# PREDICTING THE EFFECTIVENESS OF BIDIRECTIONAL HEURISTIC SEARCH

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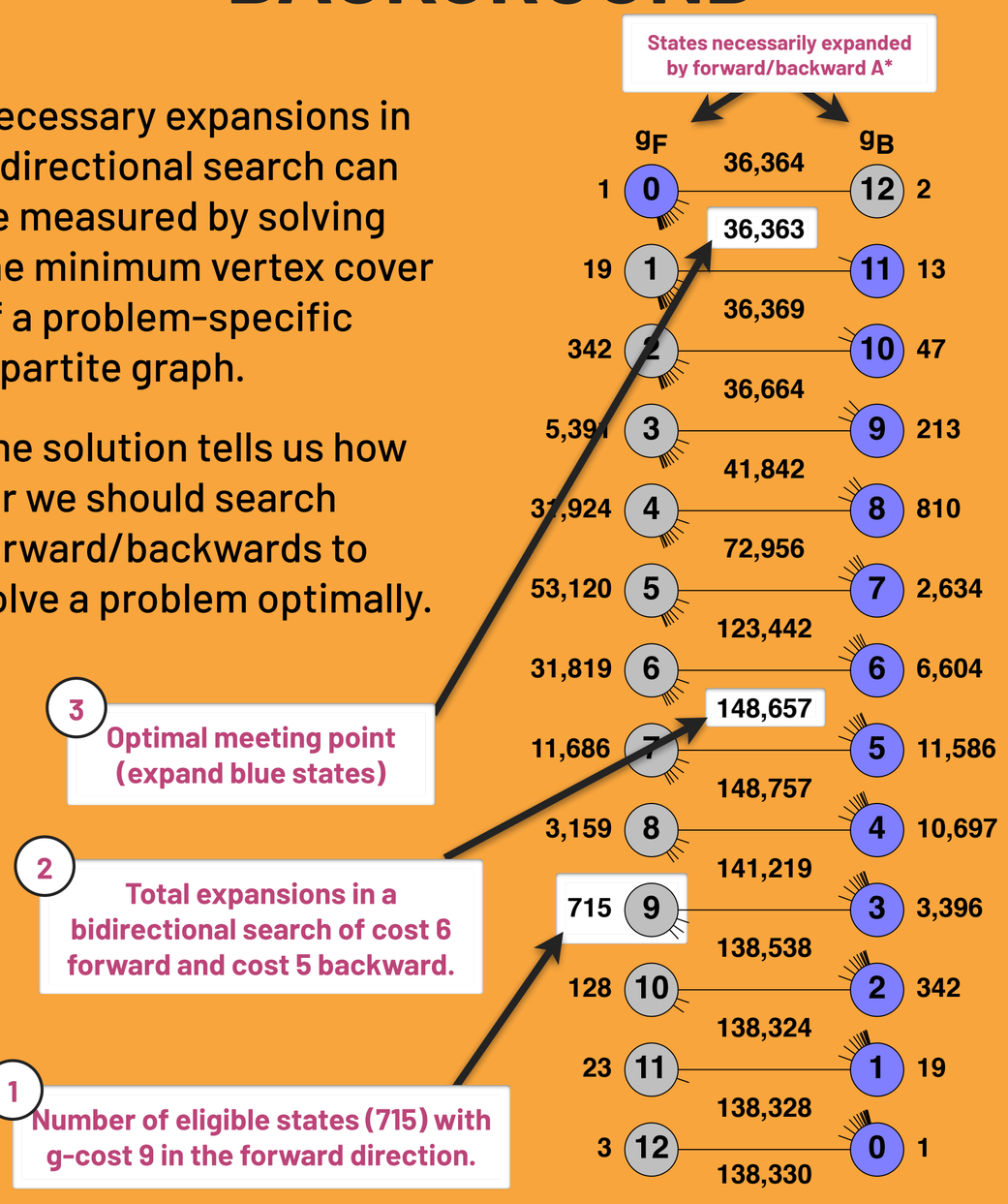
## BACKGROUND

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.

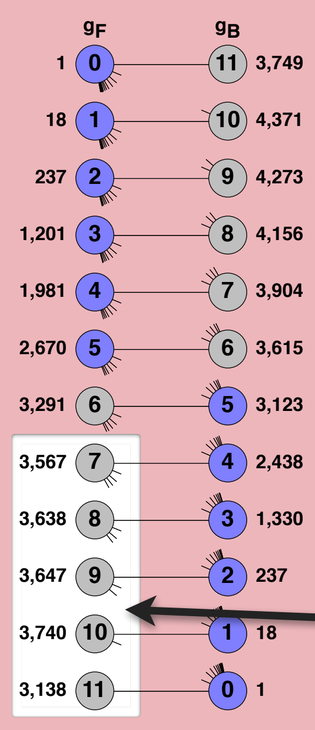


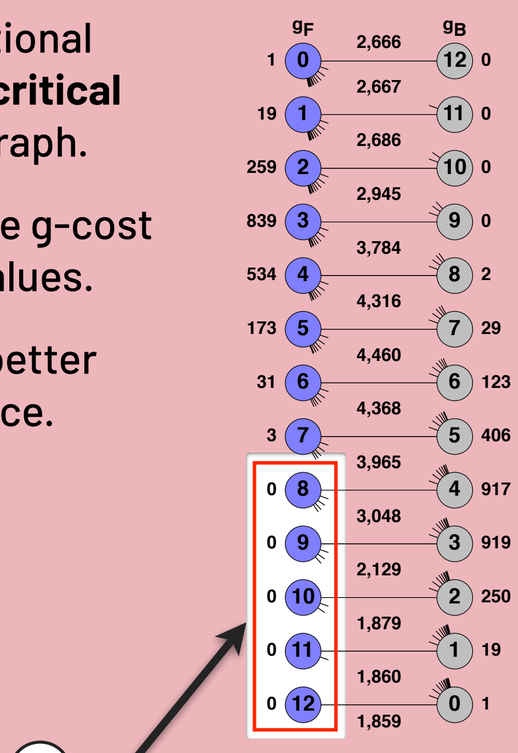

## KEY OBSERVATIONS

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

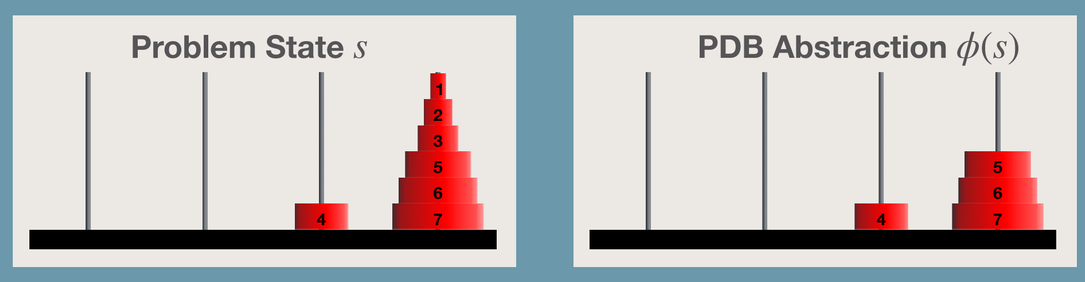
**Critical states** have large g-cost and low/inaccurate h-values.

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