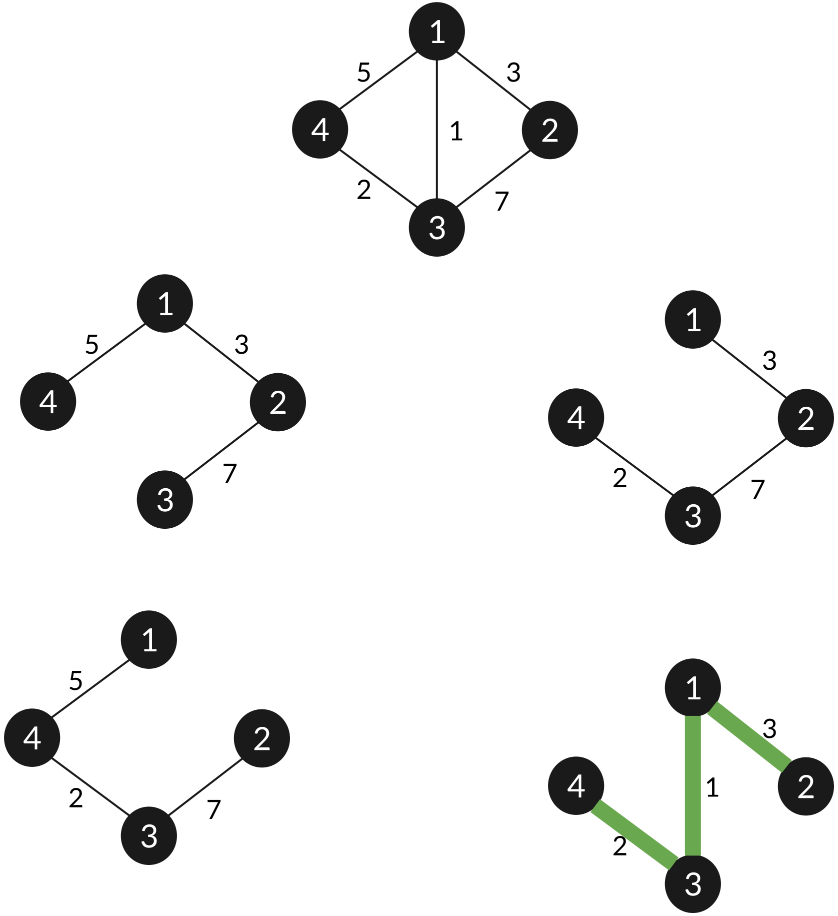
CIS 263 Introduction to Data Structures and Algorithms

Backtracking

Minimum Spanning Tree

- We have to find spanning Trees with the minimum cost
  - Search all combinations
  - Approximation Algorithms
    - **Greedy Algorithms**
      - Prim’s Algorithm
      - Kruskal’s Algorithm



- Uses heuristics
- Solution may not be optimal

Optimization Problems

Greedy Algorithms

- Mainly Heuristics based

Bruteforce

- Constraints based

Optimization Problems

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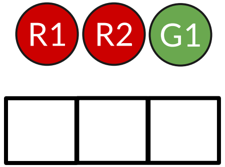
Bruteforce

- Constraints based
- Backtracking

Backtracking

- You have to fill the boxes
- No condition
- 3! solutions



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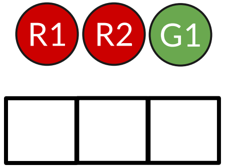
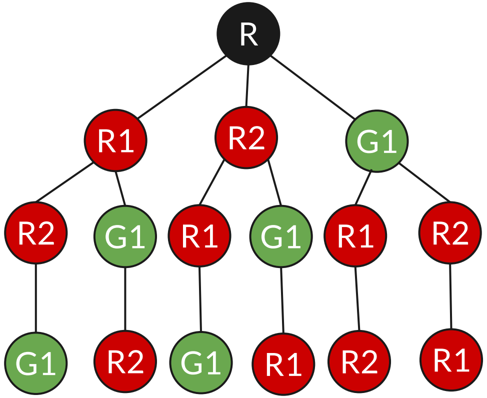
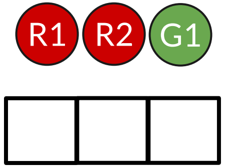


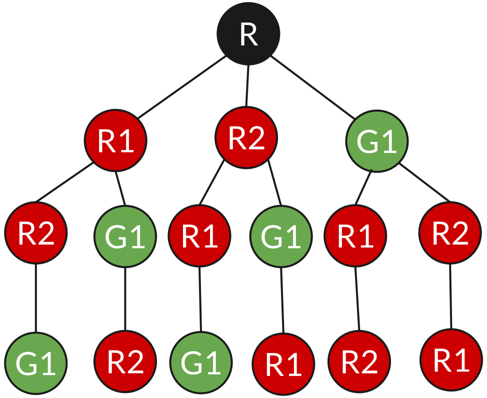


State Space Tree

Backtracking

- You have to fill the boxes
- Conditions
  - Green cannot be in the middle
- Exclude some of the 3! Solutions
- Bruteforce search
  - Apply condition as a bounding function
  - Apply Backtracking





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Backtracking

- You have to fill the boxes
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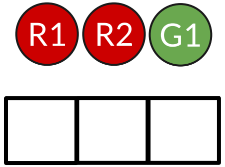
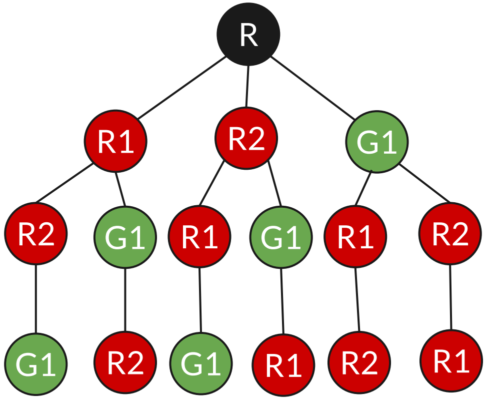
- Exclude some of the 3! Solutions
- Bruteforce search
  - Apply condition as a bounding function
  - Apply Backtracking (Preorder Traversal)





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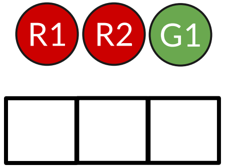
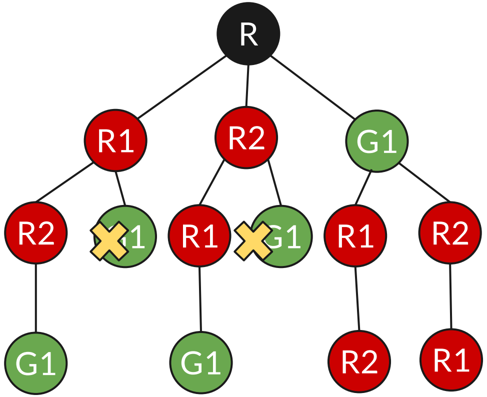
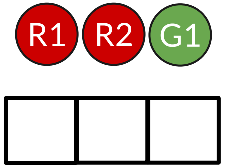


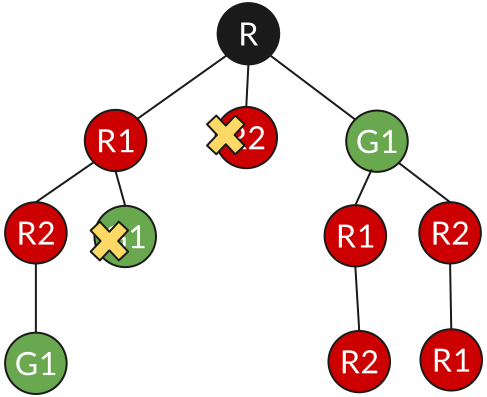


State Space Tree

Backtracking

- You have to fill the boxes
- Conditions
  - Green cannot be in the middle
  - **R2 cannot be in the first box**
- Exclude some of the 3! Solutions
- Bruteforce search
  - Apply condition as a bounding function
  - Apply Backtracking (Preorder Traversal)



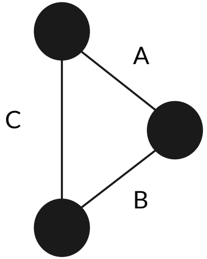


State Space Tree

Backtracking

Graph Coloring Problem

- Condition: Two adjacent nodes cannot have the same color
- Can we do it with 2 colors say {Red, Green} ?



Backtracking

?? Problem

- You are asked to make a NHL schedule, and here are the conditions:
    - You have 4 teams: {A, B, C, D}
    - A team can play only one game a day
    - Teams play following a certain format
- Q: What’s the minimum number days your schedule will require?

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- Lets first try for 3 teams

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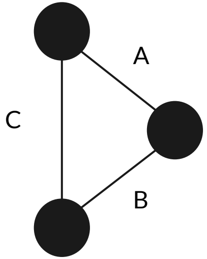
- Lets first try for 3 teams: {A, B, C}



Backtracking

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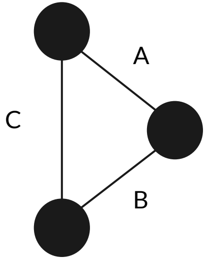
  - A team can play only one game a day
  - Teams play following a certain format
- Q: What’s the minimum number days your schedule will require?
- Lets first try for 3 teams: {A, B, C}
- An equivalent question is: What’s the minimum number of colors you will require so no two adjacent colors are the same?



Backtracking

Graph Coloring Problem

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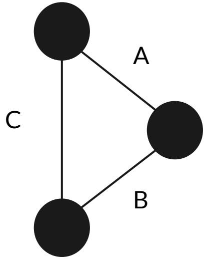

Backtracking

Graph Coloring Problem

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- Q: What's the minimum number days your schedule will require?
- Lets first try for 3 teams: {A, B, C}
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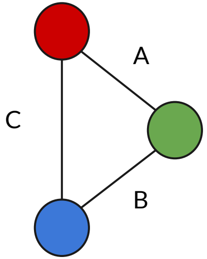
    - Graph Coloring Problem
- Answer: 3 days
- Can we do it in less than 3 days?
    - Answer: No



Backtracking

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- Lets first try for 3 teams: {A, B, C}
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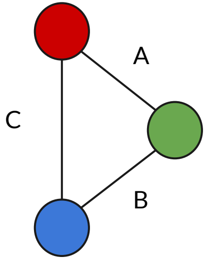
    - Graph Coloring Problem
- Answer: 3 days
- Can we do it in less than 3 days?
    - Answer: No
- What are your scheduling options; or How many combinations of days/dates you may have?



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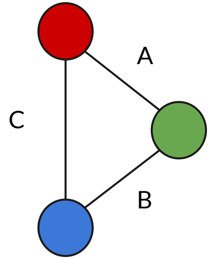
- Q: What's the minimum number days your schedule will require?
- Lets first try for 3 teams: {A, B, C}
- An equivalent question is: What's the minimum number of colors you will require so no two adjacent colors are the same?
  - Graph Coloring Problem
- Answer: 3 days
- Can we do it in less than 3 days?
  - Answer: No
- What are your scheduling options; or How many combinations of days/dates you may have?
  - Answer: We have to generate a SBT for all possibilities just like we did it in our toy example

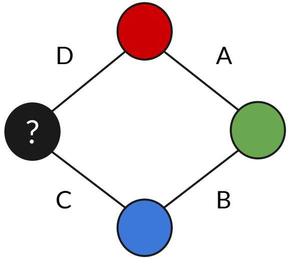


Let’s go back to our original question!

Let’s go back to our exact question!

Graph Coloring Problem

- You are asked to make a NHL schedule, and here are the conditions:
    - **You have 4 teams: {A, B, C, D}**
    - A team can play only one game a day
    - Teams play following a certain format
- Q: What’s the minimum number days your schedule will require? 4 or 3 or some other number of days ?



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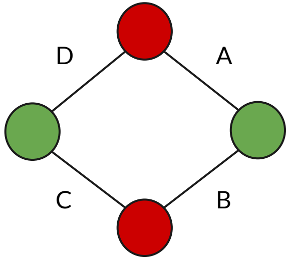
Graph Coloring Problem

- You are asked to make a NHL schedule, and here are the conditions:
  - **You have 4 teams: {A, B, C, D}**
  - A team can play only one game a day
  - Teams play following a certain format
- Q: What’s the minimum number days your schedule will require? or 3 or some other number of days ?
- Answer: 2 days (2 colors)



Is this the only solutions?

Let’s go back to our exact question!

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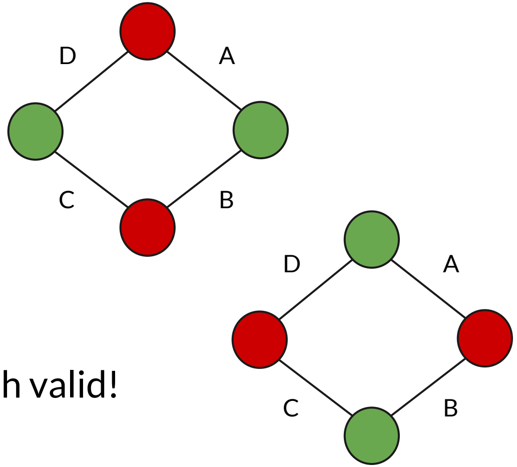

Both valid!

Let’s go back to our exact question!

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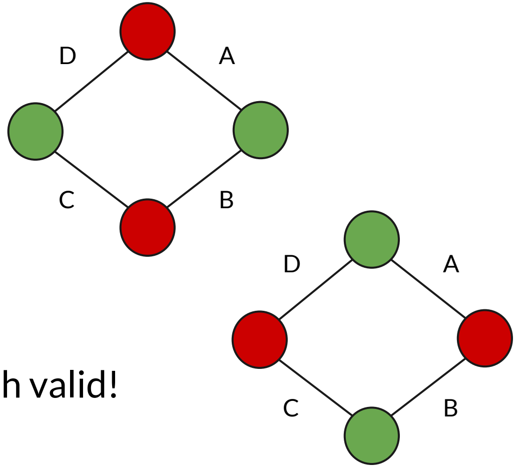
- Q: What’s the minimum number days your schedule will require? 4 or 3 days ?
- Answer: 2 days(2 colors)
- What are your scheduling options; or How many combinations of days/dates you may have?
  - Backtracking solution



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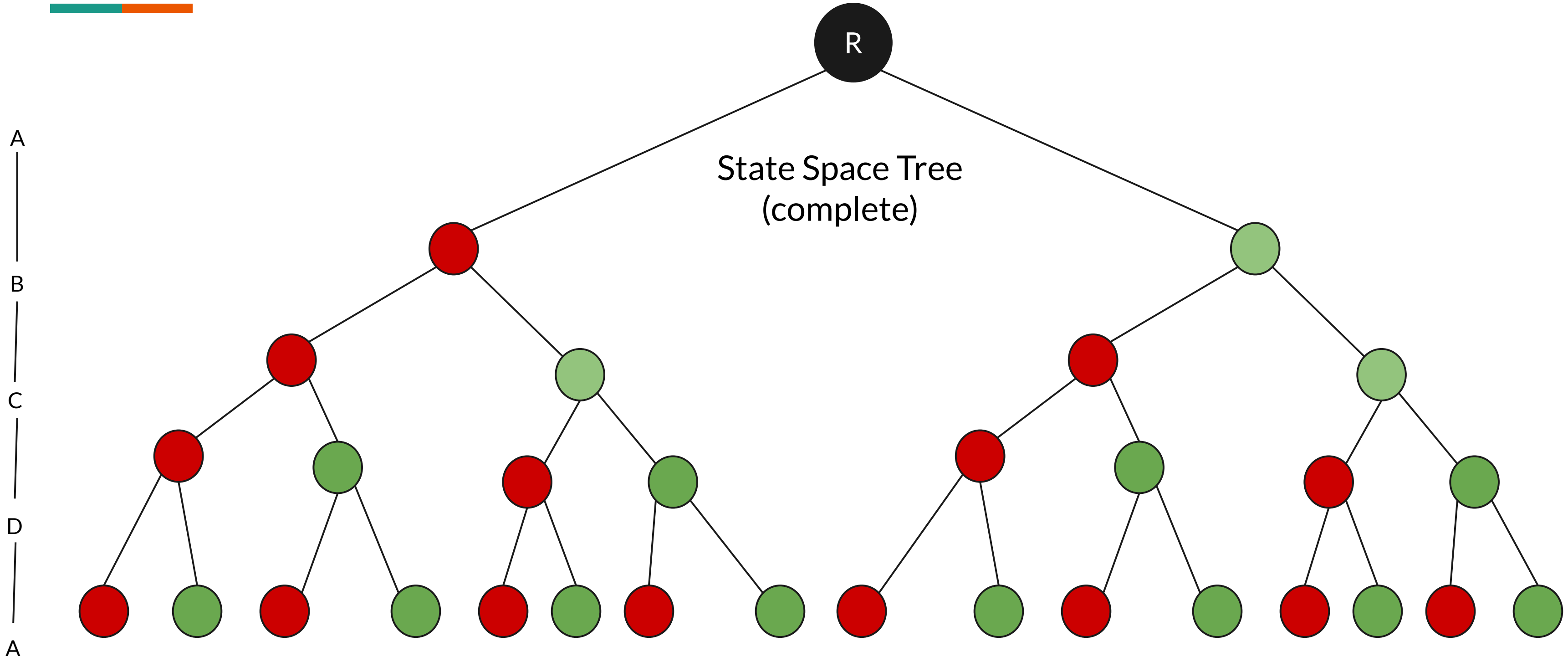
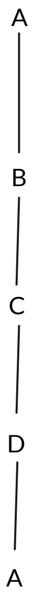
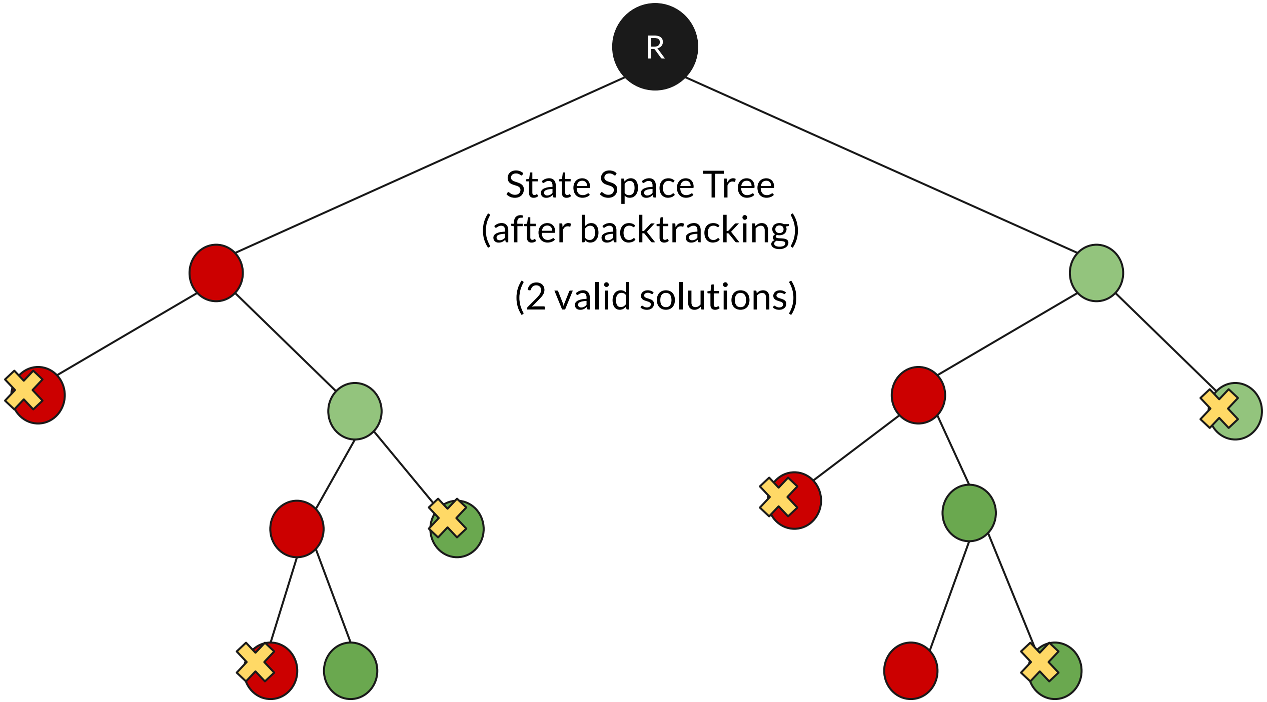


State Space Tree
(complete)





State Space Tree
(after backtracking)

(2 valid solutions)