Shortest Path (SPFA)

Pittsford Sutherland Programming Club

What is shortest path algorithm?

An algorithm that finds the shortest distance between any two nodes in a graph (either directed or undirected).

BFS(Breadth-first search) on a graph

A searching algorithm on a graph that save all the possible nodes in a queue.

Bfs node k, queue q

1. Pushes all unvisited nodes that can be reached from k into q
2. Bfs the first element of q if q isn’t empty.

Example of a shortest path problem

An undirected graph G. We define edge set, E(u,v, w)(u and v are the nodes attached to E(u, v), w is the weight of E(u, v, w)), and vertex set, V.

Find the shortest distance from v1 to v2 (v1, v2 $\in$ V).

Most popular algorithm - Dijkstra

Dijkstra is a O(ELogV)) algorithm that uses Priority Queue(STL in C++).

Dijkstra Algorithm link:

https://www.geeksforgeeks.org/dijkstras-shortest-path-algorithm-using-priority_queue-stl/

SPFA(Shortest Path Faster Algorithm)

Key idea: update the shortest path while doing BFS.

```
procedure Shortest-Path-Faster-Algorithm(G, s)
 1    for each vertex v ≠ s in V(G)
 2        d(v) := ∞
 3    d(s) := 0
 4    offer s into Q
 5    while Q is not empty
 6        u := poll Q
 7        for each edge (u, v) in E(G)
 8            if d(u) + w(u, v) < d(v) then
 9                d(v) := d(u) + w(u, v)
10                if v is not in Q then
11                    offer v into Q
```

Sample Question

https://drive.google.com/open?id=1QozDH0sN-YARbVBRwEsPwHxCnJ1CZv908TxakJHNhRw