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```
data, valid_labels, test_data, test_labels = make
```

```
.Input(shape=(n+N,), name='y_inputs')
```

```
range(cnt):
```

```
layer differently depending on what layer it is
```

```
:
```

```
= SimpleLISTALayer(A, L, init_alpha, init_Q, in
```

```
cnt > 1:
```

```
if idx_layer == 0:
```

```
x_hidden = SimpleLISTALayer(A, L, init_alpha
```

```
elif idx_layer == cnt - 1: # output is pop
```

```
output = SimpleLISTALayer(A, L, init_a
```

```
else:
```

```
x_hidden = SimpleLISTALayer(A, L
```

```
model = keras.Model(inputs=input
```

```
# compile keras model
```

```
custom_mse_loss = CustomMSEL
```

```
custom_mse_metric = Custom
```

```
model.compile(optimizer
```

```
# train model
```

```
history = model
```

Team 64: Enhancing User Detection

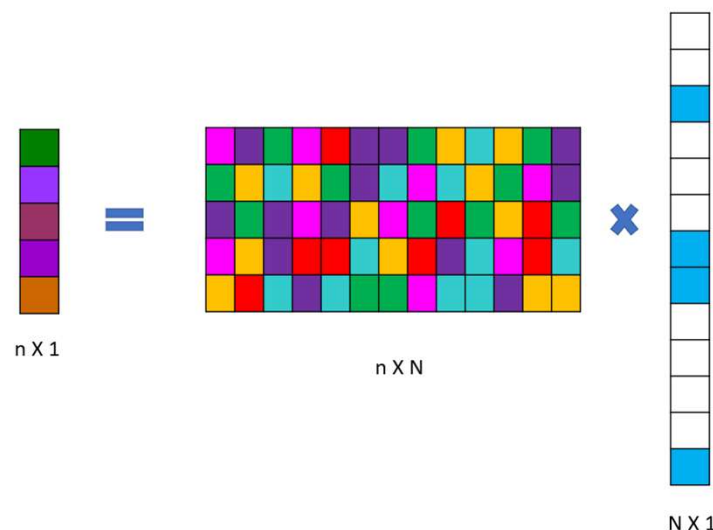
Bi-Weekly Update 1

Holly Roper

Sponsor: Dr. Krishna Narayanan

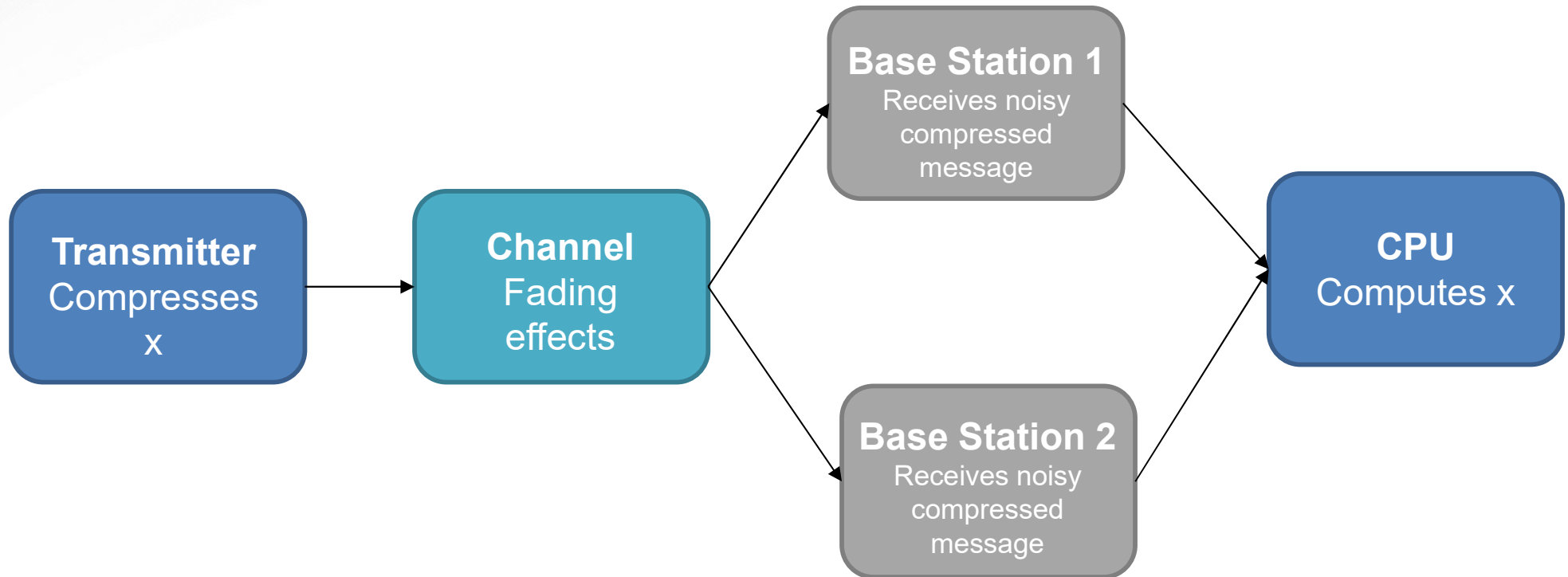
Project Summary

- We are seeking to enhance compressed sensing algorithms with deep learning
- Focusing on user detection
- LISTA converts IST to a neural network





Project Overview





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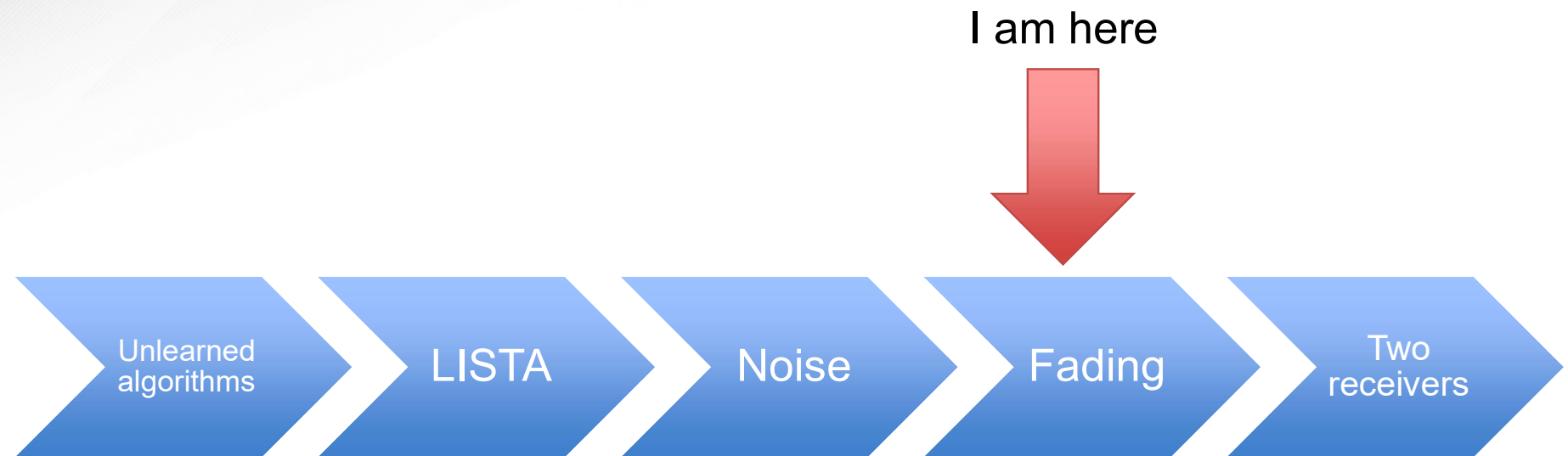
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Major Project Changes for 404

There were no major complications faced in 403, so I am still on track with the original project.



Project Timeline



Unlearned Algorithms

Holly

| Accomplishments since 403 1 hr of effort | Ongoing progress/problems and plans until the next presentation |
|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <p>Changed the way we programmed IST to line up with LISTA</p> | <ul style="list-style-type: none"> • Implement real Rayleigh fading • Evaluate performance |

$$\begin{aligned} \mathbf{z}^t &= \mathbf{y} - \mathbf{A}\mathbf{x}^t, \\ \mathbf{x}^{t+1} &= \eta(\mathbf{x}^t + s\mathbf{A}^T\mathbf{z}^t; s\lambda) \end{aligned}$$



$$\mathbf{x}^{l+1} = \eta((\mathbf{I} - \frac{1}{L}\mathbf{A}^T\mathbf{A})\mathbf{x}^l + \frac{1}{L}\mathbf{A}^T\mathbf{y})$$



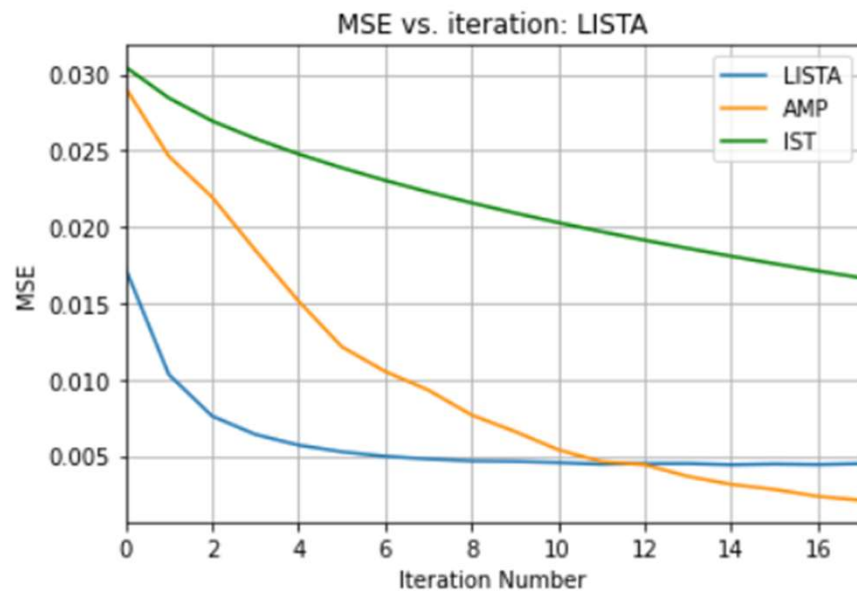
LISTA

Holly

| Accomplishments since 403 10 hrs of effort | Ongoing progress/problems and plans until the next presentation |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none">Generated MSE vs. SNR plots (Now with correct SNR values)Fixed weights of layers and trained to improve performance | <ul style="list-style-type: none">Implement real Rayleigh fadingTrain the networkEvaluate performanceStart adaptation to handle complex numbers |

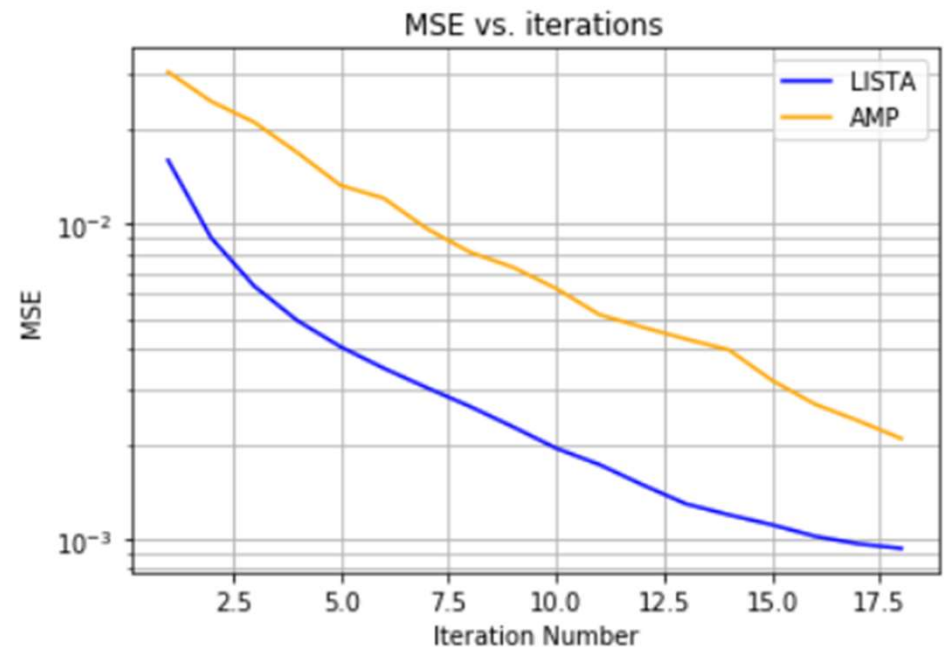
LISTA

Holly



Before adjustments, LISTA flattened around 5 layers and AMP surpassed it at 11 iterations

After adjustments, we were able to push LISTA to 18 layers and continue to see performance enhancement



Note: above graph is log scale

Execution & Plan

| | 1-Sep | 15-Sep | 1-Oct | 1-Nov | 15-Nov | 1-Dec | 15-Jan | 1-Feb | 15-Feb | 1-Mar | 15-Mar |
|-----------------------------------------------------------------|-------|--------|-------|-------|--------|-------|--------|--------|--------|--------|--------|
| Program unlearned algorithms | Green | Green | | | | | | | | | |
| Generate baseline data | | Green | | | | | | | | | |
| Learn about LISTA and develop simple network with preset layers | | | Green | Green | Green | | | | | | |
| Develop custom layers for network | | | | Green | Green | Green | | | | | |
| Train without noise | | | | | Green | Green | | | | | |
| Train with noise | | | | | Green | Green | Green | | | | |
| Add real rayleigh fading | | | | | | | Yellow | | | | |
| Add complex rayleigh fading | | | | | | | | Gray | Gray | | |
| Train with fading | | | | | | | | | Gray | Gray | |
| Expand to two base station approach | | | | | | | | | | Gray | Gray |
| Compile into a single colab notebook | | | | | | | Yellow | Yellow | Yellow | Yellow | Yellow |

