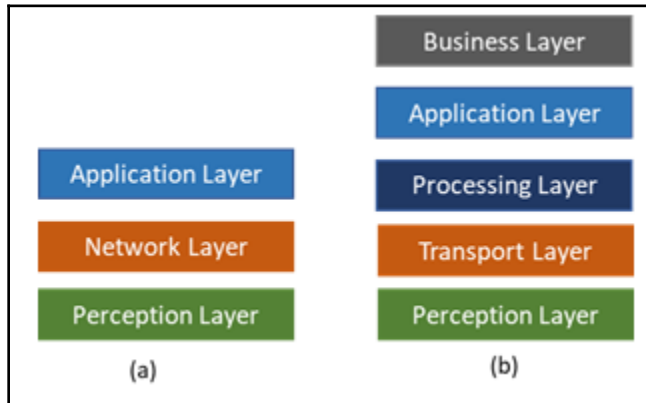
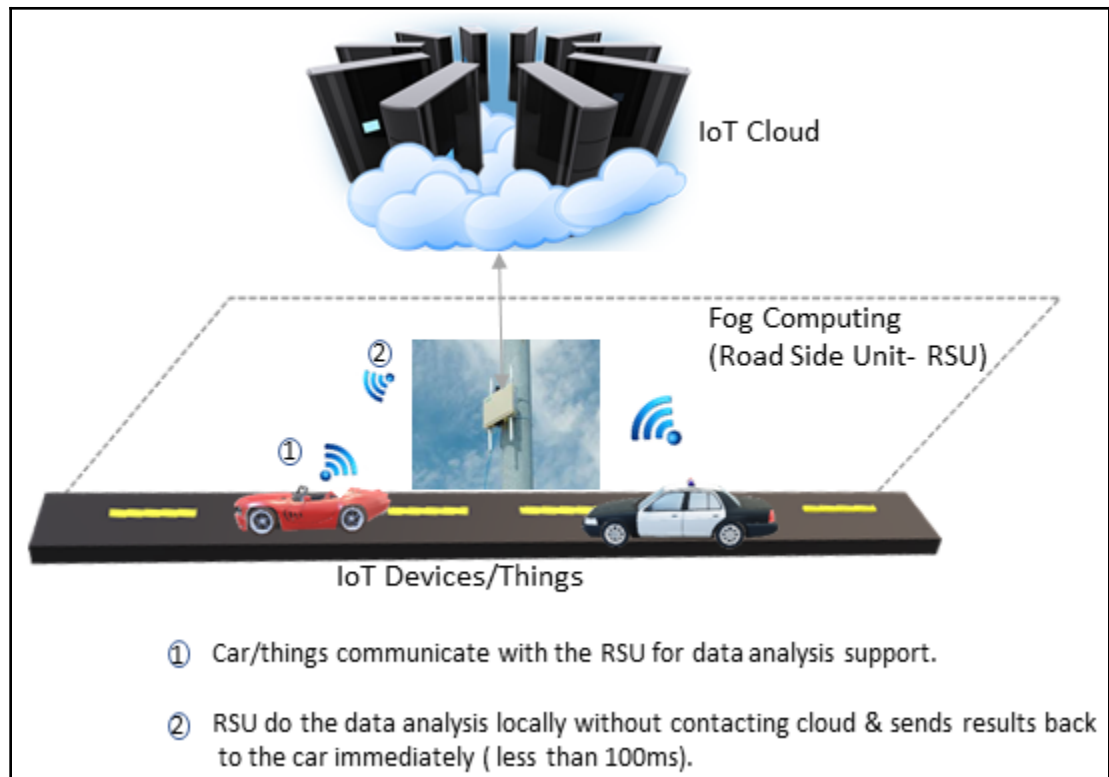
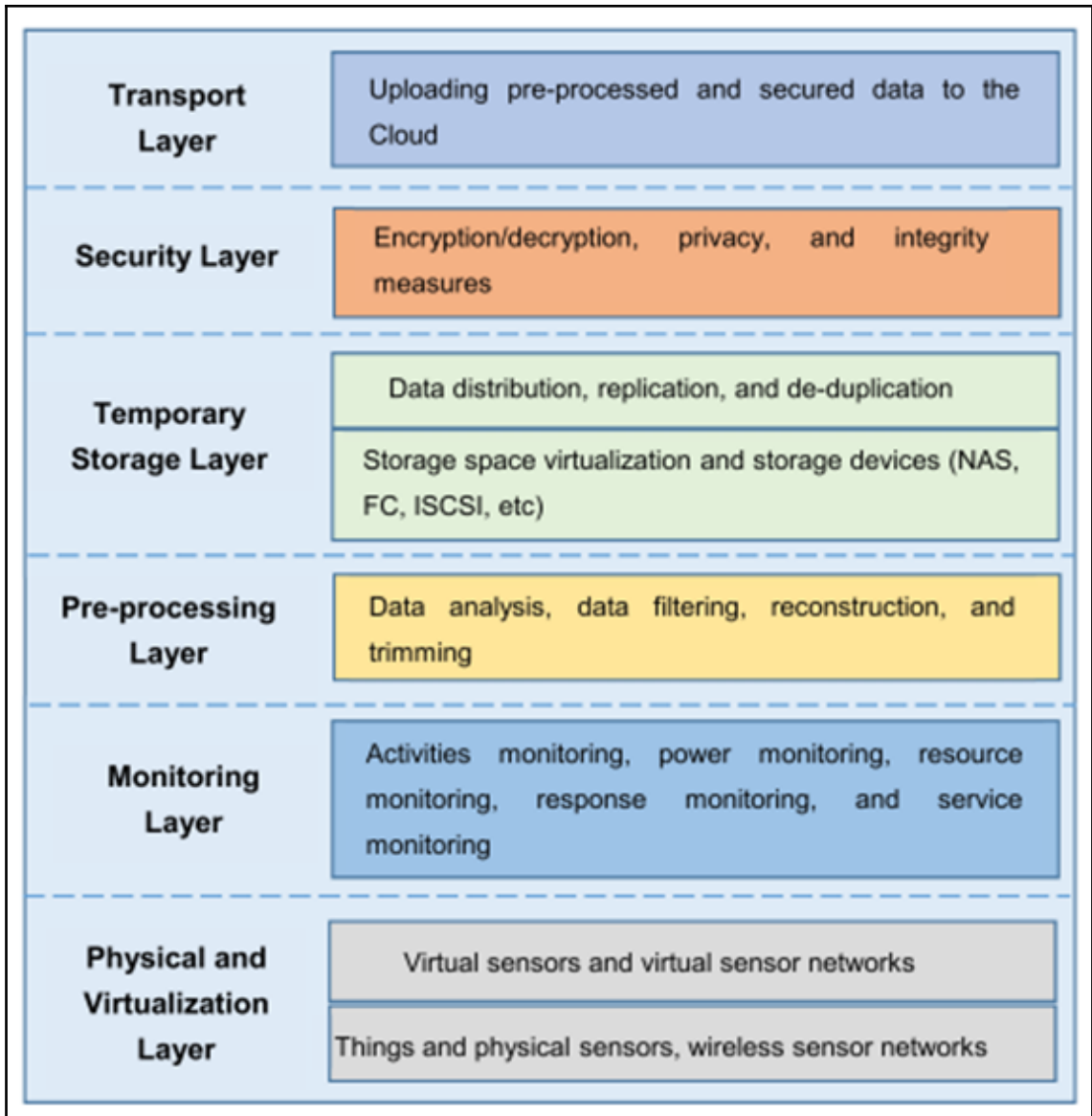
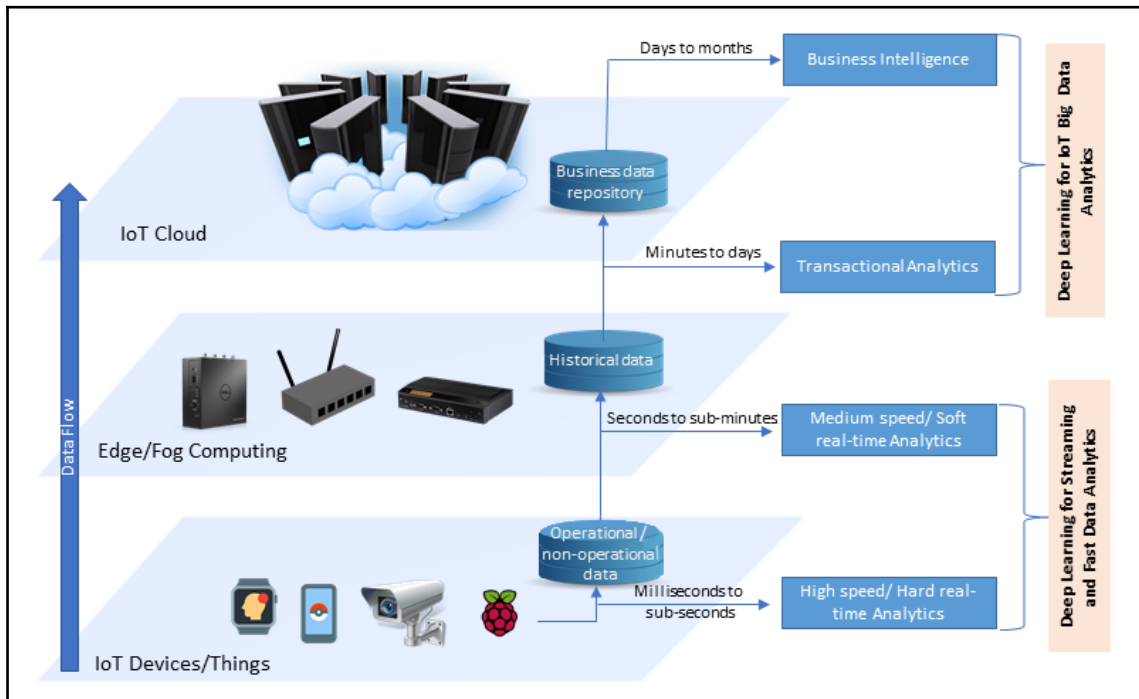
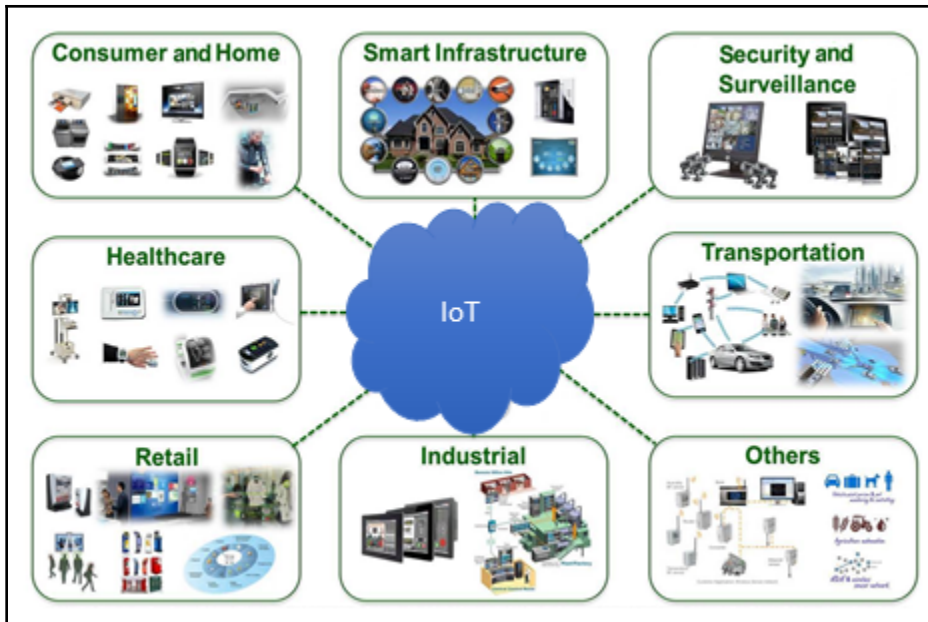


Chapter 1: The End-to-End Life Cycle of the IoT

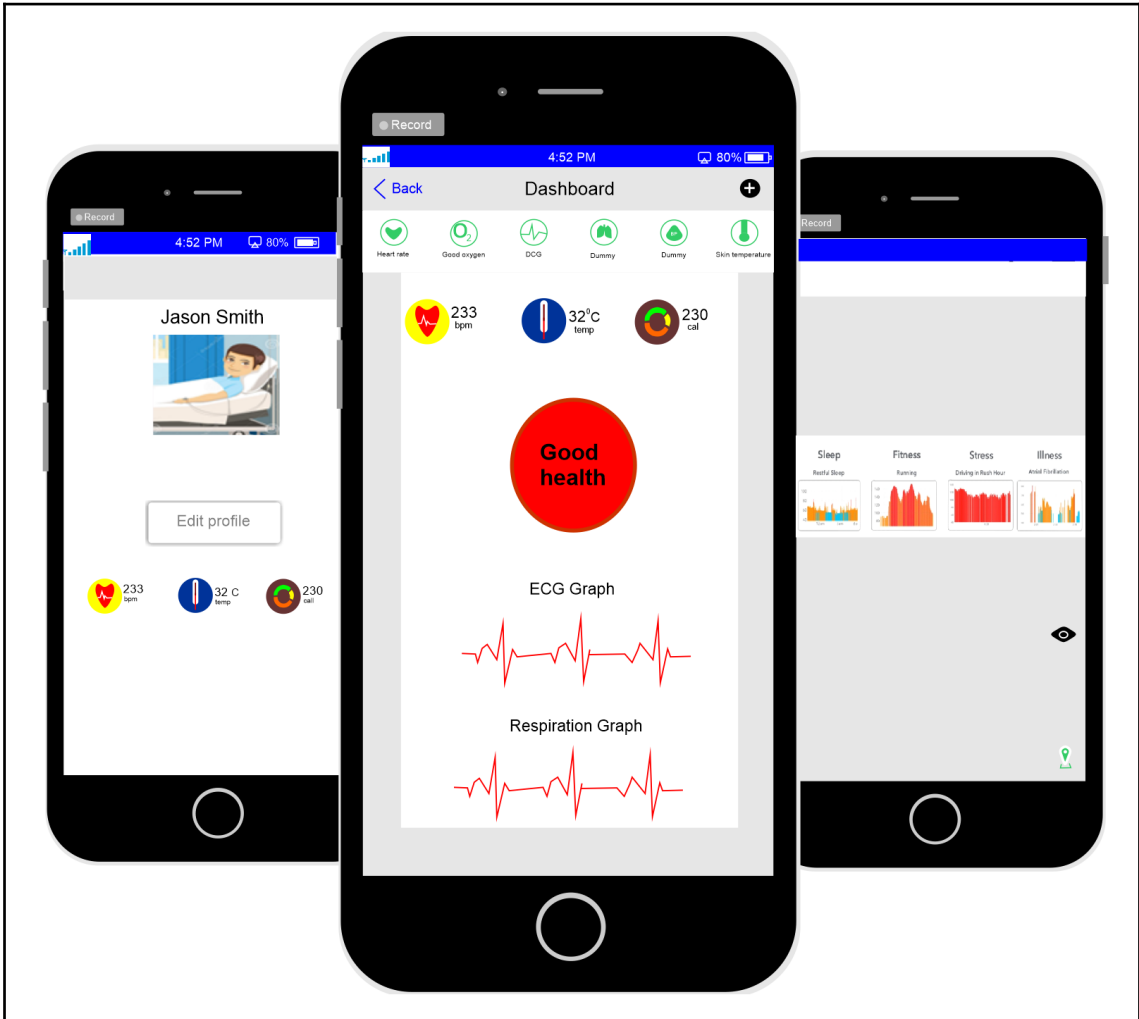






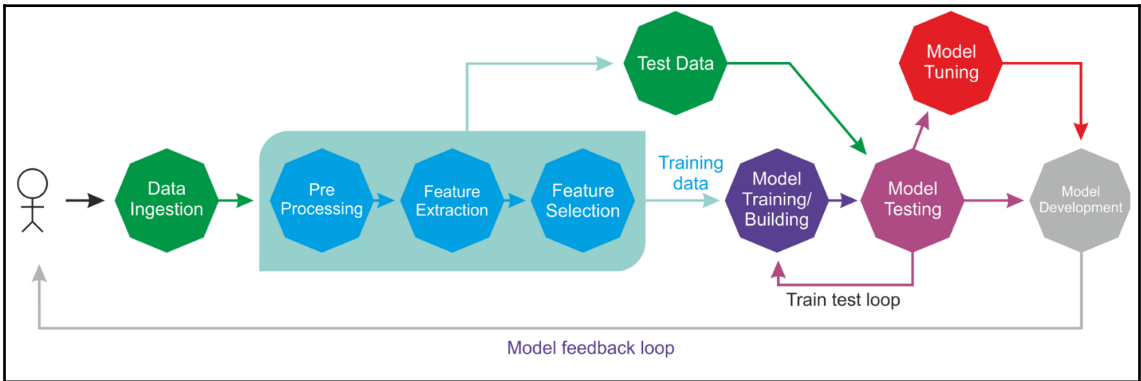
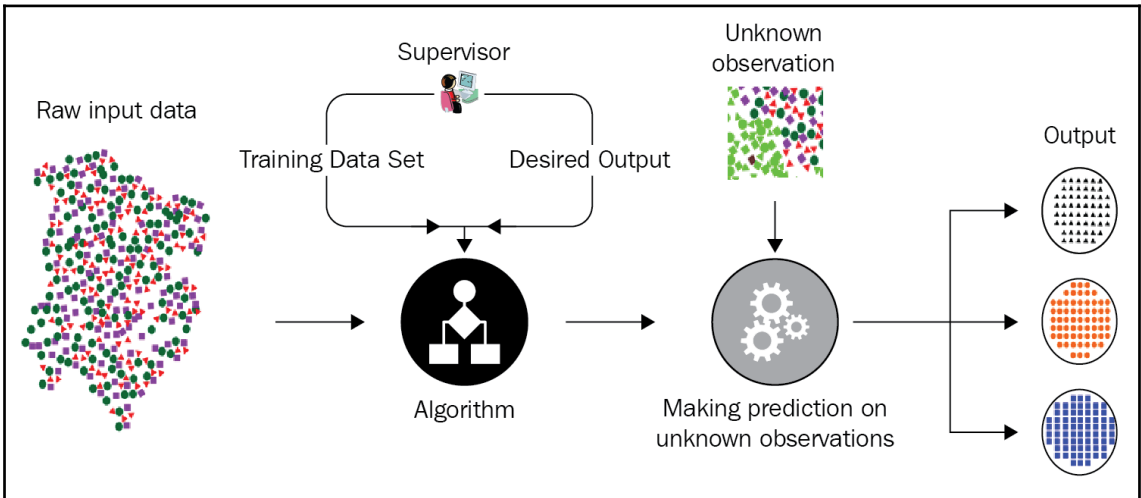
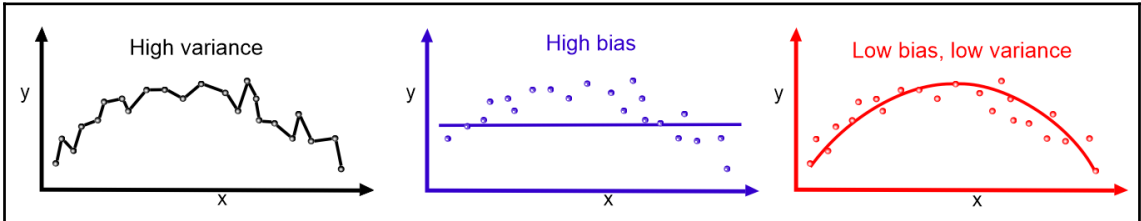


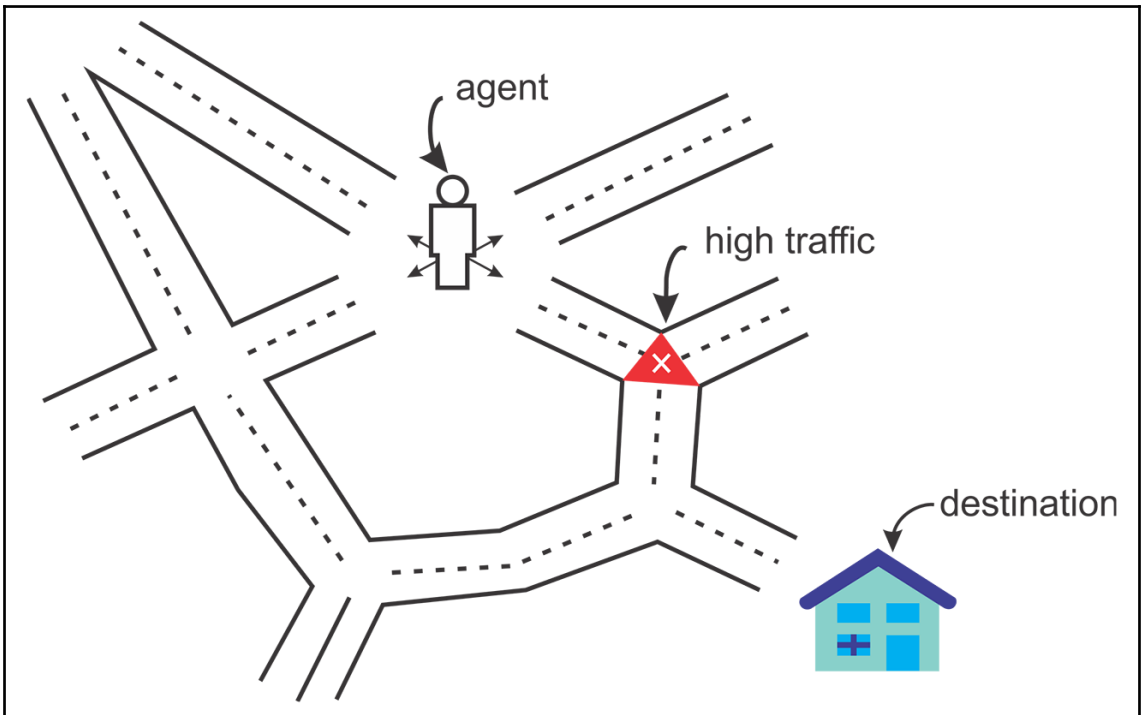
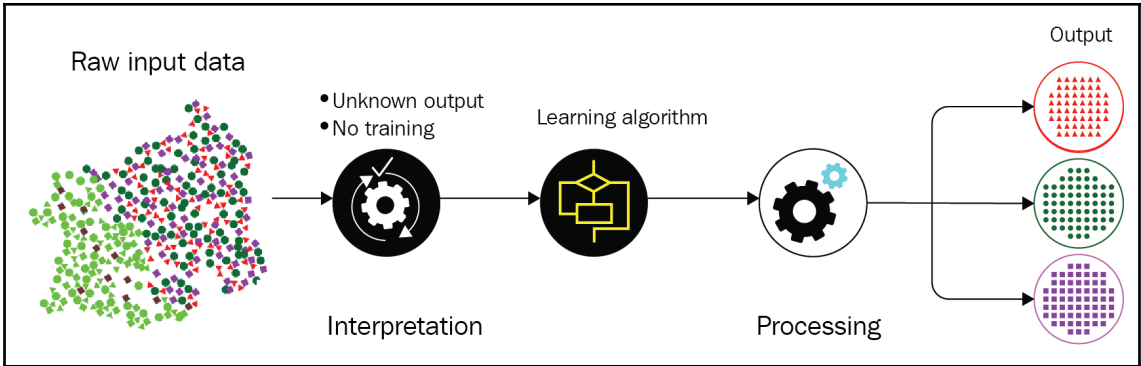
Volume	Velocity	Variety	Veracity	Variability	Value
<ul style="list-style-type: none"> How much data? Billion devices will generate data in ZetaBytes. 	<ul style="list-style-type: none"> How fast can I access? IoT data can be accessed in real time. 	<ul style="list-style-type: none"> What type of data? Structured & unstructured IoT data Heterogenous format of IoT data 	<ul style="list-style-type: none"> Is IoT data reliable? Most IoT data are. Crowdsensing data may not be. 	<ul style="list-style-type: none"> What are the rate of different IoT data flows? Flow rate depends on applications, time, and space. 	<ul style="list-style-type: none"> Usability and utility of data. Most IoT data tremendously useful.

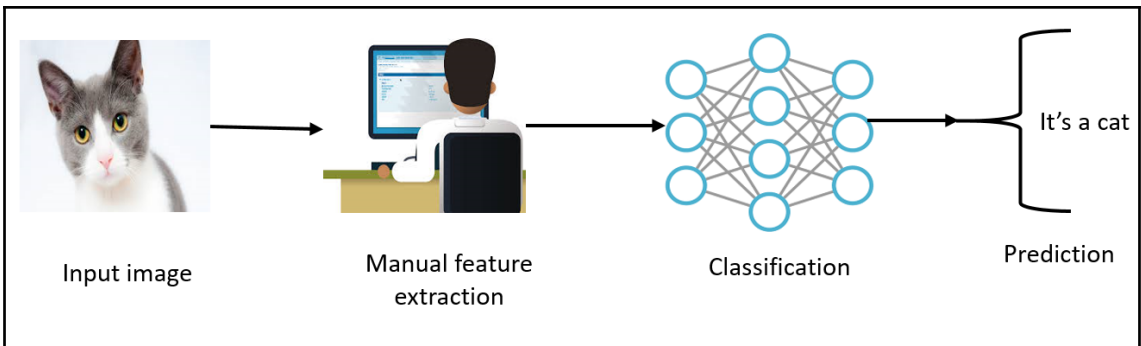
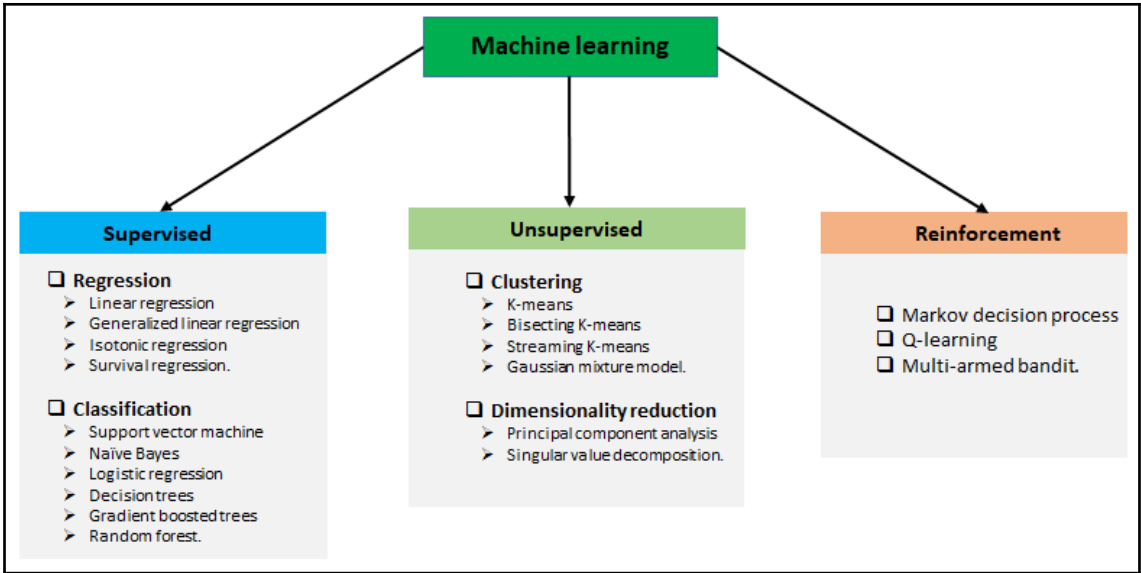


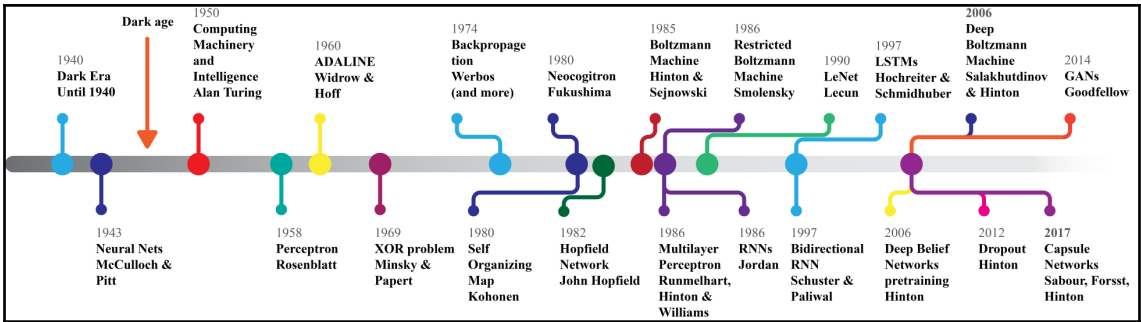
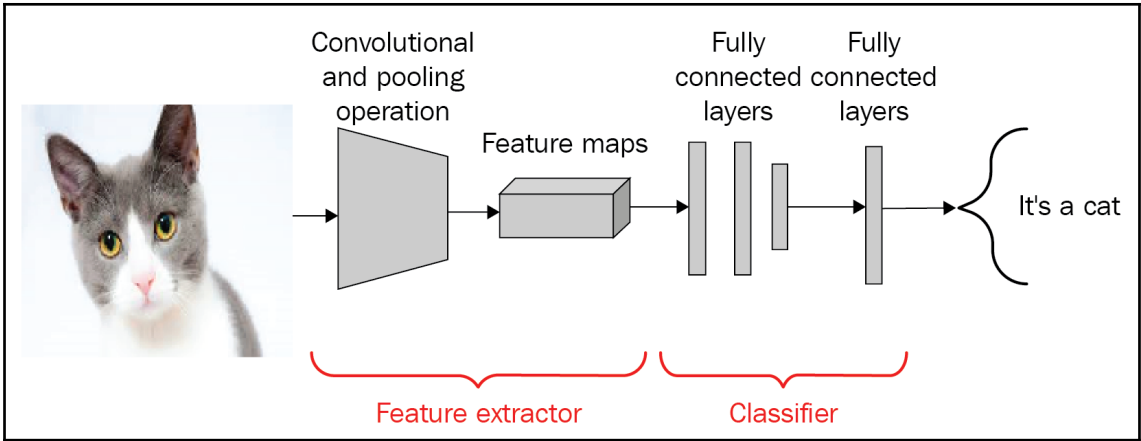


Chapter 2: Deep Learning Architectures for IoT



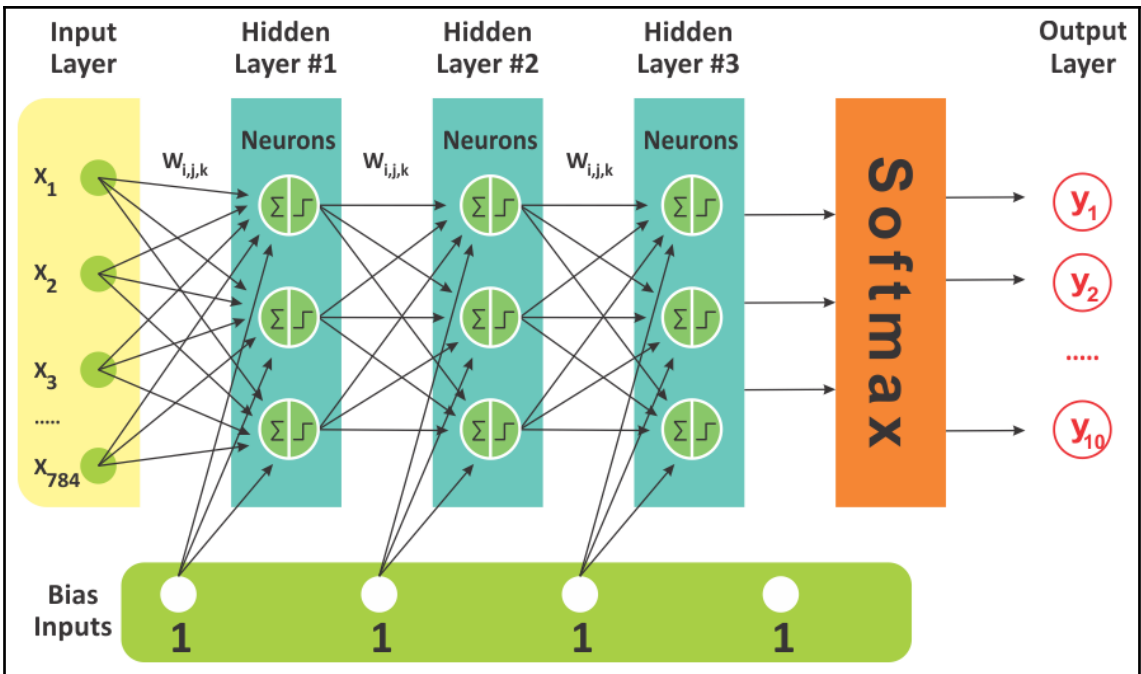
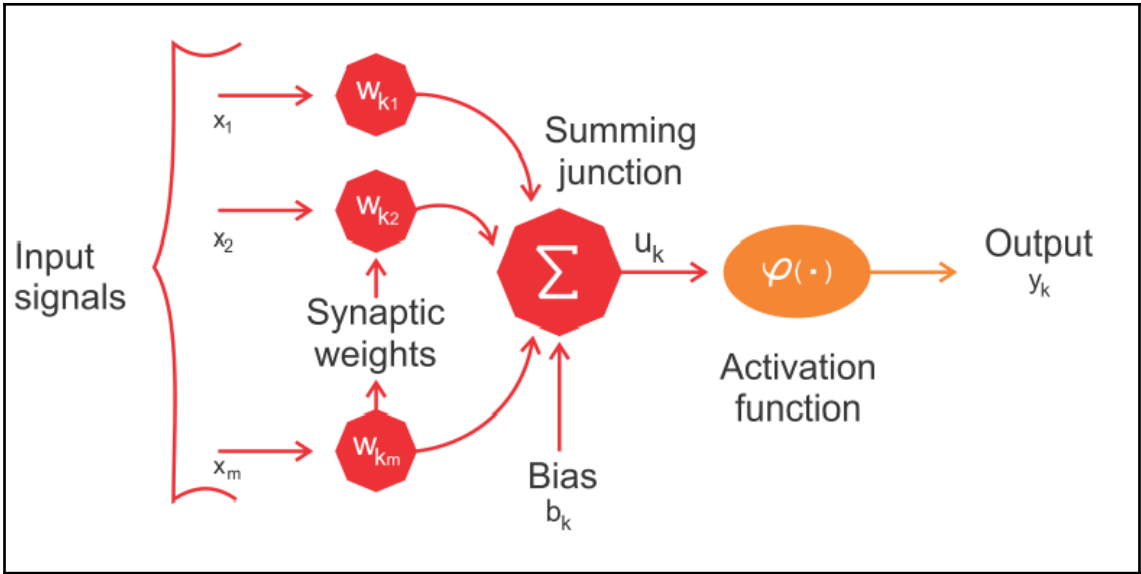






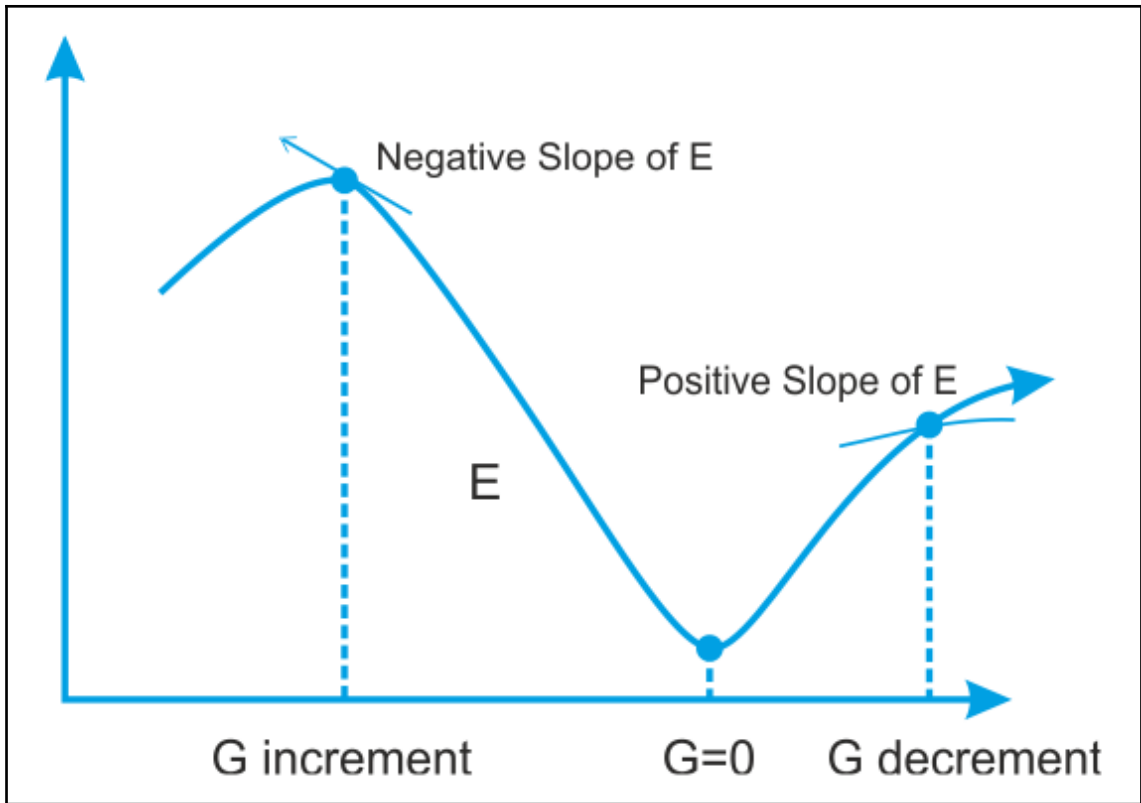
$$net_i = \sum_j W_{ij} X_j \dots \dots \dots (a)$$

$$net_i = \sum_j W_{ij} X_j + b_j \dots \dots \dots (b)$$

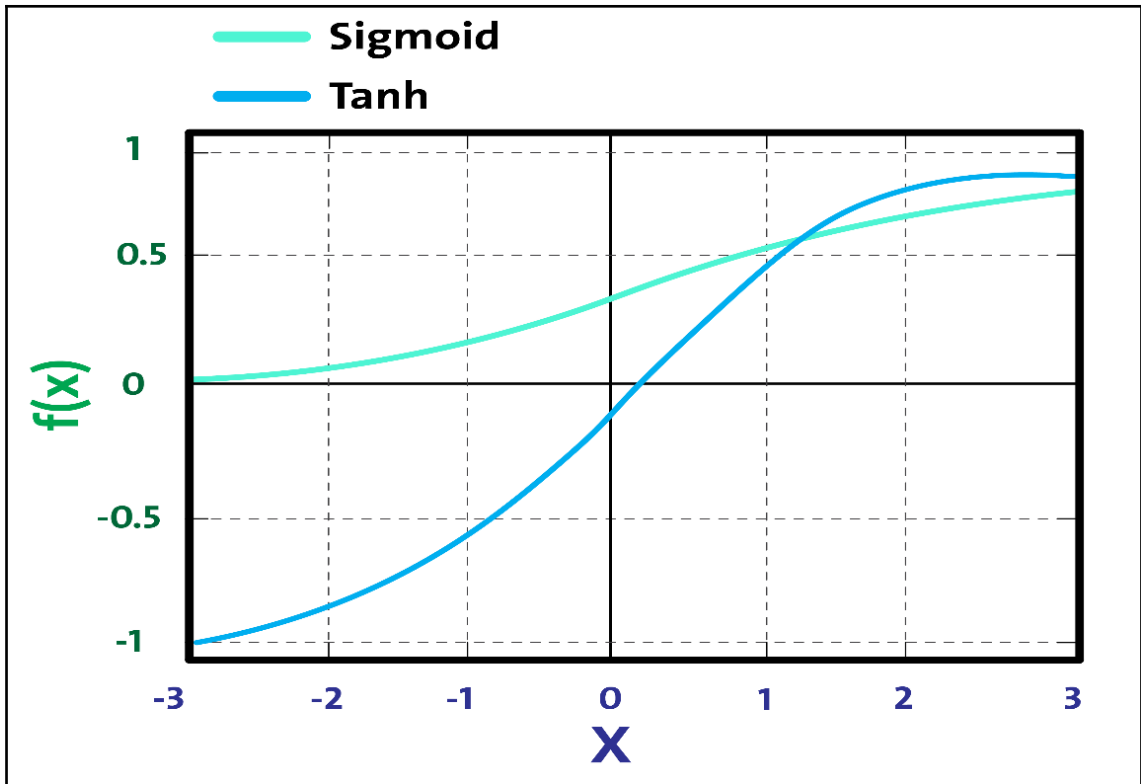


$$MSE = \frac{1}{n} \sum_{i=1}^n \left(Y_i - \hat{Y}_i \right)^2$$

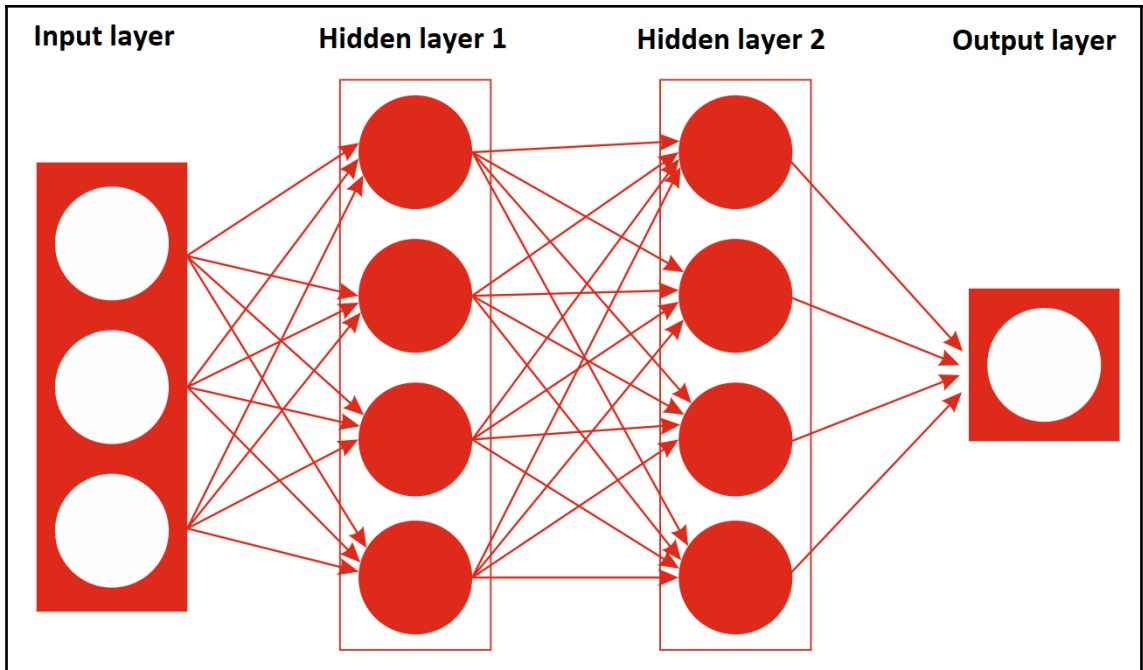
\hat{Y}

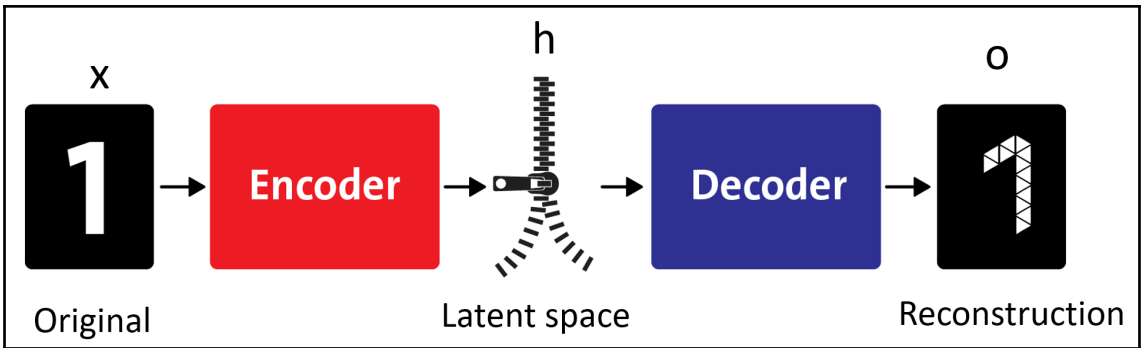
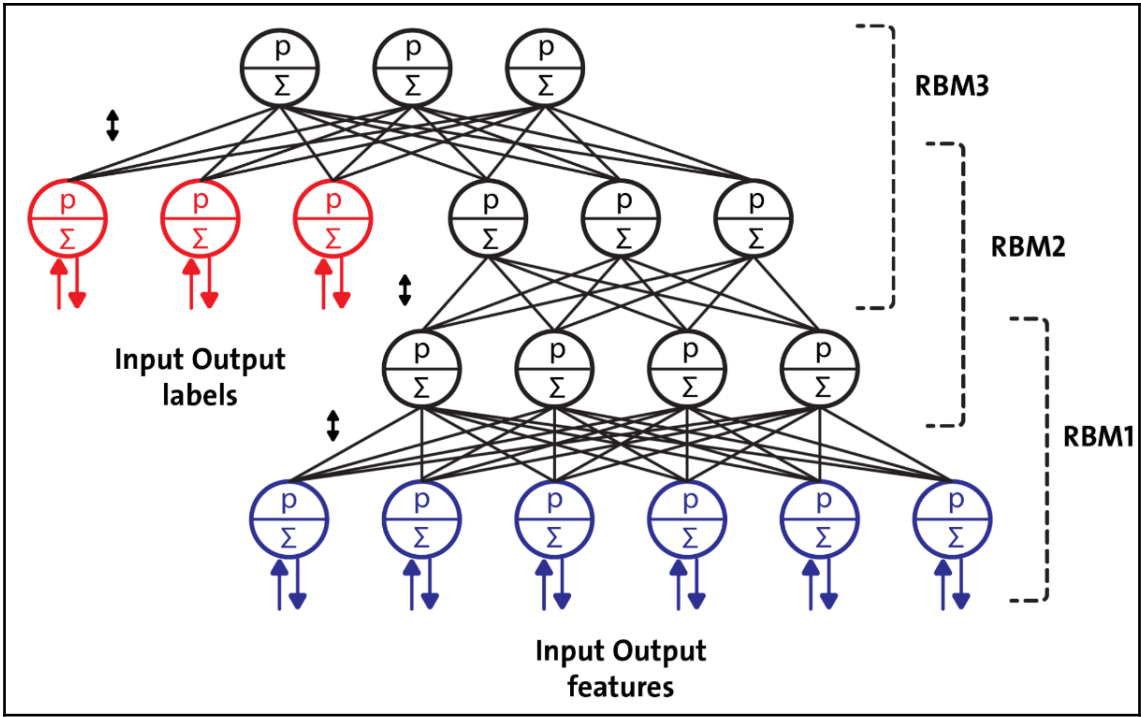


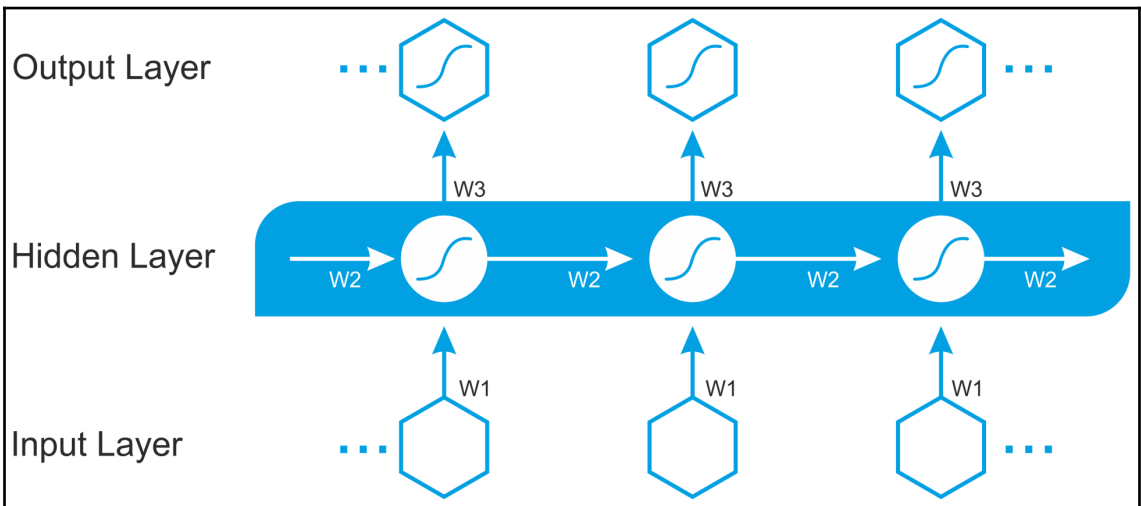
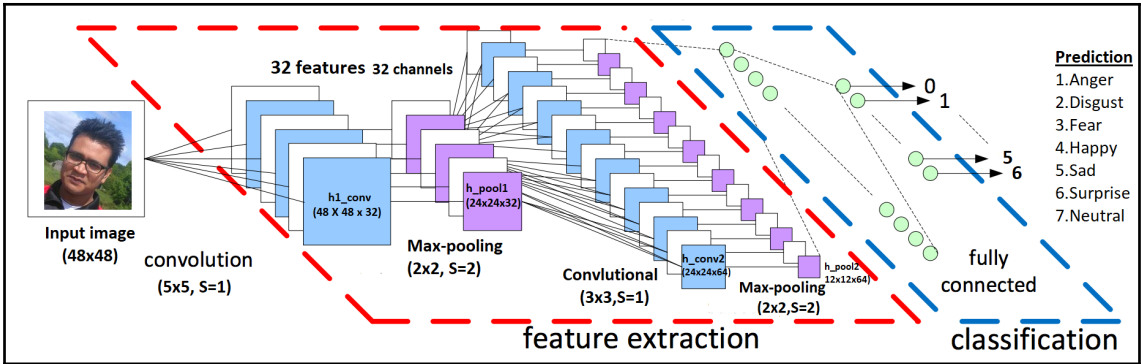
$$Out_i = \frac{1}{(1 + e^{-x})}$$

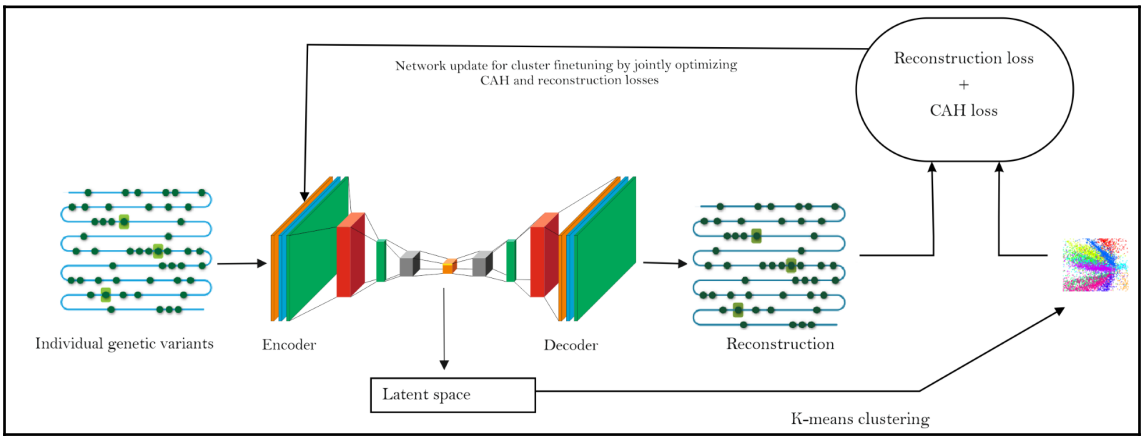
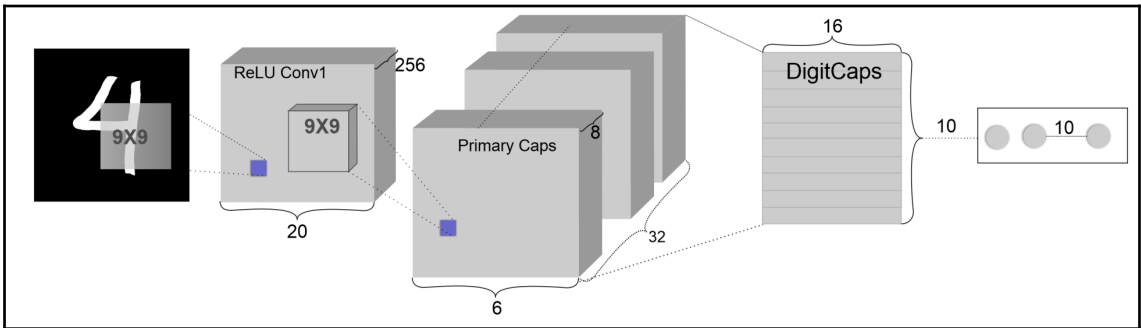
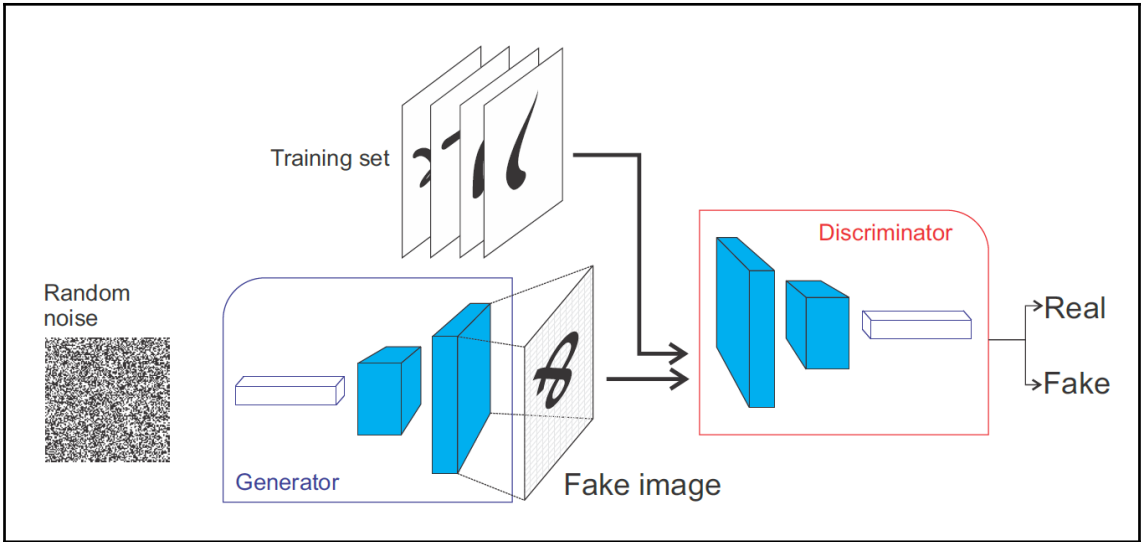


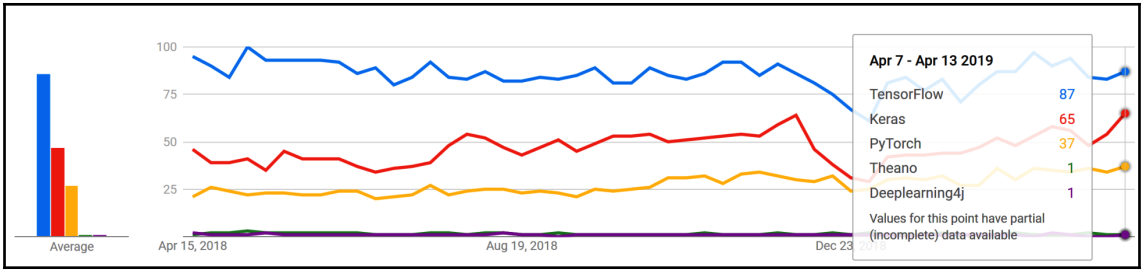
$$\tanh(x) = 2\sigma(2x) - 1$$



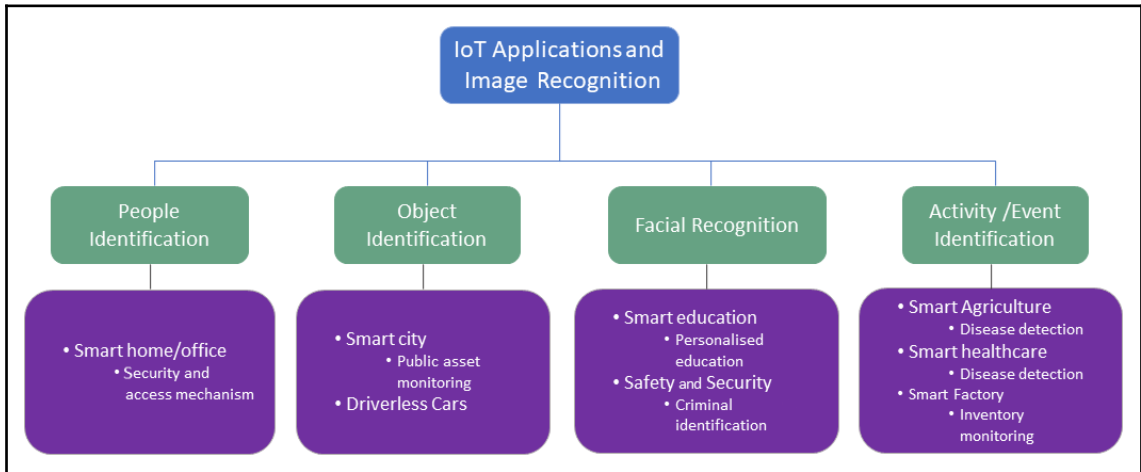


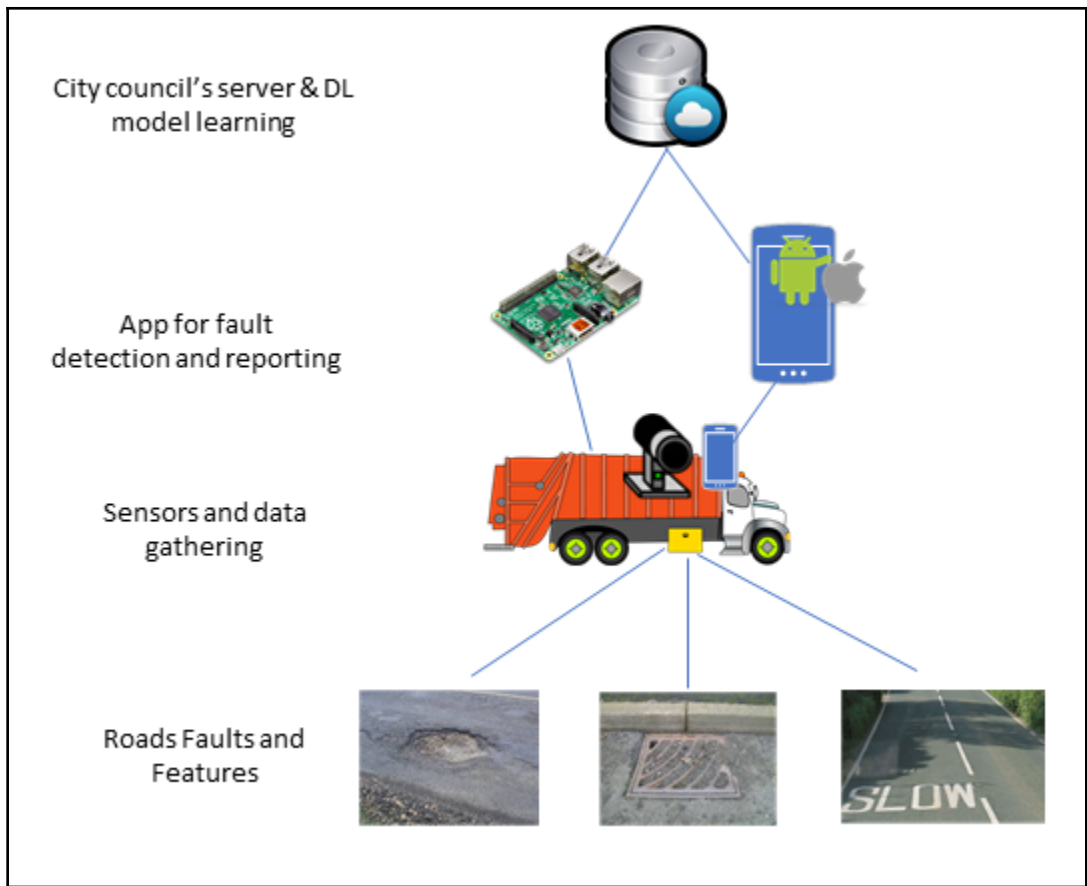


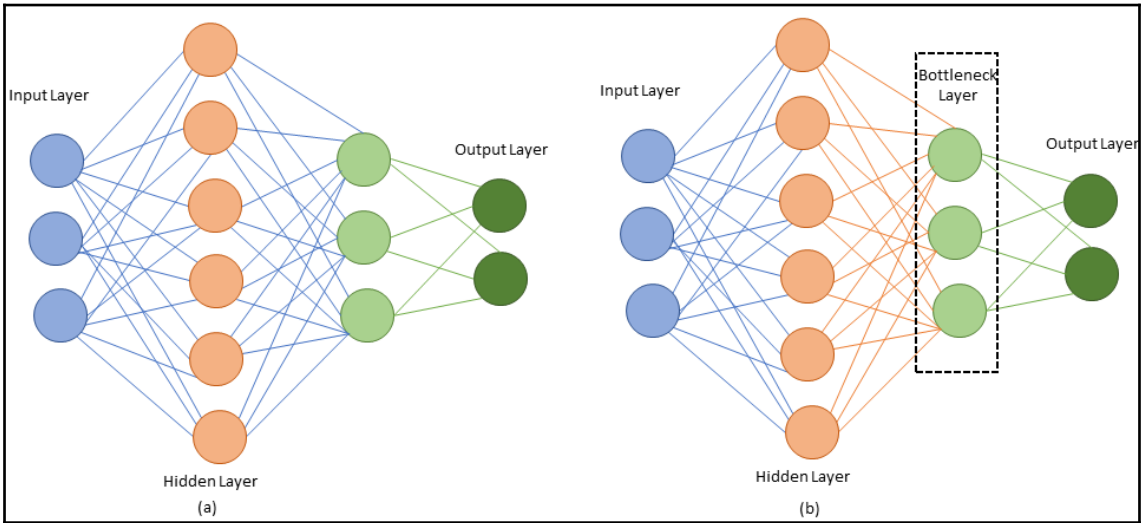
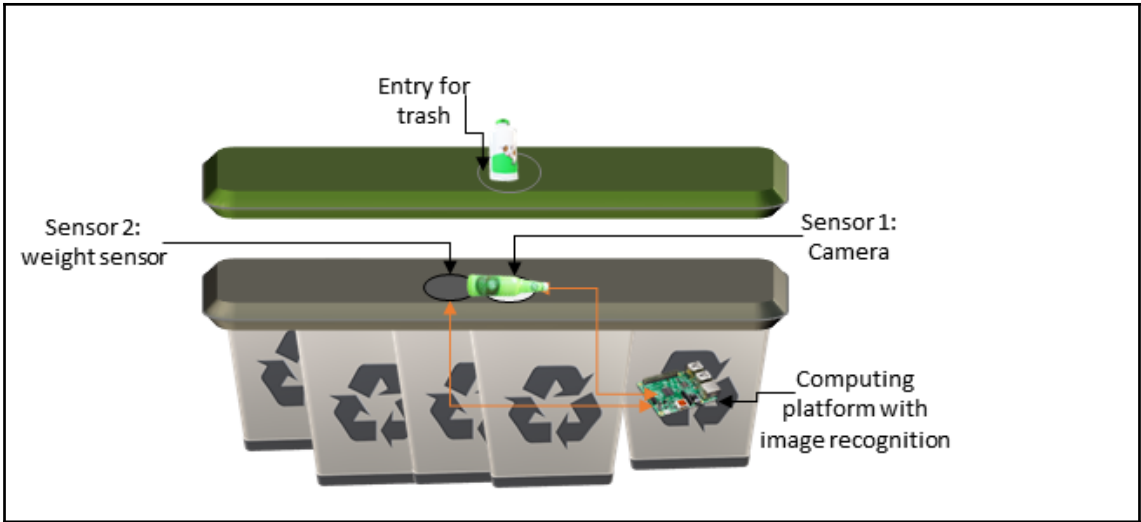


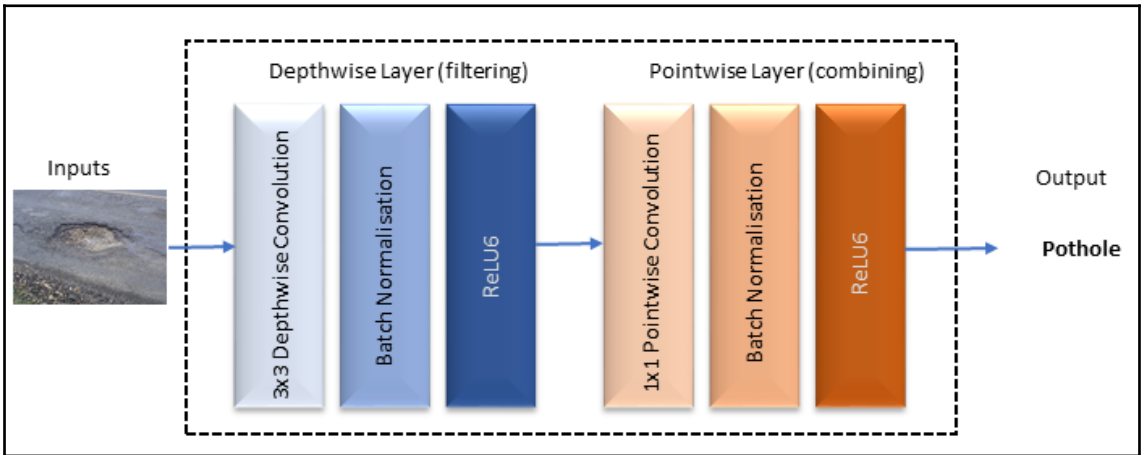
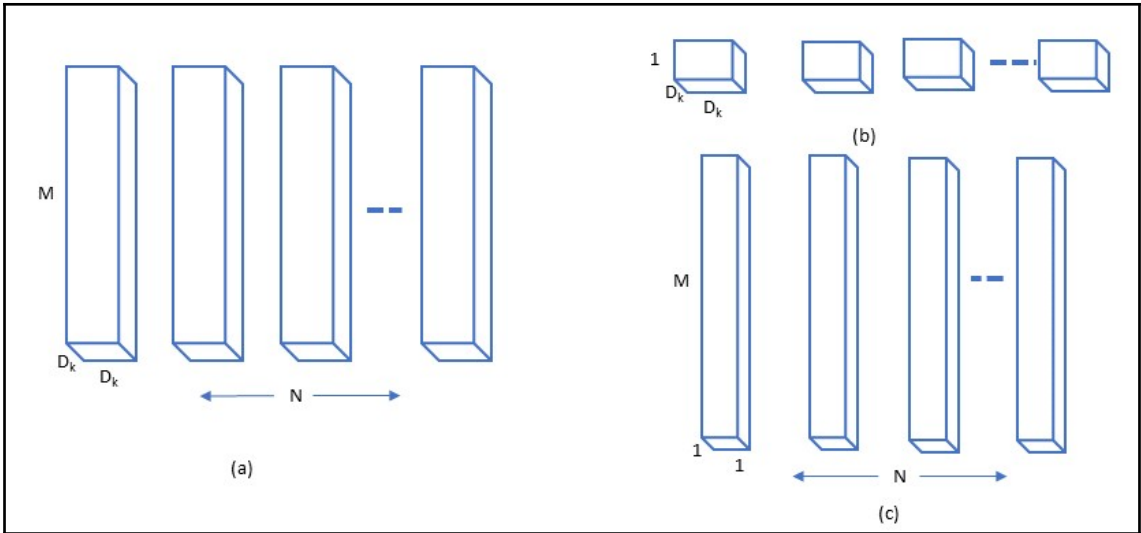


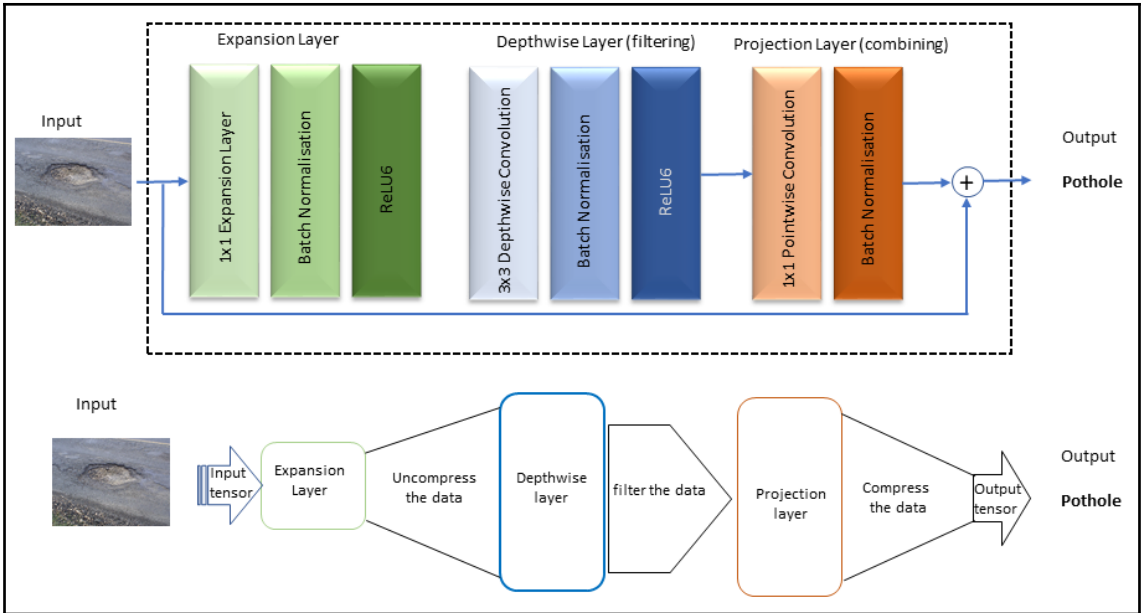
Chapter 3: Image Recognition in IoT



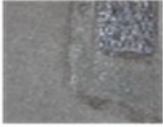




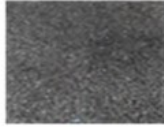
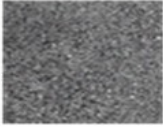




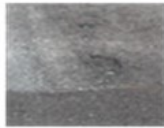
Class: manhole



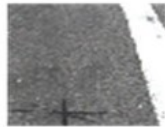
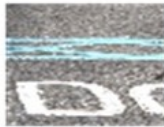
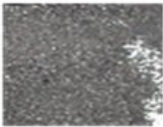
Class: pavement



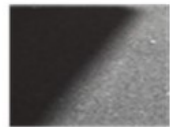
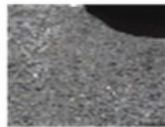
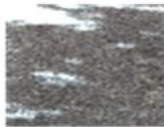
Class: pothole



Class: roadmarking



Class: shadow





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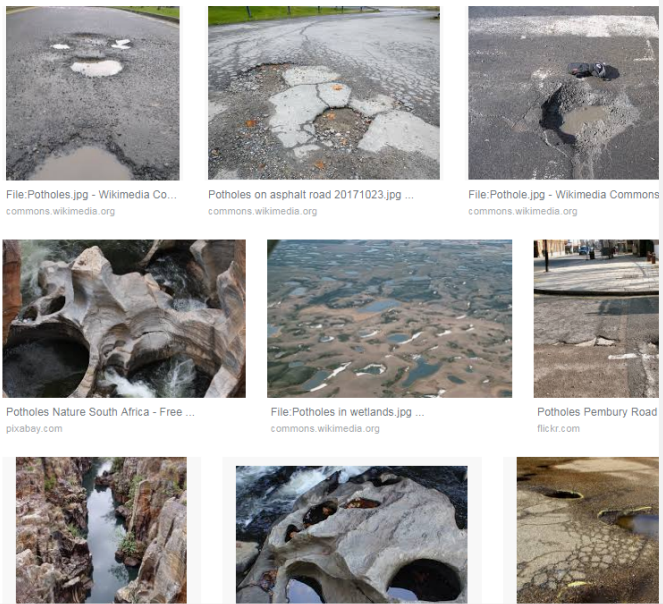
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pixabay.com

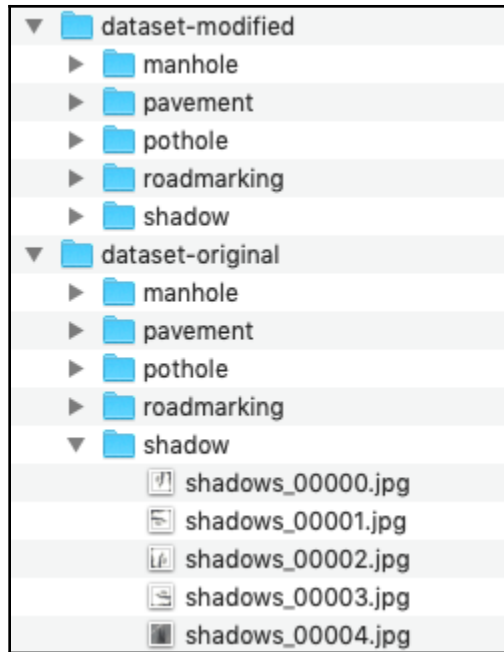
File:Potholes in wetlands.jpg ...
commons.wikimedia.org


Potholes Pembury Road
flickr.com

Elements Console Sources Network

top Filter Default levels

- No messages
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- No errors
- No warnings
- No info
- No verbose



▶  cardboard

▶  glass

▶  metal

▶  paper


▶  plastic


▼  trash

 trash1.jpg

 trash2.jpg

 trash3.jpg

 trash4.jpg

 trash5.jpg

 trash6.jpg

 trash7.jpg

 trash8.jpg

 trash9.jpg

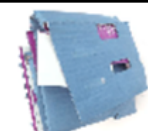
 trash10.jpg

 trash11.jpg

 trash12.jpg

 trash13.jpg

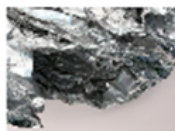
Class: cardboard



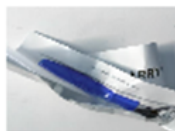
Class: glass



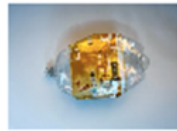
Class: metal



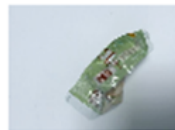
Class: paper





Class: plastic



Class: trash



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```

INFO:tensorflow:2019-01-27 18:48:59.149569: Step 3990: Train accuracy = 95.0%
INFO:tensorflow:2019-01-27 18:48:59.149738: Step 3990: Cross entropy = 0.139672
INFO:tensorflow:2019-01-27 18:48:59.284896: Step 3990: Validation accuracy = 93.0% (N=100)
INFO:tensorflow:2019-01-27 18:49:00.564238: Step 3999: Train accuracy = 95.0%
INFO:tensorflow:2019-01-27 18:49:00.564402: Step 3999: Cross entropy = 0.131412
INFO:tensorflow:2019-01-27 18:49:00.698488: Step 3999: Validation accuracy = 97.0% (N=100)
INFO:tensorflow:Final test accuracy = 94.5% (N=1035)
INFO:tensorflow:Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.

```

```

INFO:tensorflow:2019-01-27 21:49:07.512191: Step 3990: Train accuracy = 97.0%
INFO:tensorflow:2019-01-27 21:49:07.512365: Step 3990: Cross entropy = 0.122777
INFO:tensorflow:2019-01-27 21:49:07.729347: Step 3990: Validation accuracy = 96.0% (N=100)
INFO:tensorflow:2019-01-27 21:49:09.603333: Step 3999: Train accuracy = 98.0%
INFO:tensorflow:2019-01-27 21:49:09.603515: Step 3999: Cross entropy = 0.122347
INFO:tensorflow:2019-01-27 21:49:09.814565: Step 3999: Validation accuracy = 94.0% (N=100)
INFO:tensorflow:Final test accuracy = 94.0% (N=1073)
INFO:tensorflow:Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.

```

```

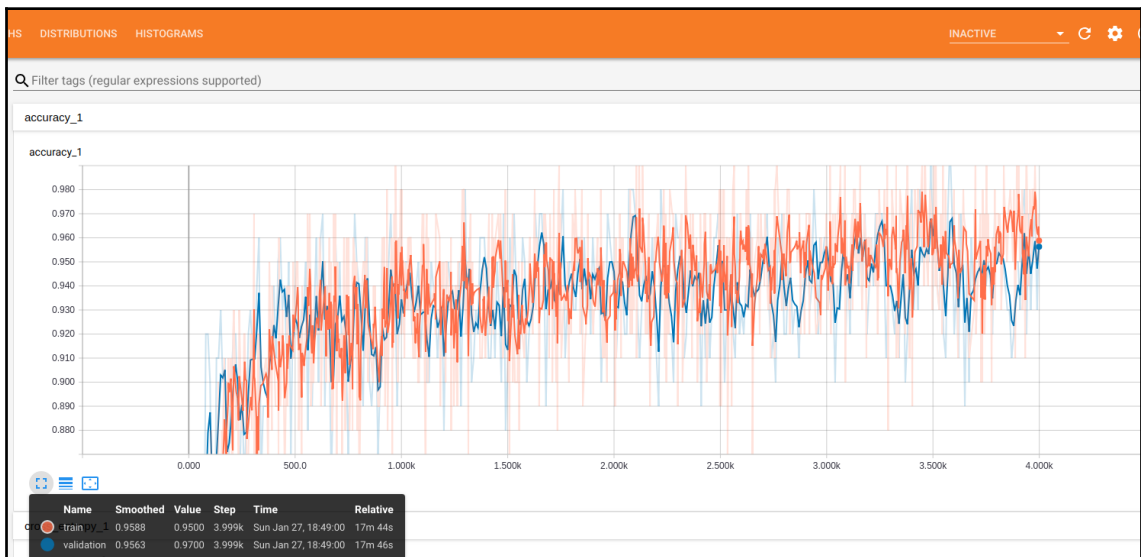
INFO:tensorflow:2019-01-27 19:44:50.069255: Step 3990: Train accuracy = 99.0%
INFO:tensorflow:2019-01-27 19:44:50.069425: Step 3990: Cross entropy = 0.035808
INFO:tensorflow:2019-01-27 19:44:50.158899: Step 3990: Validation accuracy = 99.0% (N=1035)
INFO:tensorflow:2019-01-27 19:44:50.926383: Step 3999: Train accuracy = 99.0%
INFO:tensorflow:2019-01-27 19:44:50.926563: Step 3999: Cross entropy = 0.046513
INFO:tensorflow:2019-01-27 19:44:51.006902: Step 3999: Validation accuracy = 96.0% (N=1035)
INFO:tensorflow:Final test accuracy = 95.7% (N=1035)
INFO:tensorflow:Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.

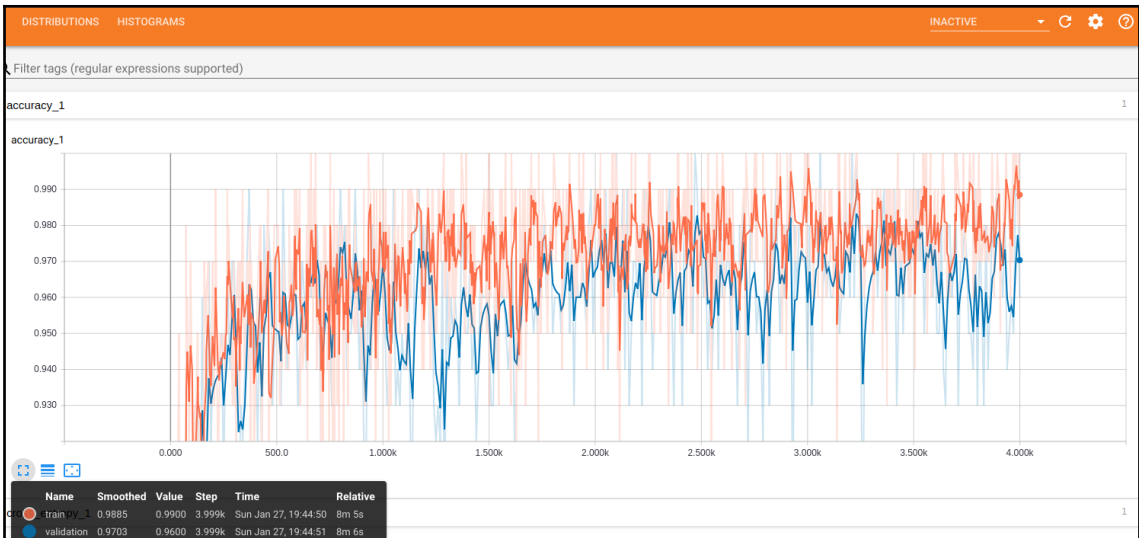
```

```

INFO:tensorflow:2019-01-27 20:28:24.273400: Step 3990: Train accuracy = 100.0%
INFO:tensorflow:2019-01-27 20:28:24.273570: Step 3990: Cross entropy = 0.063349
INFO:tensorflow:2019-01-27 20:28:24.383185: Step 3990: Validation accuracy = 95.0% (N=1035)
INFO:tensorflow:2019-01-27 20:28:25.607641: Step 3999: Train accuracy = 99.0%
INFO:tensorflow:2019-01-27 20:28:25.607888: Step 3999: Cross entropy = 0.028579
INFO:tensorflow:2019-01-27 20:28:25.759702: Step 3999: Validation accuracy = 92.0% (N=1035)
INFO:tensorflow:Final test accuracy = 96.0% (N=1073)
INFO:tensorflow:Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.

```





```

Mohammads-MacBook-Air:transformed-learning raz$ python label_image.py --graph=trained_model_mobilenetv1-modified-dataset/retrained_graph.pb --labels=trained_model_mobilenetv1-mod
labels.txt --input_layer=input --output_layer=final_result --input_height=224 --input_width=224 --image=test/pothole2.jpg
/Users/raz/anaconda3/lib/python3.6/site-packages/h5py/_init_.py:36: FutureWarning: Conversion of the second argument of issubdtype from 'float' to 'np.floating' is deprecated.
ted as 'np.float64 == np.dtype(float).type'.
    from ._conv import register_converters as _register_converters
2019-01-28 18:42:16.108124: I tensorflow/core/platform/cpu_feature_guard.cc:141] Your CPU supports instructions that this TensorFlow binary was not compiled to use: AVX2 FMA
pothole 0.99144566
shadow 0.006273513
roadmarking 0.0022471682
manhole 2.2895965e-05
pavement 1.0783568e-05
Mohammads-MacBook-Air:transformed-learning raz$ python label_image.py --graph=trained_model_mobilenetv1-original-dataset/retrained_graph.pb --labels=trained_model_mobilenetv1-orig
/Users/raz/anaconda3/lib/python3.6/site-packages/h5py/_init_.py:36: FutureWarning: Conversion of the second argument of issubdtype from 'float' to 'np.floating' is deprecated.
ted as 'np.float64 == np.dtype(float).type'.
    from ._conv import register_converters as _register_converters
2019-01-28 18:08:00.364422: I tensorflow/core/platform/cpu_feature_guard.cc:141] Your CPU supports instructions that this TensorFlow binary was not compiled to use: AVX2 FMA
pothole 0.9827071
shadow 0.014683991
roadmarking 0.0023621535
manhole 3.5012974e-05
pavement 1.1739314e-05
Mohammads-MacBook-Air:transformed-learning raz$

```

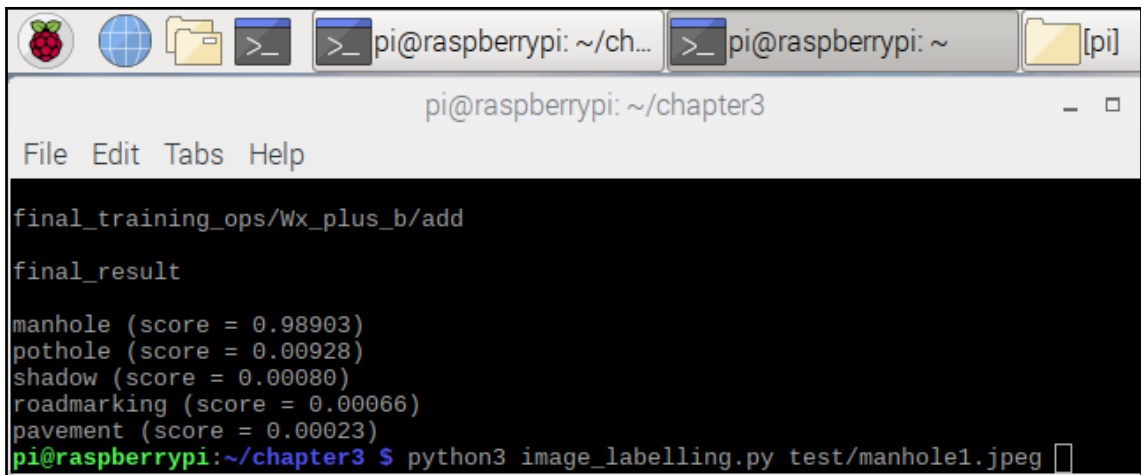
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pi@raspberrypi: ~/chapter3
File Edit Tabs Help

final_training_ops/Wx_plus_b/add
final_result

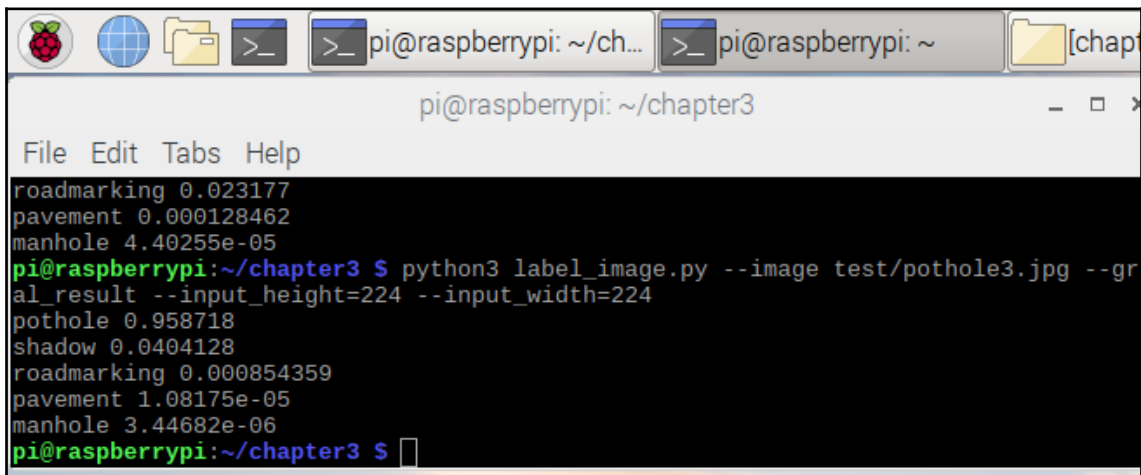
pothole (score = 0.99289)
manhole (score = 0.00507)
roadmarking (score = 0.00119)
shadow (score = 0.00084)
pavement (score = 0.00001)
pi@raspberrypi:~/chapter3 $ python3 image_labelling.py test/pothole2.jpg

```



A terminal window on a Raspberry Pi. The title bar shows the location as `pi@raspberrypi: ~/chapter3`. The window contains the following text:

```
File Edit Tabs Help
final_training_ops/Wx_plus_b/add
final_result
manhole (score = 0.98903)
pothole (score = 0.00928)
shadow (score = 0.00080)
roadmarking (score = 0.00066)
pavement (score = 0.00023)
pi@raspberrypi:~/chapter3 $ python3 image_labelling.py test/manhole1.jpeg
```



A terminal window on a Raspberry Pi. The title bar shows the location as `pi@raspberrypi: ~/chapter3`. The window contains the following text:

```
File Edit Tabs Help
roadmarking 0.023177
pavement 0.000128462
manhole 4.40255e-05
pi@raspberrypi:~/chapter3 $ python3 label_image.py --image test/pothole3.jpg --gr
al_result --input_height=224 --input_width=224
pothole 0.958718
shadow 0.0404128
roadmarking 0.000854359
pavement 1.08175e-05
manhole 3.44682e-06
pi@raspberrypi:~/chapter3 $
```

```

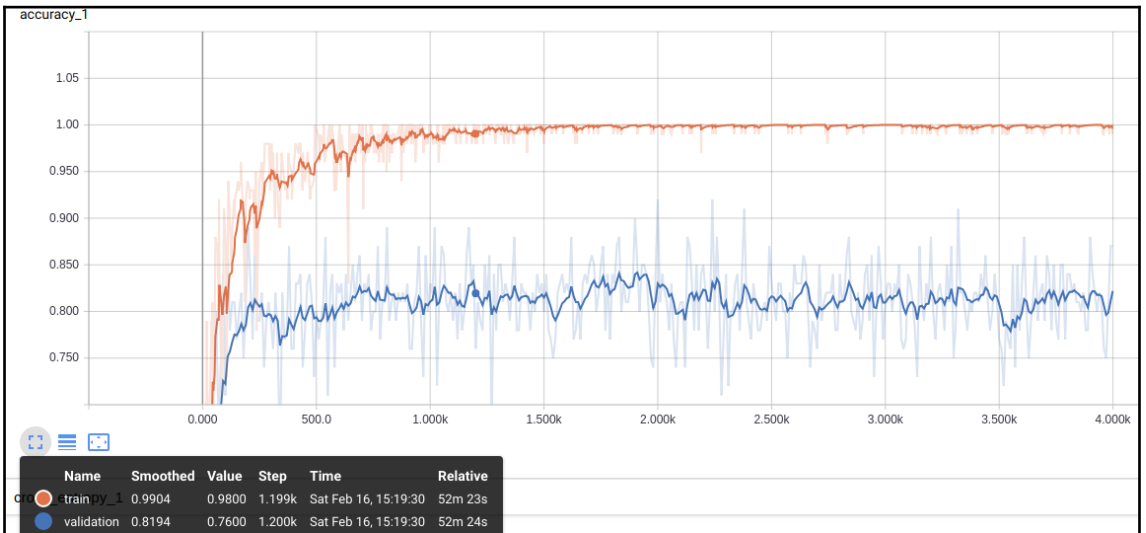
pi@raspberrypi: ~/chapter3
File Edit Tabs Help
etsv1/retrained_labels.txt --input_layer input --output_layer final_result --input_height=224 --input_width=224
manhole 0.999331
shadow 0.00059349
roadmarking 7.50034e-05
pavement 1.36896e-08
pothole 8.11927e-09
pi@raspberrypi:~/chapter3 $ python3 label_image.py --image test/manhole1.jpeg --graph trained_model_mobilenetsv1/retrained_graph.pb --labels trained_model_mobilenetsv1/retrained_labels.txt --input_layer input --output_layer final_result --input_height=224 --input_width=224

```

```

INFO:tensorflow:2019-02-16 15:22:41.199519: Step 3980: Train accuracy = 100.0%
INFO:tensorflow:2019-02-16 15:22:41.199691: Step 3980: Cross entropy = 0.014032
INFO:tensorflow:2019-02-16 15:22:41.252618: Step 3980: Validation accuracy = 81.0% (N=100)
INFO:tensorflow:2019-02-16 15:22:41.787808: Step 3990: Train accuracy = 100.0%
INFO:tensorflow:2019-02-16 15:22:41.787986: Step 3990: Cross entropy = 0.016459
INFO:tensorflow:2019-02-16 15:22:41.846011: Step 3990: Validation accuracy = 87.0% (N=100)
INFO:tensorflow:2019-02-16 15:22:42.326762: Step 3999: Train accuracy = 100.0%
INFO:tensorflow:2019-02-16 15:22:42.326932: Step 3999: Cross entropy = 0.015315
INFO:tensorflow:2019-02-16 15:22:42.392484: Step 3999: Validation accuracy = 87.0% (N=100)
INFO:tensorflow:Final test accuracy = 77.5% (N=271)

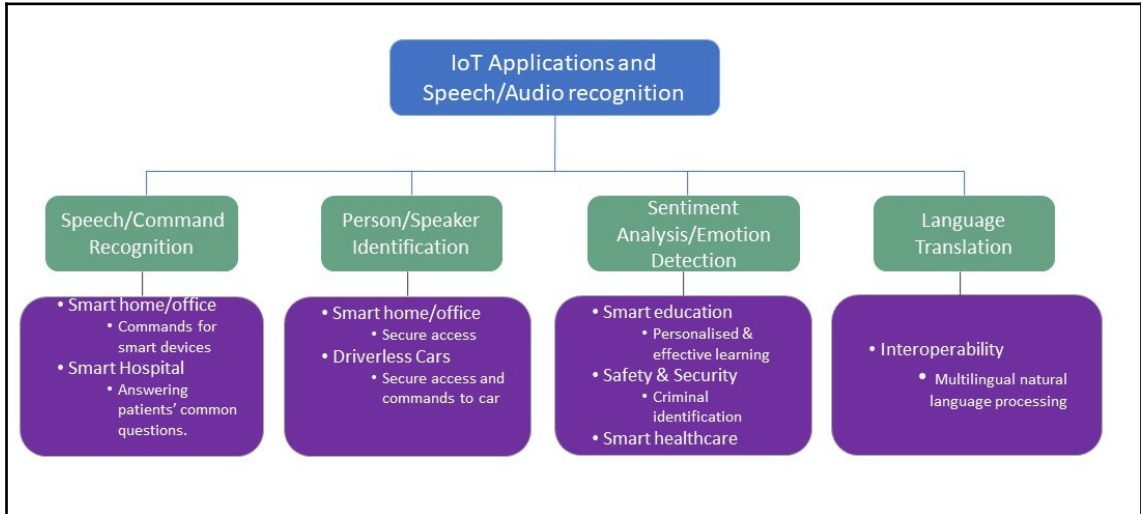
```

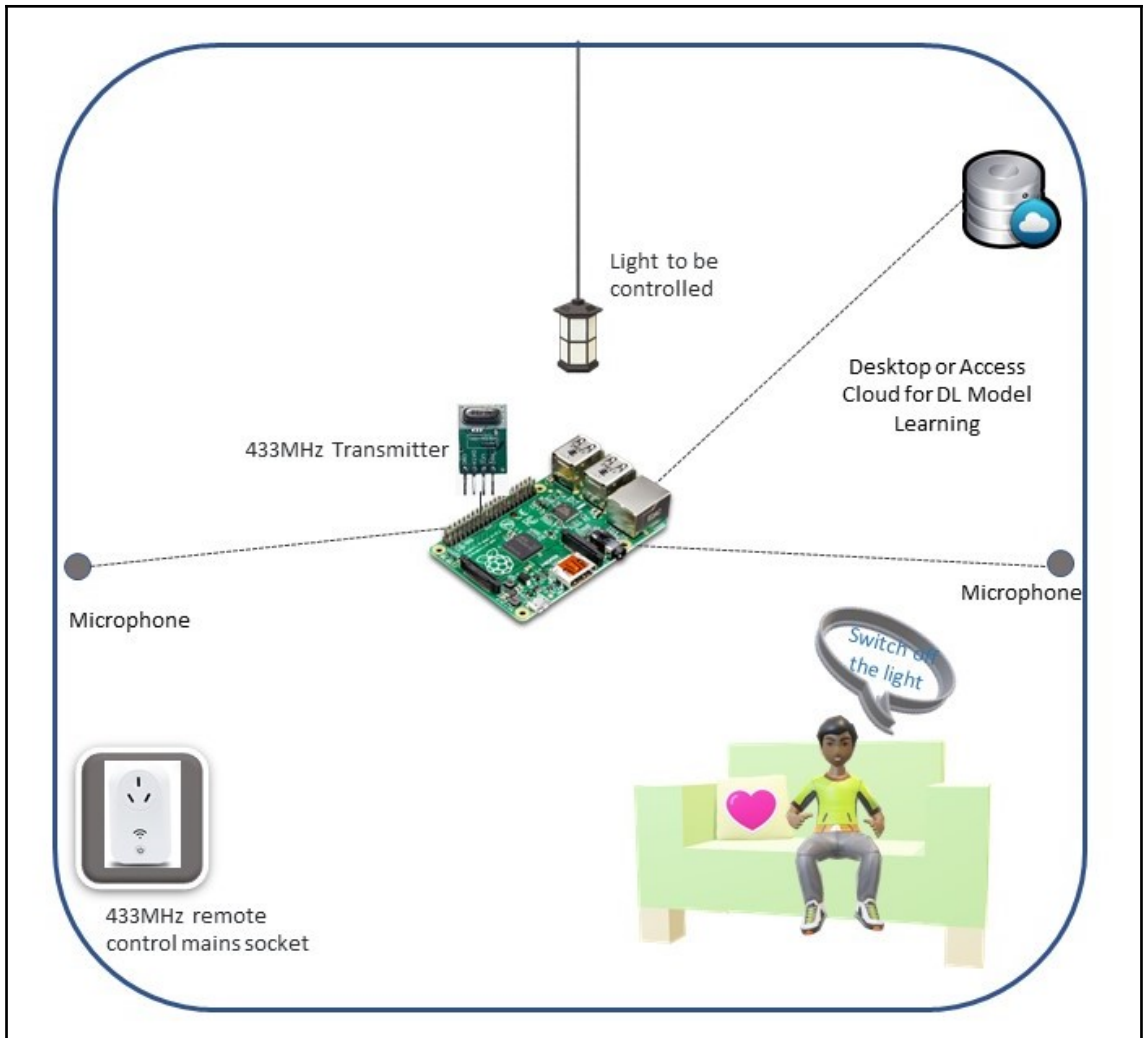


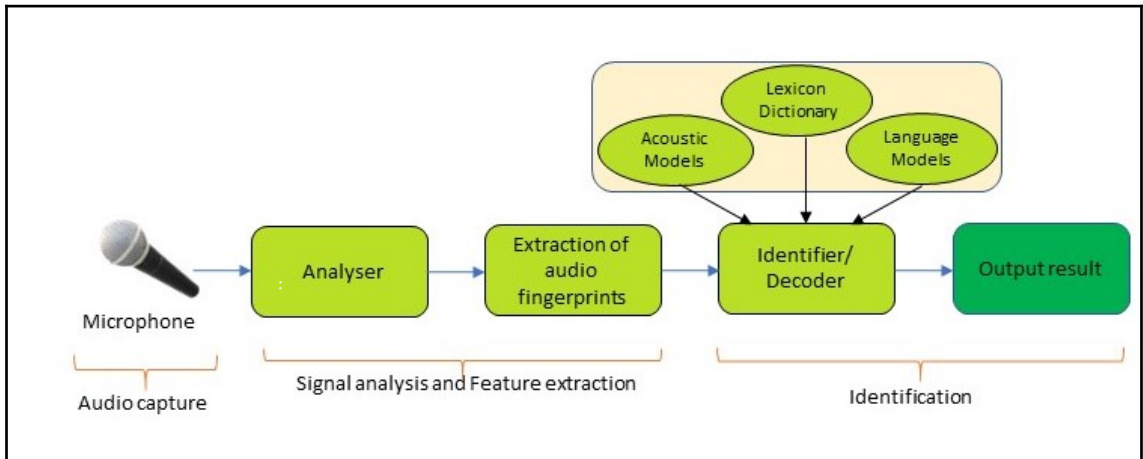
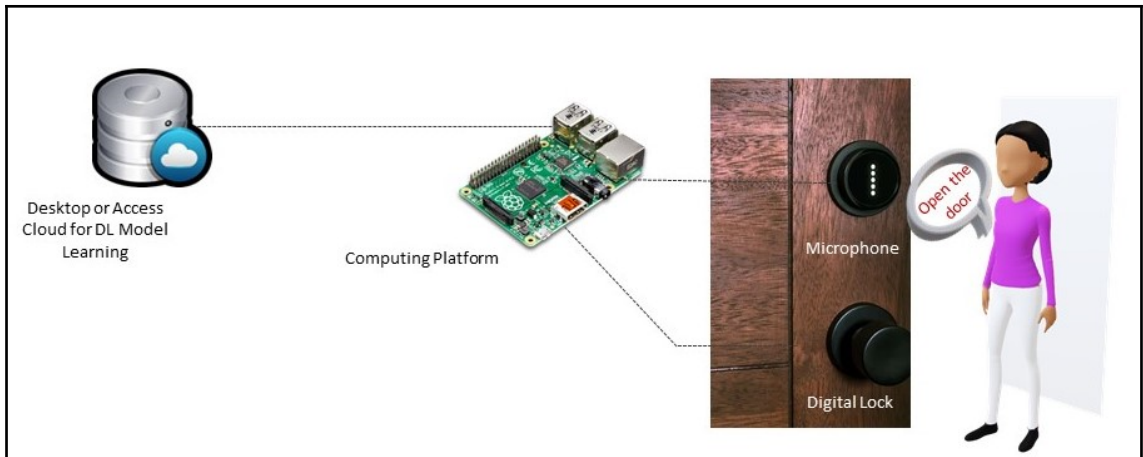
```
Mohammads-MacBook-Air:transformed-learning raz$ python label_image.py --graph=trained_model_mobilenetv1-garbage-dataset/retr
ls.txt --input_layer=input --output_layer=final_result --input_height=224 --input_width=224 --image=test-garbage/glass3.jpeg
/Users/raz/anaconda3/lib/python3.6/site-packages/h5py/__init__.py:36: FutureWarning: Conversion of the second argument of is
ted as `np.float64 == np.dtype(float).type`.
  from ._conv import register_converters as _register_converters
2019-02-16 16:05:37.535686: I tensorflow/core/platform/cpu_feature_guard.cc:141] Your CPU supports instructions that this Te
glass 0.9997981
plastic 0.0001634804
trash 1.3350626e-05
paper 8.399338e-06
cardboard 8.345092e-06
Mohammads-MacBook-Air:transformed-learning raz$ python label_image.py --graph=trained_model_mobilenetv1-garbage-dataset/retr
ls.txt --input_layer=input --output_layer=final_result --input_height=224 --input_width=224 --image=test-garbage/glass3.jpeg
```

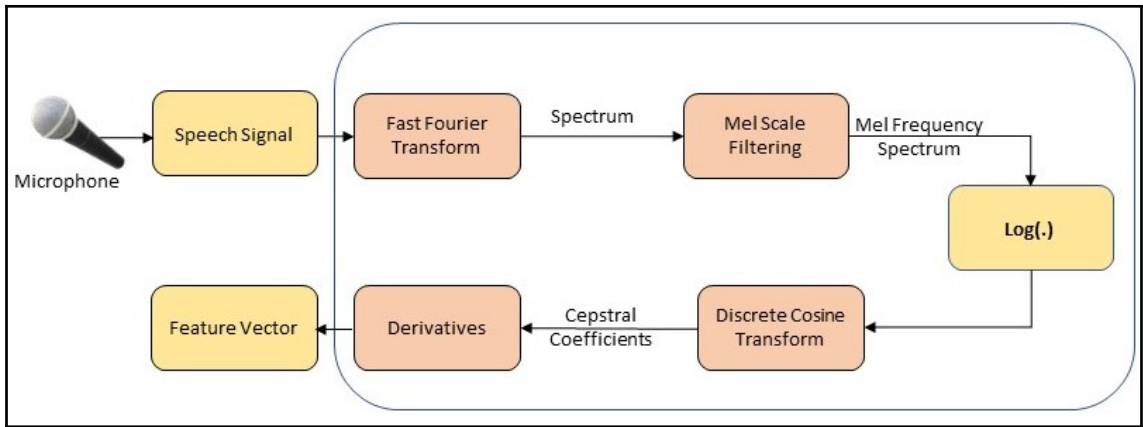
```
ls.txt --input_layer=input --output_layer=final_result --input_height=224 --input_width=224 --image=test-garbage/tin1.jpeg
/Users/raz/anaconda3/lib/python3.6/site-packages/h5py/__init__.py:36: FutureWarning: Conversion of the second argument of iss
ted as `np.float64 == np.dtype(float).type`.
  from ._conv import register_converters as _register_converters
2019-02-16 15:59:01.822456: I tensorflow/core/platform/cpu_feature_guard.cc:141] Your CPU supports instructions that this Ten
metal 0.9152763
paper 0.07105696
cardboard 0.013308621
plastic 0.00035772196
glass 2.888089e-07
```

Chapter 4: Audio/Speech/Voice Recognition in IoT



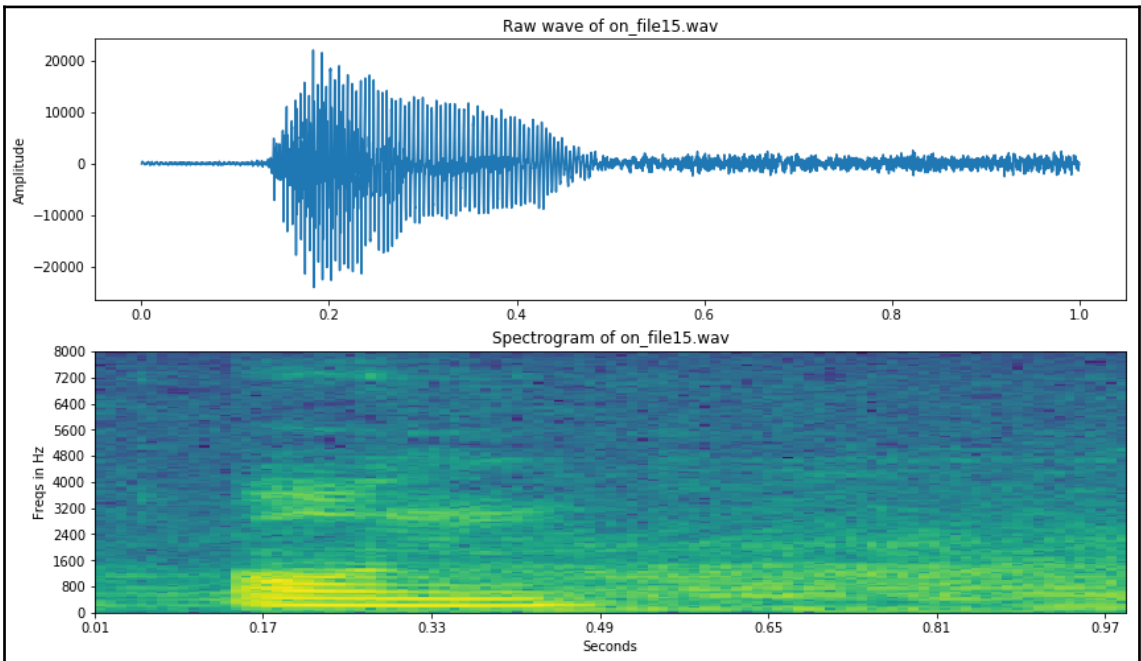


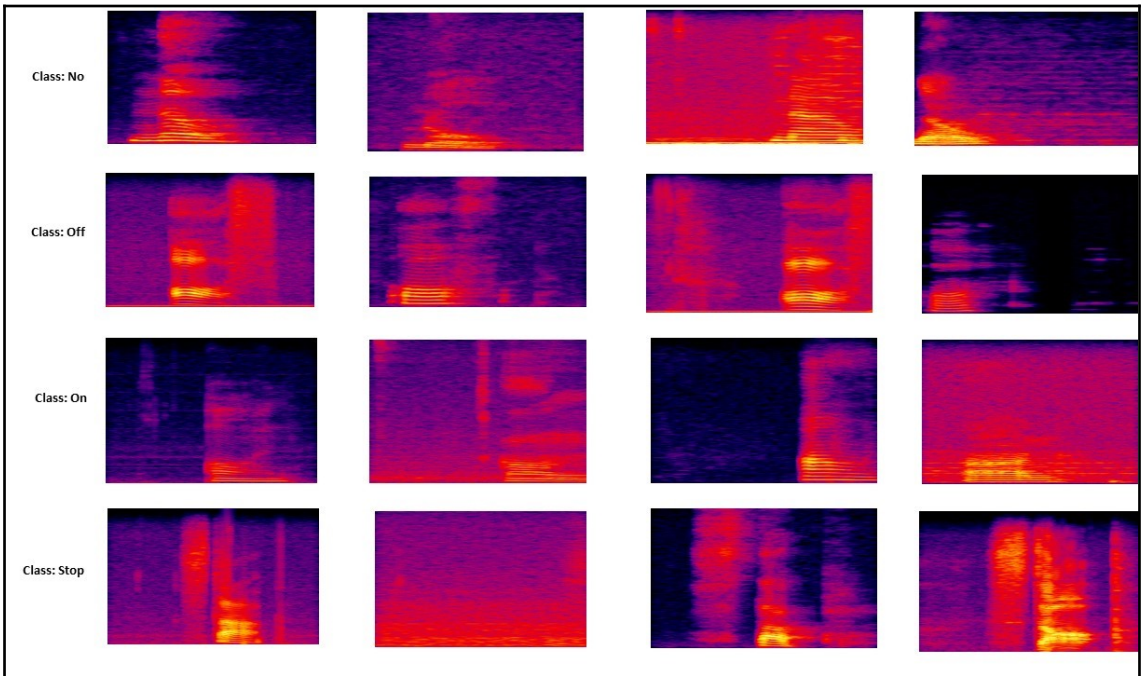
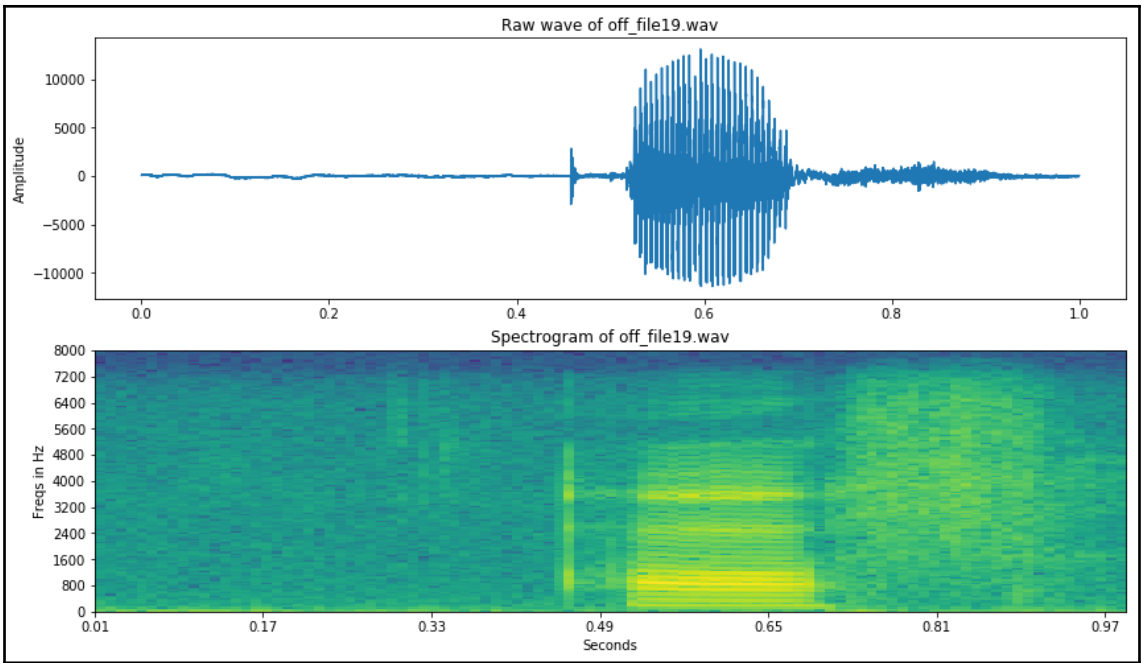


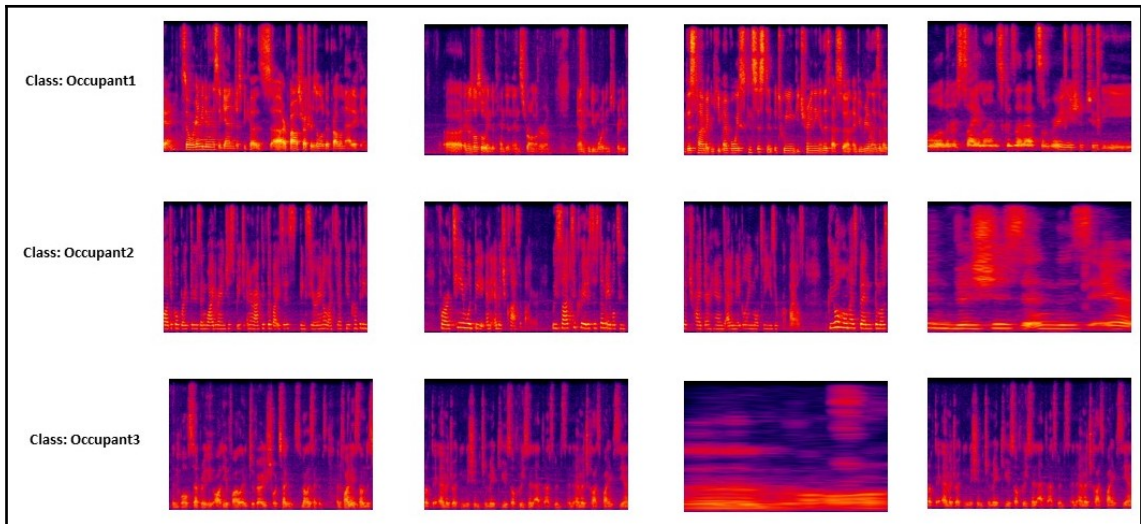


- ▼ test
 - ▶ no
 - ▶ off
 - ▶ on
 - ▶ stop
 - ▶ yes
 - ▼ train
 - ▶ cnn_cifar_data
 - ▼ train_mblnet
 - ▶ no
 - ▶ off
 - ▶ on
 - ▶ stop
 - ▶ yes
 - ▶ train_oneshot
 - ▶ yes-cifarnet

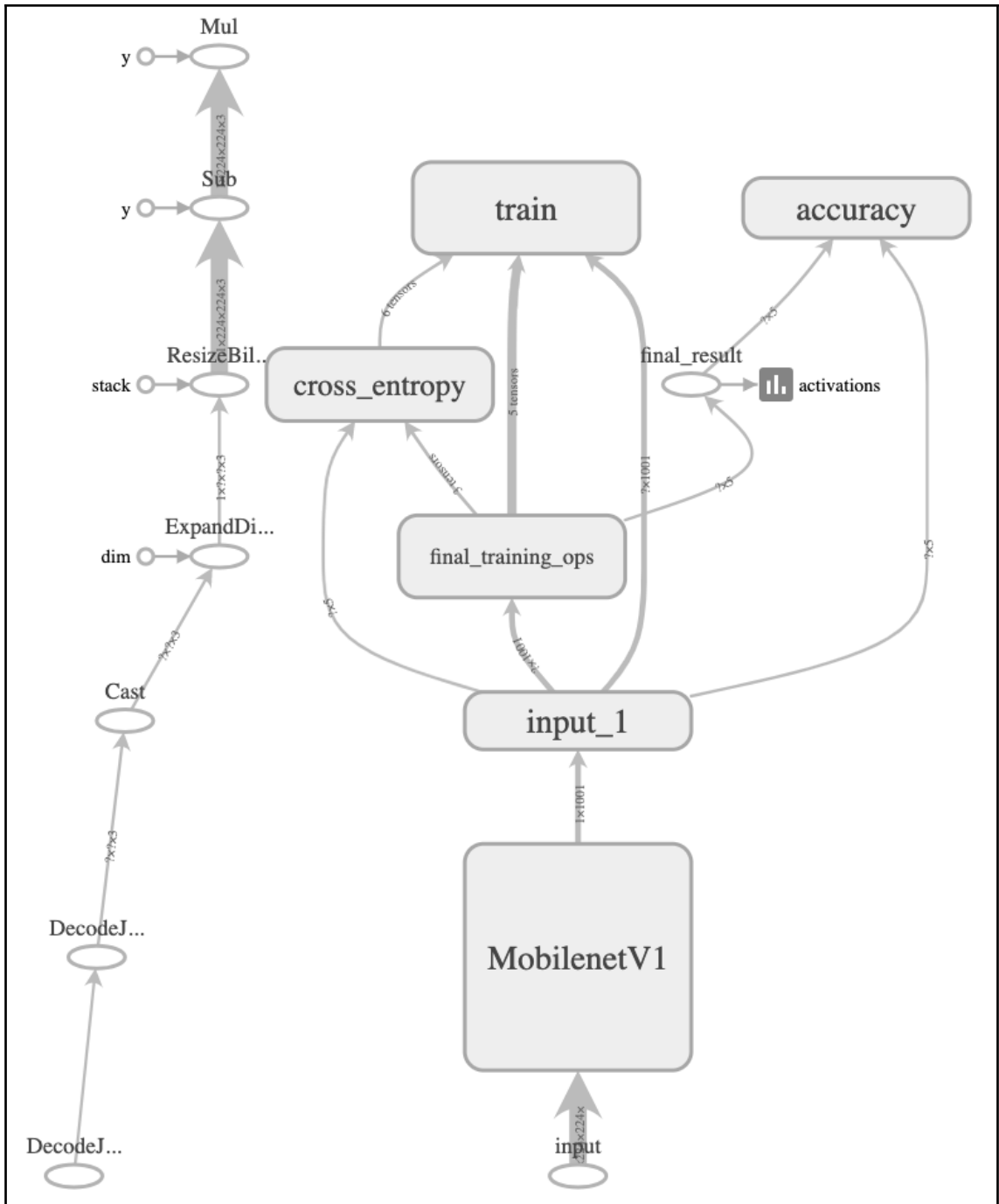
- ▼ test_3occupants
 - ▶ occupant1
 - ▶ occupant2
 - ▶ occupant3
- ▼ test_5occupants
 - ▶ occupant1
 - ▶ occupant4
- ▼ **train_3occupants**
- ▶ occupant1
- ▶ occupant2
- ▶ occupant3
- ▼ train_5occupants
 - ▶ occupant1
 - ▶ occupant2
 - ▶ occupant3
 - ▶ occupant4
 - ▶ occupant5







```
usage: retrain.py [-h] [--image_dir IMAGE_DIR] [--output_graph OUTPUT_GRAPH]
                 [--intermediate_output_graphs_dir INTERMEDIATE_OUTPUT_GRAPHS_DIR]
                 [--intermediate_store_frequency INTERMEDIATE_STORE_FREQUENCY]
                 [--output_labels OUTPUT_LABELS]
                 [--summaries_dir SUMMARIES_DIR]
                 [--how_many_training_steps HOW_MANY_TRAINING_STEPS]
                 [--learning_rate LEARNING_RATE]
                 [--testing_percentage TESTING_PERCENTAGE]
                 [--validation_percentage VALIDATION_PERCENTAGE]
                 [--eval_step_interval EVAL_STEP_INTERVAL]
                 [--train_batch_size TRAIN_BATCH_SIZE]
                 [--test_batch_size TEST_BATCH_SIZE]
                 [--validation_batch_size VALIDATION_BATCH_SIZE]
                 [--print_misclassified_test_images] [--model_dir MODEL_DIR]
                 [--bottleneck_dir BOTTLENECK_DIR]
                 [--final_tensor_name FINAL_TENSOR_NAME] [--flip_left_right]
                 [--random_crop RANDOM_CROP] [--random_scale RANDOM_SCALE]
                 [--random_brightness RANDOM_BRIGHTNESS]
                 [--architecture ARCHITECTURE]
```



retrained_graph.pb 17.1 MB
Modified: 27 January 2019 at 10:14 PM

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▼ General:

Kind: Document
Size: 17,136,207 bytes (17.1 MB on disk)
Where: Macintosh HD > Users > raz > anaconda3 > chapter3 > transformed-learning > trained_model_mobilenetv1-modified-dataset
Created: 27 January 2019 at 10:14 PM
Modified: 27 January 2019 at 10:14 PM

Stationery pad

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Where: Macintosh HD > Users > raz > anaconda3 > chapter3 > transformed-learning > trained_model_inceptionv1original-dataset
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Modified: 5 January 2019 at 9:36 PM

cnn_speaker_model_weights.h5 91.1 MB
Modified: Tuesday, 10 April 2018 at 8:55 AM

Add Tags...

▼ General:

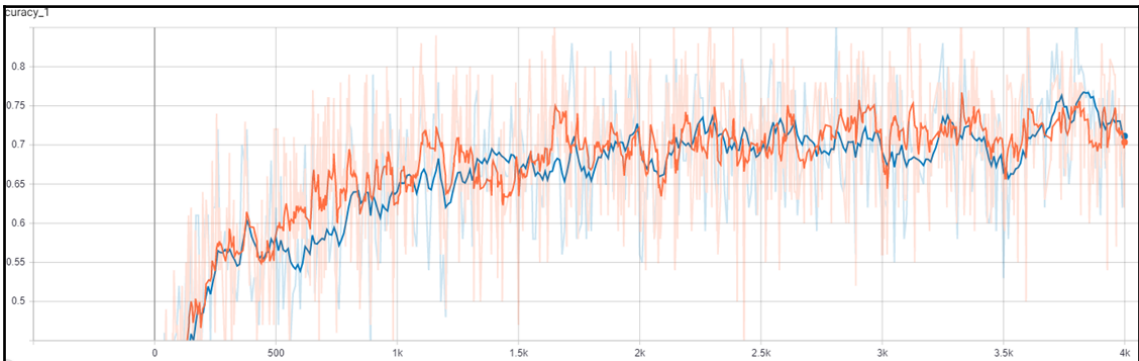
Kind: Document
Size: 91,056,928 bytes (91.1 MB on disk)
Where: Macintosh HD > Users > raz > anaconda3 > chapter4 > command_speaker_recognition > use_case2
Created: Tuesday, 10 April 2018 at 8:55 AM
Modified: Tuesday, 10 April 2018 at 8:55 AM

Stationery pad
 Locked

```

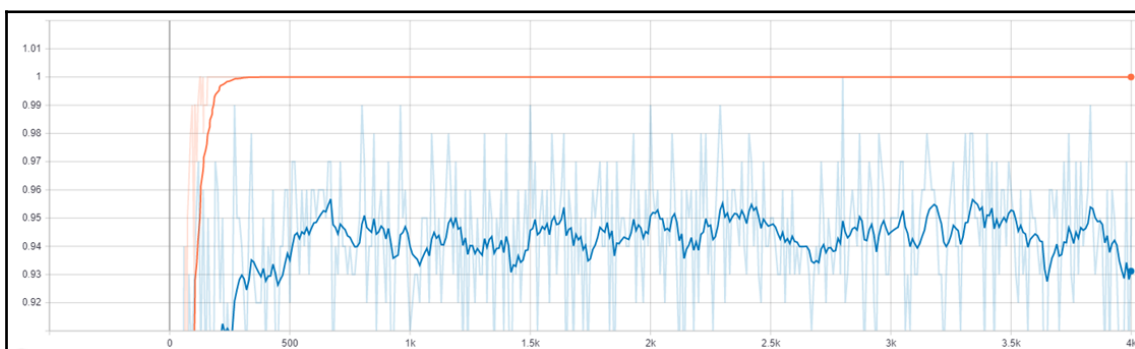
C:\> Command Prompt
INFO:tensorflow:2019-05-19 15:11:02.719906: Step 3920: Validation accuracy = 67.0% (N=100)
INFO:tensorflow:2019-05-19 15:11:03.547944: Step 3930: Train accuracy = 69.0%
INFO:tensorflow:2019-05-19 15:11:03.547944: Step 3930: Cross entropy = 1.082193
INFO:tensorflow:2019-05-19 15:11:03.626063: Step 3930: Validation accuracy = 77.0% (N=100)
INFO:tensorflow:2019-05-19 15:11:04.516587: Step 3940: Train accuracy = 84.0%
INFO:tensorflow:2019-05-19 15:11:04.516587: Step 3940: Cross entropy = 0.712184
INFO:tensorflow:2019-05-19 15:11:04.594707: Step 3940: Validation accuracy = 73.0% (N=100)
INFO:tensorflow:2019-05-19 15:11:05.408637: Step 3950: Train accuracy = 85.0%
INFO:tensorflow:2019-05-19 15:11:05.408637: Step 3950: Cross entropy = 0.566925
INFO:tensorflow:2019-05-19 15:11:05.518001: Step 3950: Validation accuracy = 77.0% (N=100)
INFO:tensorflow:2019-05-19 15:11:06.318512: Step 3960: Train accuracy = 78.0%
INFO:tensorflow:2019-05-19 15:11:06.318512: Step 3960: Cross entropy = 0.747383
INFO:tensorflow:2019-05-19 15:11:06.396632: Step 3960: Validation accuracy = 70.0% (N=100)
INFO:tensorflow:2019-05-19 15:11:07.193423: Step 3970: Train accuracy = 79.0%
INFO:tensorflow:2019-05-19 15:11:07.193423: Step 3970: Cross entropy = 0.794154
INFO:tensorflow:2019-05-19 15:11:07.271541: Step 3970: Validation accuracy = 74.0% (N=100)
INFO:tensorflow:2019-05-19 15:11:08.084003: Step 3980: Train accuracy = 68.0%
INFO:tensorflow:2019-05-19 15:11:08.084003: Step 3980: Cross entropy = 1.074563
INFO:tensorflow:2019-05-19 15:11:08.220279: Step 3980: Validation accuracy = 73.0% (N=100)
INFO:tensorflow:2019-05-19 15:11:09.063962: Step 3990: Train accuracy = 71.0%
INFO:tensorflow:2019-05-19 15:11:09.063962: Step 3990: Cross entropy = 0.928895
INFO:tensorflow:2019-05-19 15:11:09.142080: Step 3990: Validation accuracy = 62.0% (N=100)
INFO:tensorflow:2019-05-19 15:11:09.954521: Step 3999: Train accuracy = 77.0%
INFO:tensorflow:2019-05-19 15:11:09.954521: Step 3999: Cross entropy = 0.845275
INFO:tensorflow:2019-05-19 15:11:10.032663: Step 3999: Validation accuracy = 69.0% (N=100)
INFO:tensorflow:Final test accuracy = 72.0% (N=3702)
INFO:tensorflow:Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.

(tf-gpu) C:\Anaconda3\Book-DL-IoT\chapter4\DL-for-Speech&Speaker\use-case-1new>cd ..
  
```



```
INFO:tensorflow:2019-05-19 15:37:30.206873: Step 3900: Validation accuracy = 91.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:31.238052: Step 3910: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:31.238052: Step 3910: Cross entropy = 0.002250
INFO:tensorflow:2019-05-19 15:37:31.347420: Step 3910: Validation accuracy = 91.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:32.237980: Step 3920: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:32.237980: Step 3920: Cross entropy = 0.001900
INFO:tensorflow:2019-05-19 15:37:32.316100: Step 3920: Validation accuracy = 95.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:33.206647: Step 3930: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:33.206647: Step 3930: Cross entropy = 0.001575
INFO:tensorflow:2019-05-19 15:37:33.300417: Step 3930: Validation accuracy = 96.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:34.102219: Step 3940: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:34.102219: Step 3940: Cross entropy = 0.001931
INFO:tensorflow:2019-05-19 15:37:34.175381: Step 3940: Validation accuracy = 92.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:35.129765: Step 3950: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:35.129765: Step 3950: Cross entropy = 0.001272
INFO:tensorflow:2019-05-19 15:37:35.223506: Step 3950: Validation accuracy = 95.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:36.145321: Step 3960: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:36.145321: Step 3960: Cross entropy = 0.001753
INFO:tensorflow:2019-05-19 15:37:36.239062: Step 3960: Validation accuracy = 92.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:37.198380: Step 3970: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:37.198380: Step 3970: Cross entropy = 0.001600
INFO:tensorflow:2019-05-19 15:37:37.307721: Step 3970: Validation accuracy = 94.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:38.229535: Step 3980: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:38.229535: Step 3980: Cross entropy = 0.001917
INFO:tensorflow:2019-05-19 15:37:38.338903: Step 3980: Validation accuracy = 96.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:39.291961: Step 3990: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:39.291961: Step 3990: Cross entropy = 0.001936
INFO:tensorflow:2019-05-19 15:37:39.395582: Step 3990: Validation accuracy = 93.0% (N=100)
INFO:tensorflow:2019-05-19 15:37:40.176774: Step 3999: Train accuracy = 100.0%
INFO:tensorflow:2019-05-19 15:37:40.176774: Step 3999: Cross entropy = 0.001790
INFO:tensorflow:2019-05-19 15:37:40.254894: Step 3999: Validation accuracy = 96.0% (N=100)
INFO:tensorflow:Final test accuracy = 87.5% (N=32)
INFO:tensorflow:Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.
```

(tf-gpu) C:\Anaconda3\Book-DL-IoT\chapter4\DL-for-Speech&Speaker\use-case-2new>

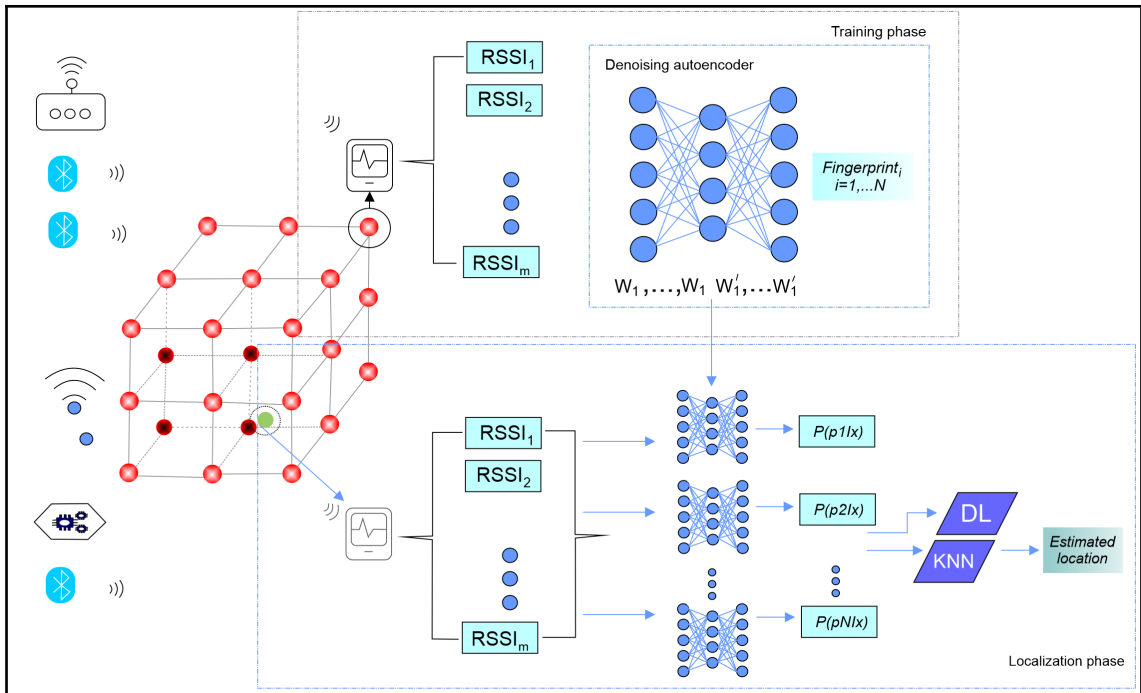


Chapter 5: Indoor Localization in IoT

$$\Omega = \{(\mathbf{f}_1, \mathbf{p}_1), (\mathbf{f}_2, \mathbf{p}_2), \dots, (\mathbf{f}_N, \mathbf{p}_N)\}$$

N

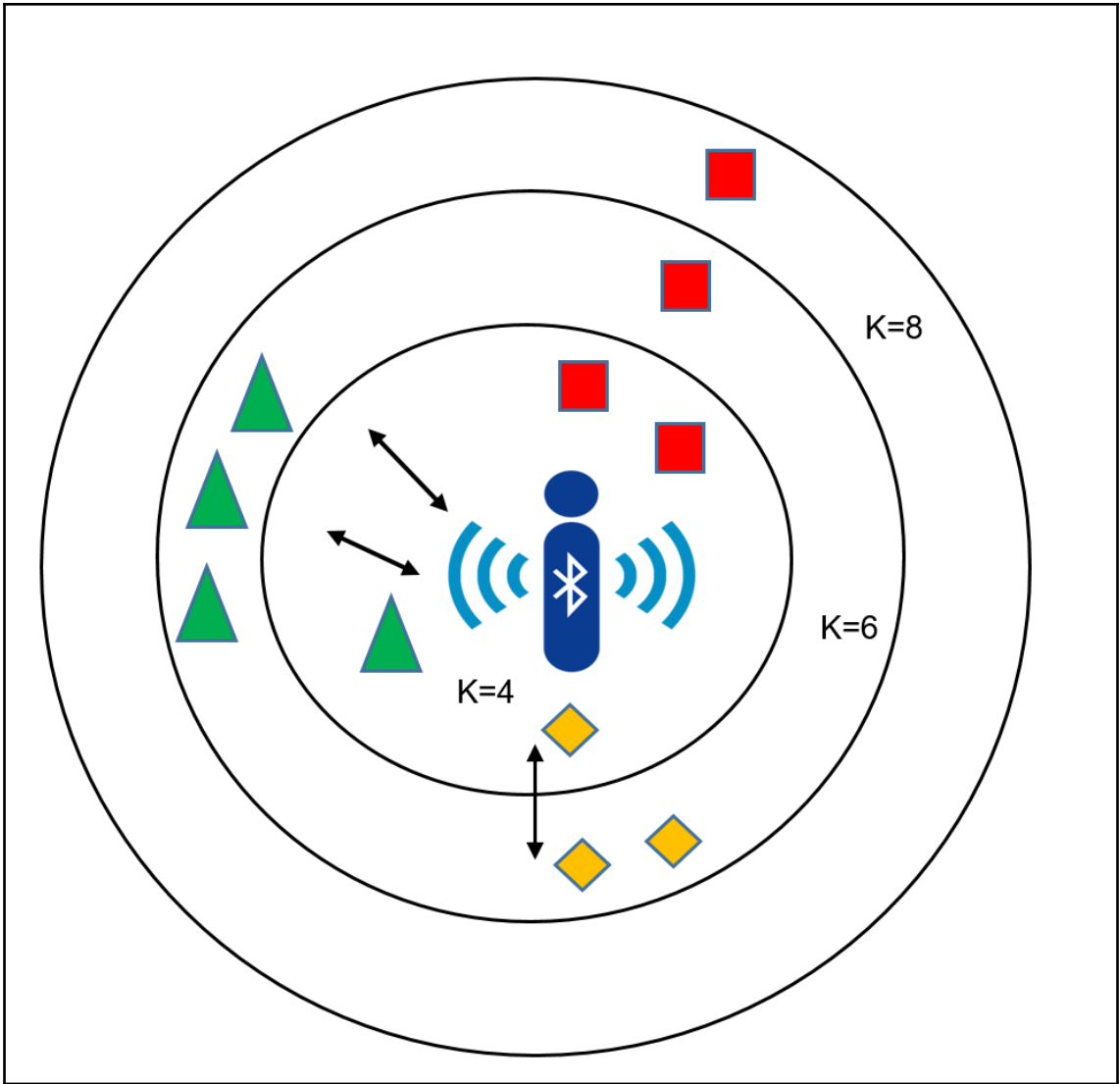
$$\mathbf{f} = [r_1, r_2, \dots, r_m]$$



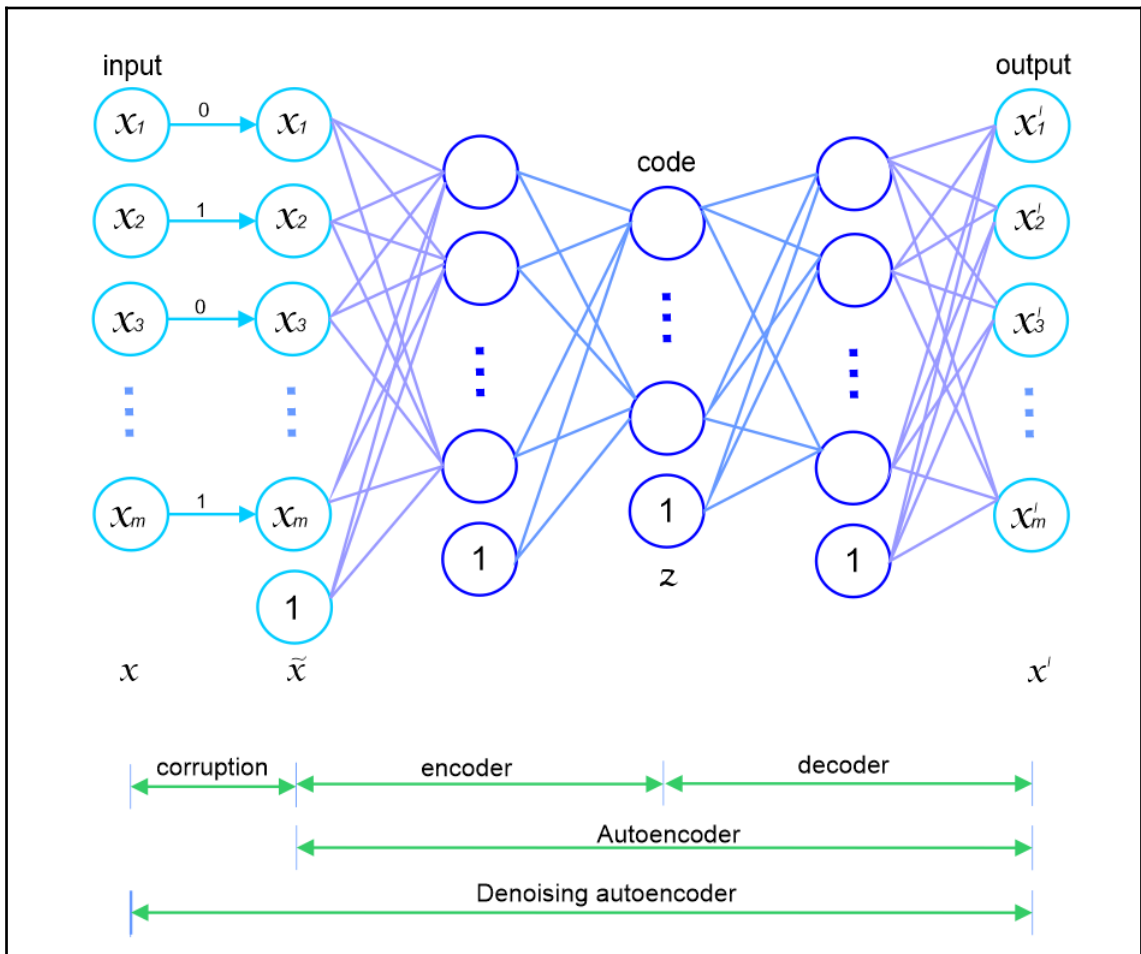
$$d_i = d(X_i, x)$$

I

d_i Y_i $i \in I$

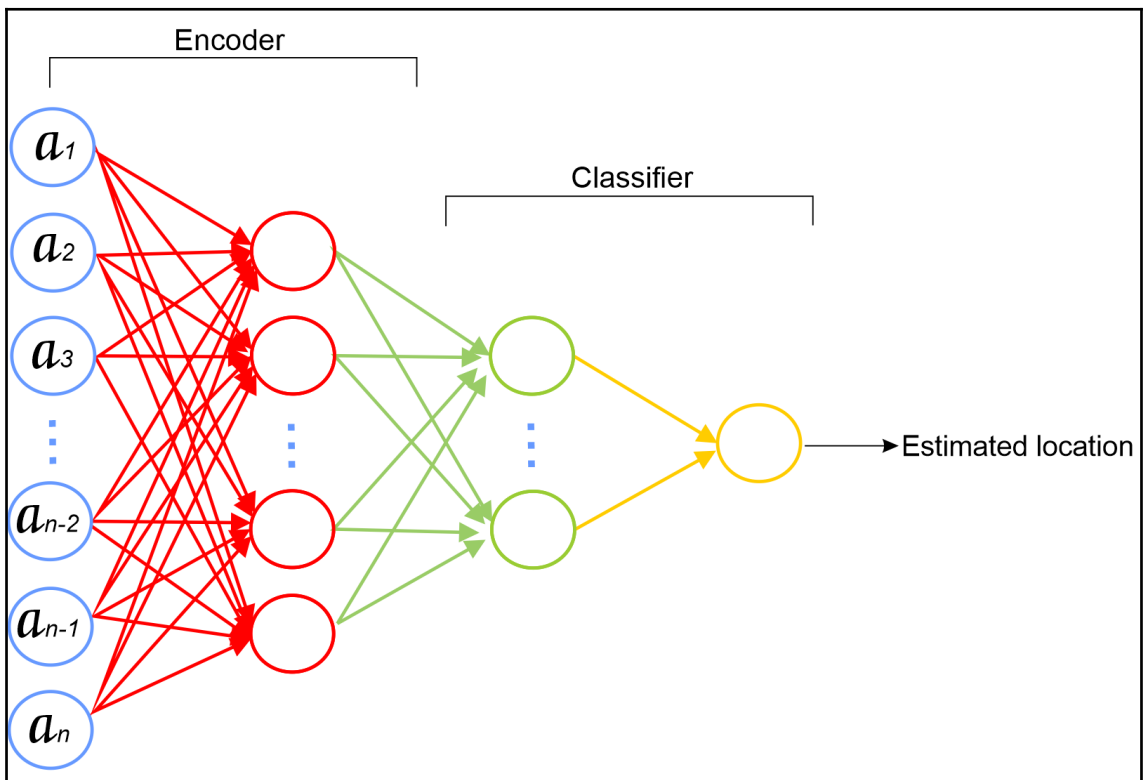


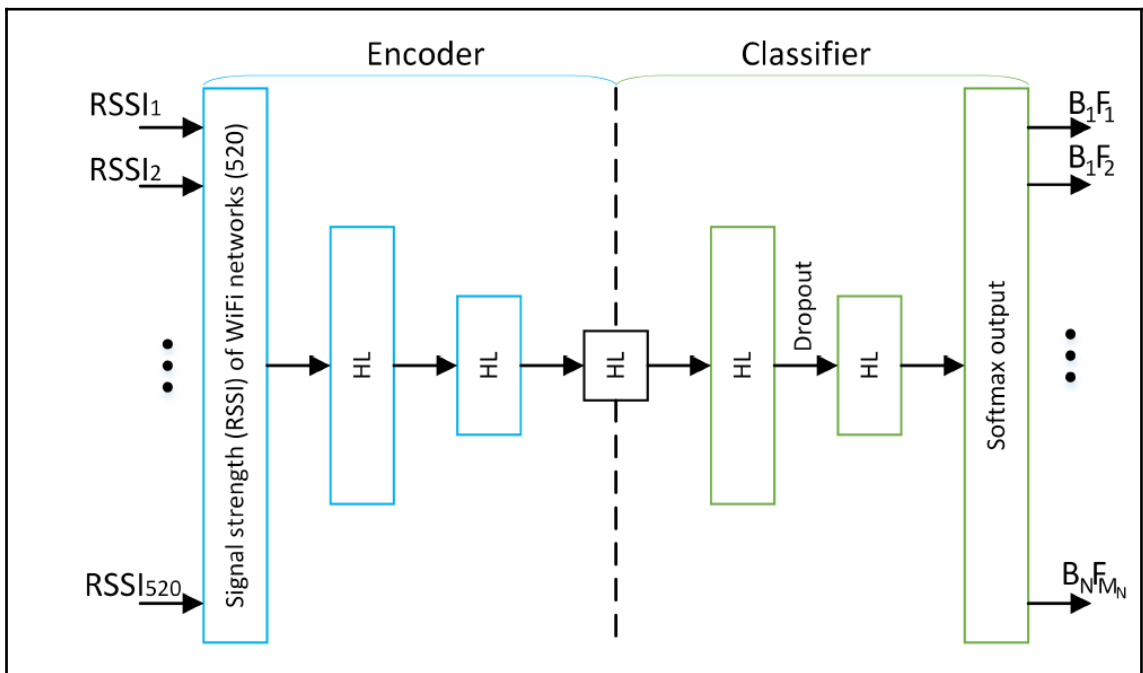
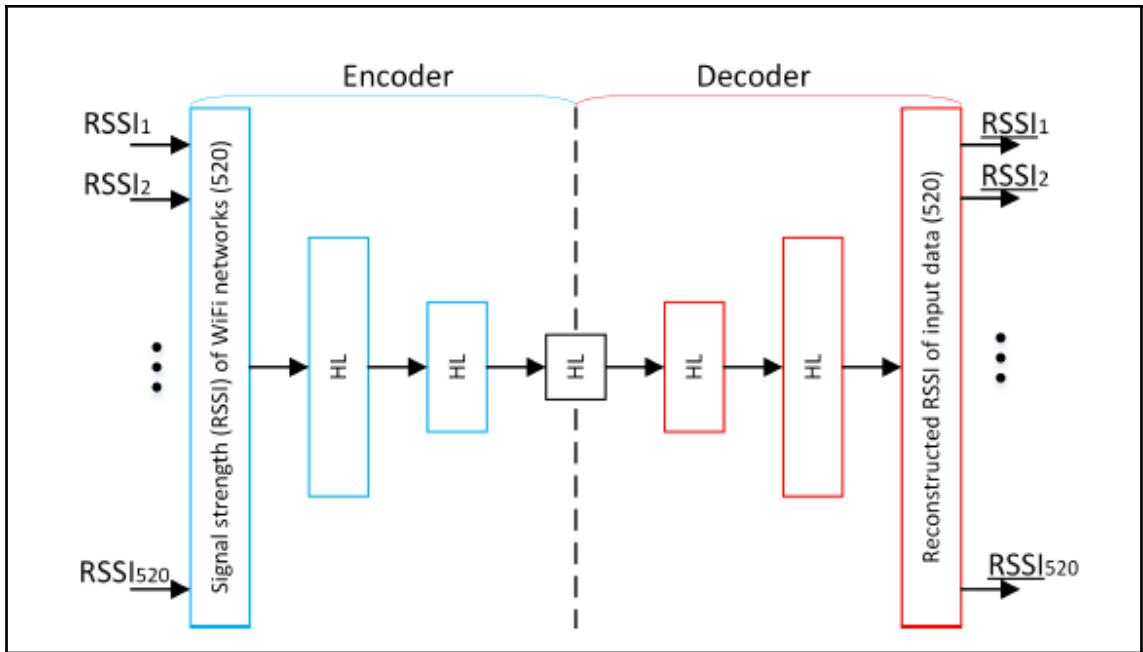
$$g(f(x)) = 0$$



$$\mathbf{f} = [w_1, w_2, \dots, w_l, w'_1, w'_2, \dots, w'_l]$$

*i*th





Dataset info

Number of variables	529
Number of observations	19937
Total Missing (%)	0.0%
Total size in memory	80.5 MiB
Average record size in memory	4.1 KiB

Variables types

Numeric	417
Categorical	0
Boolean	38
Date	0
Text (Unique)	0
Rejected	74
Unsupported	0

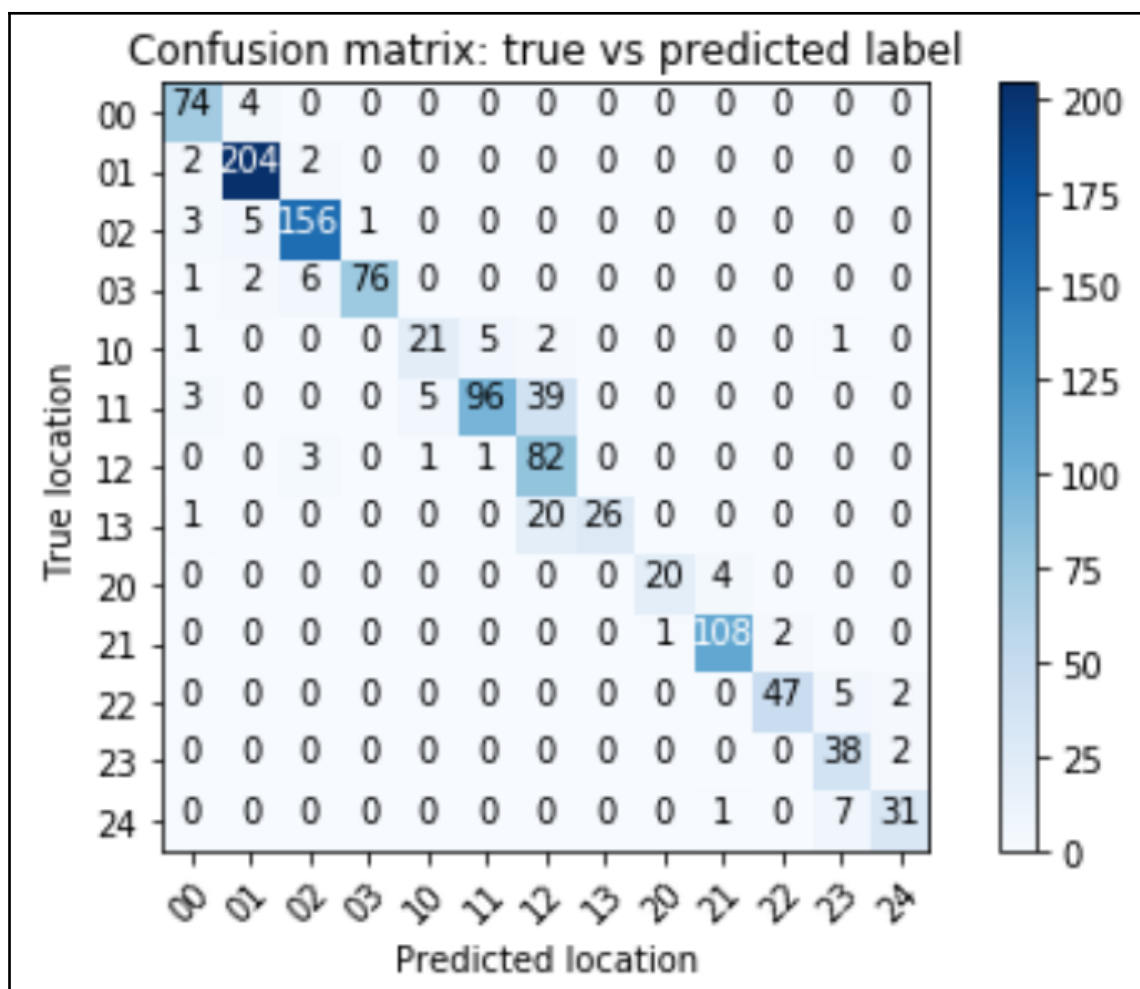
Warnings

BUILDINGID is highly correlated with LONGITUDE ($\rho = 0.95837$)	Rejected
FLOOR has 4369 / 21.9% zeros	Zeros
WAP001 is highly skewed ($\gamma_1 = -33.24$)	Skewed
WAP002 is highly skewed ($\gamma_1 = -32.355$)	Skewed
WAP003 has constant value 100	Rejected
WAP004 has constant value 100	Rejected
WAP005 is highly skewed ($\gamma_1 = -22.264$)	Skewed
WAP016 is highly correlated with WAP015 ($\rho = 0.90194$)	Rejected
WAP021 is highly skewed ($\gamma_1 = -23.154$)	Skewed
WAP022 is highly skewed ($\gamma_1 = -23.154$)	Skewed
WAP054 is highly correlated with WAP053 ($\rho = 0.92829$)	Rejected
WAP055 is highly skewed ($\gamma_1 = -25.316$)	Skewed
WAP056 is highly skewed ($\gamma_1 = -24.529$)	Skewed
WAP081 is highly correlated with WAP080 ($\rho = 0.91183$)	Rejected
WAP086 is highly skewed ($\gamma_1 = -22.29$)	Skewed
WAP092 has constant value 100	Rejected
WAP093 has constant value 100	Rejected
WAP094 has constant value 100	Rejected
WAP095 has constant value 100	Rejected

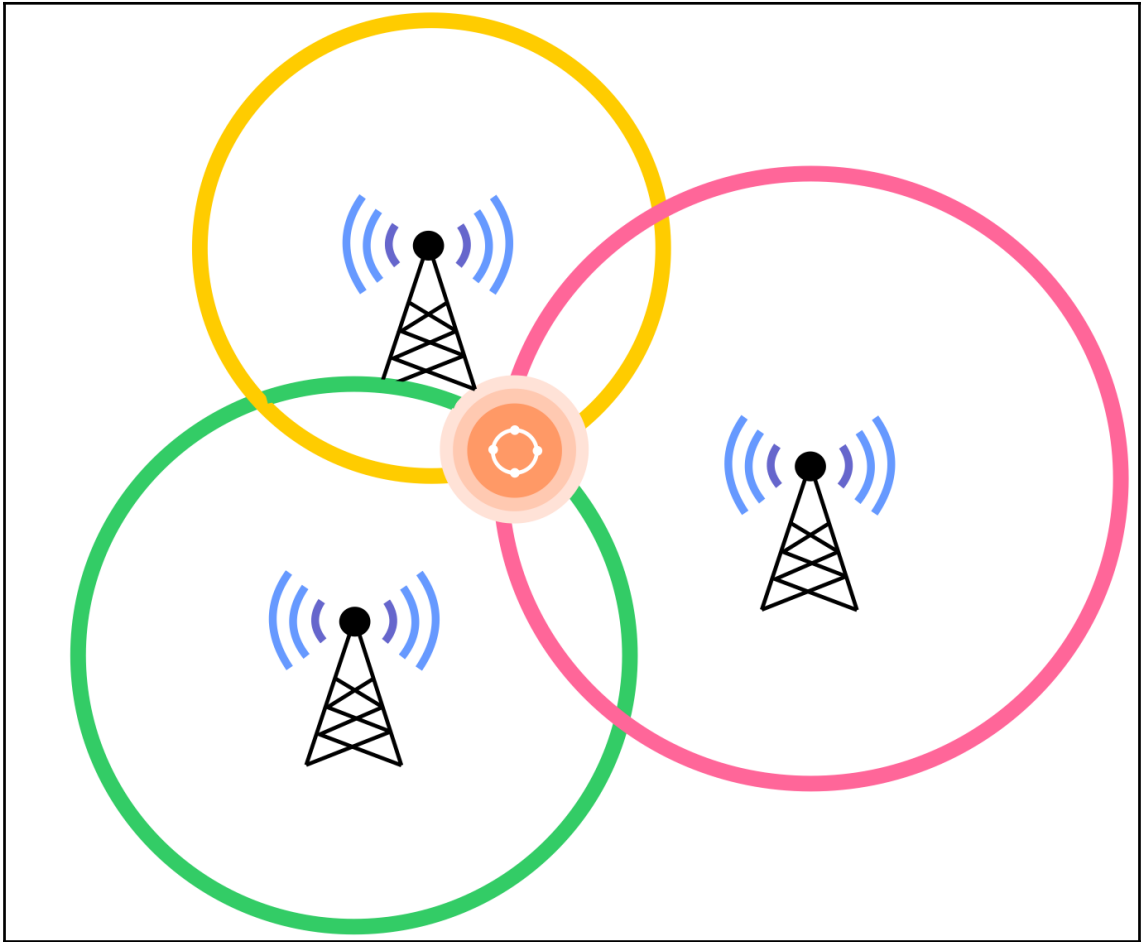
Layer (type)	Output Shape	Param #
dense_28 (Dense)	(None, 256)	133376
dense_29 (Dense)	(None, 128)	32896
dense_30 (Dense)	(None, 64)	8256
dense_31 (Dense)	(None, 128)	8320
dense_32 (Dense)	(None, 256)	33024
dense_33 (Dense)	(None, 520)	133640
Total params: 349,512		
Trainable params: 349,512		
Non-trainable params: 0		



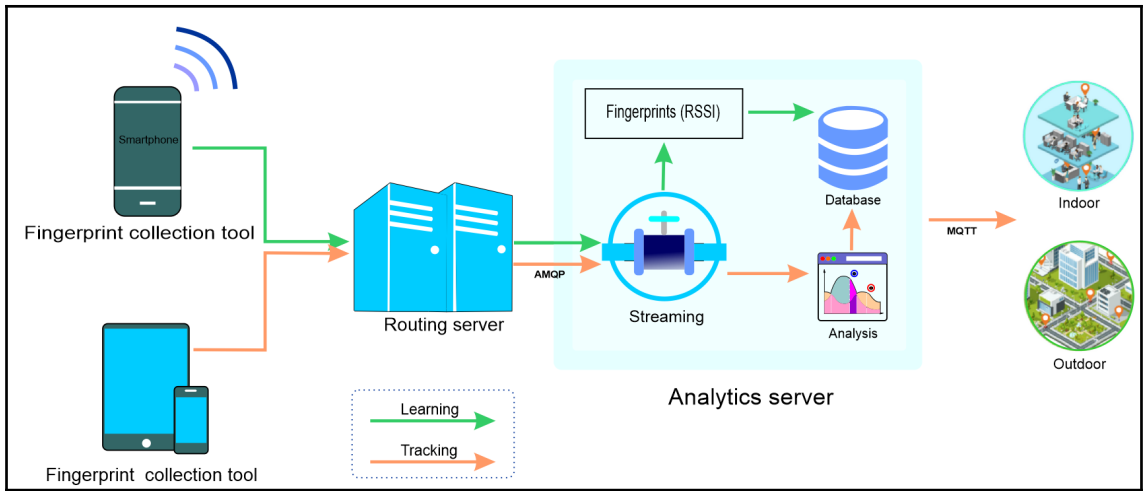
	precision	recall	f1-score	support
0	0.87	0.95	0.91	78
1	0.95	0.98	0.96	208
2	0.93	0.95	0.94	165
3	0.99	0.89	0.94	85
4	0.78	0.70	0.74	30
5	0.94	0.67	0.78	143
6	0.57	0.94	0.71	87
7	1.00	0.55	0.71	47
8	0.95	0.83	0.89	24
9	0.96	0.97	0.96	111
10	0.96	0.87	0.91	54
11	0.75	0.95	0.84	40
12	0.89	0.79	0.84	39
avg / total	0.90	0.88	0.88	1111



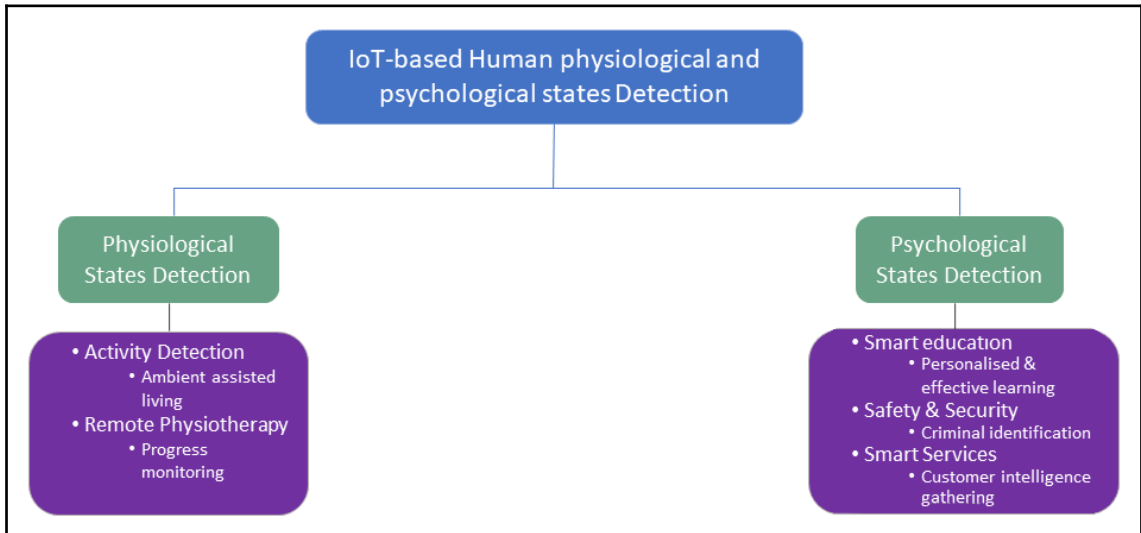
n

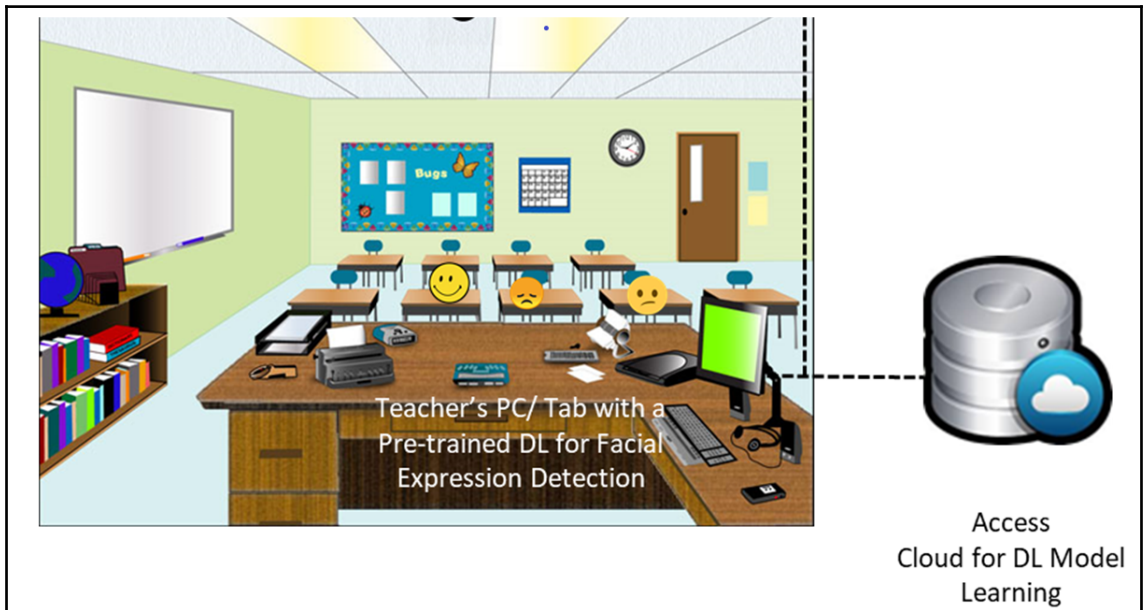
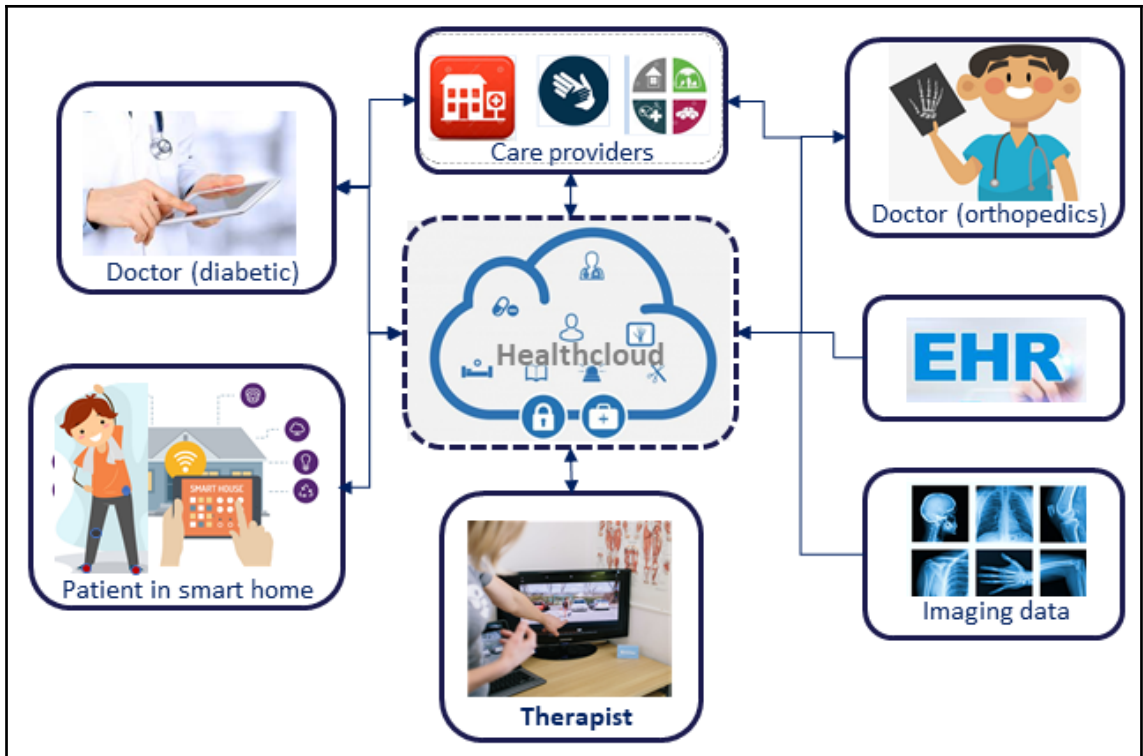


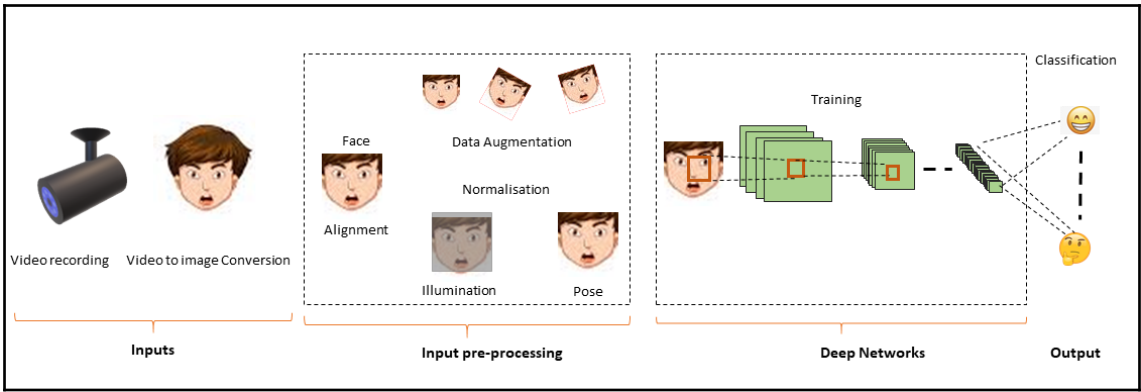
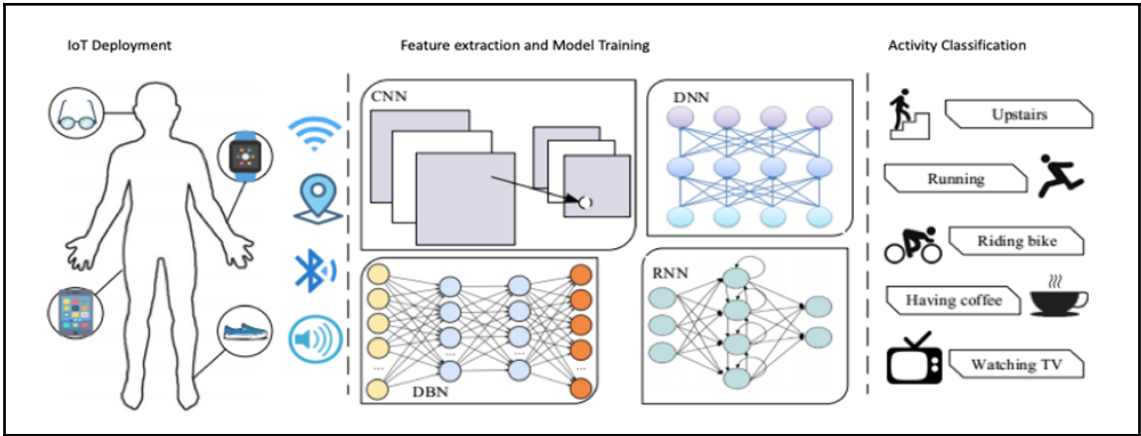
$$F_{RSSI} = (RSSI_1, RSSI_2, RSSI_3, \dots, RSSI_n)$$

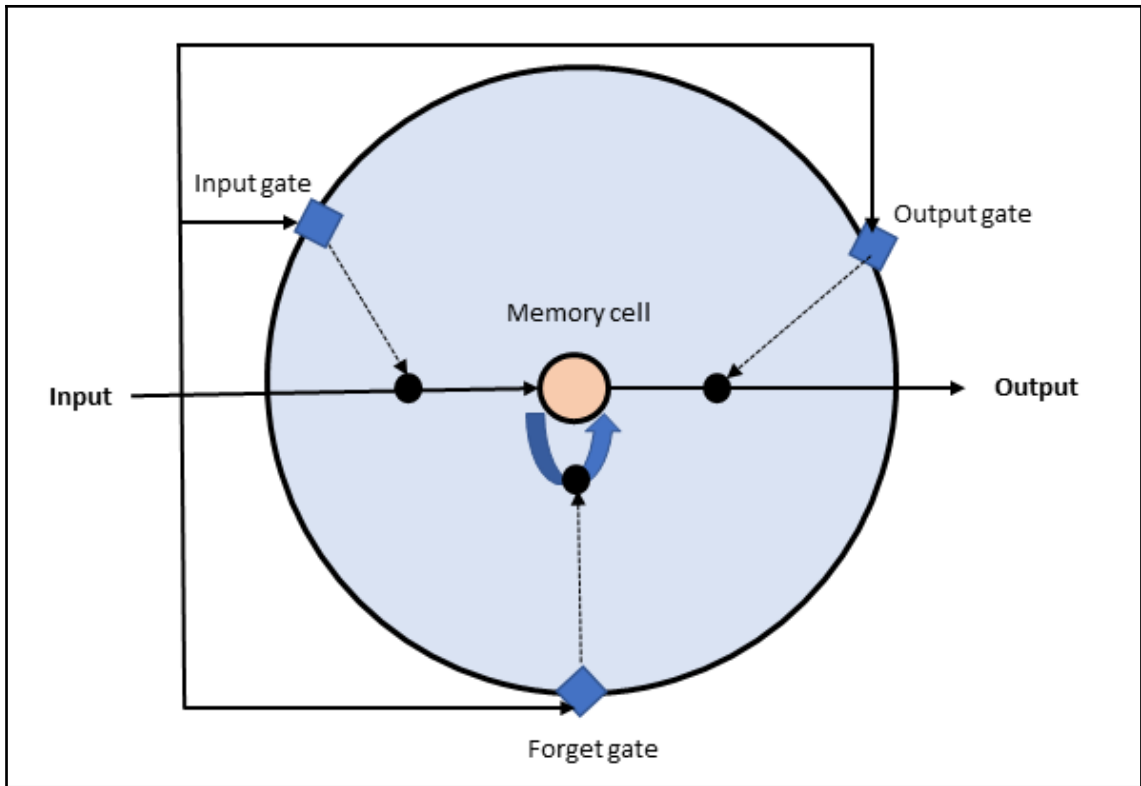


Chapter 6: Physiological and Psychological State Detection in IoT










```
columns = ['user', 'activity', 'timestamp', 'x-axis', 'y-axis', 'z-axis']
df = pd.read_csv('data/WISDM_ar_v1.1_raw.txt', header = None, names = columns)
df = df.dropna()
```


```
df.head()
```

	user	activity	timestamp	x-axis	y-axis	z-axis
0	33	Jogging	49105962326000	-0.694638	12.680544	0.503953
1	33	Jogging	49106062271000	5.012288	11.264028	0.953424
2	33	Jogging	49106112167000	4.903325	10.882658	-0.081722
3	33	Jogging	49106222305000	-0.612916	18.496431	3.023717
4	33	Jogging	49106332290000	-1.184970	12.108489	7.205164


emotion	pixels	Usage
0	70 80 82 72 58 58 60 63 54 58 60 48 89 115 121 119 115 110 98 91 84 84 90 99 110 126 143 153 158 171 1	Training
0	151 150 147 155 148 133 111 140 170 174 182 154 153 164 173 178 185 185 189 187 186 193 194 185 183	Training
2	231 212 156 164 174 138 161 173 182 200 106 38 39 74 138 161 164 179 190 201 210 216 220 224 222 21	Training
4	24 32 36 30 32 23 19 20 30 41 21 22 32 34 21 19 43 52 13 26 40 59 65 12 20 63 99 98 98 111 75 62 41 73 1	Training
6	4 0 0 0 0 0 0 0 0 0 0 3 15 23 28 48 50 58 84 115 127 137 142 151 156 155 149 153 152 157 160 162 159 1	Training
2	55 55 55 55 55 54 60 68 54 85 151 163 170 179 181 185 188 188 191 196 189 194 198 197 195 194 190 19	Training
4	20 17 19 21 25 38 42 42 46 54 56 62 63 66 82 108 118 130 139 134 132 126 113 97 126 148 157 161 155 1	Training
3	77 78 79 79 78 75 60 55 47 48 58 73 77 79 57 50 37 44 56 70 80 82 87 91 86 80 73 66 54 57 68 69 68 68 49	Training
3	85 84 90 121 101 102 133 153 153 169 177 189 195 199 205 207 209 216 221 225 221 220 218 222 223 21	Training
2	255 254 255 254 254 179 122 107 95 124 149 150 169 178 179 179 181 181 184 190 191 191 193 190 190	Training
0	30 24 21 23 25 25 49 67 84 103 120 125 130 139 140 139 148 171 178 175 176 174 180 180 178 178 182 1	Training
6	39 75 78 58 58 45 49 48 103 156 81 45 41 38 49 56 60 49 32 31 28 52 83 81 78 75 62 31 18 19 19 20 17 20	Training
6	219 213 206 202 209 217 216 215 219 218 223 230 227 227 233 235 234 236 237 238 234 226 219 212 208	Training
6	148 144 130 129 119 122 129 131 139 153 140 128 139 144 146 143 132 133 134 130 140 142 150 152 150	Training
3	4 2 13 41 56 62 67 87 95 62 65 70 80 107 127 149 153 150 165 168 177 187 176 167 152 128 130 149 149	Training
5	107 107 109 109 109 110 101 123 140 144 144 149 153 160 161 161 167 168 169 172 172 173 173 175 176	Training




angry
203 items




happy
136 items



neutral
137 items



sad
250 items

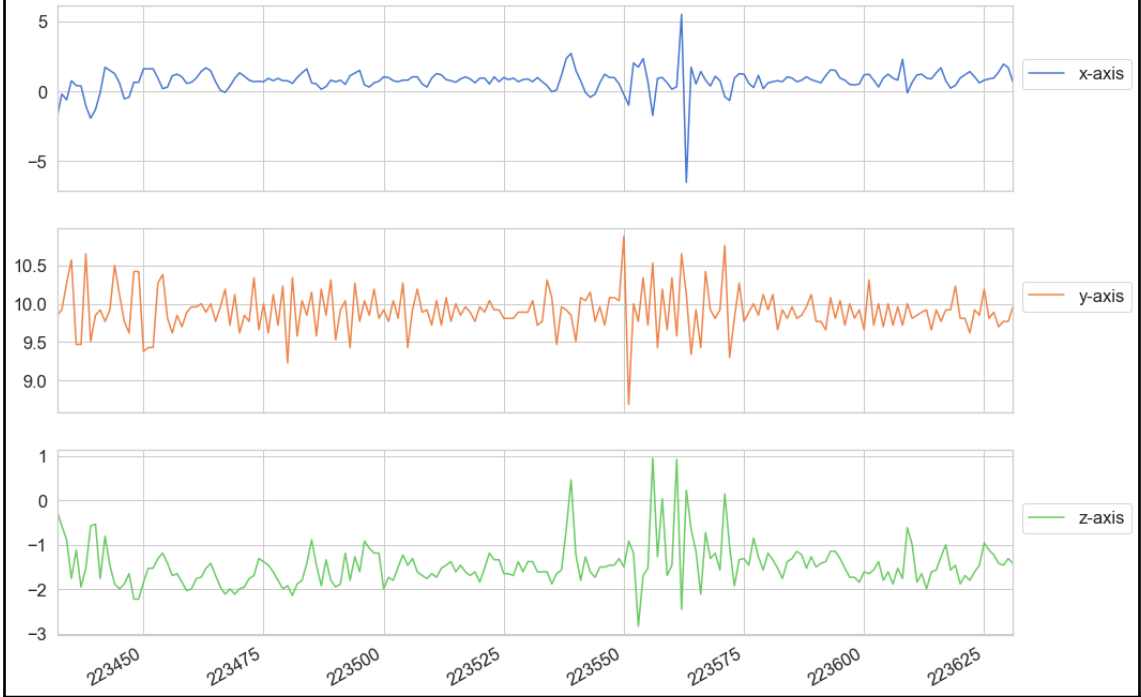


scared
167 items

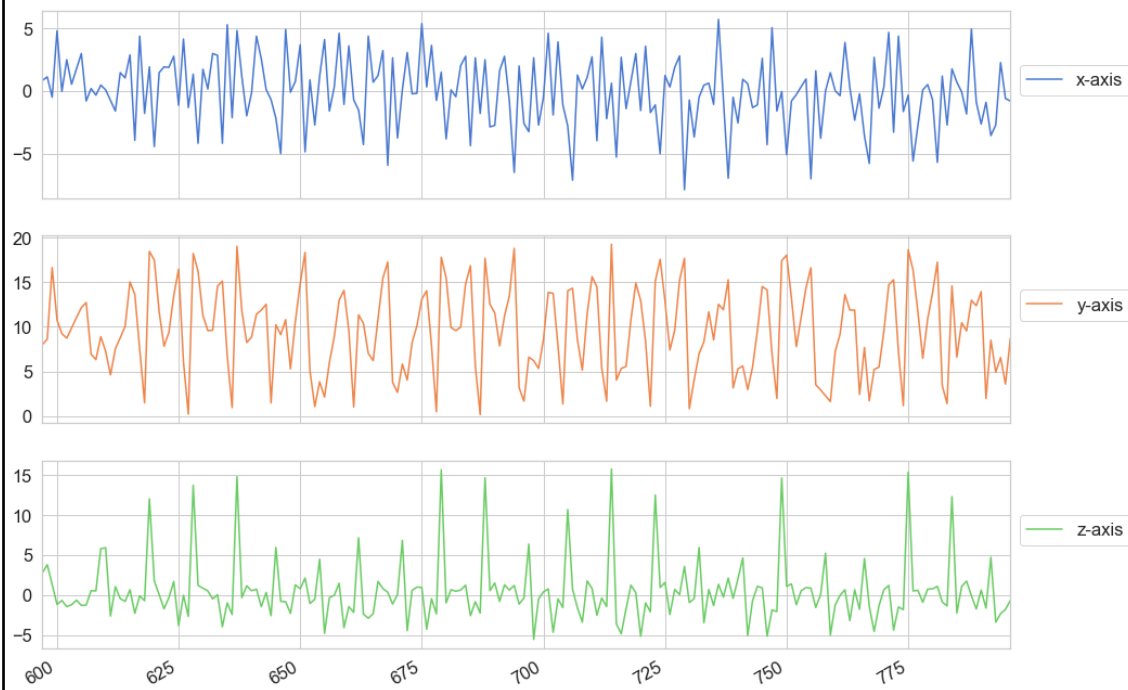
Sitting



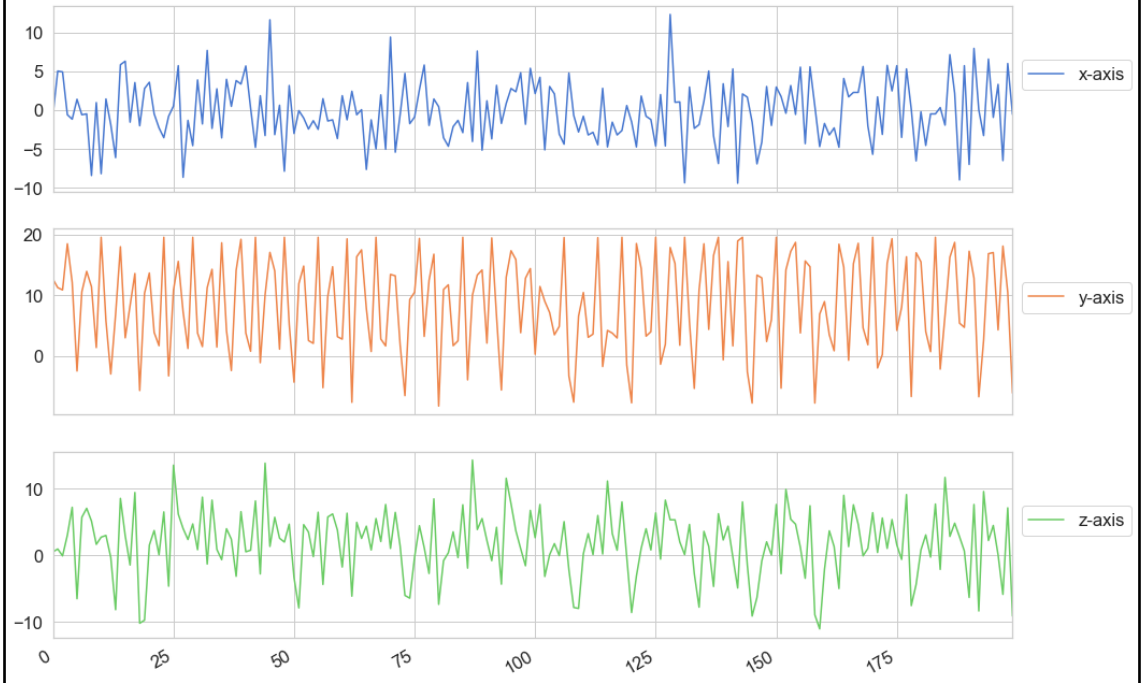
Standing



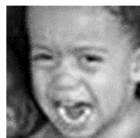
Walking



Jogging



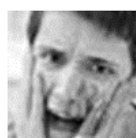
Class 0: Angry



Class 1: Disgust



Class 2: Fear

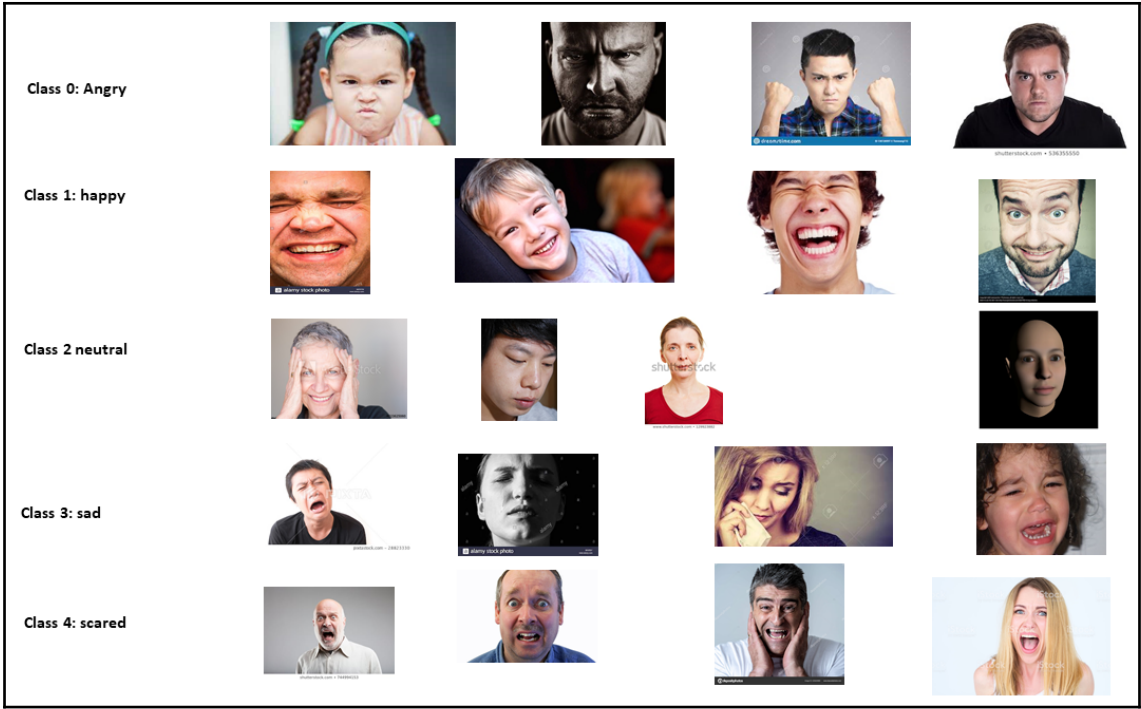


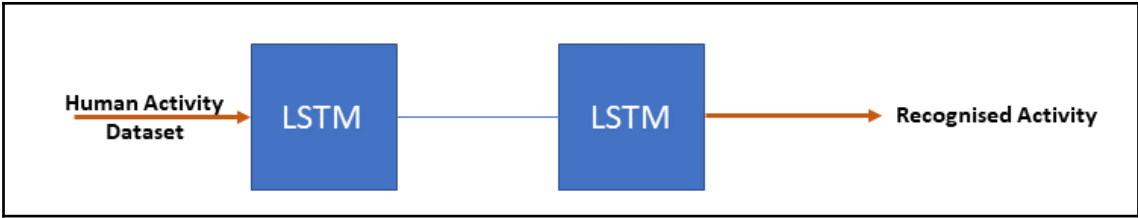
Class 3: Happy

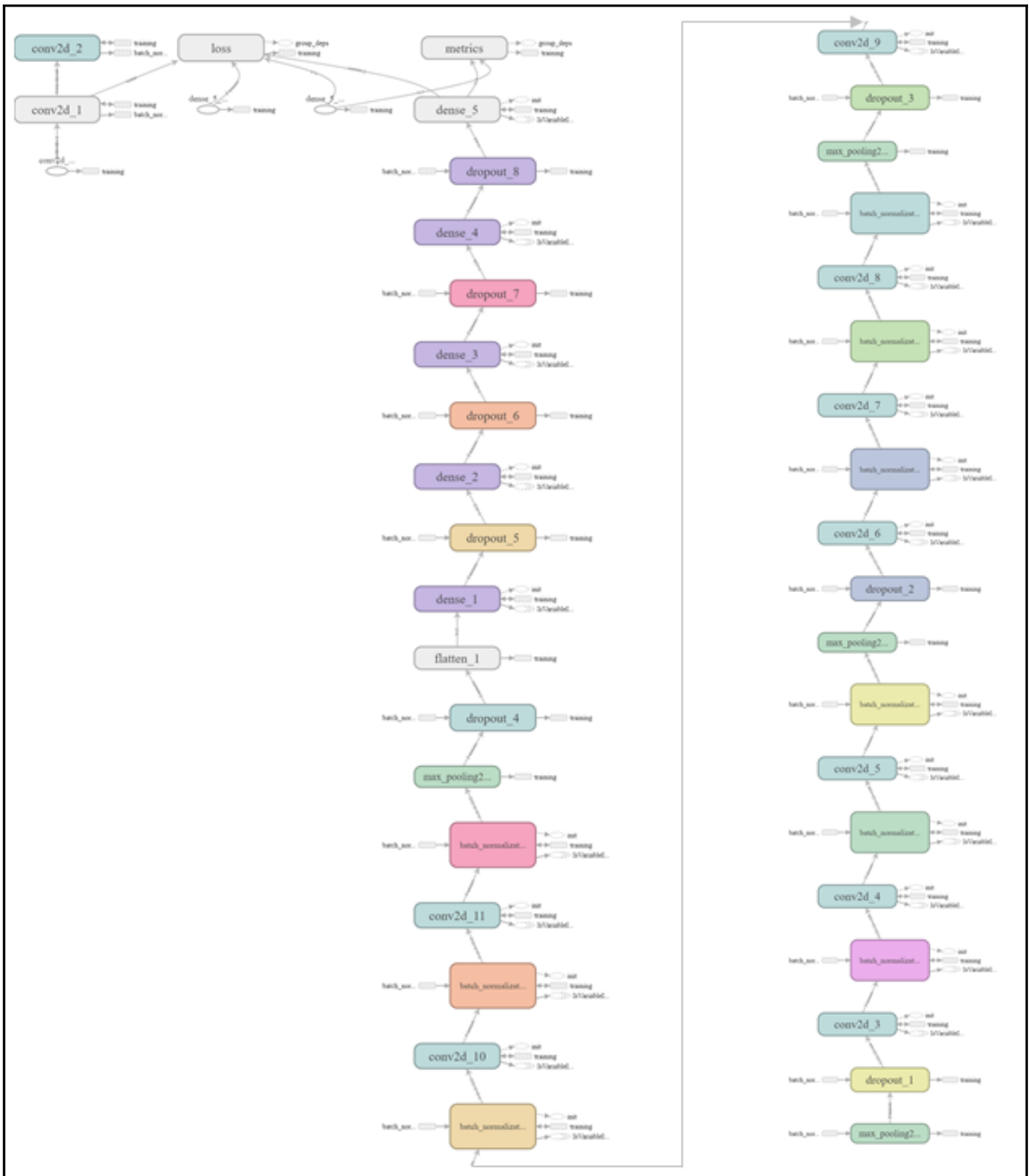


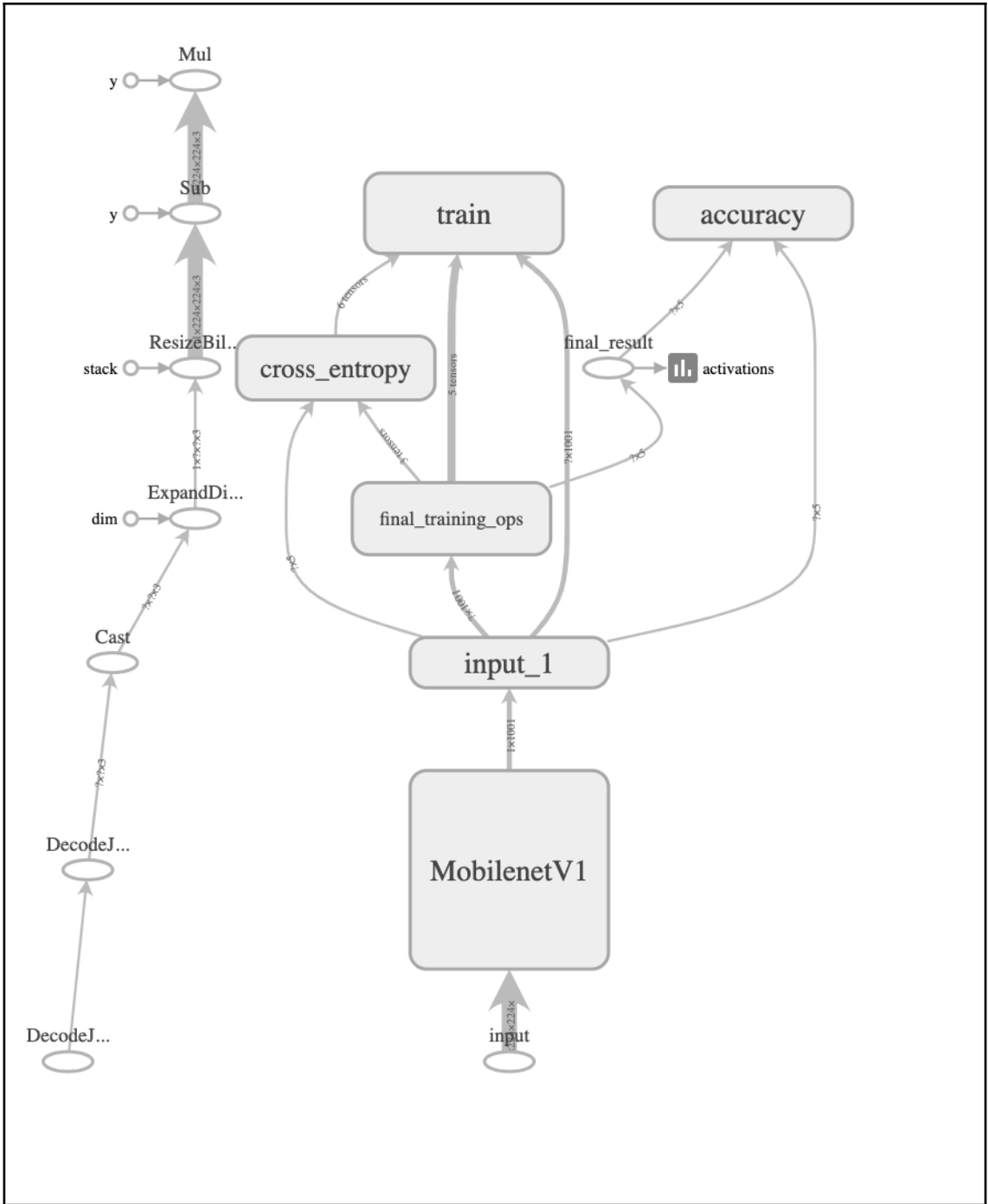
Class 4: Sad











fer2013_trained.hdf5 2.6 MB
Modified: Friday, 25 January 2019 at 12:49 AM

Add Tags...

▼ General:

Kind: Document
Size: 2,600,080 bytes (2.6 MB on disk)
Where: Macintosh HD › Users › raz › anaconda3 › chapter6 › use-case-2 › FER-2013 › trained_models
Created: Friday, 25 January 2019 at 12:49 AM
Modified: Friday, 25 January 2019 at 12:49 AM

Stationery pad
 Locked

▼ More Info:

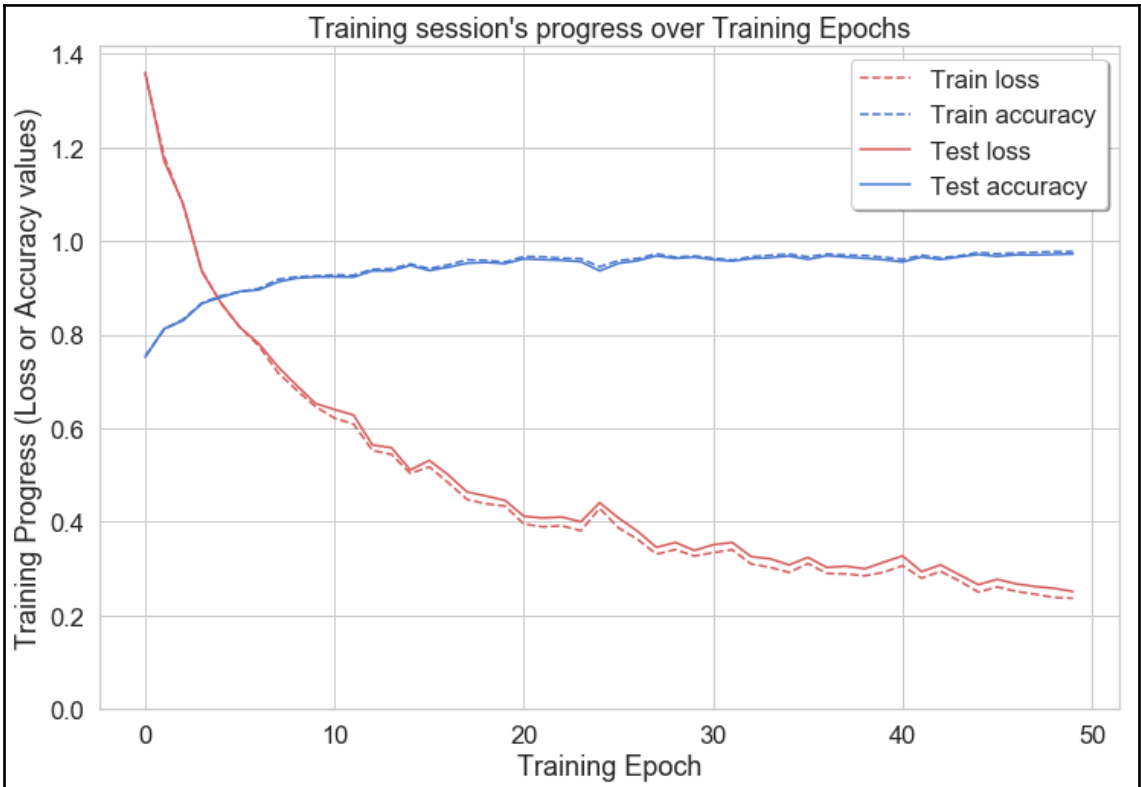
trained-mobilenet 17.1 MB
Modified: Saturday, 13 April 2019 at 3:27 AM

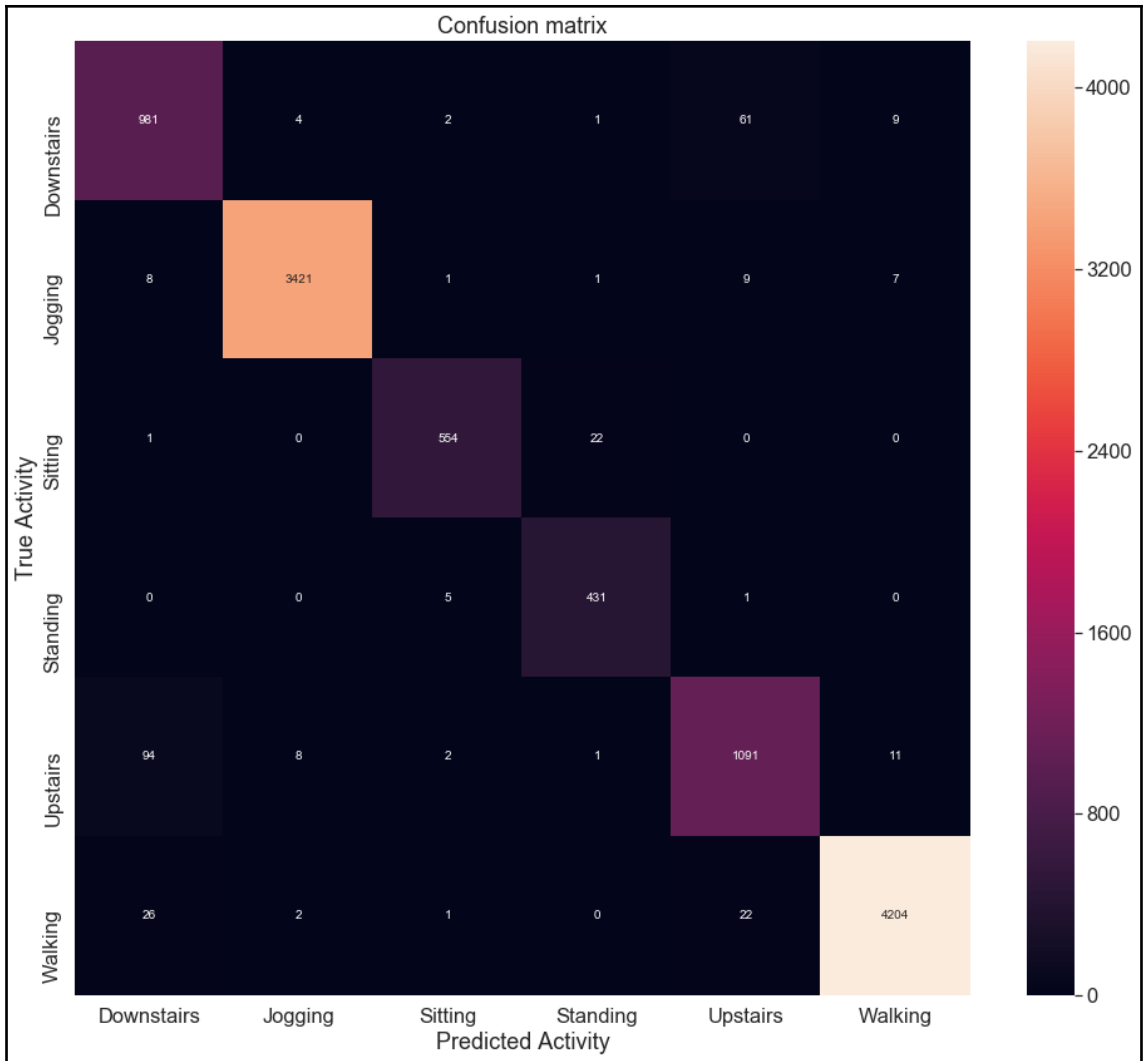
Add Tags...

▼ General:

Kind: Folder
Size: 17,144,280 bytes (17.1 MB on disk) for 3 items
Where: Macintosh HD › Users › raz › anaconda3 › chapter6 › use-case-2 › Emotion-recognition
Created: Saturday, 13 April 2019 at 1:22 AM
Modified: Saturday, 13 April 2019 at 3:27 AM

Shared folder
 Locked





```

Command Prompt - python CNN-FER2013.py
Epoch 00073: val_loss did not improve from 1.14731
Epoch 74/100
25838/25838 [=====] - 32s 1ms/step - loss: 0.5493 - acc: 0.8155 - val_loss: 1.4115 - val_acc: 0.6198

Epoch 00074: val_loss did not improve from 1.14731
Epoch 75/100
25838/25838 [=====] - 33s 1ms/step - loss: 0.5527 - acc: 0.8152 - val_loss: 1.4177 - val_acc: 0.6293

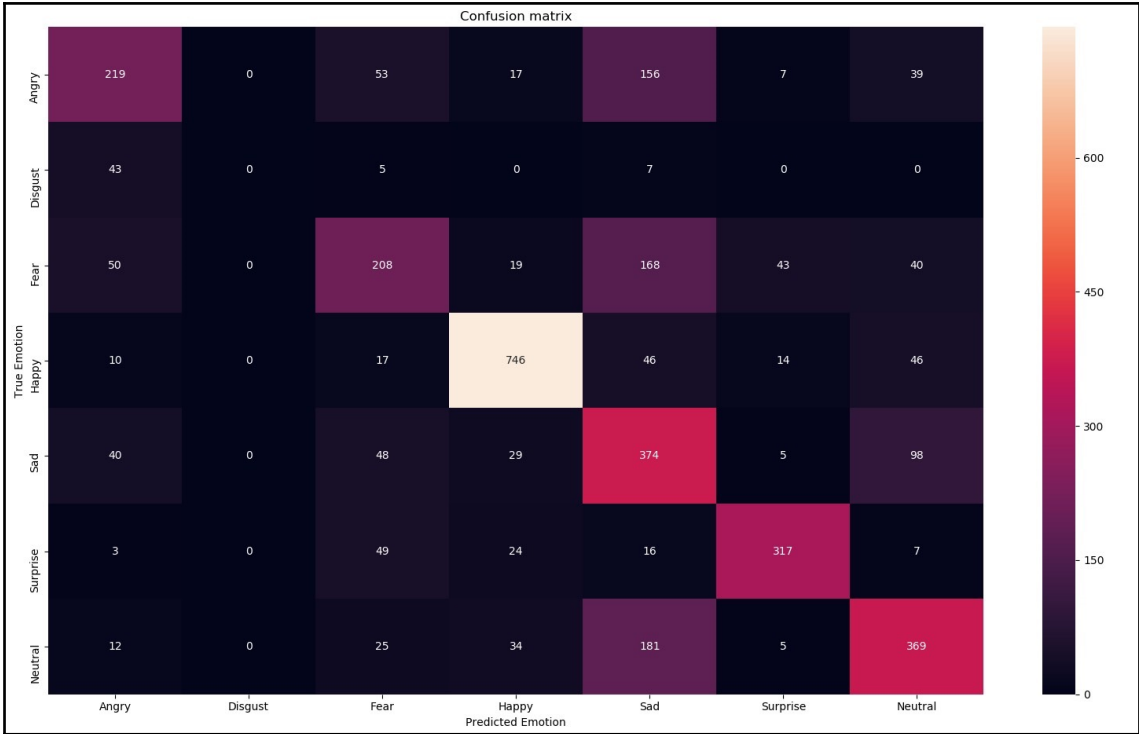
Epoch 00075: val_loss did not improve from 1.14731
Epoch 76/100
25838/25838 [=====] - 32s 1ms/step - loss: 0.5345 - acc: 0.8224 - val_loss: 1.4075 - val_acc: 0.6283

Epoch 00076: val_loss did not improve from 1.14731
Epoch 77/100
25838/25838 [=====] - 32s 1ms/step - loss: 0.5273 - acc: 0.8265 - val_loss: 1.4189 - val_acc: 0.6294

Epoch 00077: val_loss did not improve from 1.14731
Epoch 78/100
25838/25838 [=====] - 32s 1ms/step - loss: 0.5047 - acc: 0.8319 - val_loss: 1.4780 - val_acc: 0.6291

Epoch 00078: val_loss did not improve from 1.14731
Accuracy score = 0.6221788799108386
[[219  0  53  17 156  7  39]
 [ 43  0   5   0   7  0   0]
 [ 50  0 208  19 168 43  40]
 [ 10  0  17 746  46  14  46]
 [ 40  0  48  29 374  5  98]
 [  3  0  49  24  16 317  7]
 [ 12  0  25  34 181  5 369]]

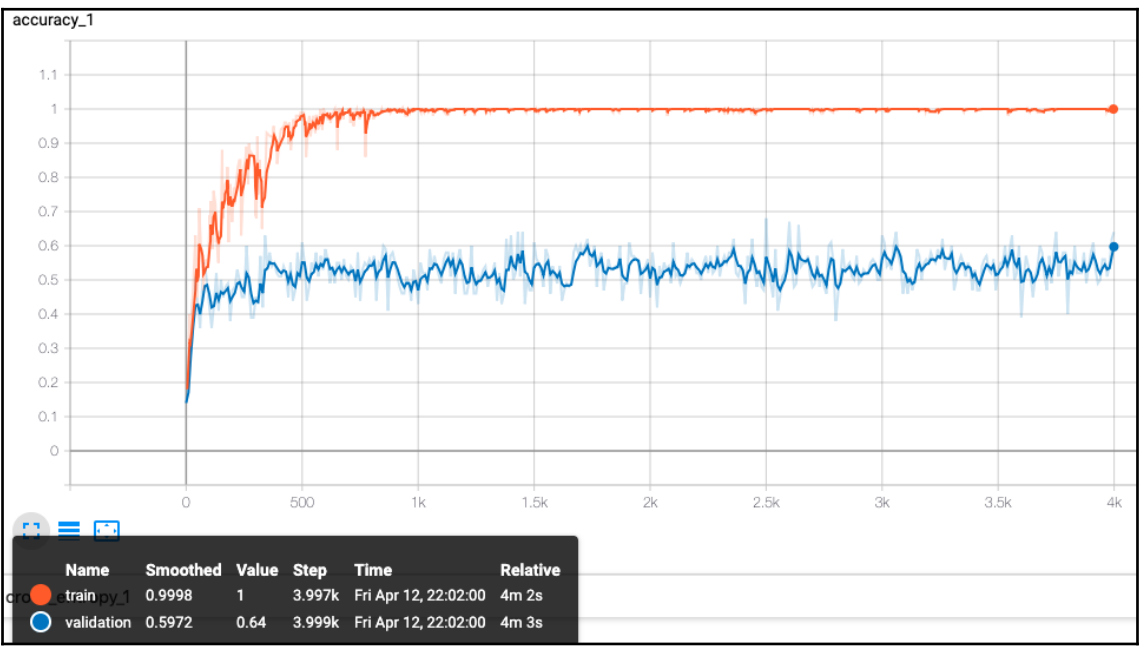
```



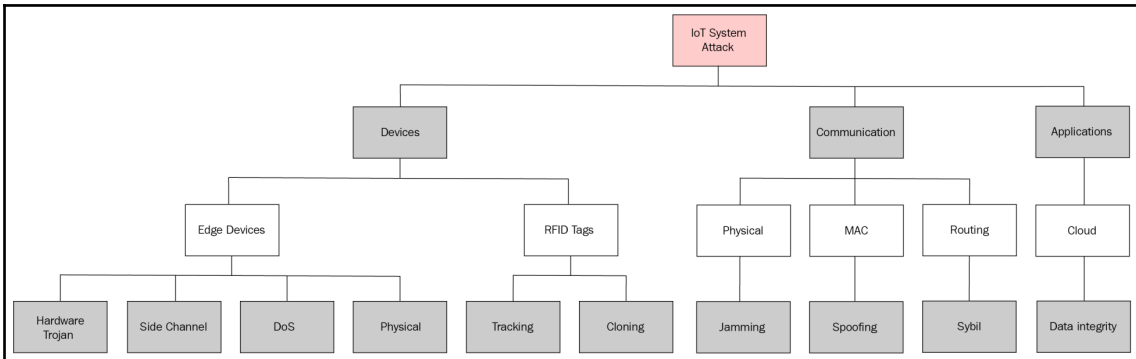
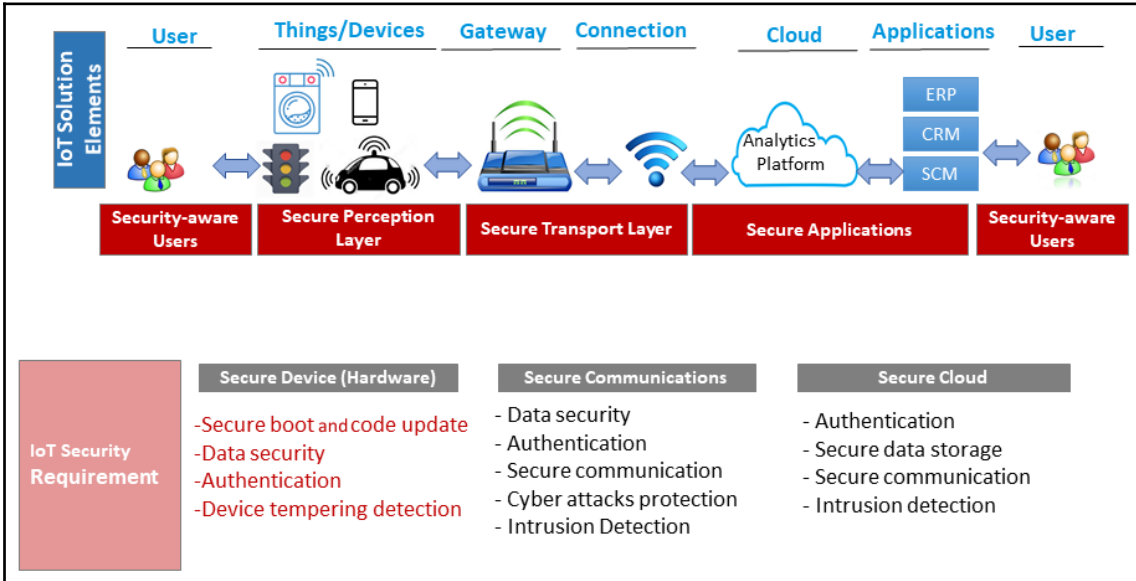
```

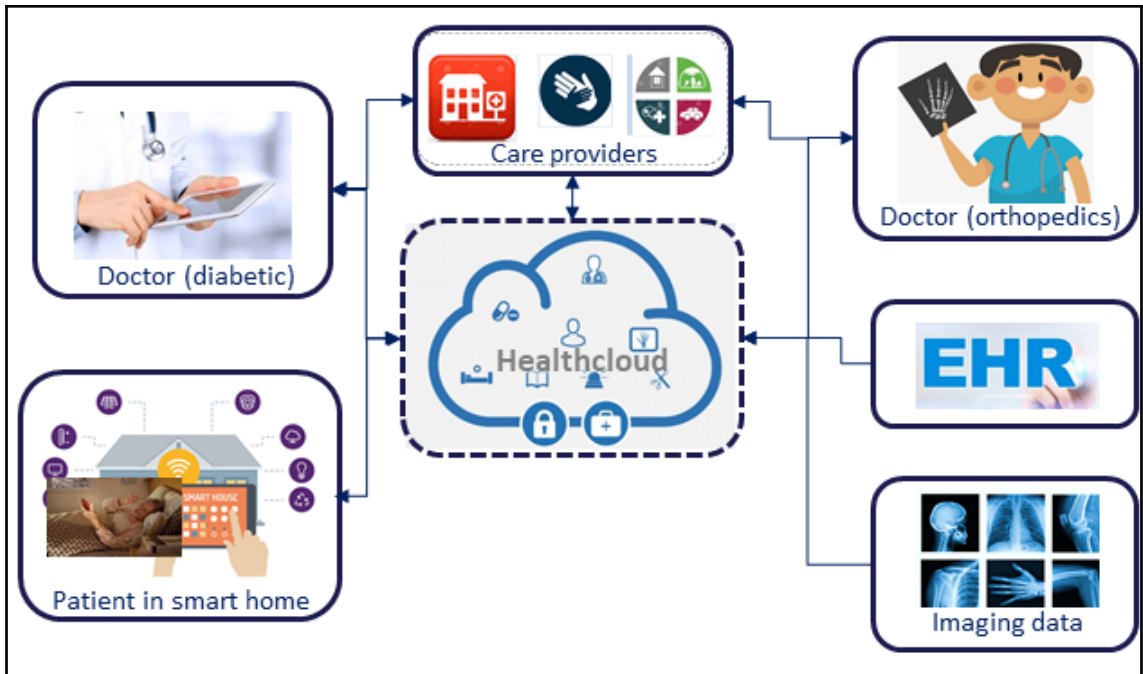
INFO:tensorflow:2019-04-12 22:01:57.172090: Step 3950: Validation accuracy = 56.0% (N=10)
INFO:tensorflow:2019-04-12 22:01:57.717492: Step 3960: Train accuracy = 100.0%
INFO:tensorflow:2019-04-12 22:01:57.717706: Step 3960: Cross entropy = 0.025000
INFO:tensorflow:2019-04-12 22:01:57.771880: Step 3960: Validation accuracy = 56.0% (N=10)
INFO:tensorflow:2019-04-12 22:01:58.327694: Step 3970: Train accuracy = 100.0%
INFO:tensorflow:2019-04-12 22:01:58.327912: Step 3970: Cross entropy = 0.019784
INFO:tensorflow:2019-04-12 22:01:58.382137: Step 3970: Validation accuracy = 51.0% (N=10)
INFO:tensorflow:2019-04-12 22:01:58.960856: Step 3980: Train accuracy = 100.0%
INFO:tensorflow:2019-04-12 22:01:58.961076: Step 3980: Cross entropy = 0.019178
INFO:tensorflow:2019-04-12 22:01:59.013968: Step 3980: Validation accuracy = 54.0% (N=10)
INFO:tensorflow:2019-04-12 22:01:59.570253: Step 3990: Train accuracy = 100.0%
INFO:tensorflow:2019-04-12 22:01:59.570446: Step 3990: Cross entropy = 0.024673
INFO:tensorflow:2019-04-12 22:01:59.623518: Step 3990: Validation accuracy = 62.0% (N=10)
INFO:tensorflow:2019-04-12 22:02:00.125422: Step 3999: Train accuracy = 100.0%
INFO:tensorflow:2019-04-12 22:02:00.125639: Step 3999: Cross entropy = 0.019731
INFO:tensorflow:2019-04-12 22:02:00.180063: Step 3999: Validation accuracy = 64.0% (N=10)
INFO:tensorflow:Final test accuracy = 48.4% (N=95)
WARNING:tensorflow:From retrain.py:838: convert_variables_to_constants (from tensorflow.
Instructions for updating:
Use tf.compat.v1.graph_util.convert_variables_to_constants
WARNING:tensorflow:From /Users/raz/anaconda3/lib/python3.7/site-packages/tensorflow/pyth
ted and will be removed in a future version.
Instructions for updating:
Use tf.compat.v1.graph_util.extract_sub_graph
INFO:tensorflow:Froze 2 variables.
INFO:tensorflow:Converted 2 variables to const ops.

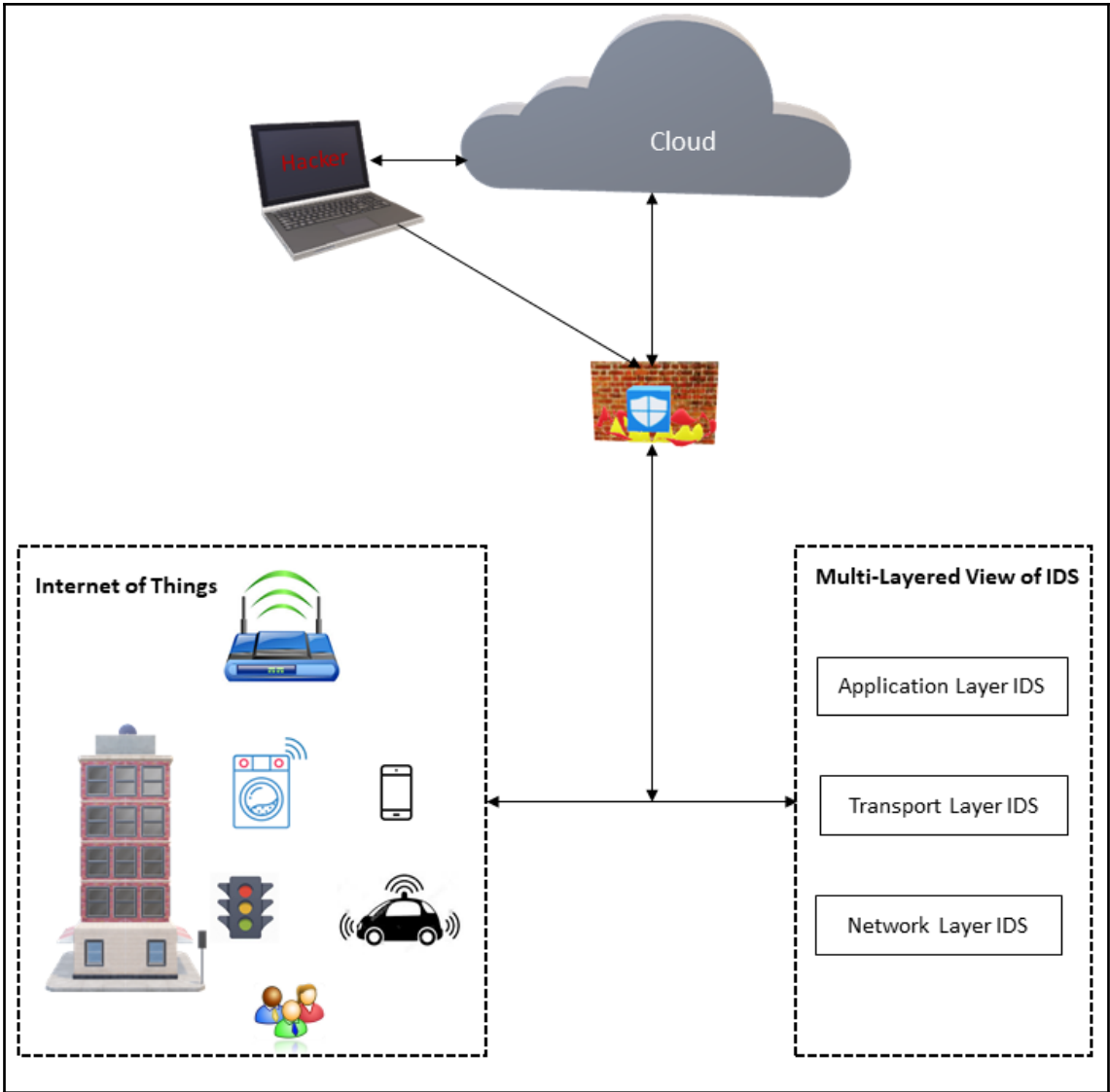
```

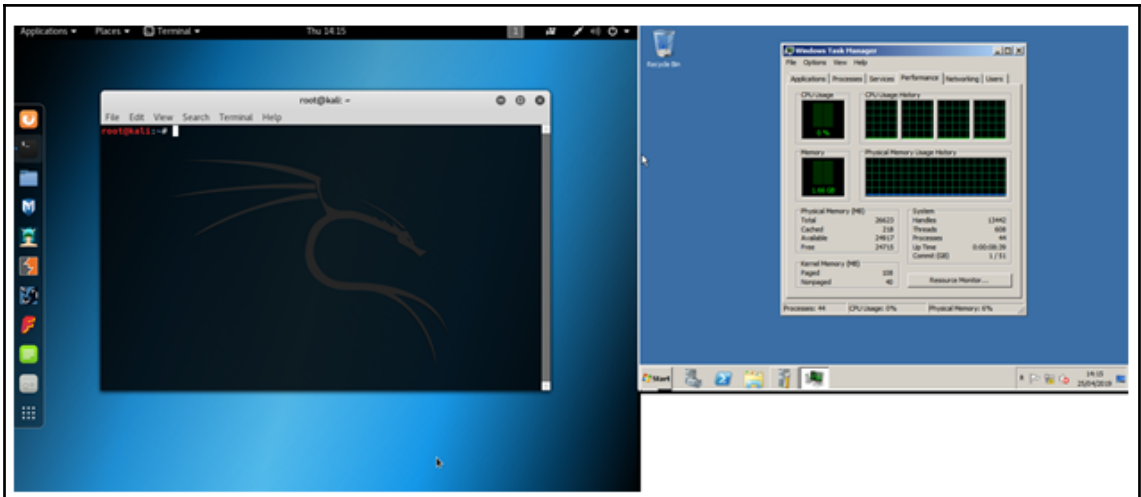
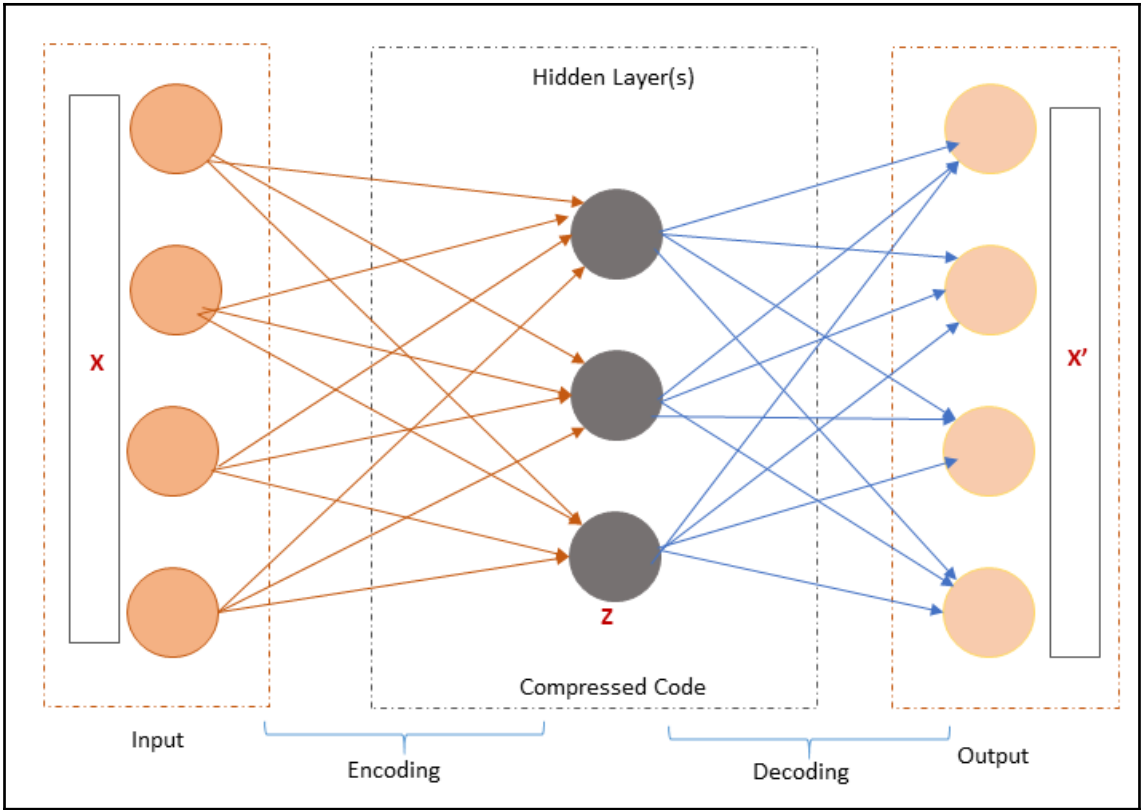


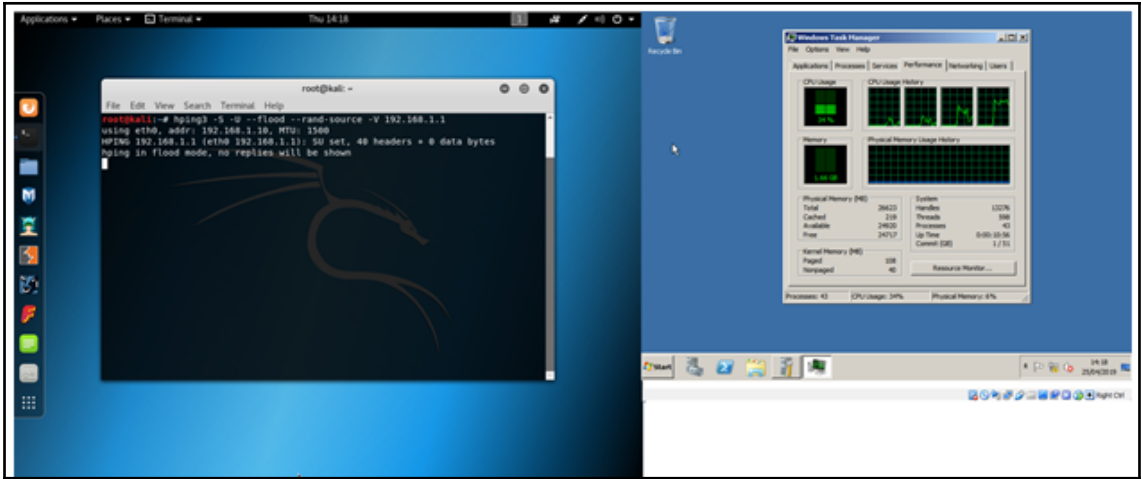
Chapter 7: IoT Security









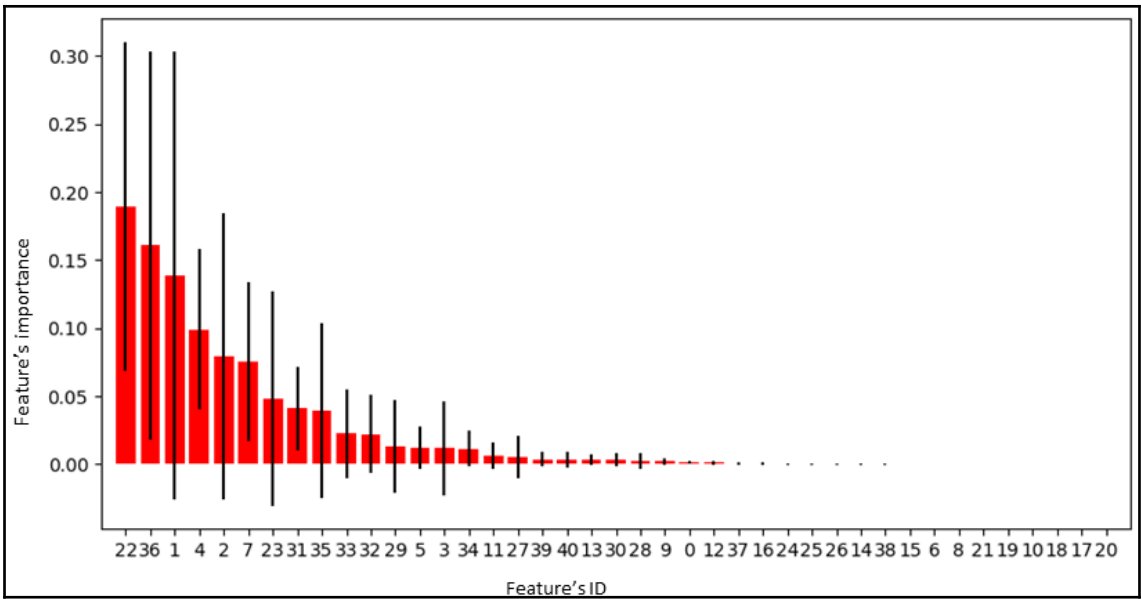


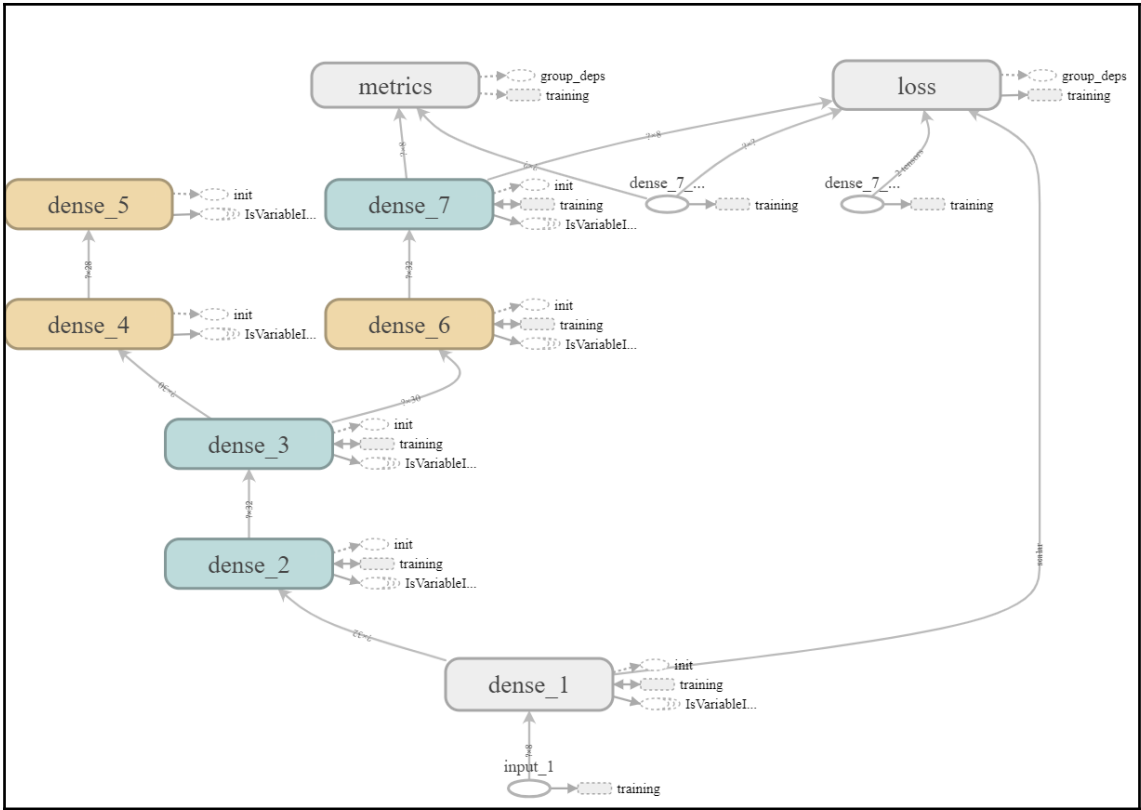
time	cpu utilisation (%)
05/04/2019 19:42	44.8
05/04/2019 19:43	44
05/04/2019 19:44	43.6
05/04/2019 19:45	43.2
05/04/2019 19:46	44
05/04/2019 19:47	43.2
05/04/2019 19:48	45.2
05/04/2019 19:49	44.8
05/04/2019 19:50	43.6
05/04/2019 19:51	42.4
05/04/2019 19:52	41.6
05/04/2019 19:53	41.2
05/04/2019 19:54	40.4
05/04/2019 19:55	40
05/04/2019 19:56	39.6
05/04/2019 19:57	39.2
05/04/2019 19:58	38.8
05/04/2019 19:59	38
05/04/2019 20:00	37.2
05/04/2019 20:01	36.8
05/04/2019 20:02	36
05/04/2019 20:03	35.2
05/04/2019 20:04	35.2
05/04/2019 20:05	34.8
05/04/2019 20:06	34
05/04/2019 20:07	35.6
05/04/2019 20:08	34.4

```

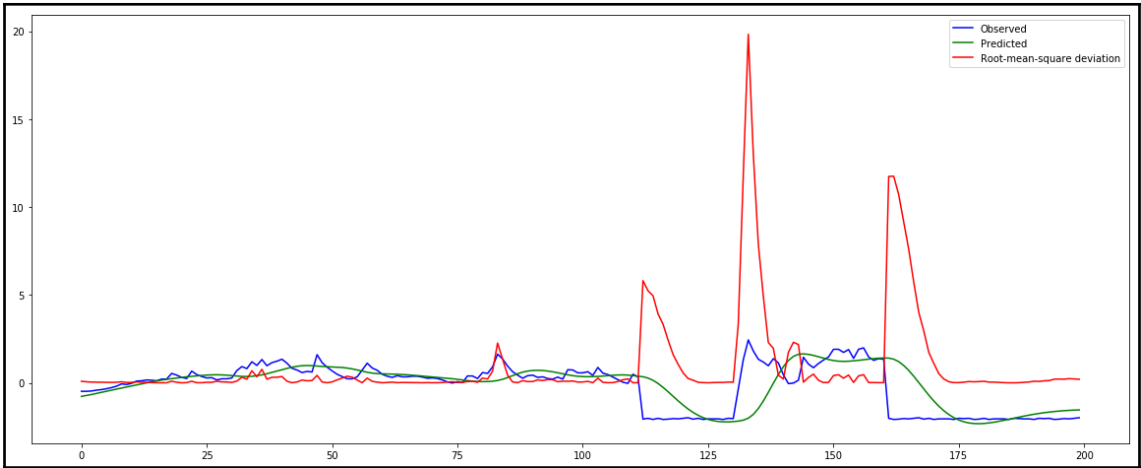
0,tcp,http,SF,181,5450,0,0,0,0,1,0,0,0,0,0,0,0,0,0,8,8,0.00,0.00,0.00,0.00,1.00,0.00,0.00,9,9,1.00,0.00,0.11,0.00,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,239,486,0,0,0,0,0,1,0,0,0,0,0,0,0,0,8,8,0.00,0.00,0.00,0.00,1.00,0.00,0.00,19,19,1.00,0.00,0.05,0.00,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,235,1337,0,0,0,0,0,1,0,0,0,0,0,0,0,0,8,8,0.00,0.00,0.00,0.00,1.00,0.00,0.00,29,29,1.00,0.00,0.03,0.00,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,219,1337,0,0,0,0,0,1,0,0,0,0,0,0,0,0,6,6,0.00,0.00,0.00,0.00,1.00,0.00,0.00,39,39,1.00,0.00,0.03,0.00,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,217,2032,0,0,0,0,0,1,0,0,0,0,0,0,0,0,6,6,0.00,0.00,0.00,0.00,1.00,0.00,0.00,49,49,1.00,0.00,0.02,0.00,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,217,2032,0,0,0,0,0,1,0,0,0,0,0,0,0,0,6,6,0.00,0.00,0.00,0.00,1.00,0.00,0.00,59,59,1.00,0.00,0.02,0.00,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,212,1940,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,2,0.00,0.00,0.00,0.00,1.00,0.00,1.00,1,69,1.00,0.00,1.00,0.04,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,159,4087,0,0,0,0,0,1,0,0,0,0,0,0,0,0,5,5,0.00,0.00,0.00,0.00,1.00,0.00,0.00,0.00,11,79,1.00,0.00,0.09,0.04,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,210,151,0,0,0,0,0,1,0,0,0,0,0,0,0,0,8,8,0.00,0.00,0.00,0.00,1.00,0.00,0.00,8,89,1.00,0.00,0.12,0.04,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,212,786,0,0,0,0,1,0,1,0,0,0,0,0,0,0,8,8,0.00,0.00,0.00,0.00,1.00,0.00,0.00,8,99,1.00,0.00,0.12,0.05,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,210,624,0,0,0,0,0,1,0,0,0,0,0,0,0,0,18,18,0.00,0.00,0.00,0.00,1.00,0.00,0.00,18,109,1.00,0.00,0.06,0.05,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,177,1985,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,1,0.00,0.00,0.00,0.00,1.00,0.00,0.00,28,119,1.00,0.00,0.04,0.04,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,222,773,0,0,0,0,0,1,0,0,0,0,0,0,0,0,11,11,0.00,0.00,0.00,0.00,1.00,0.00,0.00,38,129,1.00,0.00,0.03,0.04,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,256,1169,0,0,0,0,0,1,0,0,0,0,0,0,0,0,4,4,0.00,0.00,0.00,0.00,1.00,0.00,0.00,4,139,1.00,0.00,0.25,0.04,0.00,0.00,0.00,0.00,normal.
0,tcp,http,SF,241,259,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,1,0.00,0.00,0.00,0.00,1.00,0.00,0.00,14,149,1.00,0.00,0.07,0.04,0.00,0.00,0.00,0.00,normal.

```



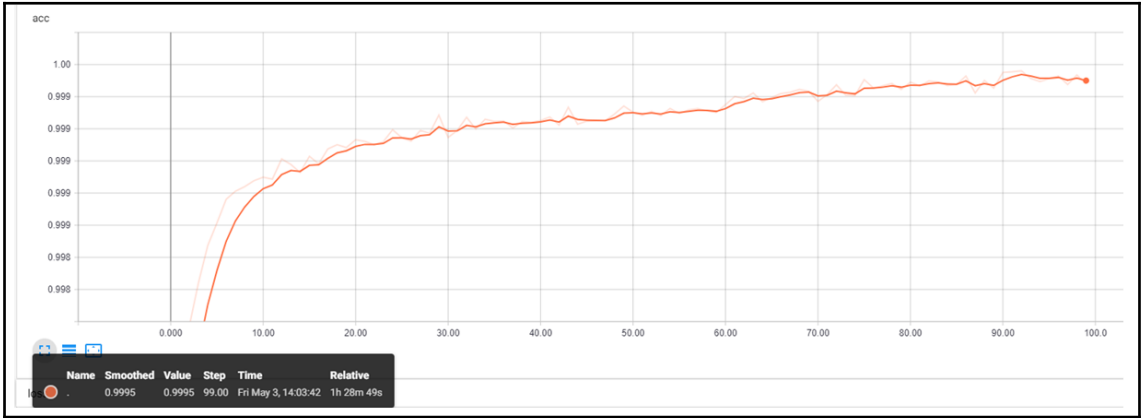
File Name	Size	Modified	Model Type
checkpoint-02.hdf5	1.5 MB	Today, 12:28 AM	LSTM
model.hdf5	85 KB	Today, 12:03 AM	AE
dnn_model.hdf5	16.3 MB	Thursday, 2 May 2019 at 7:52 PM	DNN



```

8000/8000 [=====] - 1s 119us/step - loss: 6.1625e-04 - acc: 0.9849 - val_loss: 0.0043 - val_acc: 0.9910
Epoch 92/100
8000/8000 [=====] - 1s 94us/step - loss: 6.0790e-04 - acc: 0.9863 - val_loss: 0.0043 - val_acc: 0.9925
Epoch 93/100
8000/8000 [=====] - 1s 73us/step - loss: 6.1403e-04 - acc: 0.9846 - val_loss: 0.0043 - val_acc: 0.9925
Epoch 94/100
8000/8000 [=====] - 1s 107us/step - loss: 6.0658e-04 - acc: 0.9856 - val_loss: 0.0042 - val_acc: 0.9925
Epoch 95/100
8000/8000 [=====] - 1s 80us/step - loss: 6.0448e-04 - acc: 0.9851 - val_loss: 0.0043 - val_acc: 0.9795
Epoch 96/100
8000/8000 [=====] - 1s 121us/step - loss: 6.2155e-04 - acc: 0.9840 - val_loss: 0.0043 - val_acc: 0.9925
Epoch 97/100
8000/8000 [=====] - 1s 111us/step - loss: 5.7116e-04 - acc: 0.9848 - val_loss: 0.0036 - val_acc: 0.9900
Epoch 98/100
8000/8000 [=====] - 1s 88us/step - loss: 5.2258e-04 - acc: 0.9830 - val_loss: 0.0038 - val_acc: 0.9920
Epoch 99/100
8000/8000 [=====] - 1s 84us/step - loss: 5.0029e-04 - acc: 0.9824 - val_loss: 0.0032 - val_acc: 0.9925
Epoch 100/100
8000/8000 [=====] - 1s 78us/step - loss: 5.0952e-04 - acc: 0.9850 - val_loss: 0.0033 - val_acc: 0.9920

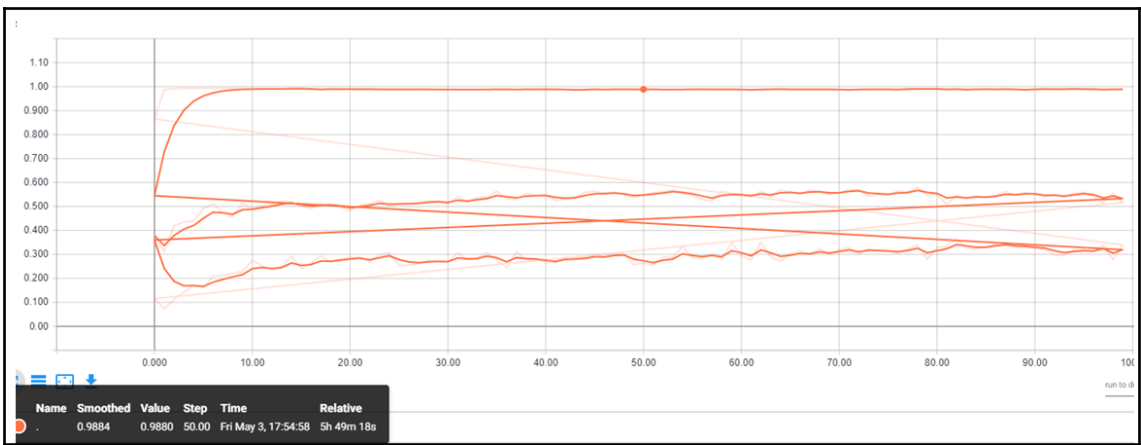
```



```

Epoch 88/100
8000/8000 [=====] - 1s 107us/step - loss: 2.1088e-04 - acc: 0.9899 - val_loss: 0.0059 - val_acc: 0.9270
Epoch 89/100
8000/8000 [=====] - 1s 110us/step - loss: 2.0525e-04 - acc: 0.9881 - val_loss: 0.0059 - val_acc: 0.9070
Epoch 90/100
8000/8000 [=====] - 1s 119us/step - loss: 2.6043e-04 - acc: 0.9841 - val_loss: 0.0058 - val_acc: 0.9160
Epoch 91/100
8000/8000 [=====] - 1s 97us/step - loss: 1.9234e-04 - acc: 0.9901 - val_loss: 0.0059 - val_acc: 0.9070
Epoch 92/100
8000/8000 [=====] - 1s 95us/step - loss: 1.7994e-04 - acc: 0.9918 - val_loss: 0.0054 - val_acc: 0.9210
Epoch 93/100
8000/8000 [=====] - 1s 109us/step - loss: 1.9276e-04 - acc: 0.9889 - val_loss: 0.0055 - val_acc: 0.9445
Epoch 94/100
8000/8000 [=====] - 1s 79us/step - loss: 2.1188e-04 - acc: 0.9884 - val_loss: 0.0059 - val_acc: 0.9005
Epoch 95/100
8000/8000 [=====] - 1s 82us/step - loss: 1.7335e-04 - acc: 0.9913 - val_loss: 0.0057 - val_acc: 0.9180
Epoch 96/100
8000/8000 [=====] - 1s 79us/step - loss: 1.9446e-04 - acc: 0.9890 - val_loss: 0.0060 - val_acc: 0.8909
Epoch 97/100
8000/8000 [=====] - 1s 80us/step - loss: 1.8210e-04 - acc: 0.9881 - val_loss: 0.0052 - val_acc: 0.9340
Epoch 98/100
8000/8000 [=====] - 1s 108us/step - loss: 2.1122e-04 - acc: 0.9864 - val_loss: 0.0056 - val_acc: 0.9230
Epoch 99/100
8000/8000 [=====] - 1s 101us/step - loss: 2.0366e-04 - acc: 0.9889 - val_loss: 0.0053 - val_acc: 0.9325
Epoch 100/100
8000/8000 [=====] - 1s 71us/step - loss: 1.7829e-04 - acc: 0.9895 - val_loss: 0.0055 - val_acc: 0.9195
(tf-gpu) C:\Anaconda3\Book-DL-IoT\chapter7\IoT-IDS\IDS-Network-layer-KDD>_

```



```

Epoch 00093: loss did not improve from 0.00189
Epoch 94/100
494021/494021 [=====] - 50s 101us/step - loss: 0.0022 - acc: 0.9995

Epoch 00094: loss did not improve from 0.00189
Epoch 95/100
494021/494021 [=====] - 53s 108us/step - loss: 0.0025 - acc: 0.9995

Epoch 00095: loss did not improve from 0.00189
Epoch 96/100
494021/494021 [=====] - 51s 104us/step - loss: 0.0022 - acc: 0.9995

Epoch 00096: loss did not improve from 0.00189
Epoch 97/100
494021/494021 [=====] - 55s 111us/step - loss: 0.0022 - acc: 0.9995

Epoch 00097: loss did not improve from 0.00189
Epoch 98/100
494021/494021 [=====] - 50s 101us/step - loss: 0.0023 - acc: 0.9995

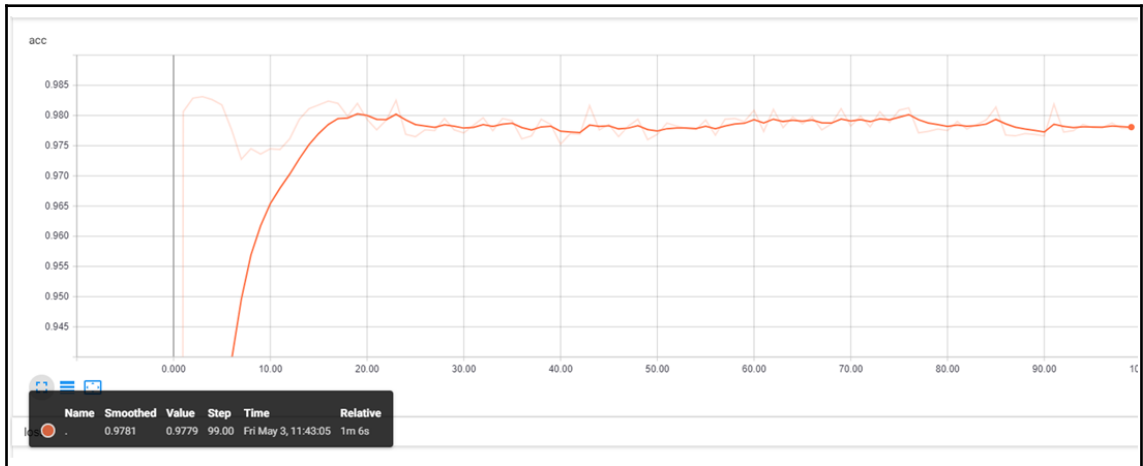
Epoch 00098: loss did not improve from 0.00189
Epoch 99/100
494021/494021 [=====] - 52s 104us/step - loss: 0.0023 - acc: 0.9995

Epoch 00099: loss did not improve from 0.00189
Epoch 100/100
494021/494021 [=====] - 51s 103us/step - loss: 0.0028 - acc: 0.9995

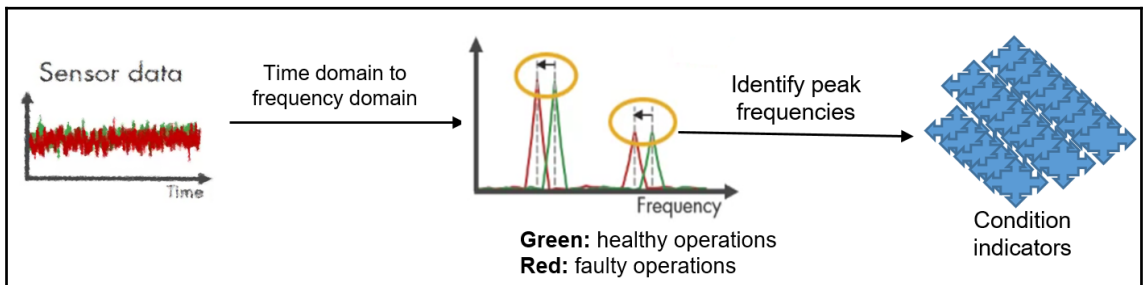
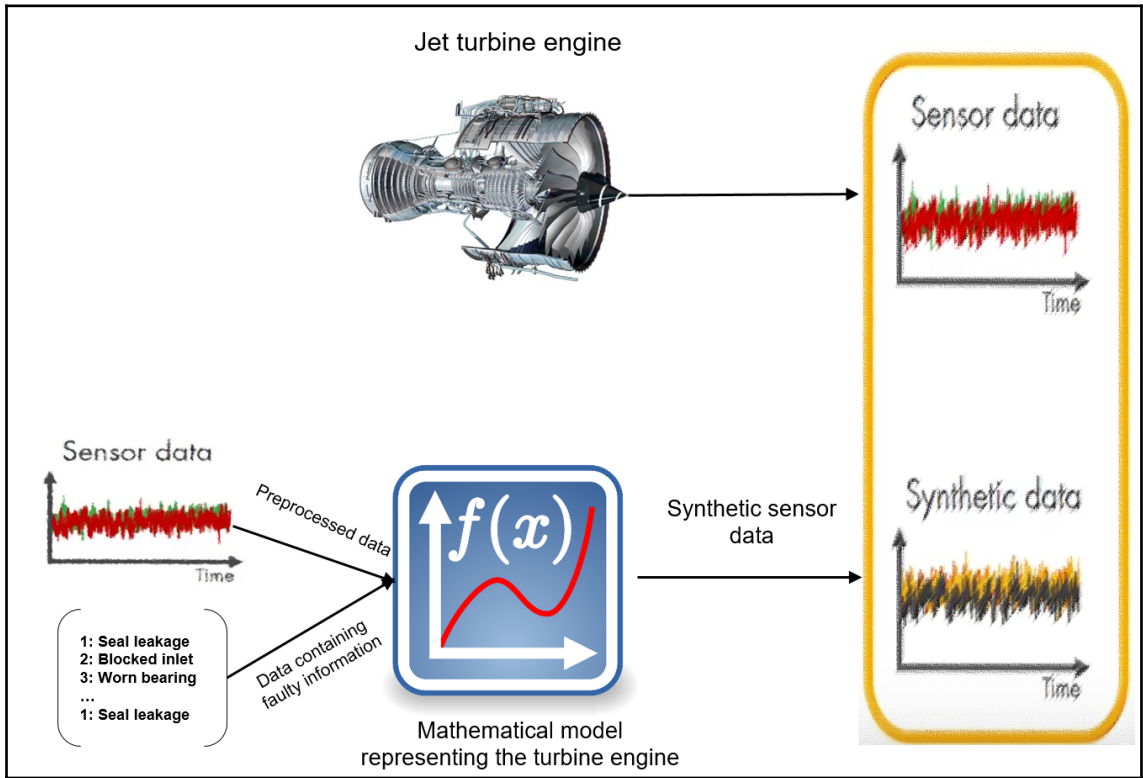
Epoch 00100: loss did not improve from 0.00189

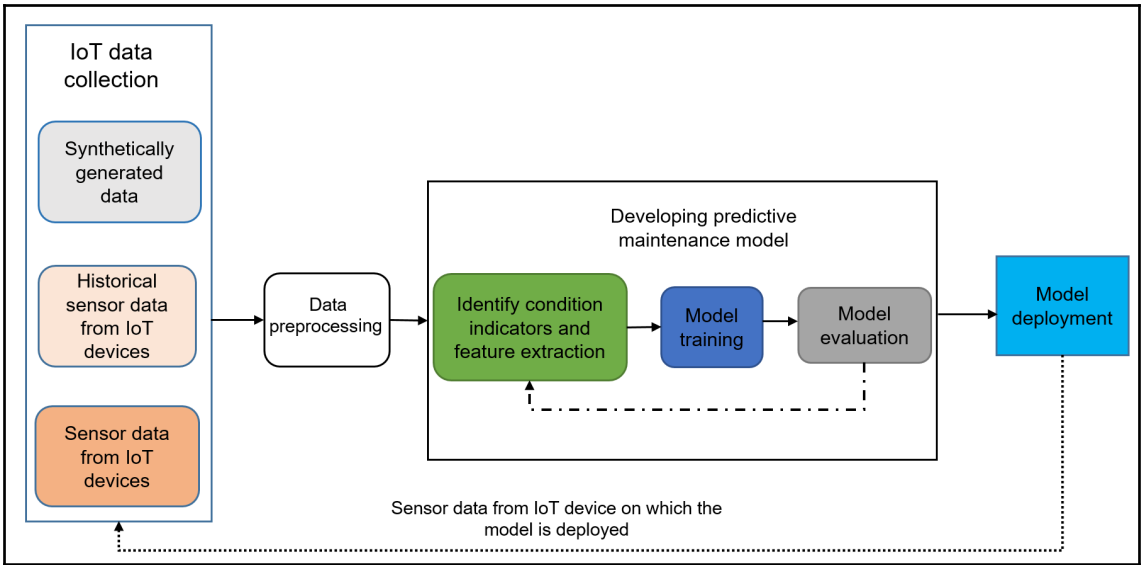
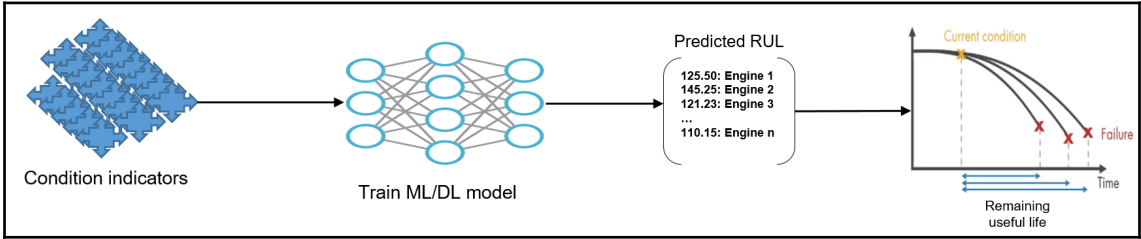
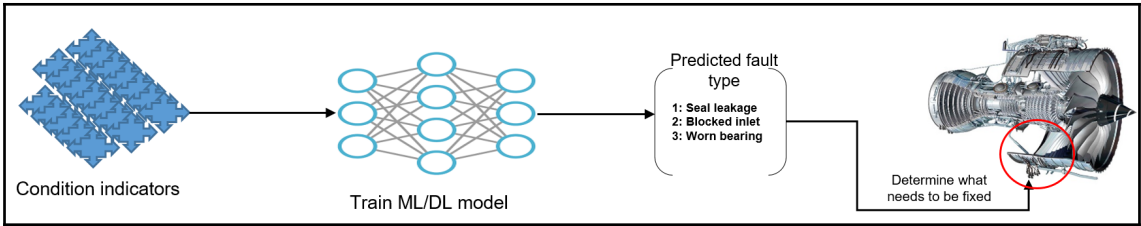
(tf-gpu) C:\Anaconda3\Book-DL-IoT\chapter7\IoT-IDS\IDS-KDD-OverAll-DNN>

```

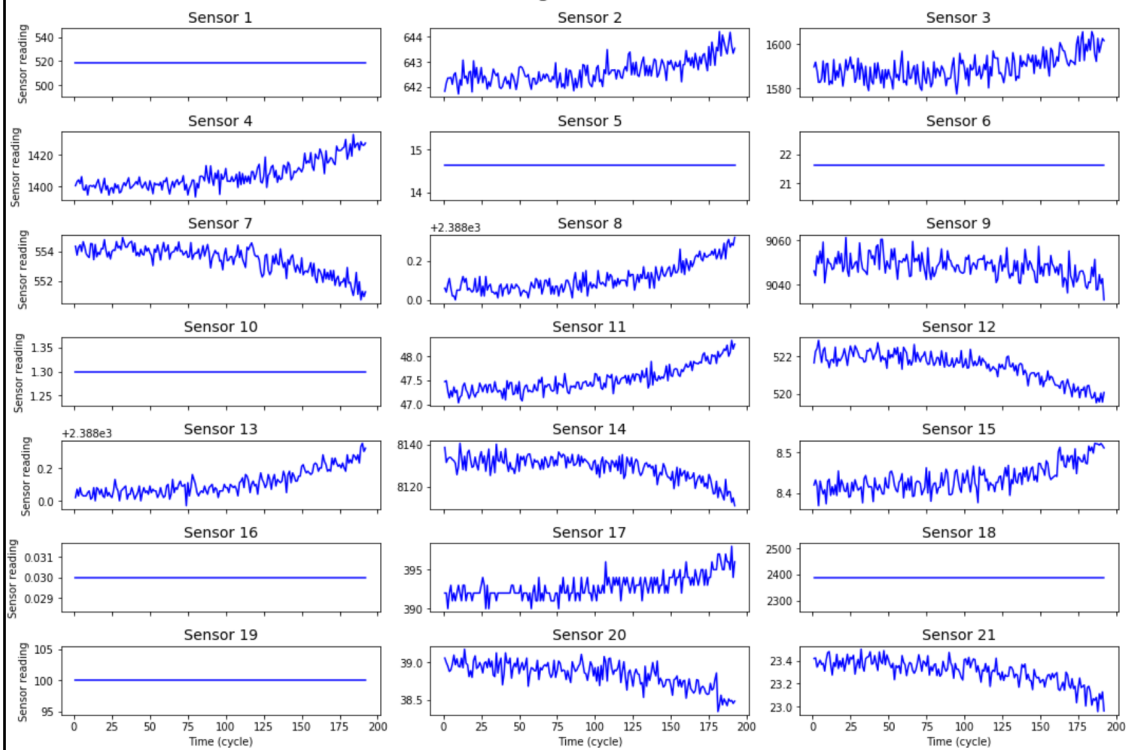


Chapter 8: Predictive Maintenance for IoT

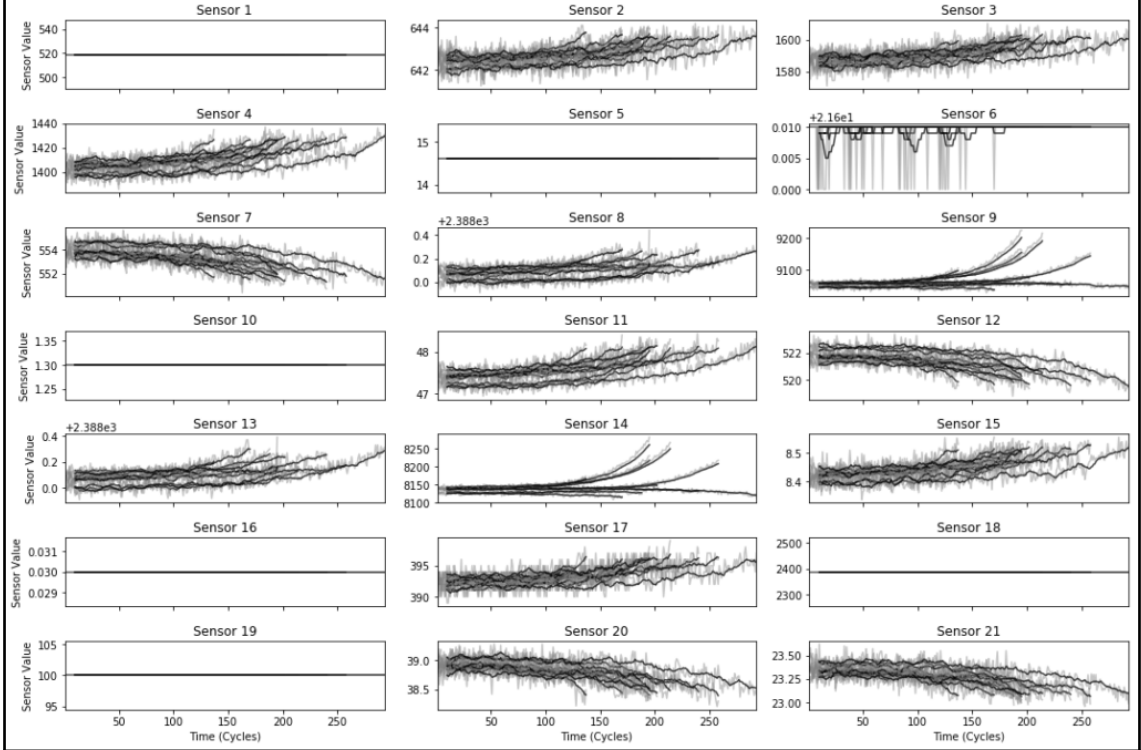




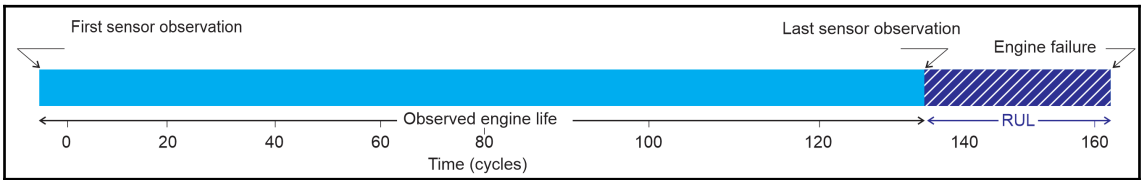
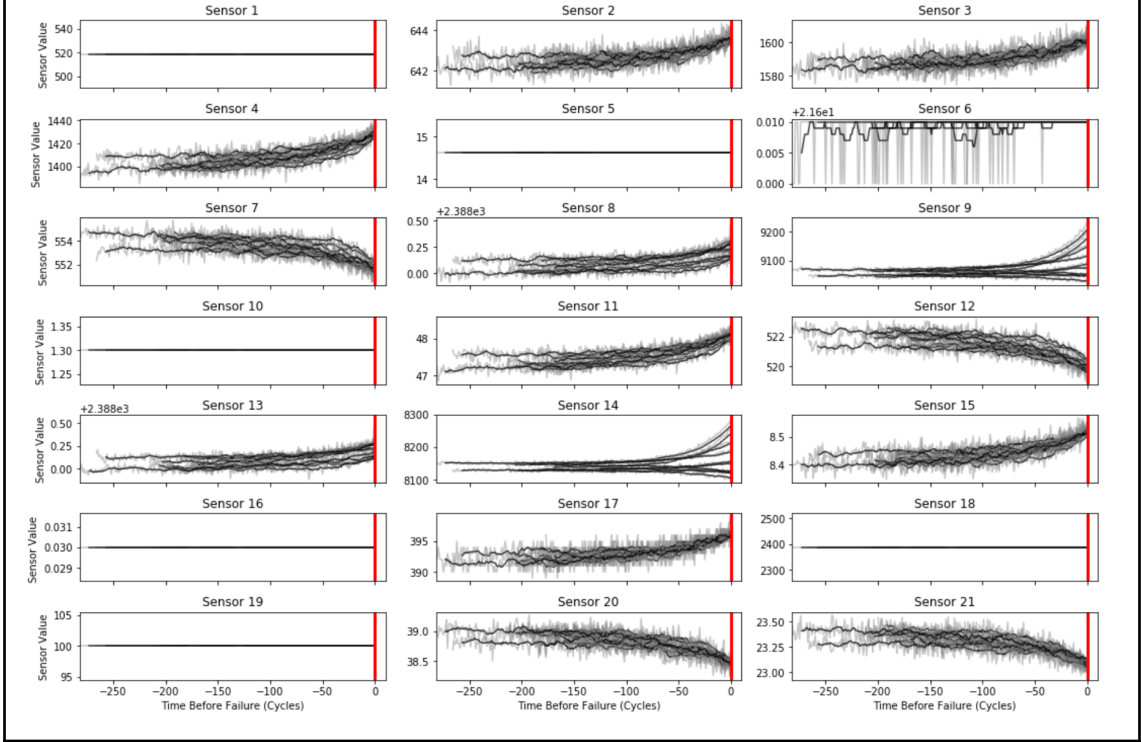
Sensor reading : unit 1, dataset 1



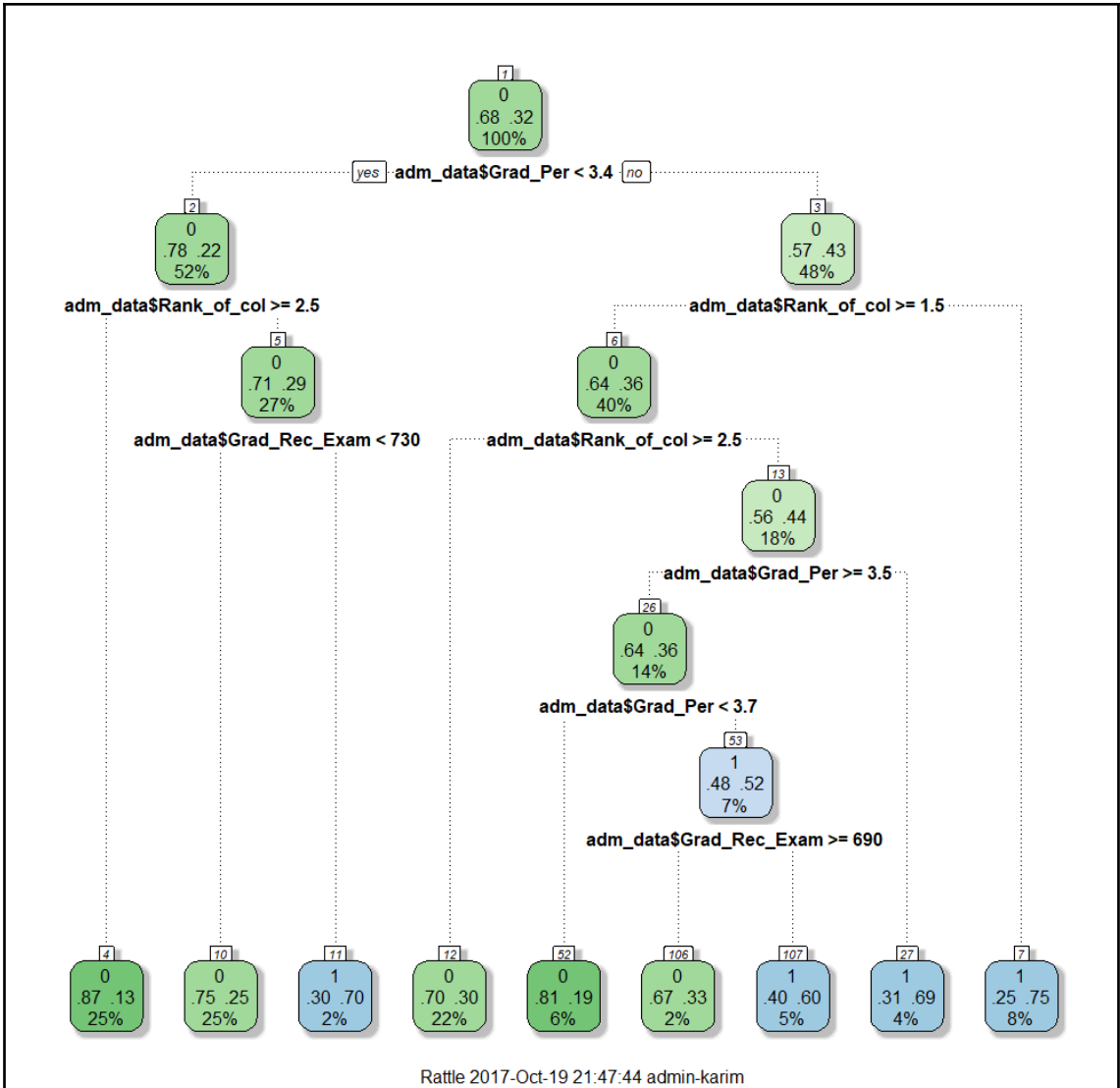
All Sensor Traces: Dataset 1 (Random Sample of 10 Units)

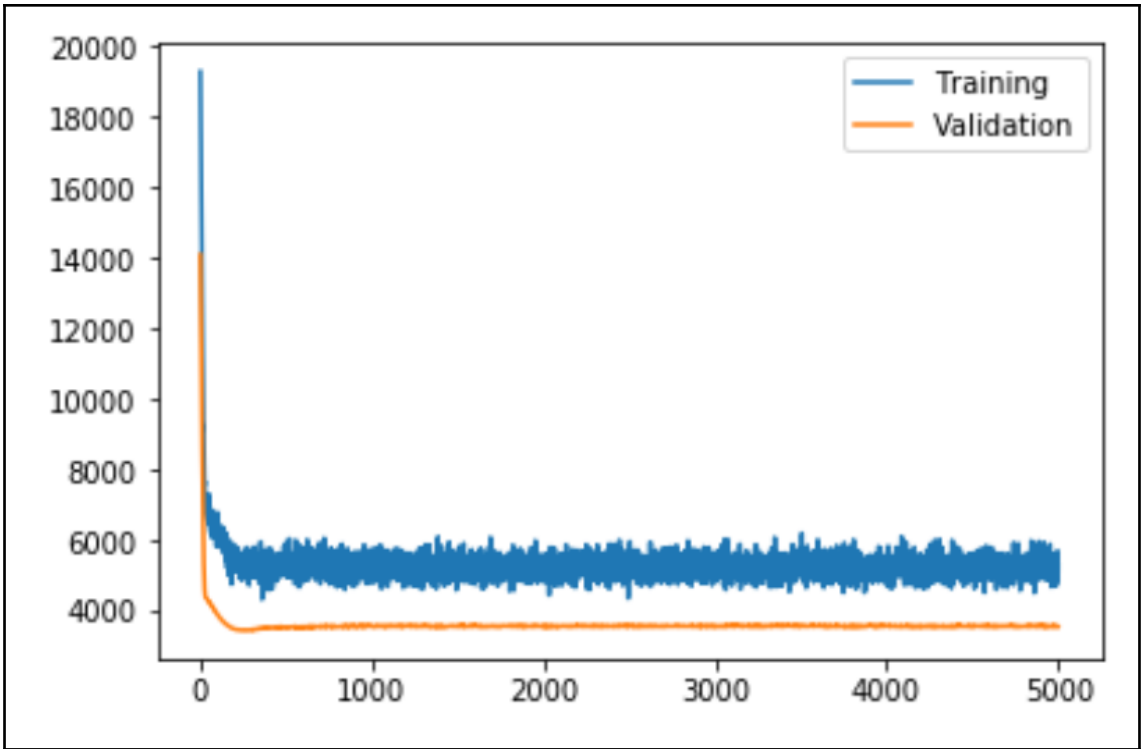
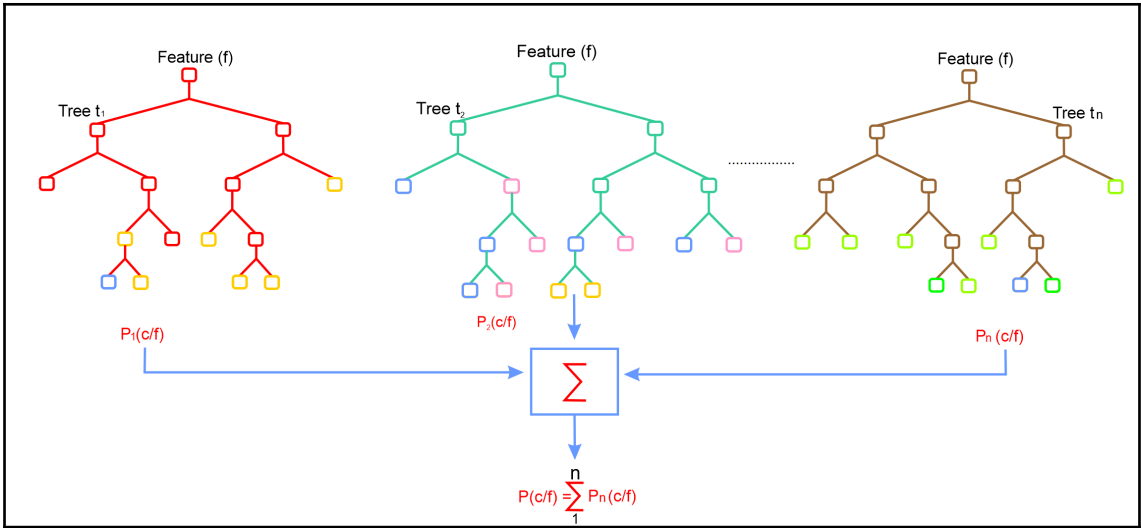


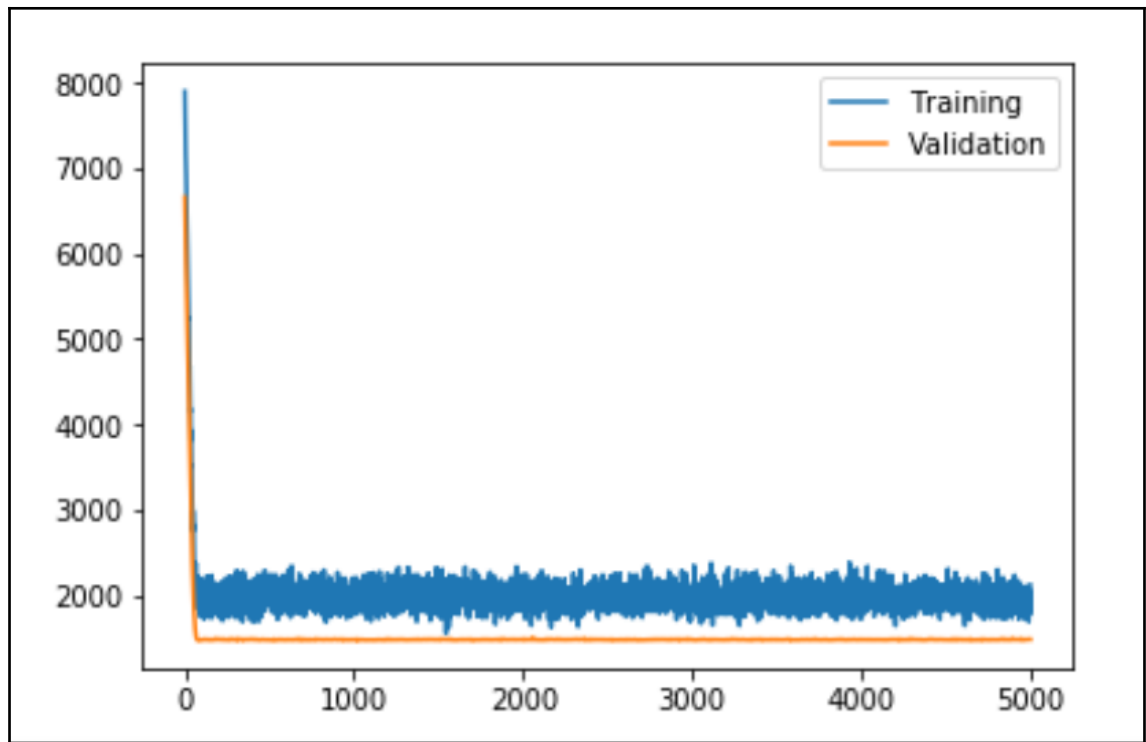
All Sensor Traces: Dataset 1 (Random Sample of 10 Units)



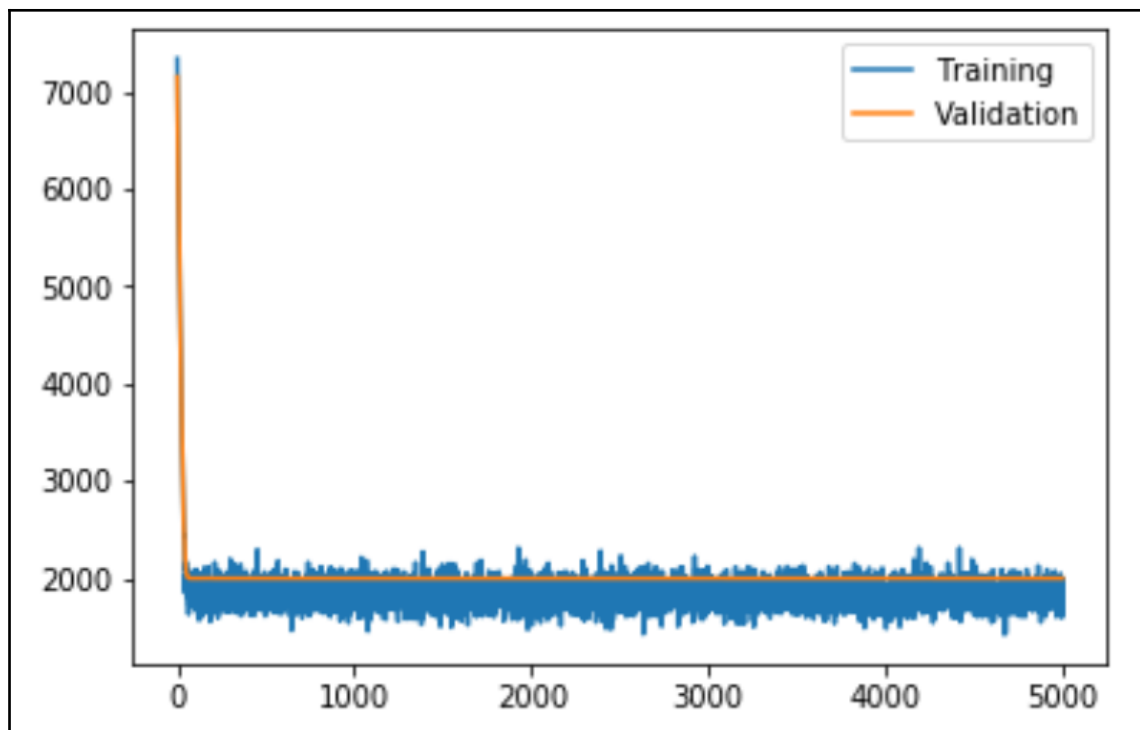
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2	2	2000-01-03 00:10:00	189
3	3	2000-01-05 09:50:00	22
4	4	2000-01-06 06:00:00	90
5	5	2000-01-07 02:30:00	236



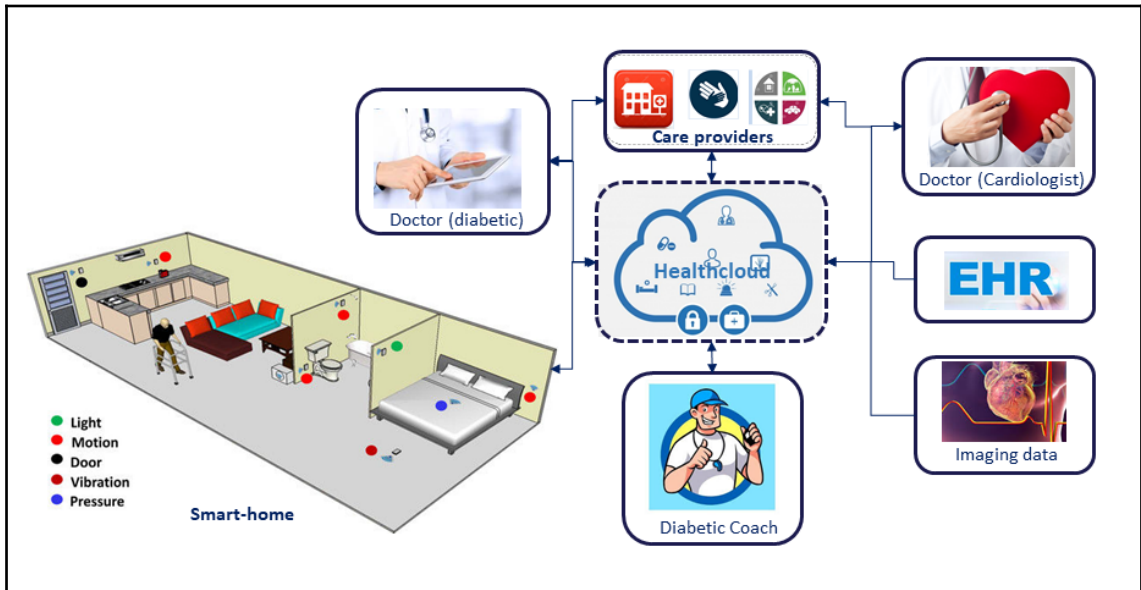
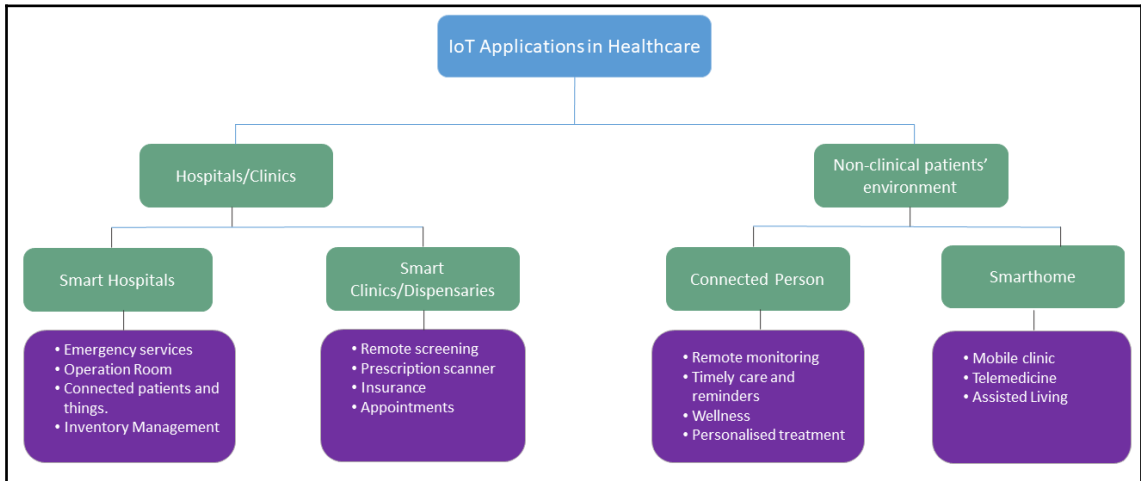


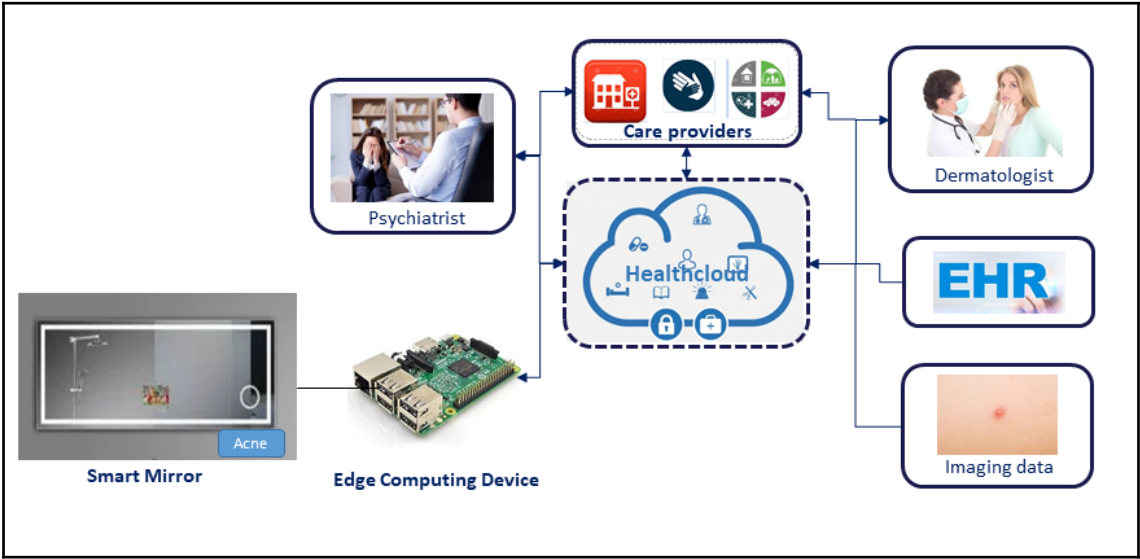


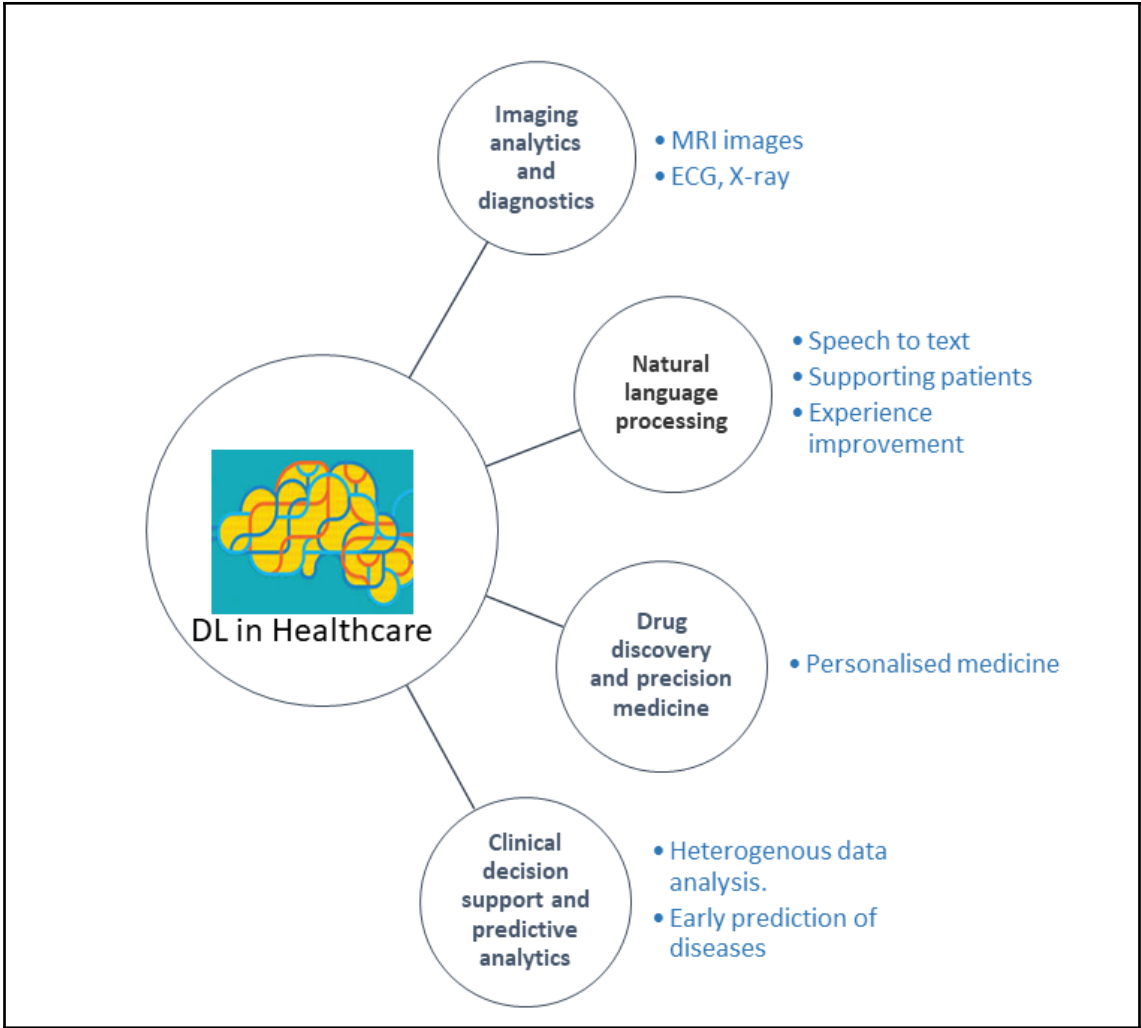
index	engine_no	cutoff_time	RUL
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2	2	2000-01-04 07:20:00	143
3	3	2000-01-06 14:30:00	119
4	4	2000-01-07 15:30:00	243
5	5	2000-01-09 15:50:00	146



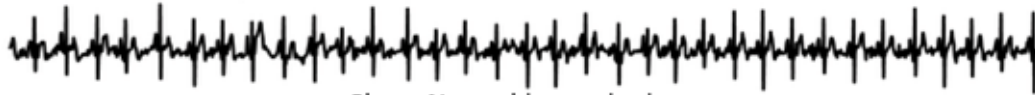
Chapter 9: Deep Learning in Healthcare IoT







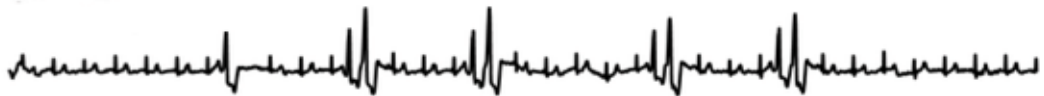




Class: Normal heart rhythm



Class: Atrial fibrillation



Class: Other rhythm




























Class: Noisy measurement

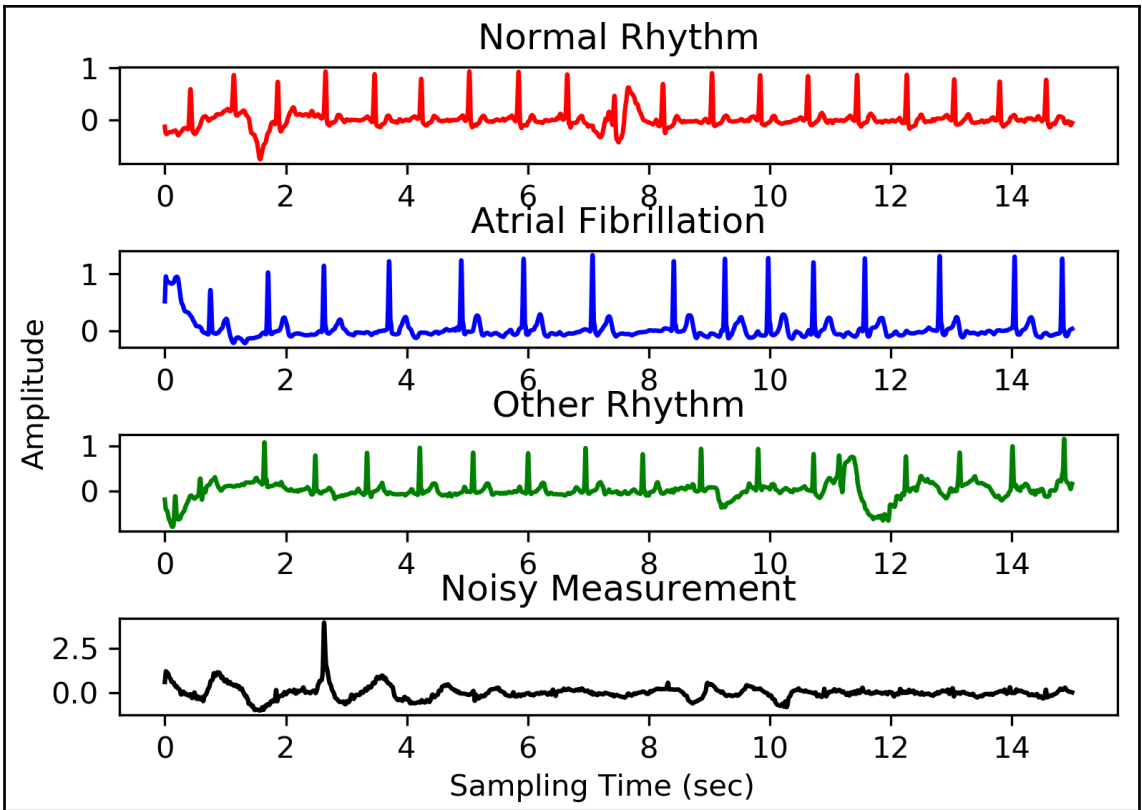


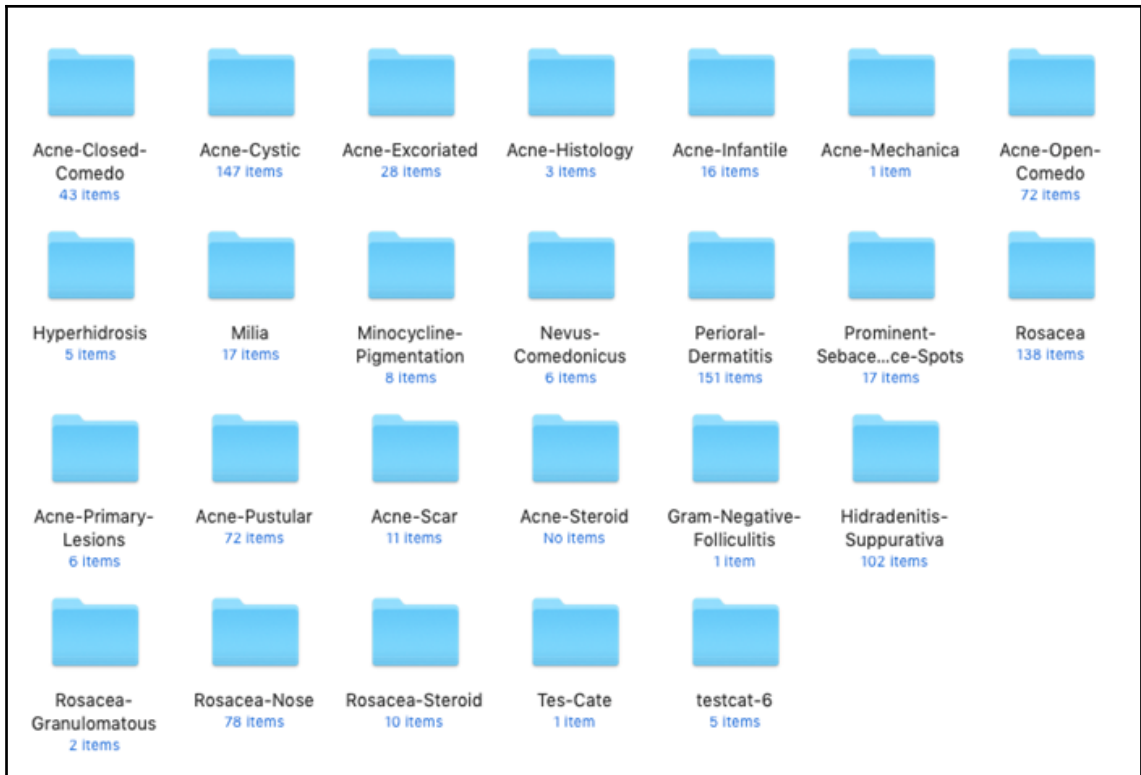
Class: Normal heart rhythm



Class: Atrial fibrillation

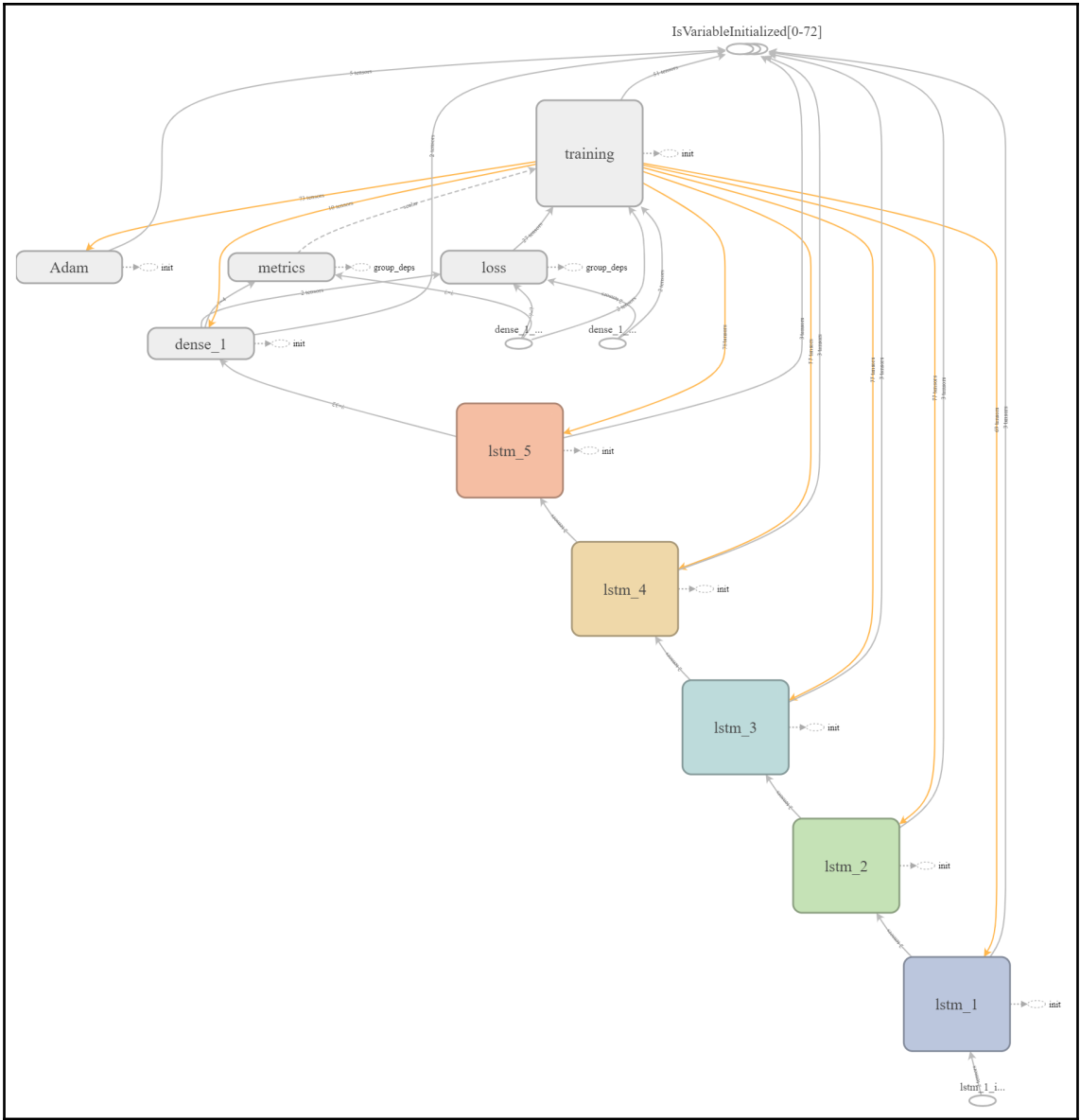
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 Acne-Cystic	08/05/2019 14:00	File folder
 Acne-Excoriated	08/05/2019 14:00	File folder
 Acne-Histology	08/05/2019 14:00	File folder
 Acne-Infantile	08/05/2019 14:01	File folder
 Acne-Mechanica	08/05/2019 14:01	File folder
 Acne-Open-Comedo	08/05/2019 14:02	File folder
 Acne-Primary-Lesions	08/05/2019 14:02	File folder
 Acne-Pustular	08/05/2019 14:03	File folder
 Acne-Scar	08/05/2019 14:03	File folder
 Acne-Steroid	08/05/2019 14:03	File folder
 Gram-Negative-Folliculitis	08/05/2019 14:03	File folder
 Hidradenitis-Suppurativa	08/05/2019 14:05	File folder
 Hyperhidrosis	08/05/2019 14:05	File folder
 Milia	08/05/2019 14:05	File folder
 Minocycline-Pigmentation	08/05/2019 14:05	File folder
 Nevus-Comedonicus	08/05/2019 14:05	File folder
 Perioral-Dermatitis	08/05/2019 14:07	File folder
 Prominent-Sebaceous-Glands-and-Fo...	08/05/2019 14:08	File folder
 Rosacea	08/05/2019 14:10	File folder
 Rosacea-Granulomatous	08/05/2019 14:10	File folder
 Rosacea-Nose	08/05/2019 14:11	File folder
 Rosacea-Steroid	08/05/2019 14:11	File folder
 Tes-Cate	08/05/2019 14:11	File folder
 testcat-6	08/05/2019 14:11	File folder

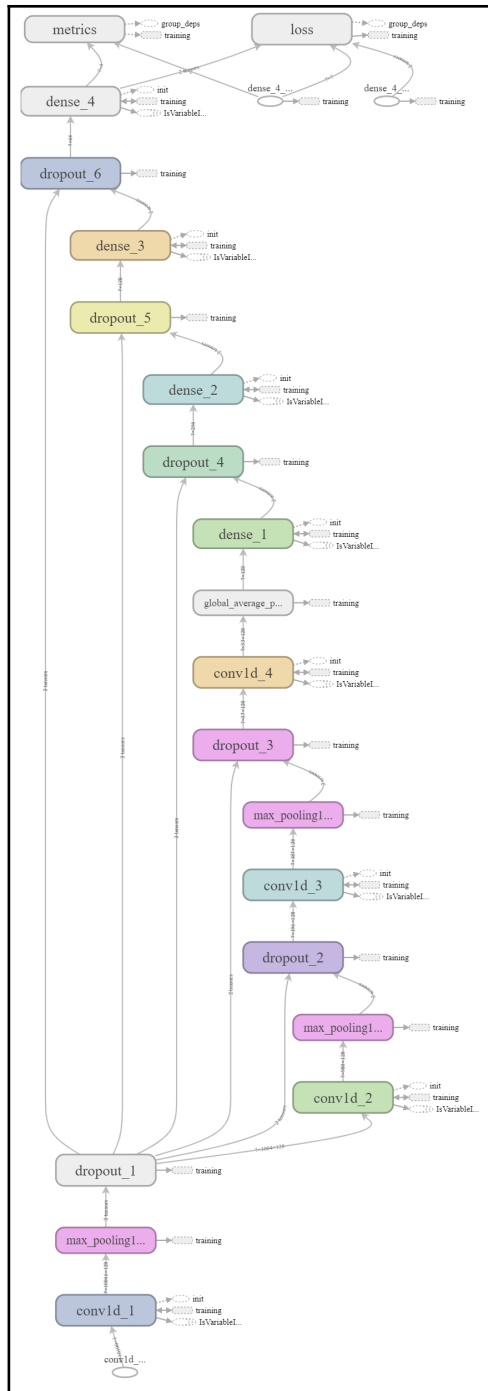


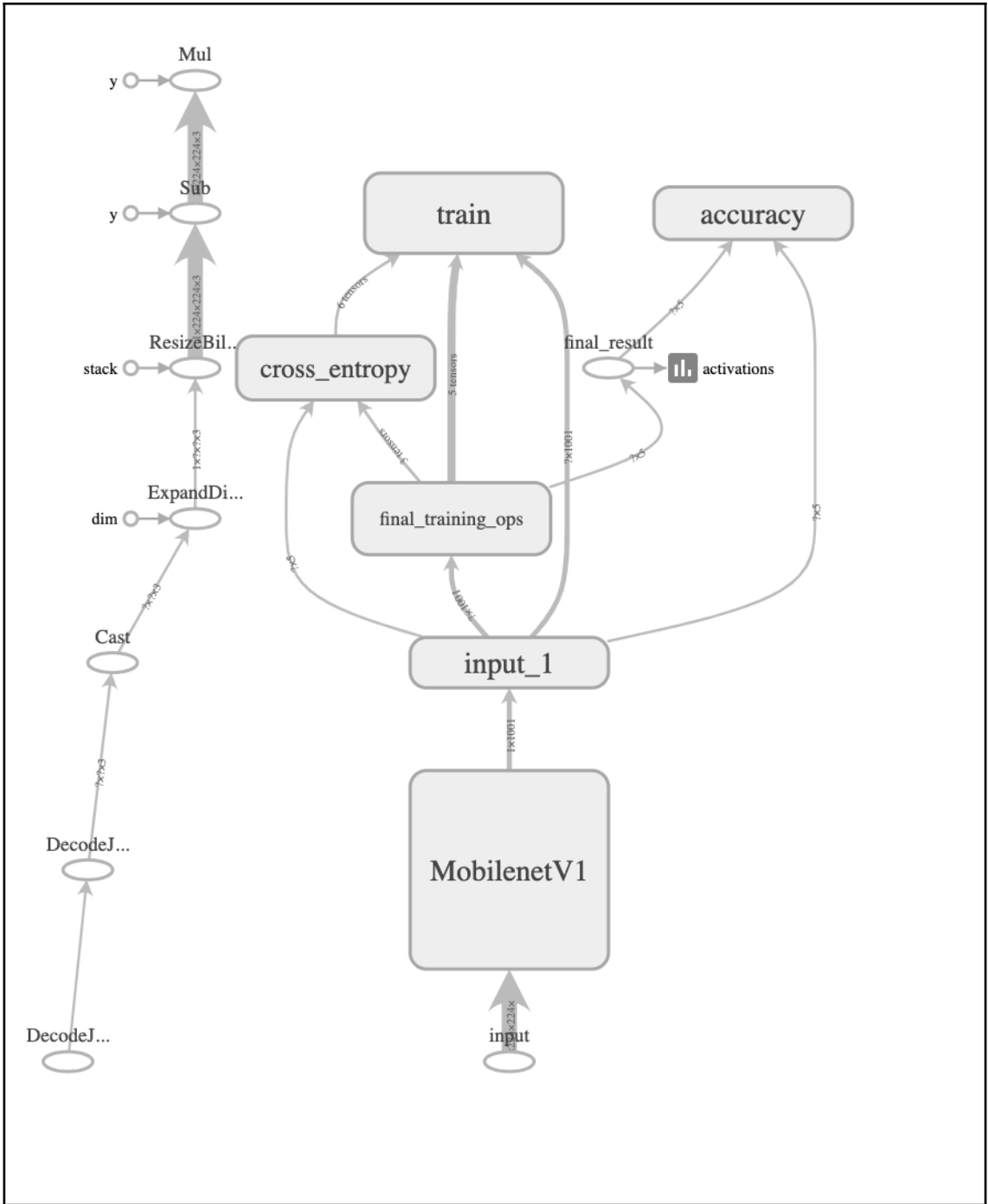


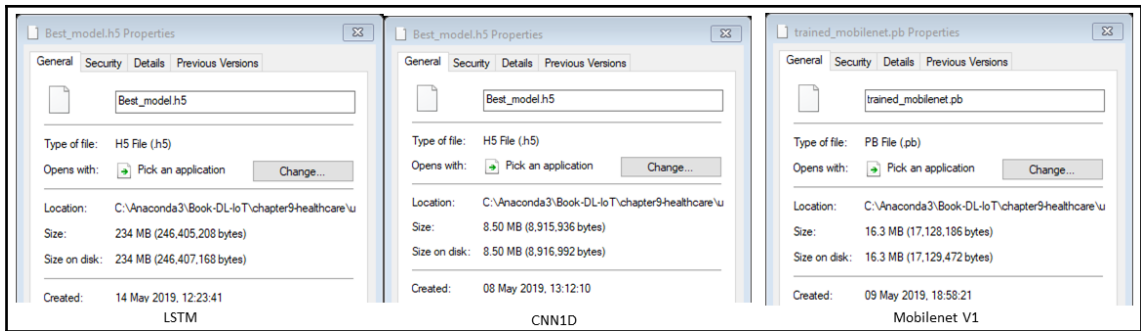
> OSDisk (C:) > Anaconda3 > Book-DL-IoT > chapter9-healthcare > use-case-2 > DL-for-SkinDisease > dataset-Acne-reduced

Name	Date modified	Type	Size
Acne-Cystic	09/05/2019 18:47	File folder	
Hidradenitis-Suppurativa	12/05/2019 16:31	File folder	
Perioral-Dermatitis	09/05/2019 18:47	File folder	
Rosacea	09/05/2019 18:47	File folder	

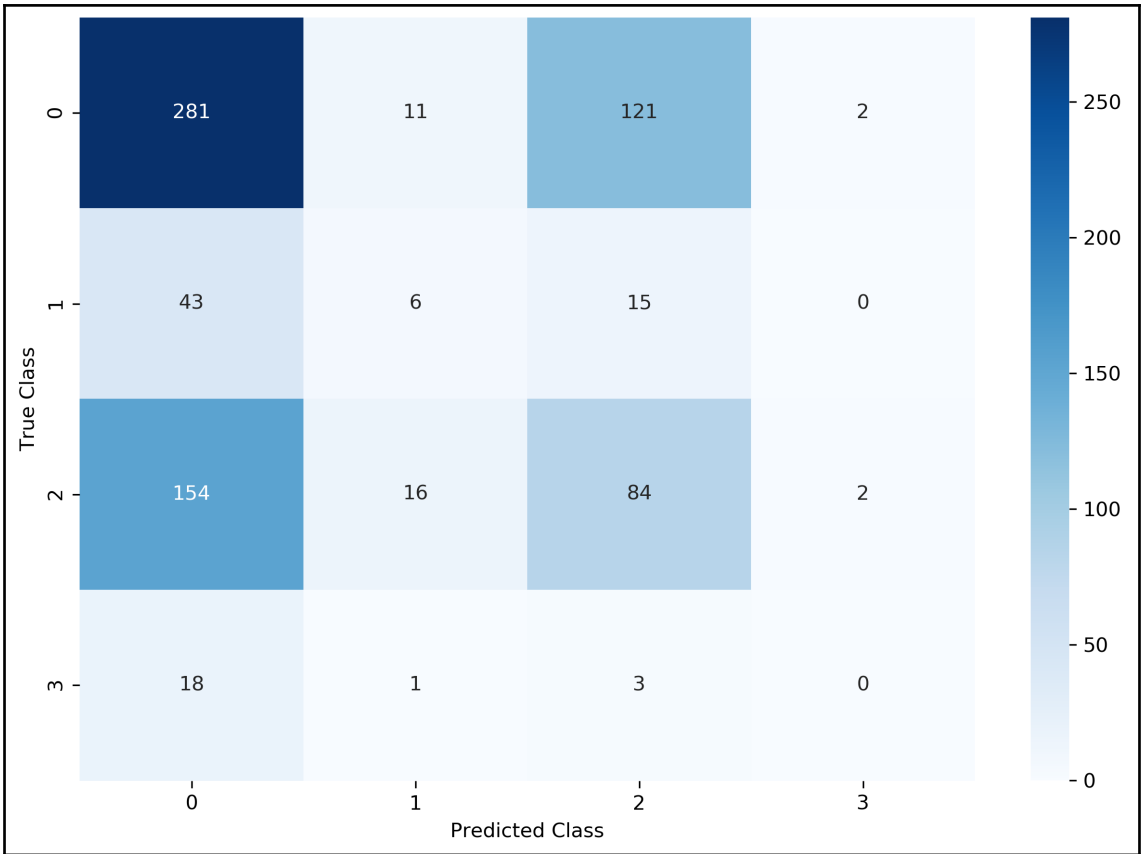
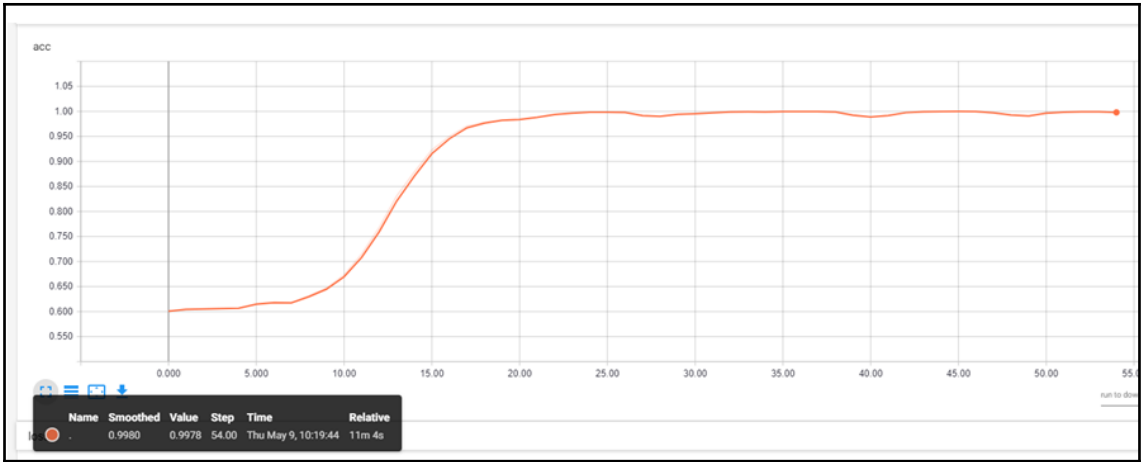




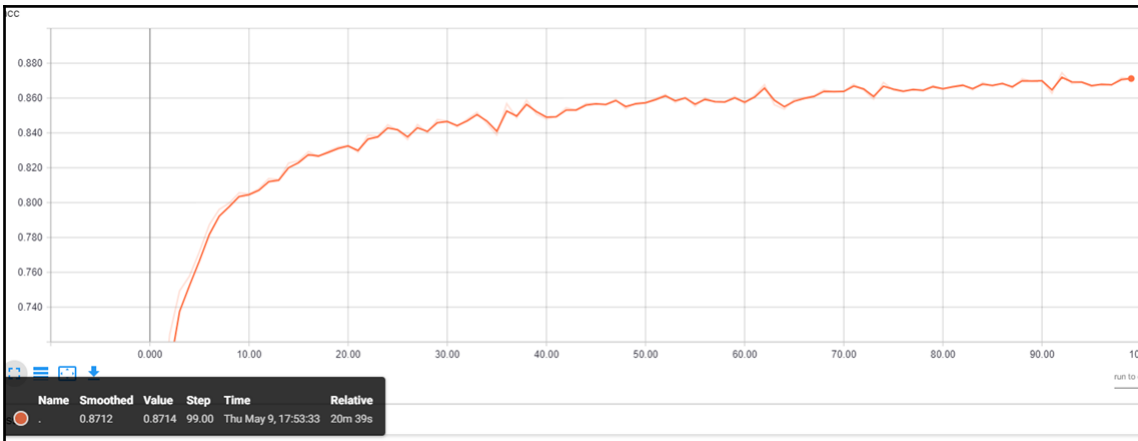


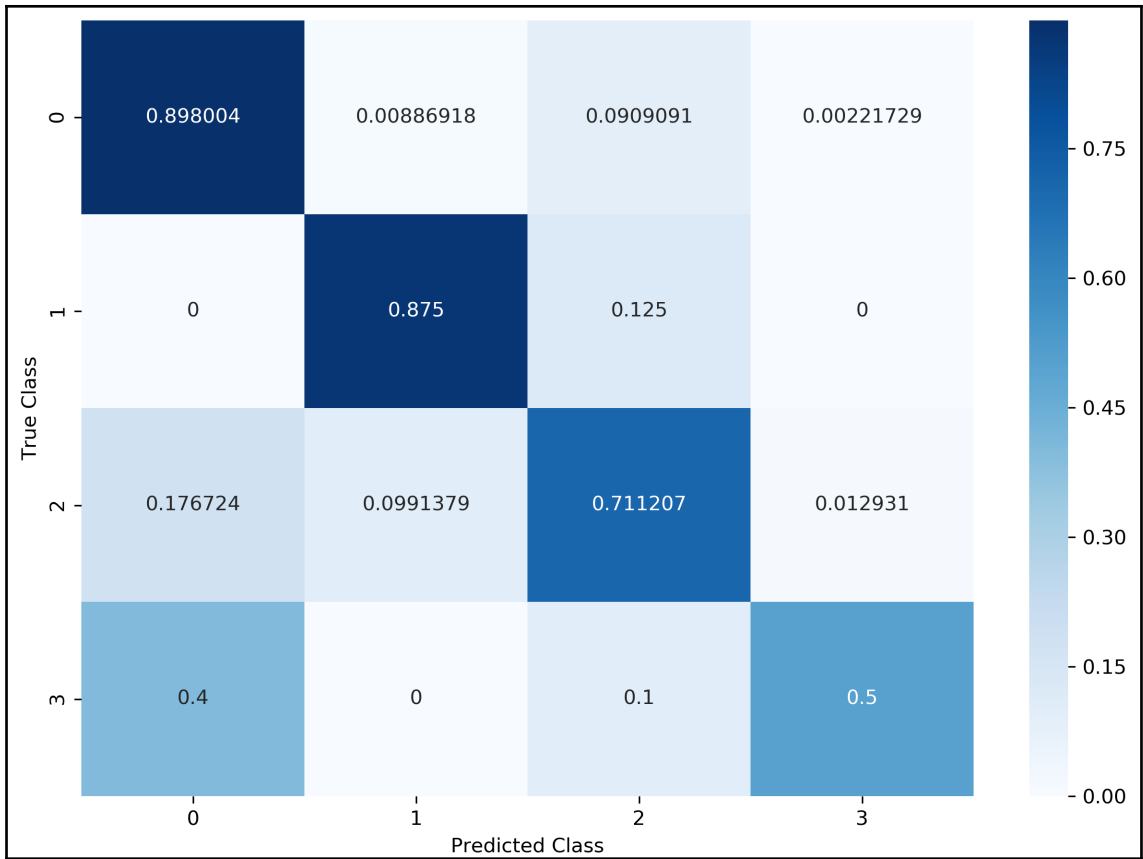


```
Epoch 42/100
- 12s - loss: 0.0260 - acc: 0.9919 - val_loss: 3.2725 - val_acc: 0.4954
Epoch 43/100
- 13s - loss: 0.0083 - acc: 0.9984 - val_loss: 3.5102 - val_acc: 0.5073
Epoch 44/100
- 13s - loss: 0.0022 - acc: 0.9997 - val_loss: 3.6529 - val_acc: 0.5033
Epoch 45/100
- 13s - loss: 0.0020 - acc: 0.9999 - val_loss: 3.7180 - val_acc: 0.4980
Epoch 46/100
- 13s - loss: 0.0017 - acc: 0.9999 - val_loss: 3.7393 - val_acc: 0.4993
Epoch 47/100
- 13s - loss: 0.0021 - acc: 0.9997 - val_loss: 3.7430 - val_acc: 0.4941
Epoch 48/100
- 13s - loss: 0.0092 - acc: 0.9969 - val_loss: 3.6456 - val_acc: 0.4729
Epoch 49/100
- 12s - loss: 0.0217 - acc: 0.9922 - val_loss: 3.3237 - val_acc: 0.4690
Epoch 50/100
- 12s - loss: 0.0306 - acc: 0.9904 - val_loss: 3.3988 - val_acc: 0.4650
Epoch 51/100
- 13s - loss: 0.0094 - acc: 0.9975 - val_loss: 3.4694 - val_acc: 0.4927
Epoch 52/100
- 12s - loss: 0.0036 - acc: 0.9987 - val_loss: 3.6257 - val_acc: 0.5033
Epoch 53/100
- 13s - loss: 0.0037 - acc: 0.9993 - val_loss: 3.6225 - val_acc: 0.4742
Epoch 54/100
- 13s - loss: 0.0022 - acc: 0.9993 - val_loss: 3.6380 - val_acc: 0.4901
```



```
- 10s - loss: 0.1073 - acc: 0.9634 - val_loss: 0.8192 - val_acc: 0.8394
Epoch 00495: val_acc did not improve from 0.85815
Epoch 496/500
- 10s - loss: 0.1155 - acc: 0.9623 - val_loss: 0.7955 - val_acc: 0.8406
Epoch 00496: val_acc did not improve from 0.85815
Epoch 497/500
- 10s - loss: 0.1181 - acc: 0.9618 - val_loss: 0.8229 - val_acc: 0.8488
Epoch 00497: val_acc did not improve from 0.85815
Epoch 498/500
- 10s - loss: 0.1081 - acc: 0.9634 - val_loss: 0.9242 - val_acc: 0.8406
Epoch 00498: val_acc did not improve from 0.85815
Epoch 499/500
- 10s - loss: 0.1013 - acc: 0.9643 - val_loss: 0.8431 - val_acc: 0.8394
Epoch 00499: val_acc did not improve from 0.85815
Epoch 500/500
- 10s - loss: 0.1054 - acc: 0.9642 - val_loss: 0.8921 - val_acc: 0.8288
Epoch 00500: val_acc did not improve from 0.85815
Last epoch's validation score is 0.8288393903868698
(tf-gpu) C:\Anaconda3\Book-DL-IoT\chapter9-healthcare\use-case-1\DeepECG-
```

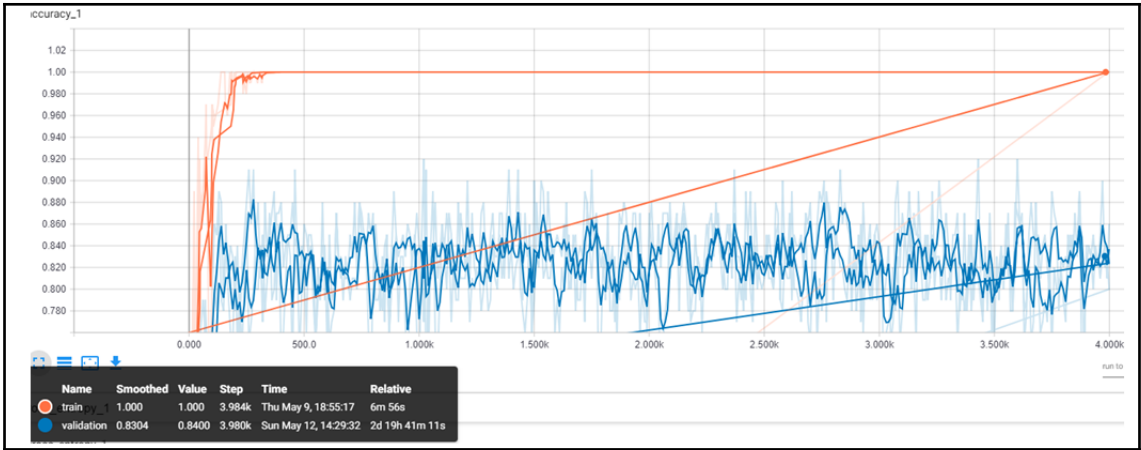




```

INFO:tensorflow:2019-05-12 14:29:29.897619: Step 3960: Train accuracy = 100.0%
INFO:tensorflow:2019-05-12 14:29:29.897619: Step 3960: Cross entropy = 0.002337
INFO:tensorflow:2019-05-12 14:29:29.999564: Step 3960: Validation accuracy = 81.0% (N=100)
INFO:tensorflow:2019-05-12 14:29:30.962488: Step 3970: Train accuracy = 100.0%
INFO:tensorflow:2019-05-12 14:29:30.962488: Step 3970: Cross entropy = 0.002503
INFO:tensorflow:2019-05-12 14:29:31.069451: Step 3970: Validation accuracy = 83.0% (N=100)
INFO:tensorflow:2019-05-12 14:29:32.018879: Step 3980: Train accuracy = 100.0%
INFO:tensorflow:2019-05-12 14:29:32.018879: Step 3980: Cross entropy = 0.002206
INFO:tensorflow:2019-05-12 14:29:32.098854: Step 3980: Validation accuracy = 84.0% (N=100)
INFO:tensorflow:2019-05-12 14:29:33.001305: Step 3990: Train accuracy = 100.0%
INFO:tensorflow:2019-05-12 14:29:33.001305: Step 3990: Cross entropy = 0.001930
INFO:tensorflow:2019-05-12 14:29:33.089275: Step 3990: Validation accuracy = 81.0% (N=100)
INFO:tensorflow:2019-05-12 14:29:33.907782: Step 3999: Train accuracy = 100.0%
INFO:tensorflow:2019-05-12 14:29:33.908782: Step 3999: Cross entropy = 0.001757
INFO:tensorflow:2019-05-12 14:29:33.992750: Step 3999: Validation accuracy = 86.0% (N=100)
INFO:tensorflow:Final test accuracy = 89.5% (N=76)




```

Chapter 10: What's Next - Wrapping Up and Future Directions

Chapter Name	IoT Use Cases	DL Models Used	Model Performance
Image Recognition in IoT	<ul style="list-style-type: none"> Image-based road's fault detection Image-based smart solid waste separation 	Two implementations of CNN: <ul style="list-style-type: none"> Incentive V3 Mobilenet V1 	<ul style="list-style-type: none"> Storage requirement suitable for transfer learning. Training and validation accuracies for both use cases are above 90%.
Audio/Speech/Voice Recognition in IoT	<ul style="list-style-type: none"> Voice controlled smart light Voice-controlled home access 	Three implementations of CNN: <ul style="list-style-type: none"> Incentive V3, Mobilenet V1, and CIFAR-10 CNN with SVM 	<ul style="list-style-type: none"> Storage requirement suitable for transfer learning. Training and validation accuracies for use case 1 are around 75% and are around 90% for use case 2.
Indoor localization in IoT	Indoor localization with WiFi fingerprinting	Autoencoder	<ul style="list-style-type: none"> Storage requirement suitable for transfer learning. Validation accuracy around 90% .
Physiological and Psychological State Detection in IoT	<ul style="list-style-type: none"> Remote progress monitoring of physiotherapy Smart Class Room 	LSTM and two implementations of CNN: <ul style="list-style-type: none"> Simple CNN Mobilenet V1 	<ul style="list-style-type: none"> Storage requirement suitable for transfer learning. Training and validation accuracies for use case 1 are above 90% and around 70% for use case 2.
Security in IoT	<ul style="list-style-type: none"> Intelligent Host Intrusion Detection in IoT Intelligent Network Intrusion Detection in IoT 	LSTM, DNN, and Autoencoder	<ul style="list-style-type: none"> Storage requirement suitable for transfer learning. Training and validation accuracies for both use cases are above 90%.
Predictive Maintenance for IoT	Predictive maintenance for aircraft gas turbine engine.	LSTM	<ul style="list-style-type: none"> Storage requirement suitable for transfer learning. Was able to successfully predict maintenance with acceptable mean error rate.
Deep learning in Healthcare IoT	<ul style="list-style-type: none"> Remote Chronic Disease Management IoT for Acne Detection and Care 	LSTM, CNN1D, and Mobilenet V1	<ul style="list-style-type: none"> Storage requirement of CNNs are suitable for transfer learning, but LSTM struggles. Validation accuracies for LSTM in use case is around 50%, CNN1D is around 85%. Accuracies for Mobilenet V1 in use case two are around 90%.

Lack of large dataset	<ul style="list-style-type: none"> Limited no. of real-life IoT datasets. Dataset size may not be big enough to avoid overfitting. May not be accessible for free use.
Preprocessing	<ul style="list-style-type: none"> Device heterogeneity and Data format heterogeneity make preprocessing challenging.
Security & privacy preserving DL models	<ul style="list-style-type: none"> DL models need to preserve IoT security & privacy as per application's need. Security of the DL model's functionality & QoS.
Big Data Issues	<ul style="list-style-type: none"> Volume: time & structure complexity, noisy & unlabeled data. Variety: heterogenous formats & conflicting sources. Velocity: streaming data need real-time processing. Veracity: lack of authenticity of data/source could make DL useless.
DL Models Limitations	<ul style="list-style-type: none"> False confidence of deep learning model. Lack of regression capability within DL model based solutions.

 retrained_graph.pb 17.1 MB Modified: 27 January 2019 at 10:14 PM Add Tags... General: Kind: Document Size: 17,136,207 bytes (17.1 MB on disk) Where: Macintosh HD - Users - raz - anaconda3 - chapter3 - transformed-learning - trained_model_mobilenetv1-modified-dataset Created: 27 January 2019 at 10:14 PM Modified: 27 January 2019 at 10:14 PM <input type="checkbox"/> Stationery pad	 retrained_graph.pb 87.5 MB Modified: 5 January 2019 at 9:36 PM Add Tags... General: Kind: Document Size: 87,458,742 bytes (92.3 MB on disk) Where: Macintosh HD - Users - raz - anaconda3 - chapter3 - transformed-learning - trained_model_inceptionv1original-dataset Created: 22 January 2019 at 10:08 PM Modified: 5 January 2019 at 9:36 PM	 cnn_speaker_model_weights.h5 91.1 MB Modified: Tuesday, 10 April 2018 at 8:55 AM Add Tags... General: Kind: Document Size: 91,056,928 bytes (91.1 MB on disk) Where: Macintosh HD - Users - raz - anaconda3 - chapter4 - command_speaker_recognition - use_case2 Created: Tuesday, 10 April 2018 at 8:55 AM Modified: Tuesday, 10 April 2018 at 8:55 AM <input type="checkbox"/> Stationery pad <input type="checkbox"/> Locked
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Resource-constrained IoT Devices	<ul style="list-style-type: none"> Limited battery, processing and memory capacity. Model learning infeasible in most devices. Inferencing using pre-trained models is infeasible in some cases.
Edge/Fog Computing Challenges	<ul style="list-style-type: none"> New discovery protocol needed. In distributed learning, model execution and task splitting is an issue. Dynamicity of mobile edge devices.
Cloud Computing Challenges	<ul style="list-style-type: none"> Response time and legal/policy. Security & privacy of user data in the cloud (processing and storage).