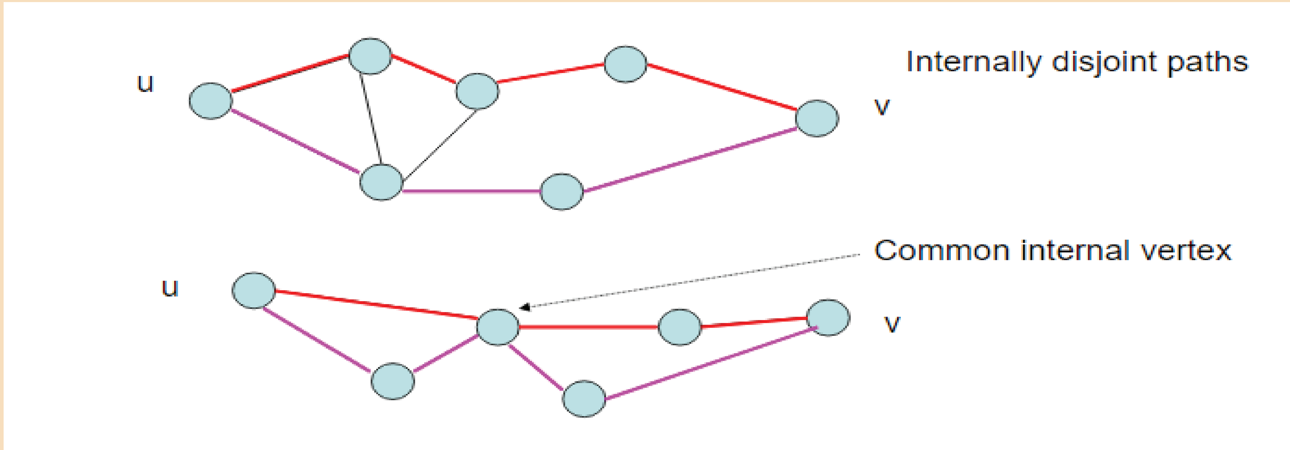
THE ESCAPE PROBLEM

Project Poster

DEFINITION

In Escape Problem we have to find the out the way to reach to destination from source via smallest possible way, from different given ways. by checking out the way where we have a less flow, so we can reach to the destination as early as possible.

VERTEX-DISJOINT PATHS



Two paths from vertex u to vertex v are said to be internally disjoint / vertex disjoint if they do not contain any common internal vertex in them.

PROBLEM STATEMENT

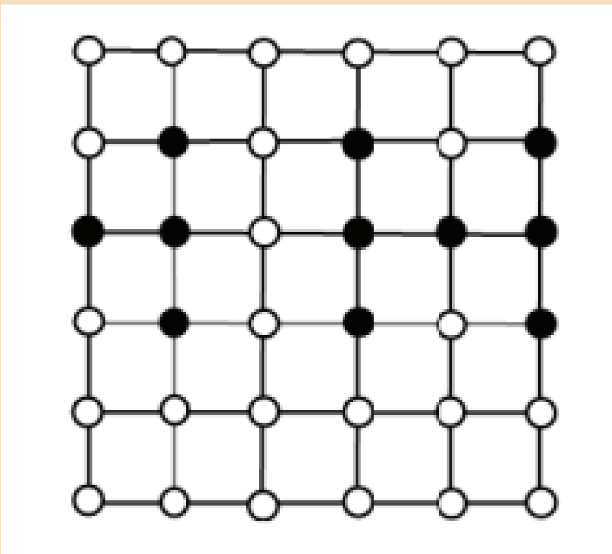
Given a set of m sources in a 2-dimensional grid, determine if it is possible to connect all sources to m points on the grid boundary using a set of vertex-disjoint paths starting from source vertices .

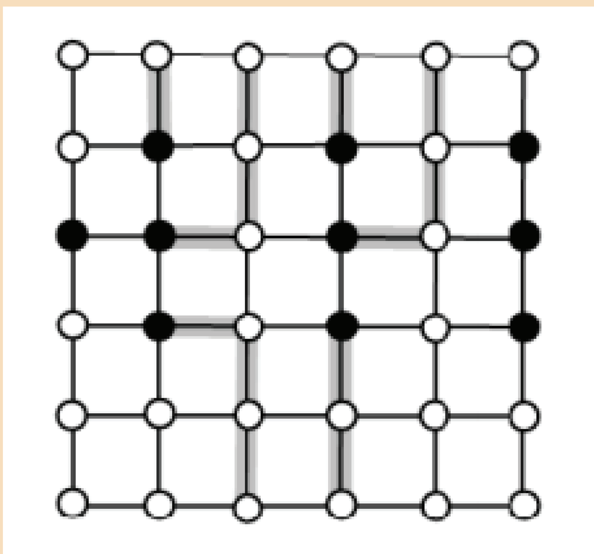
IMPLEMENTATION

Converting Escape problem to Single Source – Single Sink Maximum flow path:

- Add two artificial vertices : source and sink.
- For each vertex u in the set of starting vertices for escape problem, add an edge from s to u in with unit capacity of 1.
- Split each vertex v in the graph into two vertices: vin and vout (except source s & sink t)
- For each vertex v, add an edge of unit capacity of 1 from v in to vout
- For each of the grid boundary vertices v, add an edge from vout to t with unit capacity of 1.
- Maximum flow from s-t is calculated using Edmonds-Karp Algorithm.
- s-t max-flow gives the maximum number of s-t vertex disjoint paths
- If Maximum s-t flow = |V’|, where V’ is set of vertices in the certifier set,
- Then all the vertices in the V’ can reach boundary vertices in the grid using vertex disjoint paths.

ESCAPE PROBLEM





Determine if it is possible to connect each from the given set of starting vertices to any of the 4n – 4 boundary vertex.

ANALYSIS

Cost of splitting vertex V into two vertices vin and vout is O(V).
Cost of adding extra edges is |V| which is addition of edges between v in and v out
Modified Vertex and Edge Sets in the Maximum-Flow network
| V’ | = 2 .|V|
| E’ | = |E| + |V|
Cost of implementing Edmonds-Karp algorithm for maximum-flow = O(VE^2)
O(V’ E’^2)=0(2.V.E+V^2)

ALGORITHMIC COMPLEXITY

Total Escape problem complexity = Graph Modification cost + Max-flow Algorithm cost, Complexity:
= O(V)+ 0(2V.(E+V)^2)
= 0(2V.(E+V)^2)
Escape problem performance might vary depending upon the selection of Max-flow algorithm

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