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Hw 3

**Problem.** Men, women and gupi live on the planet Alphaomega. Imagine you are travelling by a self-driving car on this planet and you need to pass the city Beth. The road goes through this city and you cannot bypass it. There are only two entrances to the city – one from the side you are coming and another from the opposite side. Besides, you know that an evil gupi is sitting at one of the intersections in Beth. When a human being comes close to him, he kidnaps this person and makes the human being his slave. Fortunately, this gupi is lazy and he kidnaps only those who come close to him. The distance in one block is safe for you because your car can feel the presence of the gupi one block ahead of it. At the same time, other inhabitants of Beth cannot help you because you don't know their language and they don't know your language. Besides, you don't have a map of the city Beth.

a) (20 pts). Is it always possible to go through the city? Prove that your answer is correct.

It is not always possible to go through the city.

For example if the entrance A and exit B were arranged like below

with intersections  $I_1$  and evil gupi G, then there would be no real way to get through the city.



∴ it is not always possible to go through the city

b) (80 pts). If it is always possible to go through the city, design an algorithm for your car for doing this.

It is not always possible

c) (80 pts). If it is **not** always possible to go through the city, design an algorithm for your car that will allow you to go through the city when it is possible or to return back when it is impossible.

Let  $a$  be the entrance node

Let  $b$  be the exit node

Possible Path(A):

Initialize  $S$  to be a stack with one element  $a$

Initialize path to be an empty stack

While  $S$  is not empty

Pop a node  $u$  from  $S$  move car to  $u$

If  $u$  is  $b$ : // found end so stop

Return

end if

set Explored [ $u$ ] to true

Add  $u$  to stack path

For each edge  $(u, v)$  incident to  $u$

if  $v$  is not an evil gupi and Explored [ $v$ ] is false

Add  $v$  to the stack  $S$

endif

end for

end while // did not find end

while  $U$  is not  $a$

pop  $u$  from path and move car to that node

end while

return // returned to start

This algorithm is a depth first search of the city where the intersections are nodes, the streets are edges, and the city is a connected graph.

This algorithm moves the car through the city and essentially creates a tree with no loops.

It has no loops because the car will not revisit explored nodes.

It also avoids the nodes containing the evil guppi

which means the search will not go through a node which is unsafe.

When traversing the nodes this algorithm will visit every child node of each safe node that is visited until all accessible nodes are visited or until the exit to the city is found.  $\therefore$  The car will visit all accessible nodes until an exit is found & it will not make loops.

If the while loop completes then there is no way for the car to get to the exit and then the car will backtrack its steps until it reaches the entrance node a.

$\therefore$  the algorithm will search through the entire city until it finds the exit & if no exit is found then it will return to the entrance all while avoiding the evil guppi.