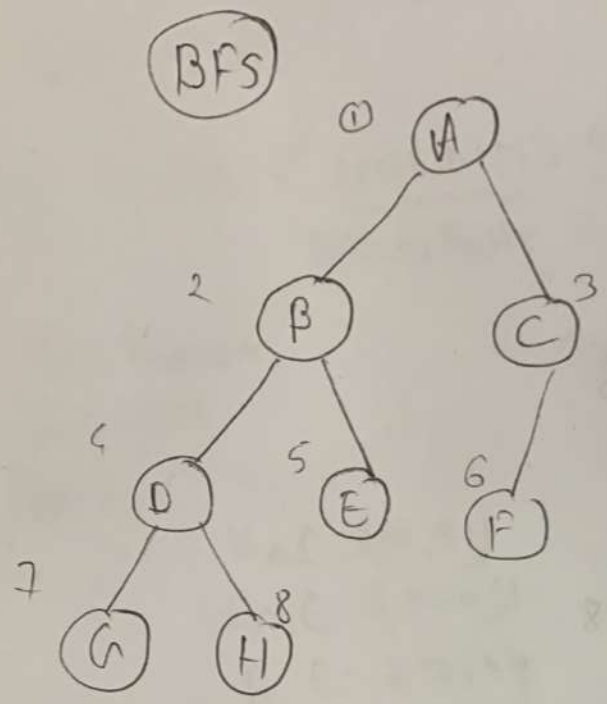
Search Algorithms



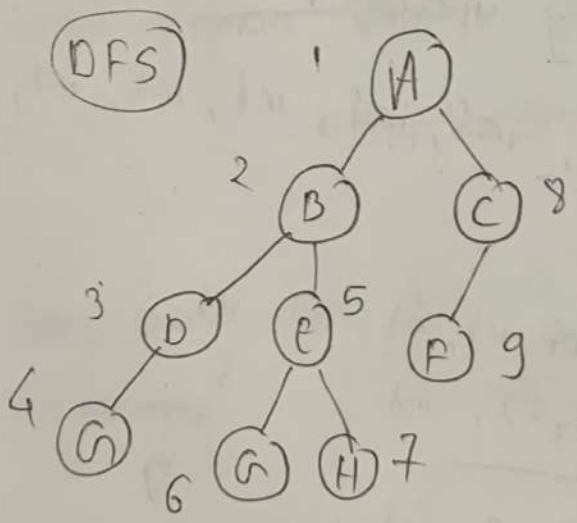
queue

[~~A~~ B C]

[D E F]

[G H]

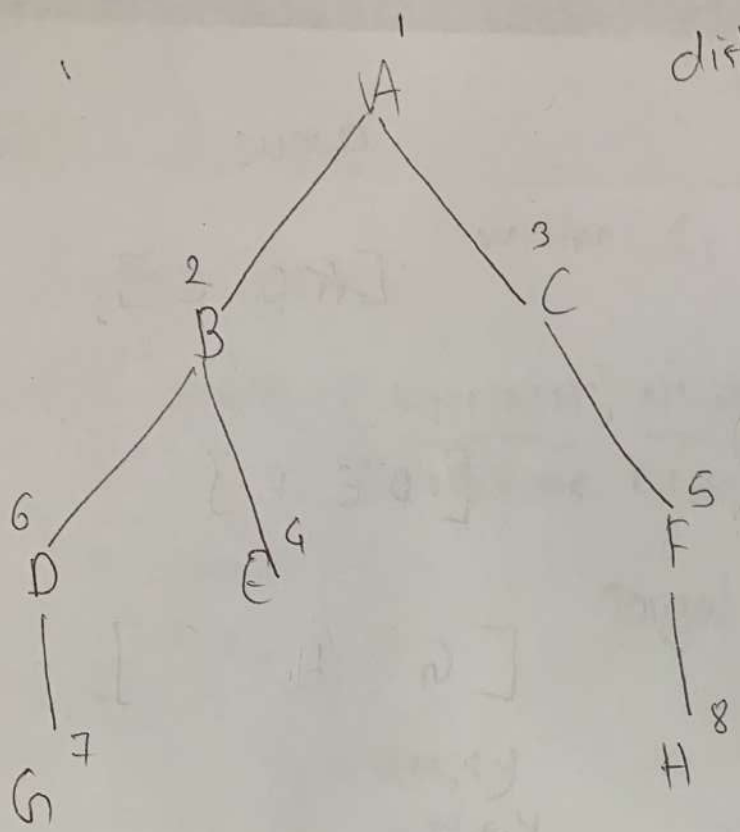
[ ]



Pre-order Traversal with stack.

Uniform cost search

(1)



distance = [0, 2, 4, 7, 6, 6, 10, 14]

---

distance array update:

d = [0, inf, inf, inf, inf, inf, inf, inf]

q = [(0, A)]

---

d = [0, 2, 4, inf, inf, inf, inf, inf]

q = [(2, B), (4, C), inf ... 3

---

d = [0, 2, 4, 7, 3, inf ... 7

q = [(3, E), (4, C), (7, D)]

---

d = [0, 2, 4, 7, 3, inf, 12, 13]

q = [(4, C), (7, D), (12, G), (13, H)]

---

d = [0, 2, 4, 7, 3, 6, 12, 13]

q = [(7, D), (12, G), (13, H)] and so-on.

9

(a)

mitten = C_1

Various cat

Starting state [NNNNIN ; NNNNNN ; N]
$H_1 H_2 H_3 H_4 H_5$ $C_1 C_2 C_3 C_4 C_5$ B

$H_1 \ldots H_n$ = Human
$C_1 \ldots C_n$ = cat
B = Boat.

Target = [sssss ; sssss ; s].

$H_n \in \{N, s Y\}$
$C_n \in \{N, s Y\}$
$B \in \{N, s Y\}$

Total = 16.

(1) ~~send Human Alone~~ : send mittens Alone (C1)

~~{H1, H2, H3, H4, H5,~~ C
[N NNNIN , S NNNIN , S]

(2) send owner and cat : 5

example: [S NNNIN , S NNNIN ; S]
for all i = 1 to 5.

(3) send mittens + 2 others : 6.

example: [NNNNNN ; N SSSNN ; S]

Include mitten! Chose 2 cats in different positions

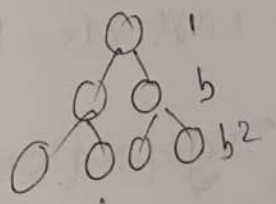
(4) send mitten + one cat (C4)

Example: [NNNNNN ; SS NNN ; S]
for q = 1 to 4, S[3] = S and S[0] = S.

(3)

Branching

(1) BFS



BFS expands total = $1+b+b^2 \cdots b^d$

$= \frac{1 \cdot b^{d+1} - 1}{b-1}$

Nodes created: when expanding nodes at d, BFS generates their children at d+1.

total = $1+b+b^2 \cdots b^d + b^{d+1}$

$= \frac{b^{d+2} - 1}{b-1}$

(2.1) Iterative Deepening . . Expanded . . .

Total nodes upto depth l = $\frac{b^{d+1} - 1}{b-1}$

Hence, Total across all iterations

$$\sum_{l=0}^{d} \frac{b^{d+1} - 1}{b-1} = \frac{1}{b-1}\left(\frac{b^{d+2} - b}{b-1} - (d+1)\right)$$

(2.2) created . . same as above, a node is created when it's generated as a child.

(3.1) $b = 10$, $d = 5$

Nodes expanded $= \frac{10^6 - 1}{9} \approx 10^{10}$.

Created $= \frac{10^7 - 1}{9} \approx 10^{12}$

Time $= 10^{10}$ ms $\approx$ 117 days

Memory $\approx$ 101 TB

Iterative.

expanded/created $= \sum_{1}^{5} 10 \cdot \frac{10^{L+1} - 1}{9} \approx 10^{10}$

Time $\approx$ 118 days

Memory $= (d+1) \times 10 \approx 60$ bytes

(3.2) BFS...

expanded $\frac{5^{101} - 1}{4} \approx 10^{70}$

Created $= \frac{5^{102} - 1}{4} \approx 10^{70}$.

Time $= 10^{59}$ years, memory $\approx 10^{72}$ bytes.

(4) Iterative deepening: nodes $\sum_{1}^{5} \frac{5^{L+1} - 1}{4} \approx 10^{70}$.

Time $= 10^{59}$ years; space $= (d+1) \times 10$ bytes $= 10$ KB. (5)