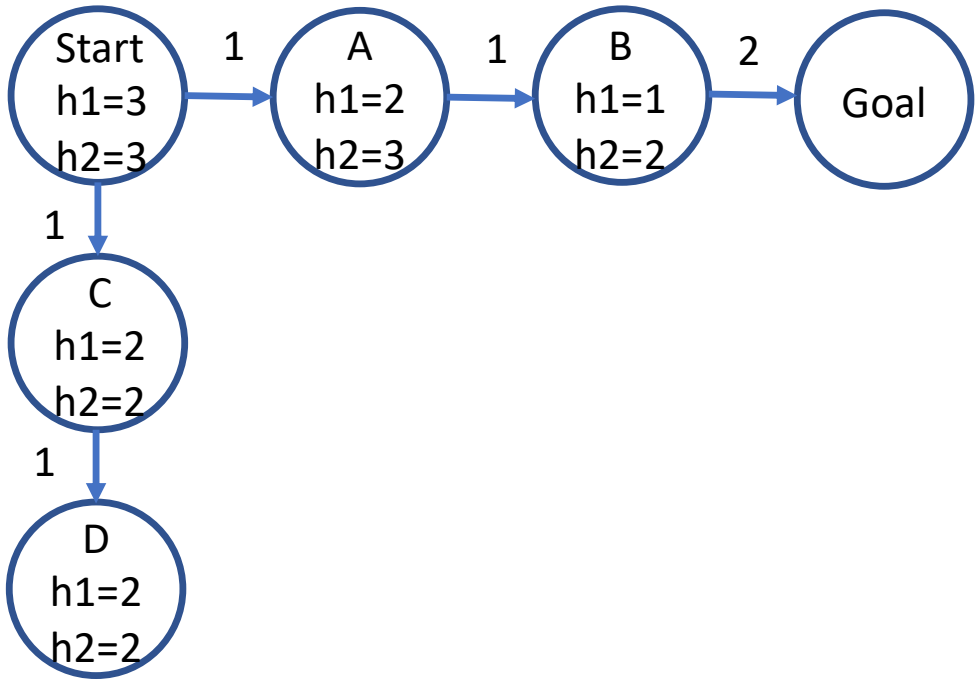
Problems Heuristic Search

Problem Solving

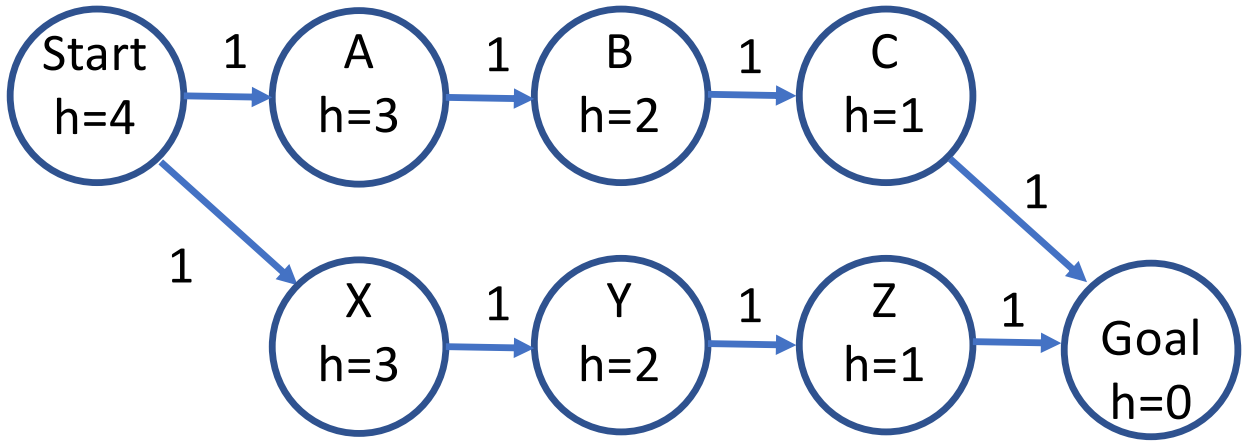
September 20, 2024

1.In the state space depicted below, indicate the order of generation and the order of expansion of nodes by the A* algorithm, using the heuristic h1 and h2 (you have to provide two traces). Ties are broken with largest g. Which is the heuristic that expand more nodes? Is it the most informed one?



2 Given the state space depicted below, show the order of generation and the order of expansión of nodes by the A* algorithm in two cases:

a. **Breaking ties of f=g+h randomly (left, right).**
b. **Breaking ties of f=g+h with largest g.**
c. **Which is more efficient? Why?**



3 Prove that if a heuristic is consistent, it must be admissible. Construct an admissible heuristic that is not consistent.

4 We said that we would not consider problems with negative path costs. Here we explore this decision more deeply.

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 step costs must be greater than or equal to some negative constant *c*? Consider both trees and graphs.

c. Suppose that a set of actions forms a loop in the state space such that executing the set in some order results in no net change to the state. If all of these actions have negative cost, what does this imply about the optimal behavior for an agent in such an environment?

d. One can easily imagine actions with high negative cost, even in domains such as route finding. For example, some stretches of 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 actions 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?