Graph Connectives Ideas

In this first proposal, I will use Adjacency Matrix to describe my solution of dealing with two graphs: G_1, G_2. The many graphs problem, I think, can be solved by the formula:

Source: www.cs.rpi.edu

Union (G_1 … G_{n-1}, G_n) = Union (G_1, Union (… Union (G_{n-1}, G_n)).

In my opinion, formulas for Join, Intersection, and Difference are similar to the above one.

I will also use *n* as number of vertices, $G_1 = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, and $G_2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ to provide examples.

1) Union.

$$\text{Union}(G_1, G_2) = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \cup \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} \mathbf{0} & \mathbf{1} & \mathbf{0} & 0 & 0 \\ \mathbf{1} & \mathbf{0} & \mathbf{1} & 0 & 0 \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & 0 & 0 \\ 0 & 0 & 0 & \mathbf{0} & \mathbf{1} \\ 0 & 0 & 0 & \mathbf{1} & \mathbf{0} \end{bmatrix}$$

Complexity: $O(\min^2(n_1,n_2))$.

Solution: Attach the smaller graph to the bigger one.

2) Join.

$$\text{Join}(G_1, G_2) = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} + \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} \mathbf{0} & \mathbf{1} & \mathbf{0} & 1 & 1 \\ \mathbf{1} & \mathbf{0} & \mathbf{1} & 1 & 1 \\ \mathbf{0} & \mathbf{1} & \mathbf{0} & 1 & 1 \\ 1 & 1 & 1 & \mathbf{0} & \mathbf{1} \\ 1 & 1 & 1 & \mathbf{1} & \mathbf{0} \end{bmatrix}$$

Complexity: $O(\min^2(n_1,n_2) + n_1 * n_2)$.

Solution: Union and then connect all vertices of one graph to all of the other.

3) Intersection.

$$\text{Intersection}(G_1, G_2) = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} \cap \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & \mathbf{1} & 0 \\ \mathbf{1} & 0 & \mathbf{0} \\ 0 & \mathbf{0} & 0 \end{bmatrix}$$

Complexity: $O(\min^2(n_1,n_2))$.

Solution: Scan all edges of the smaller graph and check with the bigger graph.

4) Difference.

$$\text{Difference } (G_1, G_2) = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix} - \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & \mathbf{0} & 0 \\ \mathbf{0} & 0 & \mathbf{1} \\ 0 & \mathbf{1} & 0 \end{bmatrix}$$

Complexity: $O(\min^2(n_1,n_2))$.

Solution: Scan all edges of the smaller graph and check with the bigger graph.

After getting feedbacks, I will continue proposing my plan in dealing with graphs which use list structures.

Tri Nguyen.