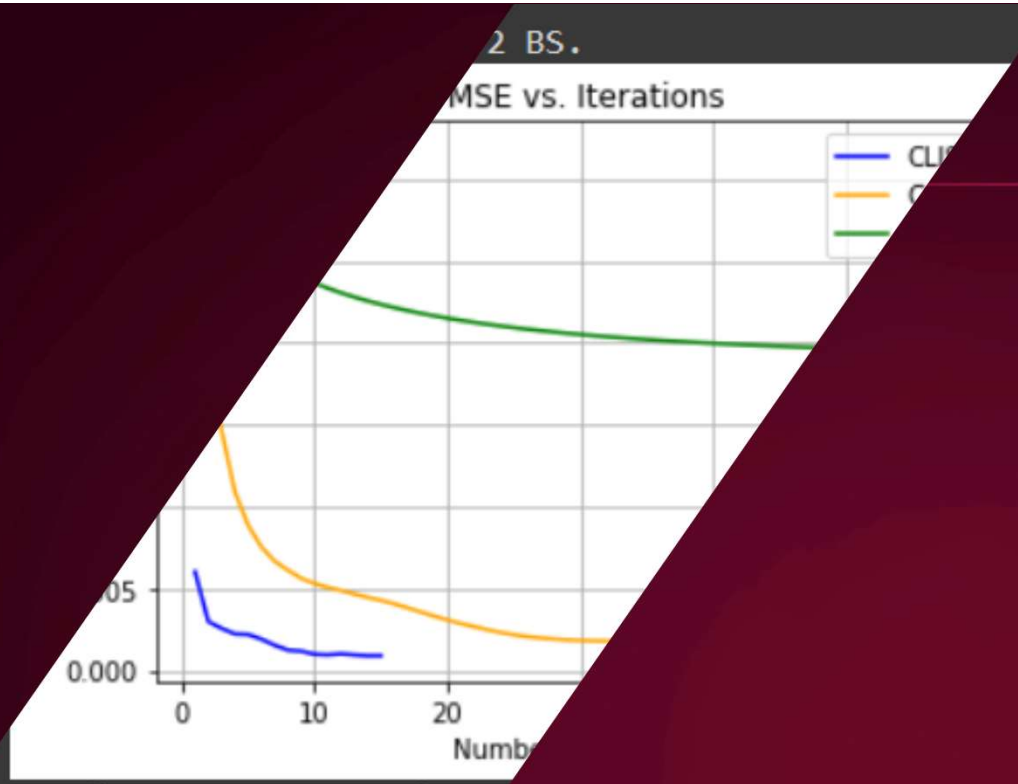


GRAND CANYON UNIVERSITY

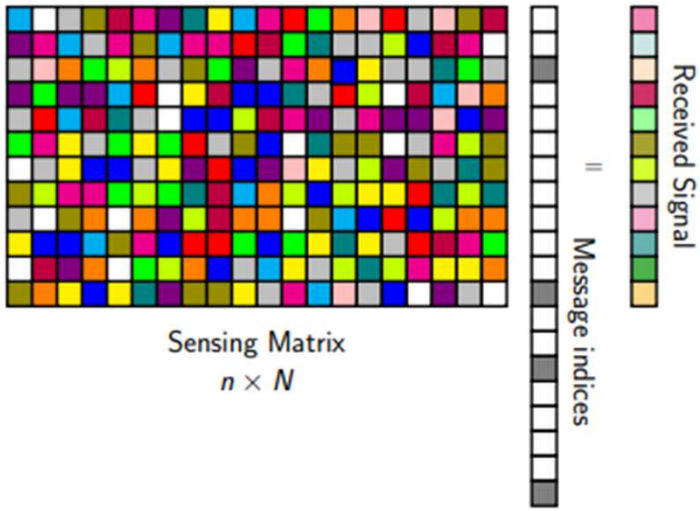
COLLEGE OF SCIENCE, ENGINEERING & TECHNOLOGY

Team 64: Enhancing User Detection Bi-Weekly Update 4

Holly Roper
Sponsor: Dr. Krishna Narayanan
Jamison Ebert
TA: Max Lesser

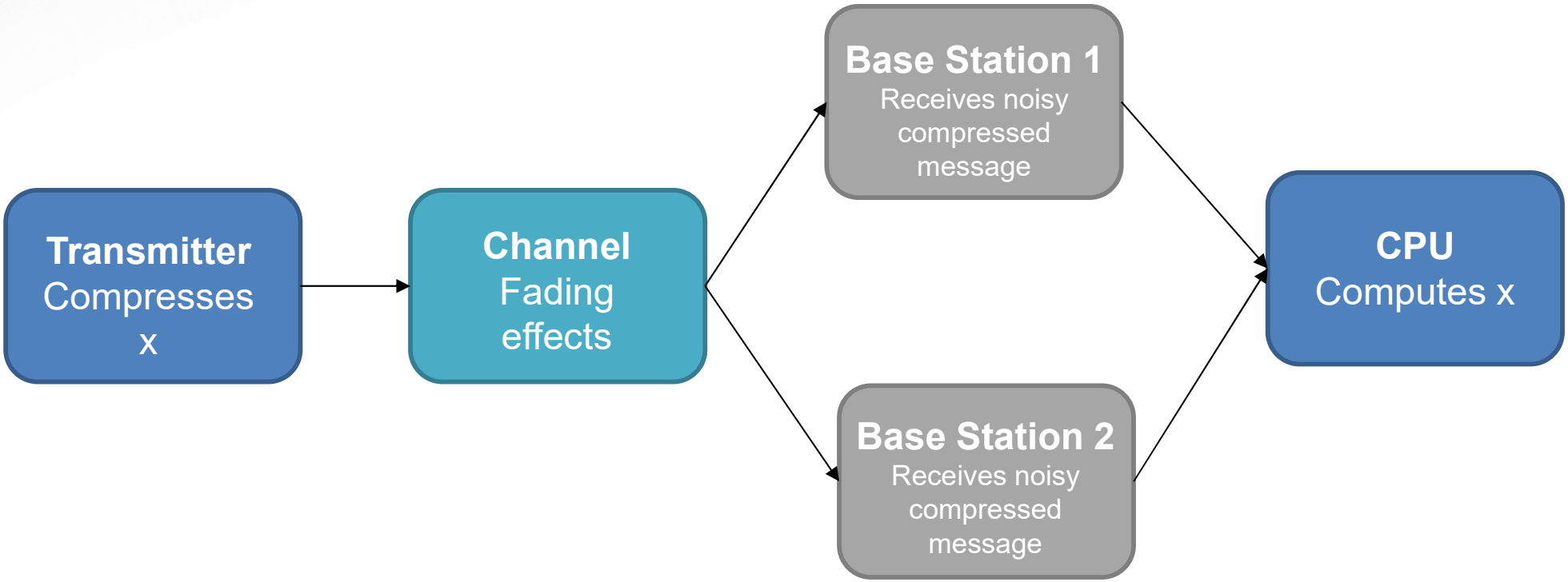
Project Summary

- With the rise in mMTC, a cell-free paradigm has been proposed to handle all the users
- In this paradigm, being able to accurately identify which users are active is critical
- Applying LISTA to the user activity detection problem in a cell-based system
- Evaluating the performance of LISTA in a cell-free system



mMTC: massive machine type communication; only a subset of users are active at any given point in time

Project Overview



Project Timeline

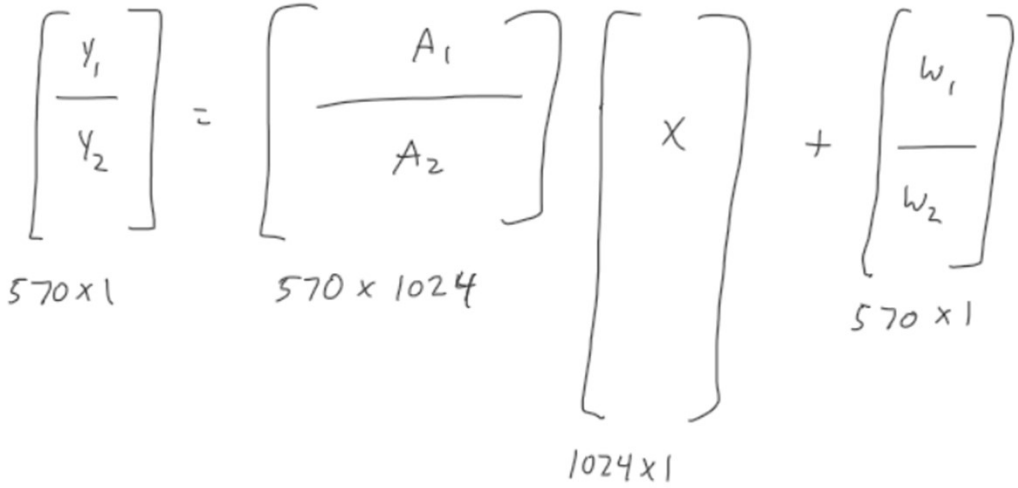
Implement unlearned algorithms	Implement LISTA	Add noise to algorithms	TISTA	Complex Rayleigh Fading	Unlearned 2 BS	Misdetections and False Alarms	Learned 2 BS

Unlearned Algorithms

Accomplishments since last update 6 hrs of effort	Ongoing progress/problems and plans until the next presentation
- 2 BS MD, FA plots - Corrected error of 2 BS sensing matrix -> broke ISTA - Fixed ISTA	Compile into a neat colab notebook

Sensing Matrix

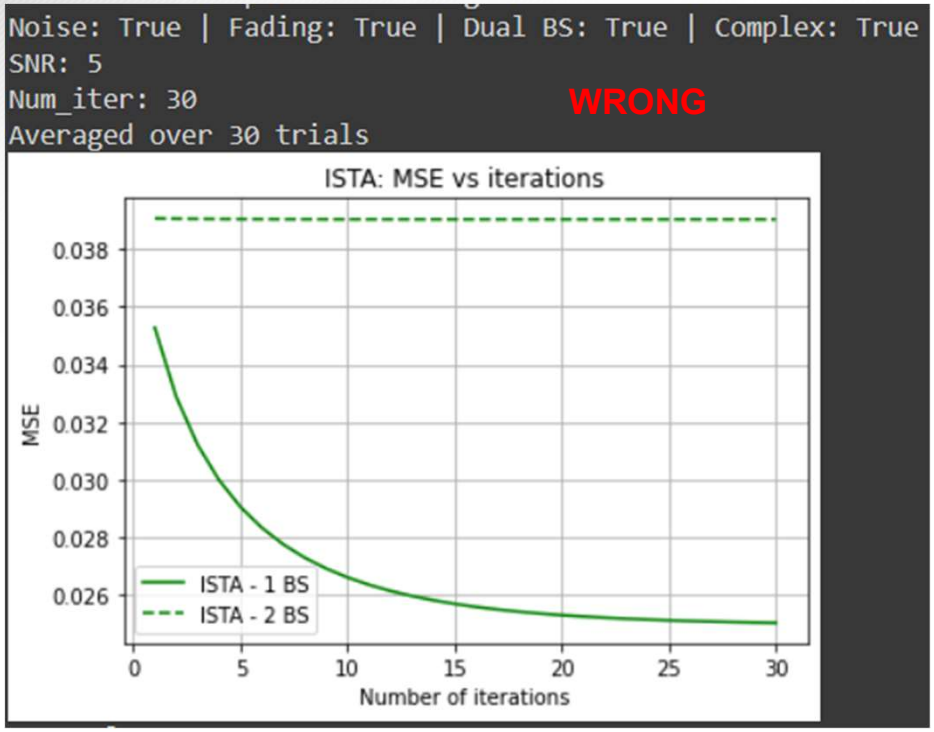
AMP is powerful, but it has some conditions that must be met to be so.
-The energy of the columns of the sensing matrix must equal one.
-The sensing matrix needs to be random/unstructured



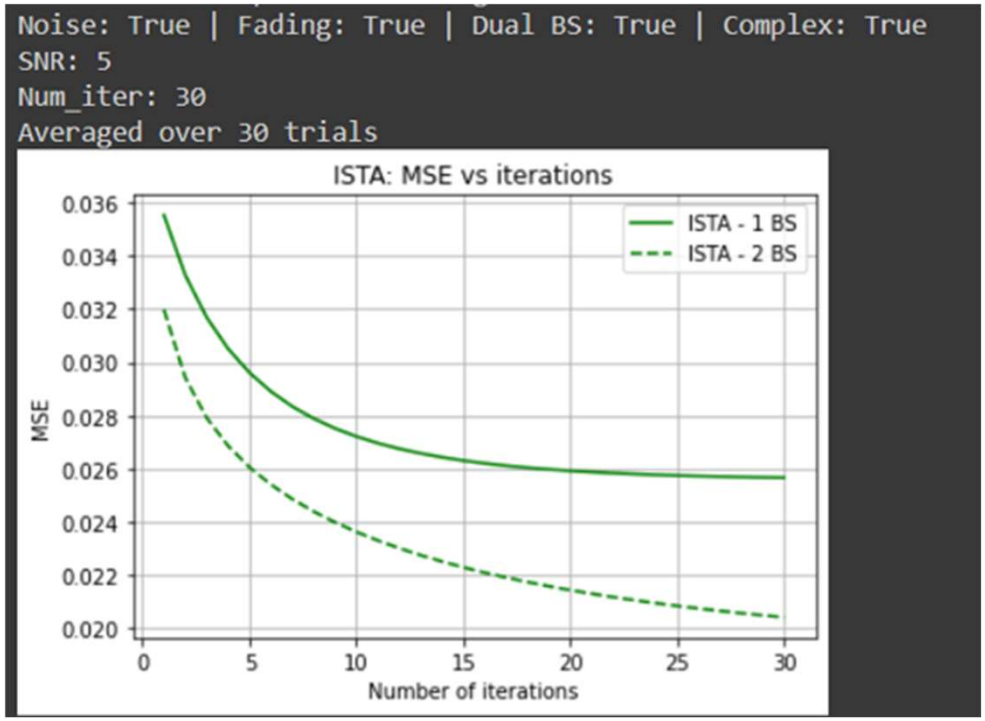
The energy of the columns of the sensing matrix need to be ½ because they get stacked together.
If no fading, A1 = A2

Fixing ISTA

Alpha is double the 1 BS case



Alpha is half the 1 BS case



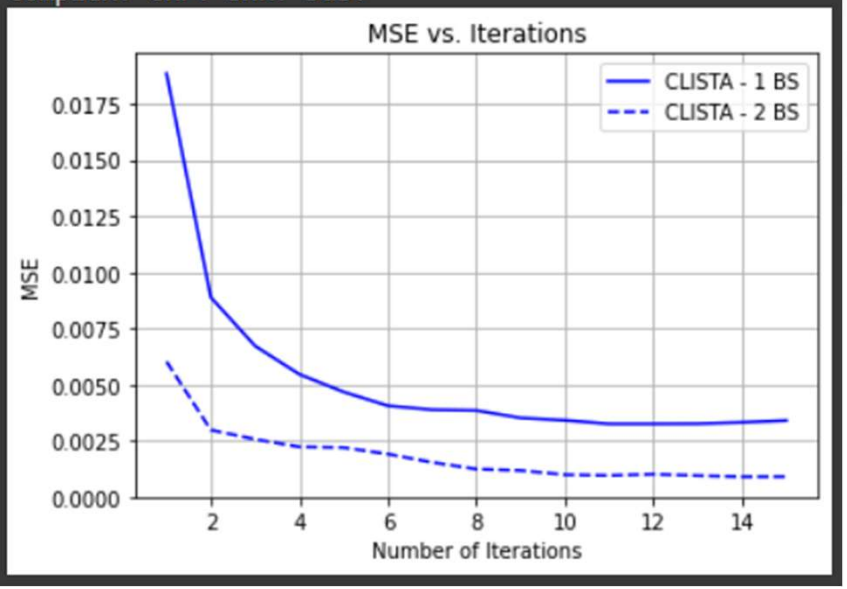
Alpha is the thresholding parameter. Since the column energy of A remains the same, but the number of elements doubled, we need a smaller threshold, so we don't force too many elements to zero too quickly.

Learned Algorithms

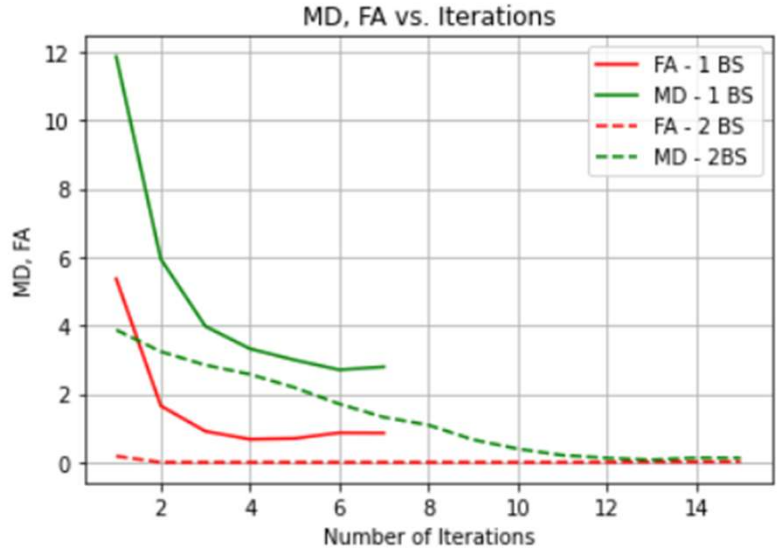
Accomplishments since last update 20 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Trying to get my code to run on the servers… - 2 BS implemented!	Compile into a neat colab notebook Generate MD, FA plots

The plots only extend until we see a flatline in results.
CLISTA plateaus faster and at a lower error than the other algorithms.

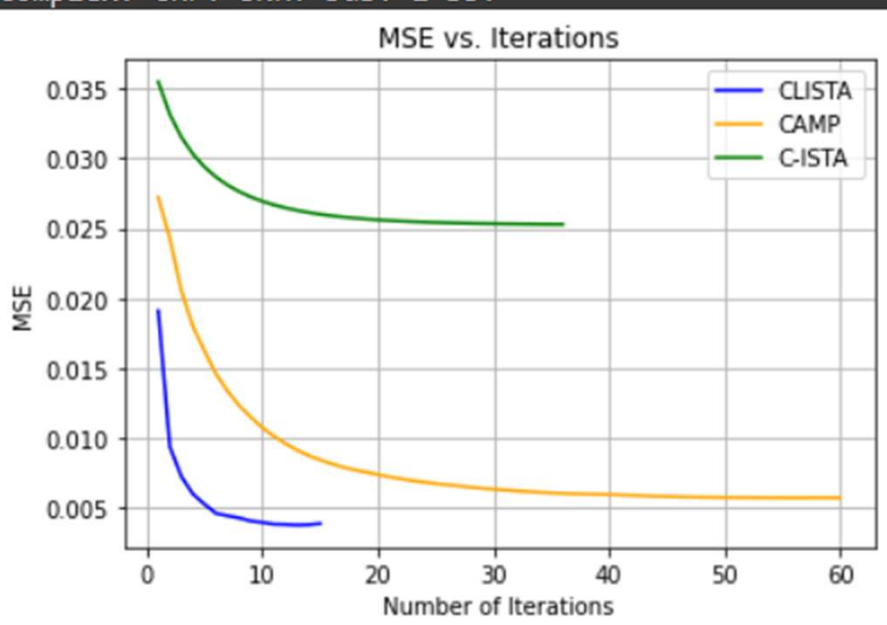
Complex. CRF. SNR: 5dB.



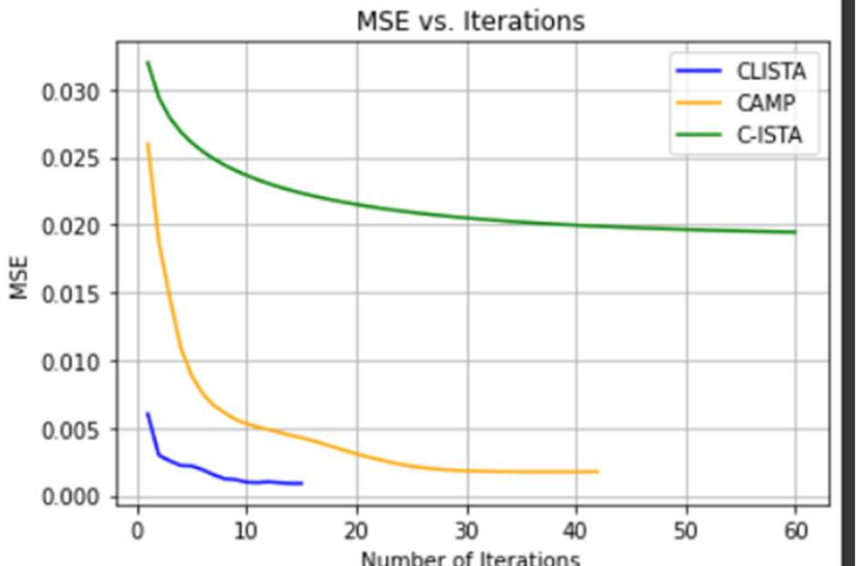
Complex. CRF. SNR: 5dB. 2 BS. Threshold: .3

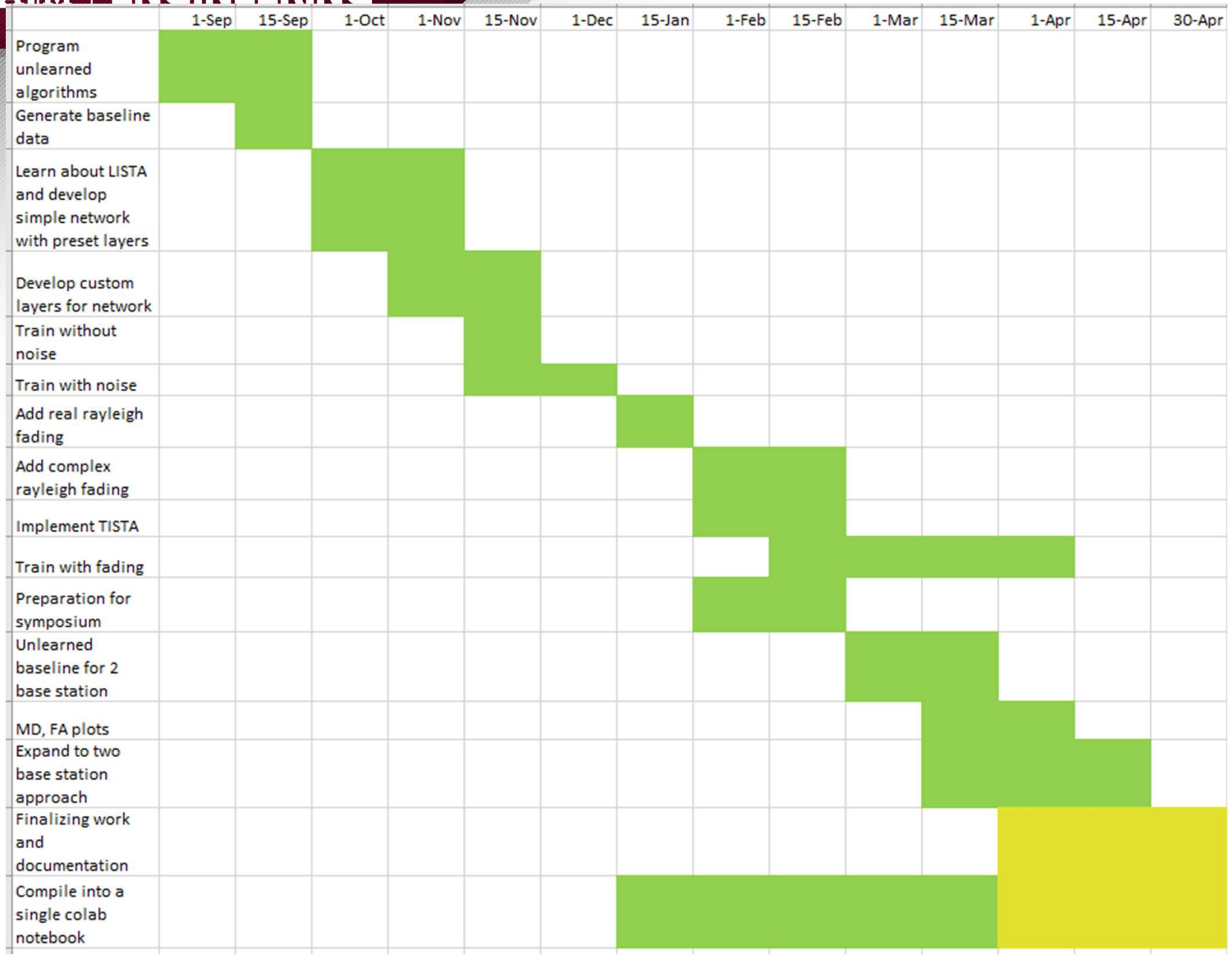


Complex. CRF. SNR: 5dB. 1 BS.



Complex. CRF. SNR: 5dB. 2 BS.




1-Sep
15-Sep
1-Oct
1-Nov
15-Nov
1-Dec
15-Jan
1-Feb
15-Feb
1-Mar
15-Mar
1-Apr
15-Apr
30-Apr
Program unlearned algorithms
Generate baseline data
Learn about LISTA and develop simple network with preset layers
Develop custom layers for network
Train without noise
Train with noise
Add real rayleigh fading
Add complex rayleigh fading
Implement TISTA
Train with fading
Preparation for symposium
Unlearned baseline for 2 base station
MD, FA plots
Expand to two base station approach
Finalizing work and documentation
Compile into a single colab notebook

Validation

We are evaluating MSE vs. iterations/layers.

The project is considered a success if the ML outperforms ISTA/AMP:

- With no noise
- With noise
- With fading
- With noise and fading

Here performance is measured by MSE and number of MD/FA.

Thank you!

Questions?