BRAINSTORMING x JOHNSON’S ALGO

DESIGN AND ANALYSIS OF ALGORITHM

(DAA)

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What is general meaning of brainstorming?

Brainstorming is a method for generating a large number of creative ideas in a short period. Brainstorming is full of energy, moves rapidly, and is synergistic, creating a large list of ideas that may eventually be boiled down, or funnel down to a smaller list of priority items later in the project.

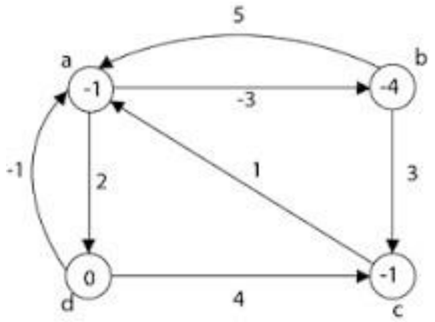
When to use brainstorming?

- When a broad range of options is desired.
- When creative ideas are desired.
- When the participation of an entire team is desired.

What is the application of brainstorming?

- Brainstorming is a problem-solving activity where **students build on or develop higher order thinking skills**. Encourages creative thought. Brainstorming encourages students to think creatively (out of the box), encouraging all students to share their ideas, no matter how far “out there” they may seem.

What is Johnson's algorithm?



Johnson's Algorithm **uses both Dijkstra's Algorithm and BellmanFord Algorithm**. Johnson's Algorithm uses the technique of "reweighting." If all edge weights w in a graph G = (V, E) are nonnegative, we can find the shortest paths between all pairs of vertices by running Dijkstra's Algorithm once from each vertex.

Problem:

Coming directly to the point, if we look into depth one of the reason in which most of the smartphone components lose their durability because of environmental factors such as temperature and humidity. One of the major factor affecting the durability of components of a smartphone is “**TEMPERATURE**”.

Real-Life Example:

Many people travel daily all across the world.Keeping this in mind, they may travel to places having harsh climate(i.e Hill-station,desert etc) to places having moderate climate. This up-down in temperature may result in over-heating of smartphone or battery freezing which may affect many components of a smartphone such as its battery life,camera,screen etc .

Solution:

Suppose a smartphone company is developing a new product and want “**BRAINSTORM”** ideas for its features**.**We can use Johnson’s algorithm to generate a list of all possible temperature diff in camera,battery life,display,memory and other features.

1)To apply Johnson algorithm ,we have to construct a directed graph keeping the following things in mind.

2)We have to take the components of a smartphone as vertex(i.e battery,display,memory,camera,processor)

3)And the weights of edges will contain temp diff within the components

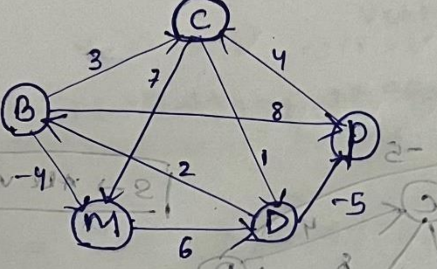
4)After getting the resultant graph we could find out the least or the most temperature difference between the components, Which would give smartphone companies to develop a software to control the temp of components which would significantly increase the durability of the smartphone as well as their profits.

***Now taking an example of a person who is travelling to a hill station ,keeping in mind the temperature of that environment we have the following solution using Johnson's algorithm w.r.t brainstorming techniques.**

Let,

camera = C.
Display = D.
memory = M
Battery = B.
Processor = P.

* considering the weights of edges as temp diff.



$G = \{V, E\}$

$|V| = 5$

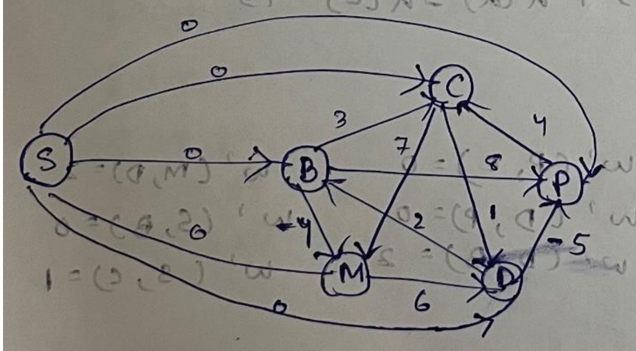
$|E| = 9.$

Step-1 (Reweighting of edge).

Add an extra vertex s to G.

so, $G' = \{V', E'\}$

$\boxed{V' = 5+1 = 6}$



* We will mark the edges from s to all vertices in the graph, lets initialize the weights of those edges as 0.

Now, calculating shortest path from S to all other vertices (Bell-man ford because of -ve edges)

$h(B) = \delta(S,B) = 0.$

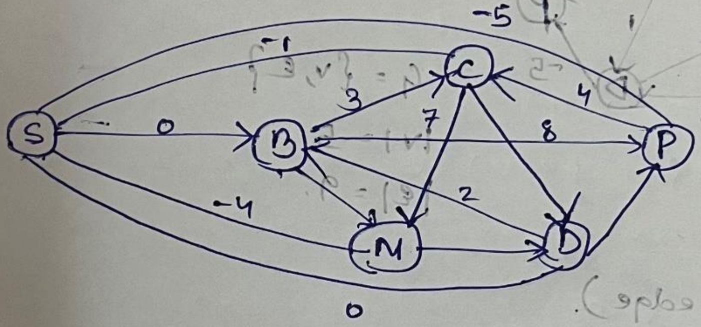
$h(C) = \delta(S,C) = S \to D \to P \to C = -1.$

$h(P) = \delta(S,P) = S \to D \to P = -5.$

$h(D) = \delta(S,D) = S \to D = 0.$

$h(M) = \delta(S,M) = S \to B \to M = 0-4 = -4$

<u>Next, Bell-man ford</u>



S → All vertices.

<u>New, cost of edges</u>

$$\boxed{w'(u,v) = \overset{old}{w(u,v)} + \overset{new}{h(u)} - \overset{new}{h(v)}}$$

$w'(B,C) = w(a,b) + h(a) - h(b) = 3+0-(-1) = 3+1 = 4$

$w'(B,P) = w(a,c) + h(a) - h(c) = 13$

<u>Similarly,</u>

$w'(B,M) = 0$

$w'(C,D) = 0$

$w'(C,M) = 10$

$w'(S,P) = 5$

$w'(S,D) = 0$

$w'(S,M) = 4.$

$w'(P,C) = 0$

$w'(D,P) = 0$

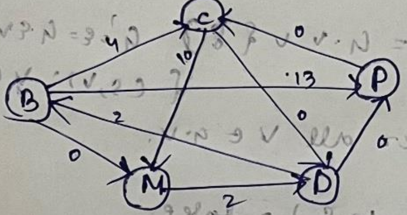
$w'(D,B) = 2$

$w'(M,D) = 2$

$w'(S,B) = 0$

$w'(S,C) = 1$

New, graph



* All the -ve edges are gone.
* now, we have to run. dijikstra algoritim for all Vertex.

To take 'B' i.e Battery as the source vertex and to find the shortest path to all other vertex.

$\delta'(B,B) = 0$ $h(B) = 0$

$\delta'(B,C) = 2$ $h(C) = -1$

$\delta'(B,P) = 2$ $h(P) = -5$

$\delta(B,D) = 2$ $h(D) = 0$

$\delta(B,M) = 0$ $h(M) = -4.$

To find δ

$$\boxed{\delta(u,v) = \delta'(u,v) - h(u) + h(v)}$$

$\delta(B,B) = \delta'(B,B) - h(B) + h(B) = 0$

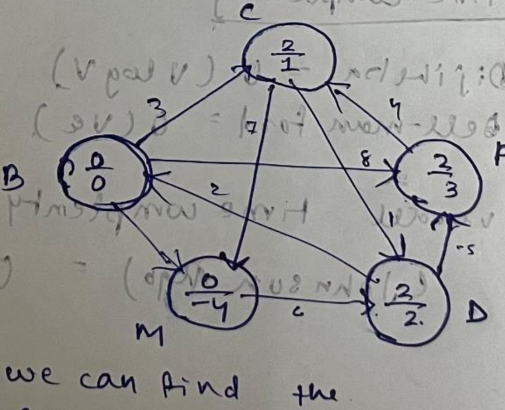
$\delta(B,C) = 1$

$\delta(B,P) = -3$

$\delta(B,D) = 2$

$\delta(B,M) = -4.$

Shortest path →



Similarly, we can find the least temp diff from C, P, D, M to all other vertices.

Algorithm

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Johnson (G, W)

1)  Compute G, where $G.V = G.V \cup \{s\}$, $G'.E = G.E \cup \{$
        $\{(s,v) : v \in G.V)$.
        and $w(s,v) = 0$ fer all $v \in G.V$.
2)  If Bell-man ford $(G', w, s)$ = false.
3)      print "input graph containe negetive cycle".
4)  Else for each vertex $v \in G'.V$.
5)      Set $h(v)$ to the value $\delta(s,v)$ computed by
        bell-man ford.
6)  for each edge $(u,v) \in G'.E$.
7)      $w'(u,v) = w(u,v) + h(u) - h(v)$.
8)  Let $D = d_{uv}$ be a new $n \times n$ matrix.
9)  for each vertex $u \in G.V$.
10)     Run Dijikstra's $(G, w', u)$ to compute $\delta'(u,v)$
        for all $v \in G.V$.
11)     for each vertex $v \in G.V$.
            $\delta(u,v) = \delta'(u,v) - h(u) + h(v)$
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Time complenity

Dijikstra = $O(V \log V)$

Bell-man ford = $O(VE)$

$V \rightarrow$ vertex;

$E \rightarrow$ edge;

Overall time complenity

(Johnson Algo) = $O(V^2 \log V + VE)$.