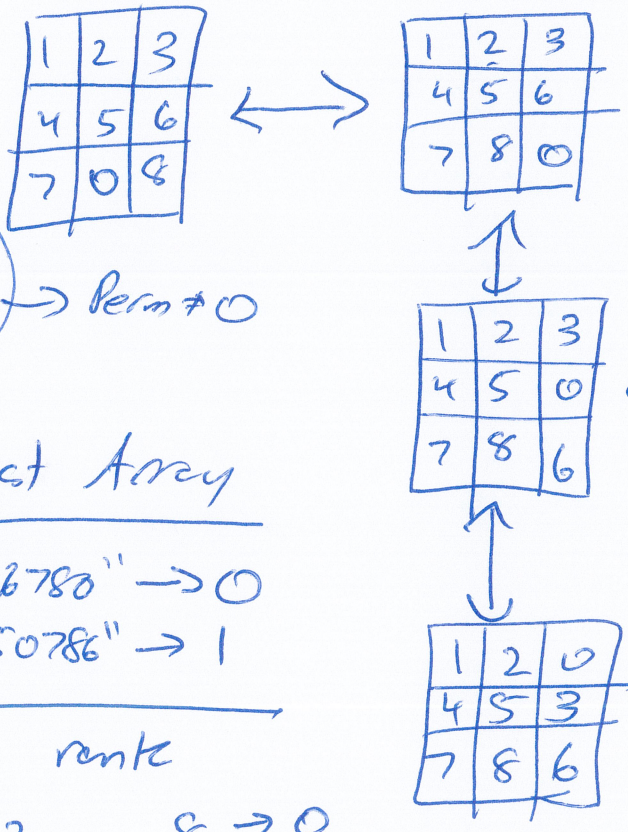
10/15/26 CS2

BFS Applications

Processes/Games where each possible "state" can be viewed as a vertex and each possible "move" as an edge in an implicit graph. Find the fewest # of moves to move the puzzle from one state to another state



0 1 2
3 4 5
6 7 8 → Perm # 0

0 = blank

9!
board states

$\frac{9!}{2}$ are reachable

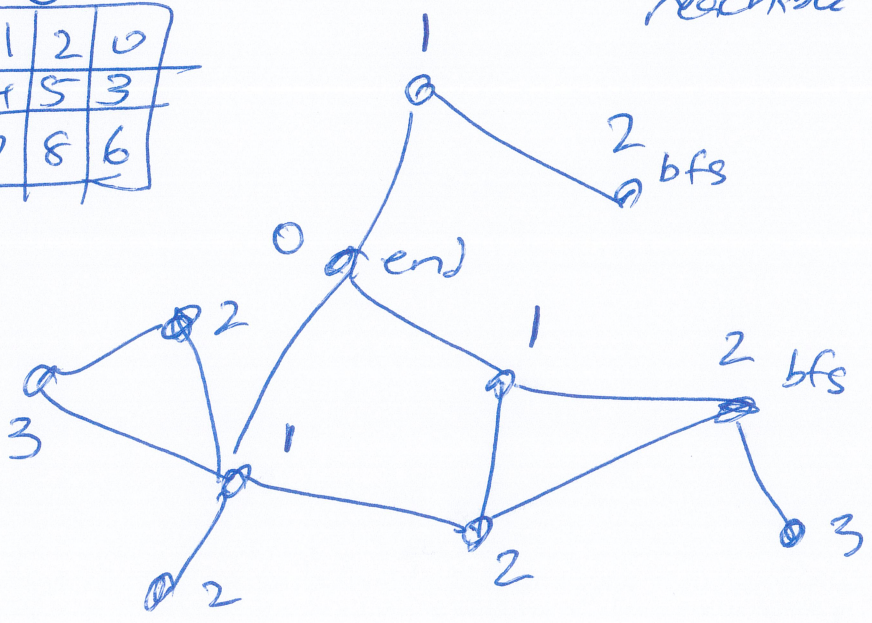
Dict Array

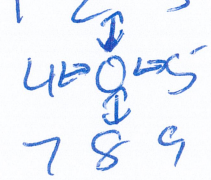
"123456780" → 0
"123450786" → 1

perm rank

{ 0, 1, 2, ... 8 → 0
{ 8, 7, 6, 5, 4, 3, 2, 1, 0 → 9! - 1

0 1 2	0
0 2 1	1
1 0 2	2
1 2 0	3
2 0 1	4
2 1 0	5





"123405789"

0 → 1, 3
1 → , 0, 2, 4
2 → 1, 5
3 → 0, 4, 6
4 → 1, 3, 5, 7
5 → 2, 4, 8
6 → 3, 7
7 → 4, 6, 8
8 → 5, 7

Storage for block game ideas

(1) Store a String of whole board

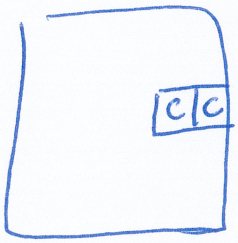
(2) for each car do a bitmask

1 bit → H or V

1 bit → size 2 or 3

6 bits → top left position

BitSet

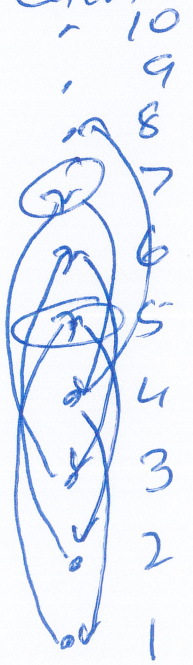


→ answer is 1

output max(1, bfs(...))

Elevator Trouble

each floor is a vertex



7 → 4 → 8 → 5

f = 10

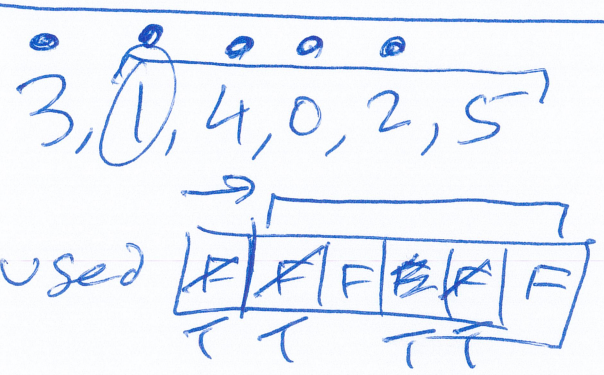
s = 7

e = 5

u = 4

d = 3

Alg for mapping perm to rank



rank += 3 × 5! process 3

rank += 1 × 4! process 1

rank += 2 × 3! process 4

rank += 0 × 2! process 0

rank += 0 × 1! process 2

0 { 0, 1, 2, ... 5 } 0
  { 5! }

1 { 5! }

2 { 5! }