Progress on Deep Learning Method

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Introduction to the Deep Learning network

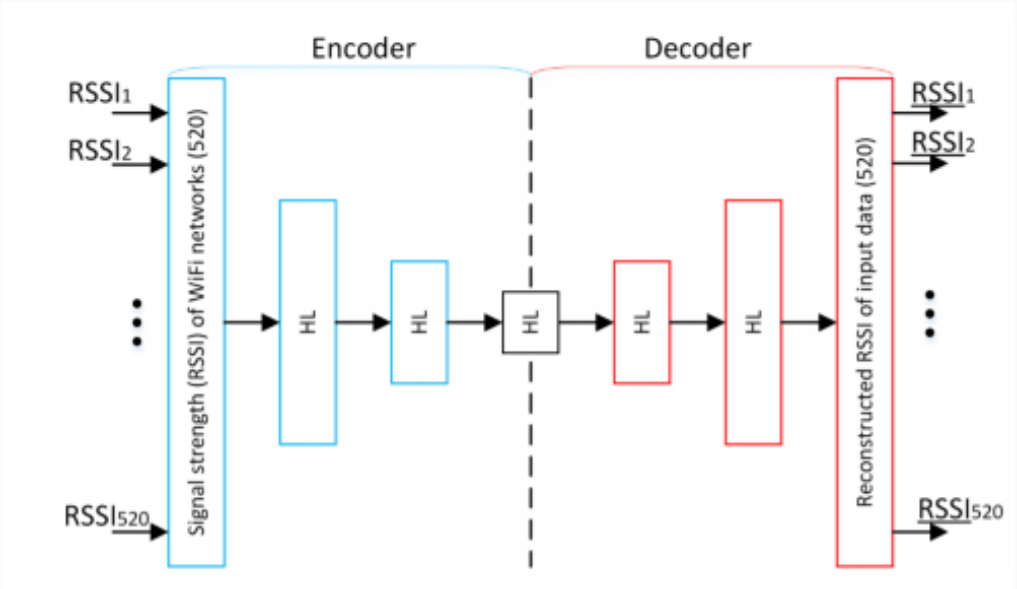
SAE: Stacked Autoencoder

Notation:

Raw input data : x

Code : $h = f(x)$

Reconstruction data : $\hat{x} = g(f(x))$

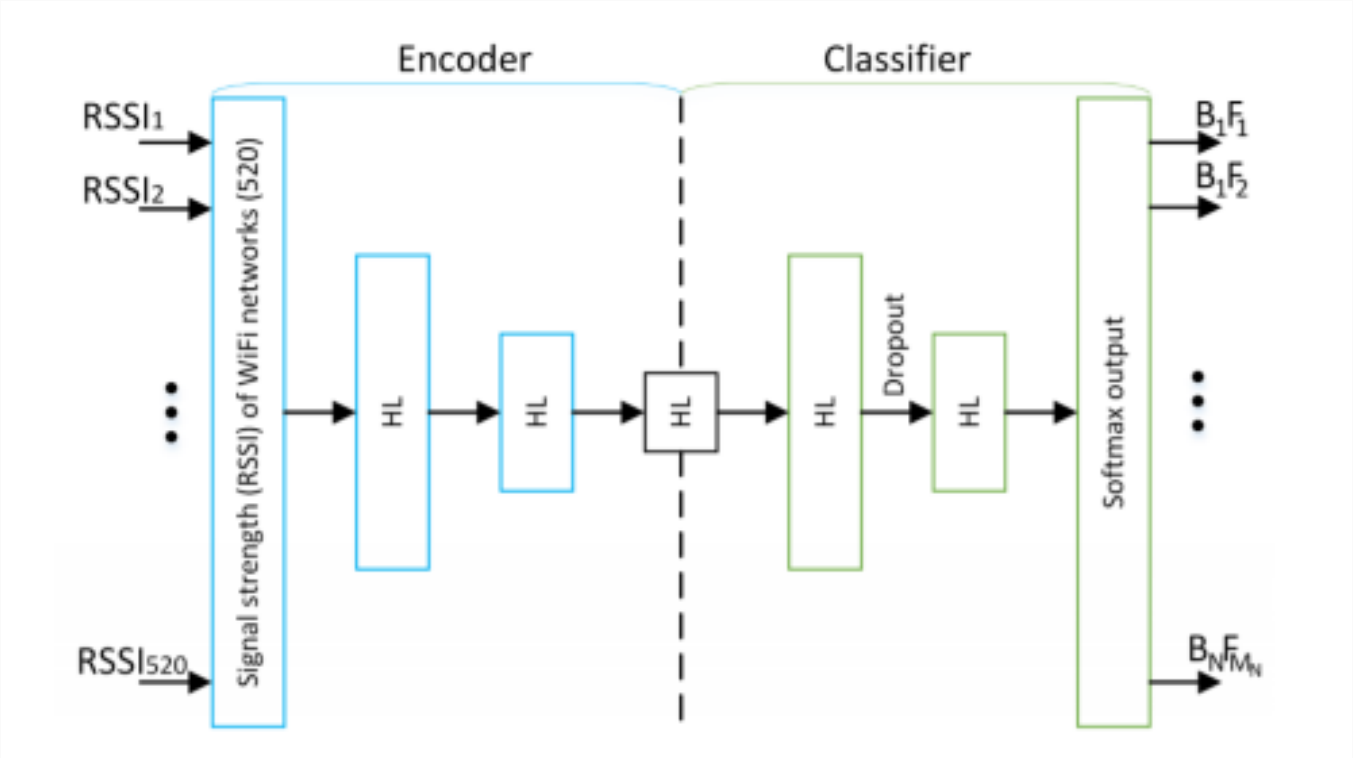


Function:

- Feature extraction
- Dimensional reduction

Ideally, we want $\hat{x}$ to approach x as closely as possible which means code h will well represent raw data with good feature extraction.

Classifier



In classifier, there are 2 fully connected layers with a softmax layer whose output is the probability of that such a RSSI is received from at a specific point.

Problem and Solving

Problem

The testing accuracy of model is not as high as expected in paper.

- Training accuracy: 98%
- Validation accuracy: 96%
- **Testing accuracy: 75% only**

Solving

Having tried several methods:

- Adjust the structure (Not significant)
- Change the activation function (1-2%)
- Dropout to prevent over-fitting (2-3%)
- Change the choice of optimizer (Better loss divergence)
- Tie the weights of SAE (Better feature extraction in SAE)

Ones that lead significant improvement:

- Change the represent of non-detection into -110 (5%)
- Jointly scale the raw data (10%)

Latest Model Setting and Results

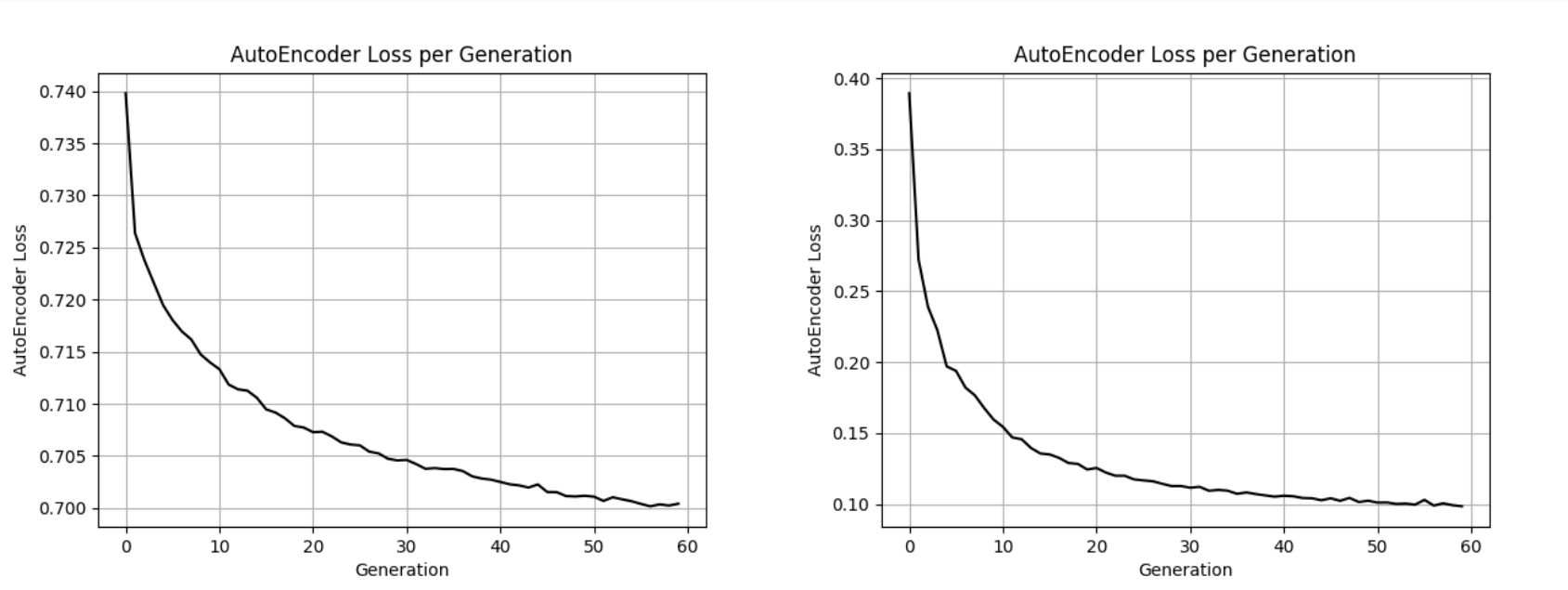
Latest Settings

The lastest version of model has follwing settings:

- Resetting the ratio of training and validation to 0.9
- Dropout with 0.5 keeping probability
- Use tanh in autoencoder while relu in classifier
- longer training epoch for SAE to get a better loss convergence

Although **relu** is a better activation function as most papers said but in my experiment the **tanh** performs better in SAE.

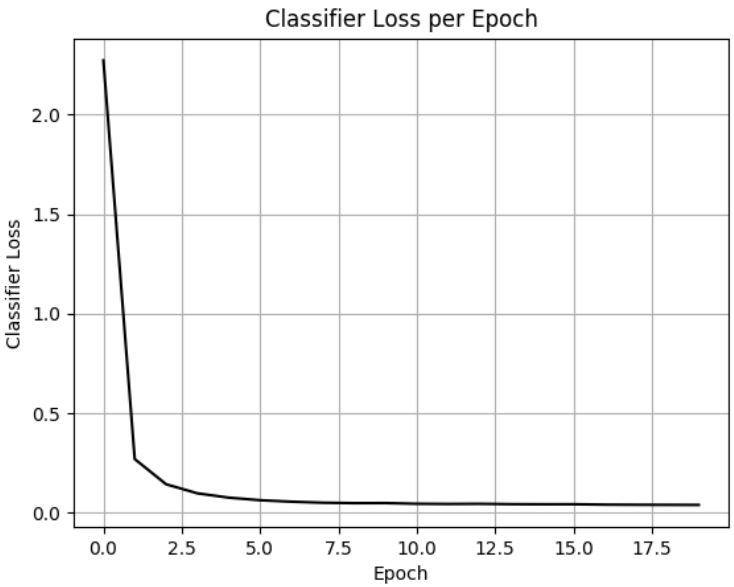
Visualized Results (SAE loss)



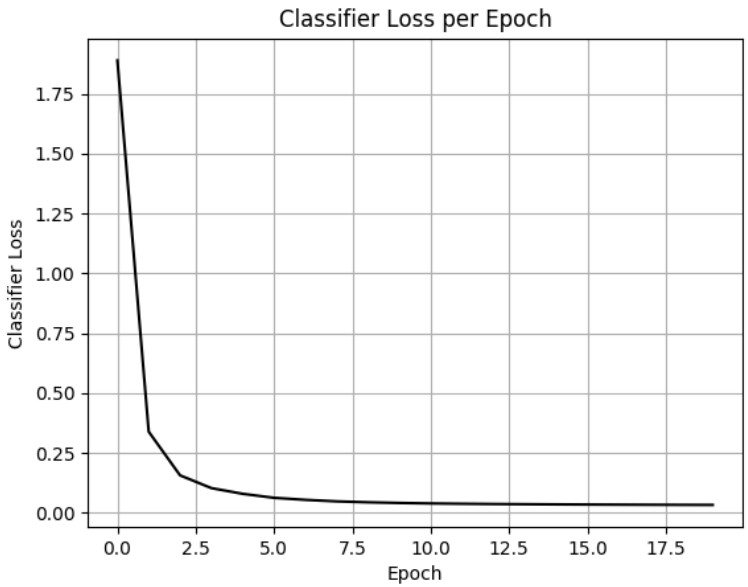
SAE uses tanh

SAE uses relu

Visualized Results (Classifier loss)



SAE uses tanh



SAE uses relu

Visualized Results (Final accuracy)

As for the testing results we have a better result using settings previously mentioned and obtain highest accuracy as 93.6994%

Further Work Needed

Further Work Needed

- The robustness of this model in practical case still need proof with our own database.
- The input dimension in our case can be much smaller (520 APs $\gg$ 100+ APs) which means the structure of this model possibly needs some changes.
- The storage of trained network that will be directly used for online localization.

Conclusion

Conclusion

1. The main idea of this model is dimensional reduction and classification using Deep Learning network.

2. We have overcome the low testing accuracy at least in theoretical case using following modifications:

- Jointly scaling of raw data
- Change represents of no-detected APs to -110
- Modification of activation function inside hidden layers
- Prevent over-fitting including dropout and ratio of training and validation set

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and finally get a accuracy of 93.6994% that is slightly higher than the result from paper.

3. Still need proof in practical cases and do necessary changes.

Thanks for listening!

Questions?