

CS472 Module 7 Part D - Representation Change and State Spaces

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Outline

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1 State Spaces

State Spaces

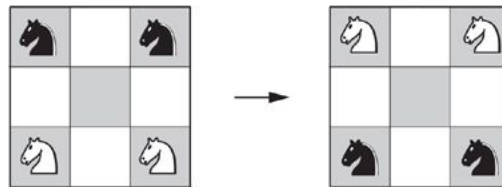
- In games, the state space is the set of all possible configurations within in the game
- For many simple games and puzzles, it is possible for one to enumerate all of the possible configurations and moves
- The moves serve as vertices in a graph of configurations

State spaces: Chess engines

- Computer chess engines have reached the point where they are capable of beating grandmaster-level players
- Implementation issues
 - Board representation: how a single position is represented in data structures
 - Search techniques: how to identify possible moves and select the most promising ones for further examination
 - Leaf evaluation: how to evaluate the value of a board position, if no further search will be done from that position

2 Guarini's Puzzle

Guarini's Puzzle: Applying representation change

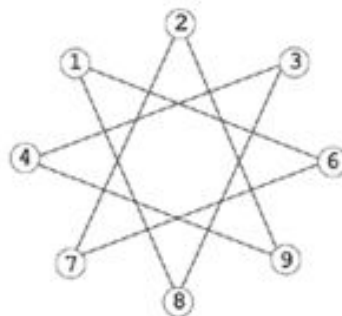


- Place four knights on a 3x3 chessboard with two white knights at the bottom corners and the two black knights at the upper corners of the board
- Goal: using only legal moves for these pieces, what are the minimum number of moves, if any, that will put the white knights at the upper corners and the black knights at the lower corners

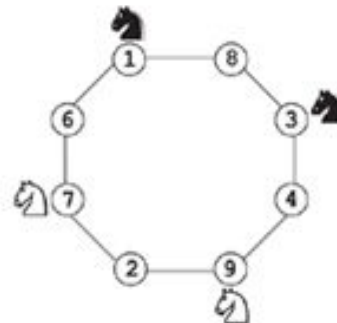
Guarini's Puzzle: Applying representation change



(a)



(b)

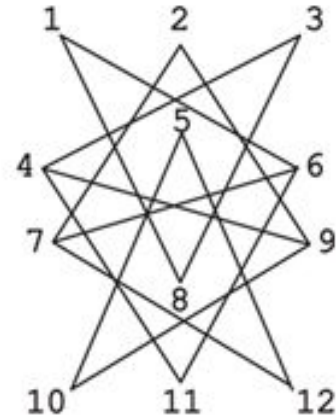
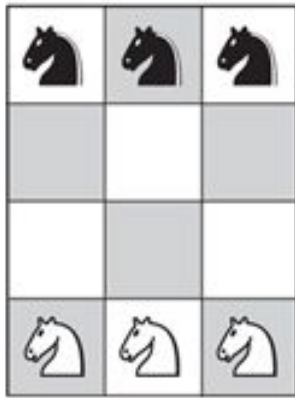


(c)

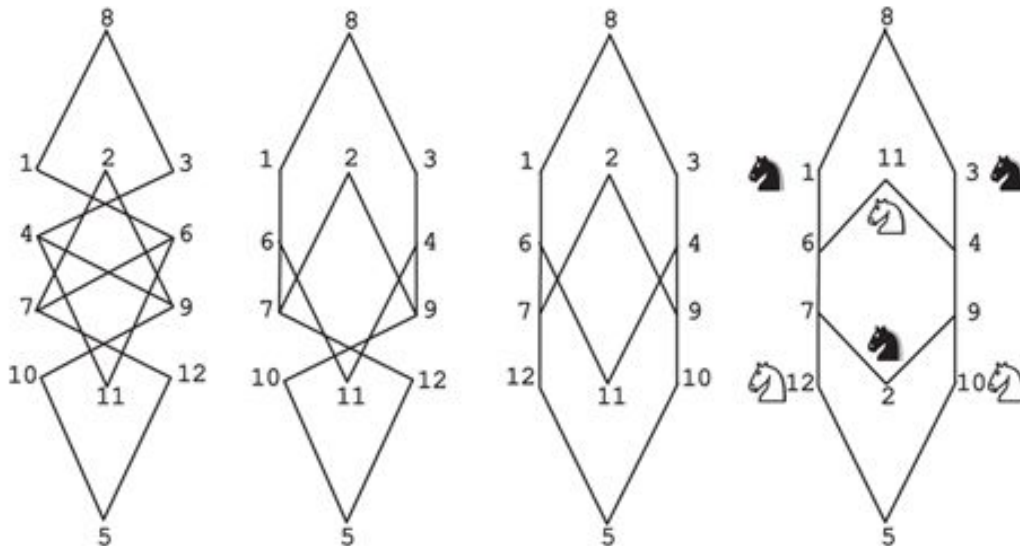
Guarini's Puzzle: Note the solution

- Knights can move only to adjacent vertices of the graph so that they preserve their clockwise (and counterclockwise) order
- A solution would require that the four knights of different colors alternate, the puzzle cannot be solved!
- Note how clarity of this fact in our alternate representation

Guarini's Puzzle: 6 Knights



Guarini's Puzzle: 6 Knights, unfolded



3 Cut-rate Travel: Using state spaces

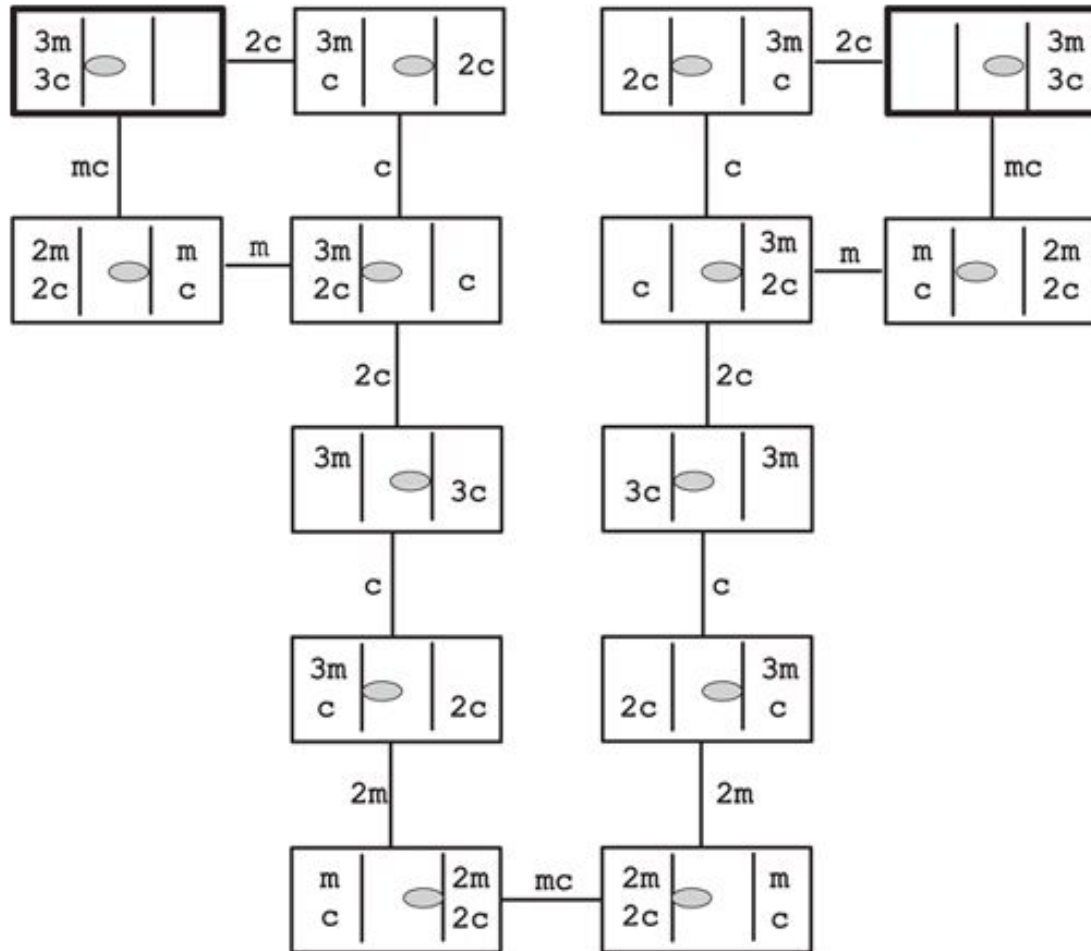
Cut-rate Travel: The Amazon Safari

You decide that it's time to take that fancy jungle safari that you've been meaning to take for years. But, you don't have a lot of money to pay for it... so you purchase your safari from the Cut-Rate Travel Agency. What you don't find out until you get to the Amazon Basin is that the reason Cut-Rate was so cheap was that they use cannibals for guides.

Cut-rate Travel: The Amazon Safari

So, you have a party of three travelers and three cannibals as guides. You come to a river where is a ferry that can only take two people at a time. Any of the travelers or any of the cannibals can row the ferry across the river. But, if at any time the number of cannibals on the river bank is larger than the number of travelers, then the travelers become the starting point for a big pot of tourist gumbo. What is the fewest number of crossings required to get everyone across the river without anyone becoming dinner?

Cut-rate Travel: The Amazon Safari



4 Key Points

Key Points

- State space representation
 - Use in AI
 - Use in game programming
- Representation change
 - Relationship to Transform and Conquer meta-heuristic