NEUR 503 Term Paper Proposal

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Note: No format for the term paper proposal was mentioned, was not entirely sure on what to write.

Proposal

For the term paper, the topic of consideration is to explore a computational model proposed by Foster et al. (2000), where the model uses a Temporal Difference (TD) learning rule to simulate hippocampal dependent navigation of a mice in the Morris water-maze task. Specifically, I intend to implement the model proposed in the paper and simulate it.

I plan to discuss the issues a navigation model would suffer from in its implementation due to the distal reward problem and the global consistency problem. In addition, the paper describes that the mathematical model represents the position of the mouse (agent) using a set of modeled place cells, which would offer another avenue of exploration on its computational/ program implementation and discussion on its mathematical aspects. There could also be discussion on the proposed "actor-critic" method for the TD learning rule, and how the mathematical implementation is learning to encode for different aspects of the navigation model. An exploration of multi-platform/escape coordinates scenario and the model's performance can be conducted as well.

As for figures, plots showing the performance of the implemented model as the timesteps for the simulated agent to find the designated region to 'escape' would be generated. In other words, the escape latency over x simulated trials can be explored. In addition, visualization of the actual path should be possible given that I have developed the place cell representation of space and position of the agent, however until I approach the end of implementation this is tentative.

If the proposed exploration and content above is not sufficient for the recommended term paper length, the paper also suggests a "combined coordinate and actor-critic" model, which would then be available for implementation and further exploration of the hippocampal dependent navigation model.

One factor yet considered is the language of implementation. Although the course focuses on MATLAB for its computational implementations, the programming language I have the most experience in is Python and its useful libraries. For a major assignment worth half of the course grade, I would like clarification on if it would be suitable to code in the programming language I am most comfortable with for the purpose of simulation and exploration.

References

Foster DJ, Morris RG, Dayan P. A model of hippocampally dependent navigation, using the temporal difference learning rule. Hippocampus. 2000;10(1):1-16. doi: 10.1002/(SICI)1098-1063(2000)10:1<1::AID-HIPO1>3.0.CO;2-1. PMID: 10706212. https://pubmed.ncbi.nlm.nih.gov/10706212/