John Mansfield

Recent Projects

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Multi-agent Learning

Replication of Greenwald and Hall Correlated Equilibria Experiments. Implemented, explored and analyzed multi-agent, friend, foe q-learners and correlated equilibria. Used linear solvers to implement non-deterministic policies in simulated environments.

Implementation of a Deep Q Neural Network

Selected and implemented an approach for solving the openAI lunar lander domain (4 discrete actions and a six-dimensional continuous state space). Solved using a DQN and Keras with a Tensorflow backend.
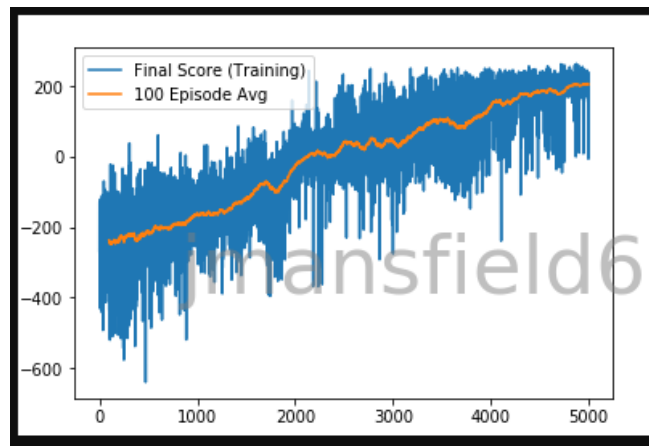
Temporal Difference Learning

Created an implementation of the TD lambda algorithm and replication of Richard Sutton's random walk experiments from his 1988 paper - Learning to Predict by the Methods of Temporal Differences.

Reinforcement Learning and Decision Making

- Created a 30 state MDP that required at least 15 iterations of policy iteration.
- Implemented a version of the KWIK learning framework with a polynomial bound on the number of unknown responses.
- Used k-step estimators to determine the best lambda values for an MDP.

Machine Learning – Unsupervised Learning and Dimensionality Reduction

Used clustering and dimensionality reduction techniques to improve performance of supervised learning techniques. Pre-processed data using principal component analysis, independent component analysis, and clustering techniques such as estimating means to optimize neural net training times.

Machine Learning – Supervised Learning

Explored and analyzed various supervised learning techniques using publicly available data sets.

Machine Learning – Randomized Optimization

Implemented local random search algorithms (randomized hill climbing, simulated annealing, genetic algorithms) and used for neural network weight training instead of backpropagation.

Robotics – Autonomous Motion Prediction - *Java/openCV*

Applied particle and Kalman filters and ML data analysis for noise reduction and motion prediction.

Runaway Robot

Created robot software to capture a 'runaway robot' in a continuous and noisy environment (both sensor and control noise). Working solution included the use and implementation of localization, Kalman and particle filters, motion planning, data smoothing, PID control, simultaneous localization and mapping.

Modeling, Evaluating and Visualizing IMDB Data

Analyzed raw movie data to investigate the relationship between attributes and box-office success. Supported conclusions with statistical insights gathered from data and visualizations.

Data and Visual analysis using R - *R/ggplot*

Graphed census data using R and ggplot.

Illinois - Professional Workers by County
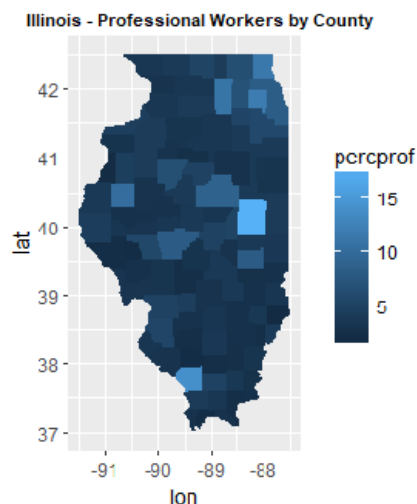
Implementation of Logistic Regression

Created a calculus-based derivation of logistic regression algorithm and analyze data, accuracy, and computational complexity.

Comparison of Search and Sort Algorithms - *.NET/MVC/C#*

Compared built-in search and sort vs. iterative search, binary search, merge sort, and insertion sort. Implemented a brute force and dynamic programming string search and analyzed computational complexity. Created a template site using the MS open web interface authentication (OWIN). Used entity framework for ORM and ADO.net connections to MS SQL server.

Market Simulator and Time Series Analysis

Used technical indicators and quantitative analysis to create a market learning strategy based on historical time series analysis.

JPM Experiment2: Impact and Daily Returns
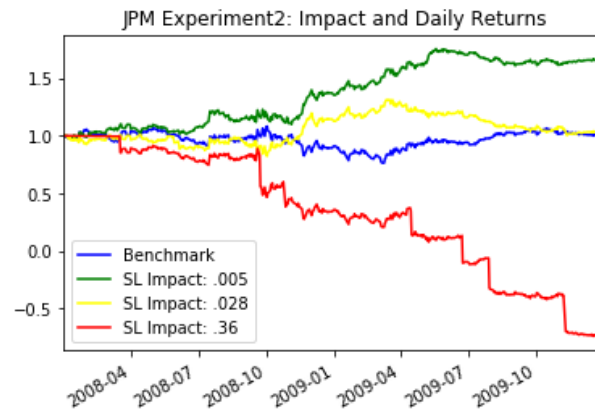
InfoSec - C/Linux Buffer Overflow, Broadcasting RSA Attack, Web Security

- Located system() and /bin/sh in memory and implemented a stack buffer overflow exploit (return-to-libc attack).
- Decrypted RSA ciphertext using Hastad's broadcast attack.
- Used cuckoo sandbox to perform malware analysis.
- Created CSRF, XSS, and SQL Injection JavaScript exploits.

SDN Application Development

Implemented and tested Bellman Ford in simulated environment. POX/Pyretic switching, routing, firewall, DoS mitigation.

Web Development – *AngularJS/Firebase/Rest API*

Implemented healthcare web application using AngularJS and Firebase NoSQL Database. Connected to MiHIN FHIR rest API for search and modify of medical records.