

NAA Tut 8

papergrid

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Given:

$L_1 = \{ (s, t, G) \mid \text{there exists a path from } s \text{ to } t \text{ in the directed graph } G \}$
 $L_2 = \{ H \mid H \text{ is a strongly connected graph directed graph} \}$

To prove: $L_1 \leq_p L_2$

L_1 runs in polynomial time, i.e. can be done by using algorithms like DFS or BFS which are polynomial

Reduction:

input (s, t, G)

- Construct new graph G' by copying G
- For each node i in G
 - add edge from vertex i to vertex s
 - add edge from vertex t to vertex i

G' is strongly connected since for any vertices $u, v \in V'$ an edge from u to s exists, an edge from s to t exists (from L_1) and an edge from t to v exists. Similarly the edge v to s exists, s to t exists, and t to u exists \Rightarrow \exists path from u to v and v to u therefore the graph is strongly connected

Copy $G \rightarrow G'$: $O(V + E)$
Adding edges : $O(V)$

\therefore polynomial running time

$$\Rightarrow L_1 \leq p L_2$$