Application of Deep Learning Algorithms to Optimization Problems in Wireless Communications

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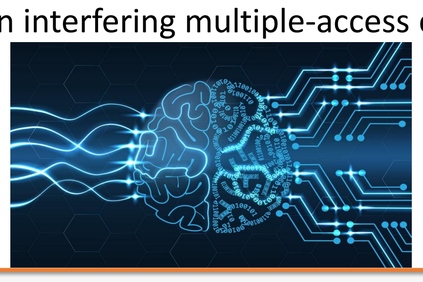
Introduction

- In this project, I focused on how to training Deep Neural Networks For Wireless Resource Management. The project demonstrates the steps involved in finding the optimal set of hyperparameters and the structure of the deep neural network.
- The aim of this project is to investigate the effectiveness with which deep neural networks (DNN) can approximate the existing iterative algorithm building on the example of the weighted minimum mean squared error (WMMSE) algorithm in interfering multiple-access channel (IMAC) model.



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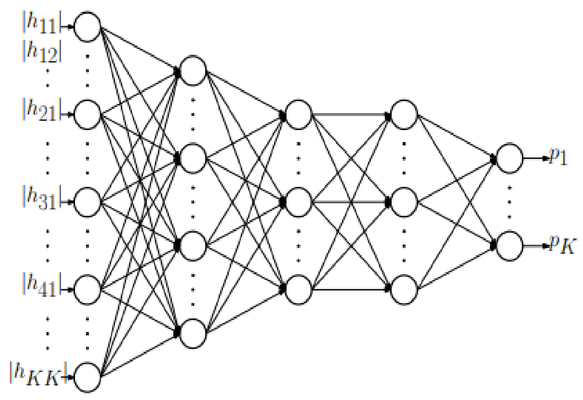
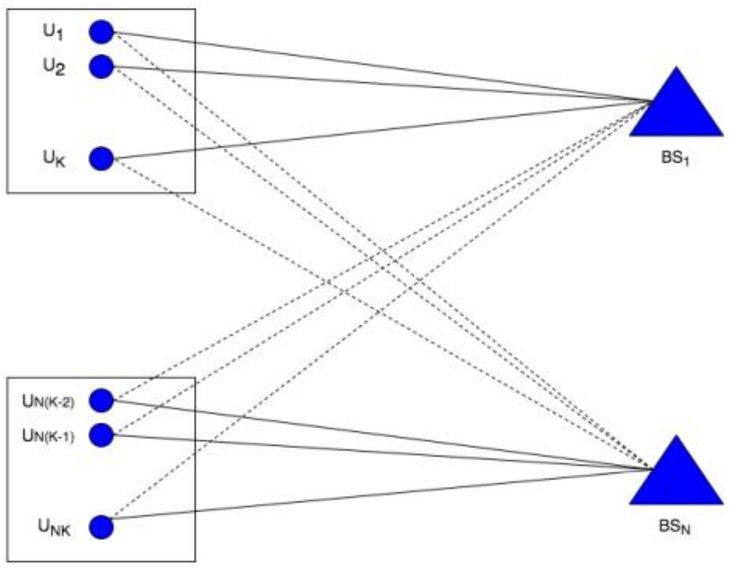
Specifications and Design Requirements

- In this project, we used IMAC model, the WMMSE algorithm and deep learning. A WMMSE algorithm was created with pseudocode and appropriate parameters were selected.



DNN Structure used in this work.



the schematic representation of IMAC, where K is the number of users in each cell and N is the number of cells and base stations.

Solution Methodology

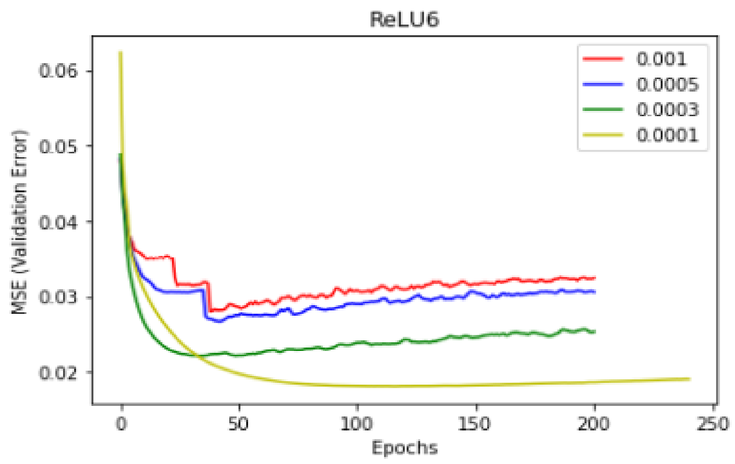
- We first characterize a class of 'learnable algorithms' and then design DNNs to approximate some algorithms of interest in wireless communications.

- For decades optimization has played a central role in addressing wireless resource management issues such as power control and beamformer design. However, these algorithms often require a significant number of iterations for convergence, creating challenges for real-time processing. In this work, we propose a new learning-based approach for wireless resource management.

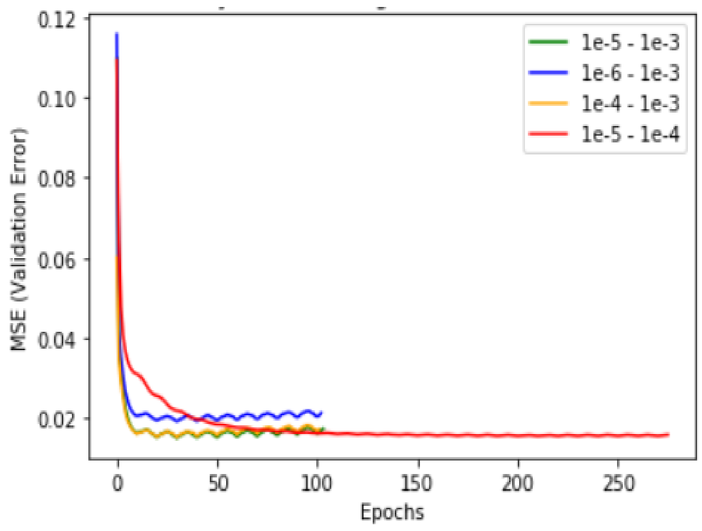
Application Areas

- Today's popularity of Wi-Fi is an issue that will not arouse suspicion. Nowadays,it has become a necessity and it is becoming more common day by day.And this project help to solving Wireless optimization problem and enchance Wireless communication performance.

Results and Discussion



The validation losses recorded of ReLU6 that we used activation function



The validation losses recorded when training the neural network with different cyclical learning rates ranges.

Weight decay value	1e-5 – 1e-3	1e-6 – 1e-3	1e-4 – 1e-3	1e-5 – 1e-4
Lowest validation error	0.0151	0.0193	0.0153	0.0156
Sum-rate approx.	95.60%	92.28%	95.22%	95.01%

The lowest validation errors achieved during training and the sum-rate approximation accuracies (averaged using 10 000 testing samples) achieved when training the neural network with different cyclical learning rates ranges.

References

Haoran Sun, Xiangyi Chen, Qingjiang Shi, Mingyi Hong, Xiao Fu, Nikos D. Sidiropoulos, "LEARNING TO OPTIMIZE: TRAINING DEEP NEURAL NETWORKS FOR WIRELESS RESOURCE MANAGEMENT", 2017 IEEE 18th International Workshop on Signal Processing Advances in Wireless Communications (SPAWC).

Acknowledgements

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