

# GraphInstruct: Empowering Large Language Models with Graph Understanding and Reasoning Capability

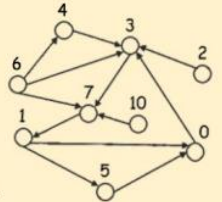
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# Problems & Ideas

- Graph Matters for LLMs
  - Graph is everywhere, such as social graphs, traffic graphs, molecular graphs...
  - Many logical reasoning tasks also fundamentally exist in the form of graphs.
  - Observations: The LLMs can not answer even the simple reasoning questions about the graph

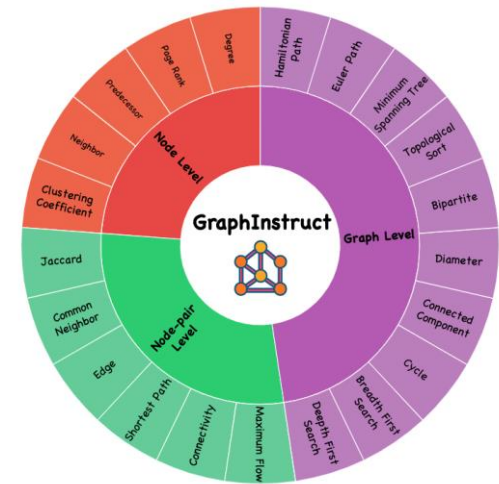
**Question:**  
Given a directed graph:  
Node 4 is connected to node 3.  
Node 3 is connected to node 7.  
Node 2 is connected to node 3.  
Node 7 is connected to node 1.  
Node 1 is connected to nodes 0, 5.  
Node 6 is connected to nodes 4, 7, 3.  
Node 0 is connected to node 3.,  
Which are the predecessor nodes of node 3? A predecessor of  $n$  is a node  $m$  such that there exists a directed edge from  $m$  to  $n$ .  
Let us answer this question step by step to make it correct.



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graph TD; 4 --> 3; 3 --> 7; 2 --> 3; 7 --> 1; 1 --> 0; 1 --> 5; 6 --> 4; 6 --> 7; 6 --> 3; 0 --> 3;
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An example of the classical graph reasoning tasks.

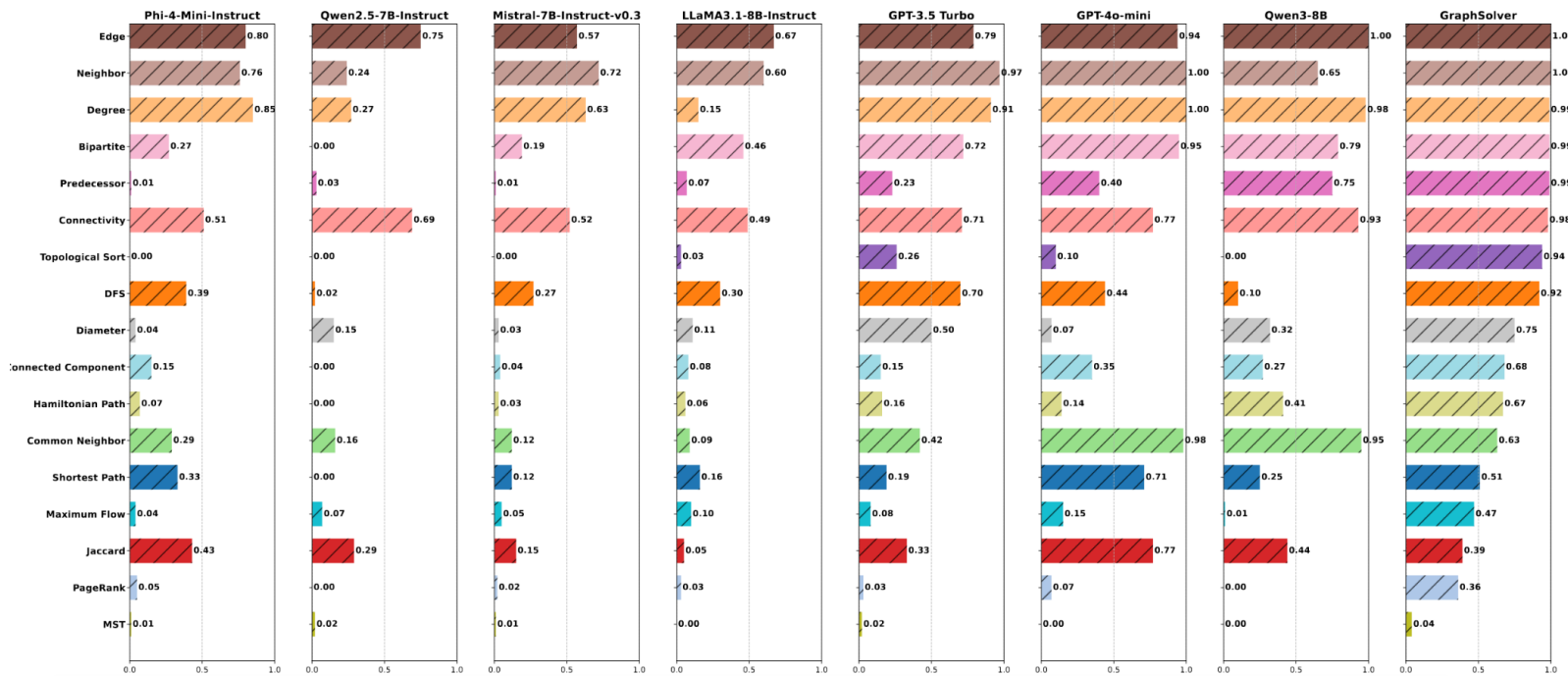
- Ideas: GraphInstruct – An automated benchmark
  - A wide range of graph reasoning tasks, encompassing 21 different tasks
  - Automated generation pipeline with intermediate reasoning steps



The complete task schema of GraphInstruct.

# Main Contributions

- Contributions:
  - GraphInstruct encompasses 21 different graph reasoning tasks with diverse graph generation pipelines and detailed intermediate steps.
  - GraphSolver and GraphSolver+ are proposed based on GraphInstruct, whose performance further verify the effectiveness of GraphInstruct as the groundwork for future advancement in enhancing graph reasoning capability.



Performance of GraphSolver on 17 in-domain graph reasoning tasks.