Problem 7
Depth First Iterative Deepening (DFID-C)

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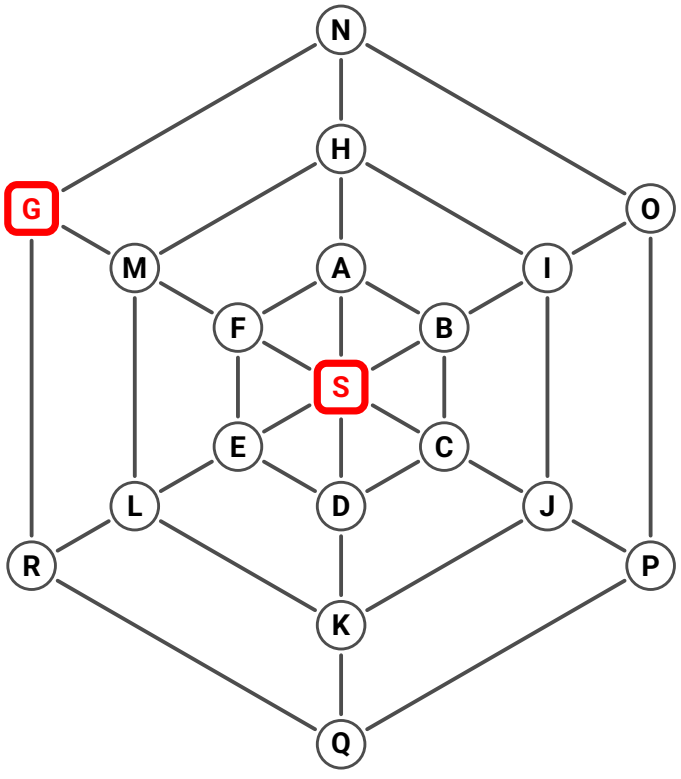
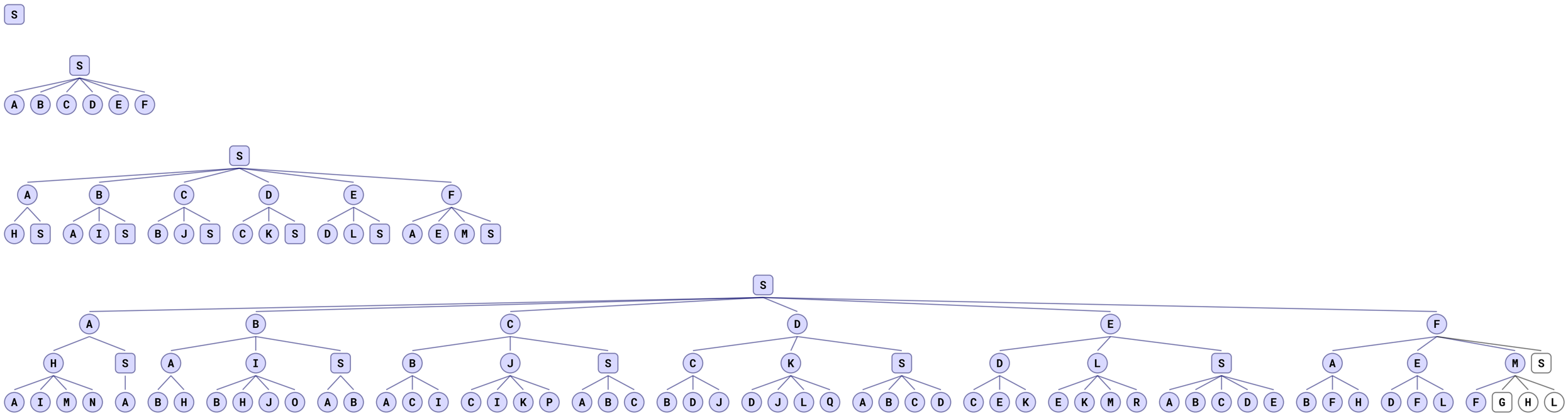
State Space



MoveGen returns nodes in ALPHABETICAL order.

```
S -> A,B,C,D,E,F
A -> B,F,H,S
B -> A,C,I,S
C -> B,D,J,S
D -> C,E,K,S
E -> D,F,L,S
F -> A,E,M,S
H -> A,I,M,N
I -> B,H,J,O
J -> C,I,K,P
K -> D,J,L,Q
L -> E,K,M,R
M -> F,G,H,L
N -> G,H,O
O -> I,N,P
P -> J,O,Q
Q -> K,P,R
R -> G,L,Q
G -> M,N,R
```

DFID-C Search Trees (d=0,1,2,3)



DFID-C Solution

The solution provided below is based on the DFID-C algorithm published in the Week 2 Notes.

```
OPEN and CLOSED carry triples: (NODE,PARENT,DEPTH)

***[DEPTH BOUND = 0]***

OPEN        (S,null,0):[]
CLOSED      []

1.
NODE        S
close       (S,null,0)

OPEN        []
CLOSED      (S,null,0):[]


***[DEPTH BOUND = 1]***

OPEN        (S,null,0):[]
CLOSED      []

1.
NODE        S
close       (S,null,0)
moveGen     A:B:C:D:E:F:[]
newNodes    A:B:C:D:E:F:[]
newPairs    (A,S,1):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]

OPEN        (A,S,1):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]
CLOSED      (S,null,0):[]

2.
NODE        A
close       (A,S,1)

OPEN        (B,S,1):(C,S,1):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (A,S,1):(S,null,0):[]

3.
NODE        B
close       (B,S,1)

OPEN        (C,S,1):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (B,S,1):(A,S,1):(S,null,0):[]

4.
NODE        C
close       (C,S,1)

OPEN        (D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (C,S,1):(B,S,1):(A,S,1):(S,null,0):[]

5.
NODE        D
close       (D,S,1)

OPEN        (E,S,1):(F,S,1):[]
CLOSED      (D,S,1):(C,S,1):(B,S,1):(A,S,1):(S,null,0):[]

6.
NODE        E
close       (E,S,1)

OPEN        (F,S,1):[]
CLOSED      (E,S,1):(D,S,1):(C,S,1):(B,S,1):(A,S,1):
            (S,null,0):[]

7.
NODE        F
close       (F,S,1)

OPEN        []
CLOSED      (F,S,1):(E,S,1):(D,S,1):(C,S,1):(B,S,1):
            (A,S,1):(S,null,0):[]


***[DEPTH BOUND = 2]***

OPEN        (S,null,0):[]
CLOSED      []

1.
NODE        S
close       (S,null,0)
moveGen     A:B:C:D:E:F:[]
newNodes    A:B:C:D:E:F:[]
newPairs    (A,S,1):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]

OPEN        (A,S,1):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]
CLOSED      (S,null,0):[]

2.
NODE        A
close       (A,S,1)
moveGen     B:F:H:S:[]
newNodes    H:S:[]
newPairs    (H,A,2):(S,A,2):[]

OPEN        (H,A,2):(S,A,2):(B,S,1):(C,S,1):(D,S,1):
            (E,S,1):(F,S,1):[]
CLOSED      (A,S,1):(S,null,0):[]

3.
NODE        H
close       (H,A,2)

OPEN        (S,A,2):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]
CLOSED      (H,A,2):(A,S,1):(S,null,0):[]

4.
NODE        S
close       (S,A,2)

OPEN        (B,S,1):(C,S,1):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

5.
NODE        B
close       (B,S,1)
moveGen     A:C:I:S:[]
newNodes    A:I:S:[]
newPairs    (A,B,2):(I,B,2):(S,B,2):[]

OPEN        (A,B,2):(I,B,2):(S,B,2):(C,S,1):(D,S,1):
            (E,S,1):(F,S,1):[]
CLOSED      (B,S,1):(S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

6.
NODE        A
close       (A,B,2)

OPEN        (I,B,2):(S,B,2):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]
CLOSED      (A,B,2):(B,S,1):(S,A,2):(H,A,2):
            (S,null,0):[]

7.
NODE        I
close       (I,B,2)

OPEN        (S,B,2):(C,S,1):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (I,B,2):(A,B,2):(B,S,1):(S,A,2):(H,A,2):
            (A,S,1):(S,null,0):[]

8.
NODE        S
close       (S,B,2)

OPEN        (C,S,1):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (S,B,2):(I,B,2):(A,B,2):(B,S,1):(S,A,2):
            (H,A,2):(A,S,1):(S,null,0):[]

9.
NODE        C
close       (C,S,1)
moveGen     B:D:J:S:[]
newNodes    B:J:S:[]
newPairs    (B,C,2):(J,C,2):(S,C,2):[]

OPEN        (B,C,2):(J,C,2):(S,C,2):(D,S,1):(E,S,1):
            (F,S,1):[]
CLOSED      (C,S,1):(S,B,2):(I,B,2):(A,B,2):(B,S,1):
            (S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

10.
NODE        B
close       (B,C,2)

OPEN        (J,C,2):(S,C,2):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (B,C,2):(C,S,1):(S,B,2):(I,B,2):(A,B,2):
            (B,S,1):(S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

11.
NODE        J
close       (J,C,2)

OPEN        (S,C,2):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (J,C,2):(B,C,2):(C,S,1):(S,B,2):(I,B,2):
            (A,B,2):(B,S,1):(S,A,2):(H,A,2):(A,S,1):
            (S,null,0):[]

12.
NODE        S
close       (S,C,2)

OPEN        (D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (S,C,2):(J,C,2):(B,C,2):(C,S,1):(S,B,2):
            (I,B,2):(A,B,2):(B,S,1):(S,A,2):(H,A,2):
            (A,S,1):(S,null,0):[]

13.
NODE        D
close       (D,S,1)
moveGen     C:E:K:S:[]
newNodes    C:K:S:[]
newPairs    (C,D,2):(K,D,2):(S,D,2):[]

OPEN        (C,D,2):(K,D,2):(S,D,2):(E,S,1):(F,S,1):[]
CLOSED      (D,S,1):(S,C,2):(J,C,2):(B,C,2):(C,S,1):
            (S,B,2):(I,B,2):(A,B,2):(B,S,1):(S,A,2):
            (H,A,2):(A,S,1):(S,null,0):[]

14.
NODE        C
close       (C,D,2)

OPEN        (K,D,2):(S,D,2):(E,S,1):(F,S,1):[]
CLOSED      (C,D,2):(D,S,1):(S,C,2):(J,C,2):(B,C,2):
            (C,S,1):(S,B,2):(I,B,2):(A,B,2):(B,S,1):
            (S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

15.
NODE        K
close       (K,D,2)

OPEN        (S,D,2):(E,S,1):(F,S,1):[]
CLOSED      (K,D,2):(C,D,2):(D,S,1):(S,C,2):(J,C,2):
            (B,C,2):(C,S,1):(S,B,2):(I,B,2):(A,B,2):
            (B,S,1):(S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

16.
NODE        S
close       (S,D,2)

OPEN        (E,S,1):(F,S,1):[]
CLOSED      (S,D,2):(K,D,2):(C,D,2):(D,S,1):(S,C,2):
            (J,C,2):(B,C,2):(C,S,1):(S,B,2):(I,B,2):
            (A,B,2):(B,S,1):(S,A,2):(H,A,2):(A,S,1):
            (S,null,0):[]

17.
NODE        E
close       (E,S,1)
moveGen     D:F:L:S:[]
newNodes    D:L:S:[]
newPairs    (D,E,2):(L,E,2):(S,E,2):[]

OPEN        (D,E,2):(L,E,2):(S,E,2):(F,S,1):[]
CLOSED      (E,S,1):(S,D,2):(K,D,2):(C,D,2):(D,S,1):
            (S,C,2):(J,C,2):(B,C,2):(C,S,1):(S,B,2):
            (I,B,2):(A,B,2):(B,S,1):(S,A,2):(H,A,2):
            (A,S,1):(S,null,0):[]

18.
NODE        D
close       (D,E,2)

OPEN        (L,E,2):(S,E,2):(F,S,1):[]
CLOSED      (D,E,2):(E,S,1):(S,D,2):(K,D,2):(C,D,2):
            (D,S,1):(S,C,2):(J,C,2):(B,C,2):(C,S,1):
            (S,B,2):(I,B,2):(A,B,2):(B,S,1):(S,A,2):
            (H,A,2):(A,S,1):(S,null,0):[]

19.
NODE        L
close       (L,E,2)

OPEN        (S,E,2):(F,S,1):[]
CLOSED      (L,E,2):(D,E,2):(E,S,1):(S,D,2):(K,D,2):
            (C,D,2):(D,S,1):(S,C,2):(J,C,2):(B,C,2):
            (C,S,1):(S,B,2):(I,B,2):(A,B,2):(B,S,1):
            (S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

20.
NODE        S
close       (S,E,2)

OPEN        (F,S,1):[]
CLOSED      (S,E,2):(L,E,2):(D,E,2):(E,S,1):(S,D,2):
            (K,D,2):(C,D,2):(D,S,1):(S,C,2):(J,C,2):
            (B,C,2):(C,S,1):(S,B,2):(I,B,2):(A,B,2):
            (B,S,1):(S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

21.
NODE        F
close       (F,S,1)
moveGen     A:E:M:S:[]
newNodes    A:E:M:S:[]
newPairs    (A,F,2):(E,F,2):(M,F,2):(S,F,2):[]

OPEN        (A,F,2):(E,F,2):(M,F,2):(S,F,2):[]
CLOSED      (F,S,1):(S,E,2):(L,E,2):(D,E,2):(E,S,1):
            (S,D,2):(K,D,2):(C,D,2):(D,S,1):(S,C,2):
            (J,C,2):(B,C,2):(C,S,1):(S,B,2):(I,B,2):
            (A,B,2):(B,S,1):(S,A,2):(H,A,2):(A,S,1):
            (S,null,0):[]

22.
NODE        A
close       (A,F,2)

OPEN        (E,F,2):(M,F,2):(S,F,2):[]
CLOSED      (A,F,2):(F,S,1):(S,E,2):(L,E,2):(D,E,2):
            (E,S,1):(S,D,2):(K,D,2):(C,D,2):(D,S,1):
            (S,C,2):(J,C,2):(B,C,2):(C,S,1):(S,B,2):
            (I,B,2):(A,B,2):(B,S,1):(S,A,2):(H,A,2):
            (A,S,1):(S,null,0):[]

23.
NODE        E
close       (E,F,2)

OPEN        (M,F,2):(S,F,2):[]
CLOSED      (E,F,2):(A,F,2):(F,S,1):(S,E,2):(L,E,2):
            (D,E,2):(E,S,1):(S,D,2):(K,D,2):(C,D,2):
            (D,S,1):(S,C,2):(J,C,2):(B,C,2):(C,S,1):
            (S,B,2):(I,B,2):(A,B,2):(B,S,1):(S,A,2):
            (H,A,2):(A,S,1):(S,null,0):[]

24.
NODE        M
close       (M,F,2)

OPEN        (S,F,2):[]
CLOSED      (M,F,2):(E,F,2):(A,F,2):(F,S,1):(S,E,2):
            (L,E,2):(D,E,2):(E,S,1):(S,D,2):(K,D,2):
            (C,D,2):(D,S,1):(S,C,2):(J,C,2):(B,C,2):
            (C,S,1):(S,B,2):(I,B,2):(A,B,2):(B,S,1):
            (S,A,2):(H,A,2):(A,S,1):(S,null,0):[]

25.
NODE        S
close       (S,F,2)

OPEN        []
CLOSED      (S,F,2):(M,F,2):(E,F,2):(A,F,2):(F,S,1):
            (S,E,2):(L,E,2):(D,E,2):(E,S,1):(S,D,2):
            (K,D,2):(C,D,2):(D,S,1):(S,C,2):(J,C,2):
            (B,C,2):(C,S,1):(S,B,2):(I,B,2):(A,B,2):
            (B,S,1):(S,A,2):(H,A,2):(A,S,1):(S,null,0):[]


***[DEPTH BOUND = 3]***

OPEN        (S,null,0):[]
CLOSED      []

1.
NODE        S
close       (S,null,0)
moveGen     A:B:C:D:E:F:[]
newNodes    A:B:C:D:E:F:[]
newPairs    (A,S,1):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]

OPEN        (A,S,1):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]
CLOSED      (S,null,0):[]

2.
NODE        A
close       (A,S,1)
moveGen     B:F:H:S:[]
newNodes    H:S:[]
newPairs    (H,A,2):(S,A,2):[]

OPEN        (H,A,2):(S,A,2):(B,S,1):(C,S,1):(D,S,1):
            (E,S,1):(F,S,1):[]
CLOSED      (A,S,1):(S,null,0):[]

3.
NODE        H
close       (H,A,2)
moveGen     A:I:M:N:[]
newNodes    A:I:M:N:[]
newPairs    (A,H,3):(I,H,3):(M,H,3):(N,H,3):[]

OPEN        (A,H,3):(I,H,3):(M,H,3):(N,H,3):(S,A,2):
            (B,S,1):(C,S,1):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (H,A,2):(A,S,1):(S,null,0):[]

4.
NODE        A
close       (A,H,3)

OPEN        (I,H,3):(M,H,3):(N,H,3):(S,A,2):(B,S,1):
            (C,S,1):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (A,H,3):(H,A,2):(A,S,1):(S,null,0):[]

5.
NODE        I
close       (I,H,3)

OPEN        (M,H,3):(N,H,3):(S,A,2):(B,S,1):(C,S,1):
            (D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (I,H,3):(A,H,3):(H,A,2):(A,S,1):(S,null,0):[]

6.
NODE        M
close       (M,H,3)

OPEN        (N,H,3):(S,A,2):(B,S,1):(C,S,1):(D,S,1):
            (E,S,1):(F,S,1):[]
CLOSED      (M,H,3):(I,H,3):(A,H,3):(H,A,2):(A,S,1):
            (S,null,0):[]

7.
NODE        N
close       (N,H,3)

OPEN        (S,A,2):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]
CLOSED      (N,H,3):(M,H,3):(I,H,3):(A,H,3):(H,A,2):
            (A,S,1):(S,null,0):[]

8.
NODE        S
close       (S,A,2)
moveGen     A:B:C:D:E:F:[]
newNodes    A:[]
newPairs    (A,S,3):[]

OPEN        (A,S,3):(B,S,1):(C,S,1):(D,S,1):(E,S,1):
            (F,S,1):[]
CLOSED      (S,A,2):(N,H,3):(M,H,3):(I,H,3):(A,H,3):
            (H,A,2):(A,S,1):(S,null,0):[]

9.
NODE        A
close       (A,S,3)

OPEN        (B,S,1):(C,S,1):(D,S,1):(E,S,1):(F,S,1):[]
CLOSED      (A,S,3):(S,A,2):(N,H,3):(M,H,3):(I,H,3):
            (A,H,3):(H,A,2):(A,S,1):(S,null,0):[]

10.
NODE        B
close       (B,S,1)
moveGen     A:C:I:S:[]
newNodes    A:I:S:[]
newPairs    (A,B,2):(I,B,2):(S,B,2):[]

OPEN        (A,B,2):(I,B,2):(S,B,2):(C,S,1):(D,S,1):
            (E,S,1):(F,S,1):[]
CLOSED      (B,S,1):(A,S,3):(S,A,2):(N,H,3):(M,H,3):
            (I,H,3):(A,H,3):(H,A,2):(A,S,1):(S,null,0):[]

...
...
Steps 11 to 75
...
...

76.
NODE        M
close       (M,F,2)
moveGen     F:G:H:L:[]
newNodes    F:G:H:L:[]
newPairs    (F,M,3):(G,M,3):(H,M,3):(L,M,3):[]

OPEN        (F,M,3):(G,M,3):(H,M,3):(L,M,3):(S,F,2):[]
CLOSED      (M,F,2):(L,E,3):(F,E,3):(D,E,3):(E,F,2):
            (H,A,3):(F,A,3):(B,A,3):(A,F,2):(F,S,1):
            (E,S,3):(D,S,3):(C,S,3):(B,S,3):(A,S,3):
            (S,E,2):(R,L,3):(M,L,3):(K,L,3):(E,L,3):
            (L,E,2):(K,D,3):(E,D,3):(C,D,3):(D,E,2):
            (E,S,1):(D,S,3):(C,S,3):(B,S,3):(A,S,3):
            (S,D,2):(Q,K,3):(L,K,3):(J,K,3):(D,K,3):
            (K,D,2):(J,C,3):(D,C,3):(B,C,3):(C,D,2):
            (D,S,1):(C,S,3):(B,S,3):(A,S,3):(S,C,2):
            (P,J,3):(K,J,3):(I,J,3):(C,J,3):(J,C,2):
            (I,B,3):(C,B,3):(A,B,3):(B,C,2):(C,S,1):
            (B,S,3):(A,S,3):(S,B,2):(O,I,3):(J,I,3):
            (H,I,3):(B,I,3):(I,B,2):(H,A,3):(B,A,3):
            (A,B,2):(B,S,1):(A,S,3):(S,A,2):(N,H,3):
            (M,H,3):(I,H,3):(A,H,3):(H,A,2):(A,S,1):
            (S,null,0):[]

77.
NODE        F
close       (F,M,3)

OPEN        (G,M,3):(H,M,3):(L,M,3):(S,F,2):[]
CLOSED      (F,M,3):(M,F,2):(L,E,3):(F,E,3):(D,E,3):
            (E,F,2):(H,A,3):(F,A,3):(B,A,3):(A,F,2):
            (F,S,1):(E,S,3):(D,S,3):(C,S,3):(B,S,3):
            (A,S,3):(S,E,2):(R,L,3):(M,L,3):(K,L,3):
            (E,L,3):(L,E,2):(K,D,3):(E,D,3):(C,D,3):
            (D,E,2):(E,S,1):(D,S,3):(C,S,3):(B,S,3):
            (A,S,3):(S,D,2):(Q,K,3):(L,K,3):(J,K,3):
            (D,K,3):(K,D,2):(J,C,3):(D,C,3):(B,C,3):
            (C,D,2):(D,S,1):(C,S,3):(B,S,3):(A,S,3):
            (S,C,2):(P,J,3):(K,J,3):(I,J,3):(C,J,3):
            (J,C,2):(I,B,3):(C,B,3):(A,B,3):(B,C,2):
            (C,S,1):(B,S,3):(A,S,3):(S,B,2):(O,I,3):
            (J,I,3):(H,I,3):(B,I,3):(I,B,2):(H,A,3):
            (B,A,3):(A,B,2):(B,S,1):(A,S,3):(S,A,2):
            (N,H,3):(M,H,3):(I,H,3):(A,H,3):(H,A,2):
            (A,S,1):(S,null,0):[]

78.
NODE        G
GOAL        G

OPEN        (G,M,3):(H,M,3):(L,M,3):(S,F,2):[]
CLOSED      (F,M,3):(M,F,2):(L,E,3):(F,E,3):(D,E,3):
            (E,F,2):(H,A,3):(F,A,3):(B,A,3):(A,F,2):
            (F,S,1):(E,S,3):(D,S,3):(C,S,3):(B,S,3):
            (A,S,3):(S,E,2):(R,L,3):(M,L,3):(K,L,3):
            (E,L,3):(L,E,2):(K,D,3):(E,D,3):(C,D,3):
            (D,E,2):(E,S,1):(D,S,3):(C,S,3):(B,S,3):
            (A,S,3):(S,D,2):(Q,K,3):(L,K,3):(J,K,3):
            (D,K,3):(K,D,2):(J,C,3):(D,C,3):(B,C,3):
            (C,D,2):(D,S,1):(C,S,3):(B,S,3):(A,S,3):
            (S,C,2):(P,J,3):(K,J,3):(I,J,3):(C,J,3):
            (J,C,2):(I,B,3):(C,B,3):(A,B,3):(B,C,2):
            (C,S,1):(B,S,3):(A,S,3):(S,B,2):(O,I,3):
            (J,I,3):(H,I,3):(B,I,3):(I,B,2):(H,A,3):
            (B,A,3):(A,B,2):(B,S,1):(A,S,3):(S,A,2):
            (N,H,3):(M,H,3):(I,H,3):(A,H,3):(H,A,2):
            (A,S,1):(S,null,0):[]

PATH        S:F:M:G:[]
```