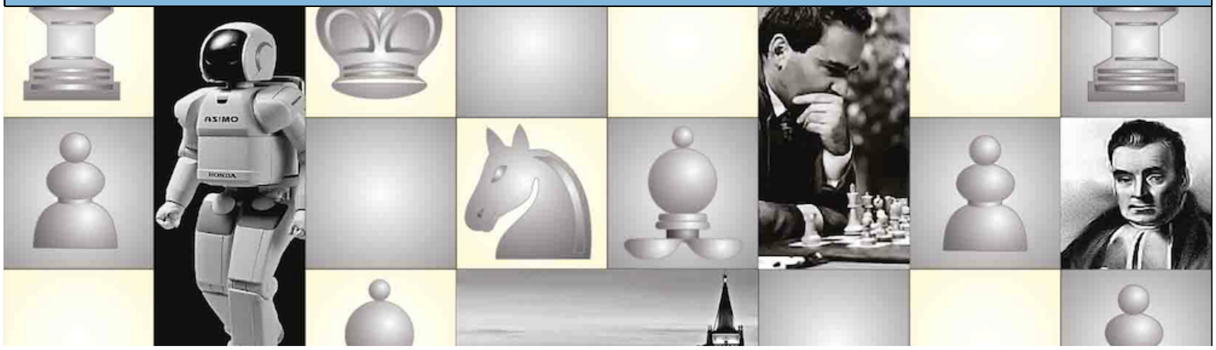
# Fall 2024 - CSC545/645 Artificial Intelligence - Assignment 2




**Due date: Thursday, September 12, 2024, 2 pm. Please create a folder called** `assignment2` **in your local working copy of the repository and place all files and folders necessary for the assignment in this folder. Once done with the assignment, add the files and folders to the repo with** `svn add` *`files,folders`* **and then commmit with** `svn ci -m "SOME USEFUL MESSAGE"` *`files,folders`*.

**Exercise 2.1** [6 points]
Read chapter 3.1 – 3.5 (problem-solving agents – uninformed search strategies) of the textbook.

1. Explain why problem formulation must follow goal formulation.
   [1 point]
2. The textbook says that we would not consider problems with negative path costs. In this exercise, we explore this in more depth.
   5 points]
   (a) Suppose that actions can have arbitrarily large negative costs; explain why this possibility would force any optimal algorithm to explore the entire state space.
   (b) Does it help if we insist that step costs must be greater than or equal to some negative constant c? Consider both trees and graphs.
   (c) Suppose that there is a set of operators that form a loop, so that executing the set in some order results in no net change to the state. If all of these operators have negative cost, what does this imply about the optimal behavior for an agent in such an environment?
   (d) One can easily imagine operators with high negative cost, even in domains such as route finding. For example, some stretches of a road might have such beautiful scenery as to far outweigh the normal costs in terms of time and fuel. Explain, in precise terms, within the context of state-space search, why humans do not drive around scenic loops indefinitely, and explain how to define the state space and operators for route finding so that artificial agents can also avoid looping.
   (e) Can you think of a real domain in which step costs are such as to cause looping?

**Exercise 2.2** [14 points]
The sheeps and wolves problem is usually stated as follows: Three sheeps and three wolves are on one side of a river, along with a boat that can and must hold either one or two animals. Find a way to get everyone to the other side without ever leaving a group of sheeps in one place outnumbered by the wolves in that place. This problem is famous in AI because it was the subject of the first paper that approached problem formulation from an analytical viewpoint [Ama68].

1. Formulate the problem precisely, making only those distinctions necessary to ensure a valid solution. Draw a diagram of the complete state space (without repeated states).
   [4 points]

2. Implement and solve the problem optimally using an appropriate search algorithm.
   [8 points]

3. Is it a good idea to check for repeated states?
   [1 point]

4. Why do you think people (humans) have a hard time solving this puzzle, given that the state space is so simple?
   [1 point]

## References

[Ama68] Saul Amarel. On representations and modeling in problem solving and on future directions for intelligent systems. Technical report, RCA LABS PRINCETON NJ, 1968.