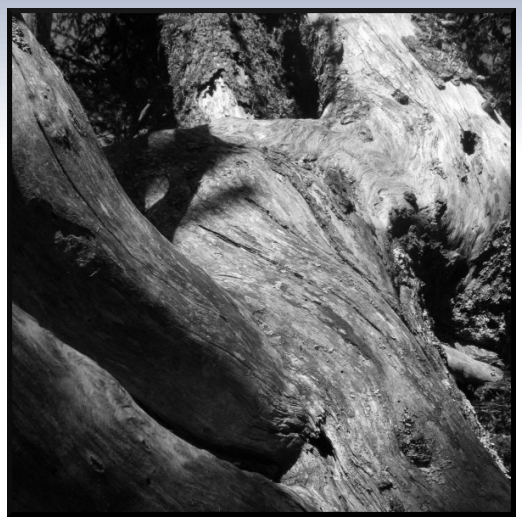

Bi-directional A* Algorithm and its applications in shortest path finding in road networks

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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.

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)

Analysis of Breadth First Search

Analysis of Breadth First Search			
Source	Goal	CPU TIME	Nodes Expanded
77	16	0.079001	89
57	88	0.090384	89
29	16	0.052228	89
9	81	0.113933	89
24	69	0.063325	89
1	89	0.057499	89
39	9	0.039167	89
60	15	0.082170	89
1	31	0.040618	89
60	57	0.035796	89

Analysis of Bidirectional Breadth First Search

Analysis of Bidirectional Breadth First Search			
Source	Goal	CPU TIME	Nodes Expanded
77	16	0.006709	37
57	88	0.009811	58
29	16	0.011009	44
9	81	0.12481	29
24	69	0.010771	50
1	89	0.011606	33
39	9	0.008798	48
60	15	0.008914	62
1	31	0.008168	32
60	57	0.010941	70

Analysis of Uniform Cost Search

Analysis of Uniform Cost Search			
Source	Goal	CPU TIME	Nodes Expanded
77	16	0.035542	81
57	88	0.048537	46
29	16	0.037394	37
9	81	0.071756	85
24	69	0.052444	37
1	89	0.048286	48
39	9	0.035821	29
60	15	0.063824	21
1	31	0.041920	25
60	57	0.046630	20

Analysis of A* Algorithm

Analysis of A* Algorithm			
Source	Goal	CPU TIME	Nodes Expanded
77	16	0.008620	21
57	88	0.009511	34
29	16	0.003370	42
9	81	0.004098	70
24	69	0.003485	59
1	89	0.009368	37
39	9	0.003540	64
60	15	0.003429	18
1	31	0.009609	38
60	57	0.006954	33

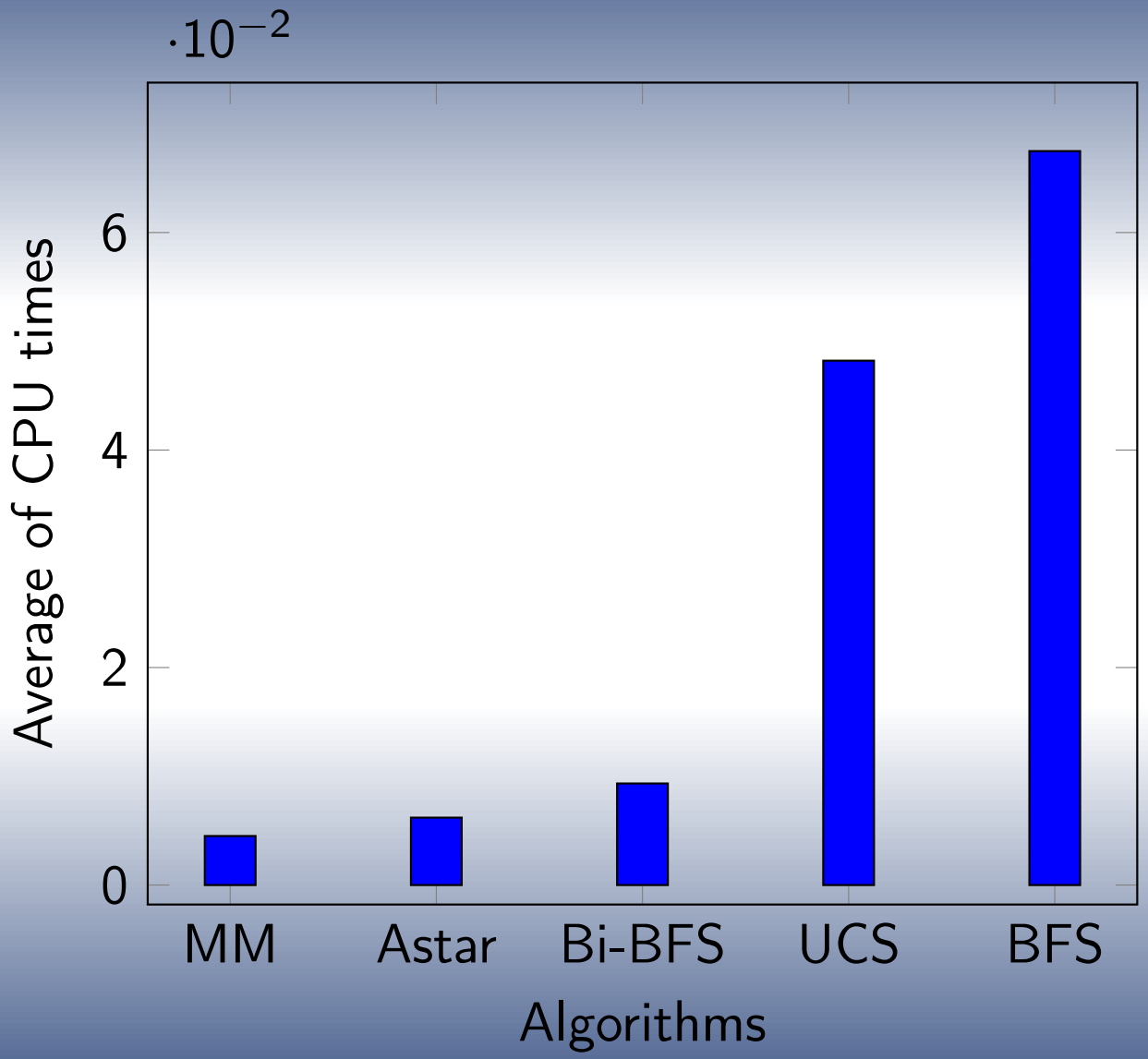
Analysis of MM Algorithm

Analysis of MM Algorithm			
Source	Goal	CPU TIME	Nodes Expanded
77	16	0.006631	21
57	88	0.007077	26
29	16	0.006778	36
9	81	0.002864	69
24	69	0.002525	51
1	89	0.002984	36
39	9	0.002704	62
60	15	0.002826	16
1	31	0.006941	34
60	57	0.005307	34

Analysis of CPU times of all Algorithms

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

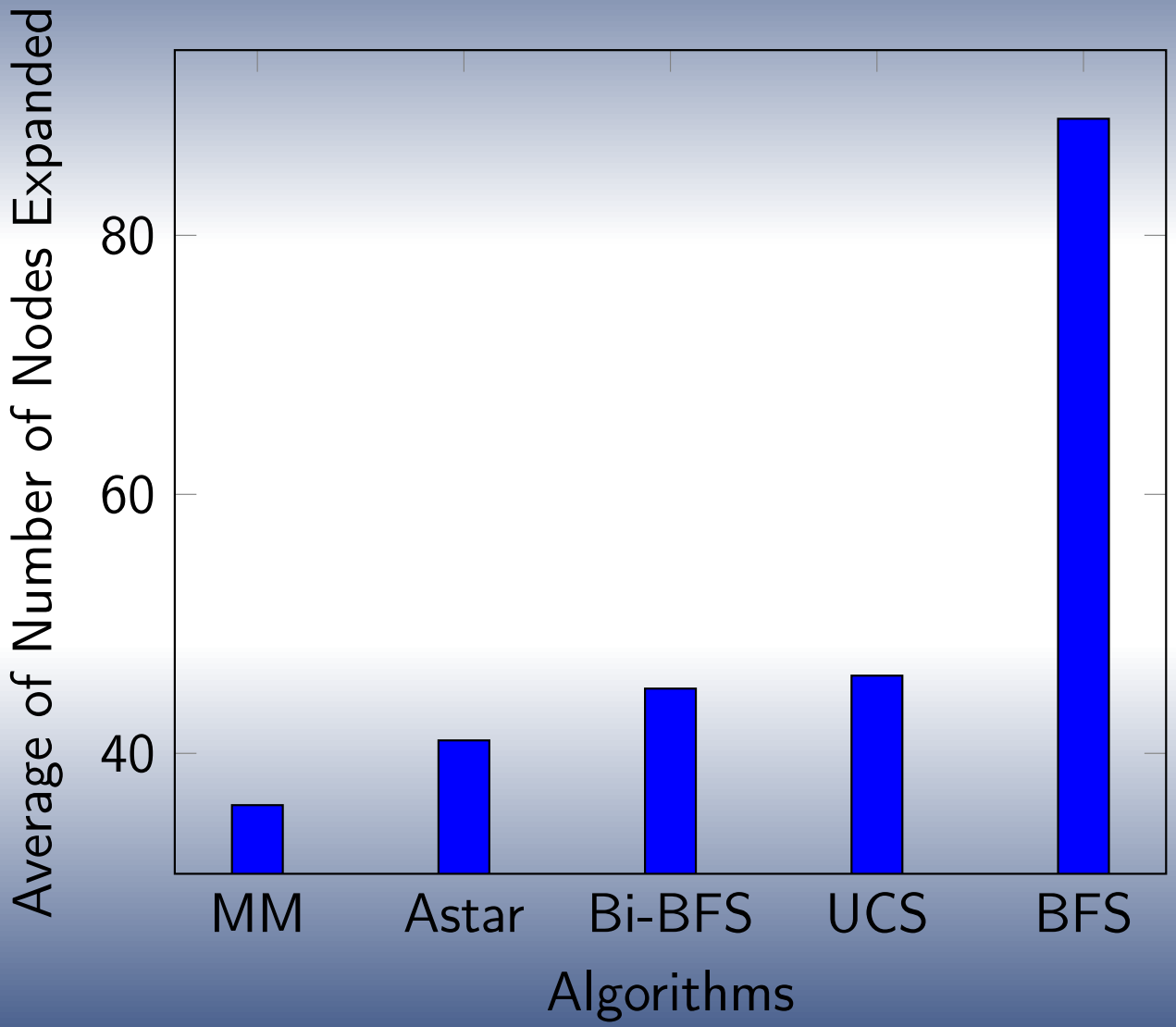
Graph of CPU times of all Algorithms



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



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