DFS & BFS / Backtracking

2010 NTNU CSIE Winter Training

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Search

• Find a solution
  • To a maze
  • To a puzzle
  • ...
• Enumeration
  • Till the end of time?
• Algorithm
  • Thinking!
Algorithms

• D.F.S.
  • Depth-First Search
  • Try to be the deepest
  • Uchiha Sasuke in *Naruto* - Raikin

• B.F.S.
  • Breadth-First Search
  • Try to be the widest(?)
  • Uzumaki Naruto in *Naruto* - Kage Bunshin no Jutsu
• Backtracking
  • Enumeration
  • Cut
    • Abandons each partial candidate $c$ as soon as it determines that $c$ cannot possibly be completed to a valid solution.

• Eight Queens Puzzle
  • $64 \times 63 \times 62 \times 61 \times \ldots \times 1 = 64! = 1.26886932 \times 10^{89}$
  • Check first when you build candidates
Visualization

• Youtube is our friend!
  • http://www.youtube.com/watch?v=2XjzjAfGWzY
  • Path-Finding Demonstration using Pac-Man
  • BFS
  • DFS
  • Hill Climbing
  • A*

• Google is our friend, too
  • Google://BFS Animation
Application

• Classic Puzzles / Problems
  • Eight Queens Puzzle
  • 8-Puzzle
  • Sudoku
  • Field Counting

• Extensions
  • N Queens Puzzle
  • 15-Puzzle
Flood Fill

- **Flood Fill, also called Seed Fill**
  - Determines the area connected to a given node in multi-dimensional array.
  - Counts connected fields
- **Implementations**
  - D.F.S.
    - May cause stack overflow
  - B.F.S.
Flood Fill (cont.)

Flood-Fill (node, target_color, replacement_color) do

1. If the color of node is not equal to target_color, then return

2. Set the color of node to replacement_color

3. Perform Flood-Fill (step to the west of node ...)
   Perform Flood-Fill (step to the east of node ...)
   Perform Flood-Fill (step to the north of node ...)
   Perform Flood-Fill (step to the south of node ...)

4. Return

end
Flood Fill (cont.)

Flood-Fill (node, target_color, replacement_color) do

1. If the color of node is not equal to target_color, then return

2. Set Q to the empty queue, and add node to Q

3. For each element n of Q:

   If the color of n is equal to target_color

   Set w and e equal to n

   Move w to the west until the color of node to the west of w no longer matches target_color, so does e (east).

   Set the color of nodes between w and e to replacement_color

   For each node n between w and e:

   If the color of the node to the north of n is target_color, then add that node to Q, so does south.

4. Return

end
Uva Problems

• 195 – Anagram
• 216 – Getting in Line
• 639 – Don’t Get Rooked
• 762 – We Ship Cheap
• 784 – Maze Exploration