# Everything I know about BFS/DFS

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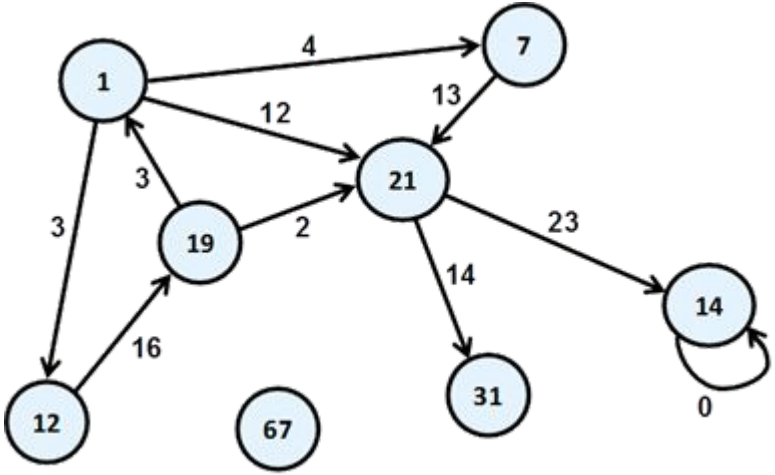
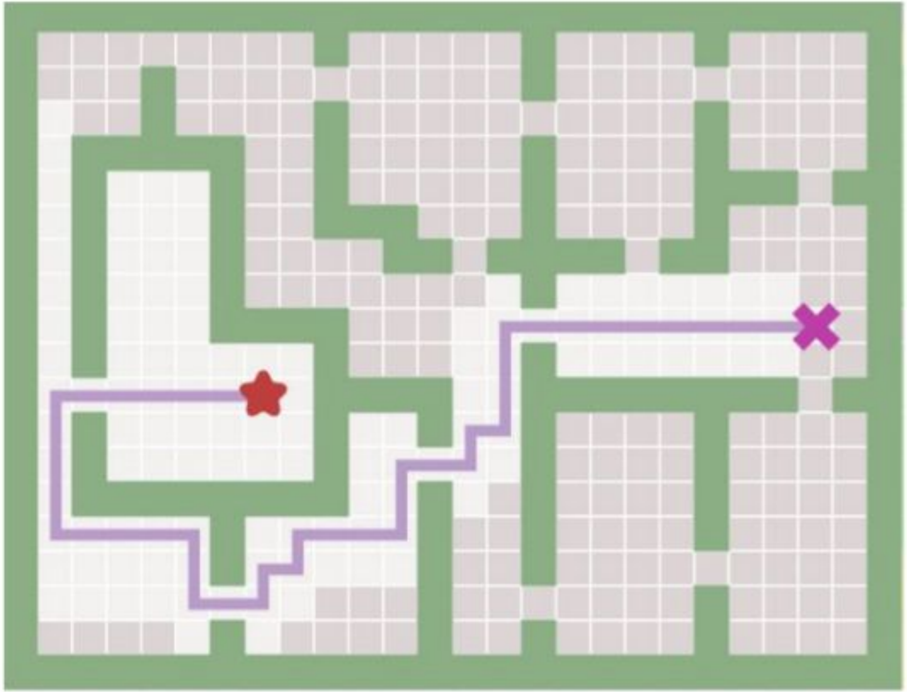
# Disclaimer :)

# What I’m not going to talk about

- Big Oh Omega and Theta
- Space vs time complexity
- Advantages and limitations between graph vs tree search, BFS vs DFS vs…
- When each algorithm fail

# To get you thinking





# Potential use cases

- Searching for the shortest/ longest path
- Search if there is a path between 2 nodes
- Searching if a node is contained in the graph/tree

# Quick summary of prereq knowledge

- Queue
- Stack
- Set
- Priority Queue
- Graphs vs Trees

# What is BFS/DFS

- Algorithms that specify how to search
- Graph search algorithms
- Use a fringe/frontier

# Compare

Breadth First Search

- Search each level first
- Implemented with queue
- Graph/Tree variant

Depth First Search

- Search to the deepest level
- Implemented with stack
- Graph/Tree variant

# General Implementation

Tree Search

```
INITIALIZE fringe
LOOP through condition
    TAKE a node out of the fringe
    IF it’s the goal state then return
    ELSE add expanded nodes to fringe
END
```

Graph Search

```
INITIALIZE open and closed fringe
LOOP through condition
    TAKE a node out of the fringe
    IF it’s the goal state then return
    ELSE add node to closed fringe and
    add expanded nodes to open fringe
END
```

# BFS vs DFS Specifics

Breadth First Search

```
INITIALIZE queue
LOOP through condition
    DEQUEUE a node out of the queue
    IF it’s the goal state then return
    ELSE enqueue expanded nodes
END
```

Depth First Search

```
INITIALIZE stack
LOOP through condition
    POP a node out of the stack
    IF it’s the goal state then return
    ELSE push expanded nodes
END
```

# Other cool stuff

- Iterative Deepening DFS
- Uniform Cost Search (UCS) - backward cost
  - Dijkstra's Algorithm
- Greedy Search - forward cost
- A*

# Try it out yourself

Shortest path https://open.kattis.com/problems/buttonbashing

Generate graph from input https://codeforces.com/contest/796/problem/D

Shortest path with walls https://codeforces.com/contest/877/problem/D

https://codeforces.com/contest/60/problem/B

https://codeforces.com/contest/884/problem/C

https://codeforces.com/contest/60/problem/C