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3/28/12

Professor Matthew Botvinick

Independent Work Checkpoint Firm

I believe I've made good progress so far. I began the semester by reading various relevant texts and studies (see the bibliography below for the most relevant pieces). After completing the reading, I met with Carlos Diuk and Alec Solway, who helped me better understand the various algorithms used in model-free and model based learning

As a sanity check, as well as an easy way to begin to interact with the data, I wrote a quick R script that examined the stay-proportions after common and rare transitions, in the rewarded and unrewarded cases. This R script allowed me to successfully recreate figure 2C of Daw's study.

I then attended a very useful workshop on model-free and model-based learning, run by Professor Yael Niv. Using the workshop as a foundation, I was able to complete the Matlab code for generating model-free and model-based agents, and am currently in the process of debugging it. I believe the code is able to generate models for both agents successfully

The next step is to implement code to determine the relative contributions of model-free and model-based agents to each subject's actual data. From there, we can determine correlations with reaction time, using R to perform the correlation analysis, which will yield our result

After performing the correlation analysis, there are a number of possible avenues for further research. One potential avenue for further study is to create a series of hybrid models that take into account both the model-free and model-based agents. Along the same lines, a second option would be to use the subject's reaction times as constraints to build more accurate computational models. Finally, a third possibility would be to examine the distribution of reaction times for each subject using drift diffusion models. After these models were developed, we would attempt to determine which of many model-based learning algorithms the subject used, based on the reaction time signatures. I will meet with Professor Botvinick at this point to help determine which course of action would be best.

Bibliography

Daw, Nathaniel D., Samuel J. Gershman, Ben Seymour, Peter Dayan, and Raymond J. Dolan. "Model-Based Influences on Humans' Choices and Striatal Prediction Errors." *Neuron* 69.6 (2011): 1204-215.

Botvinick, Matthew and Solway, Alec. "Goal-Directed Decision Making as Probabilistic Inference: A Computational Framework and Potential Neural Correlates." *Psychological Review* 119.1 (2012): 120-54.

Sutton, R.S., and A.G. Barto. "Reinforcement Learning: An Introduction." *IEEE Transactions on Neural Networks* 9.5 (1998): 1054.