# Problem 7
# Breadth First Search
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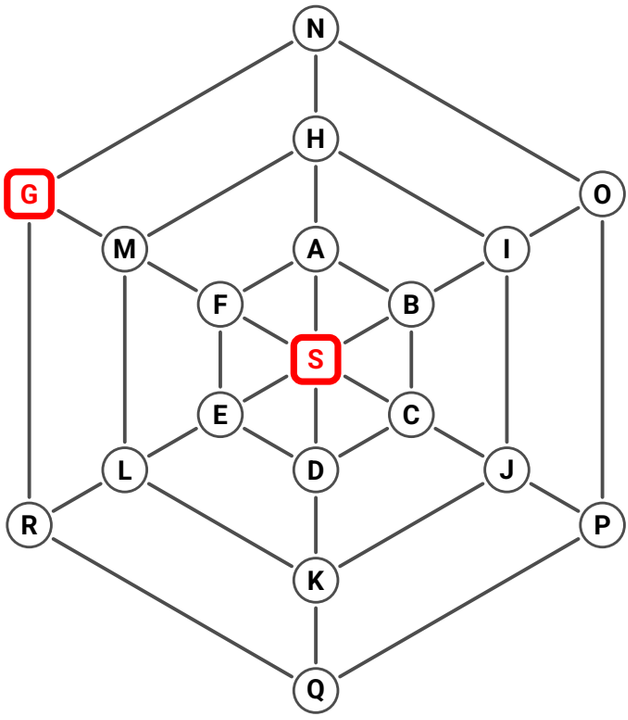
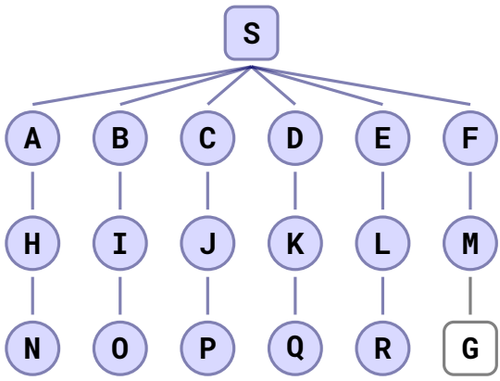
## State Space




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
```

## Breadth First Search – Search Tree



## Breadth First Search – Solution

```
OPEN and CLOSED carry pairs: (NODE,PARENT)

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

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

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

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

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

3.
NODE       B
close      (B,S)
moveGen    A:C:I:S:[]
newNodes   I:[]
newPairs   (I,B):[]

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

4.
NODE       C
close      (C,S)
moveGen    B:D:J:S:[]
newNodes   J:[]
newPairs   (J,C):[]

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

5.
NODE       D
close      (D,S)
moveGen    C:E:K:S:[]
newNodes   K:[]
newPairs   (K,D):[]

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

6.
NODE       E
close      (E,S)
moveGen    D:F:L:S:[]
newNodes   L:[]
newPairs   (L,E):[]

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

7.
NODE       F
close      (F,S)
moveGen    A:E:M:S:[]
newNodes   M:[]
newPairs   (M,F):[]

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

8.
NODE       H
close      (H,A)
moveGen    A:I:M:N:[]
newNodes   N:[]
newPairs   (N,H):[]

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

9.
NODE       I
close      (I,B)
moveGen    B:H:J:O:[]
newNodes   O:[]
newPairs   (O,I):[]

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

10.
NODE       J
close      (J,C)
moveGen    C:I:K:P:[]
newNodes   P:[]
newPairs   (P,J):[]

OPEN       (K,D):(L,E):(M,F):(N,H):(O,I):
           (P,J):[]
CLOSED     (J,C):(I,B):(H,A):(F,S):(E,S):
           (D,S):(C,S):(B,S):(A,S):(S,null):[]

11.
NODE       K
close      (K,D)
moveGen    D:J:L:Q:[]
newNodes   Q:[]
newPairs   (Q,K):[]

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

12.
NODE       L
close      (L,E)
moveGen    E:K:M:R:[]
newNodes   R:[]
newPairs   (R,L):[]

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

13.
NODE       M
close      (M,F)
moveGen    F:G:H:L:[]
newNodes   G:[]
newPairs   (G,M):[]

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

14.
NODE       N
close      (N,H)
moveGen    G:H:O:[]
newNodes   []
newPairs   []

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

15.
NODE       O
close      (O,I)
moveGen    I:N:P:[]
newNodes   []
newPairs   []

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

16.
NODE       P
close      (P,J)
moveGen    J:O:Q:[]
newNodes   []
newPairs   []

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

17.
NODE       Q
close      (Q,K)
moveGen    K:P:R:[]
newNodes   []
newPairs   []

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

18.
NODE       R
close      (R,L)
moveGen    G:L:Q:[]
newNodes   []
newPairs   []

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

19.
NODE       G
GOAL       G

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

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