| CPSC 3750 – A.I. | **Due Feb. 26** (in class) |
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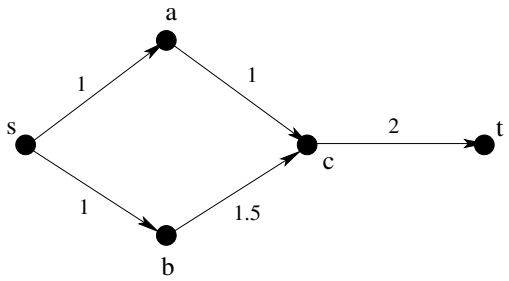
| Assignment 2 | Total marks: 70 |

1) **(5 pts)** What is an admissible heuristic function? What is a consistent heuristic function?

2) **(25 pts)** The figure below depicts a state space with five states. The successor function is shown by the oriented arcs and the initial and target states are $s$ and $t$ respectively. For example, from state $s$ there are only two possible actions leading towards states $a$ and $b$. Each edge is labelled with the cost of its corresponding action. For example, there are two possible paths leading to the target state, but the optimal path is *sact* with the path cost 4.




   (a) A trivial admissible heuristic function is given by the following values: $h(s) = h(t) = h(a) = h(b) = h(c) = 0$. Define another admissible heuristic function by listing its values.
   (b) As before, list the values of a consistent heuristic function.
   (c) List the values of a heuristic function that is admissible but NOT consistent.
   (d) Using the previous admissible but not consistent function, explain why A* search based on the *graph-search* algorithm from Fig. 3.19, p. 83 in your text (the search avoiding repeated states) could return a sub-optimal path, namely *sbct*.
   (e) Using the heuristic function from (2c), trace the steps taken by the A* search based on the *tree-search* algorithm (which does not avoid repeated states). Draw a table where each row represents a step in the algorithm. For each row: list the fringe, give the objective function for each state in the fringe, and briefly explain the decision of the algorithm.

3) **(10 pts)** Suppose you are given a non-admissible heuristic function that overestimates by at most a value $c$. Argue that A* search using this heuristic will never return a solution whose cost exceeds the optimal solution by more than $c$. If you cannot make a general argument, you may use the example from Problem 2

4) **(5 pts)** Explain the difference between online and offline search agents.

5) **(10 pts)** Give a precise formulation as a constraint satisfaction problem for the *class scheduling problem*. Given are: a list of professors, a list of classes, a list of classrooms, and a list of possible time slots for the classes. Each professor has a list of classes that she can teach.

6) **(15 pts)** Solve the cryptarithmetic puzzle from Fig. 5.2 in your text, by hand, using forward checking with the minimum remaining values heuristic. Be brief and precise.