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**CS3018 - Reinforcement Learning**

**Assignment 3**

**Due Date: 27th April, 2025**

**Objective**

In this assignment, you will explore three sample-based reinforcement learning algorithms—Monte Carlo Control, SARSA, and Q-Learning—by applying them to the FrozenLake environment. You will modify an existing policy iteration model-based script and implement each method, visualize the agent's learned behavior, and compare the performance using multiple evaluation metrics.

**Instructions**

You are provided with a Python file (`frozenLake.py`) that uses model-based Policy Iteration.

You are required to:

1. Implement three sample-based learning algorithms:

* Monte Carlo Control
* SARSA
* Q-Learning

2. Train each agent for at least 10,000 episodes.

3. Visualize the agent's final policy as a 4x4 grid showing the best action from each state.

4. Simulate and animate at least 10 episodes of the agent's movement for each method.

5. Compare the three methods based on the following evaluation metrics:

* Average return per episode
* Success rate (percentage of episodes reaching the goal)
* Time to compute (optional)

**Deliverables**

1. Python script (`frozenlake\_sample\_based.py`) implementing all three methods.

2. Visualizations of the policy grid and simulation runs (images or video).

3. A report (PDF/Word) comparing the algorithms using the above metrics.