AI Planning for Autonomy

Problem Set I: Heuristic Search

1. Choose **one** of the problems listed below and describe a simple example along with its corresponding *State Model*.

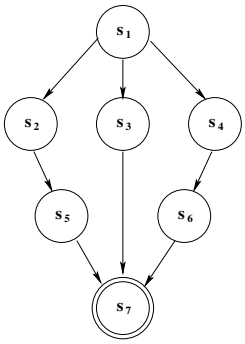
The problems are:

1. 8-Puzzle.
2. Travelling Salesman Problem.

Definition should be brief, clear, and compact [1]

- State space S
- Initial state $s_0 \in S$
- Set of *goal* states $S_G \subseteq S$
- Applicable actions function $A(s)$ for each state $s \in S$
- Transition function $f(s, a)$ for $s \in S$ and $a \in A(s)$
- Cost of each action $c(a, s)$ for $s \in S$ and $a \in A(s)$

2. 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

[1] *Compact* means using mathematical notation to define sets, i.e. $S = \{x | x \in V\}$ to define that there are as many states as elements in the set V, and pseudo-code, i.e. to define the transition function.

and the heuristic values for each state:

s	$h(s)$
s_1	4
s_2	3
s_3	5
s_4	3
s_5	2
s_6	2
s_7	0

Describe the execution of A^* in this problem by filling in a table like the one below. Show the contents of the OPEN and CLOSED lists at the end of each iteration, each node must be *named*, e.g. $n_3 = \langle s_3, f(n), g(n), n_{parent} \rangle$. The node should contain all the relevant information for the search.

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

- Is h *admissible*? explain.
- Is h *consistent*? explain.
- Which is the path returned by A^* as a solution?
- Is this the optimal plan? Has the algorithm proved this?