

Problem Statement:

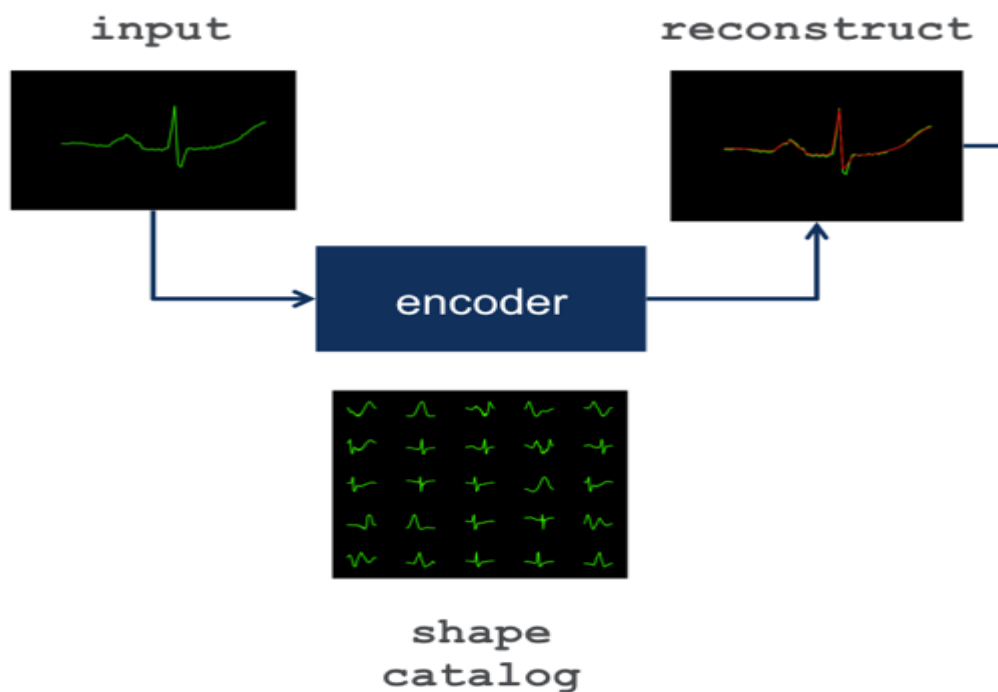
Anomaly detection first establishes what normal behavior is, then compares it to the observed behavior and generates an alert if significant deviations from normal are identified

Description:

Consider we have EKG signal like in figure below, we can see there are lot of variation and randomness. To detect anomaly detection here on threshold basis, the model would fail eventually. We propose a solution to learn this pattern and consider it as normal pattern and any abnormality detected, it must raise alert.

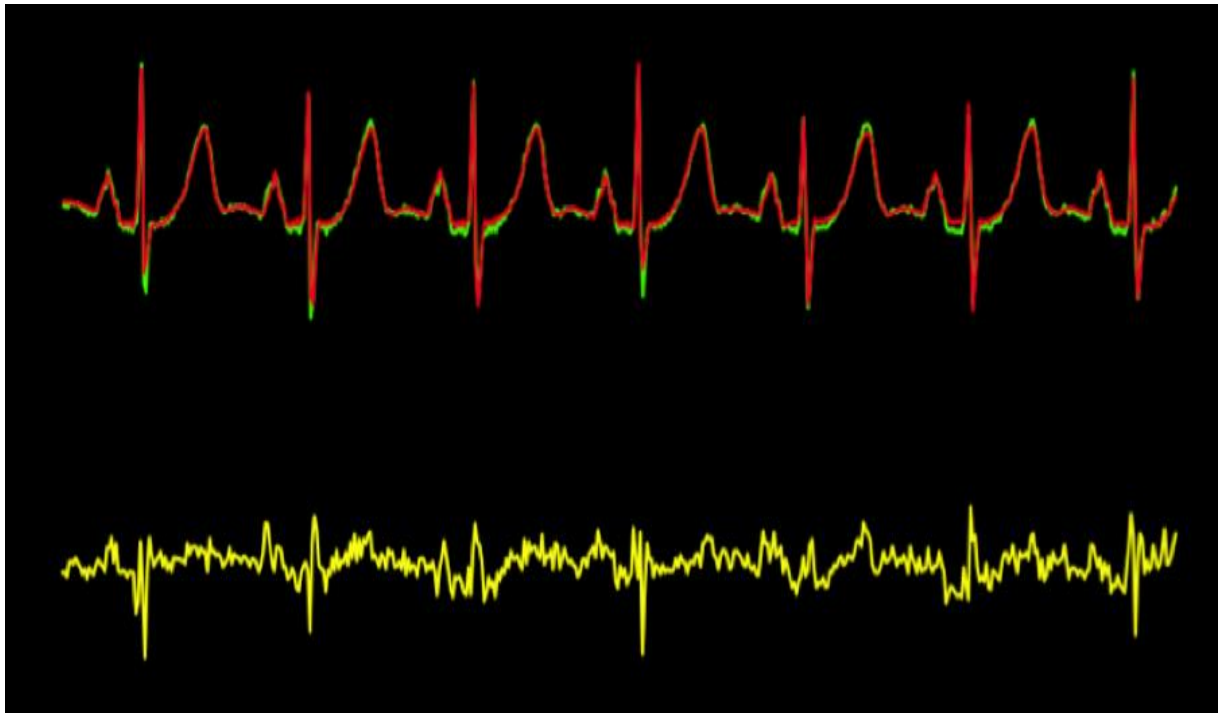


How to do it?



Approach is to use auto encoders to encode the patterns which are usually normal pattern. As we can see encoder learns lot of patterns of normal input EKG signal above.

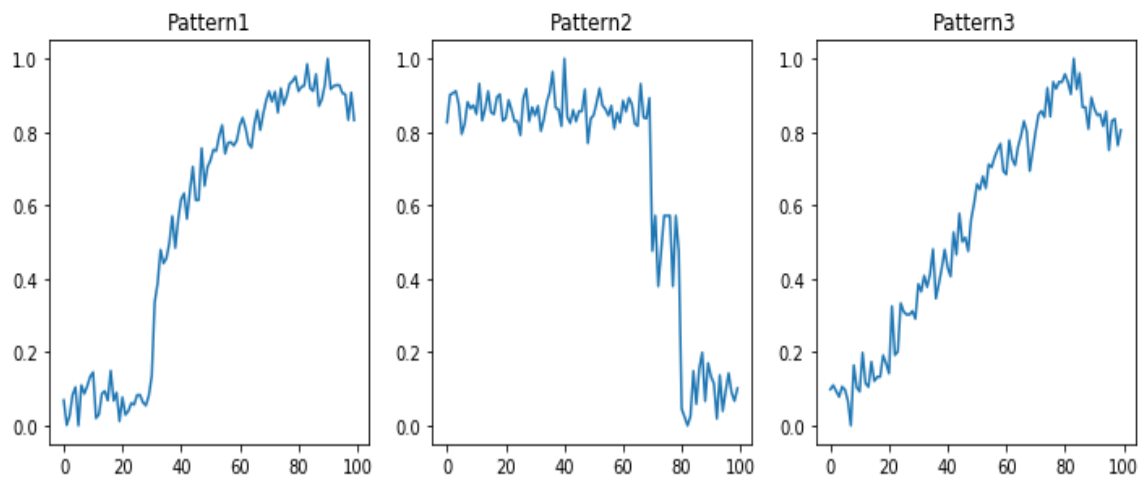
Once encoder learns it, given further input, it reconstruct signal to most nearly matching pattern it has learnt. The red signal in reconstruct is the closest match with given green input signal



Then we find the difference between green and red signal to get error signal. If euclidean distance between these signal are greater than threshold, then we detect an anomaly

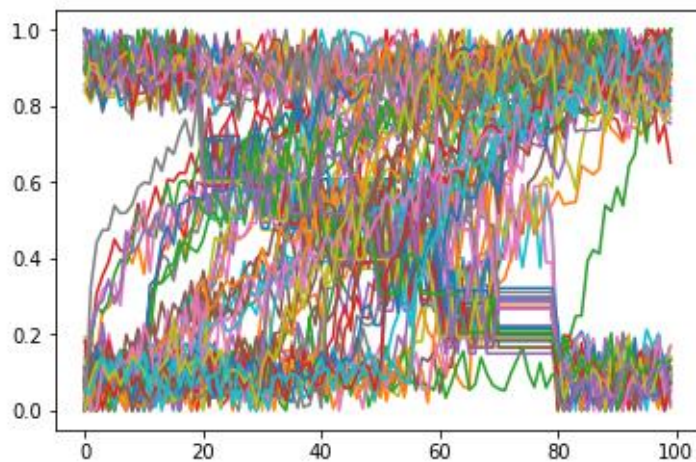
Practical Implementation:

1. We have set of 3 patterns which are monitored on edge device. Below are the pattern captured on that edge device



2. Now this are our normal pattern which our encoder must learn and give minimum error when given normal input signal.

3. This is the combination of all normal signal



4. This is where we defined auto encoder model

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## Defining model
from keras.layers import Dense, Input
from keras.models import Model

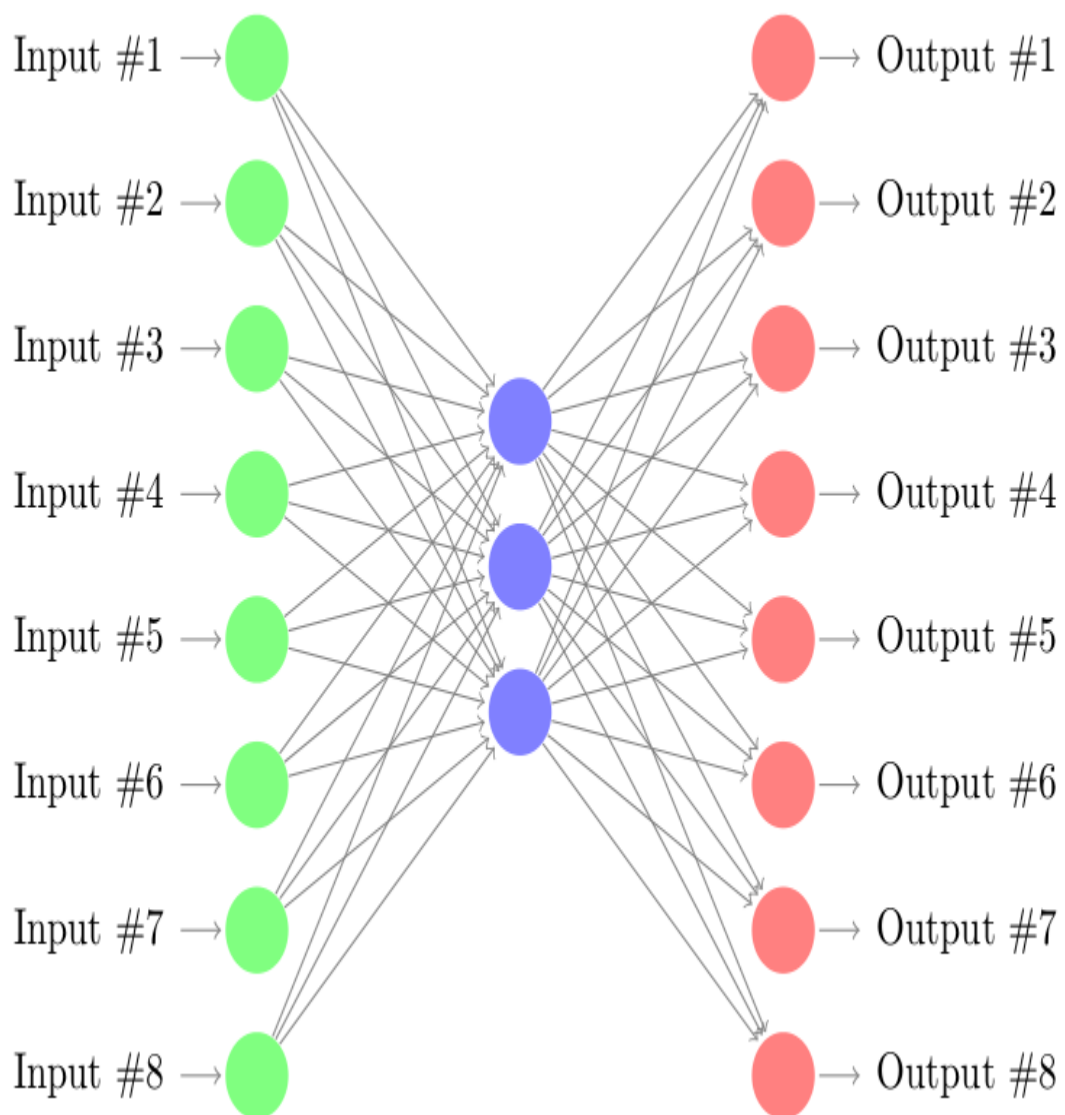
encoding_dim=80
input=Input(shape=(100,))
encoded=Dense(encoding_dim, activation="relu")(input)
decoded=Dense(100,activation="sigmoid")(encoded)

autoencoder=Model(inputs=input,outputs=decoded)
encoder=Model(inputs=input, outputs=encoded)

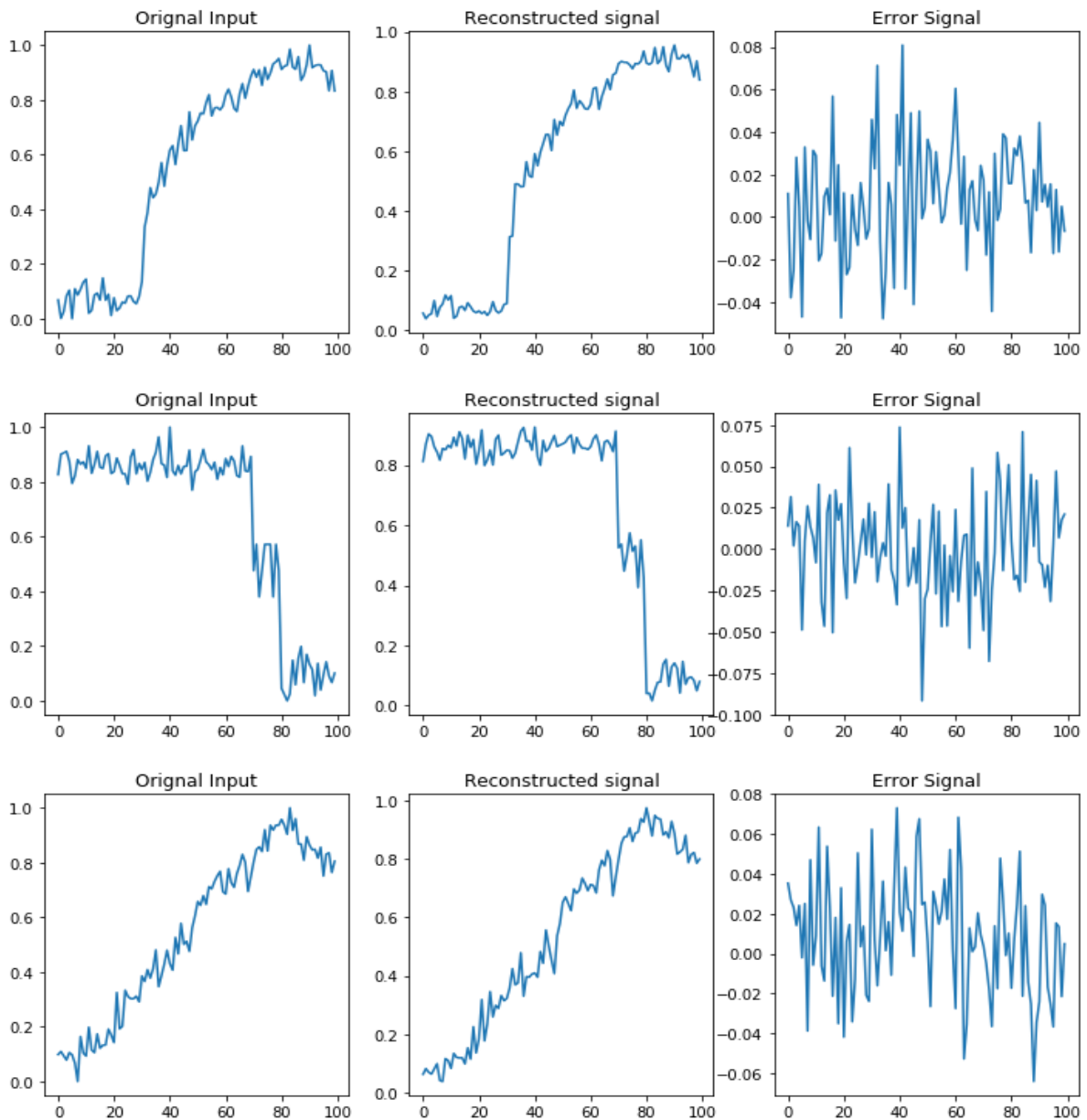
encoded_input=Input(shape=(encoding_dim,))
decoder_layer=autoencoder.layers[-1]

decoder=Model(inputs=encoded_input, outputs=decoder_layer(encoded_input))
```

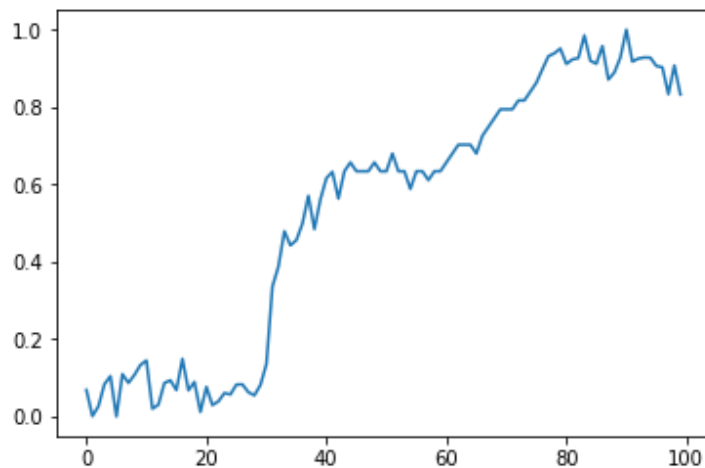
5. A autoencoder is a neural network that has three layers: an input layer, a hidden (encoding) layer, and a decoding layer. The network is trained to reconstruct its inputs, which forces the hidden layer to try to learn good representations of the inputs.



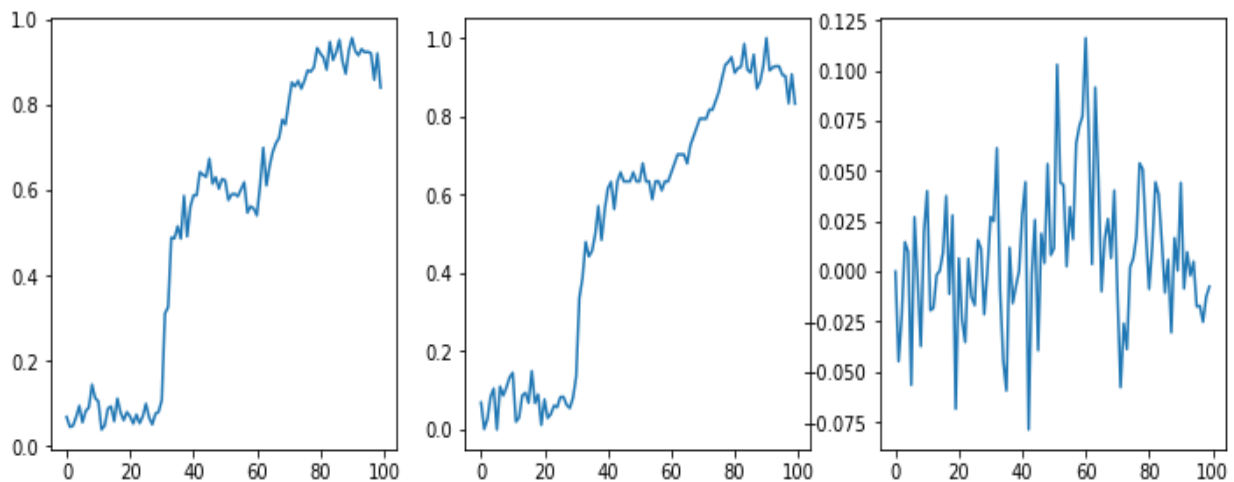
6. After training it for given input patterns, we test on those patterns and encoder almost reconstruct exactly similar signal and error value is quite less than 0.08.



7. While testing on test image which is quite similar to first pattern with some abnormality at middle of sequence



8. As can be seen auto encoder tries to reconstruct it to most similar possible shape but still get a larger error. Error is the euclidean distance and its value come out for this scenario 3.6 which is greater than the threshold 3.



9. one more pattern which is quite different from rest of the pattern let see the error value for it.

