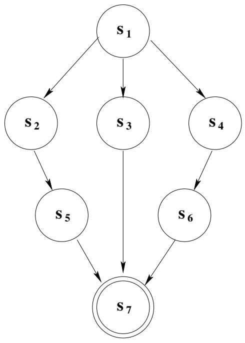
AI Planning for Autonomy

Problem Set II: Heuristic Search

1. Consider the following state space S, where $s_0 = s_1$ and $S_G = \{s_7\}$



where actions changing a state s into another state s' are given by the edges. The cost to transition from state s to s' is given by the following table:

s	s'	$c(s, s')$	s	s'	$c(s, s')$
s_1	s_2	2	s_3	s_7	10
s_1	s_3	2	s_4	s_6	1
s_1	s_4	1	s_5	s_7	3
s_2	s_5	2	s_6	s_7	4

and heuristic estimates for each state:

s	$h_1(s)$	$h_2(s)$	$h_3(s)$
s_1	4	6	6
s_2	3	5	1
s_3	5	10	1
s_4	3	5	5
s_5	2	3	3
s_6	2	4	4
s_7	0	0	0

- Which heuristics are admissible?

- Which are consistent?

- Does any heuristic *dominate* any other?

Describe the execution of one of the following algorithms in this problem using one of the heuristics above. Fill in a table like the one below, showing the contents of the Open and Closed lists at the end of each iteration.

Choose one of: A*, WA* ($w = 5$), or Greedy Best-First Search.

	Iteration 1	Iteration 2
OPEN	$n_1 = \langle s_1, 6, 0, nil \rangle$ *	$n_2 = \langle s_2, 5, 2, n_1 \rangle$ $n_3 =$ $n_4 =$
CLOSED		n_1

- Which is the path returned as a solution?
- Is this the optimal plan? Has the algorithm proved this?

2. Consider an $m \times m$ manhattan grid, and a set of coordinates G to visit in any order.
   - Formulate a state-based search problem to find a tour of all the desired points (i.e. define a state space, applicable actions, transition and cost functions).
   - What is the branching factor of the search?
   - What is the size of the state space in terms of m and G.
   - Define an admissible heuristic function.