CAP 6929 Homework 2

Due: Feb-25 (Friday), 2022 (11:59PM)

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1. Please read the lecture notes and fill in the definitions for the following terms:

(a) p(s',r|s,a) = Pr (St+1=s',Rt+1=r|St=s,At=a) transition probabilities distribution models MDP

(b) R(s,a) = = E[rt | st = s, at = a, st+1 = s 0] reward function mapping state and action learning policy eligibility trace for state action pair

(c) π (s,a) = Pr{At = a | St = s, θt = θ} mapping from states to action probabilities for optitmal policy.

(d) π* = argmax max optimum policy

(e) V(s) = optimal value function value of a state

(f) Q(s,a) = Q-learning model = r(s,a)+ymax_a Q(s',a)

$$Q(s,a) = \mathbf{E}\left[\sum_{n=0}^{N} \gamma^n r_n\right]$$

2. Multiple choices for the following problems

A) Decide which learning type the following tasks belong to. Choose from the options supervised, unsupervised, or reinforcement learning?

1. Training a program to play tic tac toe = *reinforcement learning model-based*

2. Finding patterns in marketing data = *supervised*

3. Analyzing the sentiment of a sentence = *unsupervised deep learning*

4. Determining the credit worthiness of bank customers = *supervised*

5. Have a robot balance = reinforcement learning model-free

6. Analyze how a sequence of treatments affects a patient's health = *This one could use either supervised classification with unsupervised deep learning or ensambles classification.*

7. Predict tomorrow's weather = *classification prediction through regression or time series analysis but you can also use Deep Learning Weather Prediction models which use CNN with semi-label data sets.*

8. Determine number of species in various animal data = *for this we can use supervised classification and unsupervised clustering*

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B) Which approach of reinforcement learning model based or model free would you choose for the following games and explain the reasons for your choice?

1. **Tic-tac-toe** = We will implement grid world game by iteratively updating Q value function, which is the estimating value of (state, action) pair. We would define a model so therefore use model-based.
2. **Chess** = Is more complex and would need a model-free free Q-learning implementation so the state and actions implement a policy. I would use Deep Reinforcement Learning to optimize decision making through previously defined strategies models.