Alexandria University
Faculty of Engineering
Computer and Systems Engineering Department

Due : Wednesday 6/1/2021
CSED :Data Mining

Assignment#3 Modulation Classification (Total 100Points)

Submit a report and the codes used. Report should detail and illustrate every step in the assignment. Report worthes (25 points).

Problem Statement

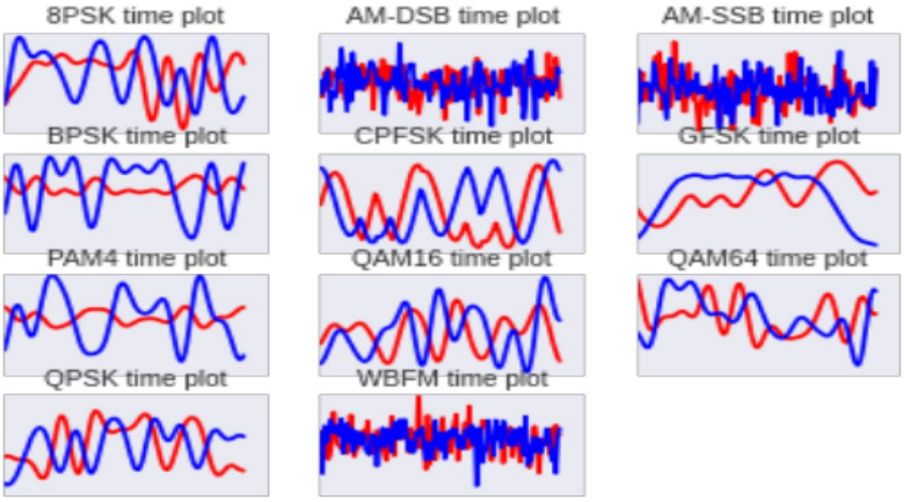
DeepSig Dataset: RadioML 2016.04C

A synthetic dataset, generated with GNU Radio, consisting of 11 modulations. This is a variable-SNR dataset with moderate LO drift, light fading, and numerous different labeled SNR increments for use in measuring performance across different signal and noise power scenarios.

1. Download Data (10 points)

a. http://opendata.deepsig.io/datasets/2016.10/RML2016.10b.tar.bz2

2. Create feature Spaces (30 points)



Every sample is presented using two vectors each of them has 128 elements. You might try the raw features and you can make a battery of more features such as

1. Raw time series as given (two channels)
2. First derivative in time (two channels)
3. Integral in time (two channels)
4. combinations of 1,2 and 3. (More channels)

4. Supervised Learning Step (40 Points)

- Split the data into 70% for training/validation and 30% for testing.
- Use 5% of the training and validation dataset for validation.

- **Baseline Classifiers:**
  Use the following classifiers as baseline models:

  - Logistic Regression Classifier
  - Decision Tree
  - Random Forest
  - A fully connected dense layer:
    - Non-linear function: Relu
    - Optimizer: ADAM
    - Early stopping

  For the first three classifiers use the built-in Scikit learn models.

- **CNN Model:**
  You will apply the CNN architecture shown below. The number of channels in the input layer might be changed as you apply different types of features.

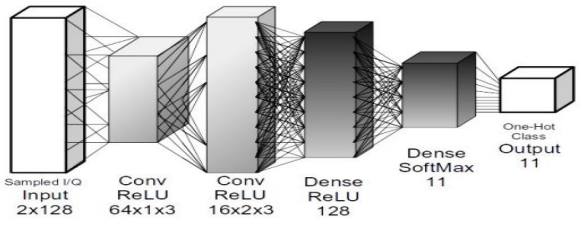
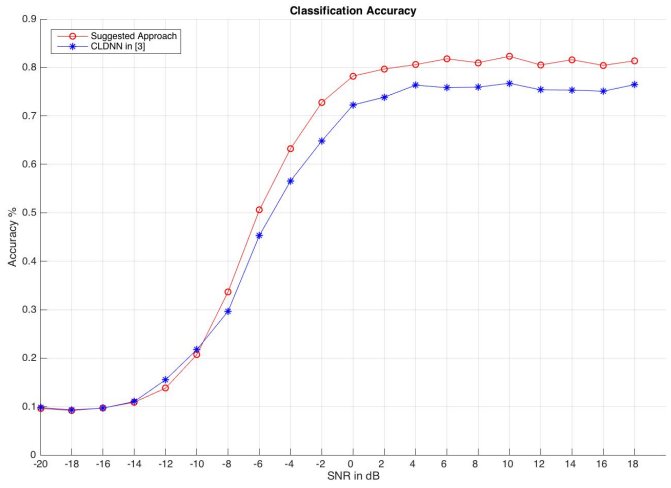


Figure 3. CNN Architecture

5. Big Picture (20 Points)

Compare the performance of the learned models (Different features, and different learning models) by realizing the following for each model:

1. Plots of the accuracy against the SNR as below.
2. Report the average overall accuracy as well as the results at SNR=0dB.
3. Show confusion matrices and find the most confusing classes.



6. References

- [1] T. O'shea, N. West "Radio Machine Learning Dataset Generation with GNU Radio", https://pubs.gnuradio.org/index.php/grcon/article/download/11/10/
- [2] T. O'Shea, J. Corgan, and T. Clancy "Convolutional Radio Modulation Recognition Networks" https://arxiv.org/pdf/1602.04105.pdf
- [3] N. West, T. O'shea "Deep Architectures for Modulation Recognition", https://arxiv.org/pdf/1703.09197.pdf
- [4] K. Karra, S. Kuzdeba, J. Peterson "Modulation recognition using hierarchical deep neural networks" http://ieeexplore.ieee.org/document/7920746/?anchor=authors

GOOD LUCK