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1. **Title:**
2. **Introduction:**
    - Background and context:
        - Neuropixel probes are state-of-the-art electrode arrays that can simultaneously record large neuronal populations from deep within the brain. Traditional methods of mapping neuropixel recordings to intended movements or stimuli use classical machine-learning methods, particularly linear discriminant analysis (LDA) or support vector machines.
    - Statement of the problem
        - Lorem ipsum
3. **Research objectives:**
    - We aim to build a novel, graph-based decoder that may outperform such methods. Intuitively, graphical inputs appear to better represent neural data as they can encapsulate both spatial and temporal relationships for individual neuron spiking.
4. **Relevant literature/research**
    - Previous literature and research studies utilize classical machine learning methods to decode neural activity. We hope to represent neural connectivity as a graph neural network, where neurons can be represented as nodes and their interaction
    - Converting medical neuroimaging data into grpahical formats achieves SOTA performance when classifying diseases.
    - https://www.eneuro.org/content/5/4/ENEURO.0414-17.2018 <<< classical models, less neurons, try sampling from multiple brain regions instead of just one
    - GNNs have been used as a transformative tool for decoding brain connectivity. A recent study, focusing on brain graphs, showcases the efficiency of GNNs over classical machine learning methods in learning the intricate graph structure of non-Euclidean data types. The study specifically highlights GNN applications in tasks such as missing brain graph synthesis and disease classification.
        - This highlights the relevance of GNNs in our project, as they offer a promising option for decoding neural data
5. **Research Methodology**
    - Research Design:

    - Our study adopts a data-driven approach, by first filtering, cleaning, and transforming spiking data into high-resolution graphs where each node will represent a single unit (a single neuron or small cluster of neurons). Next, we will experiment with various graph-based architectures, including Graphical Attention Layers and Graphical Convolutional Networks. To compare performance across different architectures, we will evaluate various metrics including cross entropy loss.
  - Participants
    - N/A
  - Data collection
    - We will use data published by the Allen Institute, where 10-mm probes were inserted into wild mice, allowing them to record from subcortical visual areas. The mice were later shown a series of various stimuli, including photos of moving dots, natural images (such as other animals), etc.
6. **Expected Results**

7. **Significance and Contribution to Knowledge**
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8. **Limitations:**
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9. **Conclusion**
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Graph nns outperform the traditional methods of using classical models, particularly LDA. (linear discimriniatntn analysis)