CS 7641 Machine Learning
Assignment 4

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Due Sunday April 22nd, 2018 11:59pm

Introduction

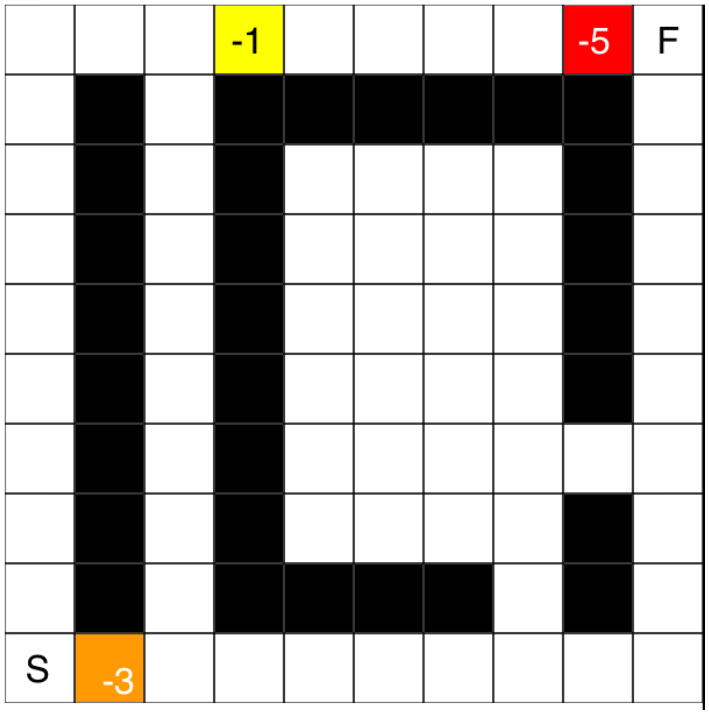
This assignment explores reinforcement learning. It begins by choosing two Markov Decision Procceses (MDPs). Both MDPs are solved using both value iteration and policy iteration, and the results are compared against each other. Afterwards, Q-learning is applied to both problems and those results are then compared to the original results.

Problems Chosen

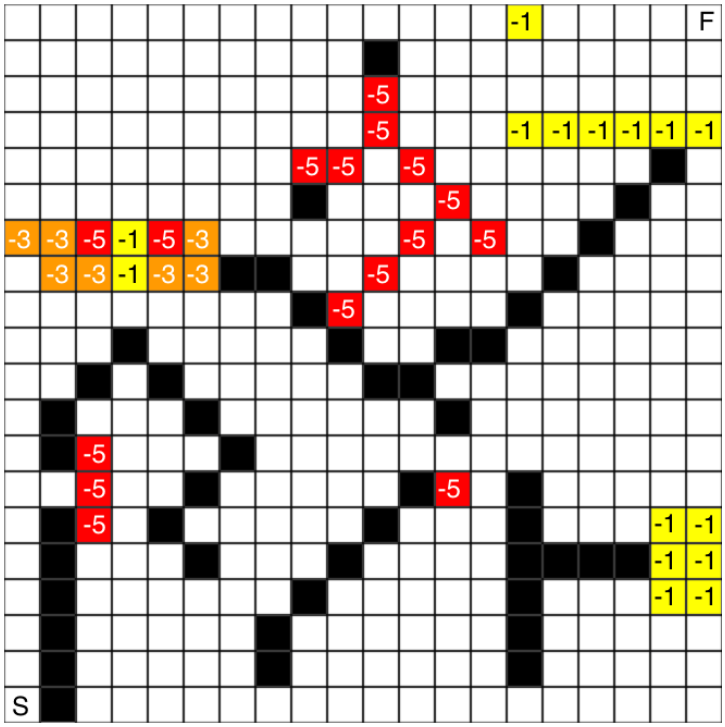
Gridworld was chosen as the basis for the two Markov Decision Processes. This was done for a few different reasons. First, the ease in visual representation and understanding. Second, path finding is a common problem in real-life that has applications from walking to work, to driving cross-country, etc. Third, it is easy to scale the complexity of a grid as well as increase in the number of states. Fourth, for a solveable grid, one or more optimal solutions must exist. All-in-all, gridworld is great for demonstration reinforcement learning.

The first gridworld problem is an "easy" configuration. It has a 10x10 shape with 70 possible states. The start state is in the bottom left corner and the end state is in the top right corner. Various "walls" exist that cause the learner to optimize around.

The second gridworld problem is a "hard" configuration. It has a 20x20 shape with 353 possible states. The start state is in the bottom left corner and the end state is in the top right corner. Various "walls" exist that cause the learner to optimize around.



10x10 Easy Gridworld w/ 70 States



20x20 Hard Gridworld w/ 353 States

Datasets

The datasets chosen were the same datasets chosen for assignment 1. The first dataset is the US permanent visa dataset. This dataset is interesting due to its potential to aid in the visa application process from a cost and time savings potential. It could also enable confidence in those interested in applying for a US permanent visa but doubting their chances of acceptance. At the end of the day, the goal is it to try to determine the application result before time, money, nd other resources are spent. As before, 6 features are used.

The second dataset is a home sale price prediction dataset taken from an ongoing Kaggle competiton. This dataset is interesting for two primary reasons: real-world applicability and participating in a Kaggle challenge. First, modeling home prices is both a difficult and lucrative task. If one can succesfully model home sale prices on large sets of data, he/she can make large amounts of money investing in real estate when he/she detects outliers in listed price vs. what it is expected to sell for. This applies to flipping, investing, and remodeling. Second, the dataset is part of an ongoing Kaggle competition that does not have a winning solution yet. By taking part of the competition, the dataset presents the opportunity to work towards a winning solution and advance ones algorithms over time. As before, 11 features are used.

Part 1: Clustering Algorithms

Introduction

K-means clustering is the first algorithm applied to the datasets and expectation maximization is the second. Both algorithms work by clustering: gathering groups of instances together based upon their features. The rationale is that similar instances will likely be labeled the same way–such as identical visa applications obtaining the same outcome.