

RL Lab Assignment - 1
CS 414: Reinforcement Learning Lab
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INSTRUCTIONS: You have to give clear and detailed plots and solution to each of the questions. **Submit one single pdf file containing solutions to all problems in google class room before 19th Jan, 11.30 am before the RL class. Submit the code as .py file or as python notebook along with the solution pdf. Only one member of the group has to submit the assignment. Name your pdf with rollno1_rollno2_rollno3.** For example 190010005_190010006_190010007.pdf. Late submissions will not be graded. Students can discuss but must write their solutions based on their understanding independently. Do not use web resources or answers from your peers to obtain solutions. If anyone is involved in malpractice of any sort, then suitable disciplinary action will be taken.

1. Sample $n=100, 1000, 10000$ points from
 - (a) Multinomial distribution with four outcomes say $\{1, 2, 3, 4\}$ with corresponding probabilities $[0.2 \ 0.4 \ 0.3 \ 0.1]$
 - (b) Uniform Distribution in 0 to 1.
 - (c) Gaussian Distribution with mean 0 and variance 1.
 - (d) Exponential Distribution with rate parameter $= 0.5$.

Verify if the points are generated according to the respective distribution by plotting a histogram of the fraction of points in each case. Label graph properly. Use inbuilt library functions for sampling from each of the above mentioned distributions. Try to implement your code in python version > 3.0 not Mat-Lab or C as it will help in implementing RL algorithms in your subsequent assignments.

2. Generate normal random variable samples with mean μ and variance σ^2 from uniform random variable. Here, assume you get uniform samples from the interval $(0, 1)$ from inbuilt library functions. Verify if your method indeed generates normal random samples. Justify your procedure clearly.
3.
 - (a) Plot the $\sqrt{\sin(x)}$ function. Find the area under the curve of $\sqrt{\sin(x)}$ in the interval $(0, \pi)$ using concepts taught in class not using numerical techniques.
 - (b) Plot the $\sqrt{\sin(x)} \exp(-x^2)$ function. Find the area under the curve of $\sqrt{\sin(x)} \exp(-x^2)$ in the interval $(0, \pi)$ using concepts taught in class not using numerical techniques.

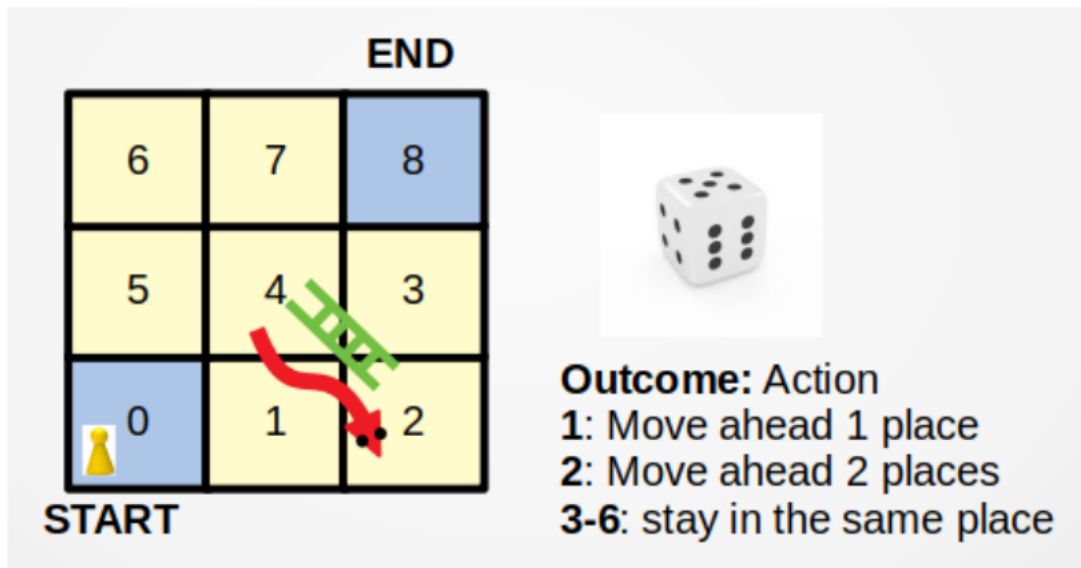


Figure 1: Snakes and Ladders

4. Consider a very peculiar game of Snakes and Ladders shown in Figure 1. The player starts with their pawn in state 0. In each step, a fair six-sided die is tossed. If the die outcome is 1, the player's pawn can move ahead one position, if the outcome is 2, the pawn can move ahead 2 positions, and for any other outcome, the pawn has to stay in the same position. Notice that there is a snake as well as a ladder between the positions 2 and 4. Thus if the pawn visits any of these states, it will get stuck in an infinite loop and the game would never end.
 - (a) Represent this game as a Markov Chain and draw it clearly showing the states, transitions and their probabilities.
 - (b) What is the probability that starting from position 0, the player ever reaches the end state? You solve this using simulations. Try to solve it analytically as well and cross check.