Fiete Lab
2020 Trimester 1 Goals

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Project 1 - Overview

See Leenoy's presentation from last week's Theory Meeting

`https://drive.google.com/drive/u/1/folders/`
`1IuUrh0hq1Sl8MBfCQkXGkLwz1OnKXDZ7`

Project 2 - Overview

Goals:

1. Understand how neurally-plausible mechanistic models solve IBL task

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- How do model design choices (e.g. learning rules, size, connectivity, noise) affect the learnt solution, and why?

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Research Questions

- What computation(s) do plausible neural models execute to solve the same IBL task solved by mice?
- How do model design choices (e.g. learning rules, size, connectivity, noise) affect the learnt solution, and why?
- How does gradient descent on a high dimensional error landscape enable learning the IBL task's structure?

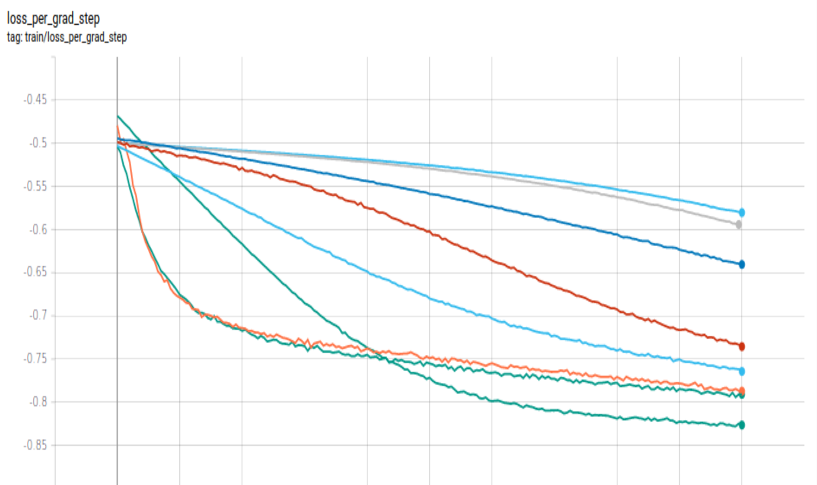
Project 2 - Implementation Details

- Loss: Cross Entropy
- Stimuli sampled from $\mathcal{N}(-1,1)$ and $\mathcal{N}(1,1)$ plus block prior
- Architectures: RNN (tanh), LSTM, GRU
- Number of stacked layers: 1
- Hidden dimension: 10, 20, 50, 100, 200
- Weight Initializations: Uniform $\pm\frac{1}{\text{hidden state size}}$, Identity
- Optimizer: SGD with LR=0.01, no momentum

Project 2 - Preliminary Results

Models appear to learn task:

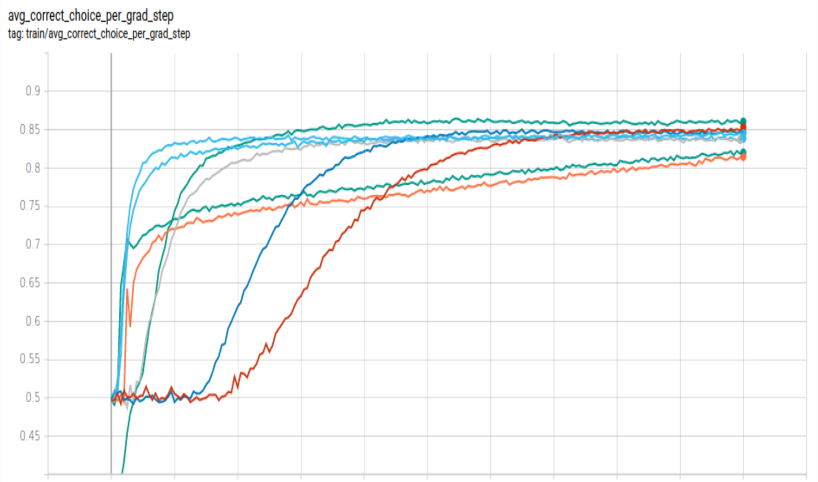
Figure 1: Loss vs Grad Step



Project 2 - Preliminary Results

Models appear to learn task:

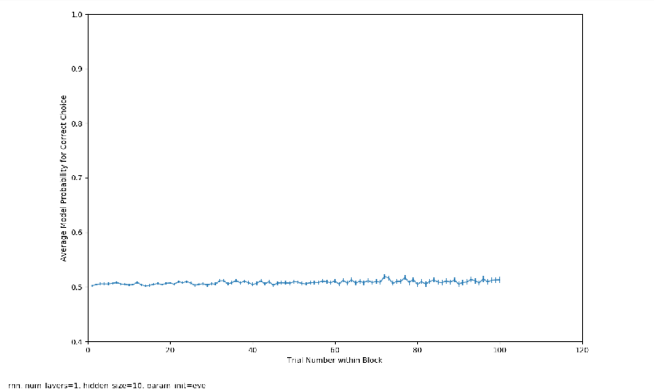
Figure 2: P(Correct Choice) vs Grad Step



Project 2 - Preliminary Results

Models appear to learn task's block structure:

Figure 3: P(Correct Action) vs Trial Number within Block



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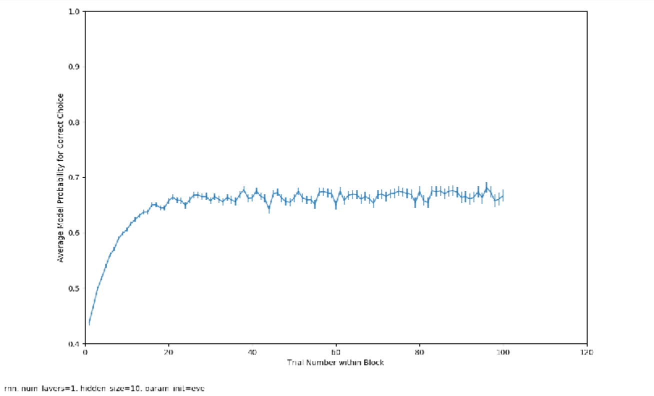

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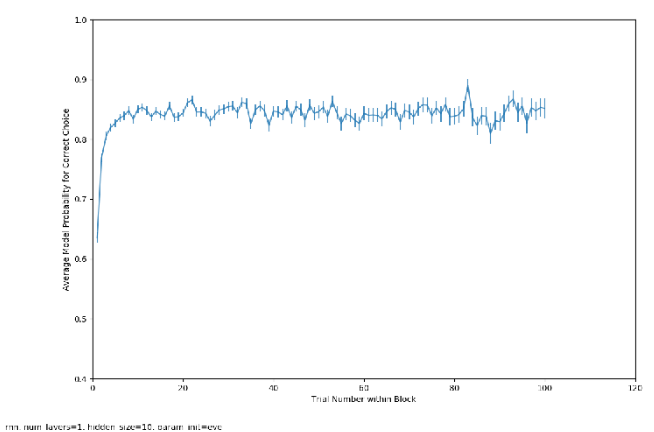
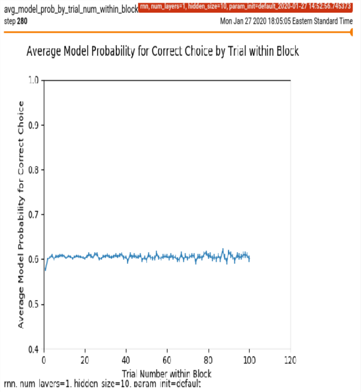
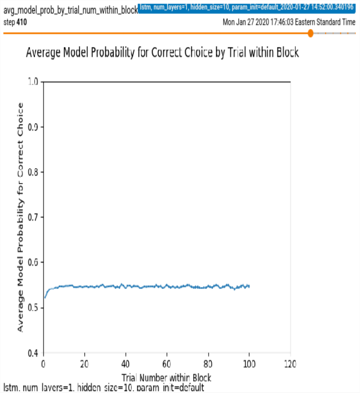


Project 2 - Preliminary Results

Architecture appears to effect learning strategy.

Consider P(Correct Action) after first indication that model recognizes block structure:

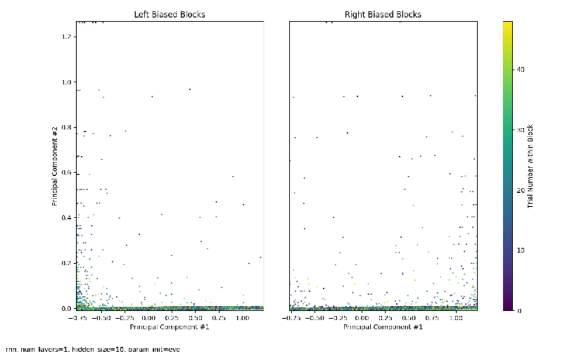




Project 2 - Preliminary Results

Models (sometime) reveal 2D manifold reflecting task structure:

Figure 4: RNN Phase State projected onto first two PCs



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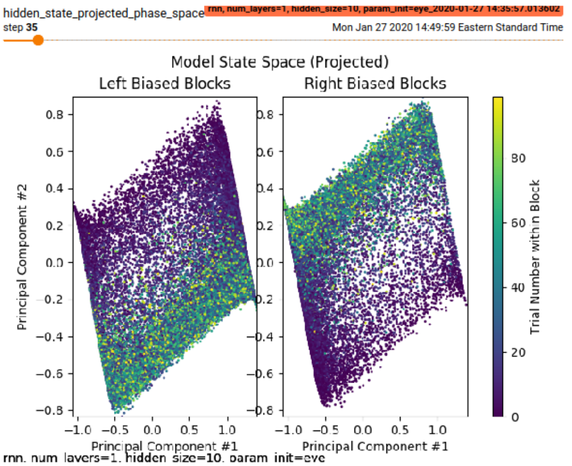
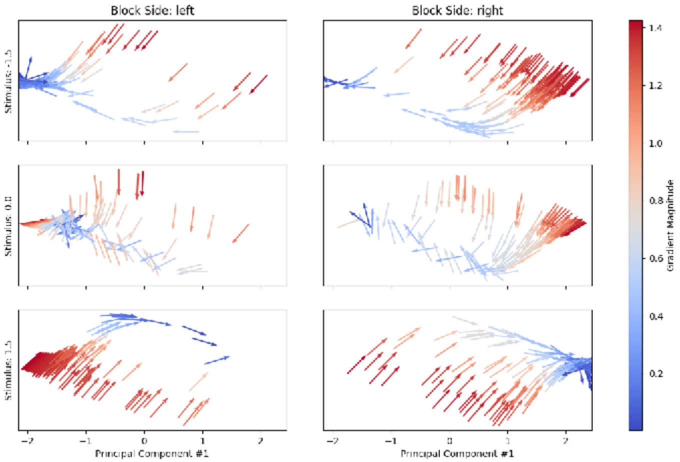


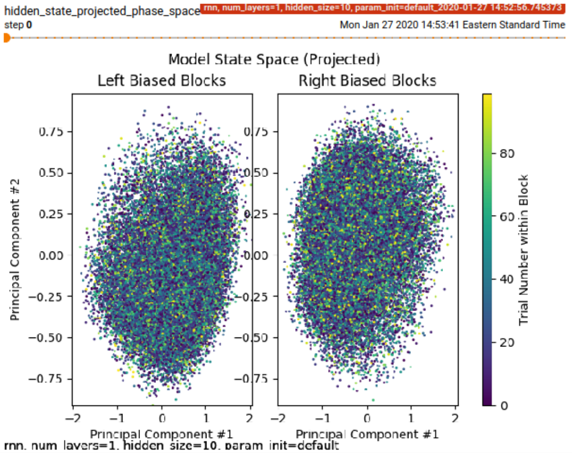
Movement in projected phase space for left, neutral, right stimuli:

Figure 5: P(Correct Choice) vs Grad Step



Models (sometime) do not appear to learn 2D manifold:

Figure 6: RNN Phase State projected onto first two PCs



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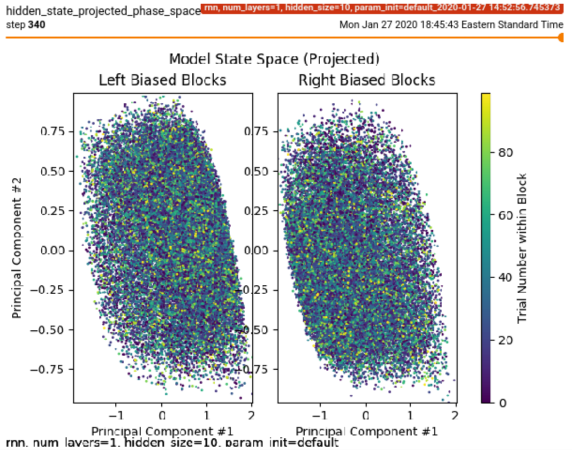


Project 2 - Preliminary Results

Figure 7: Hidden units correlations before learning.

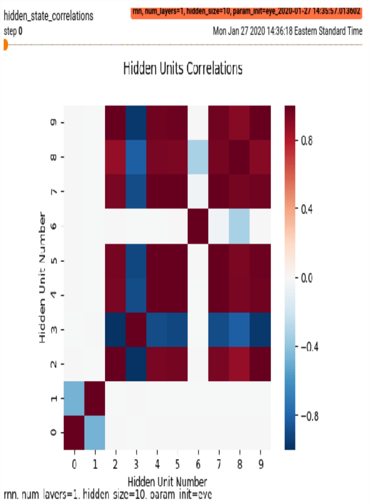
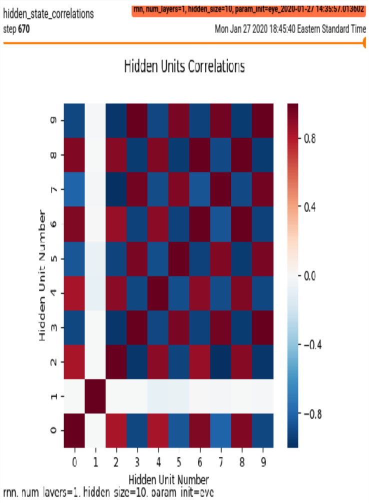


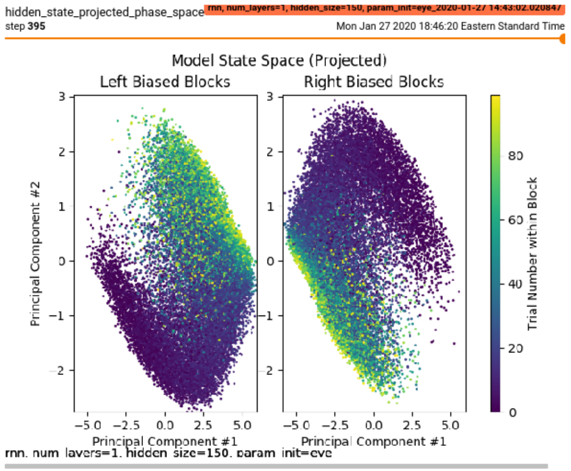
Figure 8: Hidden units correlations after learning.



Project 2 - Preliminary Results

Other manifolds,

Figure 9: RNN Phase State projected onto first two PCs



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