

Assignment 5 – Written Part

1. These first problems are related to the code above.

- a) Explain what Create is doing. It is guaranteed to generate a maze that always has a unique solution. Why?

Create knock down walls of each cell. Because we start from the middle cell of the maze, and according the Create method, there must be two exits of it. Thus, there must be a unique solution go through the start position to the end position.

- b) If there are n rows and m columns, then how many times is Create called when making a maze?

There are $n * m$ times.

- c) What is the purpose of the p^2 ?

Use XOR rule. when p^2 , the direction will flip. For instance, assume p is 0 which directs left, thus $p^2 = 2$ which directs right.

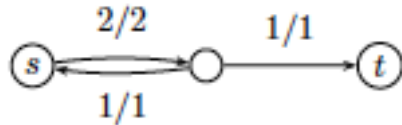
2. Generate an estimate of the number of vertices in the backtracking tree for the 8 by 8 queens problem. In picking your “random” row positions, simply use the lowest numbered valid row about estimating the size of the tree. Compare with the actual size of the tree.

There are 92 solutions of the 8 queens. Thus there should be a $92 * 8$, and should be $92 * 8$ vertex.

3. True or false. If true provide a short proof, if false give a counterexample:

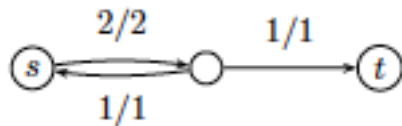
- a) In any max flow, there is no directed cycle on which every edge carries positive flow.

False.



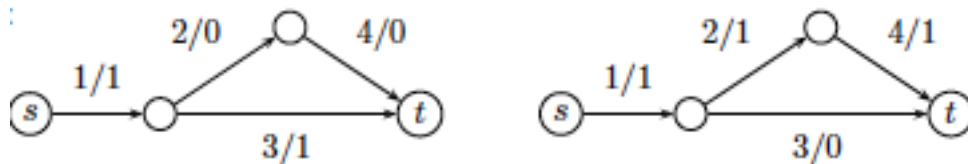
- b) **There exists a max flow for which there is no directed cycle on which every edge carries positive flow**

True.



- c) **If all edge capacities are distinct, the max flow is unique**

False.



- d) **If all edge capacities are increased by an additive constant, the min cut remains unchanged**

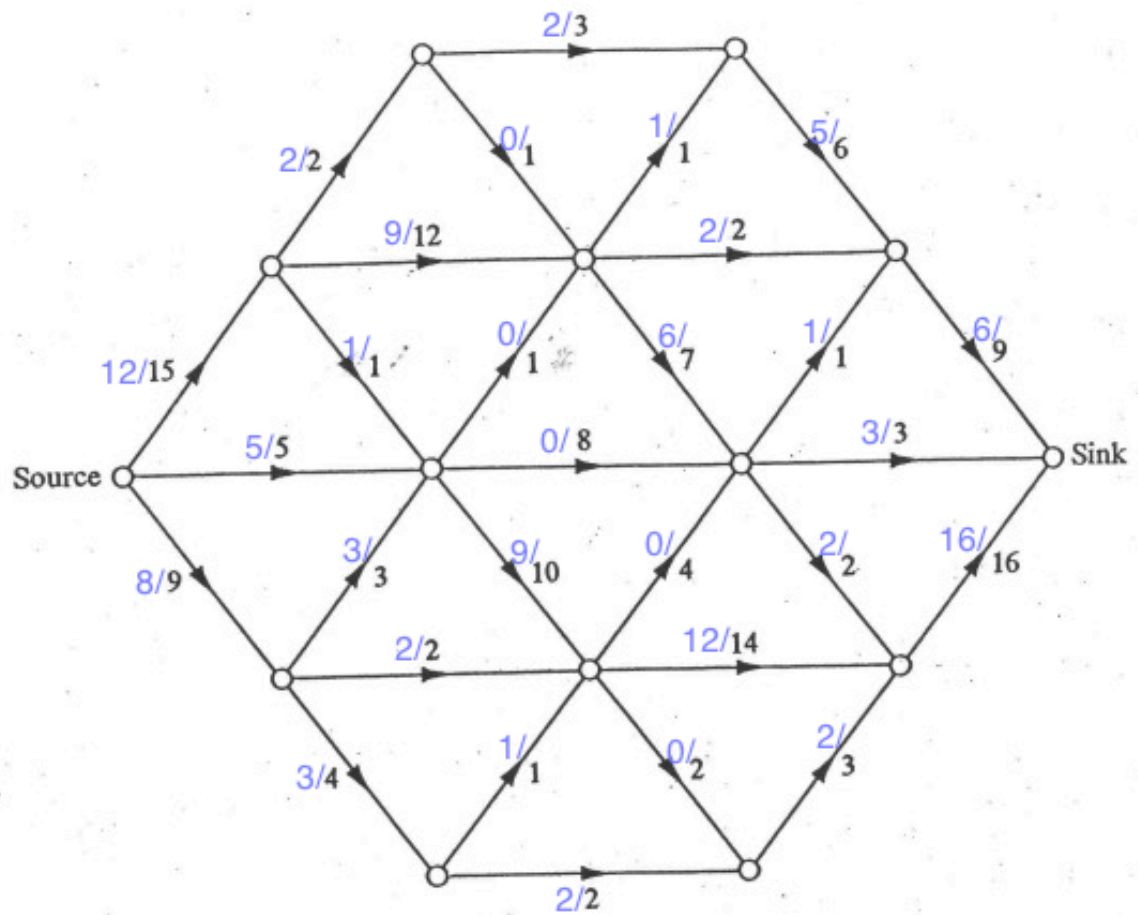
False.



- e) **If all edge capacities are multiplied by a positive integer, the min cut remains unchanged**

True. Because the value of every cut get multiplied by a positive integer, then the relative order of cuts will not change.

4. Find the max-flow and min-cut in the attached network as it would be found by the Ford-Fulkerson algorithm.



Max flow is $25 = 12 + 5 + 8$

