# AI-Powered 6G Beam Management Demo

Edmund Gunn Jr.

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Final Project

NYU Tandon School of Engineering

# Introduction

- 6G beam management challenge
  - Exhaustive sweeping too slow
  - ML can predict beams from partial CSI

# Carrier Frequency Selection

- 28 GHz practicality vs. 100 GHz potential
  - Debated 100 GHz for THz potential
  - Chose 28 GHz for built-in profiles
  - 100 GHz exploration for future work

# DFT Codebook & Array Setup

- Arrays & Codebook
  - BS: 4×4 URA (16 antennas)
  - UE: 4×2 URA (8 antennas)
  - 64 beams from 8×8 az/el grid ±60°

# Dataset Generation

- 10,000 i.i.d. Gaussian CSI samples
  - Flatten to 256-d feature vectors
  - Label by exhaustive beam sweep

# MLP Architecture

- Two hidden layers
  - 128 units each, ReLU
  - Softmax output for 64 classes

# Training Results

- Test Accuracy: 2.07%
  - Training up to ~70% (overfit)
  - Validation ~2% (chance)

# Glossary

- Key Terms
  - URA: Uniform Rectangular Array
  - Beamforming: Directing signal energy with antenna arrays
  - DFT Codebook: Predefined set of beamforming vectors using Discrete Fourier Transform
  - CSI: Channel State Information: complex channel matrix measurements
  - MLP: Multi-Layer Perceptron: a feedforward neural network
  - ReLU: Rectified Linear Unit activation function
  - Adam: Adaptive Moment Estimation optimizer
  - Confusion Matrix: Table showing true vs. predicted classes

# Conclusion

- Summary & Next Steps
  - Baseline set at chance level
  - Framework ready for enhancements