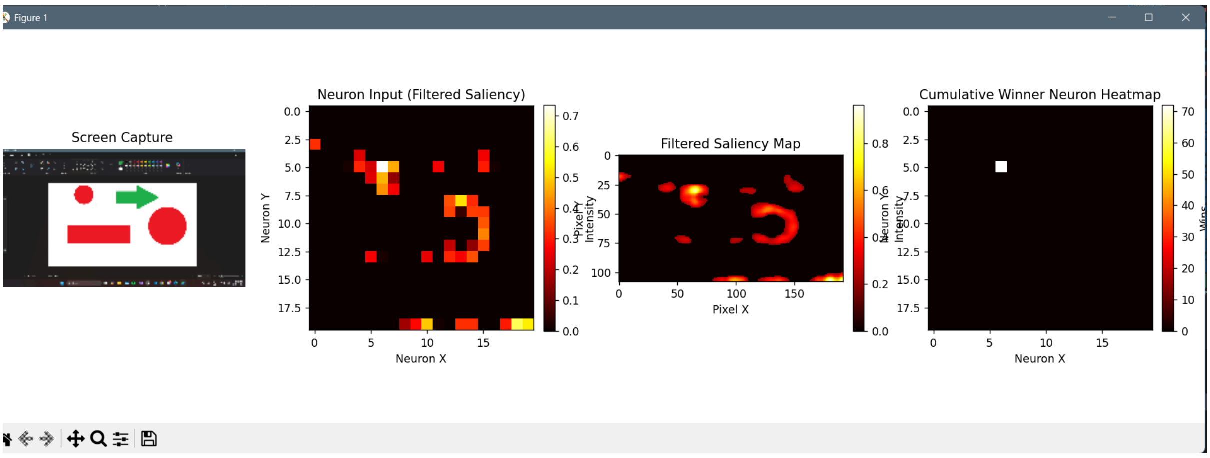
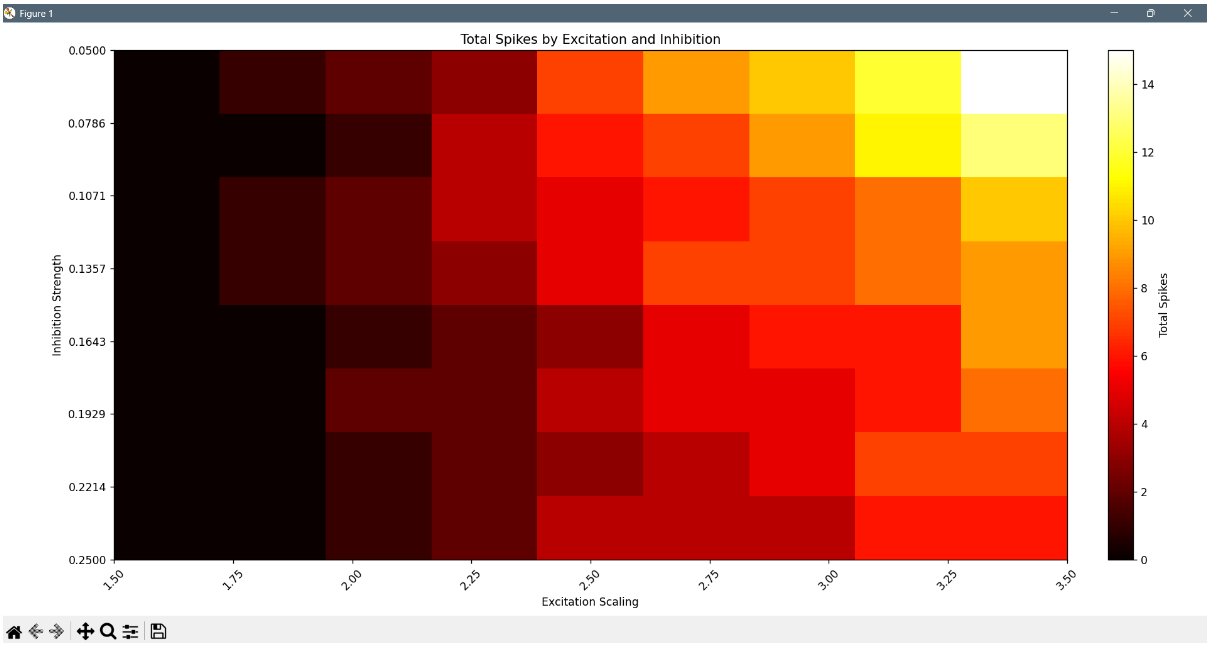
Project Overview





<u>Project:</u>
Biologically inspired computational model simulating how humans shift their gaze (saccadic eye movements) in response to visual stimuli.

Uses real-time webcam and custom neural architecture modeled after actual brain structures in eye movement control, specifically the superior colliculus and frontal eye fields

<u>Core Components:</u>
1. Real-time eye tracking system (openCV)
    - The computer vision component
    - Captures eye positions in real time using webcam
    - Provides initial data (actual gaze position) that the neural model will learn from and eventually mimic
2. Biologically Inspired Neural Network

- The computational neuroscience component
- Architecture Inspiration
  - Superior Colliculus (SC): A midbrain structure responsible for initiating eye movements
  - Frontal Eye Fields (FEF): A region of the prefrontal cortex that helps decide when and where to look
- Key Mechanisms
  - LIF neurons: will mimic how biological neurons accumulate signals and fire when hit a threshold - proxy for a saccade (rapid jerky movement of the eye)
  - Lateral Inhibition: Competing neurons suppress each other when making a decision - similar to how our visual system avoids being distracted by irrelevant things
  - Neural Noise and Adaptation: Introduces variability - simulate real biological randomness and habituation
    - Habituation: occurs when the brain becomes less responsive to a constant or repetitive visual input

3. Simulating Visual Attention and Gaze Shifts
   - The output and the results of the work described
   - The model will take in real time camera data, predict which visual region the eyes should jump to
   - Uses activation thresholds, competition, and stimulus salience to make these decisions

<u>Specifics</u>

Parameters to vary and consider

1. Excitation Threshold: How easily a neuron fires
2. Inhibition Strength: How strongly a neuron suppresses others
3. LIF Time Constants: How fast a neuron decays
4. Stimulus Complexity: Simple vs. busy images
5. Neural Noise: The randomness in the system

Performance Measurements

- Saccadic Reaction Time: Time between seeing something and the saccade
- Fixation Duration: How long the model decides to fixate on something
- Saccade Amplitude: Distance between two fixation points
- Prediction Accuracy: How close the model's predicted gaze shifts are to actual eye tracking data

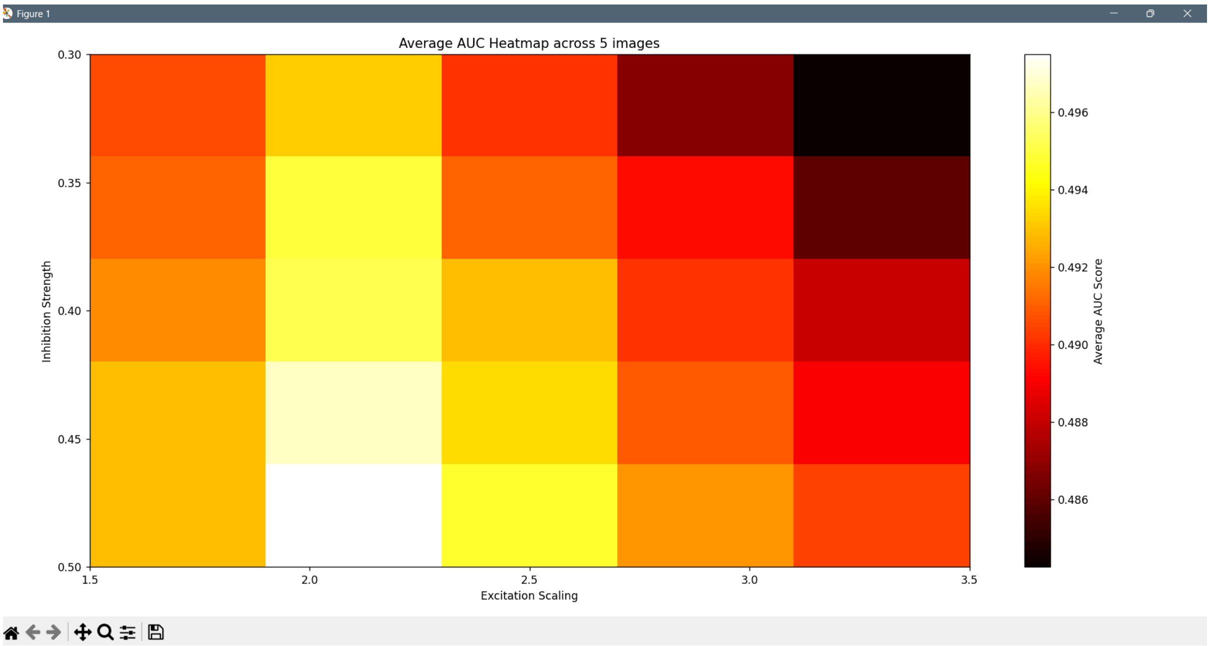


Figure 1
Average AUC Heatmap across 5 images
Inhibition Strength
0.30
0.35
0.40
0.45
0.50
1.5
2.0
2.5
3.0
3.5
Excitation Scaling
0.496
0.494
0.492
0.490
0.488
0.486
Average AUC Score