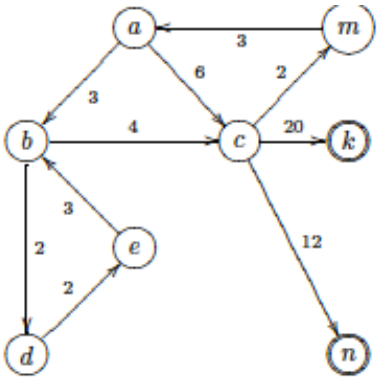
Practice Midterm Problems for CPSC 322, Winter 2010 Term 1

The midterm will contain a combination of short questions (see review file for samples of those), and longer problems. The two problems below will help you practice for this second type of questions. (Solutions in another file, but try hard to solve them on your own first).

1. Search [22 points]

Consider the following directed graph where *a* is the start node and *k* and *n* are both goal nodes, the true cost function is given by the edge labels, and h is an admissible heuristic function.



node	*h(node)*
a	16
b	16
c	11
d	20
e	18
k	0
m	2
n	0

In answering these questions show your work and justify your conclusions.

1. [**7 points**] A*
   Assume that ties are broken alphabetically.

   (a) What sequence of paths is expanded by A*? (If you like, you can describe each path just by giving the last node in the path.)
   (b) What path is returned?
   (c) What is the cost of this path?

2. [**7 points**] (Depth First) Branch-and-bound search with cycle checking, in which neighbors are expanded according to *f*
   Assume that ties are broken alphabetically.

   (a) What sequence of paths are expanded (or considered for expansion) by branch-and-bound? (If you like, you can describe each path just by giving the last node in the path.)
   (b) What path is returned?
   (c) What is the cost of this path?

3. [**8 points**] Consider a complete binary search tree with finite depth *d*, and with only one goal, which is at depth $k < d$. The search begins at the root node (let's call this node's depth 1).

   (a) In the best case:
      i. Exactly how many nodes would be expanded by breadth-first search? (including the goal node)

ii. Exactly how many paths would be on the frontier just before the goal node is expanded?

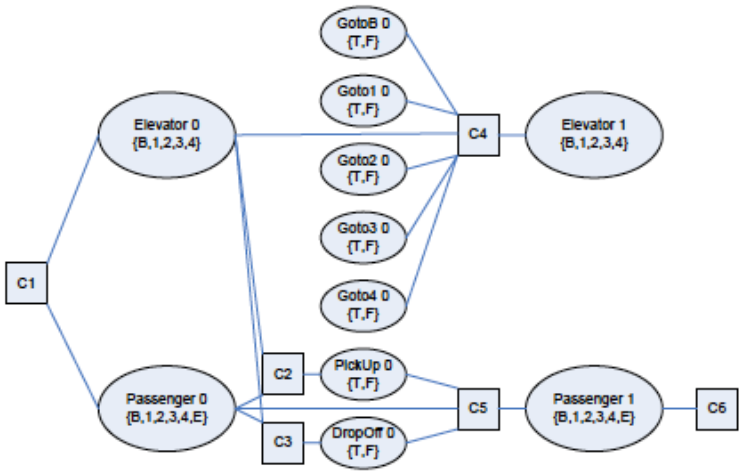
(b) In the best case:

i. Exactly how many nodes would be expanded by depth-first search? (including the goal node)

ii. Exactly how many paths would be on the frontier just before the goal node is expanded?

2. [22 points] CSP Planning

Consider the one-stage unrolling of a CSP planning problem represented below, in which we have an elevator that can be on different floors and a passenger who can be waiting at different floors or can be in the elevator. Notice that for the sake of simplicity the model is not realistic.



The constraint tables[1] are as follows (with * representing a wildcard or don't-care condition).

[1] Recall that constraint tables list the joint variable assignments that are *allowed.*

C1

Elevator 0	Passenger 0
2	3

C2

Elevator 0	Passenger 0	PickUp 0
3 *	3 *	T F

C3

Passenger 0	Elevator	PickUp 0
E *	4 *	T F

C4

Elevator 0	GotoB 0	Goto1 0	Goto2 0	Goto3 0	Goto4 0	Elevator 1
B	F	F	F	F	F	B
1	F	F	F	F	F	1
2	F	F	F	F	F	2
3	F	F	F	F	F	3
4	F	F	F	F	F	4
*	T	F	F	F	F	B
*	F	T	F	F	F	1
*	F	F	T	F	F	2
*	F	F	F	T	F	3
*	F	F	F	F	T	4

C5

Passenger 0	PickUp 0	DropOff 0	Passenger 1
B	F	F	B
1	F	F	1
2	F	F	2
3	F	F	3
4	F	F	4
E	F	F	E
3	T	F	E
E	F	T	4

C6

Passenger 1
4

1. [**7 points**] Perform arc-consistency on this CSP. (Just cross out the values on the figure above). What is the outcome? What does it mean?

2. [**9 points**] Give a STRIPS representation of the problem, including variables, domains, start state, goal states and action descriptions.

3. [**6 points**] What is the smallest horizon for which this CSP planner can be solved, if a constraint is added to make all actions mutually exclusive? Report the plan that it would find.