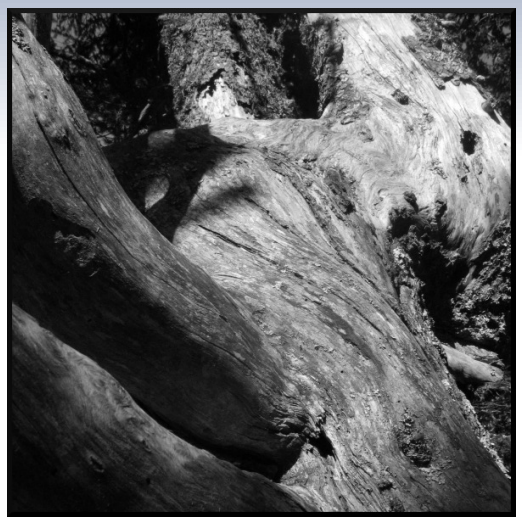

Bi-directional A* Algorithm and its applications in shortest path finding in road networks

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Project Code: BPV02

Supervisor: Viswanath P

Group Members
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Objectives

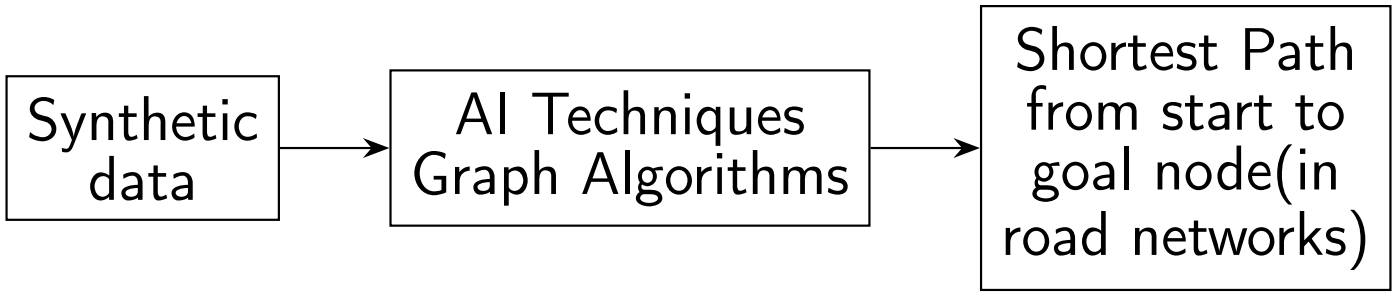
- Finding the shortest path in a dynamically varying Graph.
- We propose to explore the Bi-directional A* algorithm and its variants [1].
- Task-1: To implement BFS, Uniform cost search, A* search and its bi-directional variants.
- Task-2: To study the effect of dynamically adding/deleting an edge to/from the graph.
- Task-3: To study the effect of both nodes and edges being added or deleted.

[1] Holte, Robert C., et al. "MM: A bidirectional search algorithm that is guaranteed to meet in the middle." Artificial Intelligence 252 (2017): 232-266.

Scope of the proposed work

- AI and Graph Algorithm techniques are used.
- To speedup the search process, we propose to use
  Case Based Reasoning: New problems are solved by reusing and if necessary adapting the solutions to similar problems that were solved in the past.
  Graph Indexing: Storing reusable information related to the graph so that shortest path finding can be done quickly.

Workflow Diagram



Workdone so far

- Uni-BFS (Breadth First Search)
- UCS (Uniform Cost search)
- Bi-BFS (the Bi-directional BFS algorithm)
- A* algorithm.
- MM (the Bi-directional A* algorithm)

Comparison of Number of Nodes Expanded by Different Algorithms

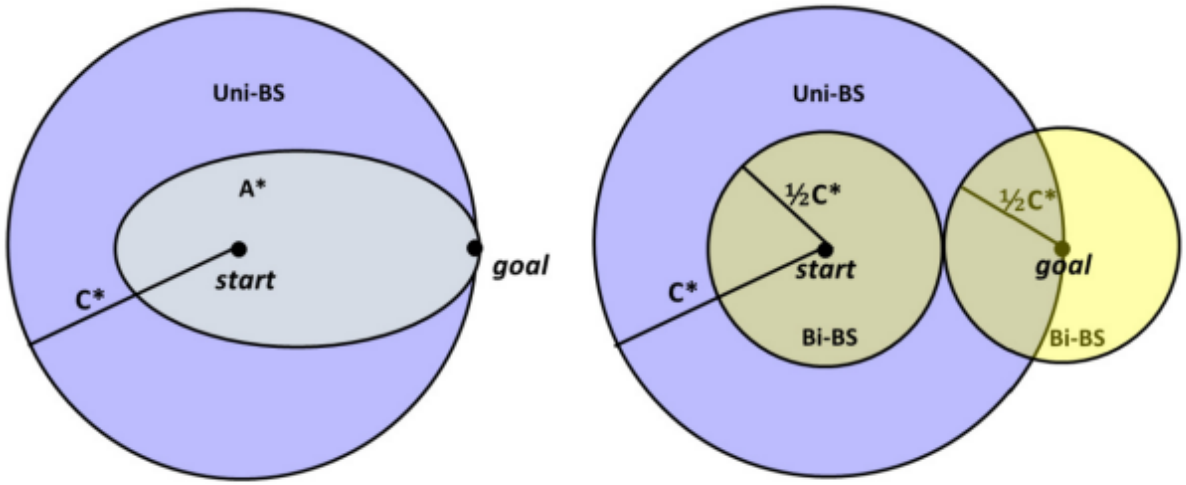


Fig. 1. Uni-BS compared to A* (left) and Bi-BS (right).

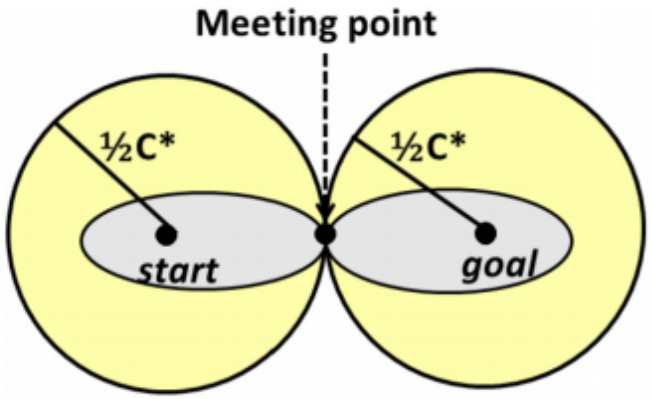
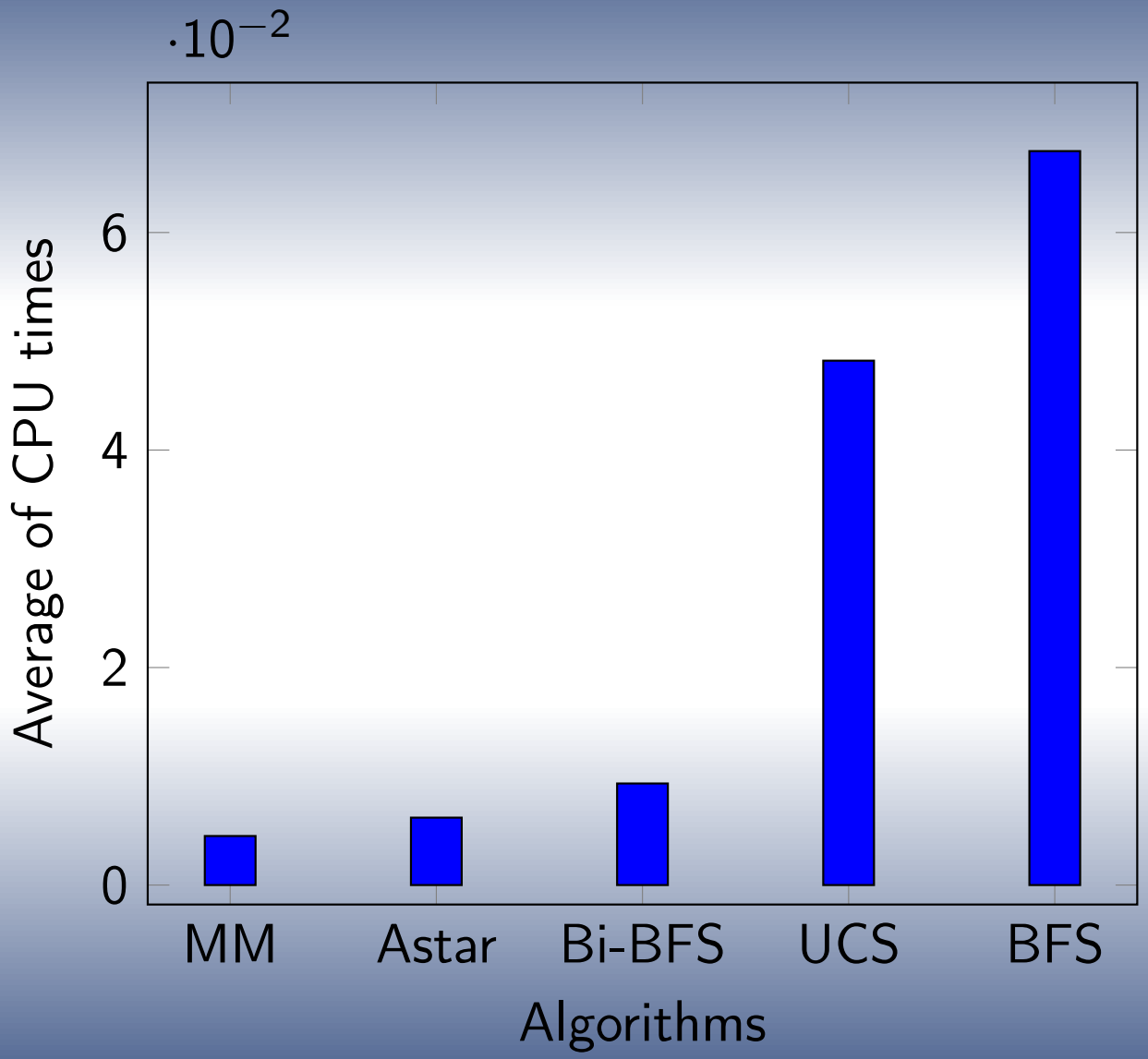


Fig. 2. The circles represent a Bi-BS system that meets in the middle and the ovals represent a Bi-HS that does further pruning.

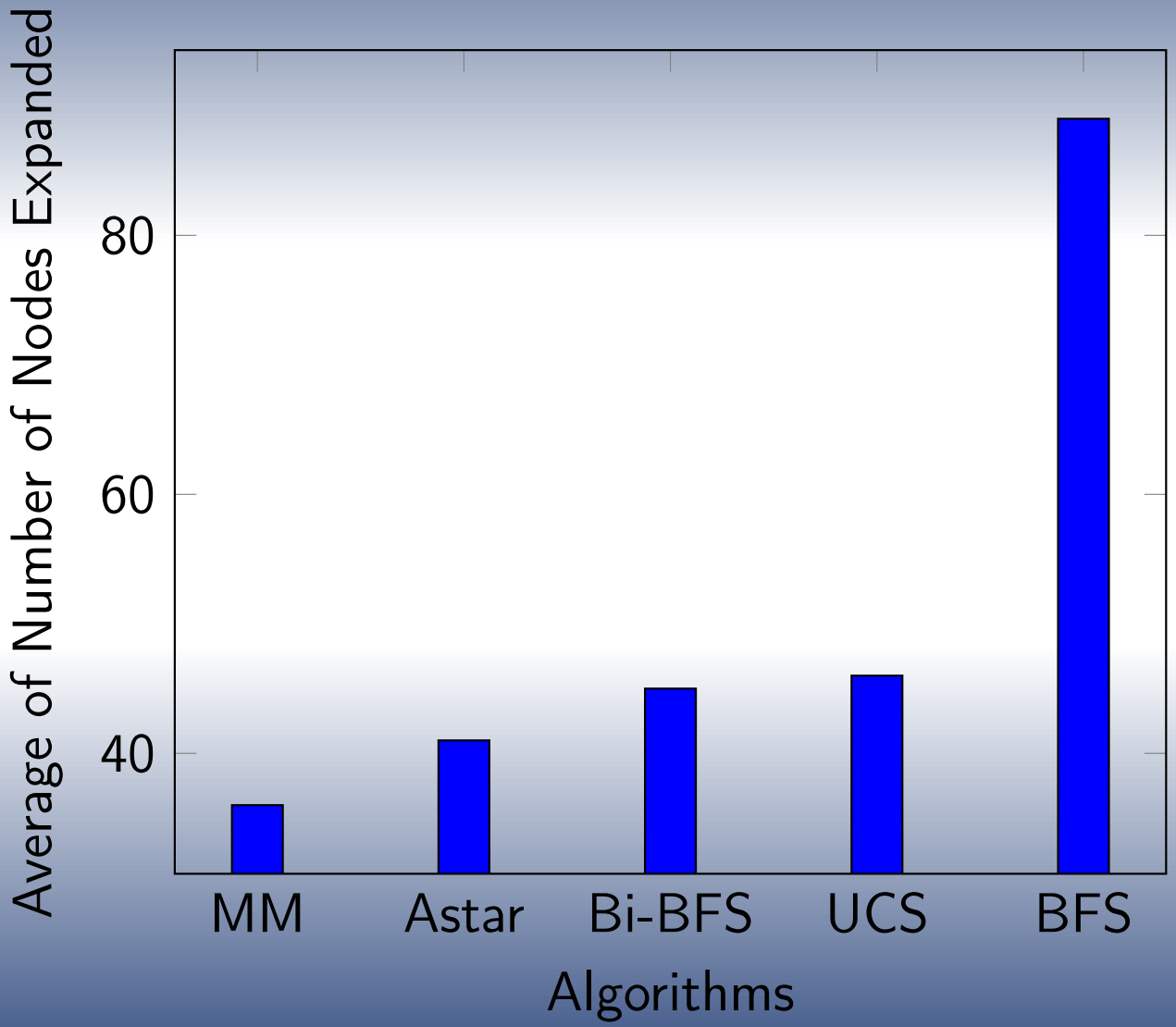
Analysis of CPU times of all Algorithms

Analysis of CPU times of all Algorithms	
Algorithm	Average CPU time(sec)
MM	0.00450845454545
Astar	0.0061984
Bi-BFS	0.00934036363636
UCS	0.0482154
BFS	0.0674858181818

Graph of CPU times of all Algorithms



Analysis of Average Number of Nodes Expanded for all Algorithms

Analysis of Average Number of Nodes Expanded for all Algorithms	
Algorithm	Average Number of Nodes Expanded
MM	36
Astar	41
Bi-BFS	45
UCS	46
BFS	89

Graph of Average Number of Nodes Expanded for all Algorithms