# Solving Rubix Cube Using Search Techniques

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## Problem Formulation

* States:
  + For IDFS

class State:  
 cube = None  
 cost = 0  
 parent = None  
 move = None

* + For IDA\*

class State:  
 cube = None  
 g = 0  
 h = 0  
 parent = None  
 move = None

* Actions:
  + FrontClockwise,FrontAnti-Clockwise, UpClockwise, UpAnti-Clockwise, DownClockwise, DownAnti-Clockwise, LeftClockwise, LeftAnti-Clockwise, RightClockwise, RightAnti-Clockwise, BackClockwise, BackAnti-Clockwise
* State space:
  + 43 252 003 274 489 856 000

## Search algorithms

* IDFS
* IDA\*

## Heuristics

* h1 <corner\_edge\_sum\_max>
  + Admissible
  + It returns the Max(Sum\_ManhattanDist\_of\_Corners, Sum\_ManhattanDist\_of\_Edges)
* h2 <corner\_db\_heuristic>
  + Admissible and Consistent
  + Storing the corner configurations along with their depths in the database
  + Depth is used as heuristic

## Result

In this section you will give results on form of following table. You can also create graph but that is optional.

For example if you have used IDFS and IDA\* with 2 heuristics H1 and H2 then your table should be as follow

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Depth of goal  (d) | Search cost (nodes generated) | | | Effective Branching Factor (b\*) | | | Time consumed (seconds) | | |
| IDFS | IDA\* (h1) | IDA\* (h2) | IDFS | IDA\* (h1) | IDA\* (h2) | IDFS | IDA\* (h1) | IDA\* (h2) |
| 1 | 12 | 12 | 12 | 12 | 1 | 1 | <1 | <1 | <1 |
| 2 | 107.2941 | 36 | 24 | 11.15385 | 1 | 1 | <1 | <1 | <1 |
| 3 | 1054.526 | 72 | 36 | 10.84579 | 1.5 | 1 | <1 | <1 | <1 |
| 4 | 12270 | 180 | 48 | 10.86 | 1.56 | 1.25 | 2.55 | <1 | <1 |
| 5 | 124585 | 1428 | 588 | 10.8 | 2.27 | 1.6 | 24.8 | <1 | <1 |
| 6 |  | 76680 | 1164 |  | 3.33 | 1.37 |  | 48 | <1 |

## Discussions and Conclusion

According to the findings after trying different heuristics we found that the heuristic with pattern database is the best solution as it finds the solution in less time as compared to others.

Another technique we tried with different heuristic in which we calculated displaced corners and edges. This heuristic was not admissible and it was increasing goal height more than the input height.