PREDICTING THE EFFECTIVENESS OF BIDIRECTIONAL HEURISTIC SEARCH

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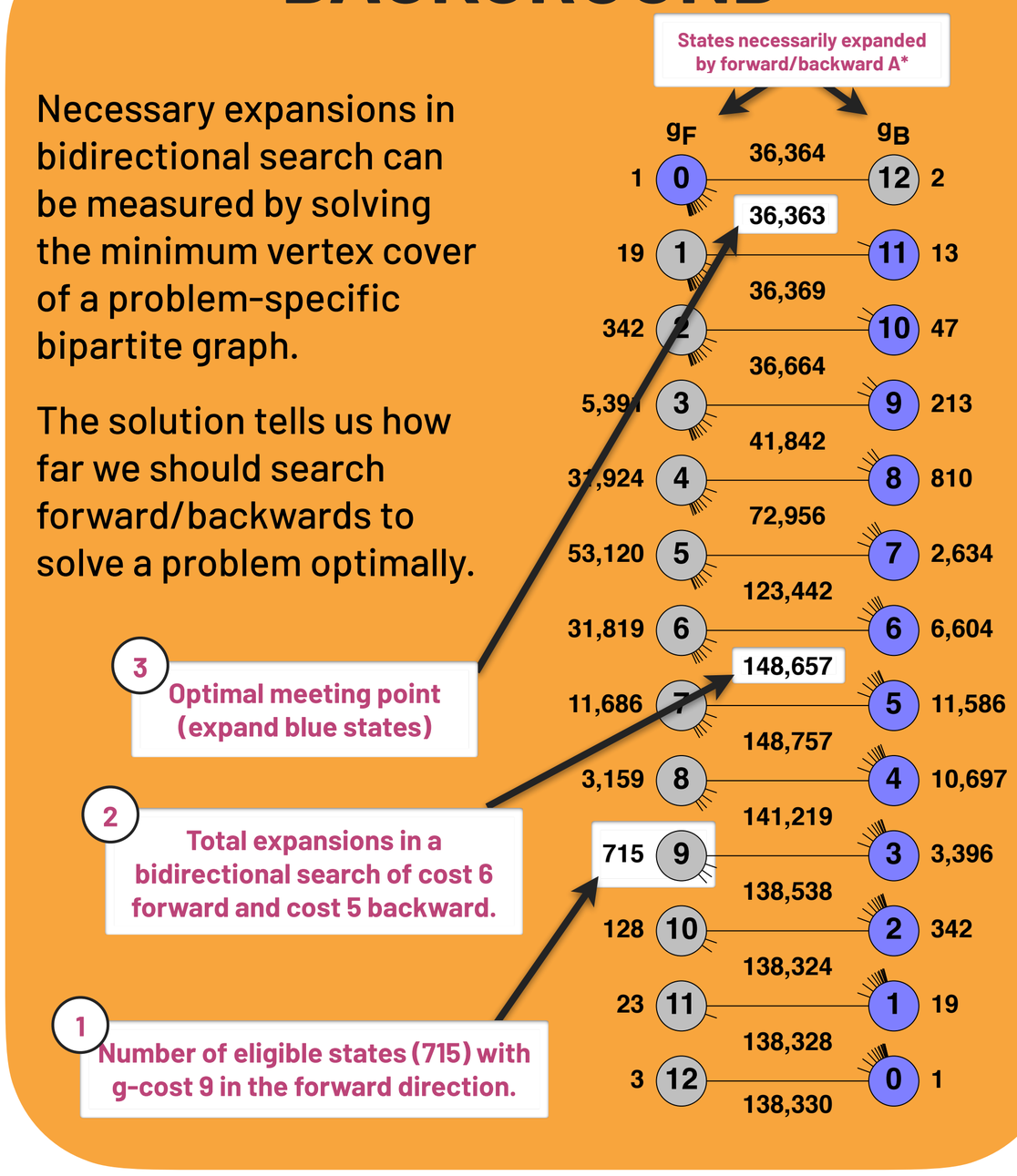
BACKGROUND

Necessary expansions in bidirectional search can be measured by solving the minimum vertex cover of a problem-specific bipartite graph.

The solution tells us how far we should search forward/backwards to solve a problem optimally.

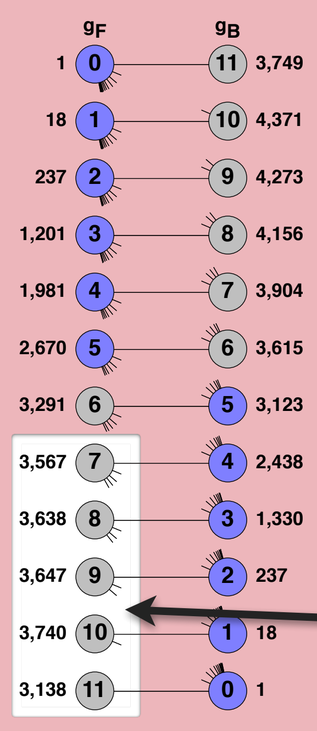


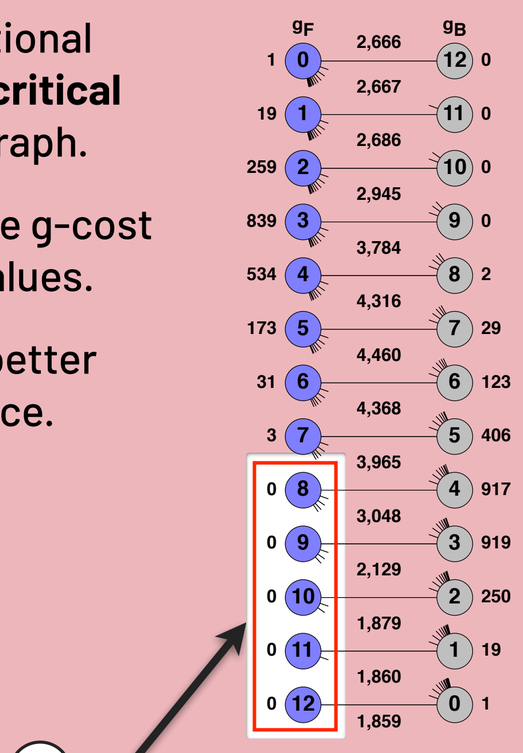
KEY OBSERVATIONS

Performance of bidirectional search depends on the **critical states** in the bipartite graph.

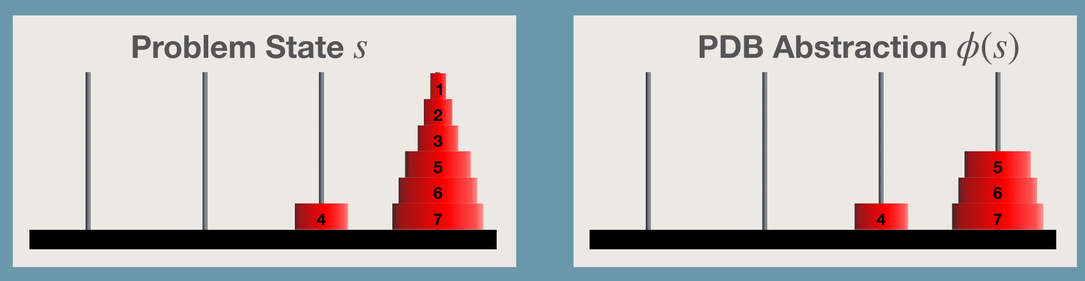
Critical states have large g-cost and low/inaccurate h-values.

More **critical states** → better bidirectional performance.





EXAMPLE: 4-PEG TOWERS OF HANOI



In 4-peg Towers of Hanoi a PDB heuristic might divide the discs into groups and compute the exact heuristic for each group. This results in many critical states (states with low and inaccurate heuristic values).

Such a heuristic would return a value of 1 on the problem above where the optimal solution is 9. Thus, there are many critical states in this problem.

Nodes expanded by different algorithms and heuristics. (Heuristic is # discs in pattern.)

	Unidir	Bidirectional	
Heuristic	A*	NBS$_\epsilon$	DVCBS$_\epsilon$
10+2	64,334	100,080	69,010
8+4	457,401	411,085	434,347
6+6	789,603	446,603	525,811
4+8	548,850	411,212	427,702
2+10	172,088	199,880	192,271
Zero	8,262,691	450,539	425,578

For more info...

See paper for:

- measures for critical states
- a discussion of asymmetry
- extensive experimental results