그래프의 탐색

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탐색 : 모든 정점과 간선을 검사함으로써 그래프를 탐험하는 체계적인 절차

- 수도권 전철망의 모든 역(정점)의 위치를 출력
- 항공사의 모든 항공편(간선)에 대한 노선 정보를 수집

- DFS(깊이 우선 탐색, Depth First Search)
- BFS(너비 우선 탐색, Breath First Search)

DFS 깊이 우선 탐색

‘스택‘ 자료구조를 사용한 그래프 탐색 알고리즘

루트 노드에서 시작하여 다른 분기(Branch)로 넘어가기 전, 현재 탐색중인 분기를 완벽하게 (깊게) 탐색하는 방식

1. 루트 노드를 스택에 넣고 방문처리 한다.
2. 스택 최상단 노드의 인접 노드 중 방문하지 않은 노드 하나를 스택에 넣고 방문처리 한다. 만약 인접 노드를 모두 방문한 경우 스택을 pop한다.
3. 2단계를 더 이상 수행할 수 없을 때 까지 반복한다.

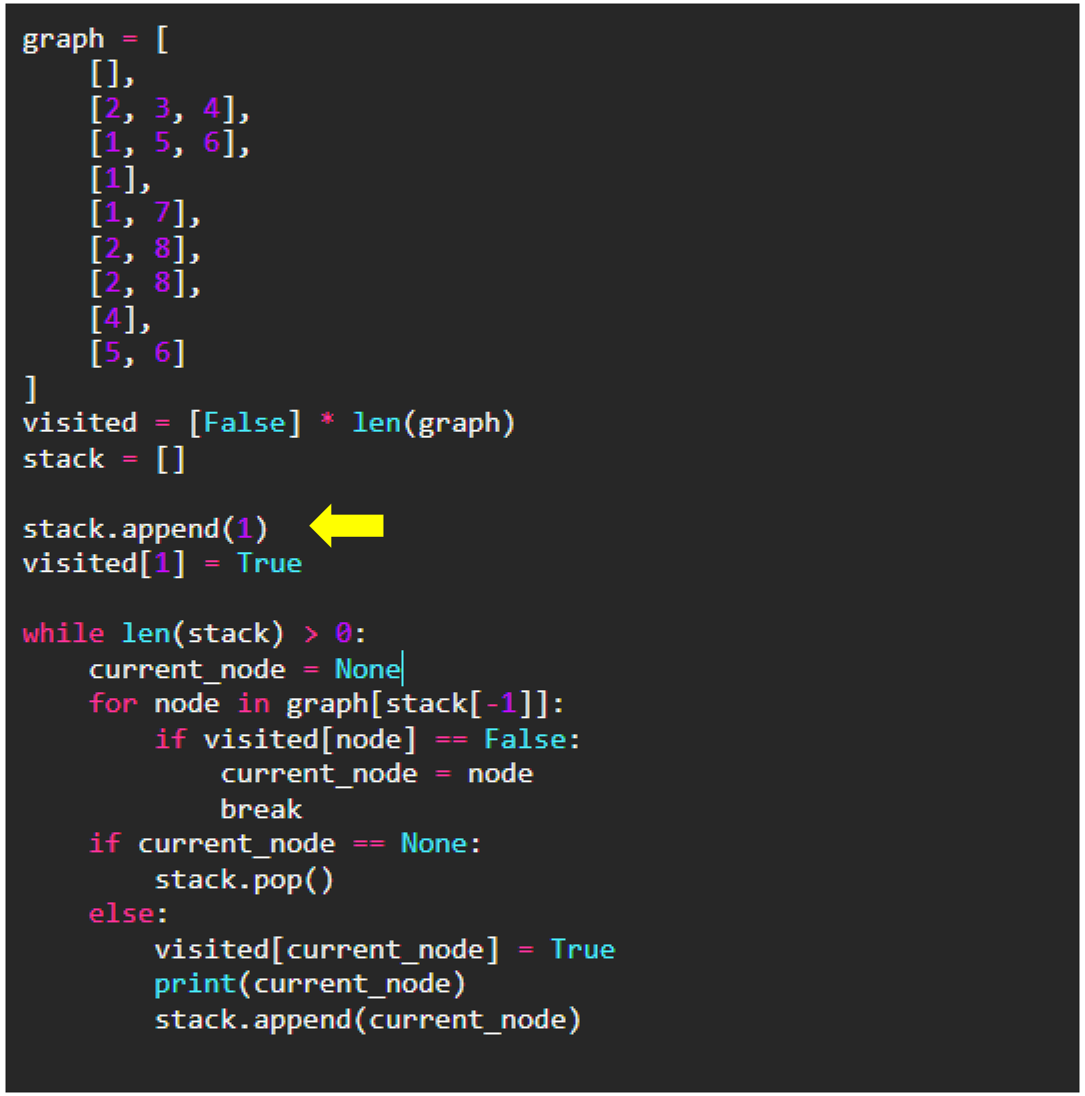
DFS 깊이 우선 탐색

장점

- 현재 경로상의 노드들만 기억하면 되므로, 저장 공간의 수요가 비교적 적음
- 구현이 너비 우선 탐색(BFS) 보다 간단함

단점

- 단순 검색 속도는 너비 우선 탐색(BFS)보다 느림
- 얻어진 해가 최단 경로가 된다는 보장이 없음



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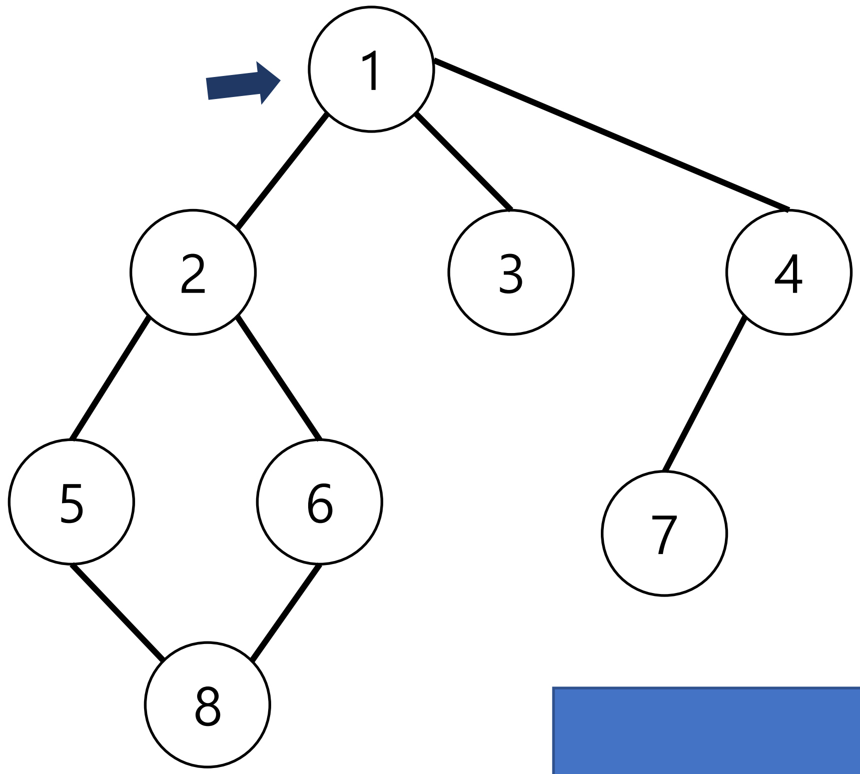

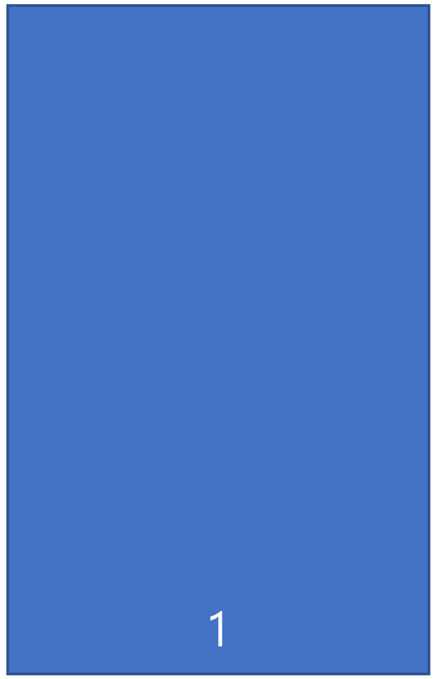

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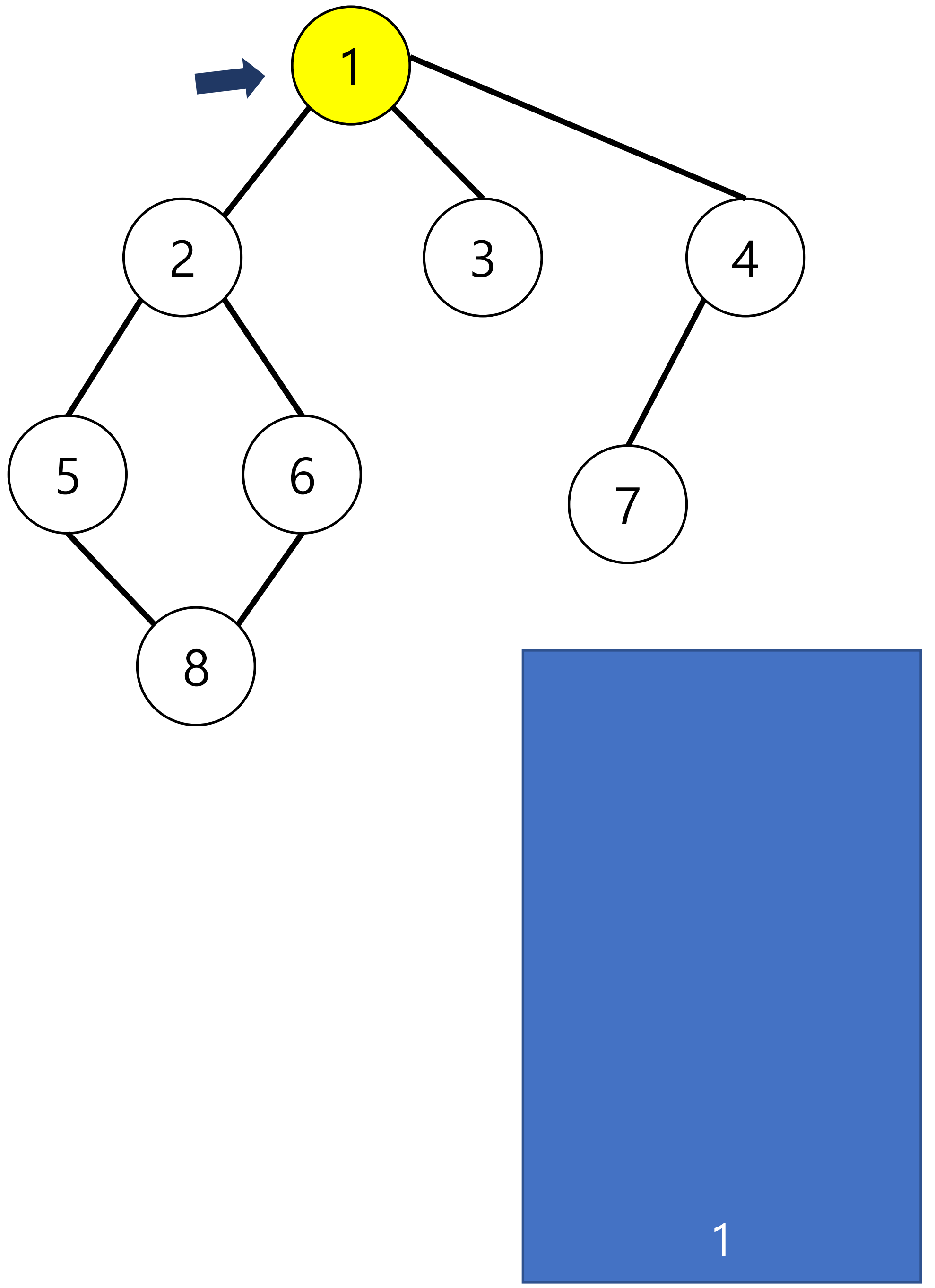

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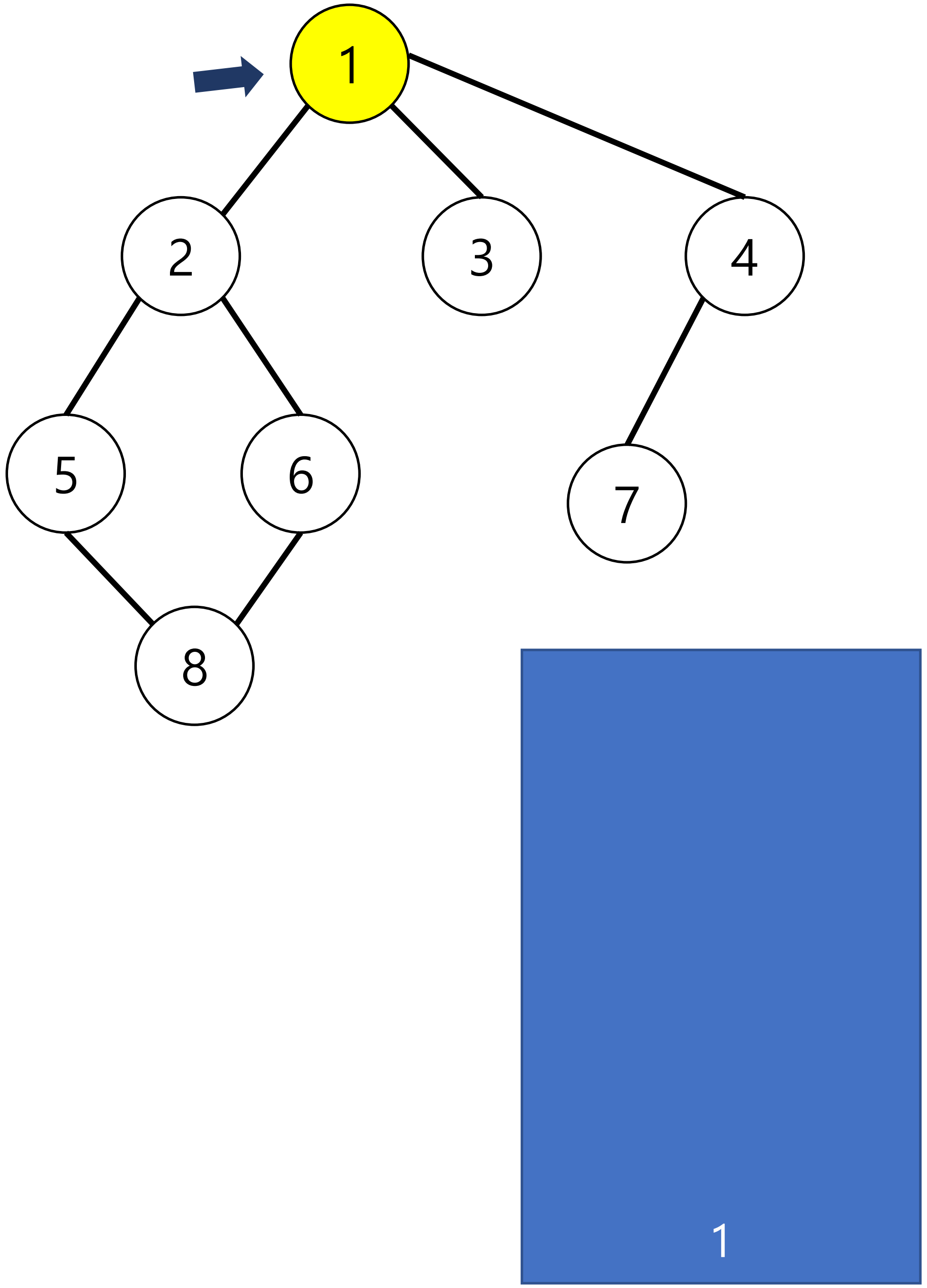

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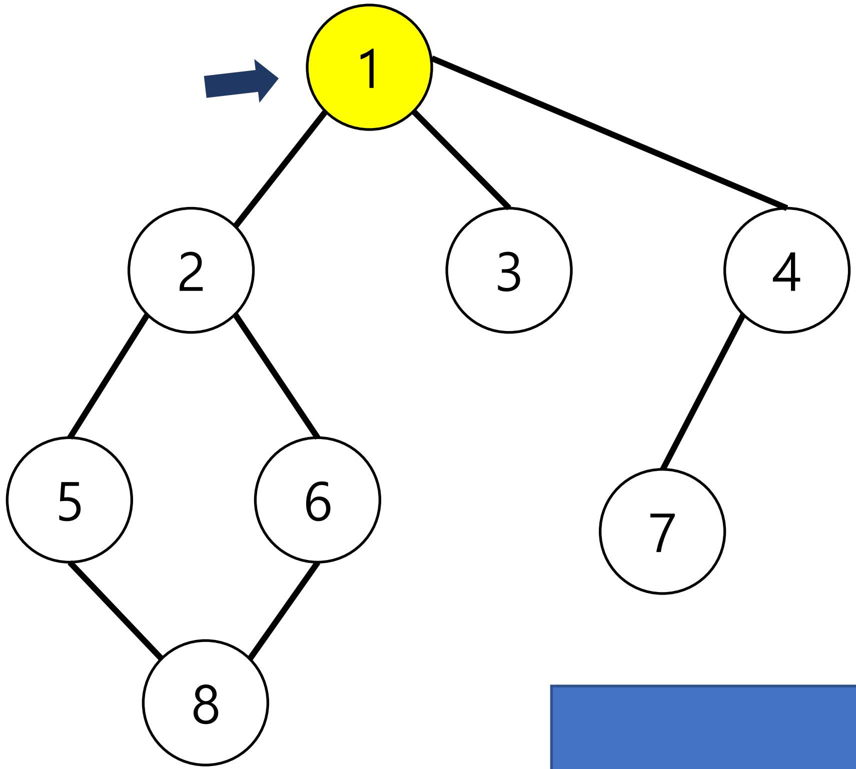
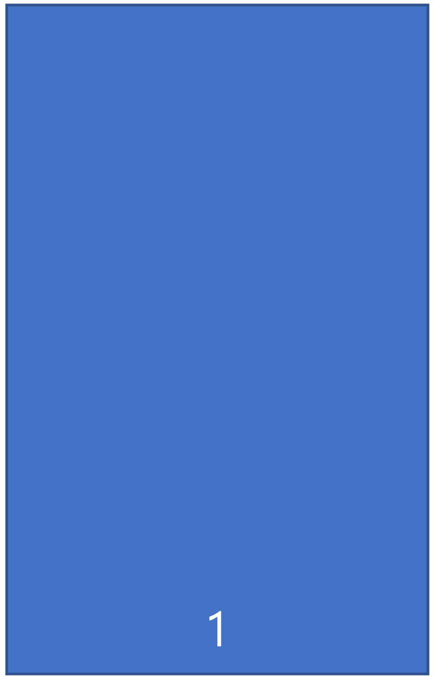
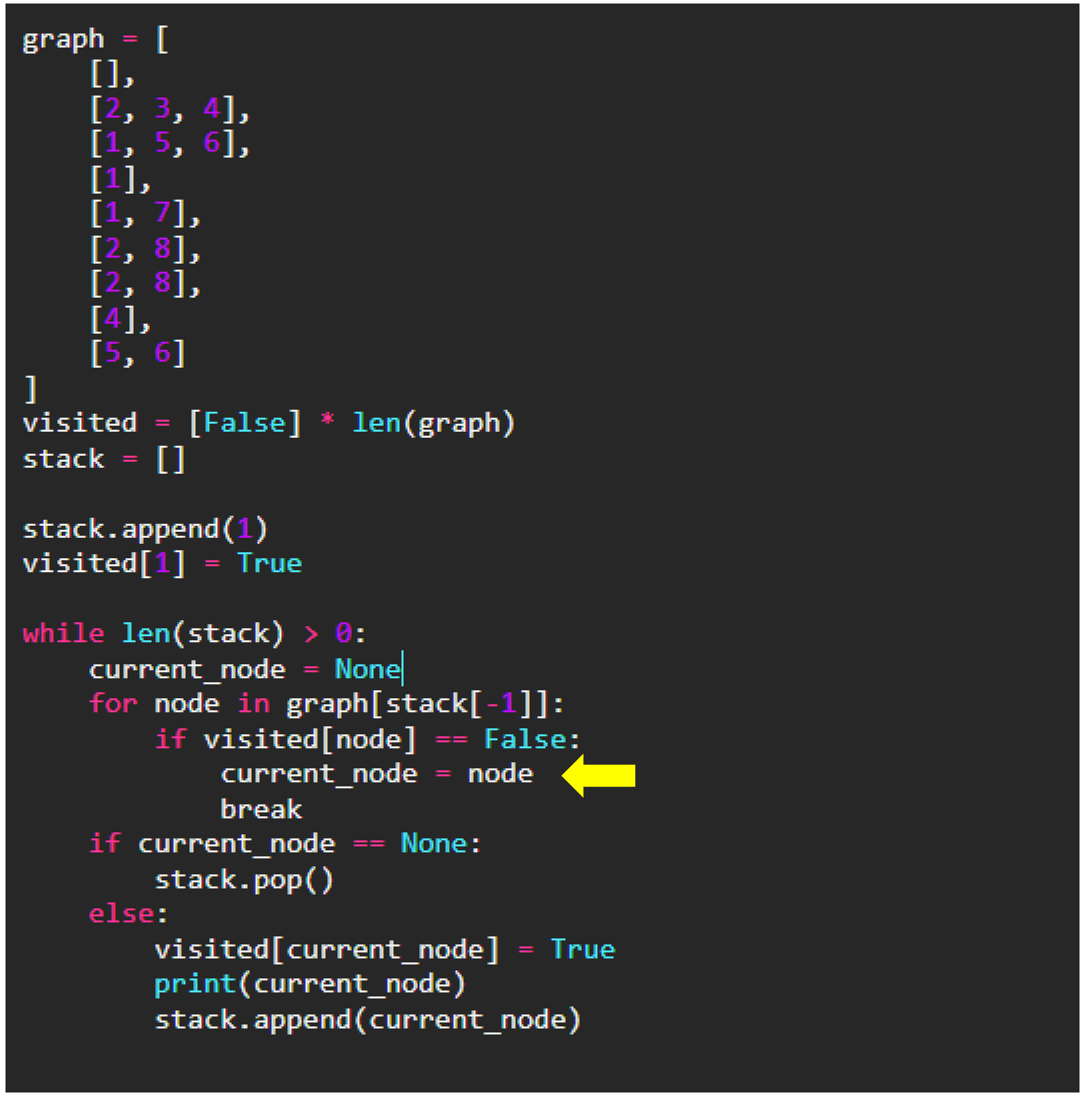
```javascript
for(i=0;i<graph[stack[-1]].length;i++){
    node = graph[stack[-1]][i];
}
```







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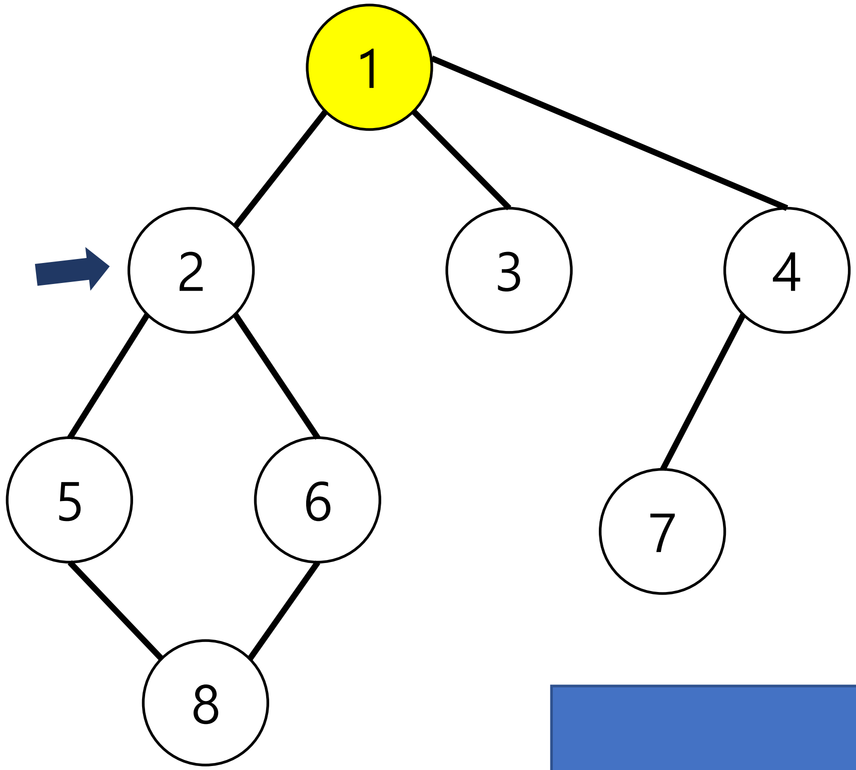

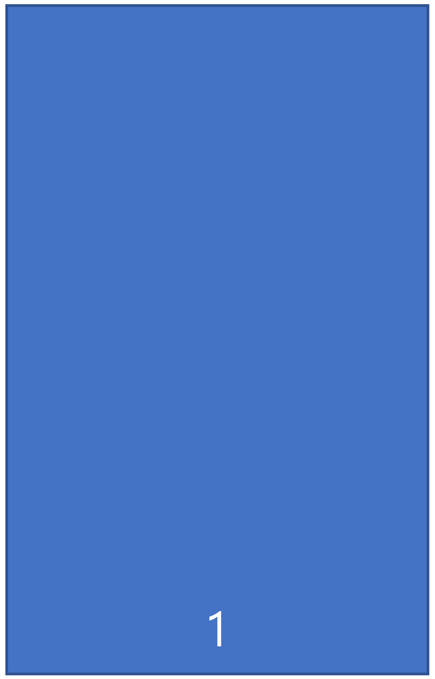

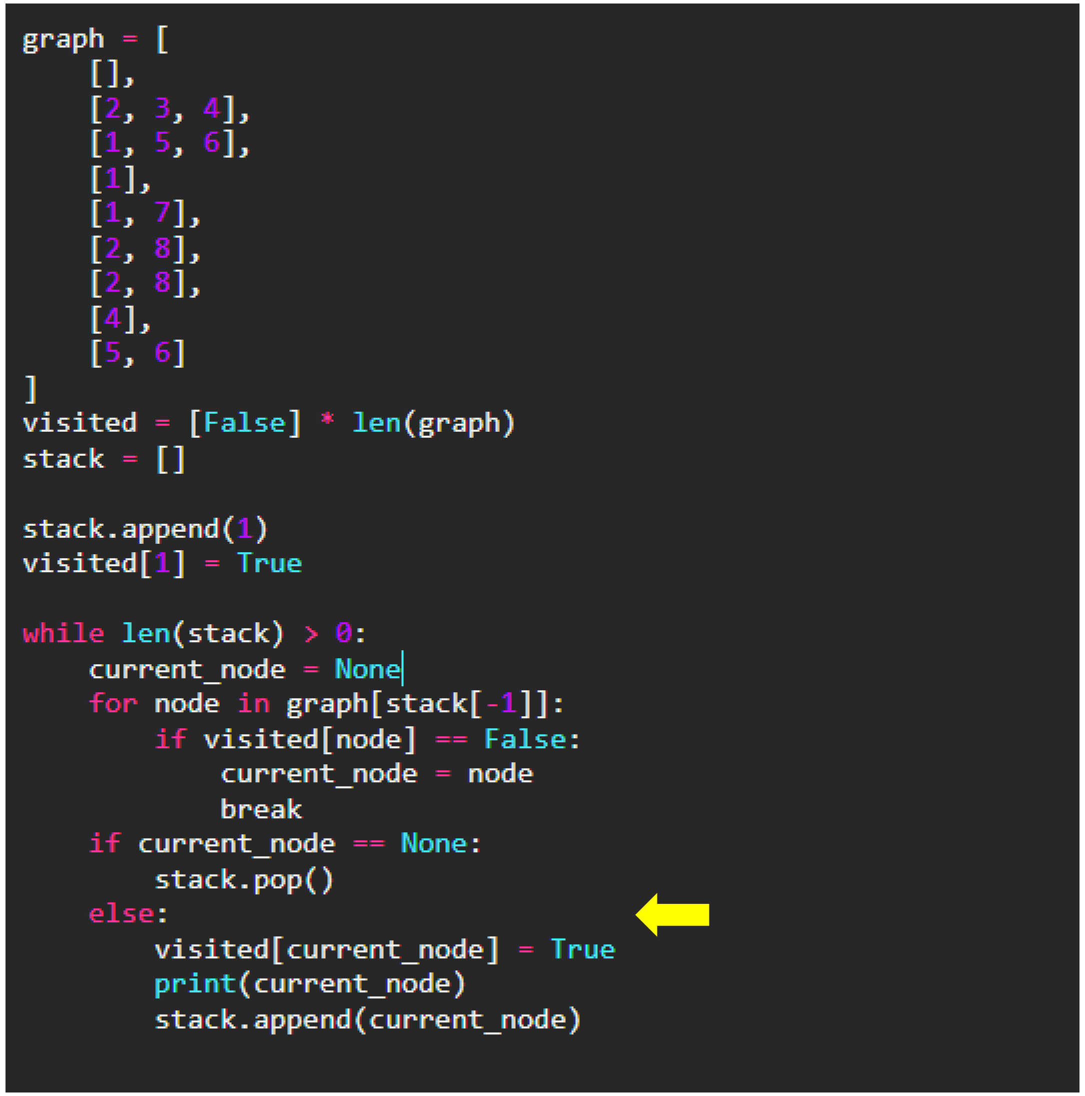

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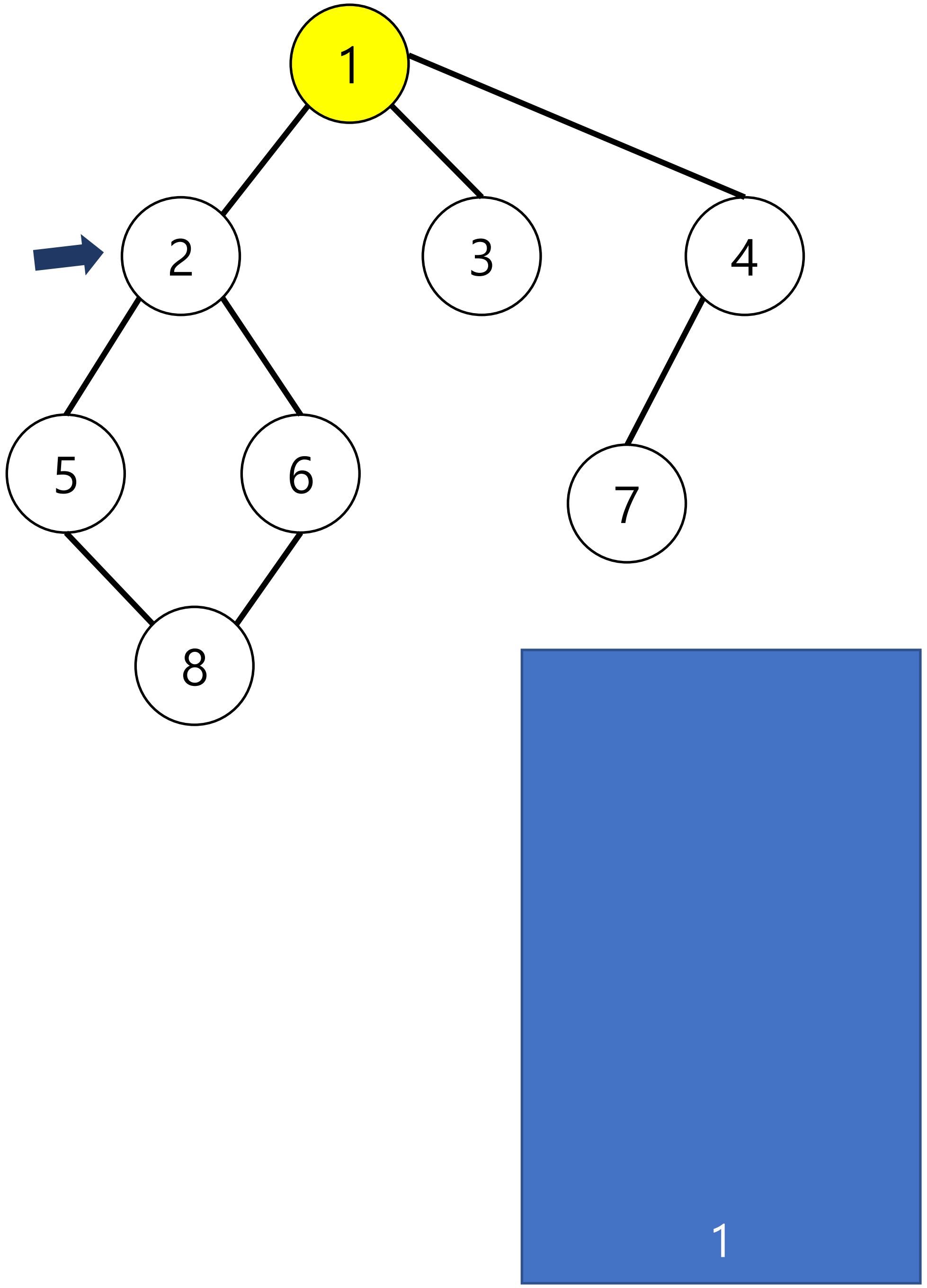

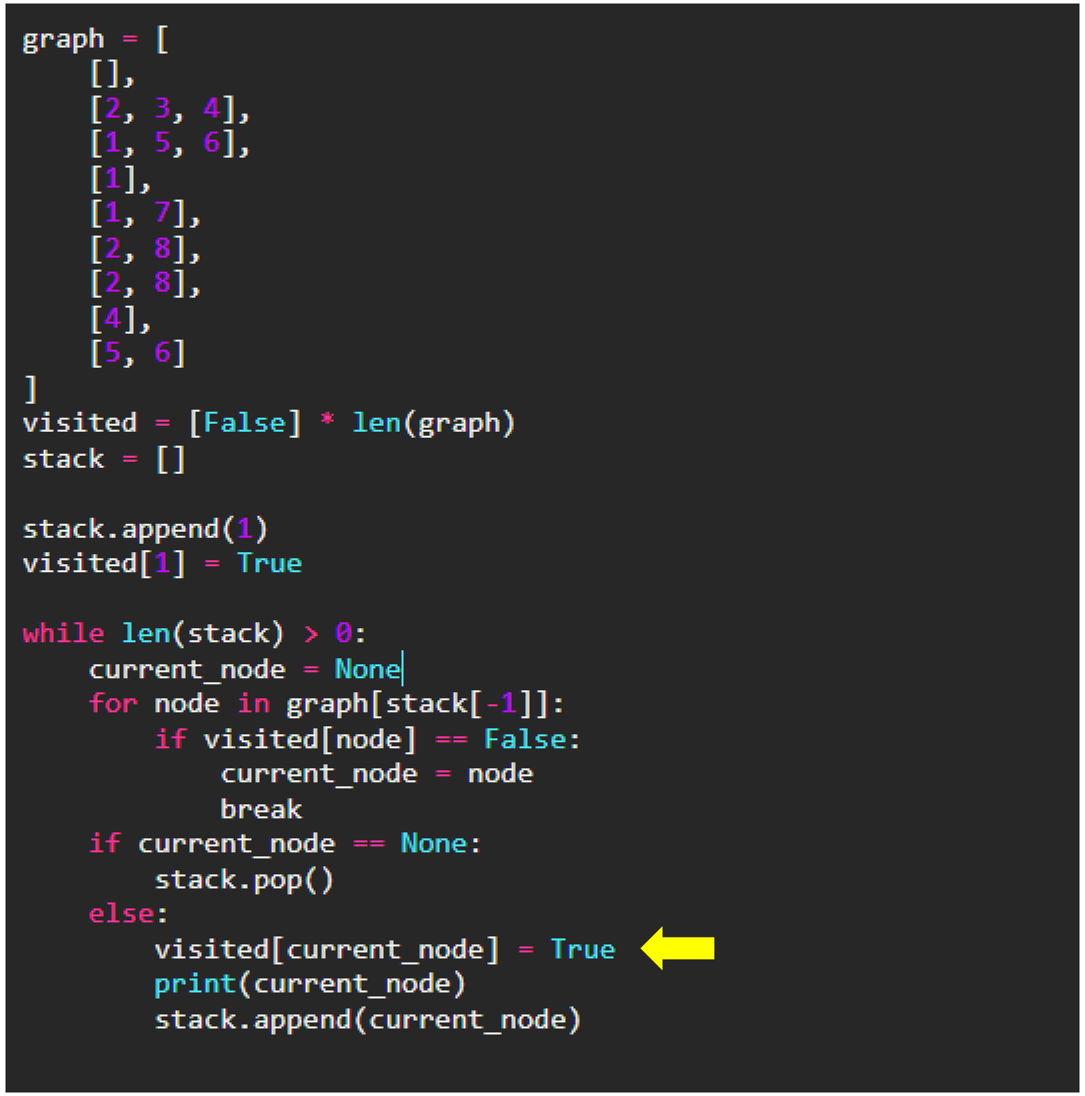

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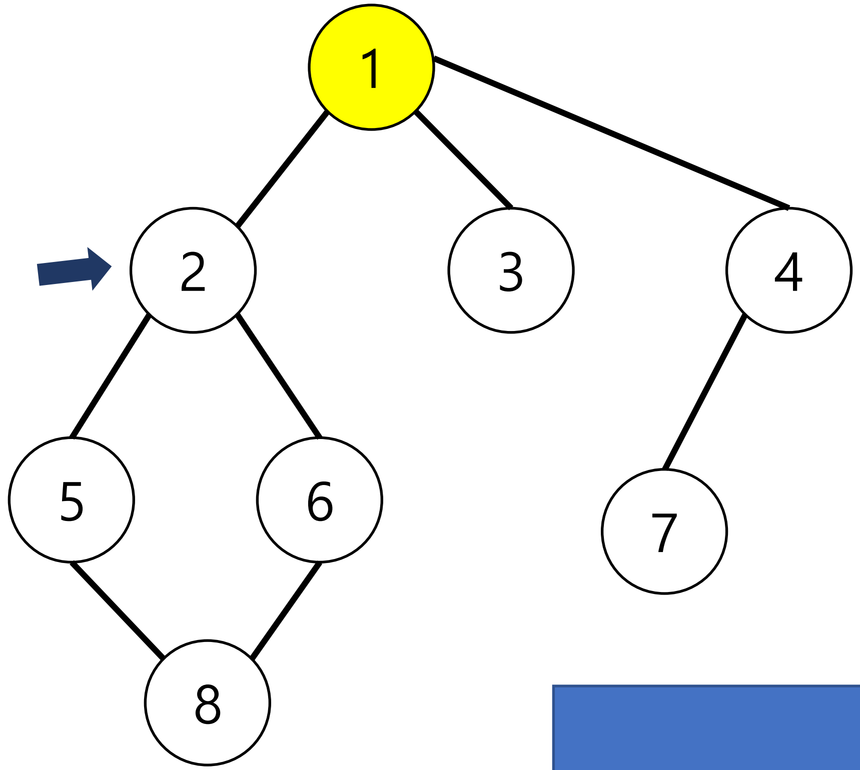

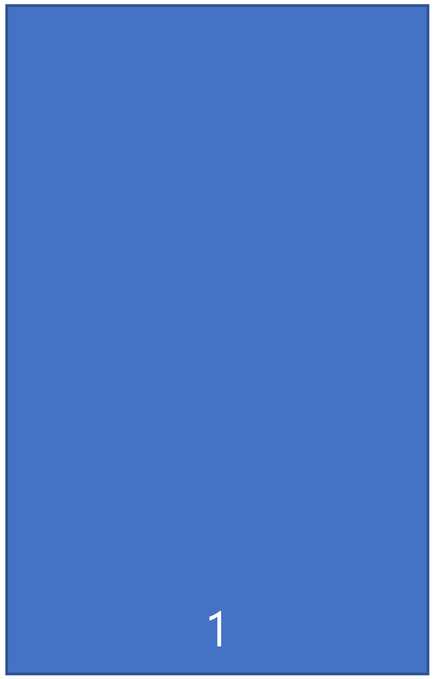

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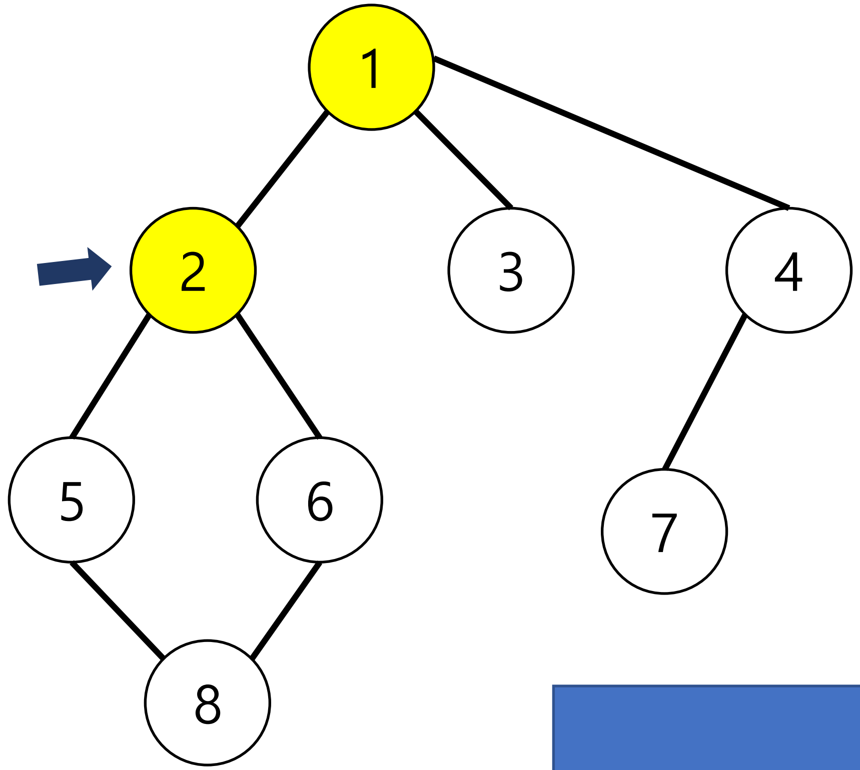

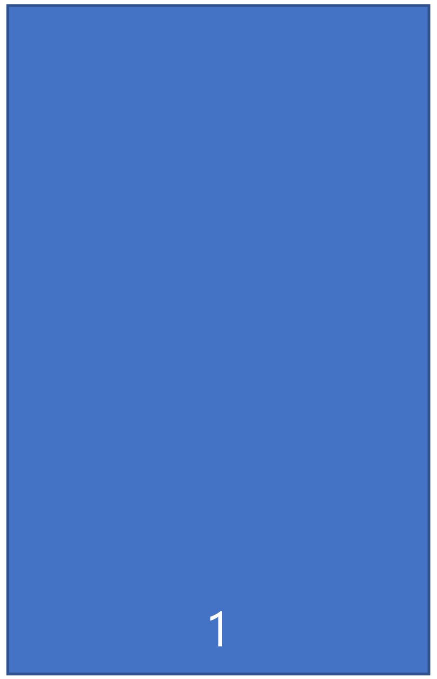

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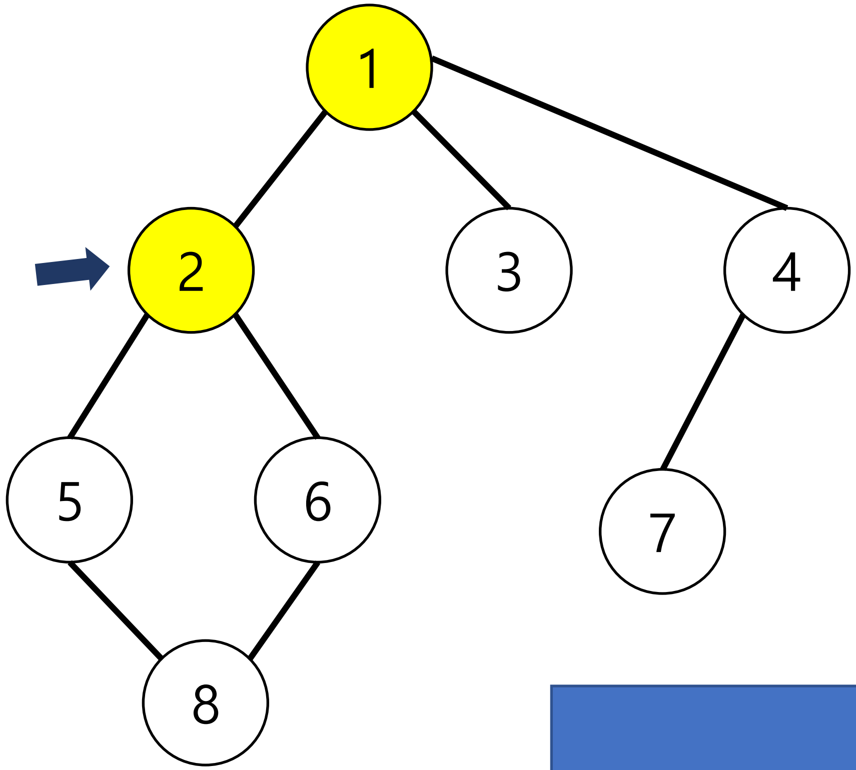

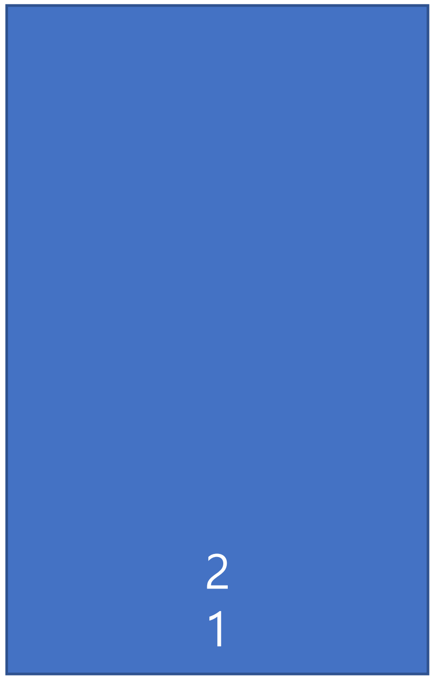

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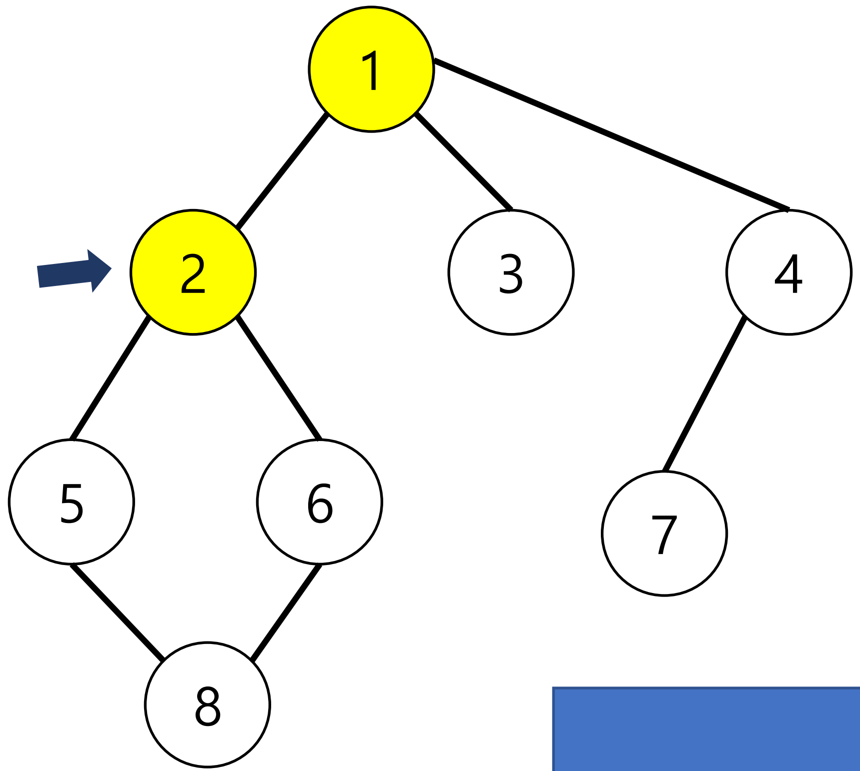

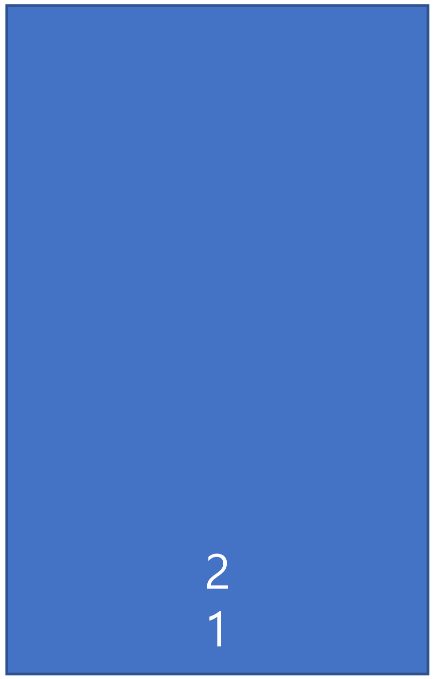

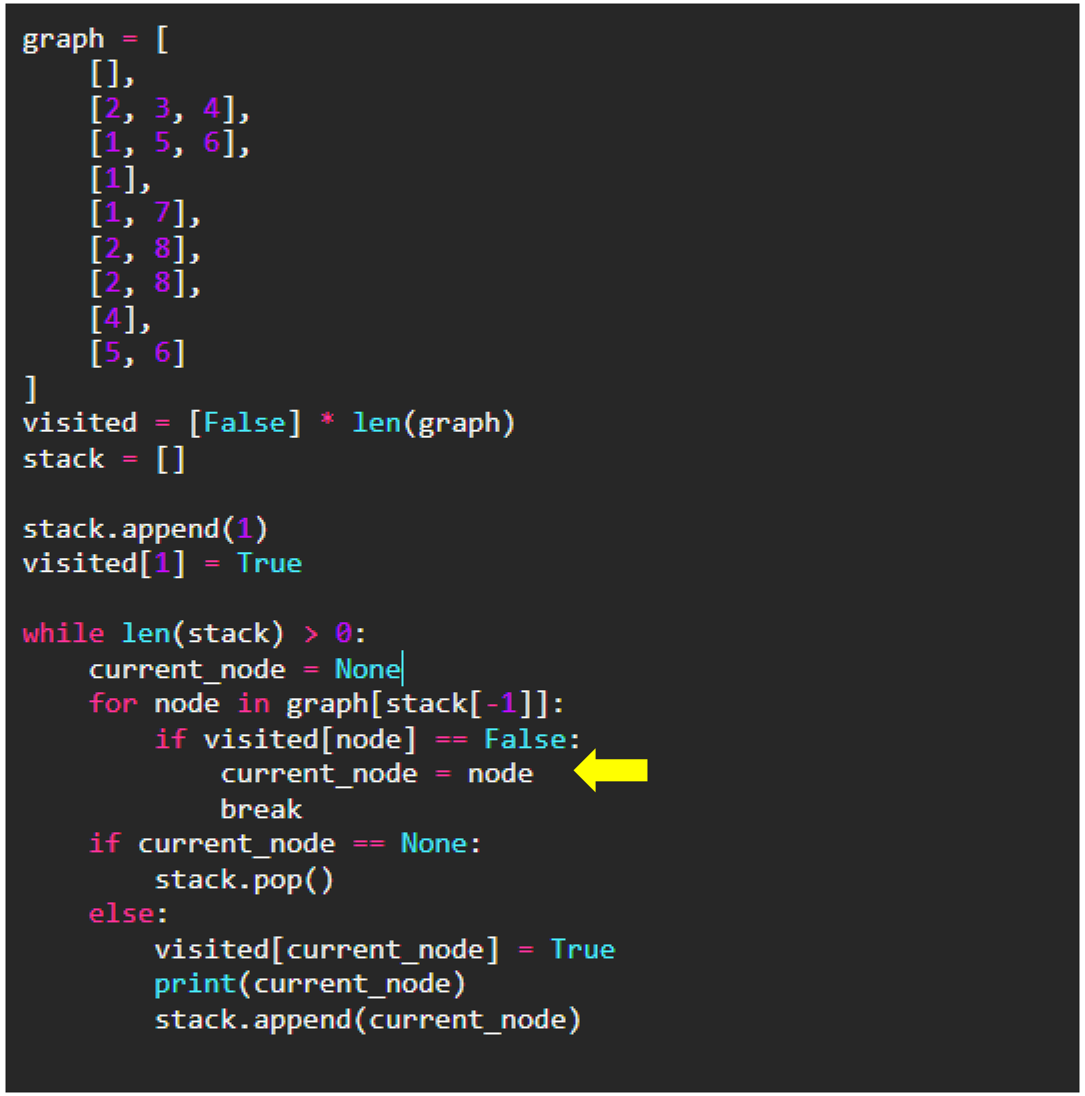

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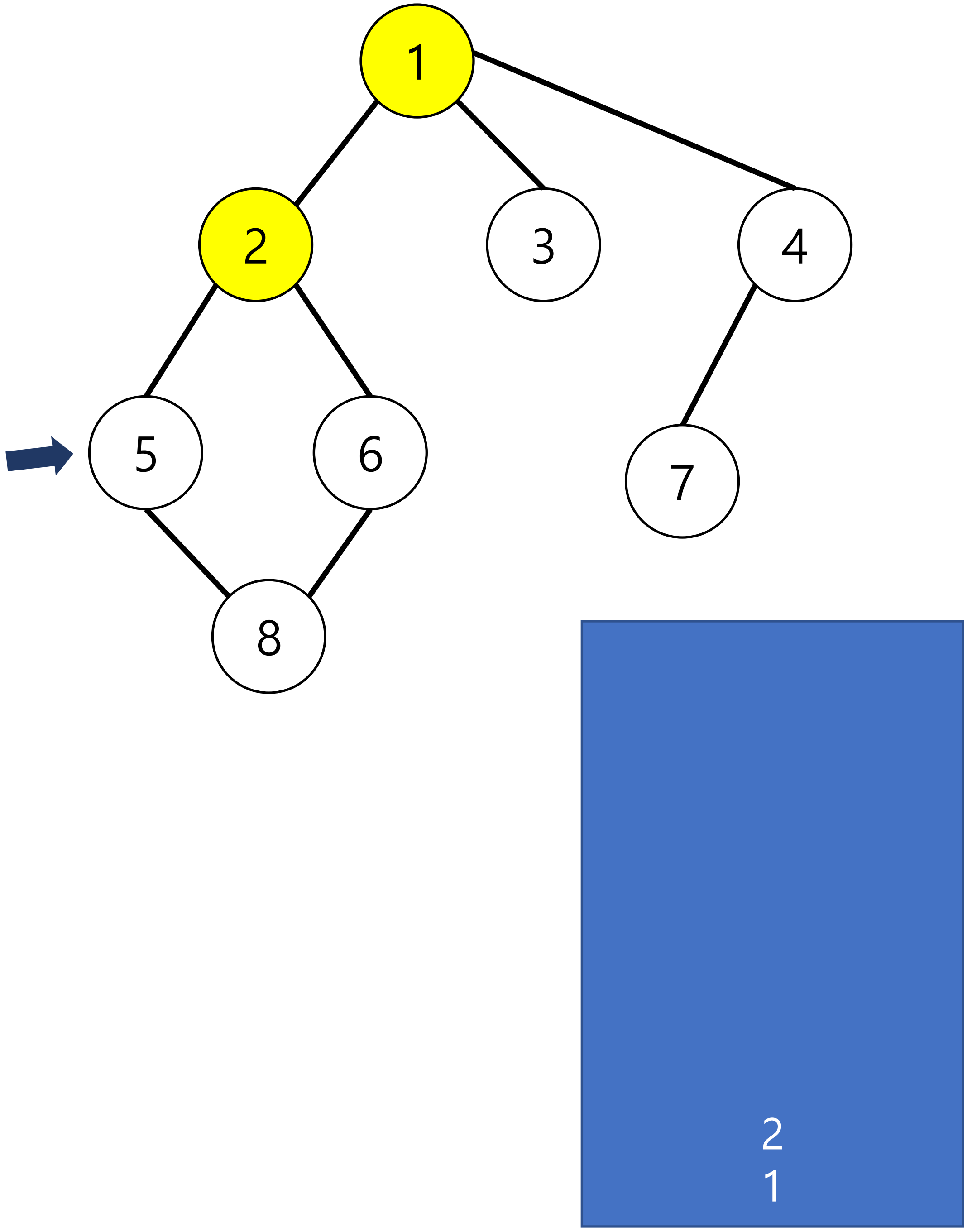

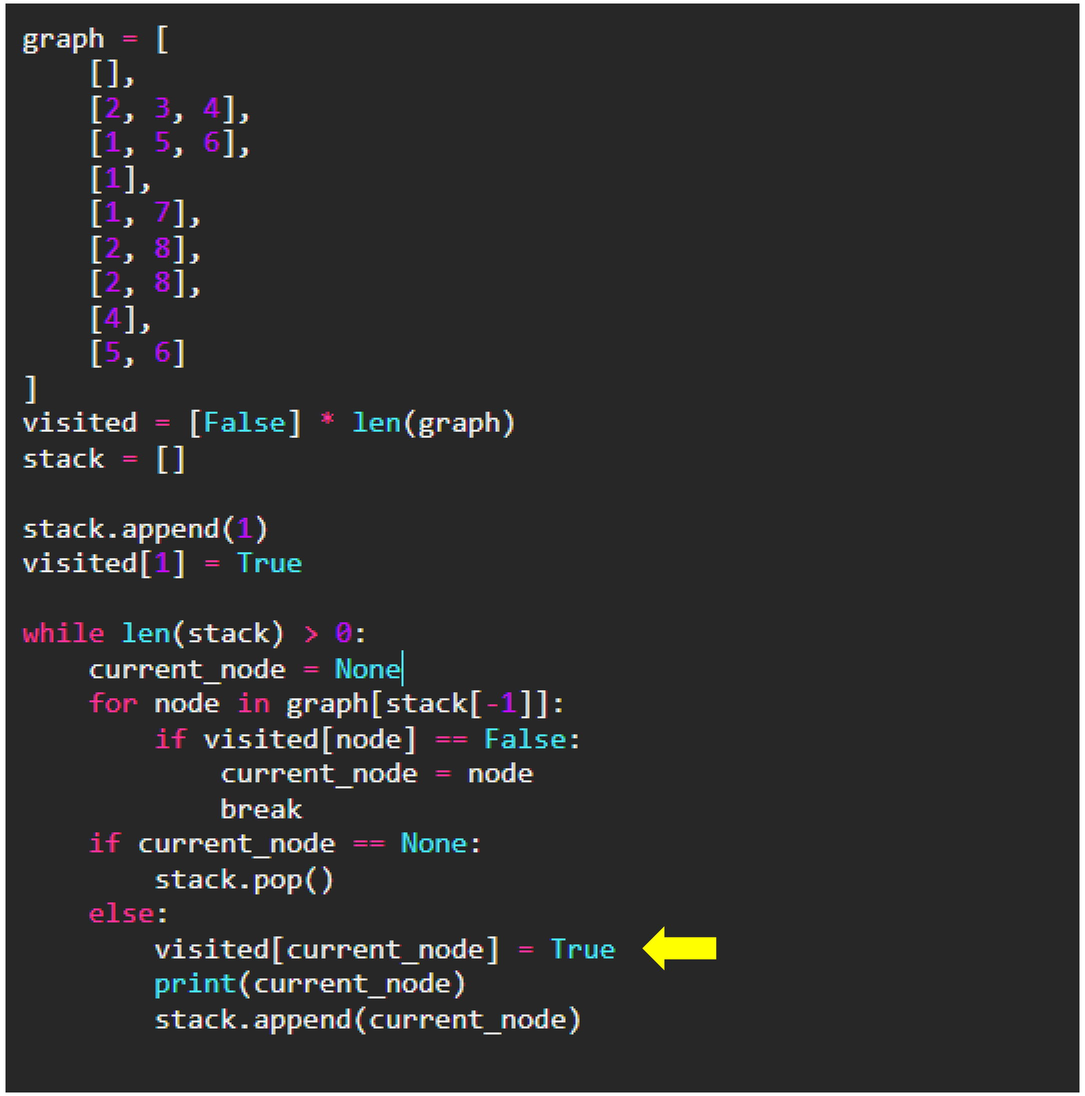

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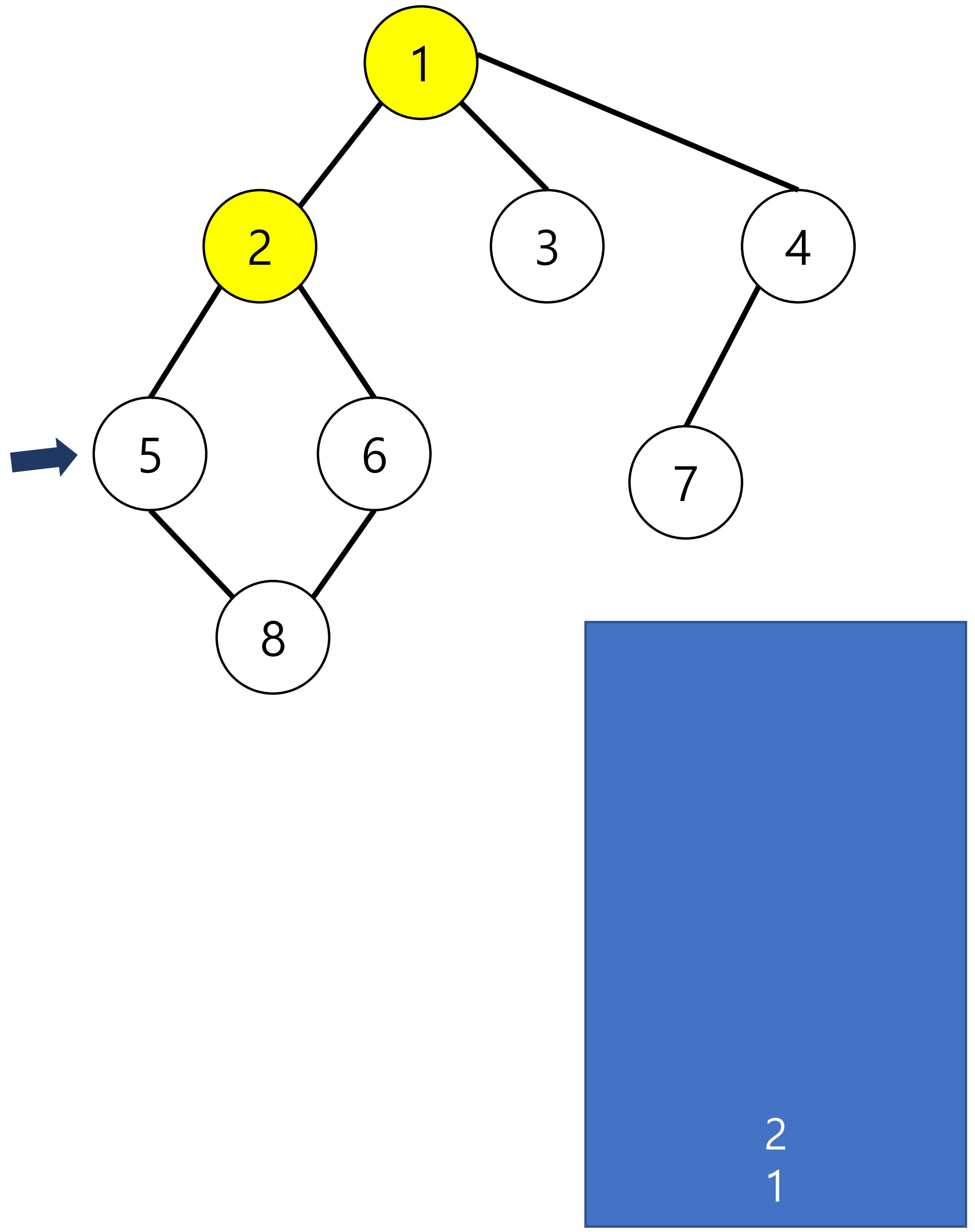

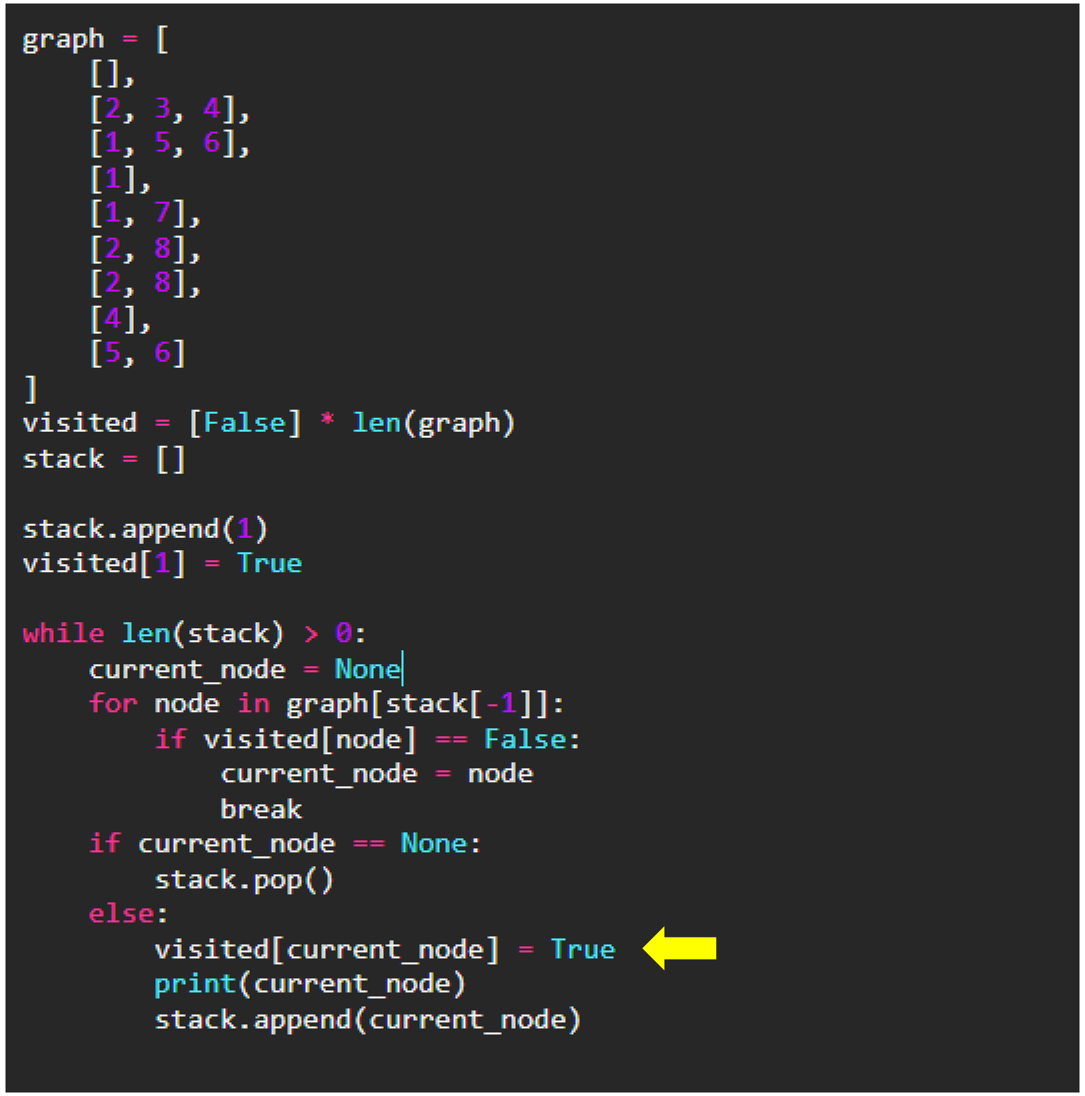

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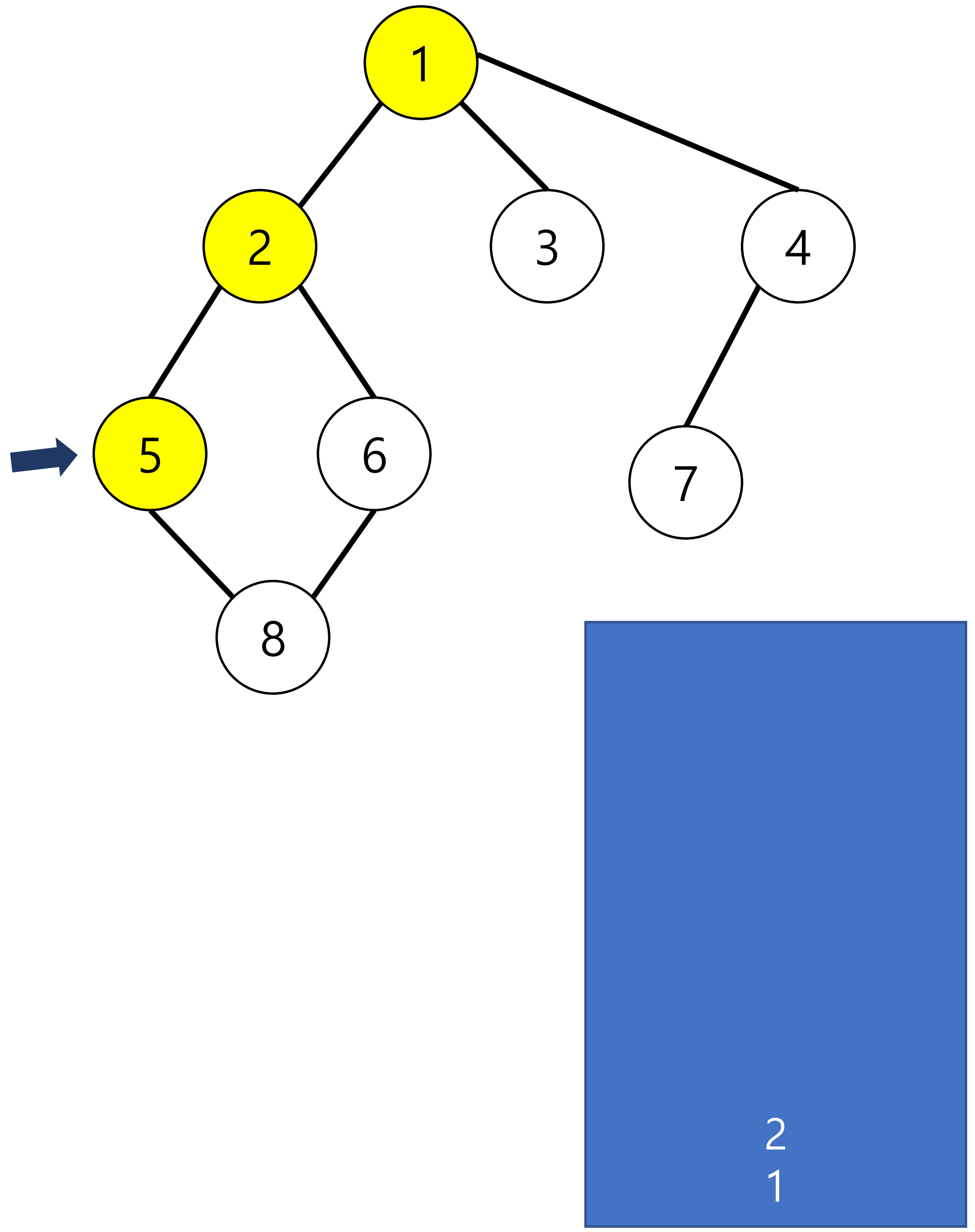

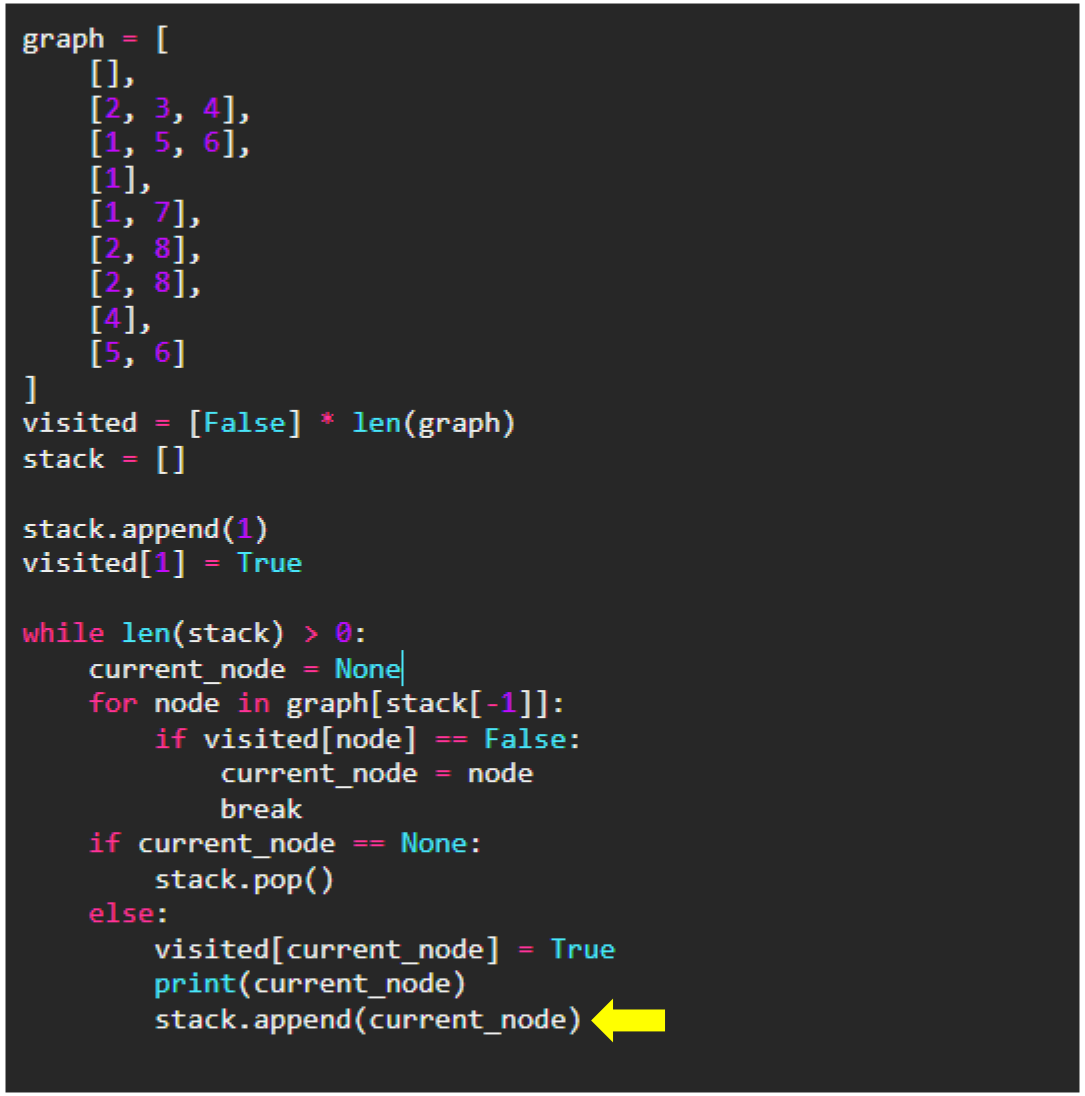

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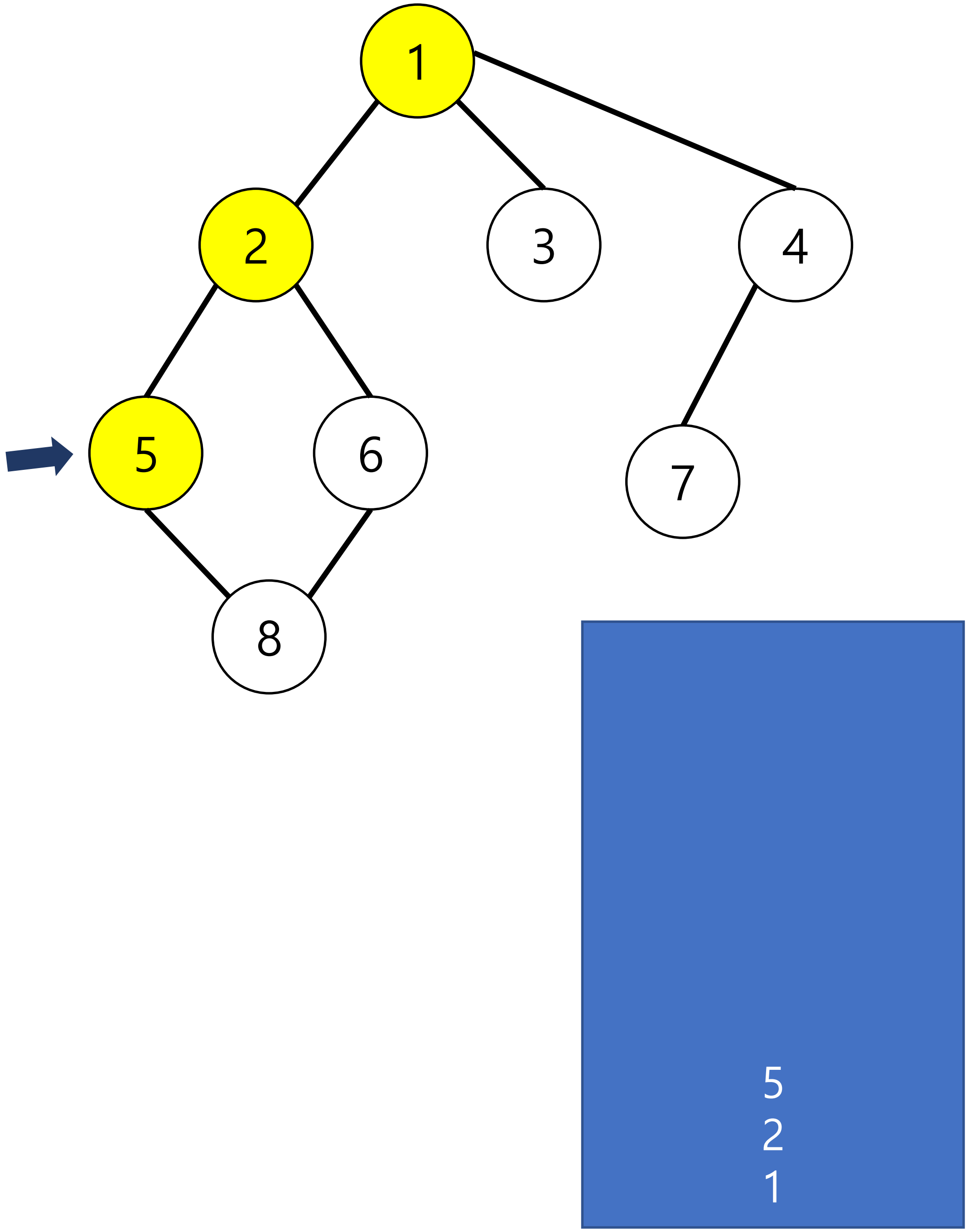

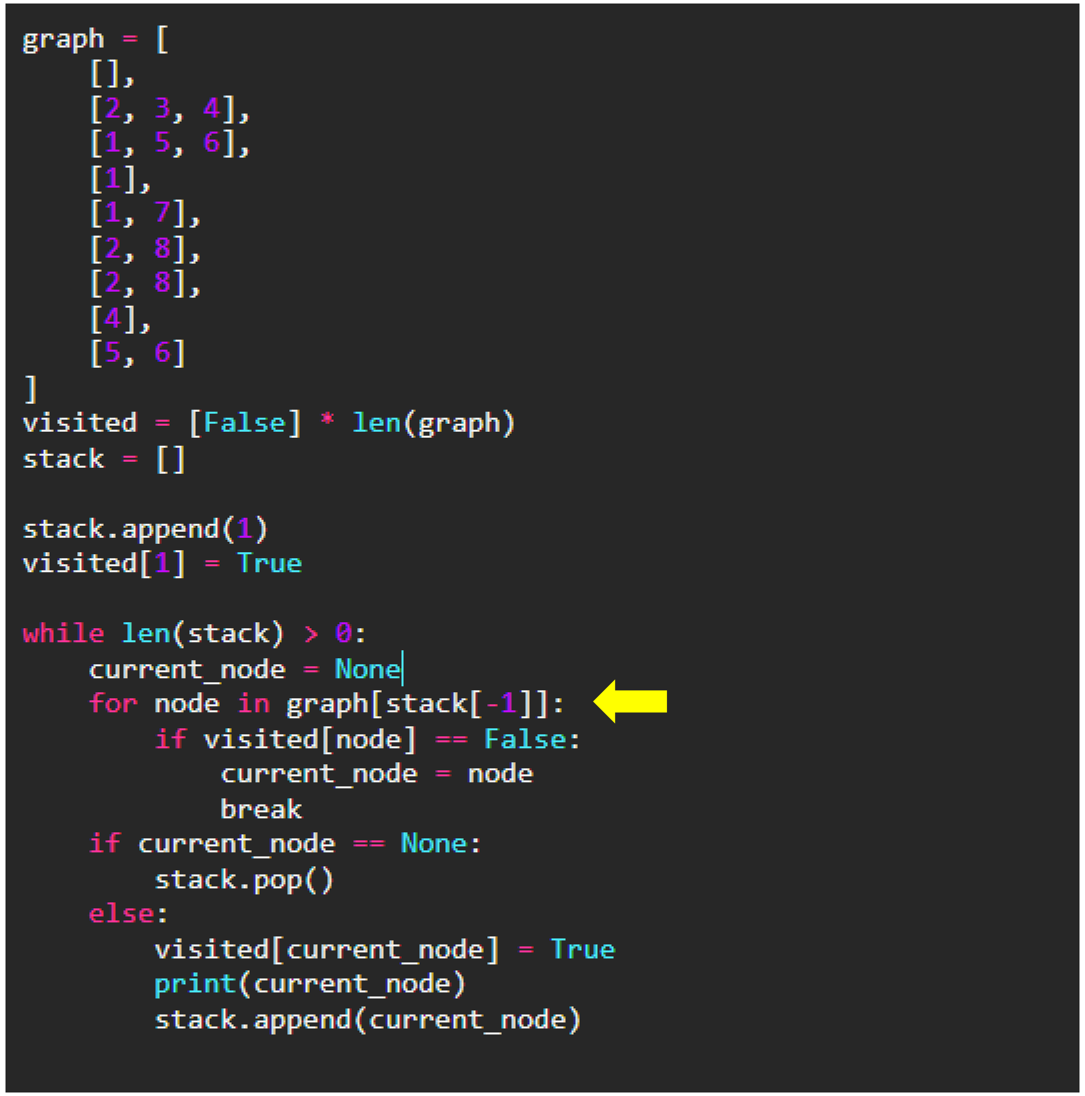

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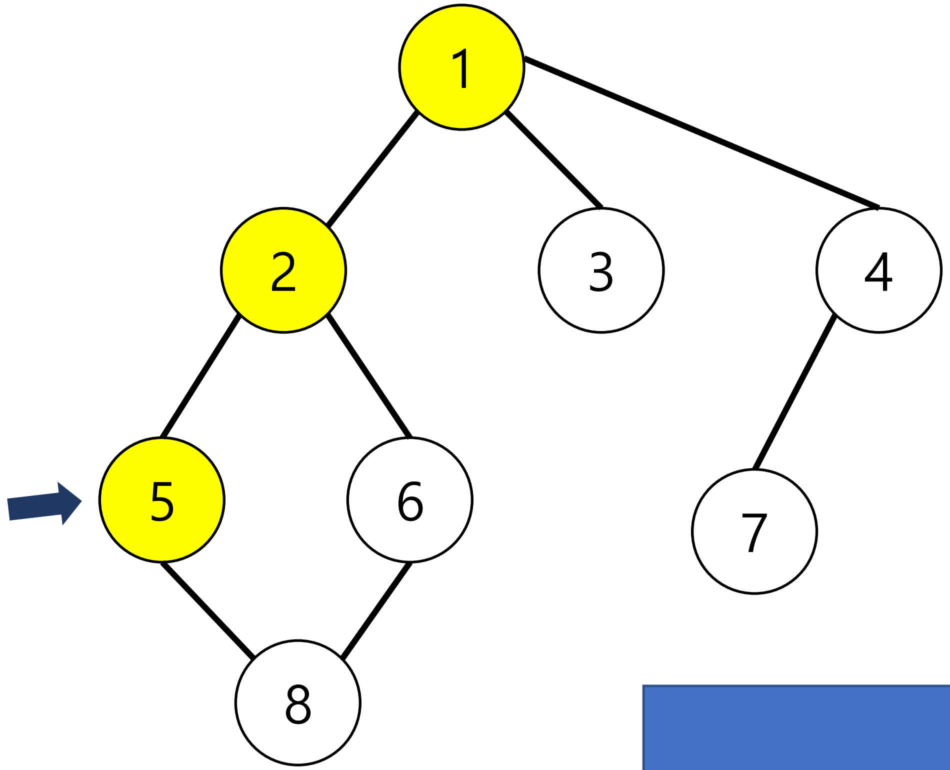

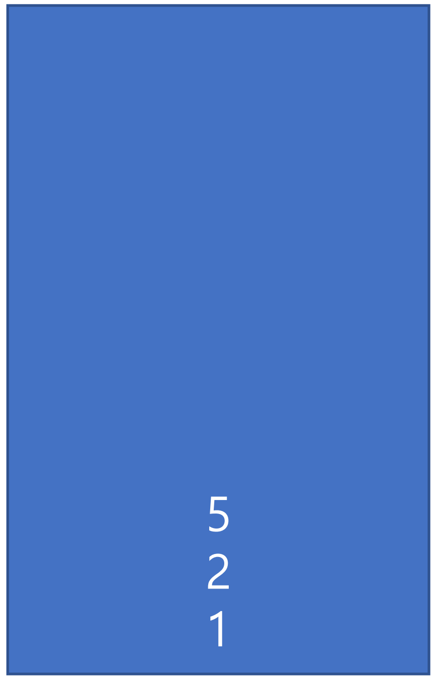

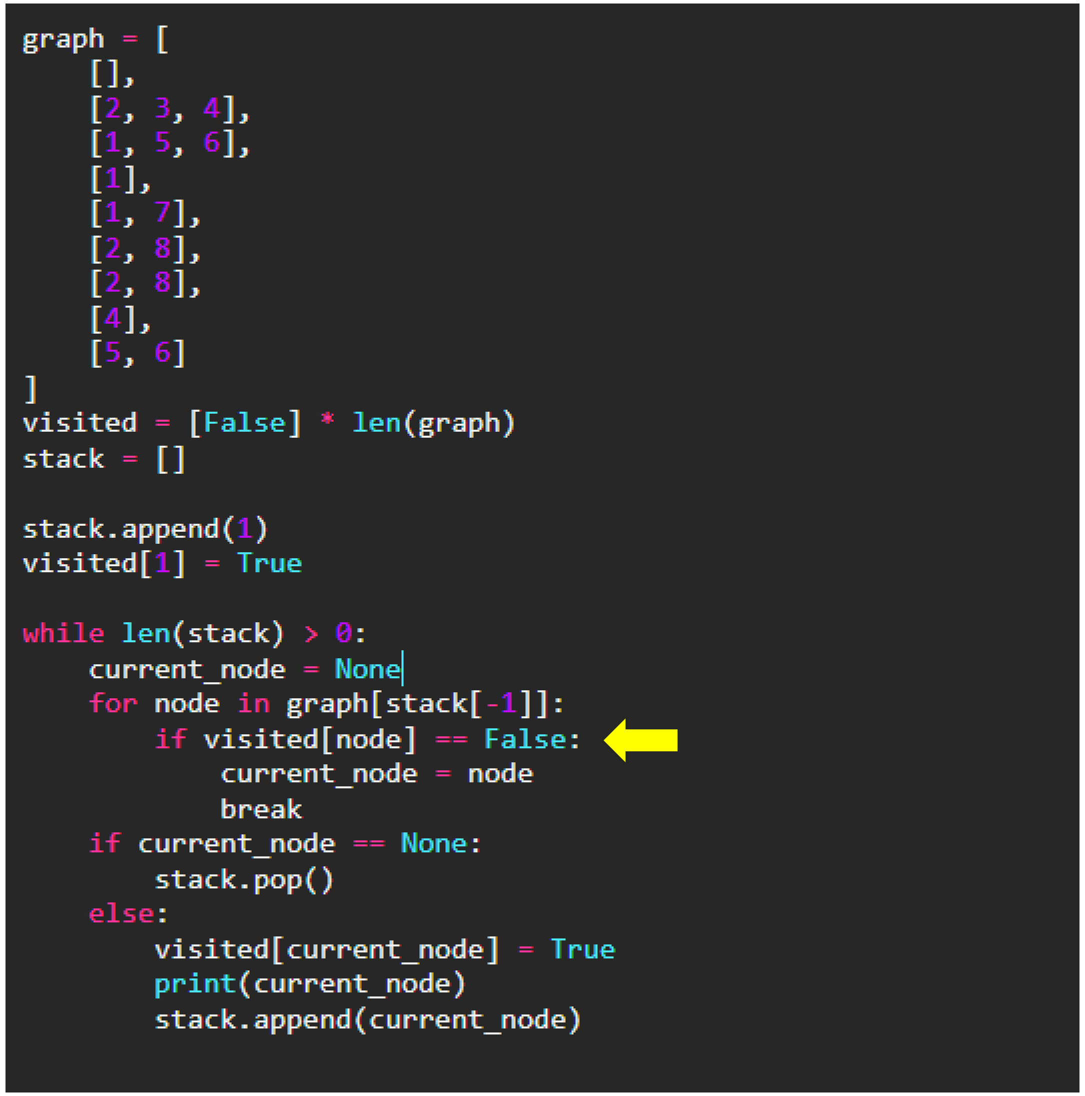

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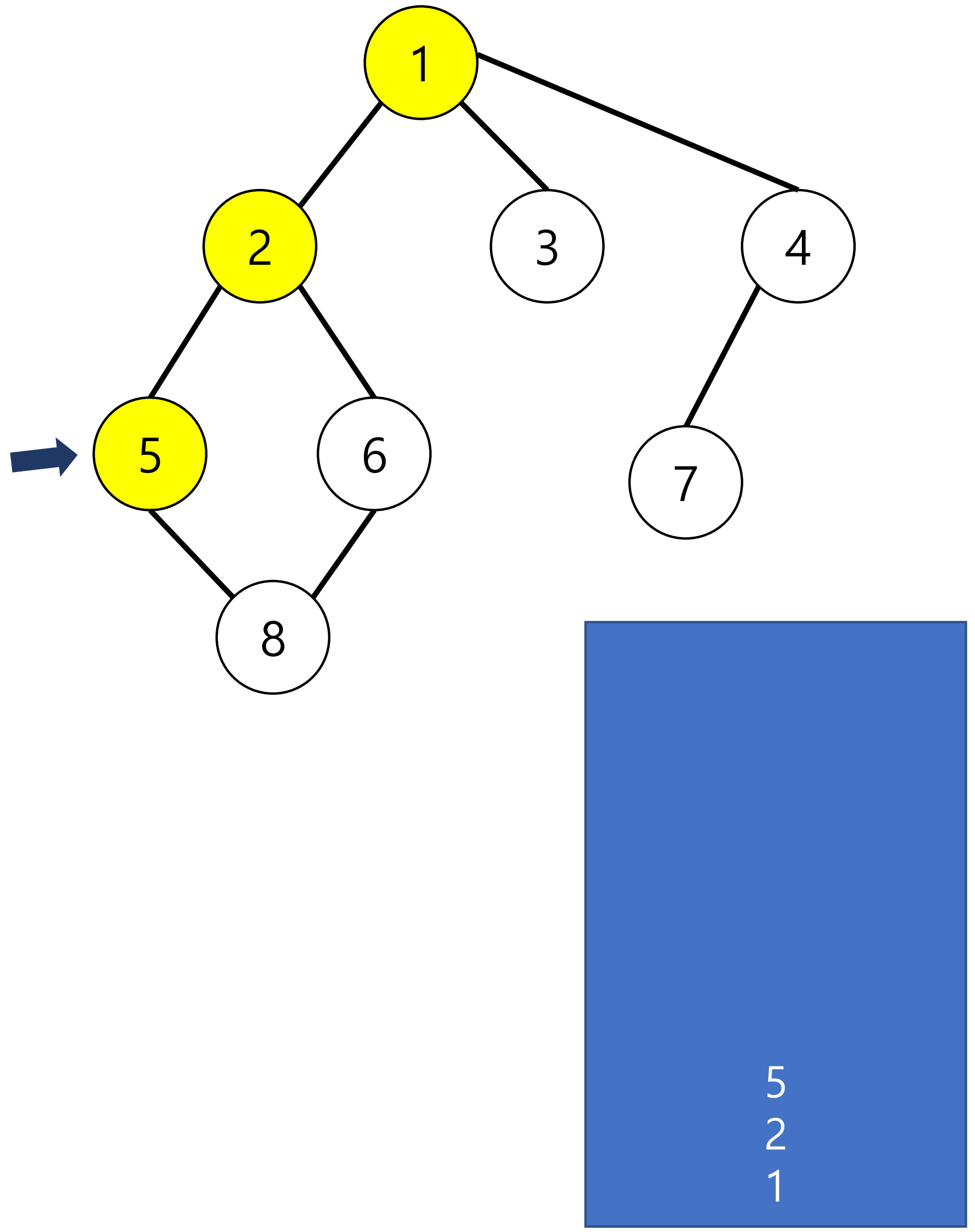

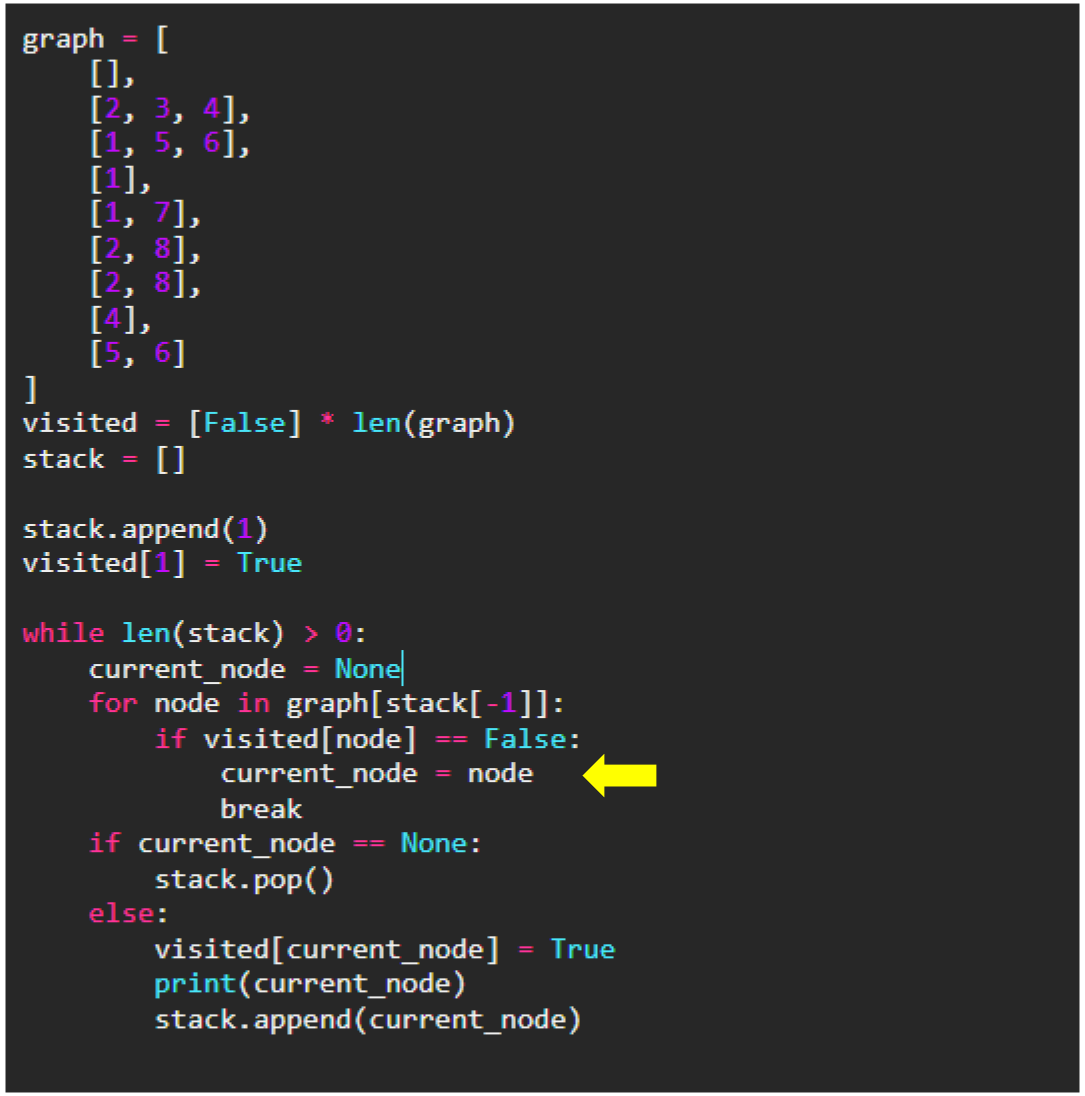

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    [1, 7],
    [2, 8],
    [2, 8],
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        stack.pop()
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        visited[current_node] = True
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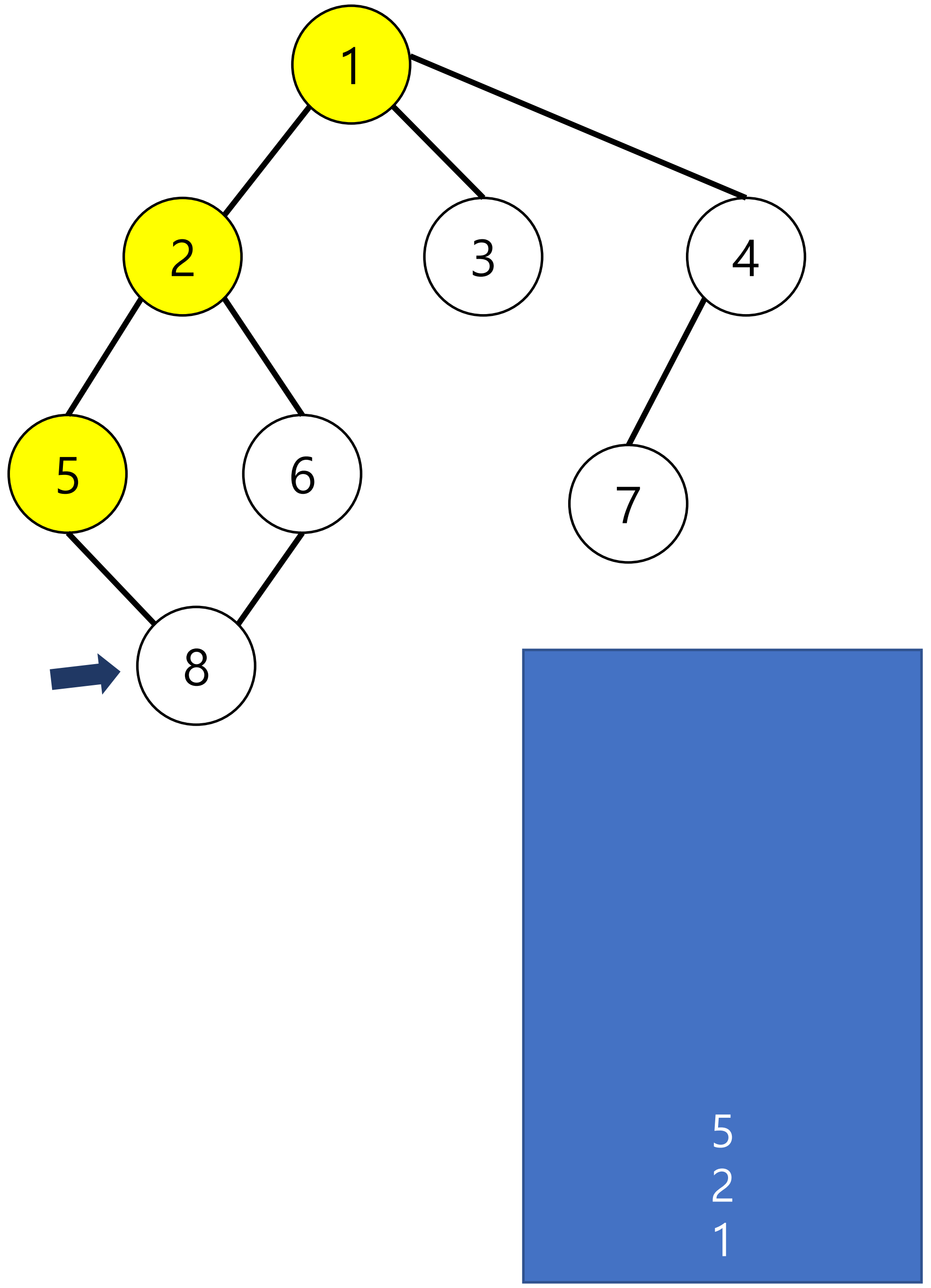

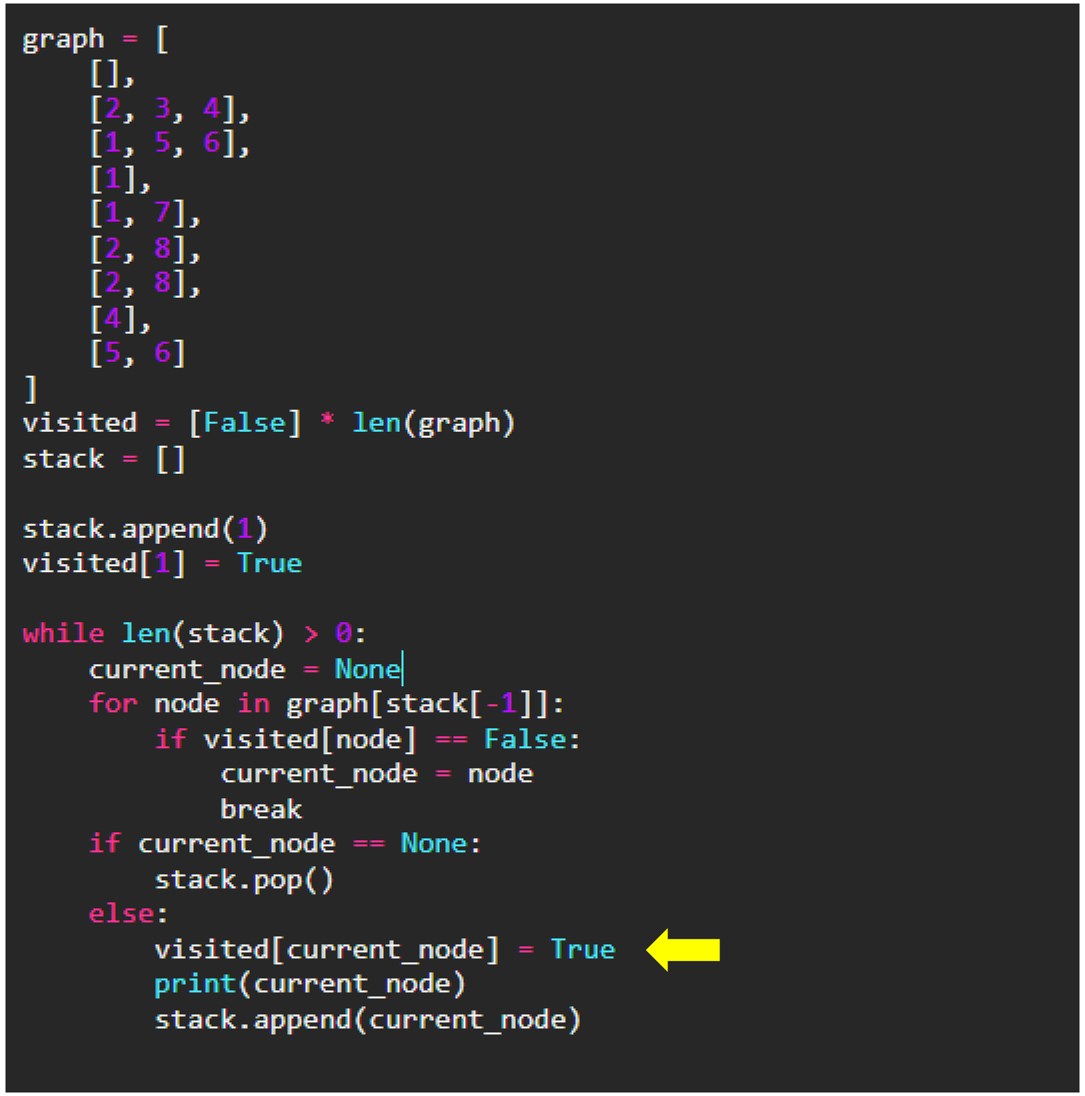

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graph = [
    [],
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    [1, 5, 6],
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    [2, 8],
    [2, 8],
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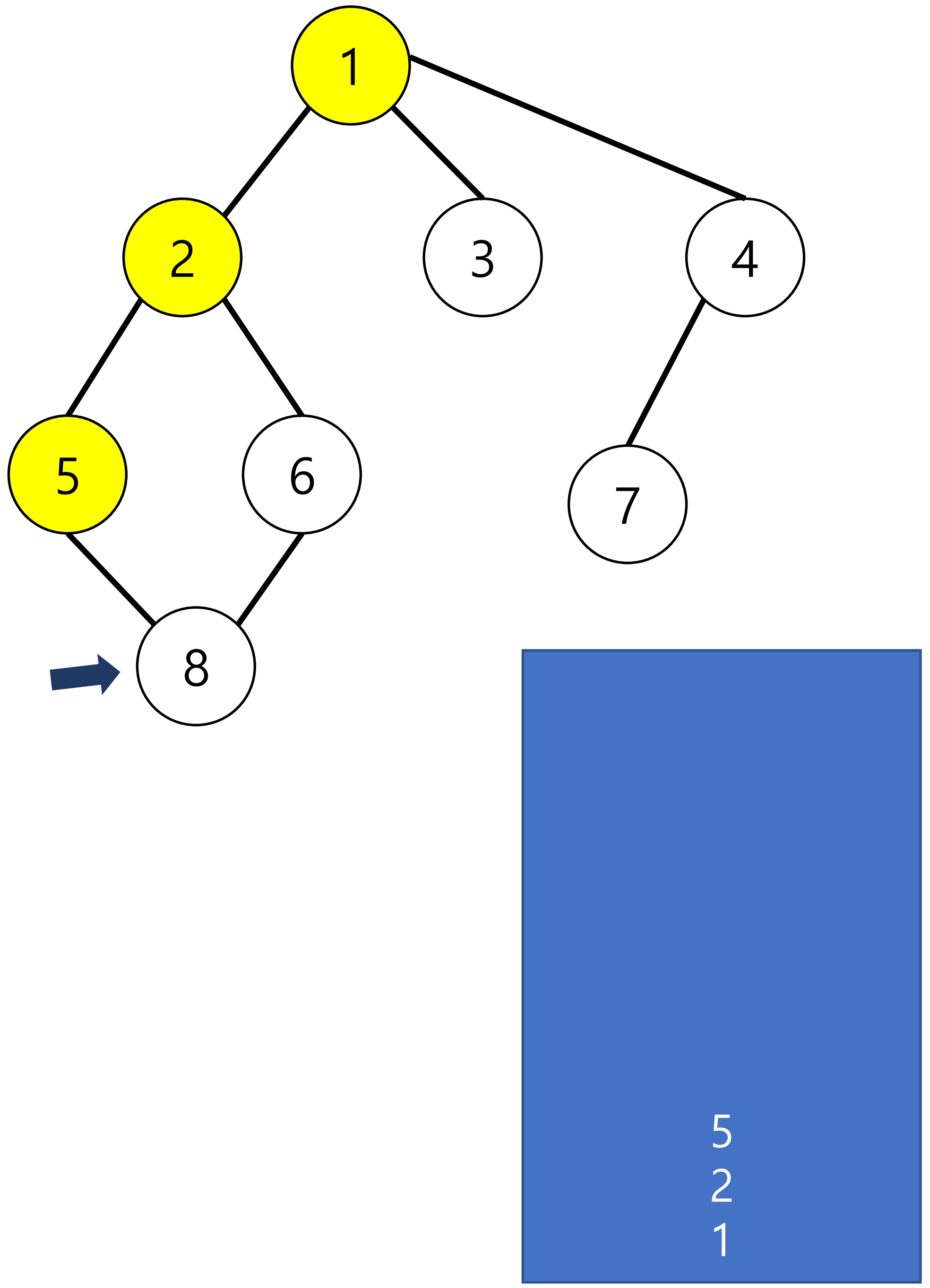

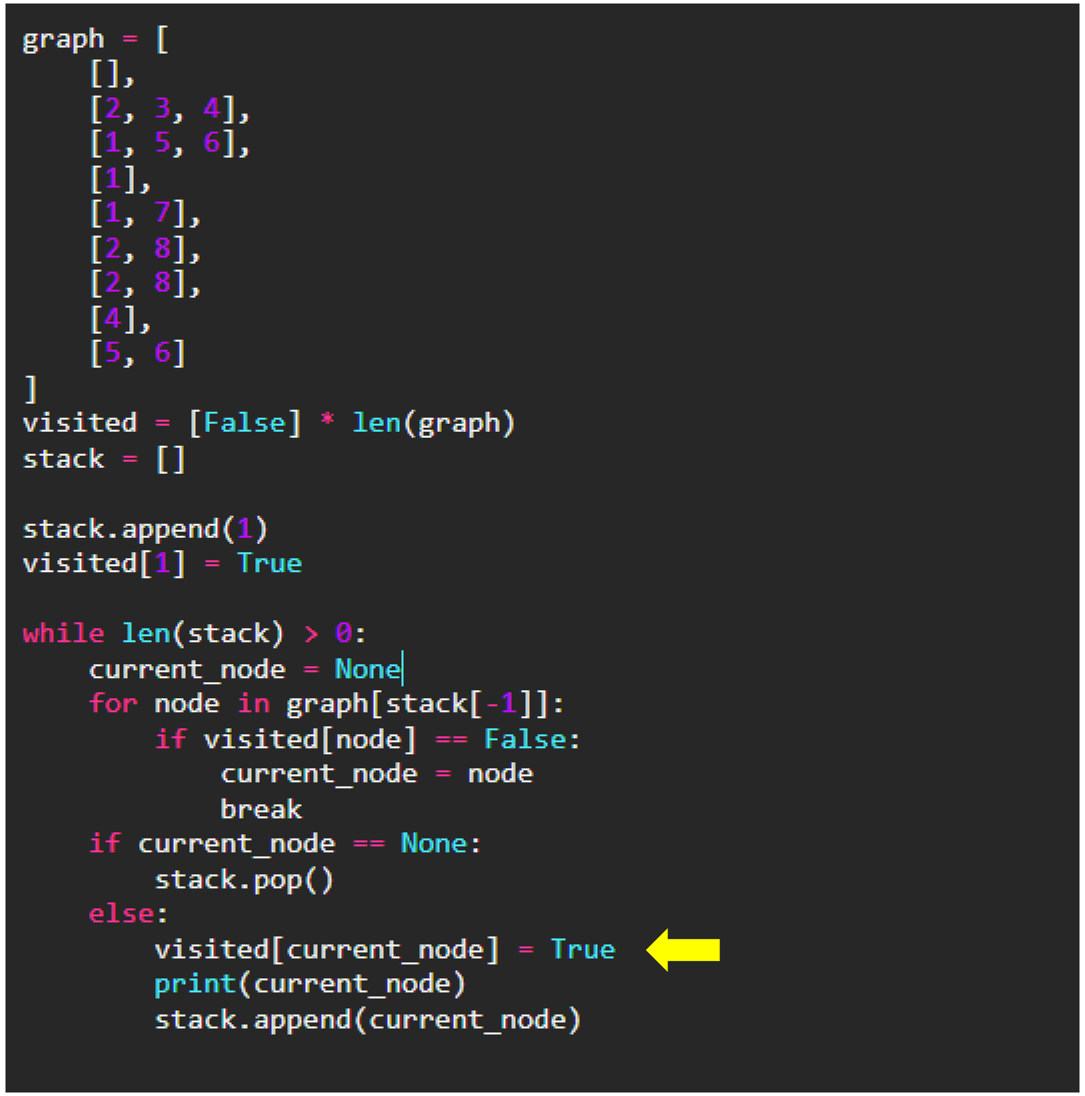

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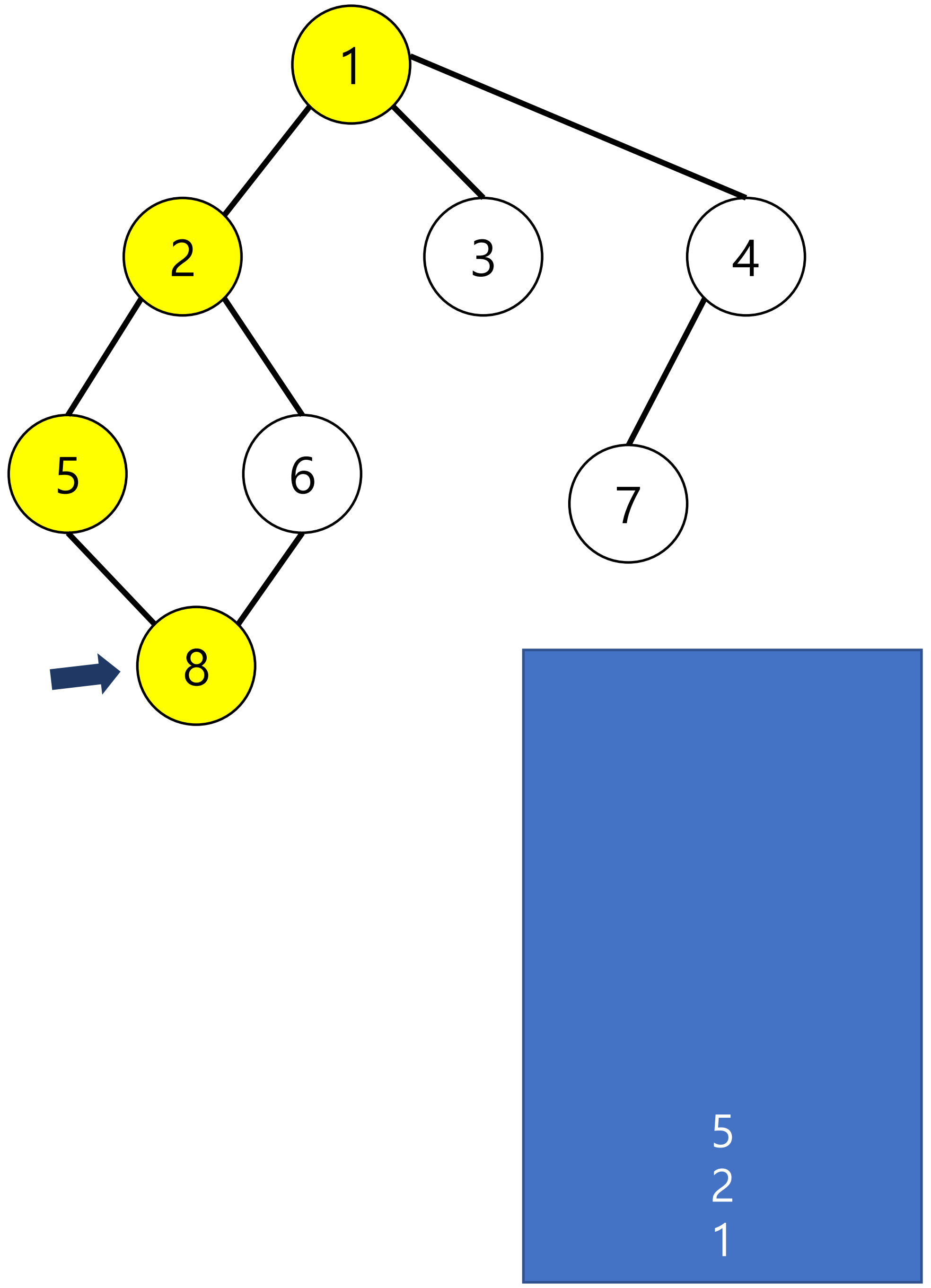

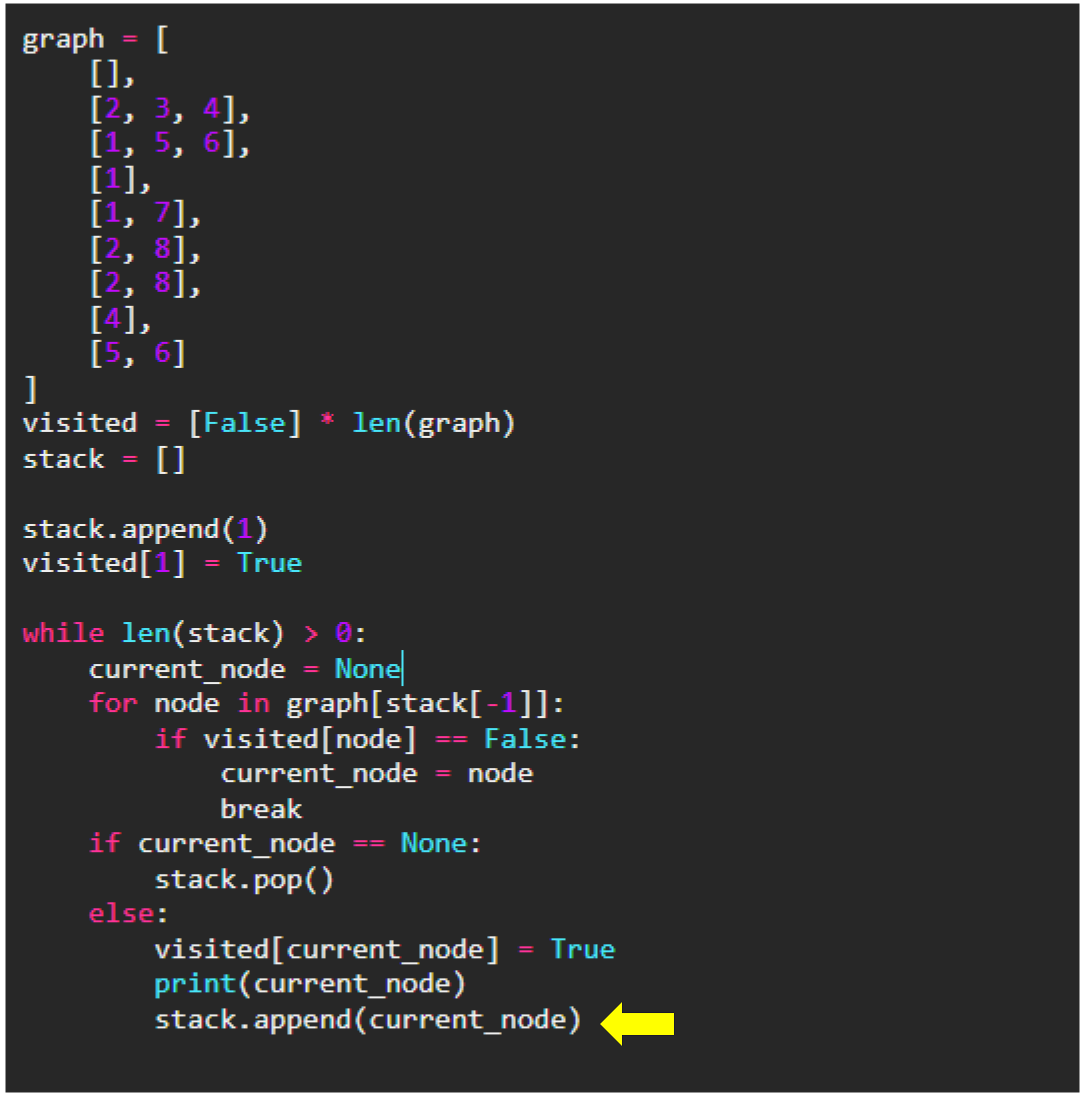

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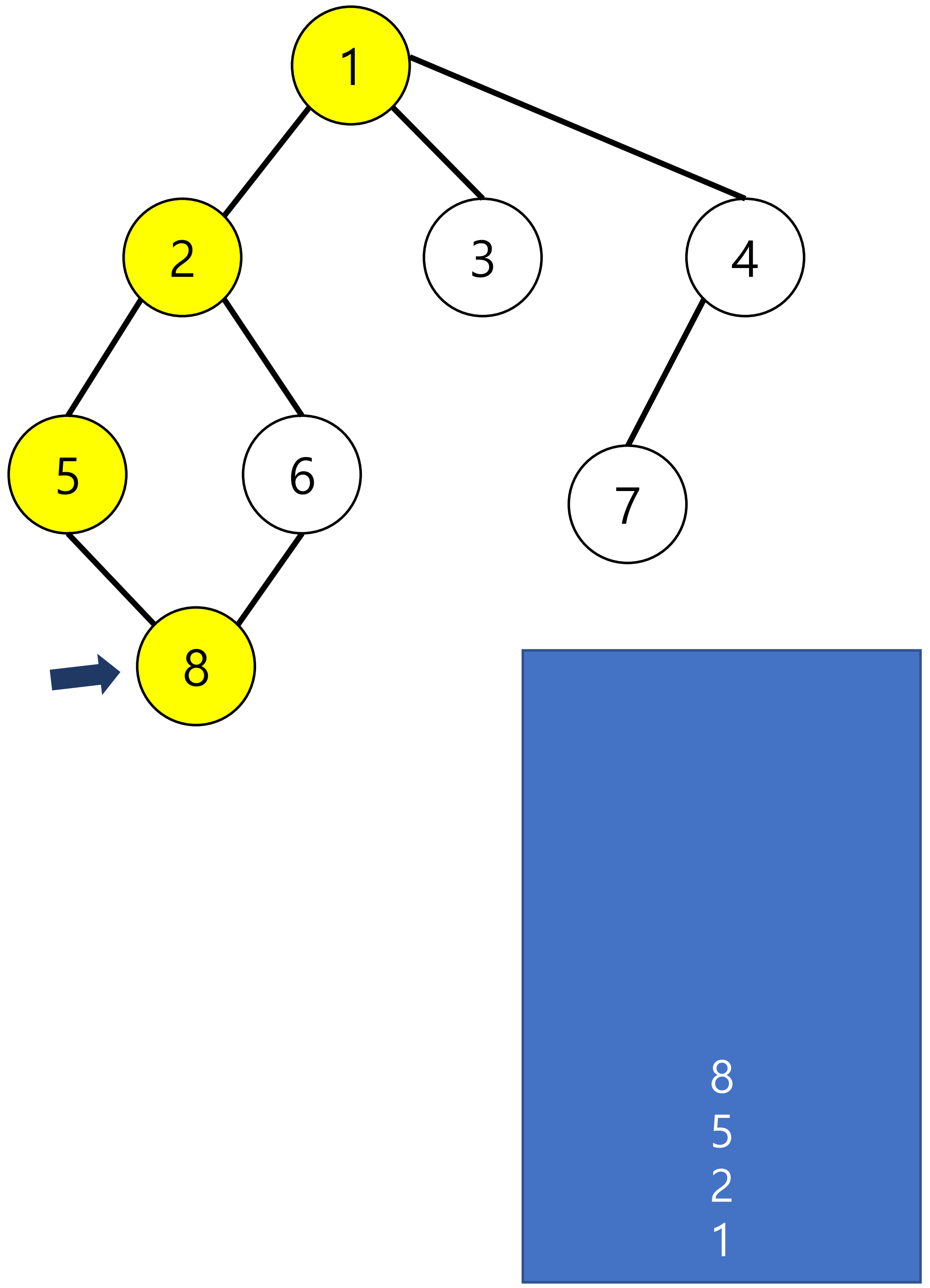

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    [],
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    [2, 8],
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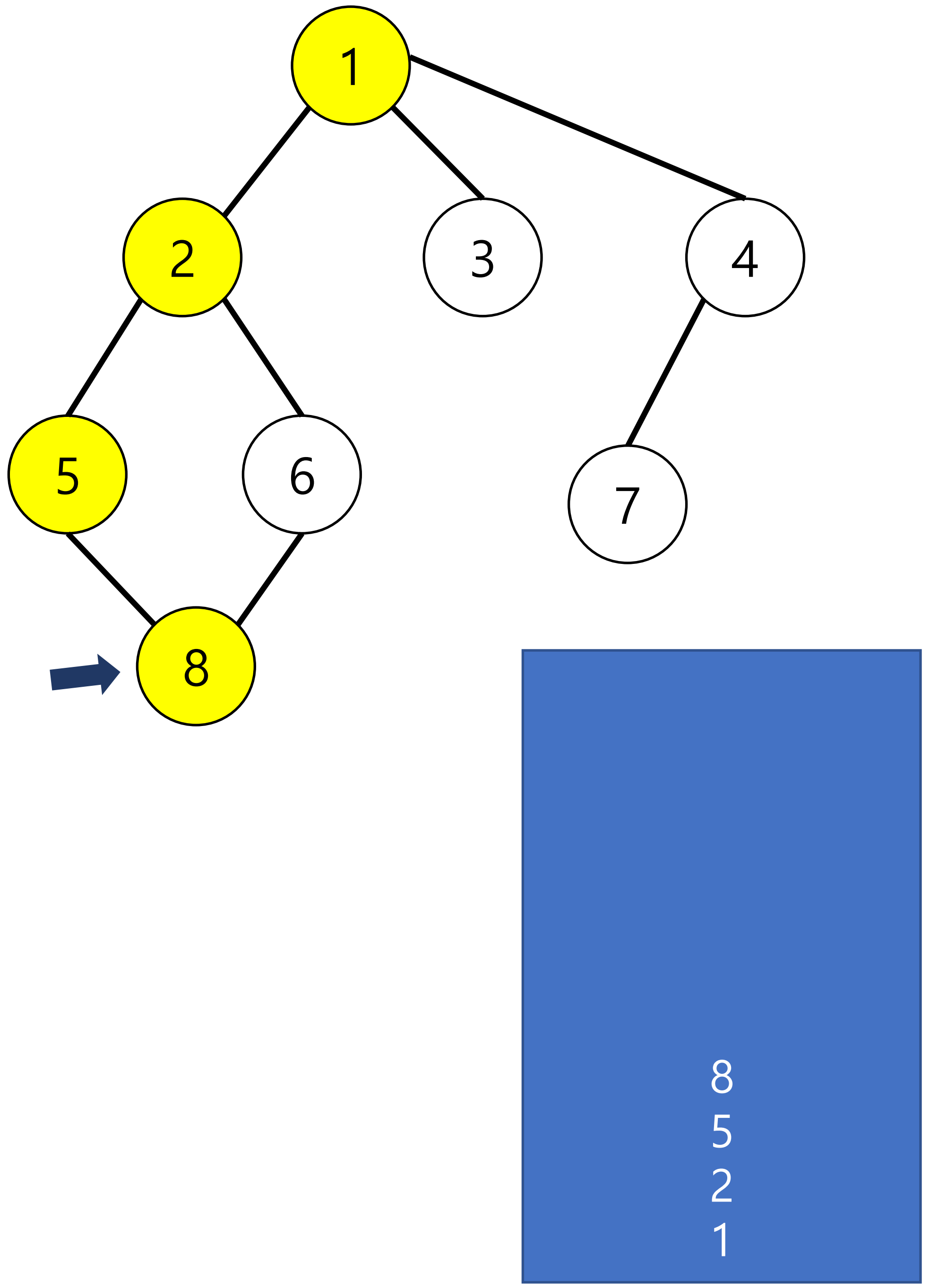

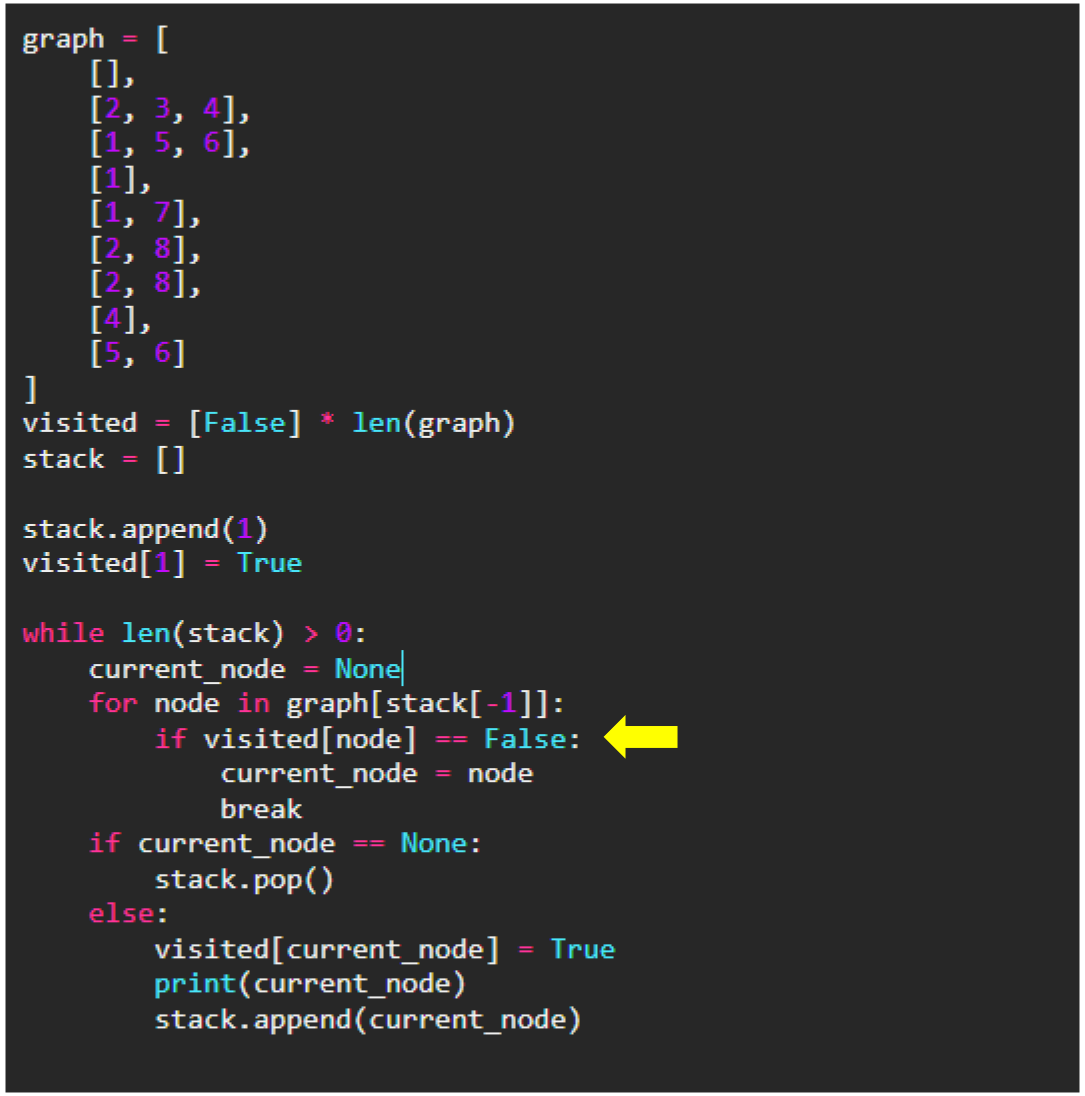

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    [],
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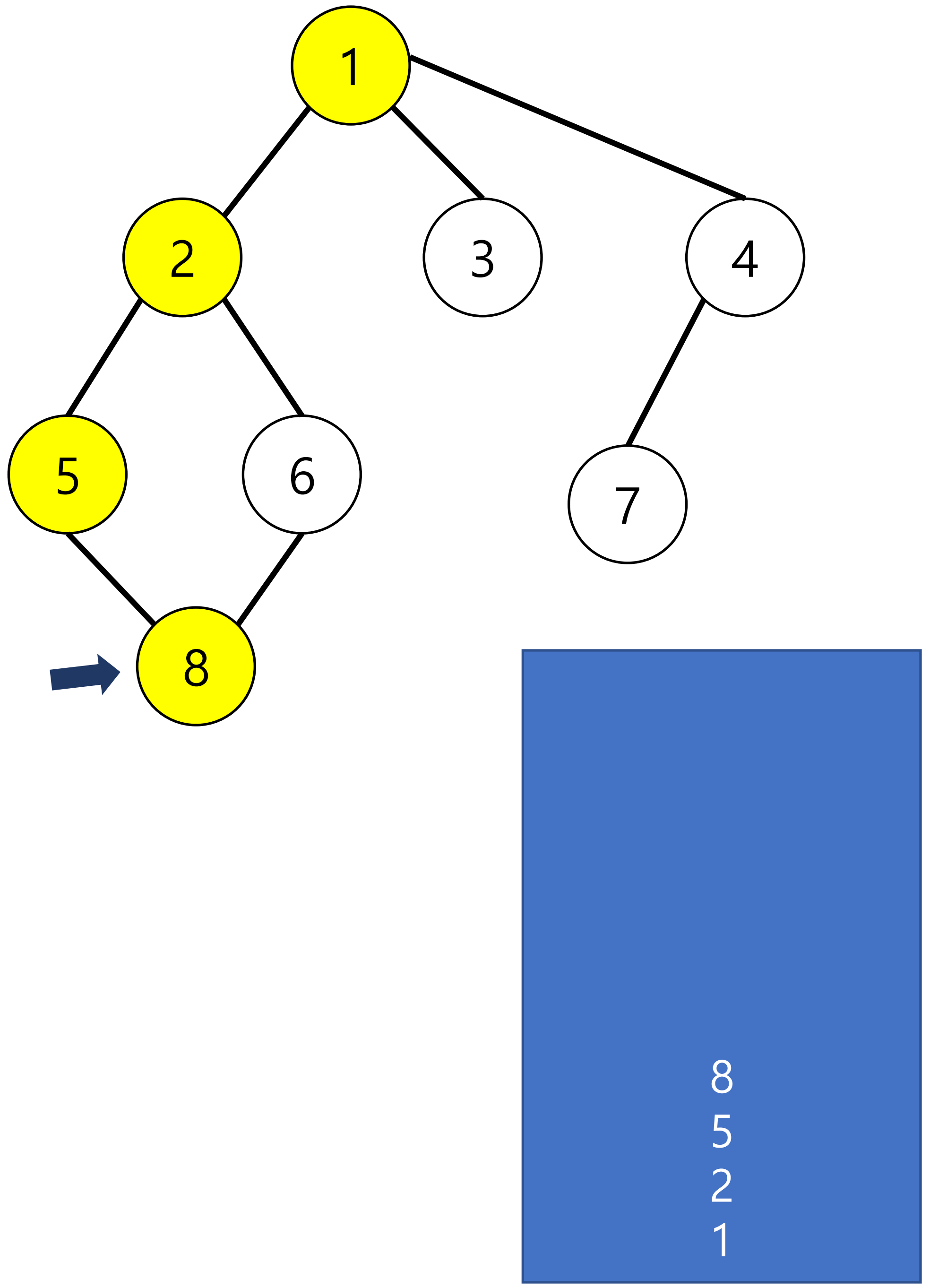

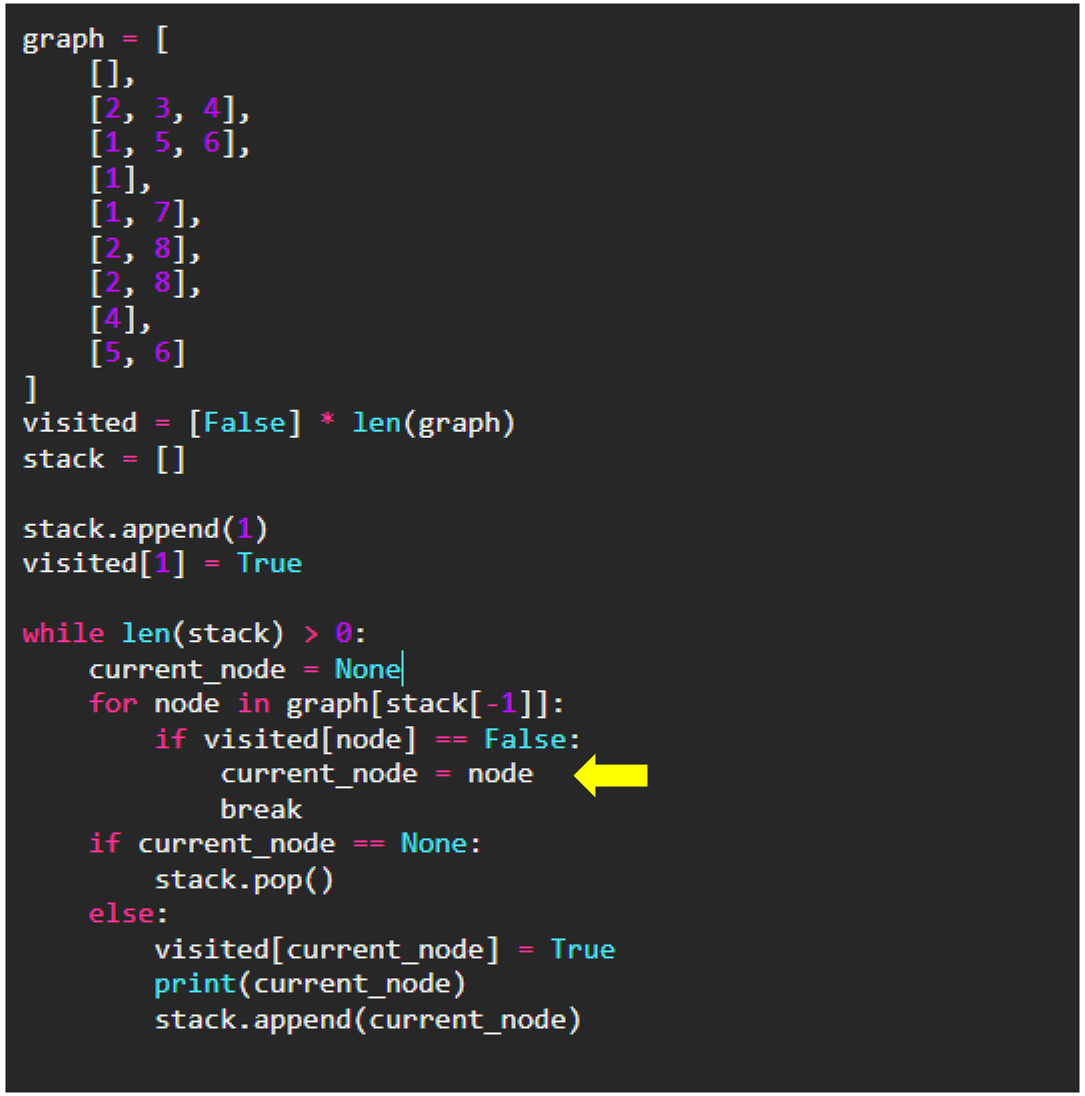

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    [1, 5, 6],
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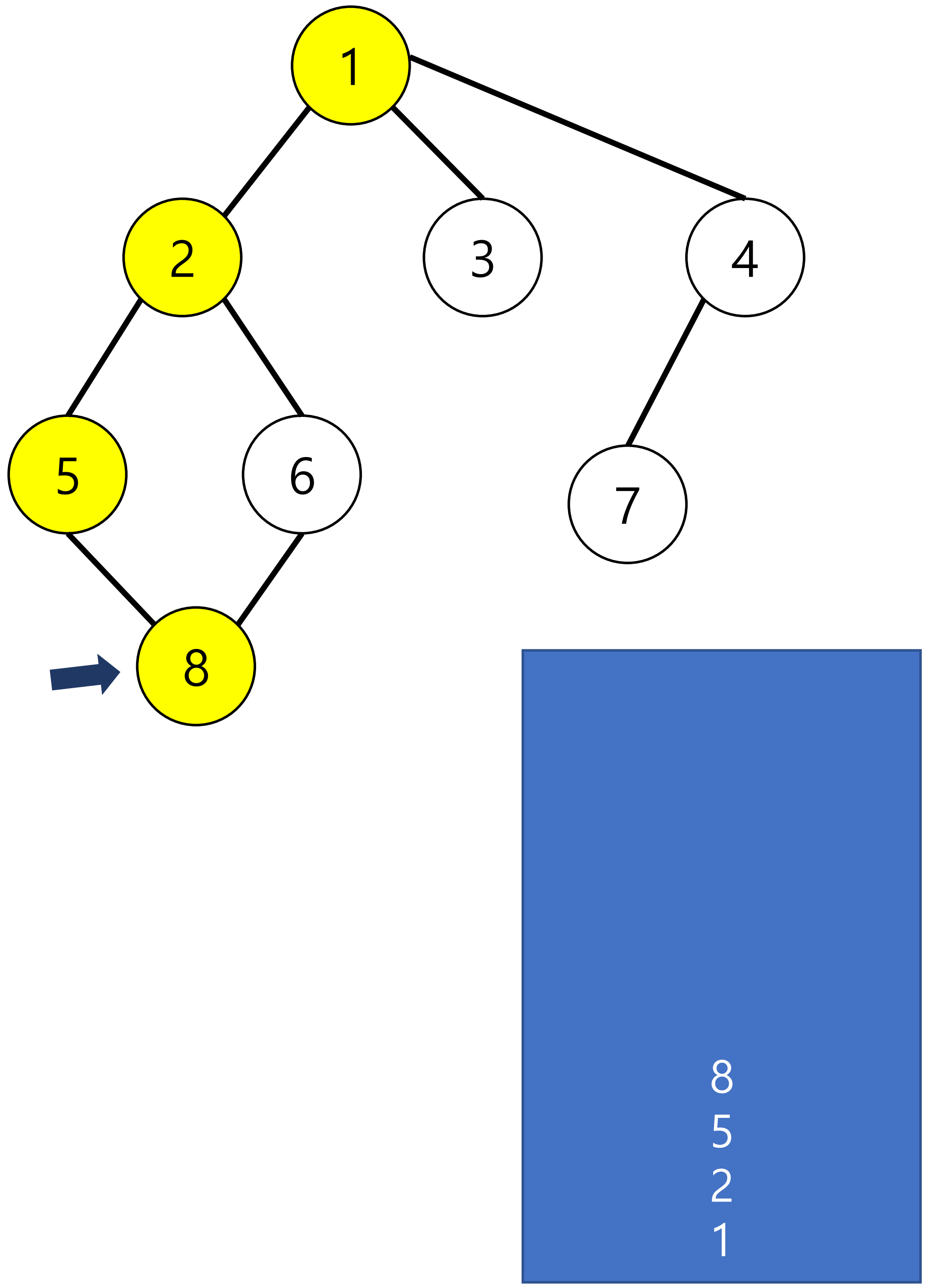

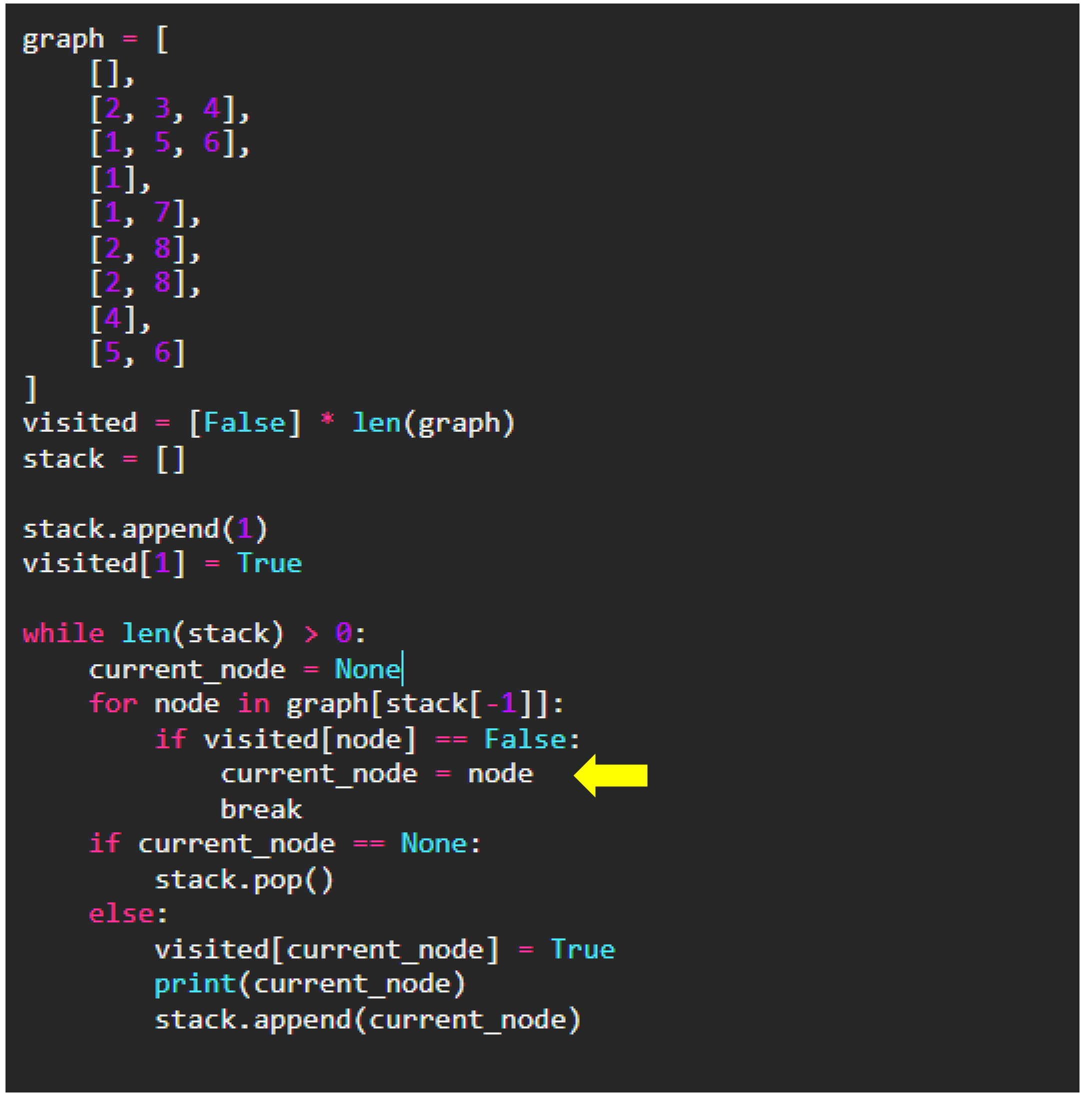

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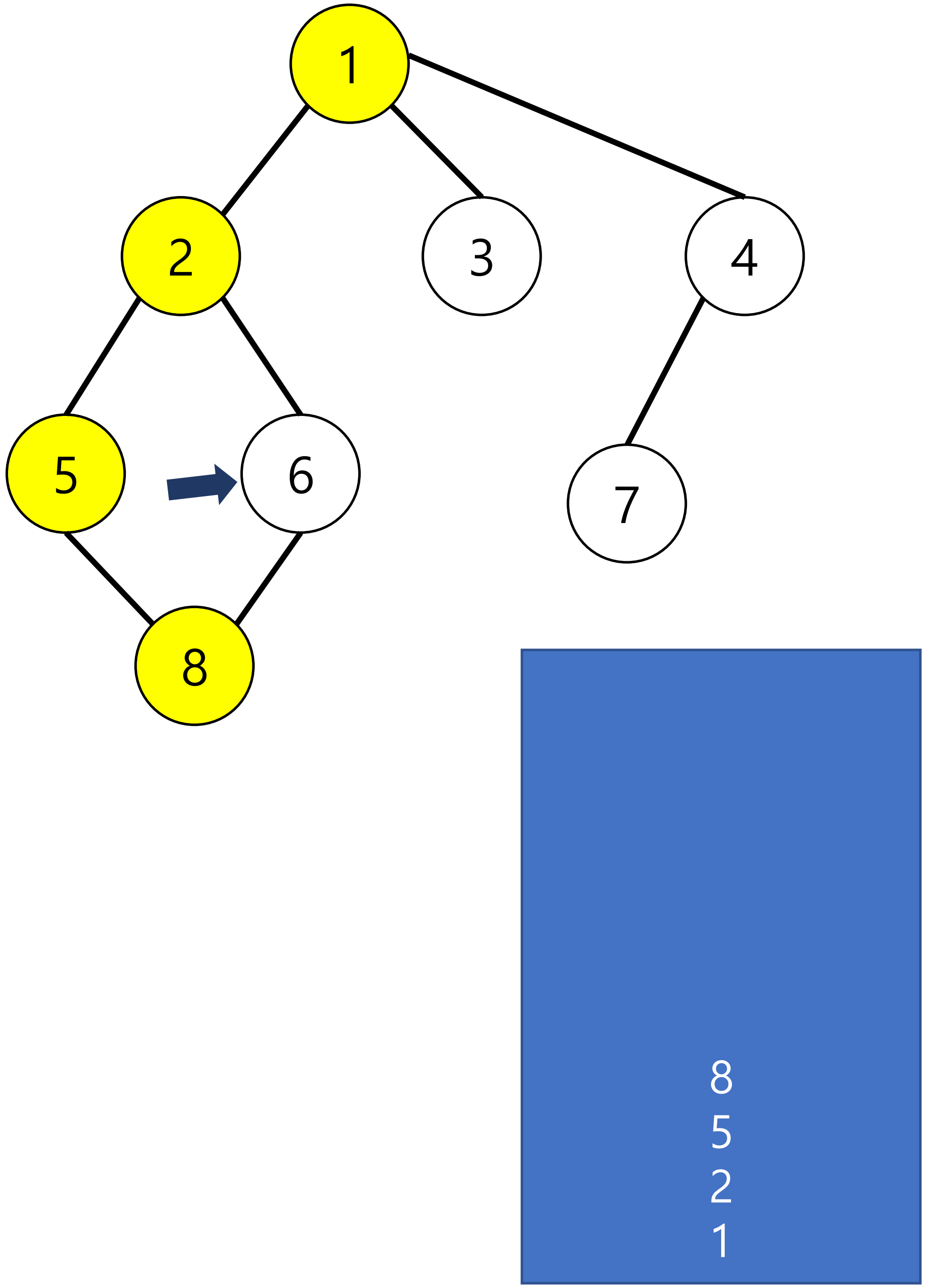

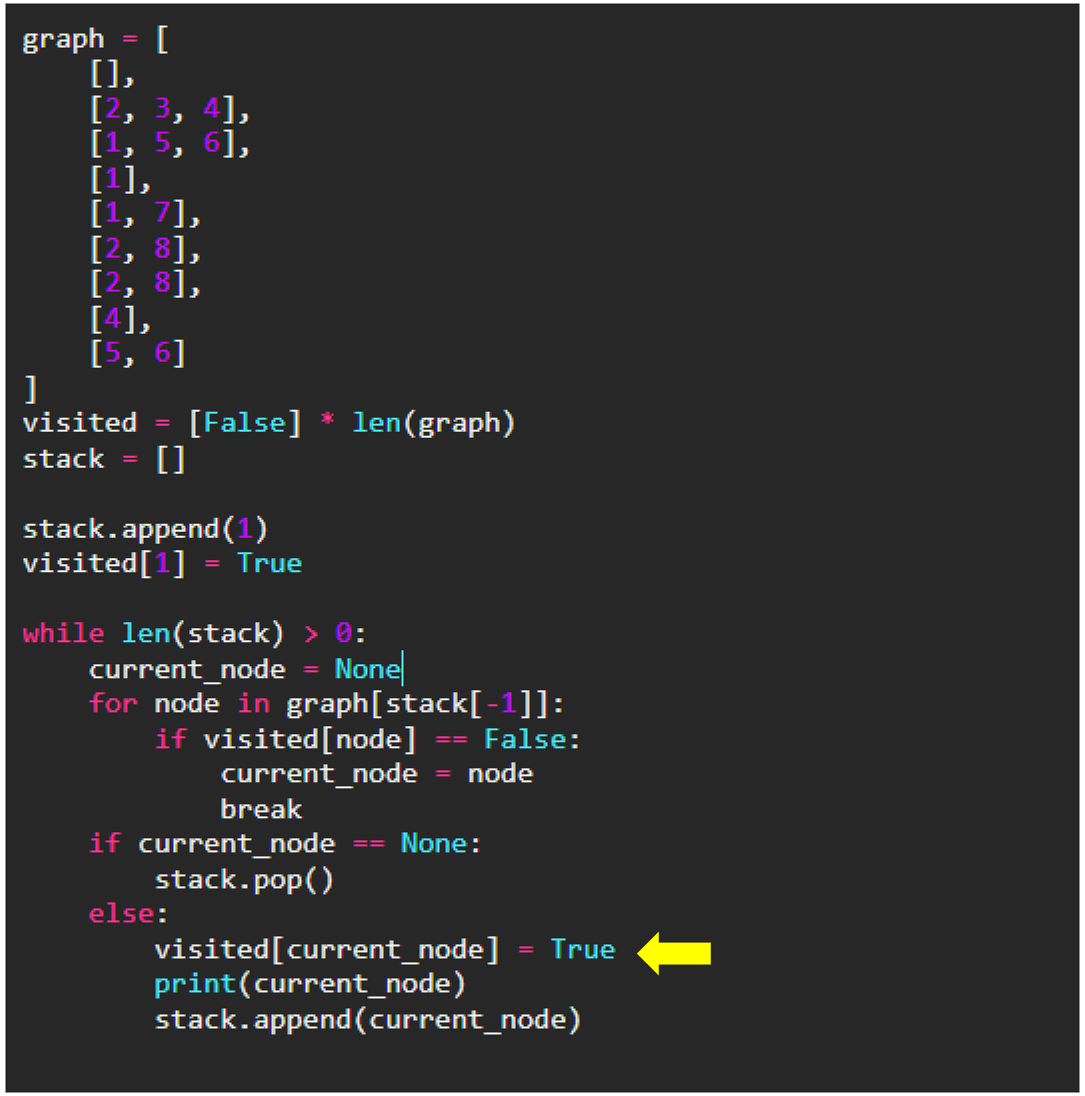

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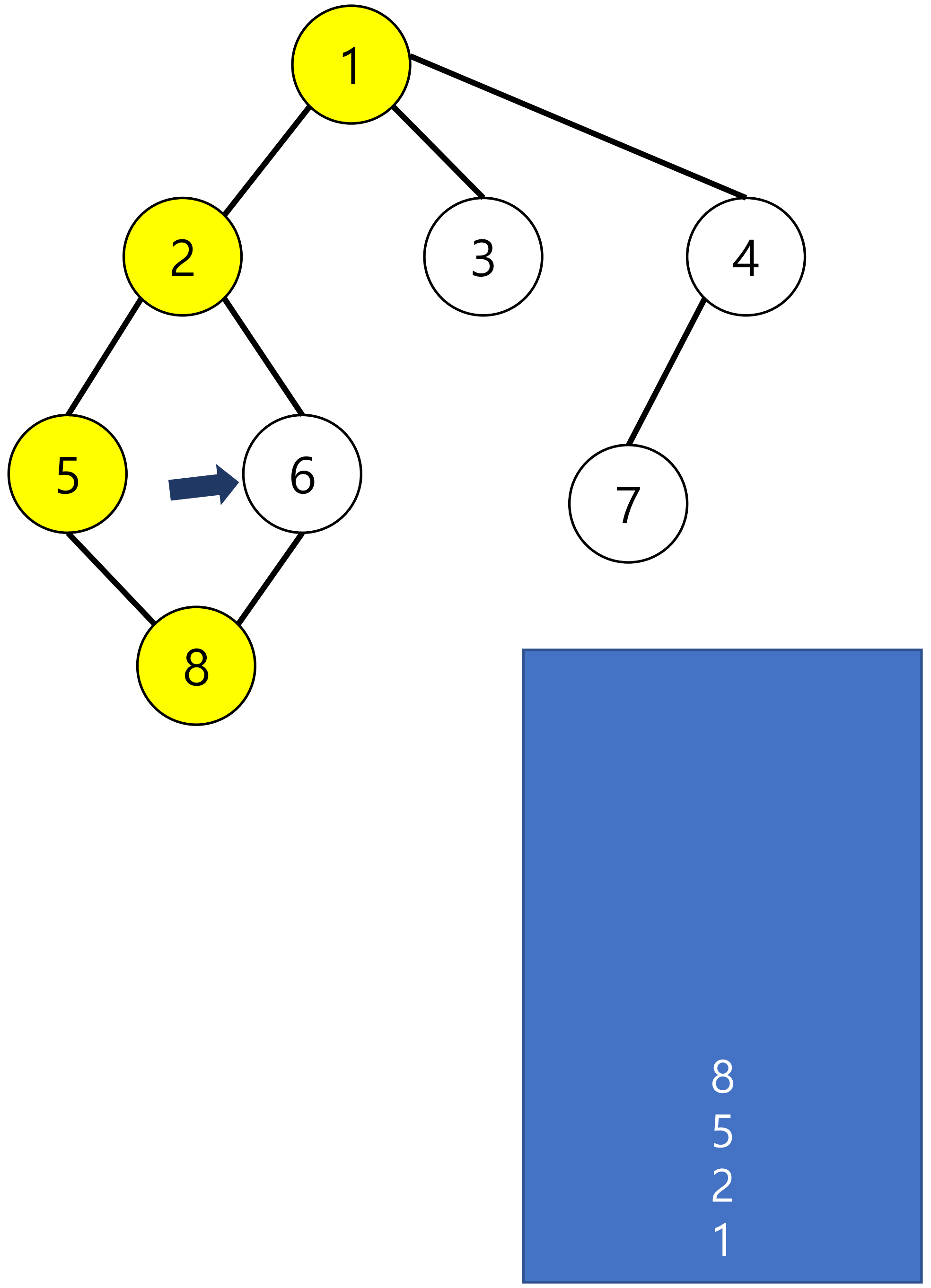

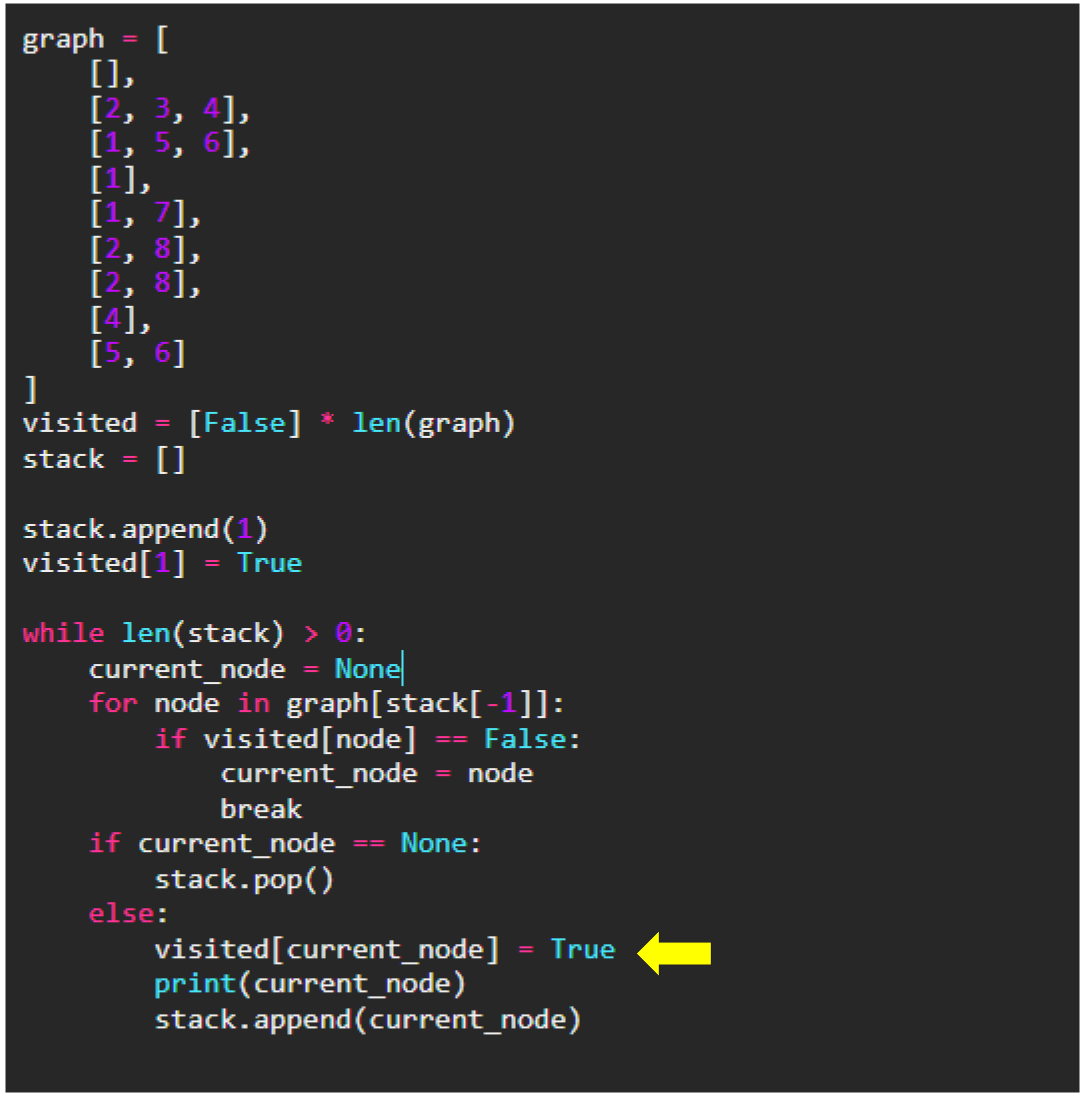

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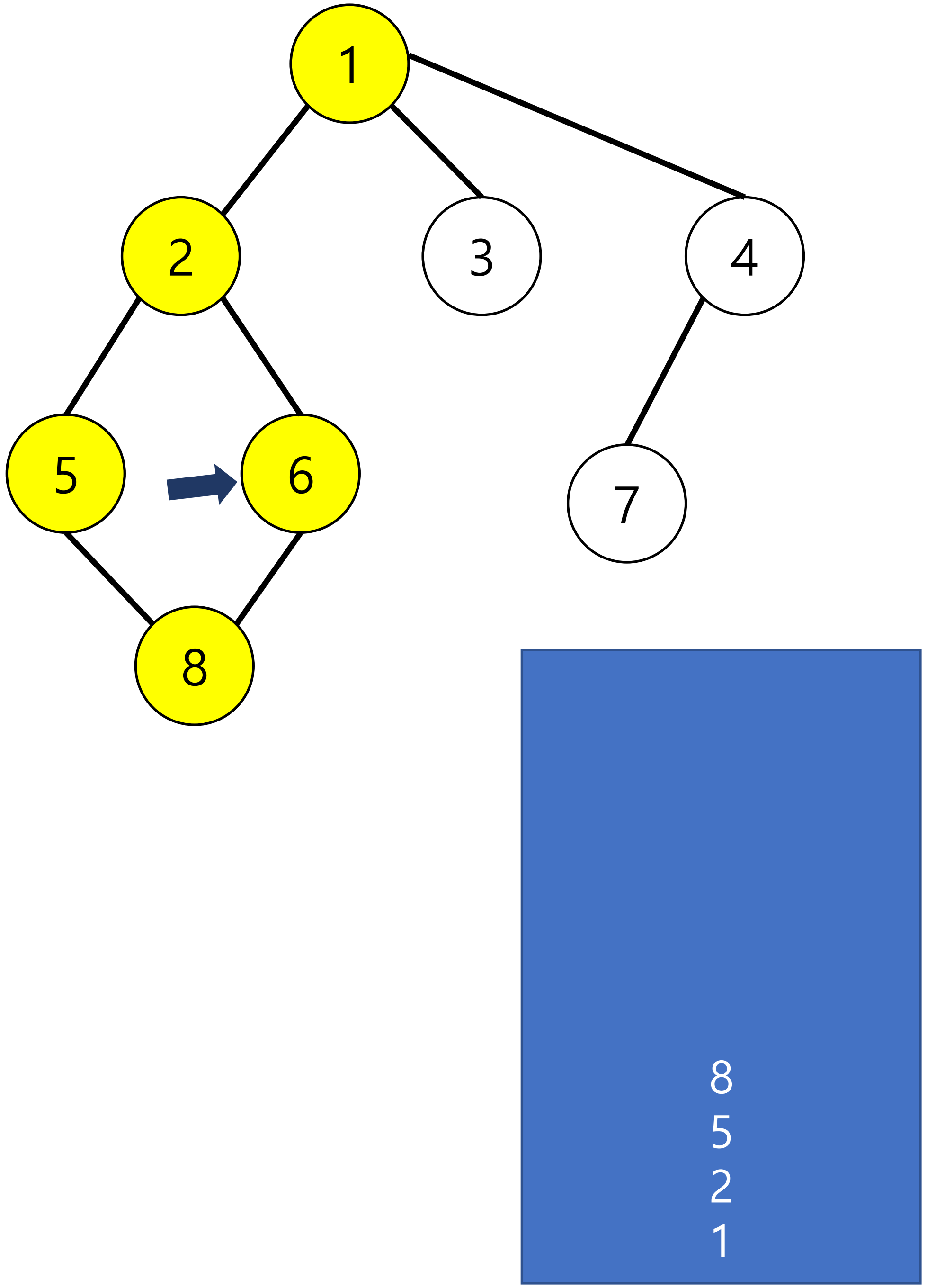

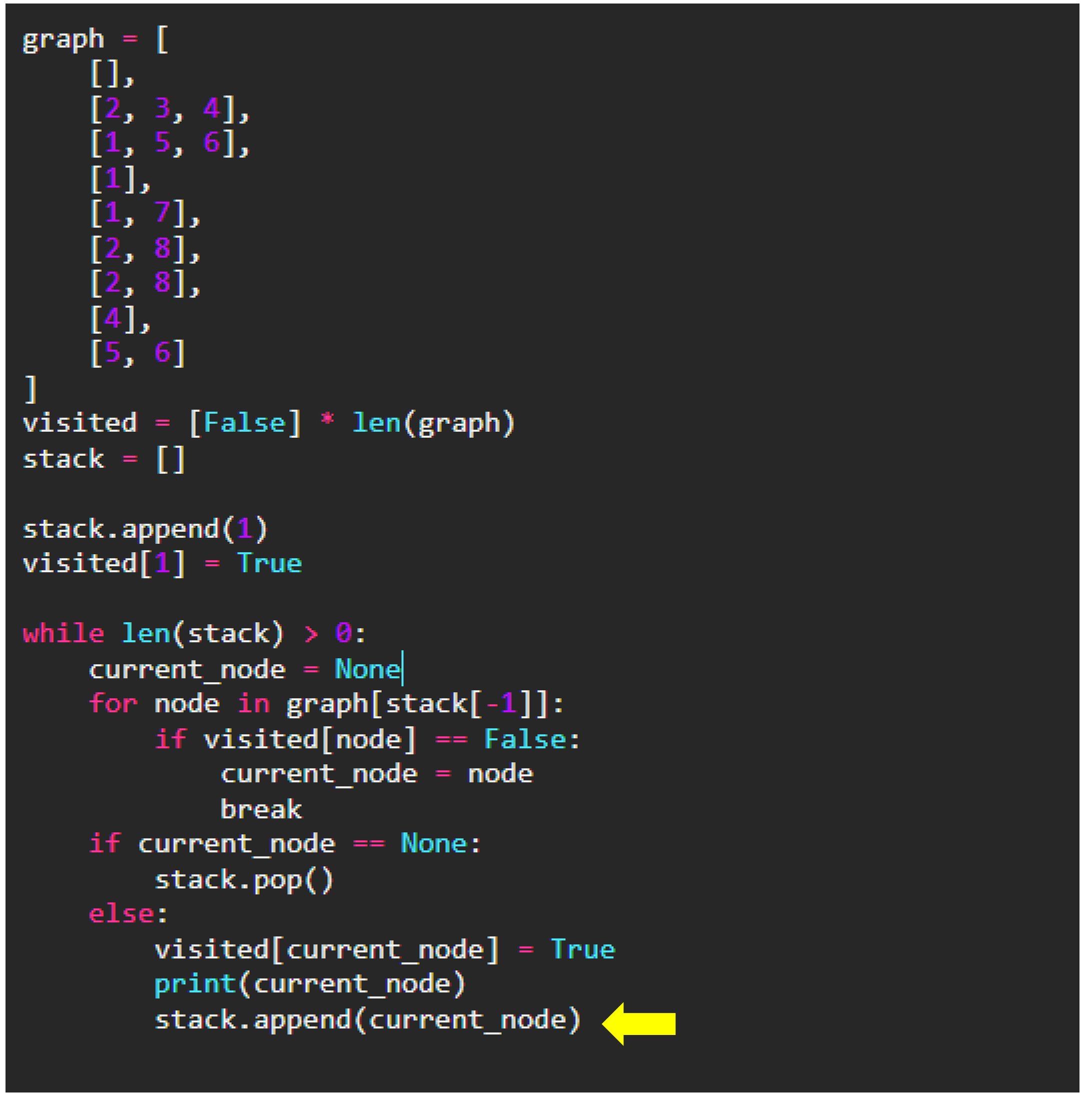

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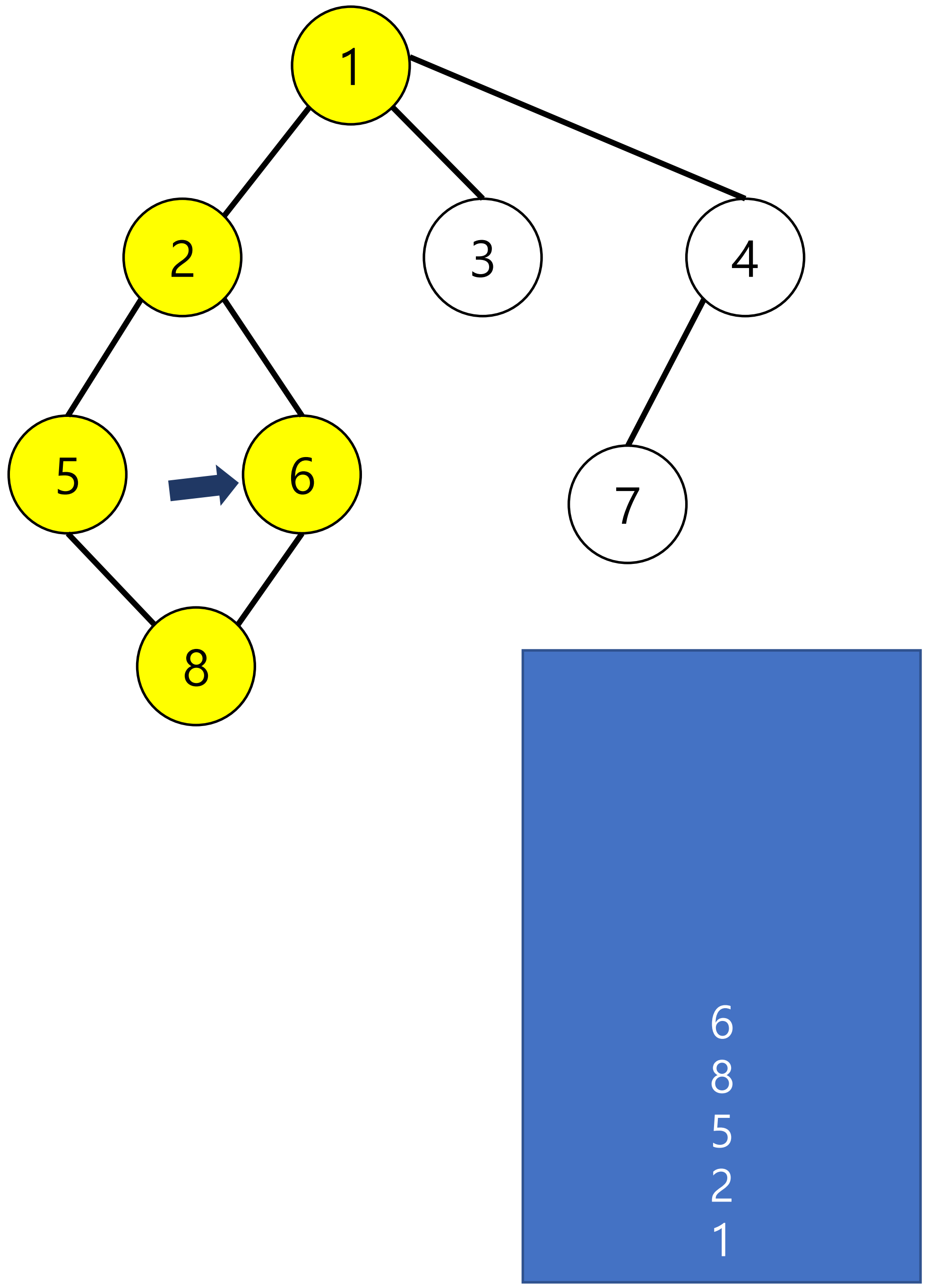

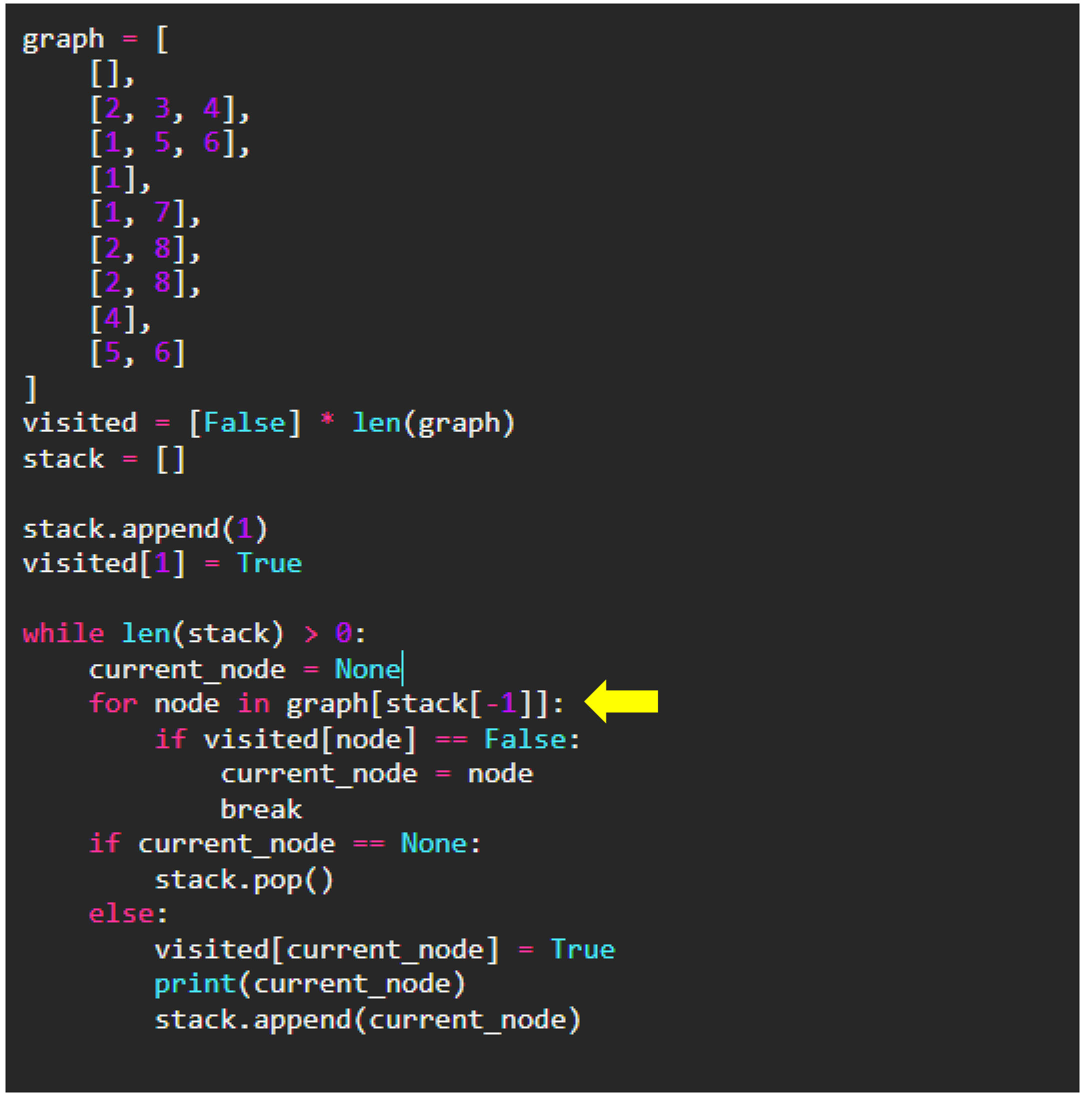

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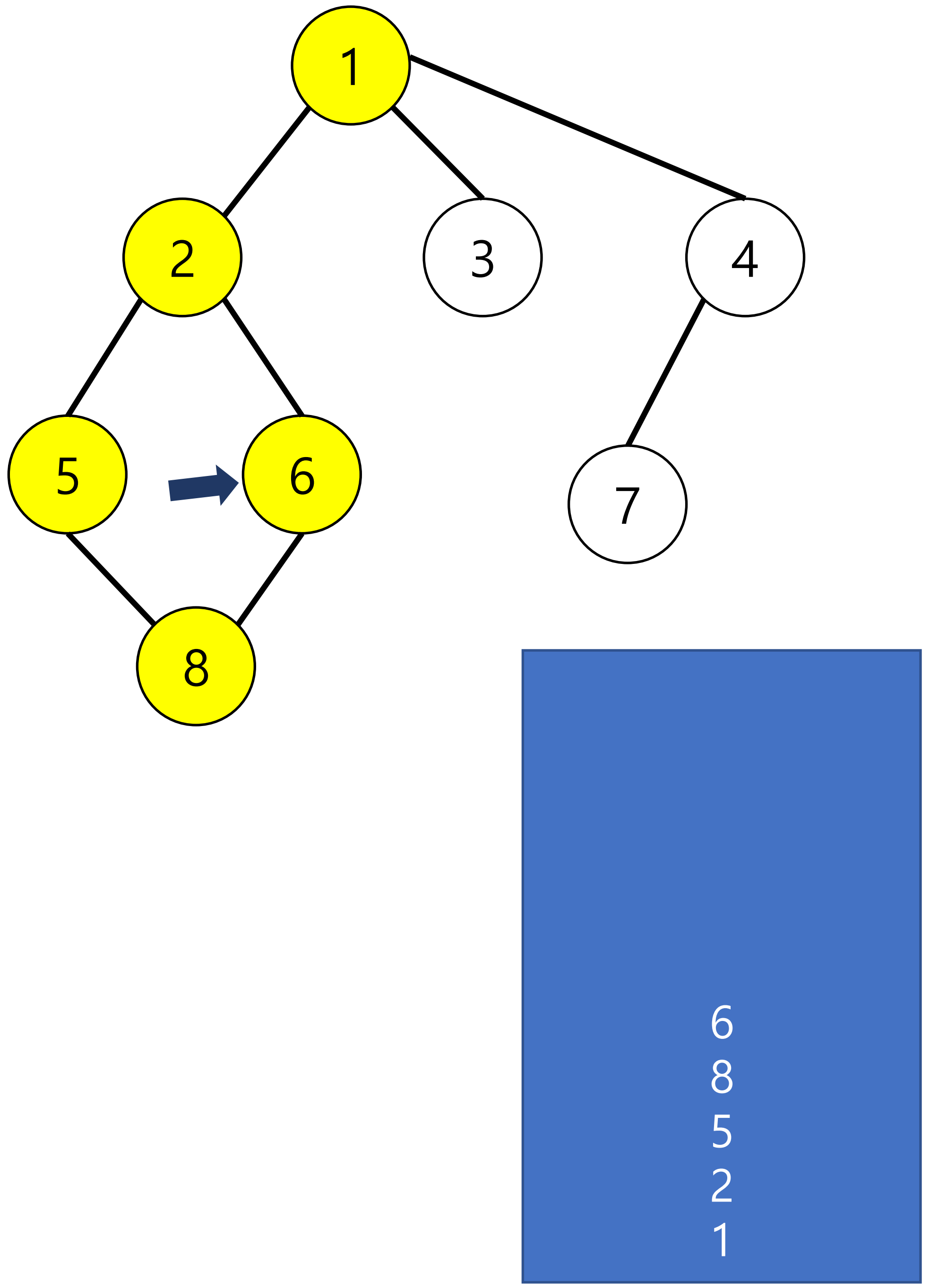

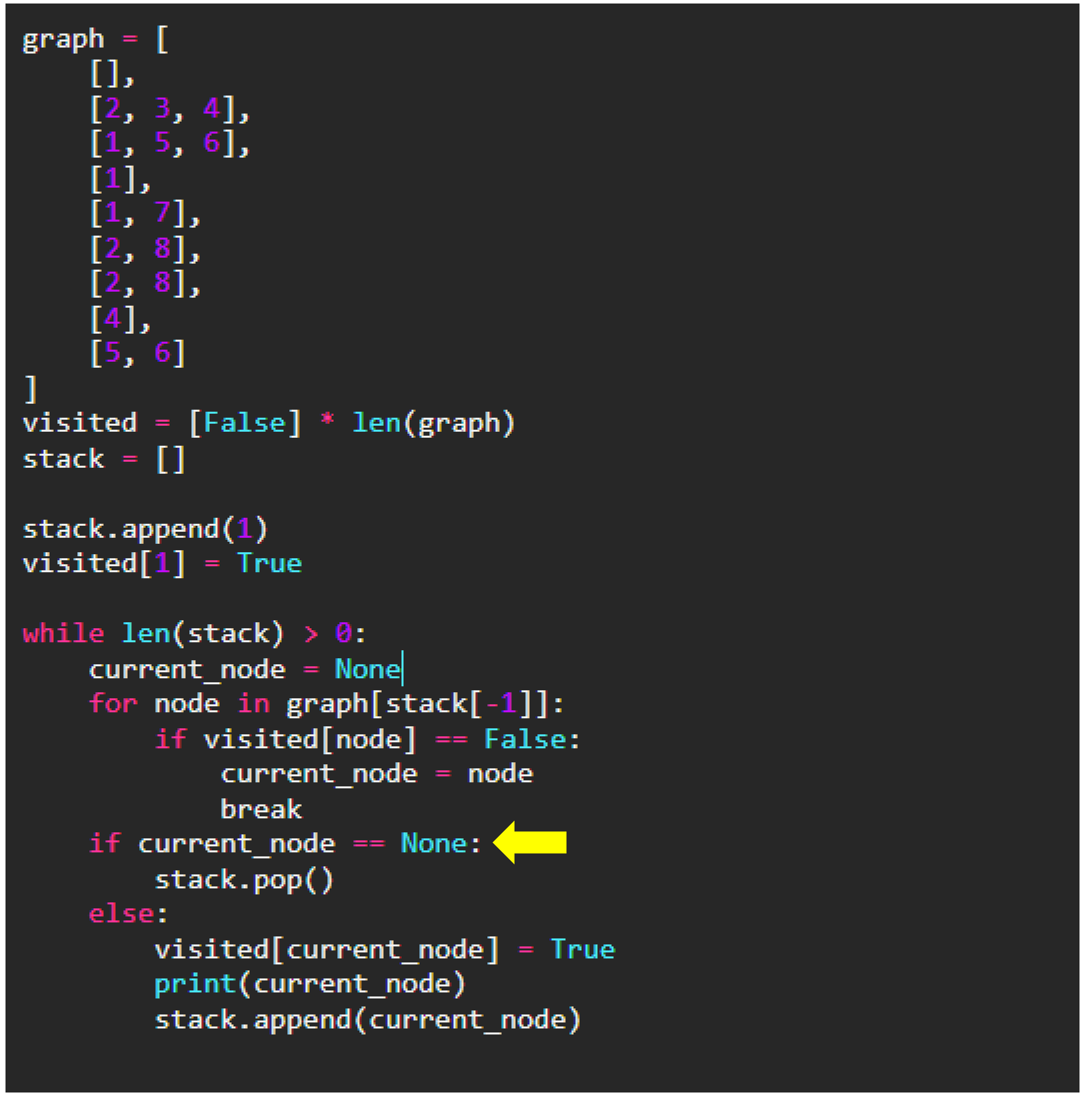

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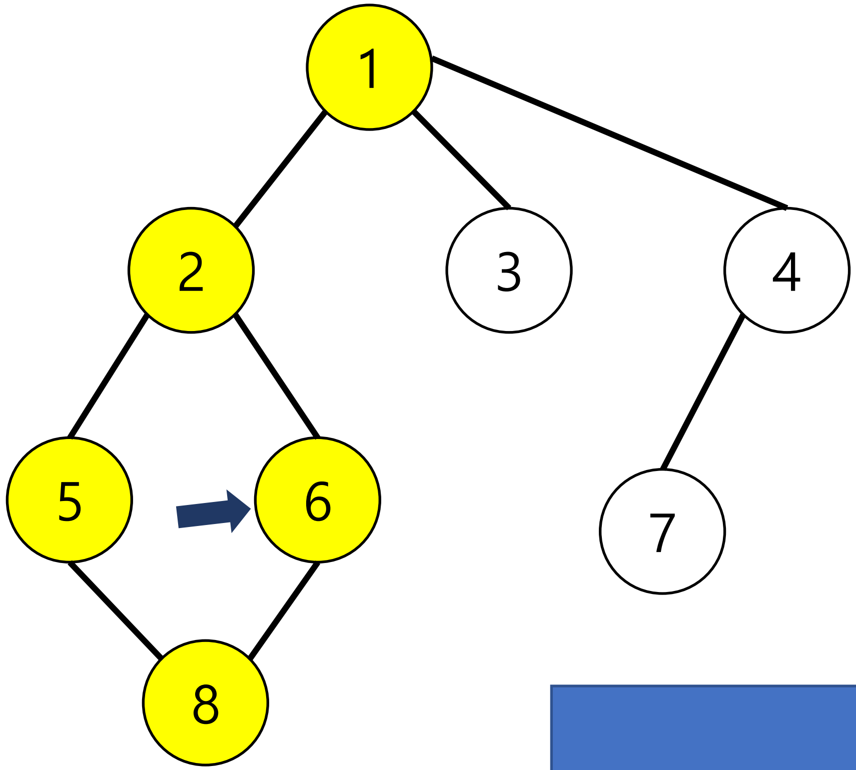

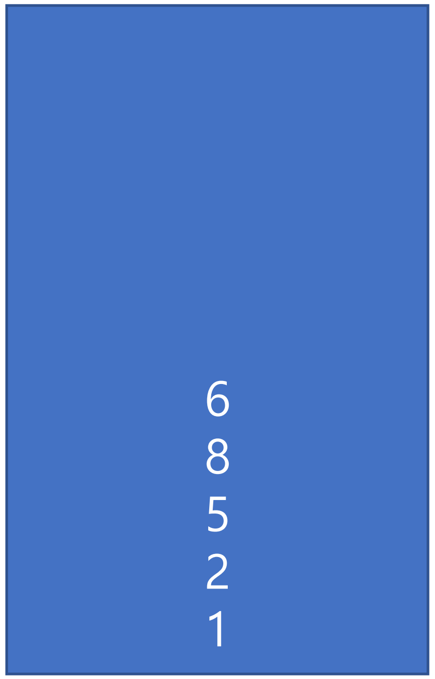

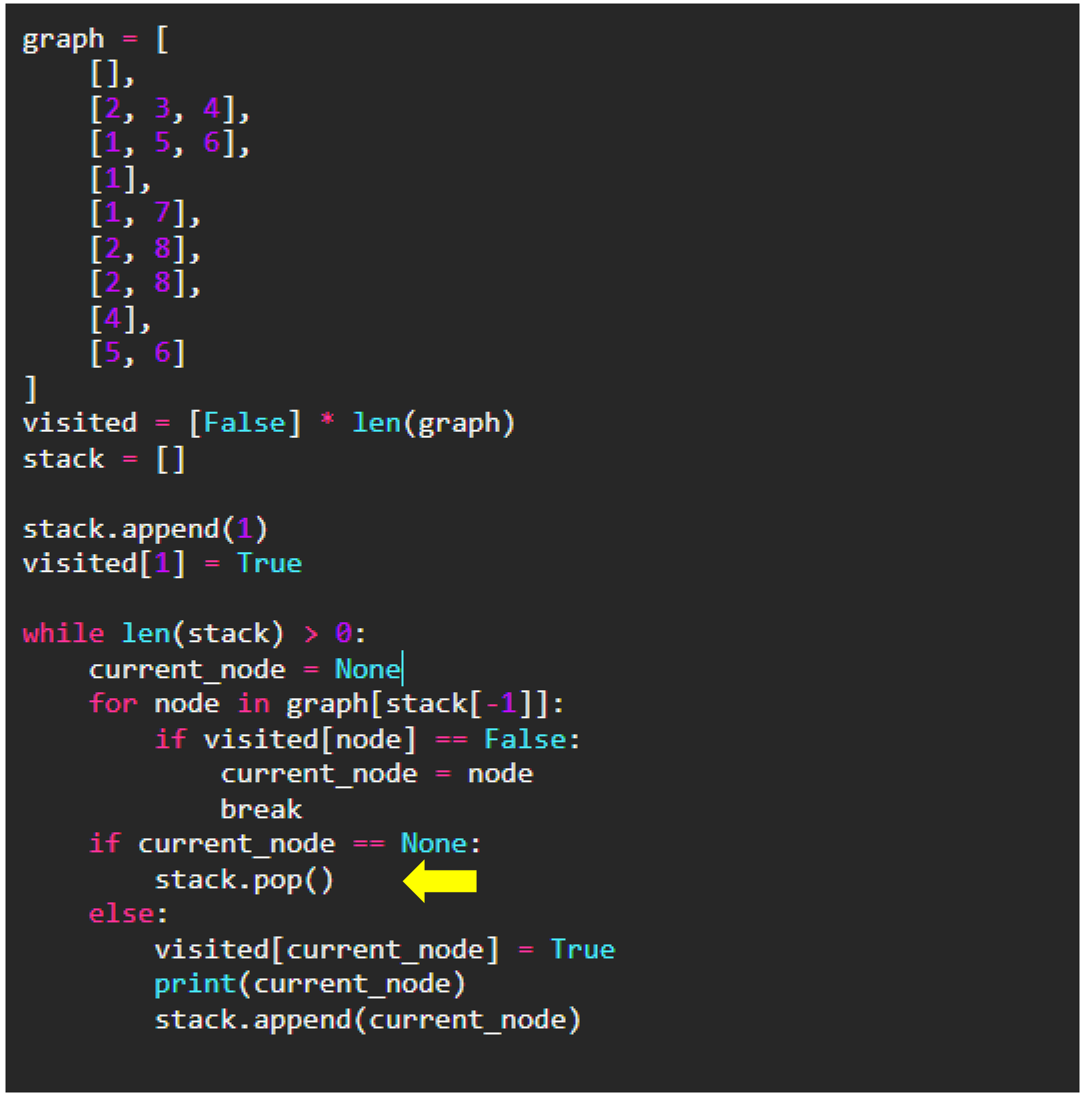

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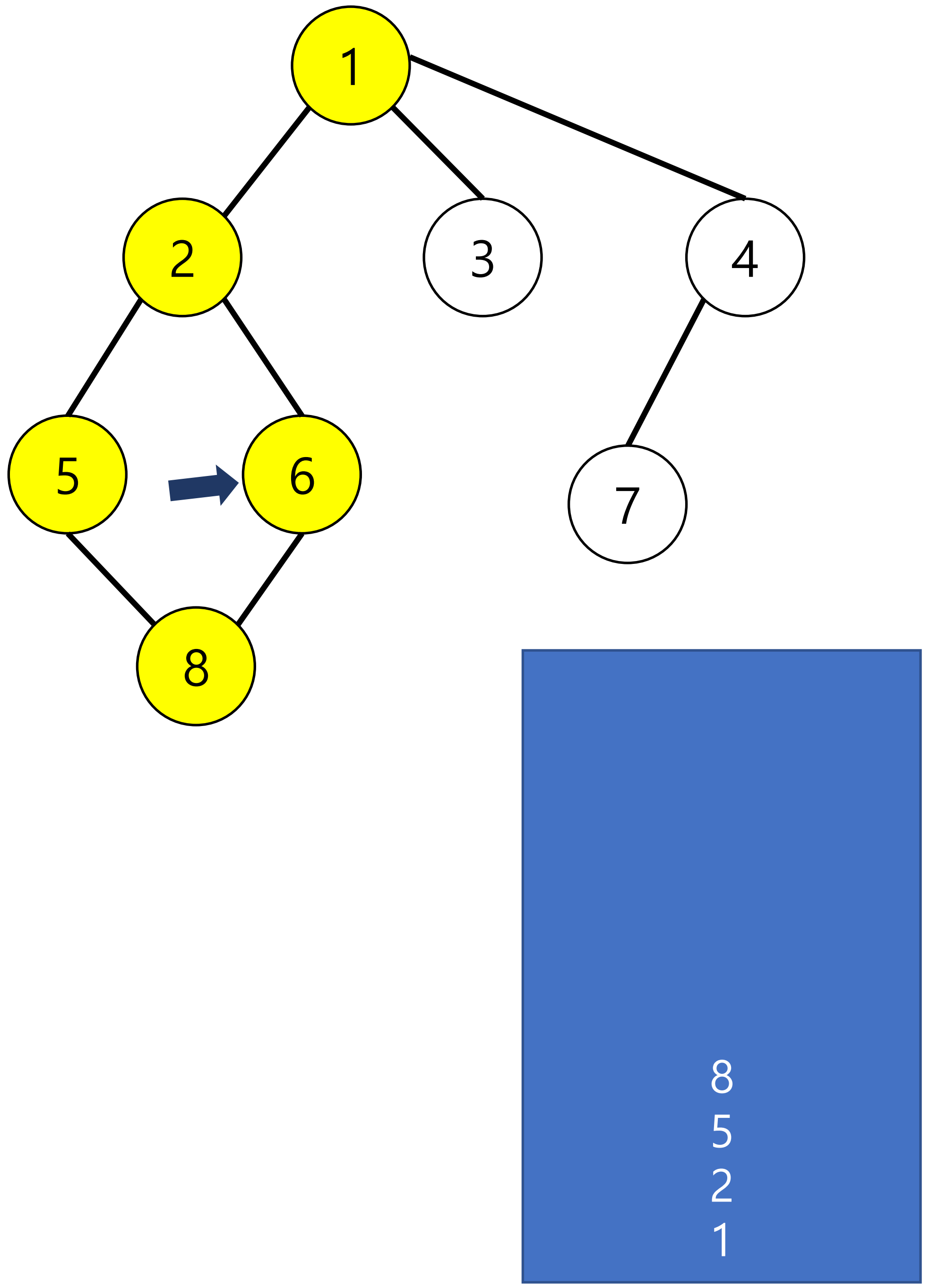

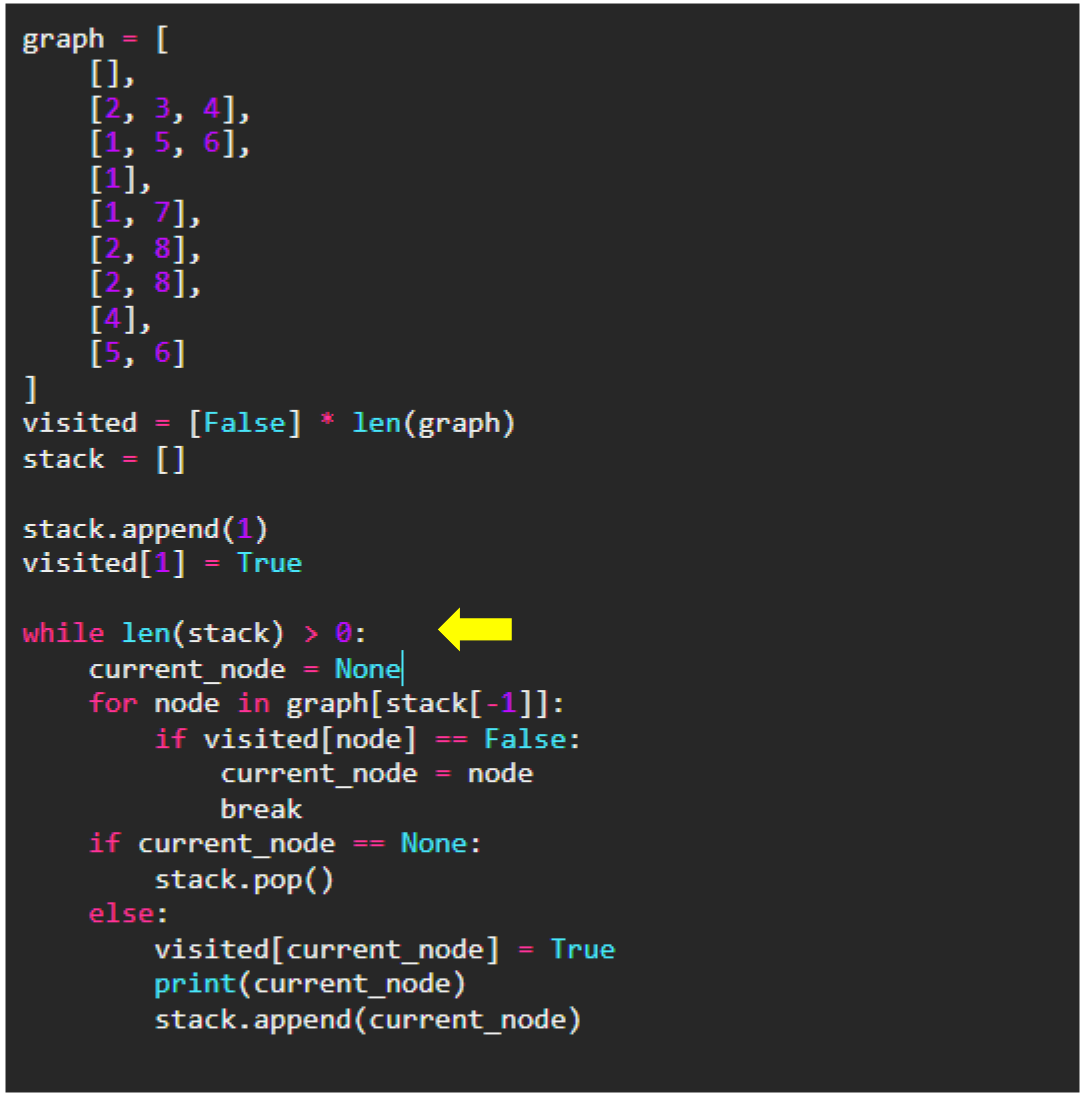

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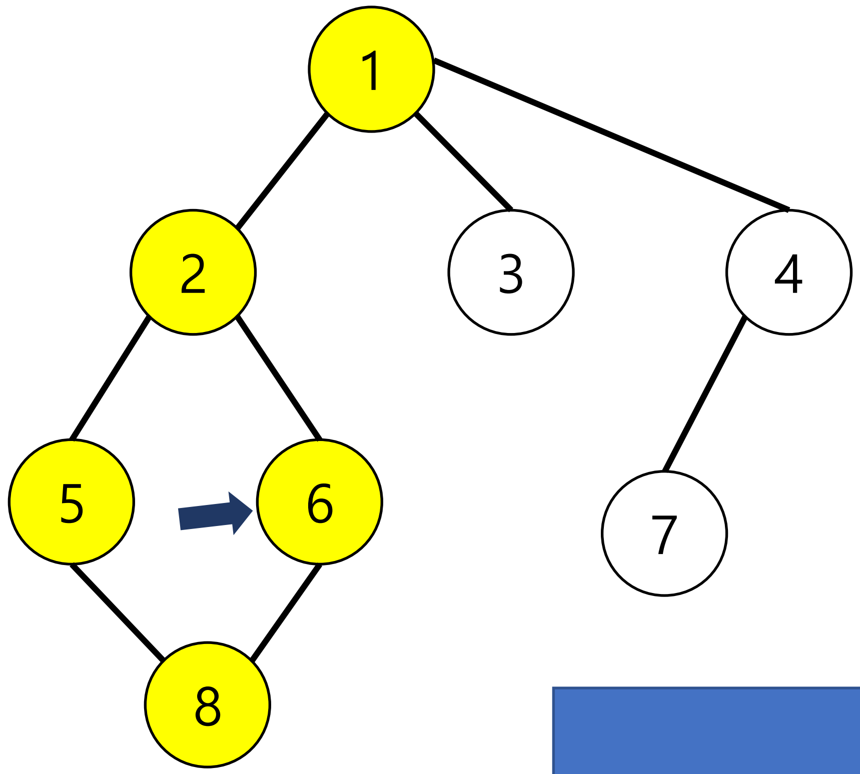

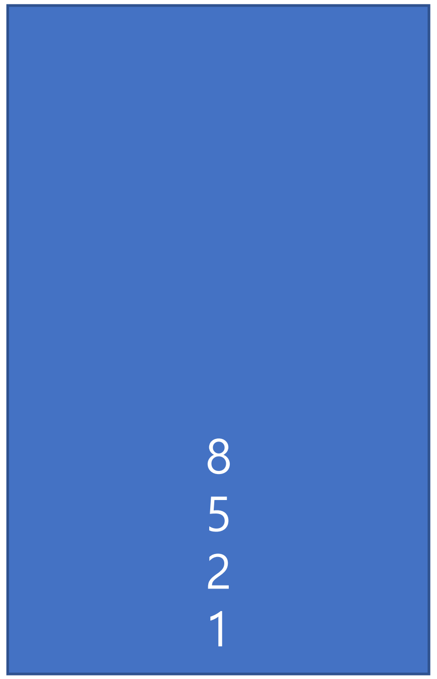

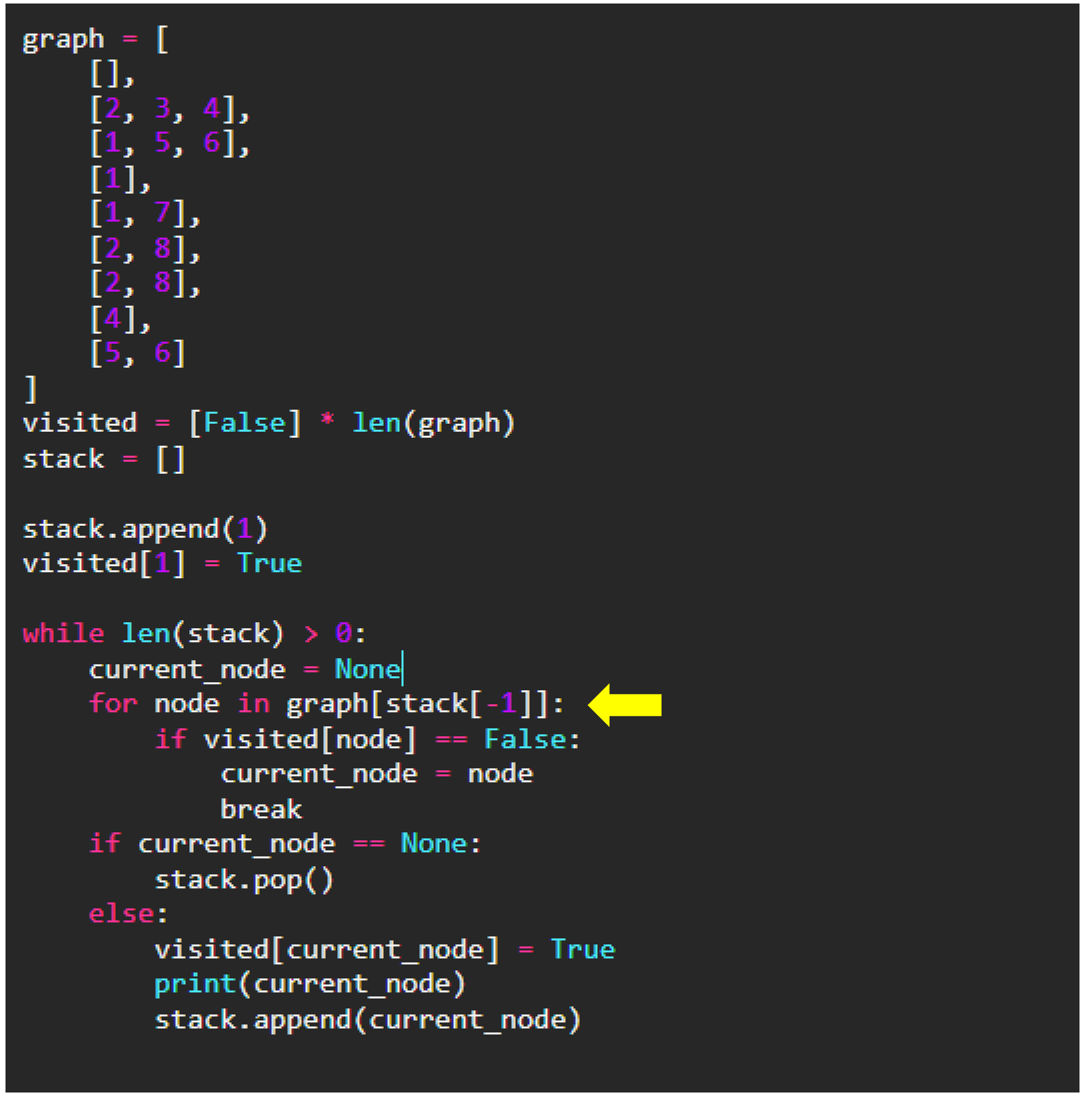

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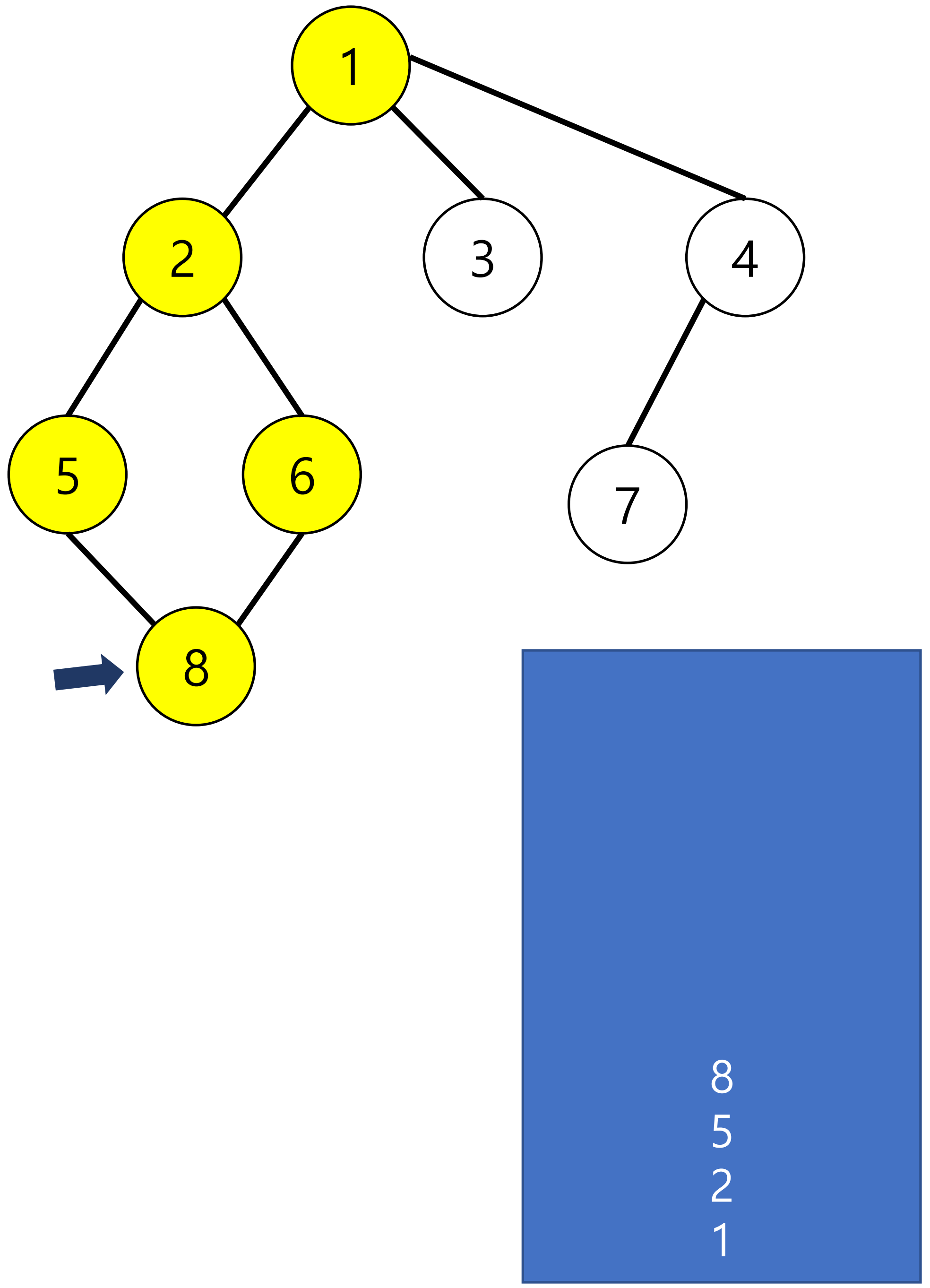

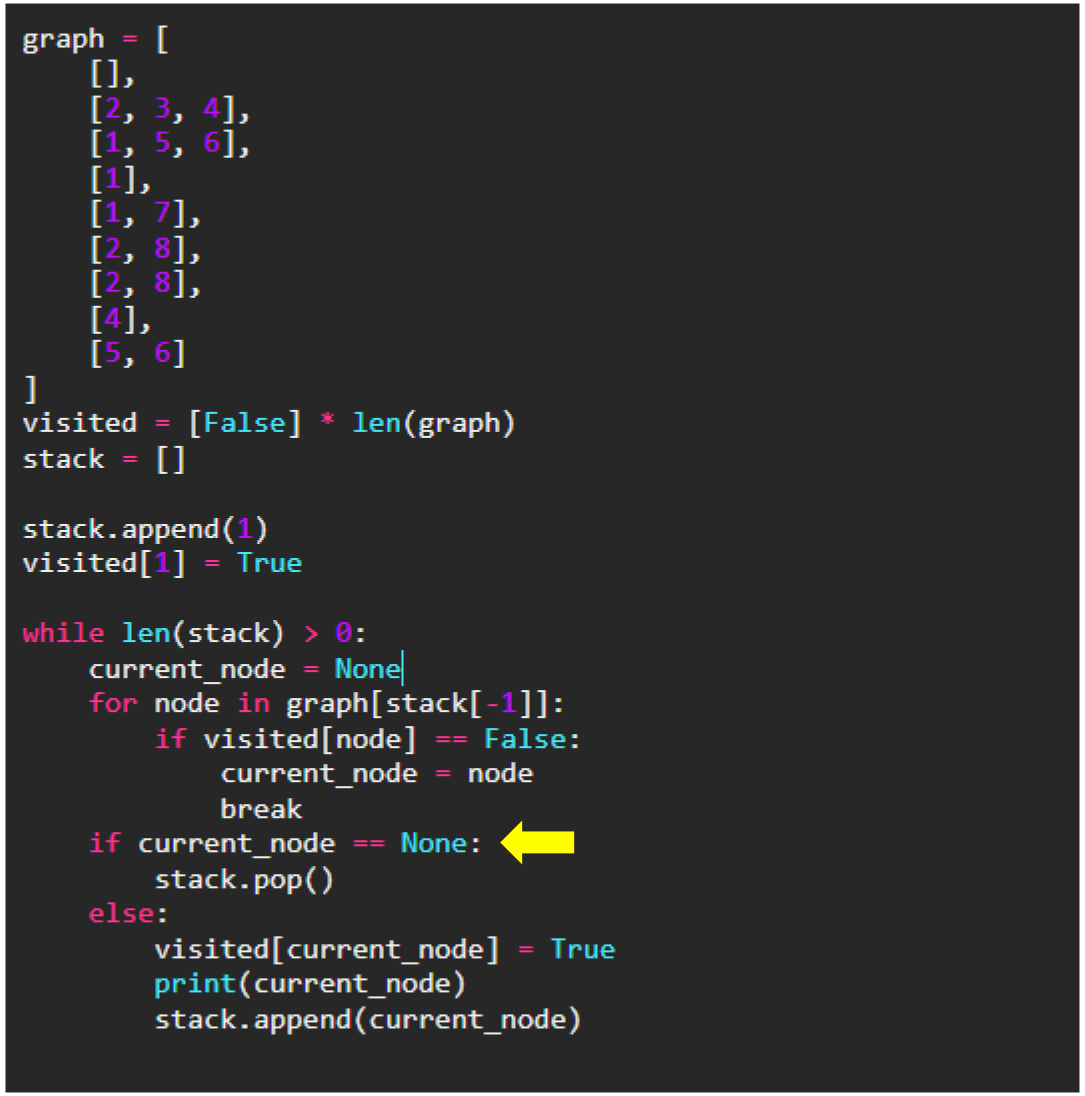

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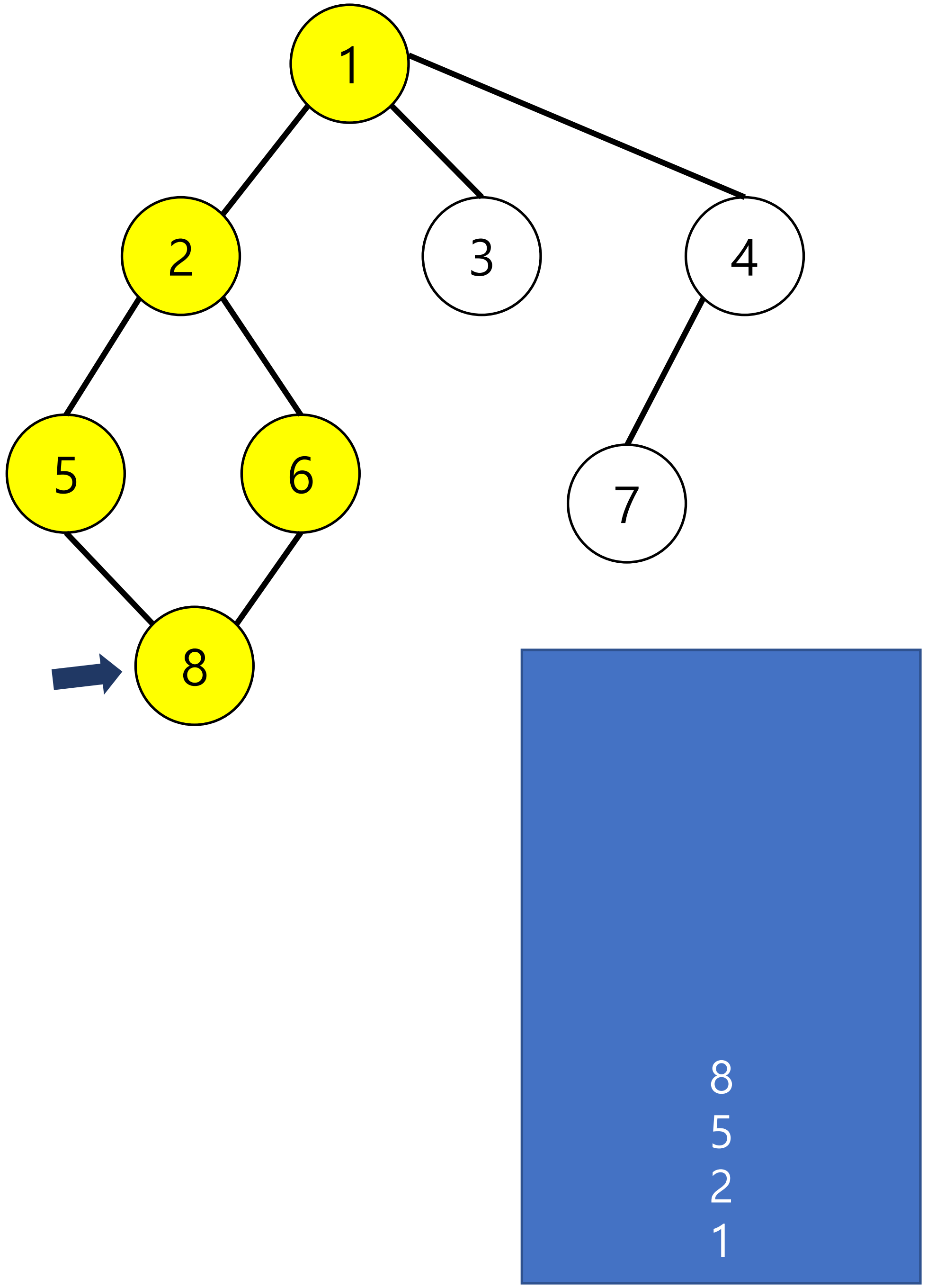

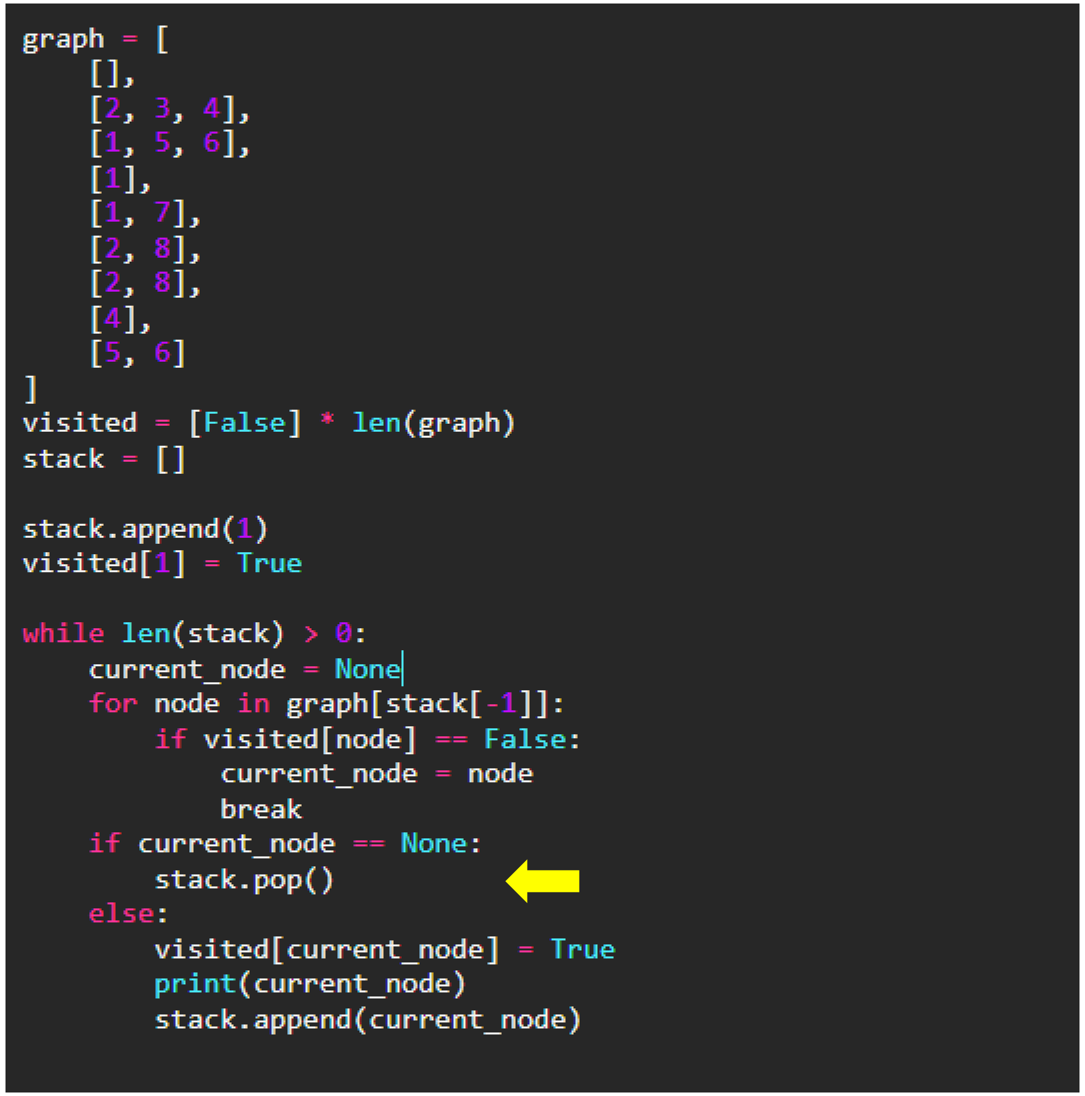

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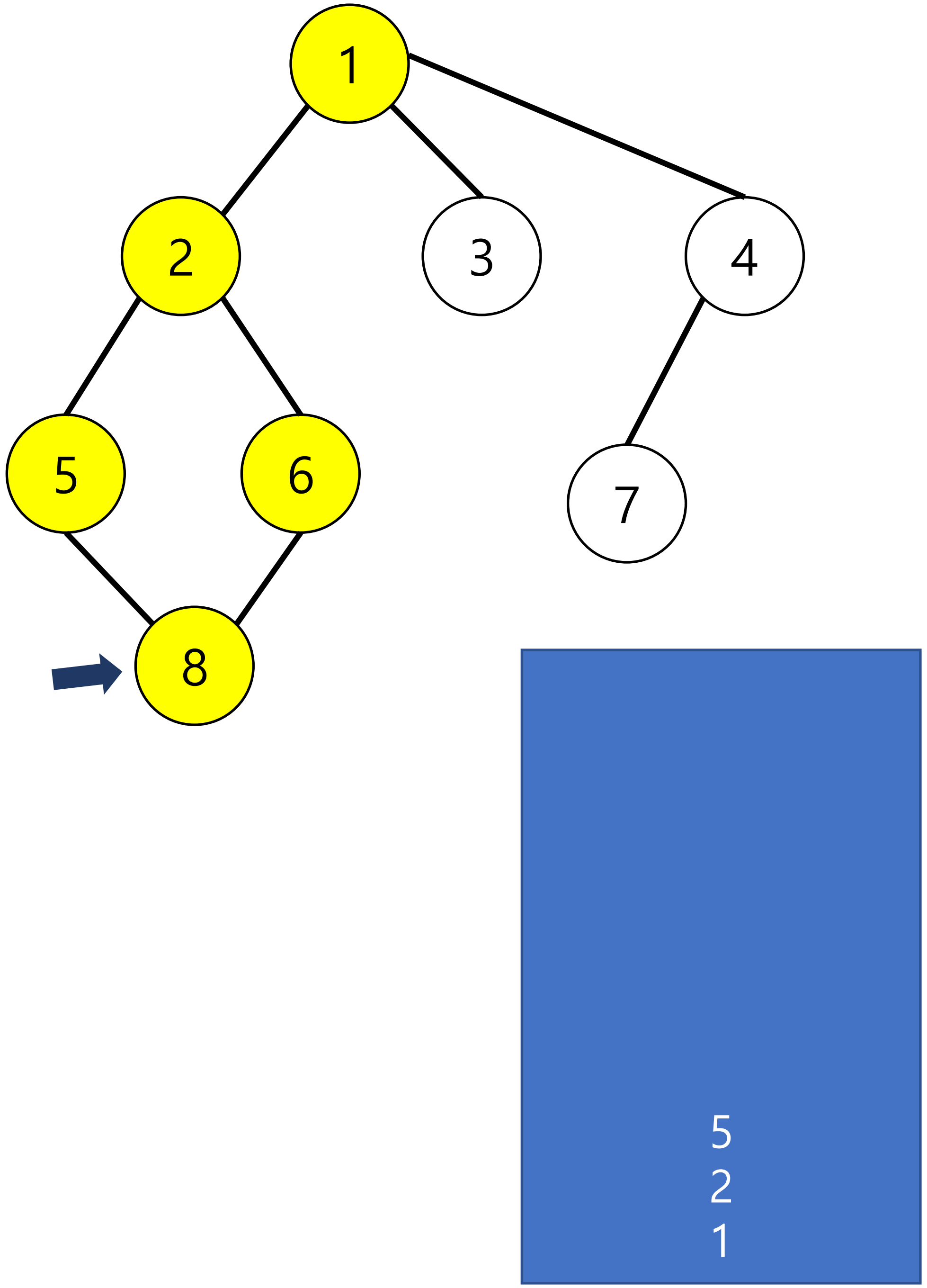

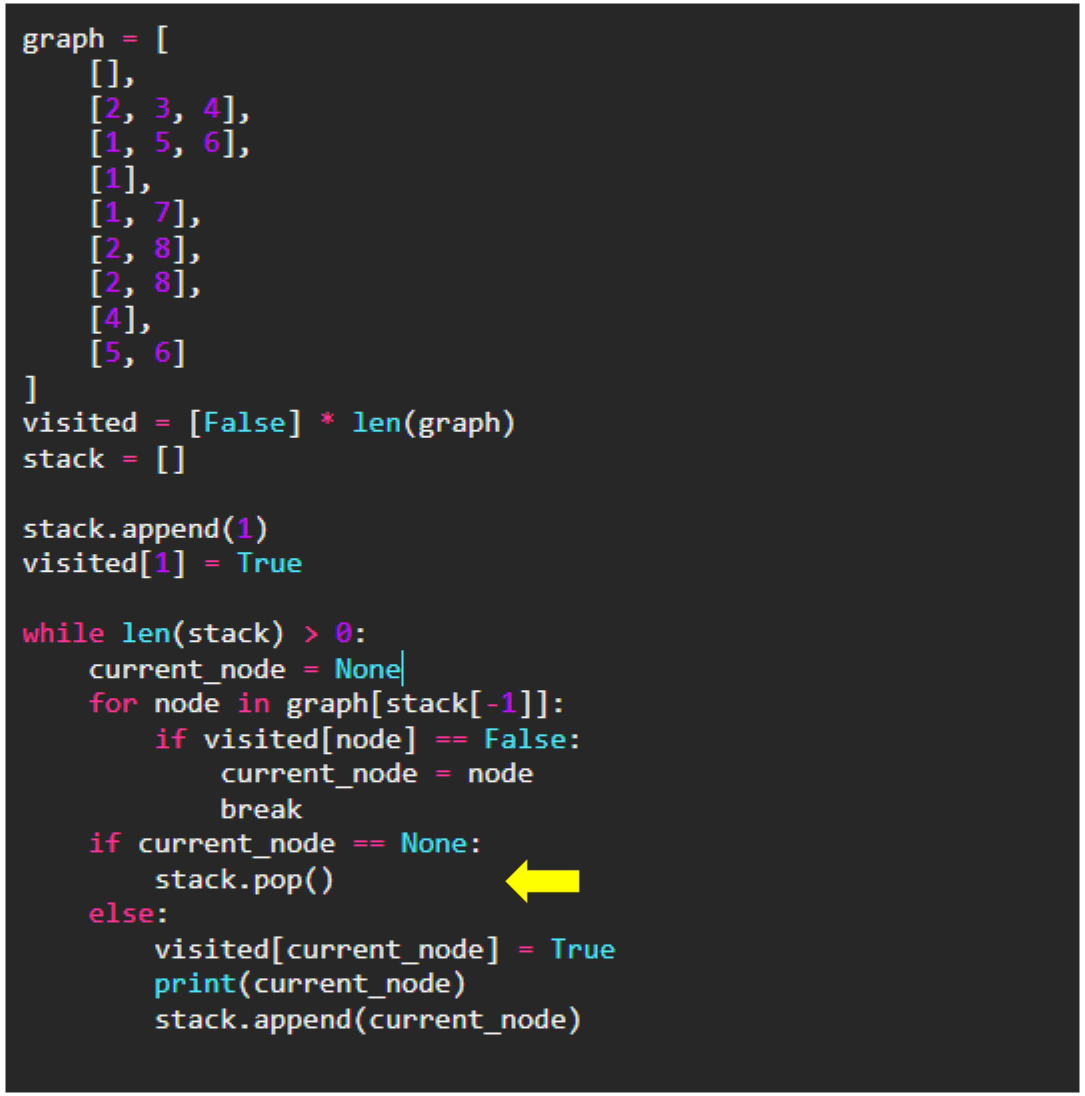

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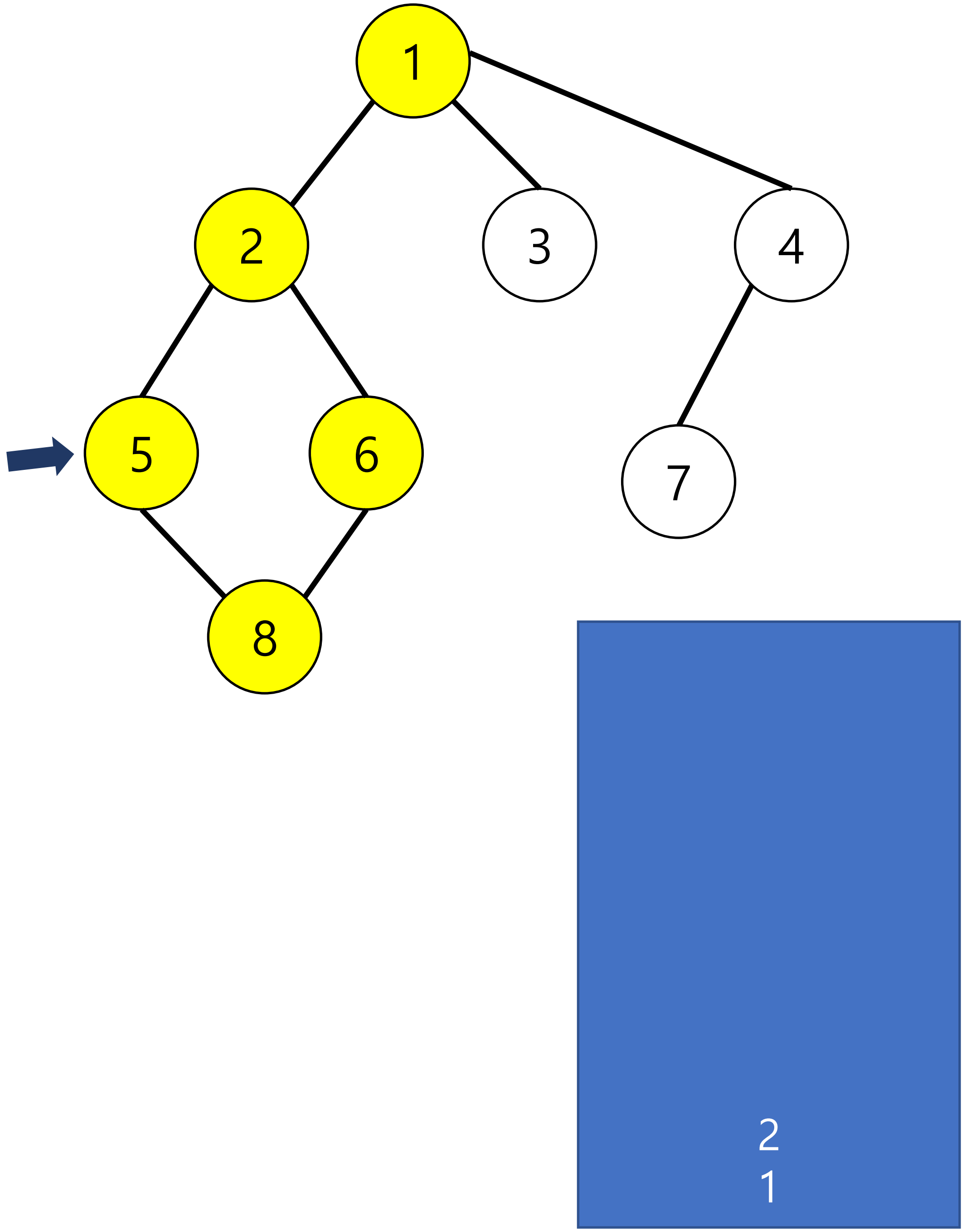

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    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
    [4],
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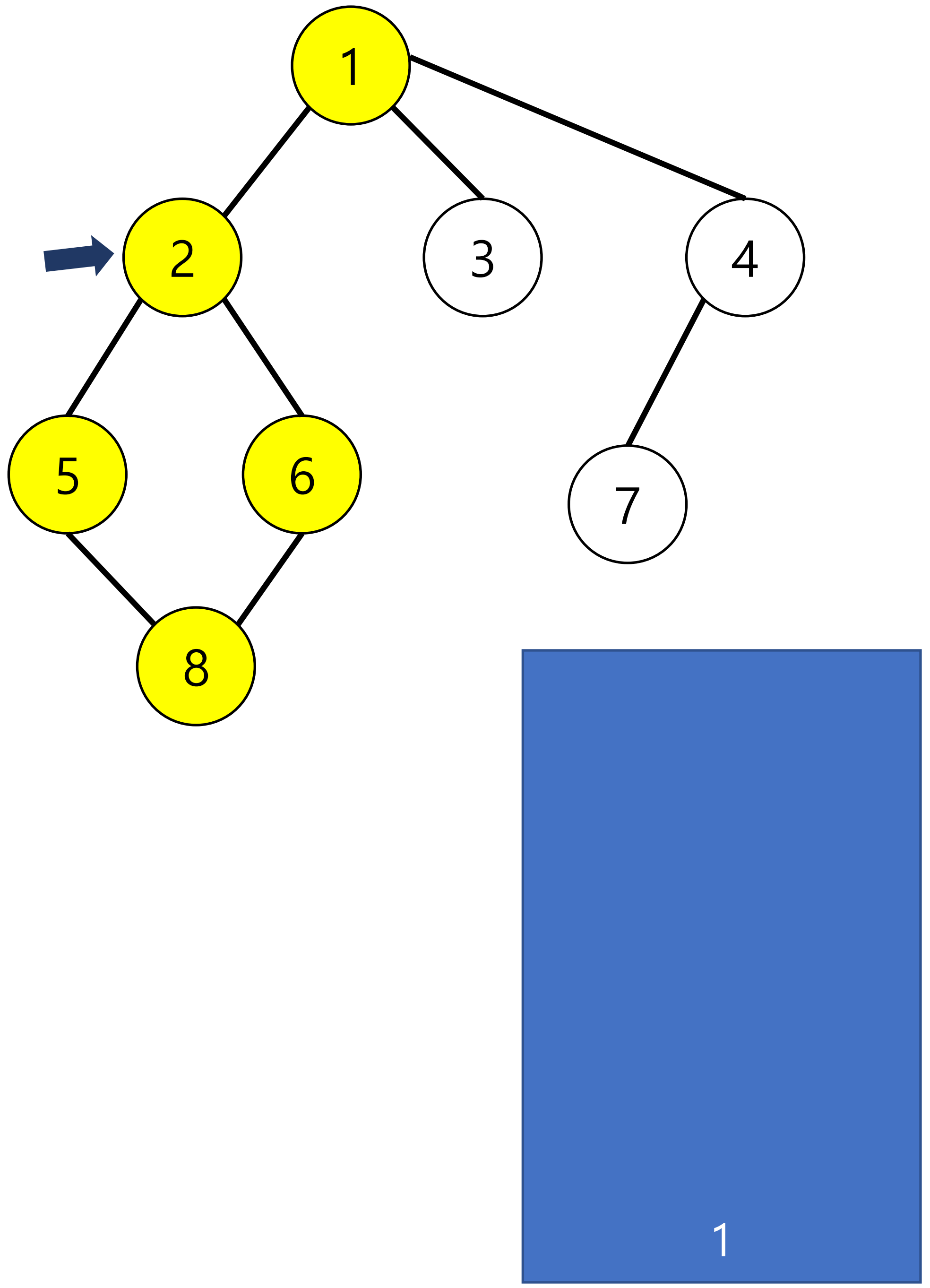

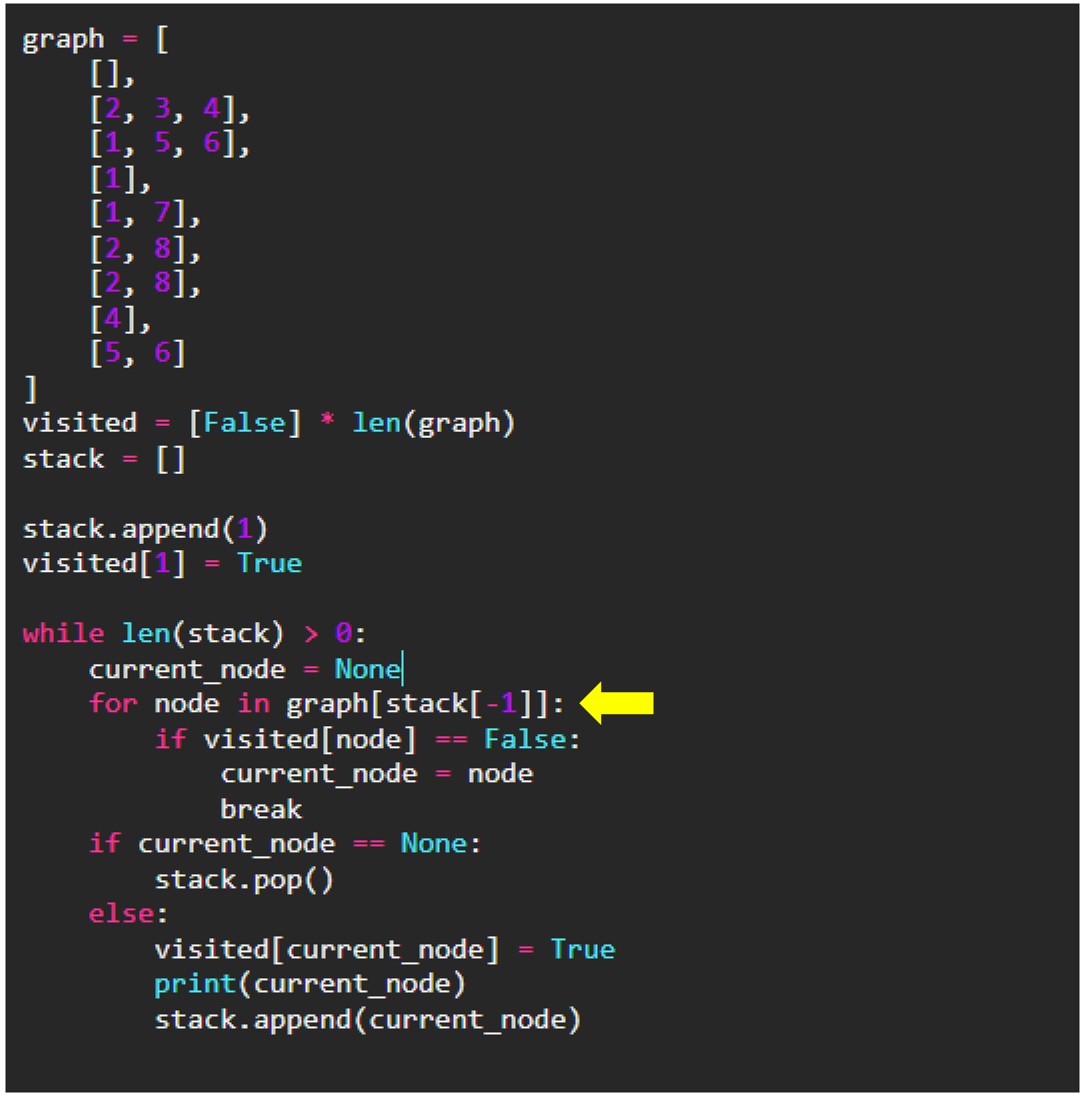

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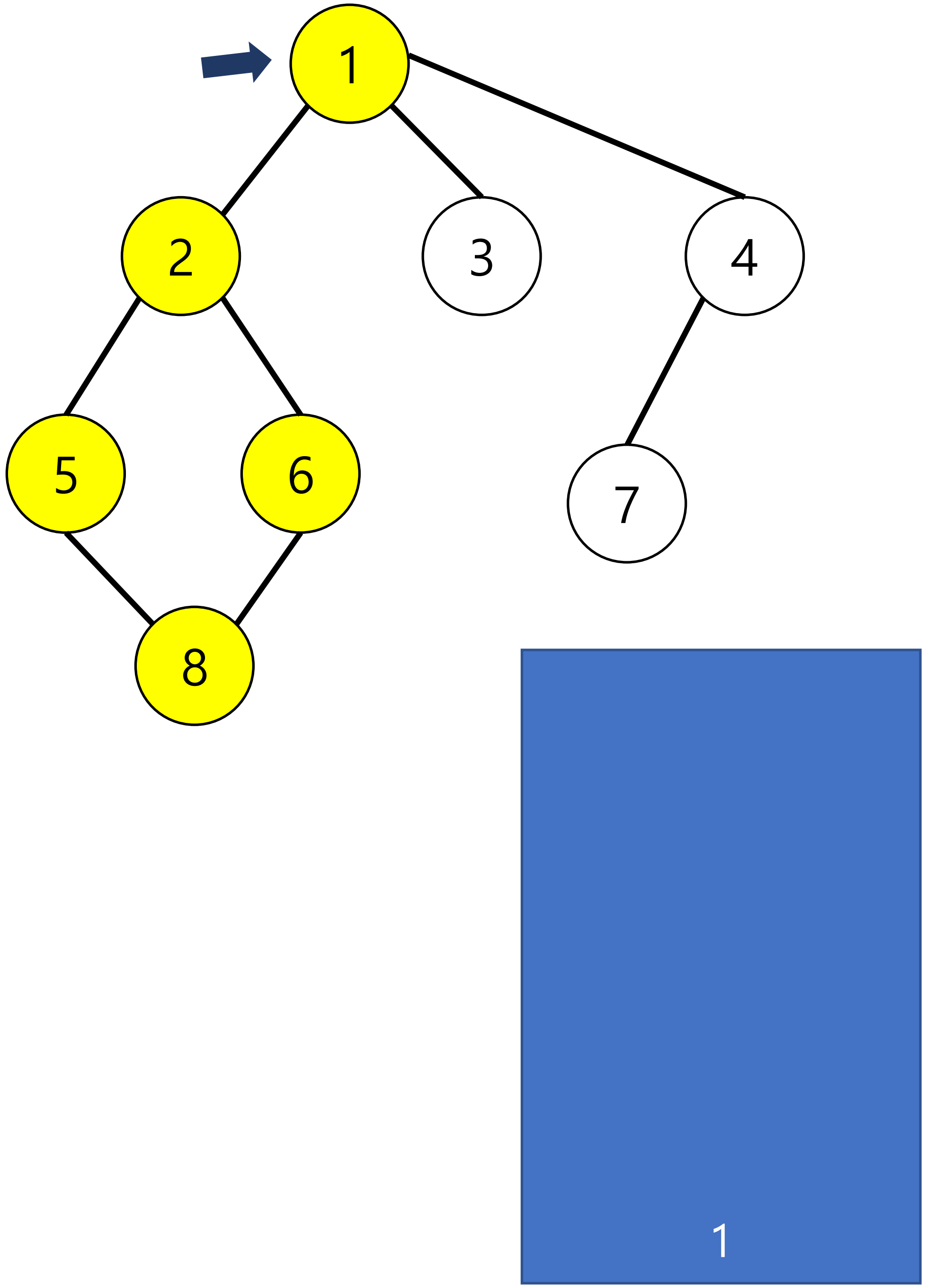

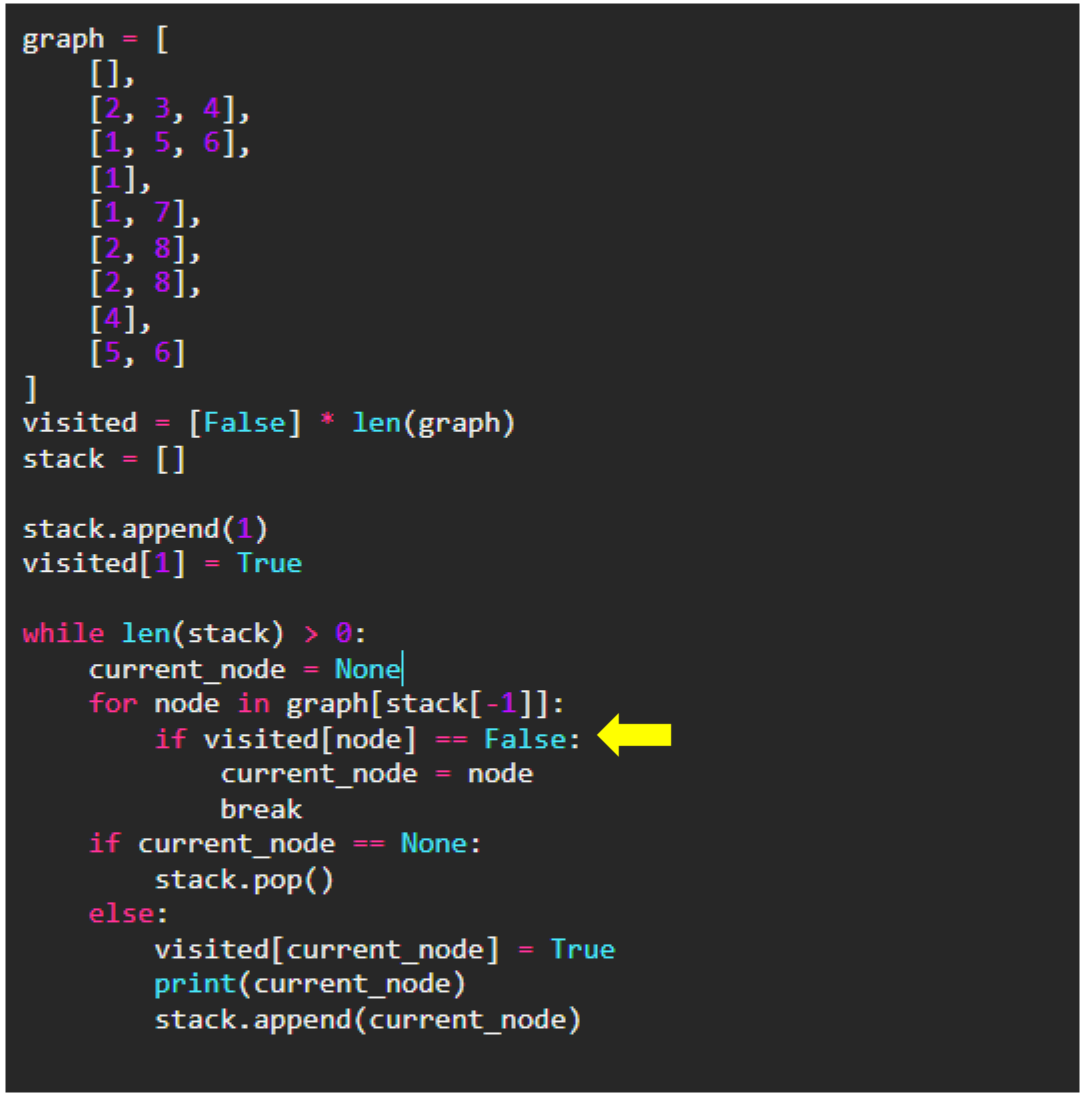

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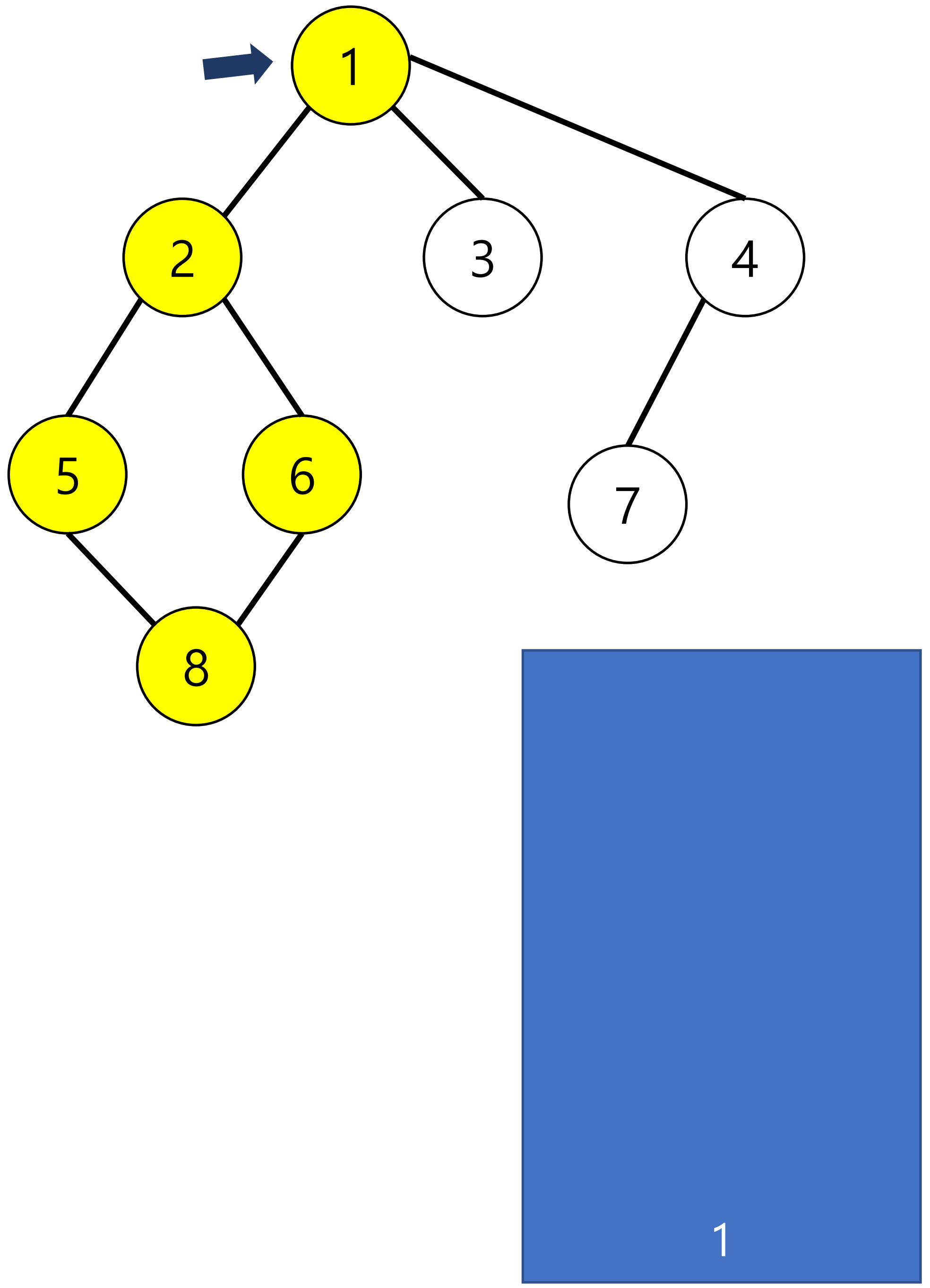

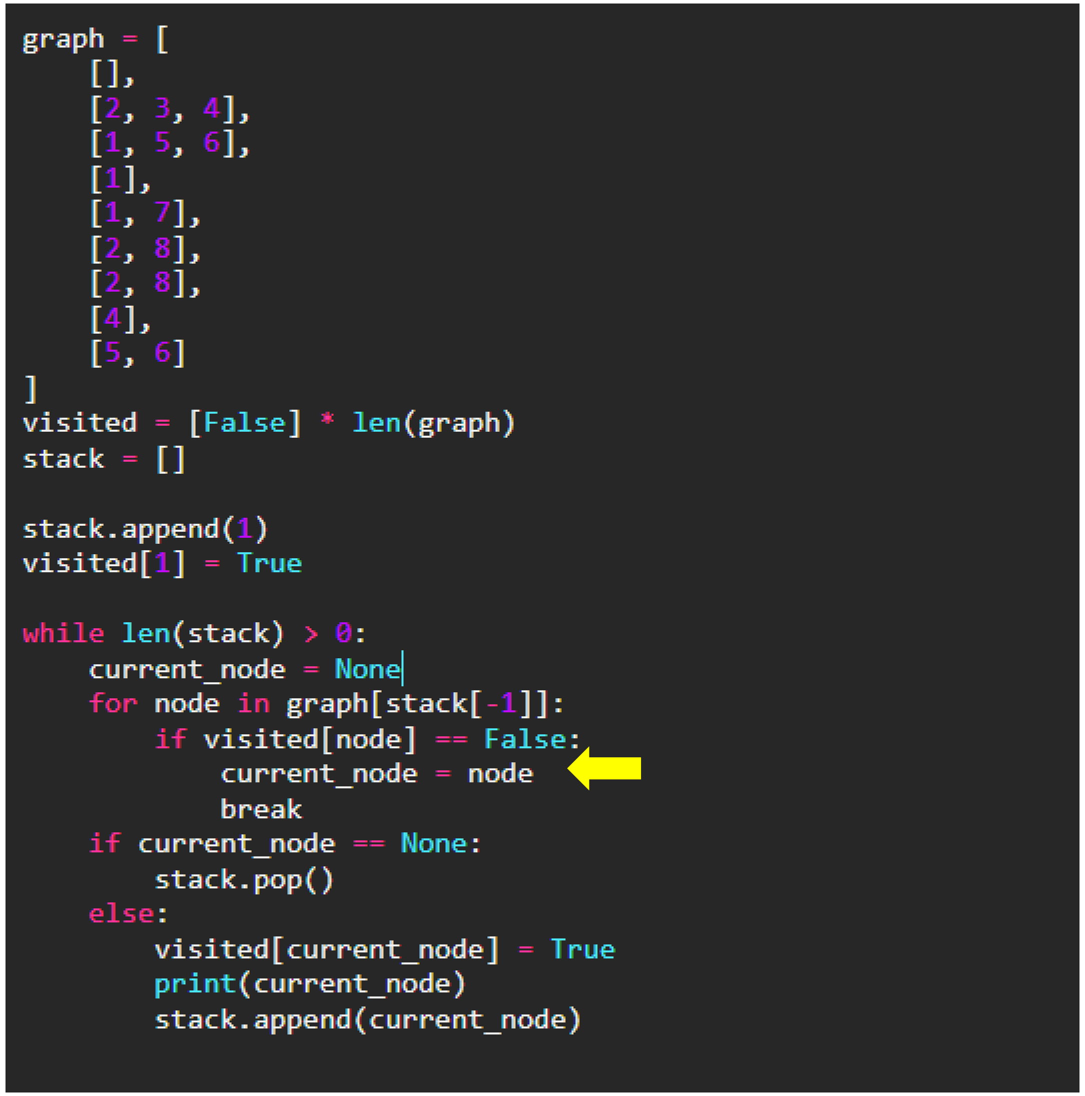

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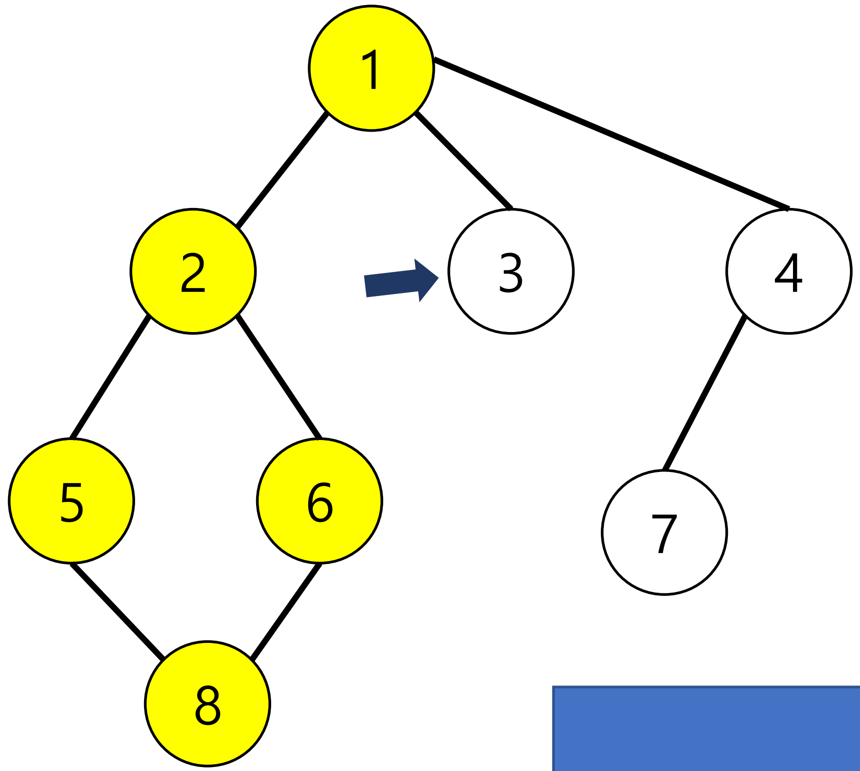

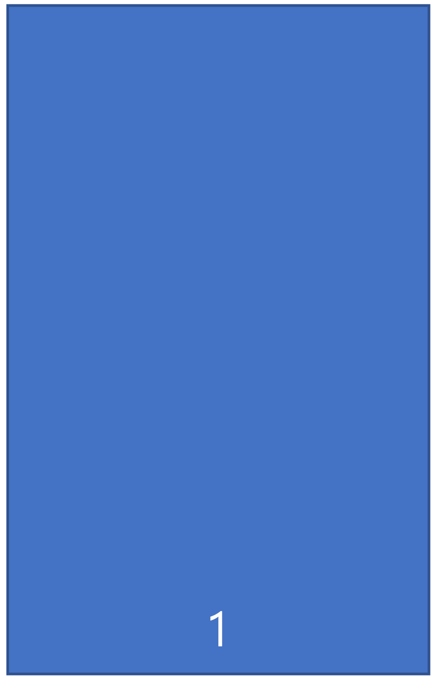

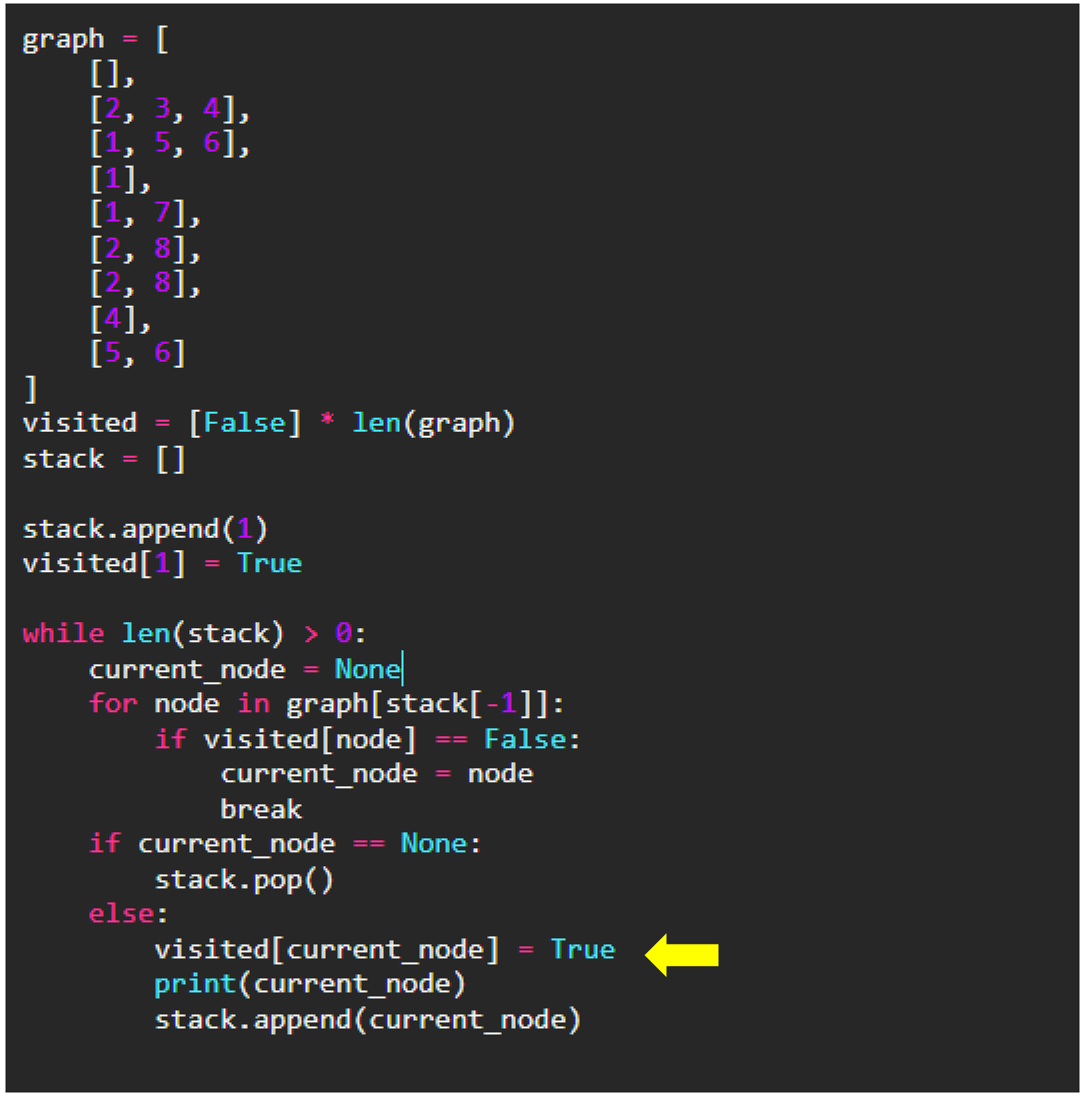

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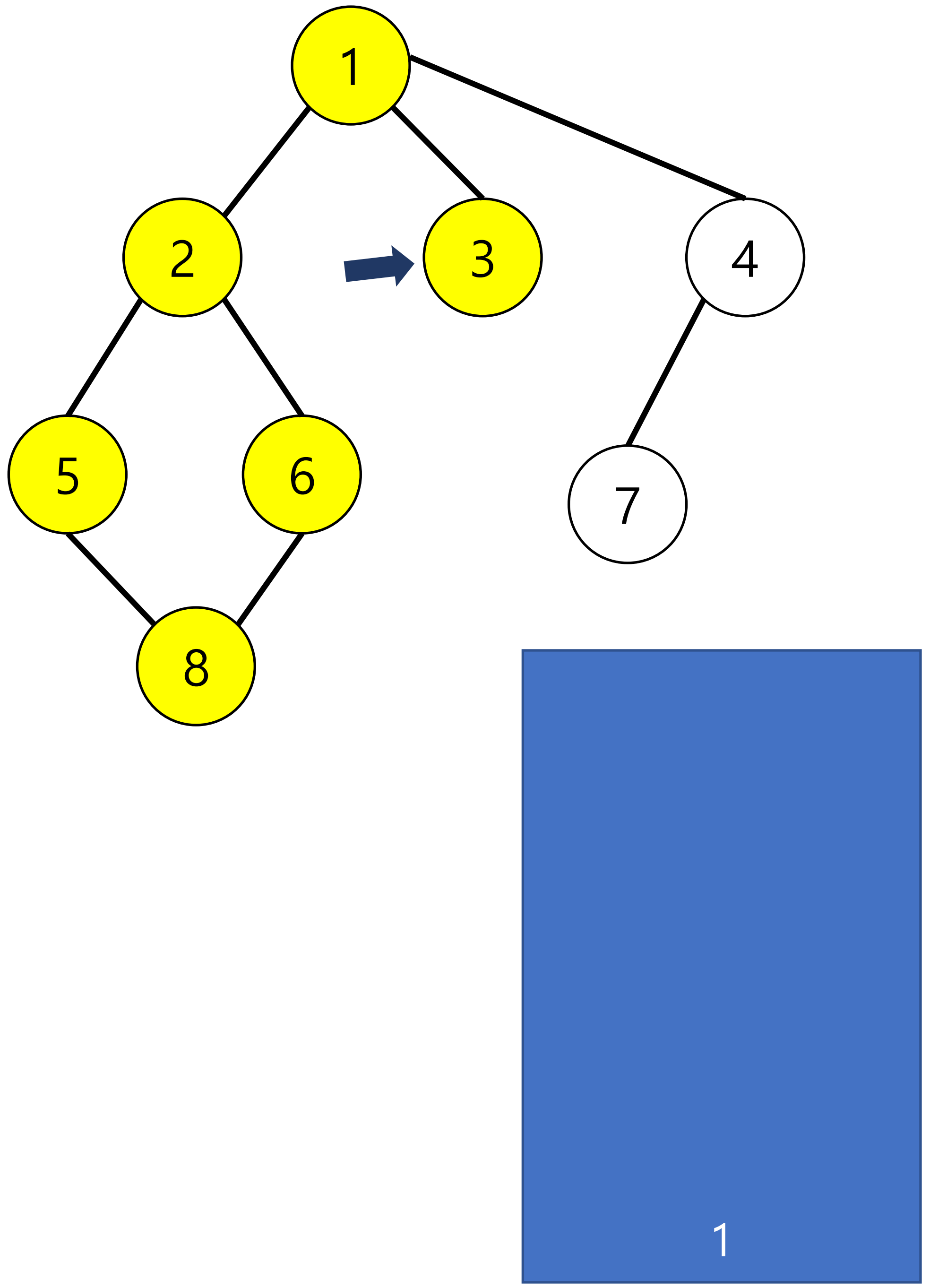

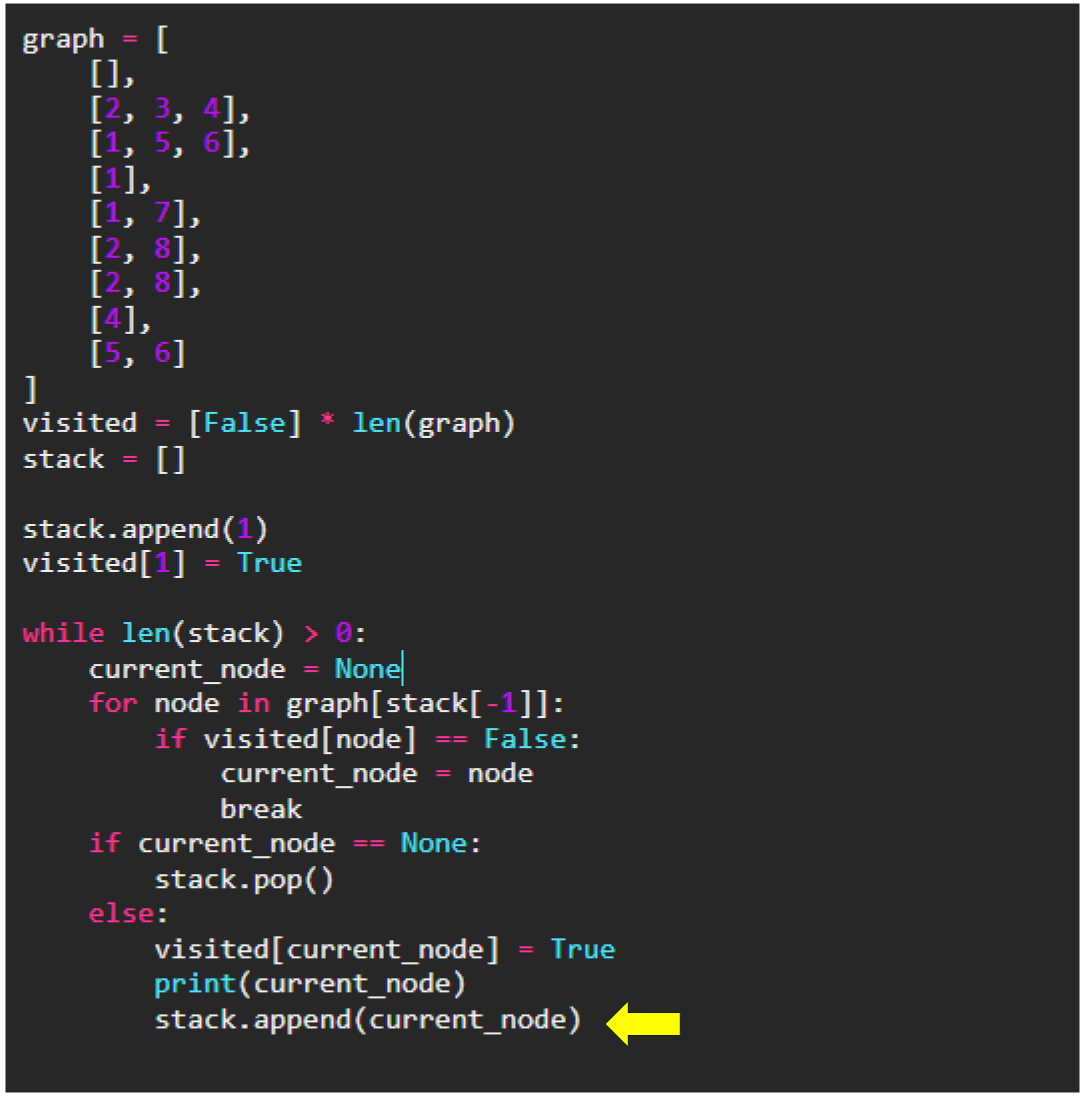

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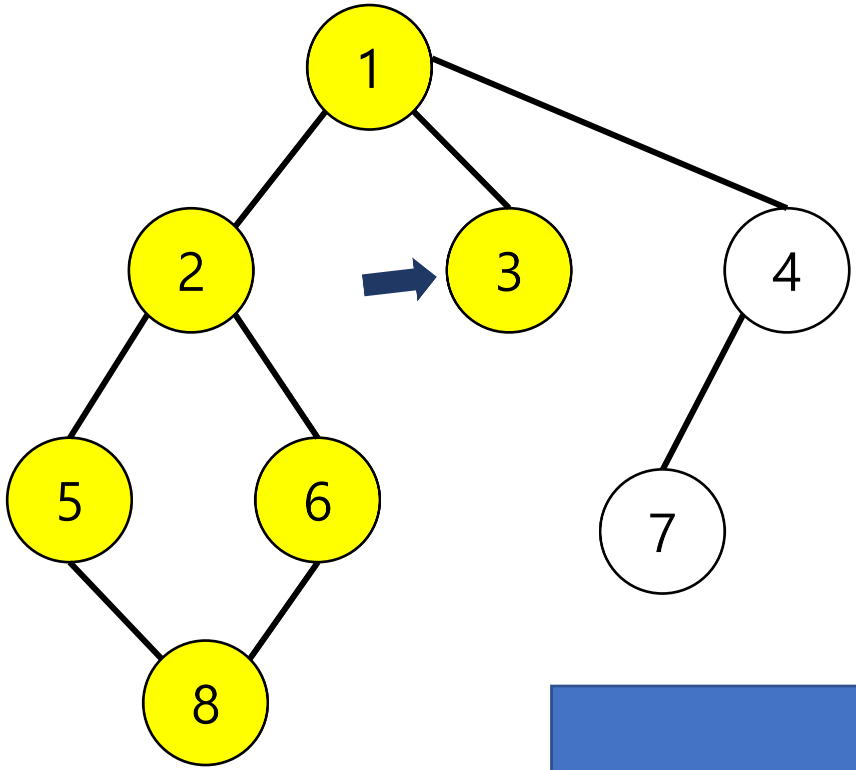

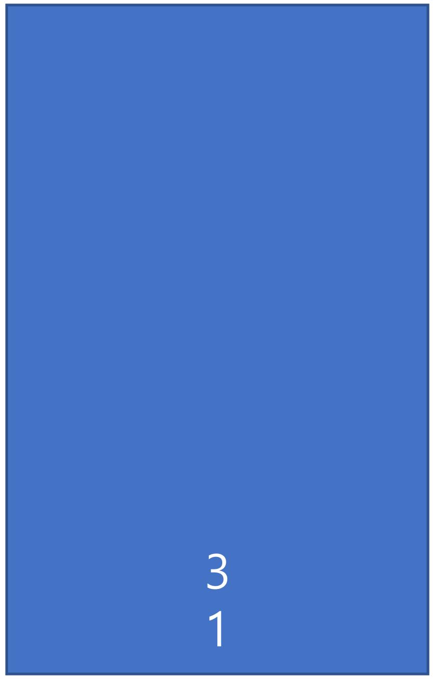

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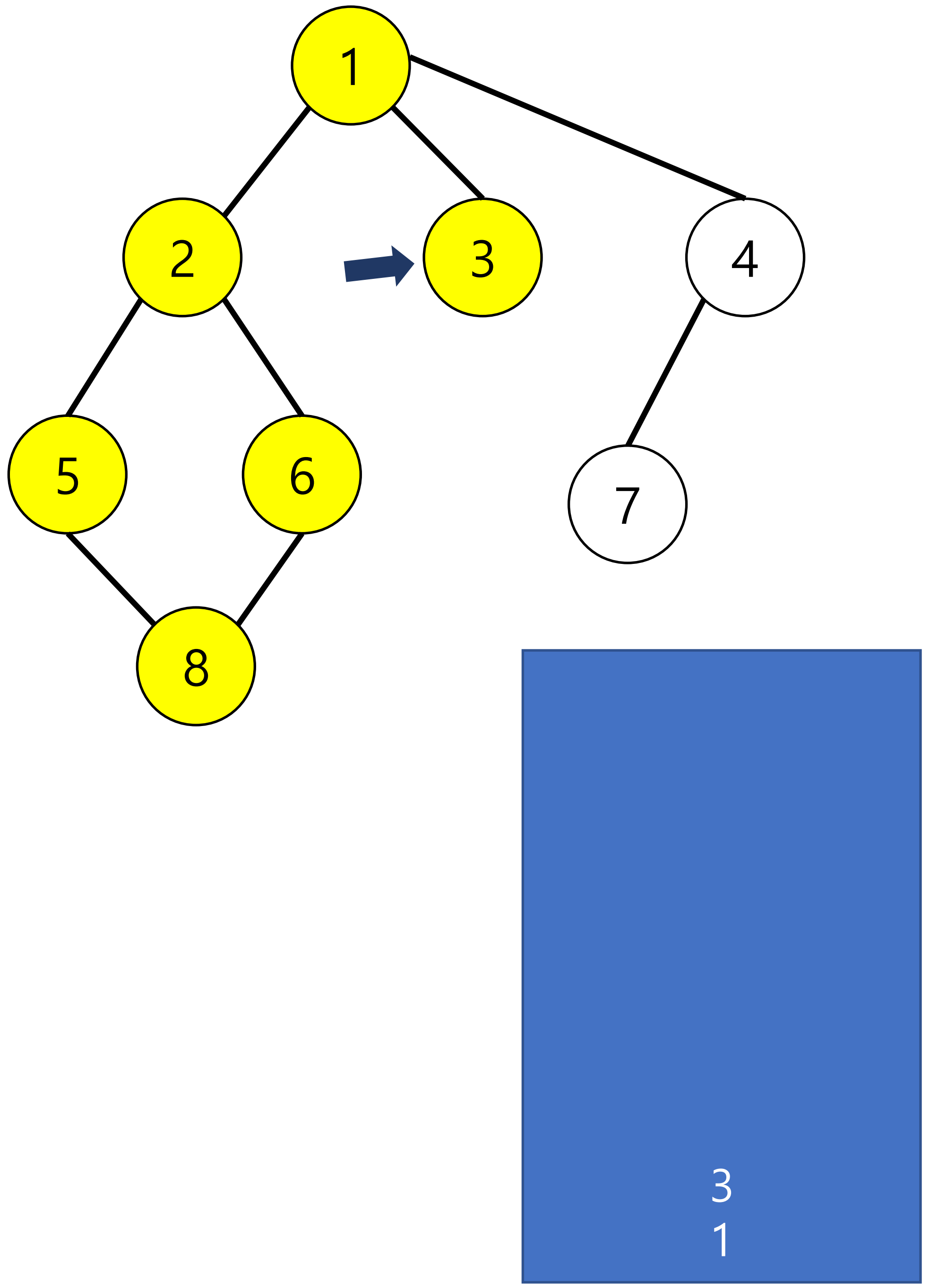

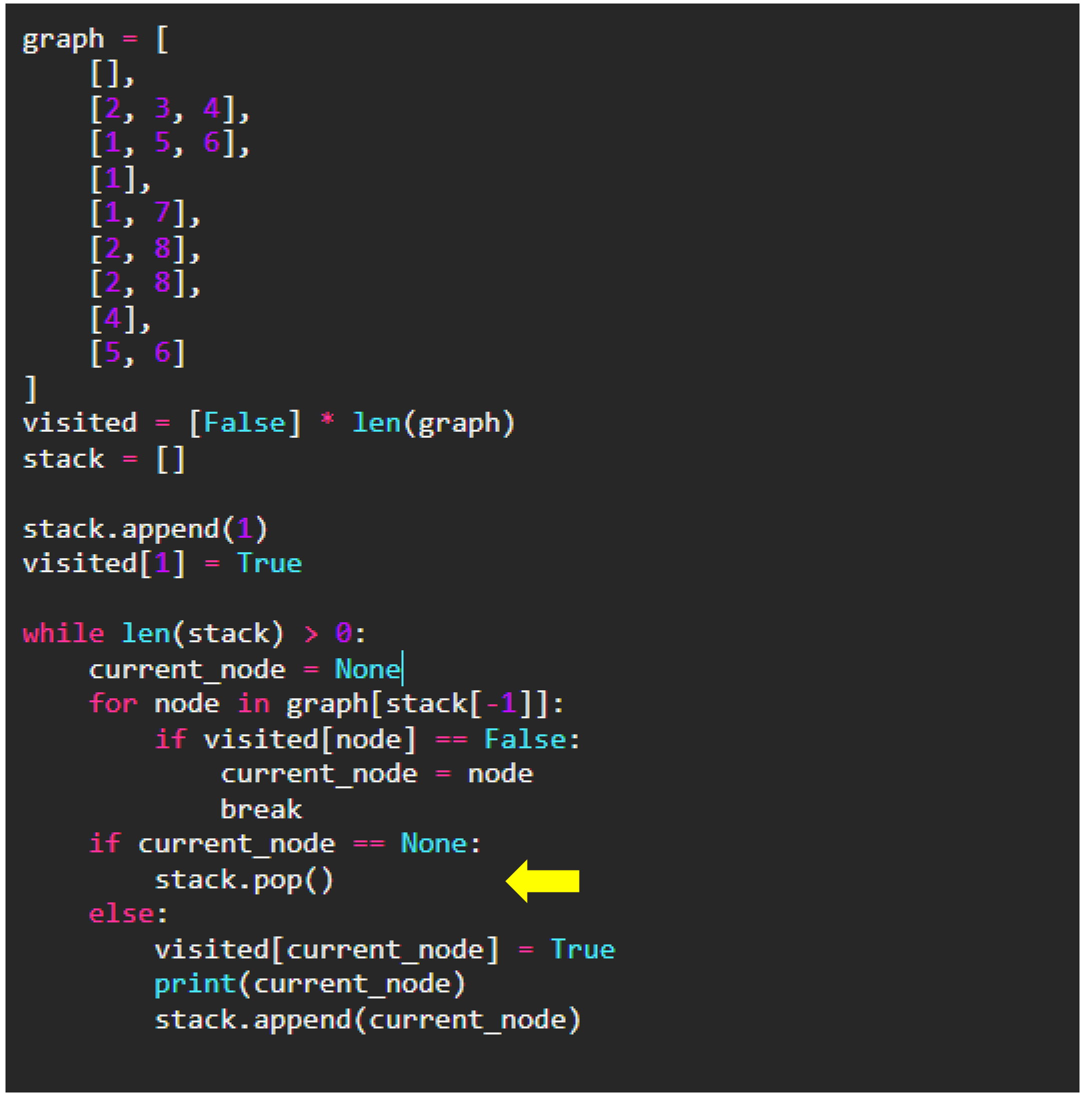

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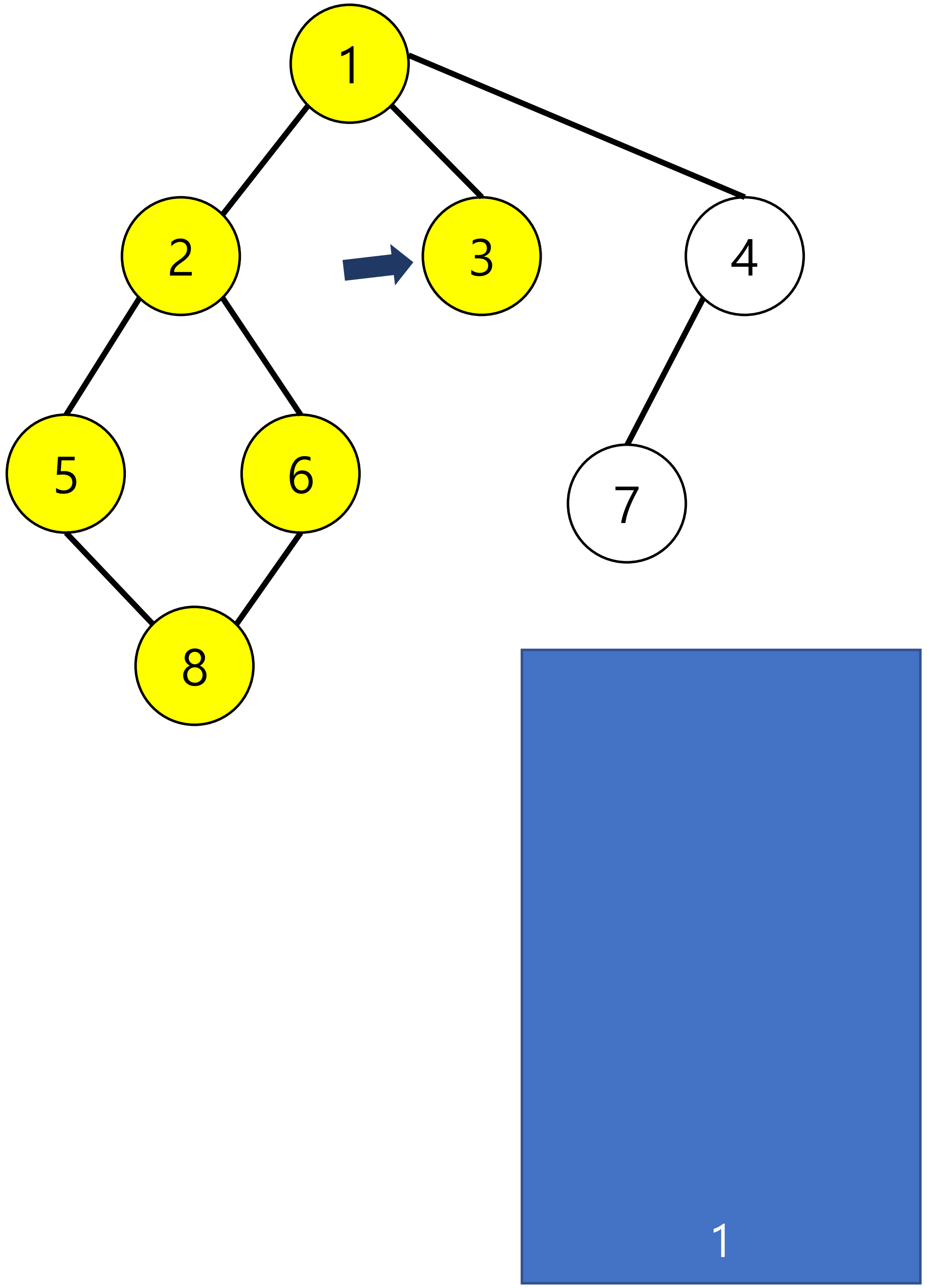

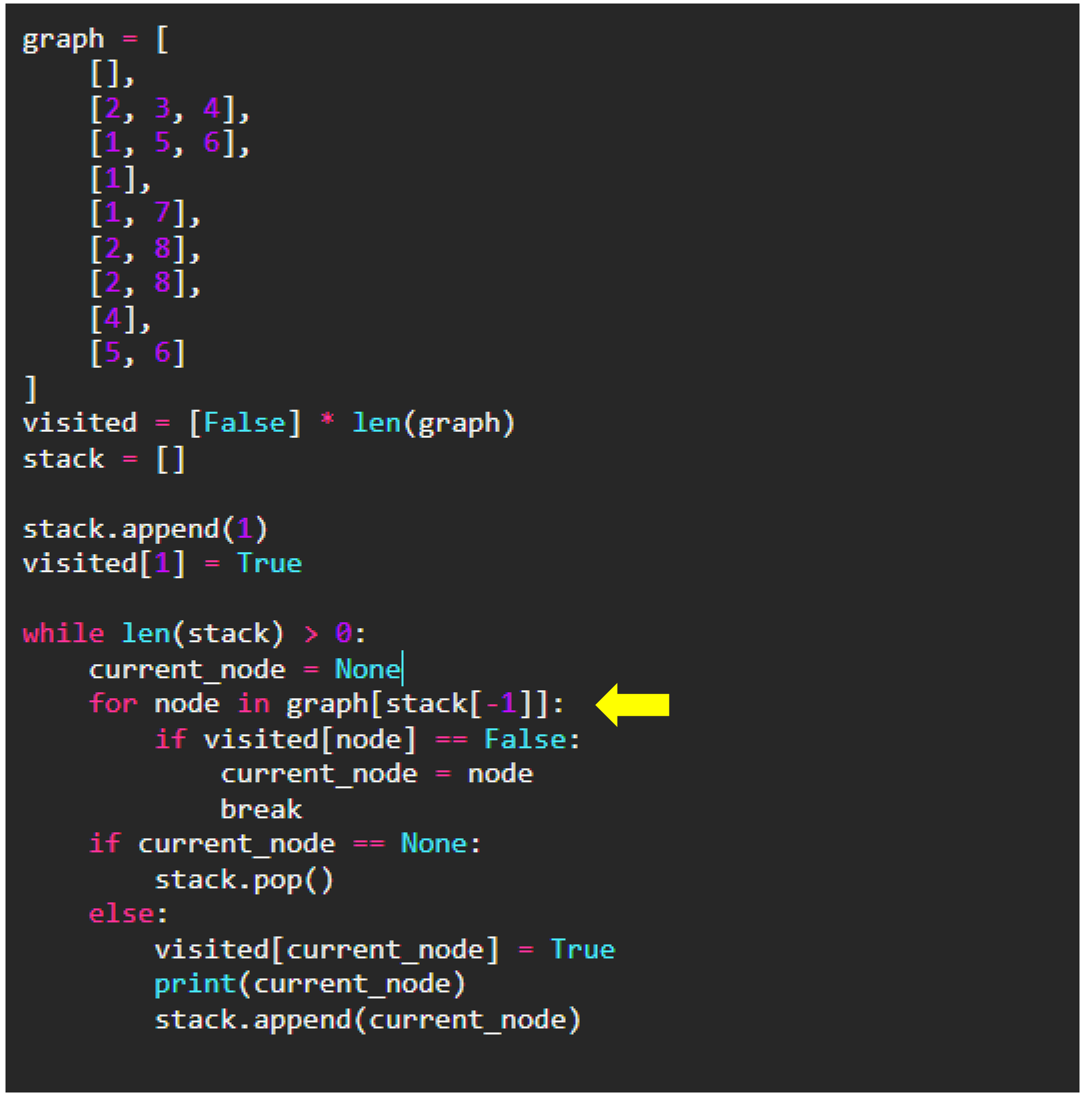

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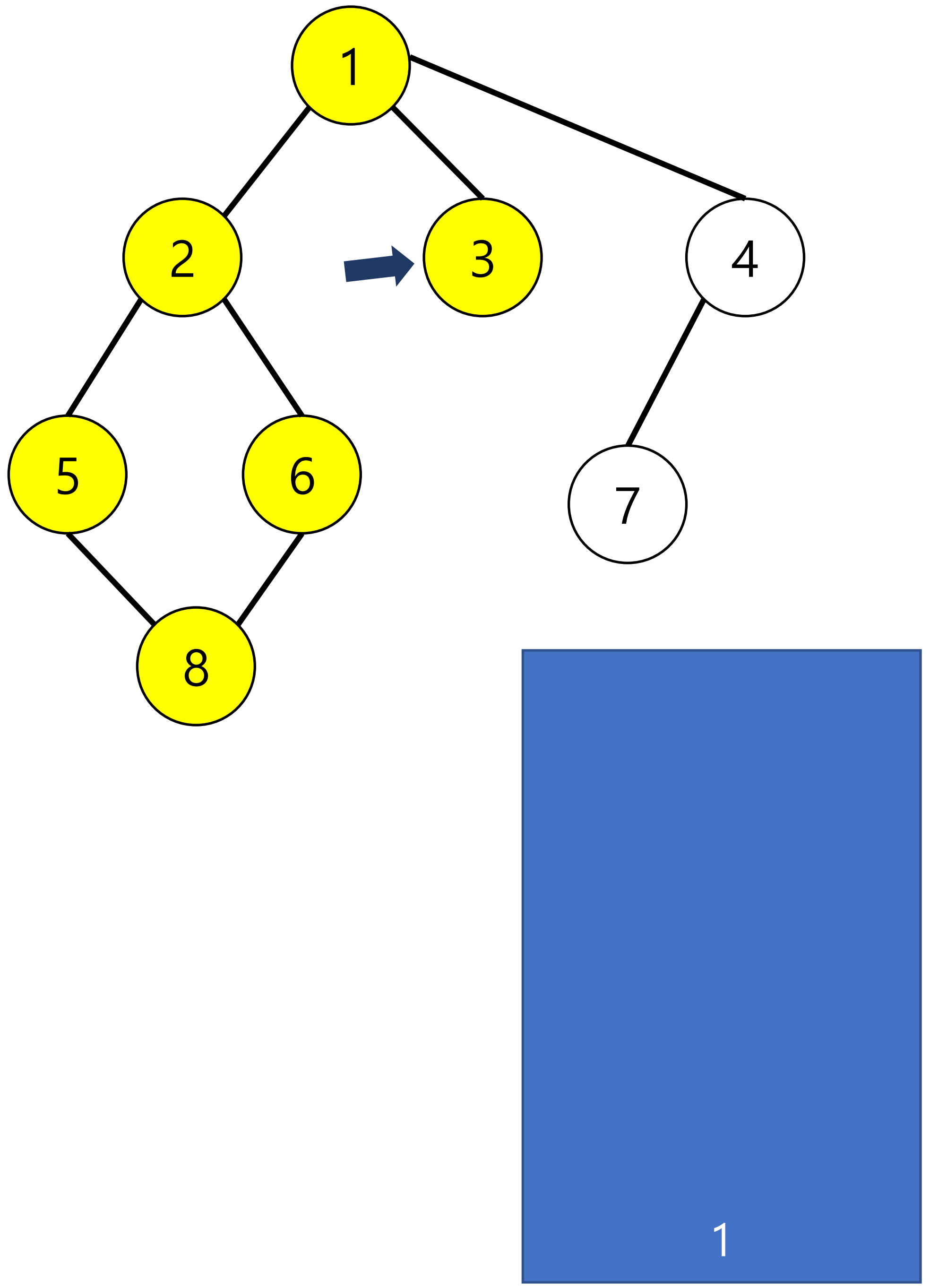

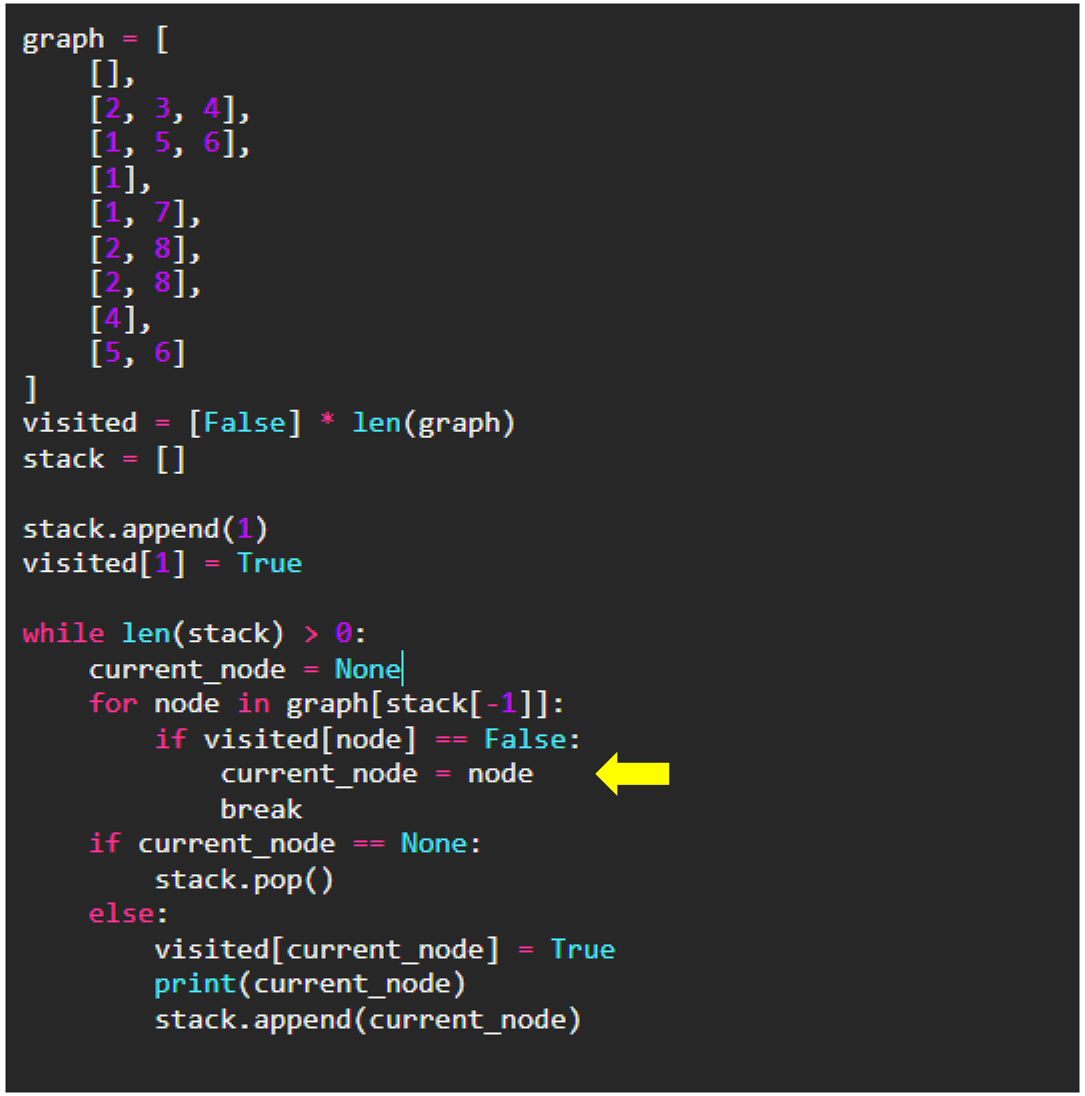

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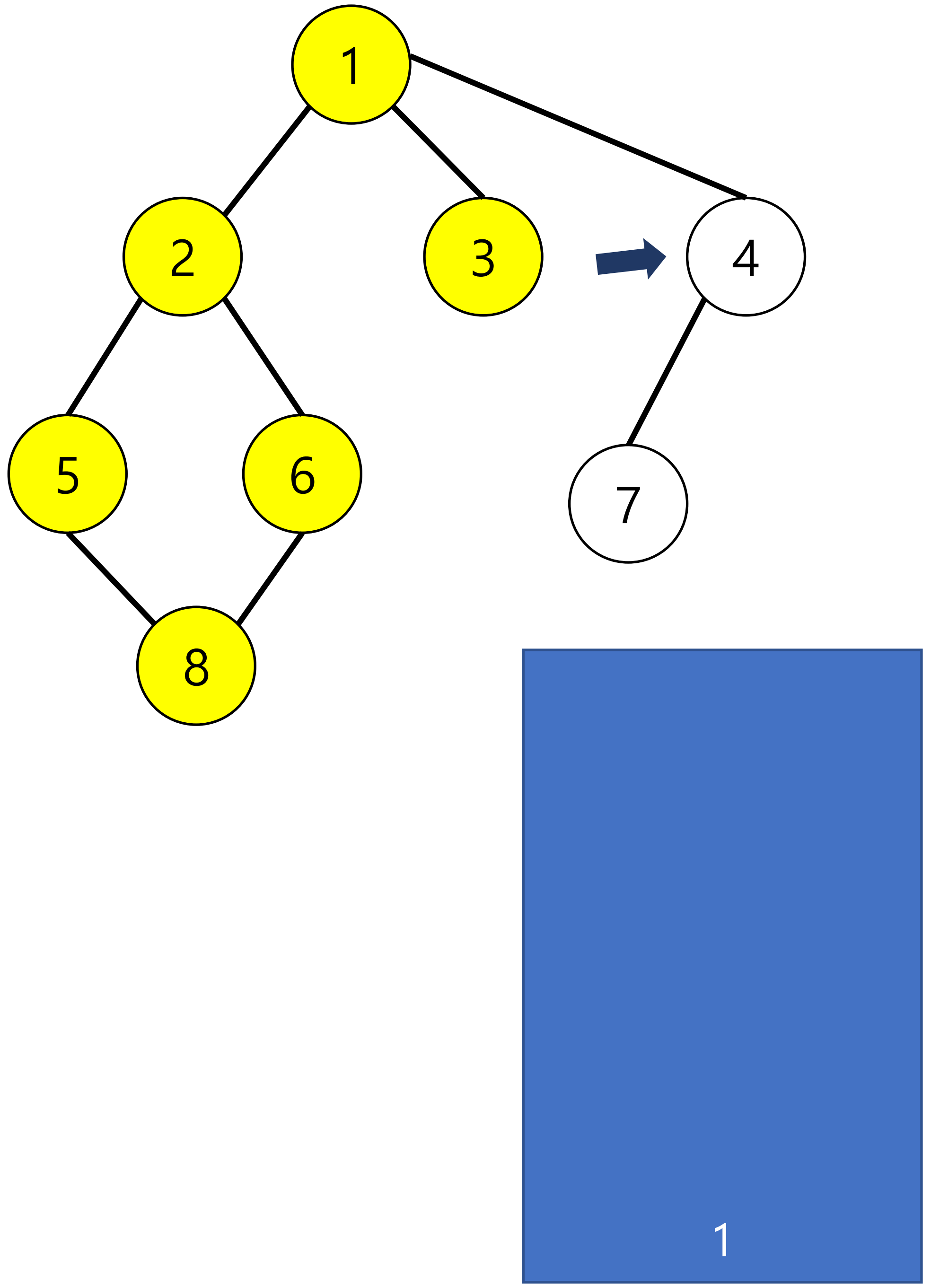

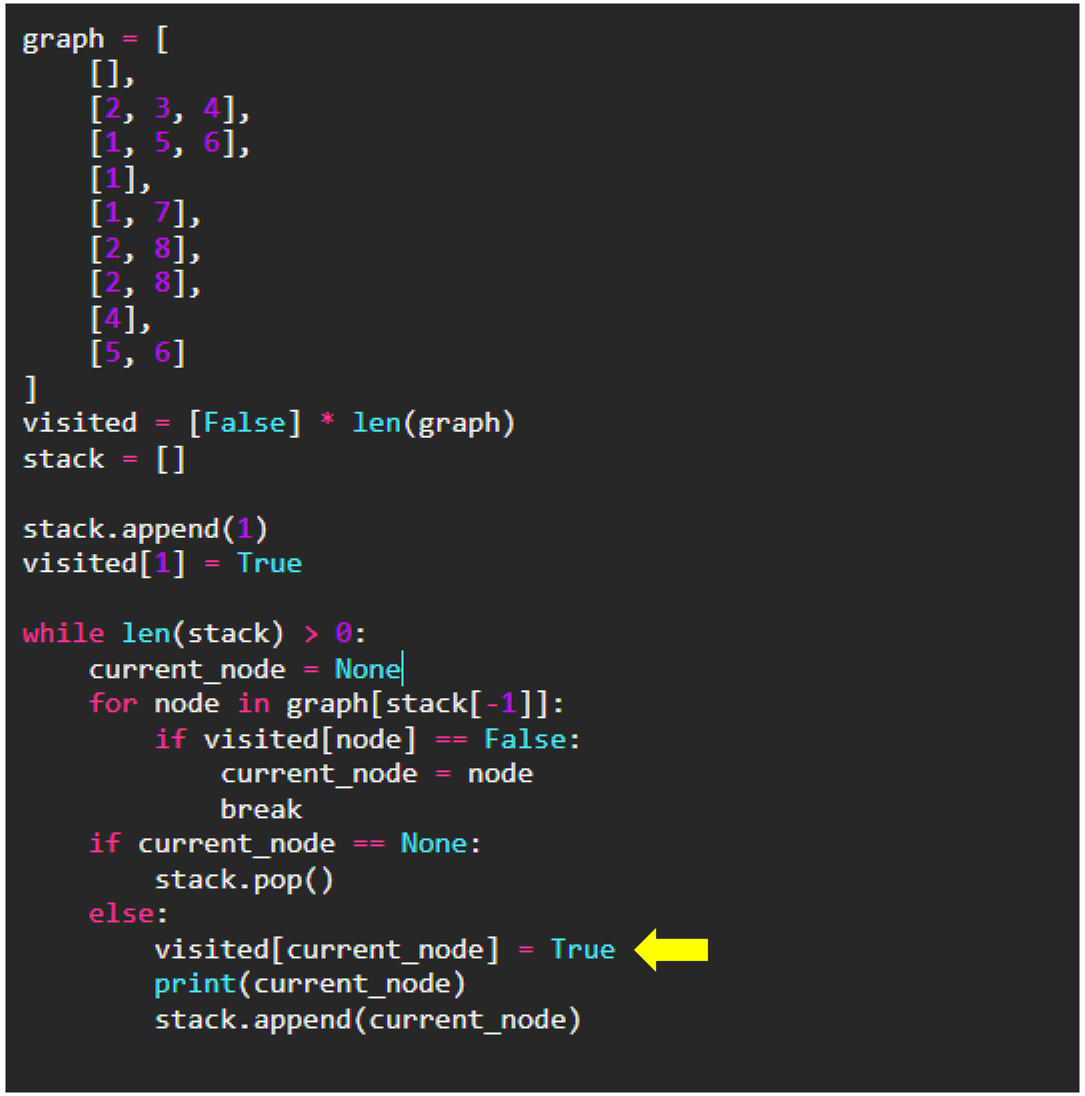

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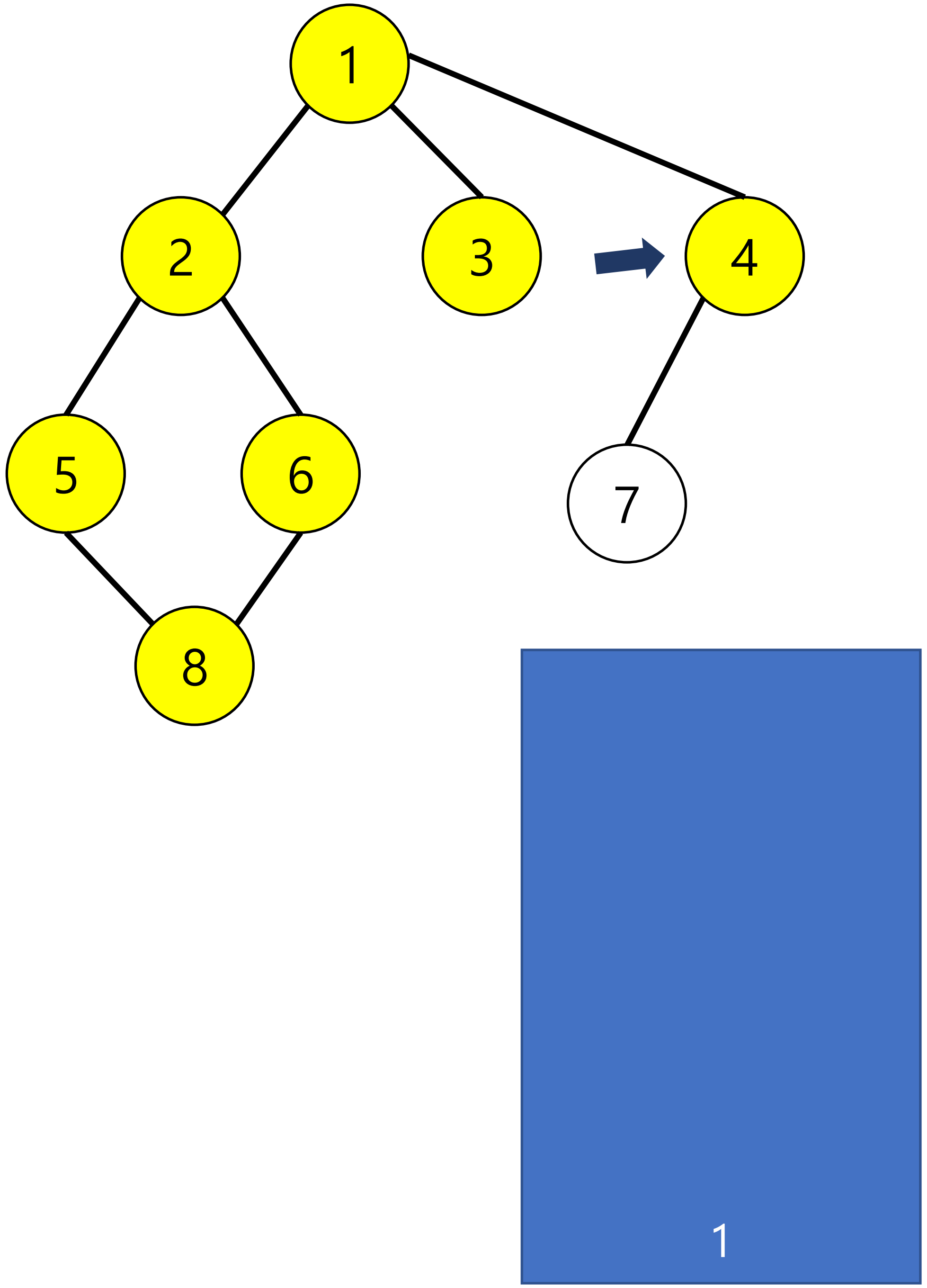

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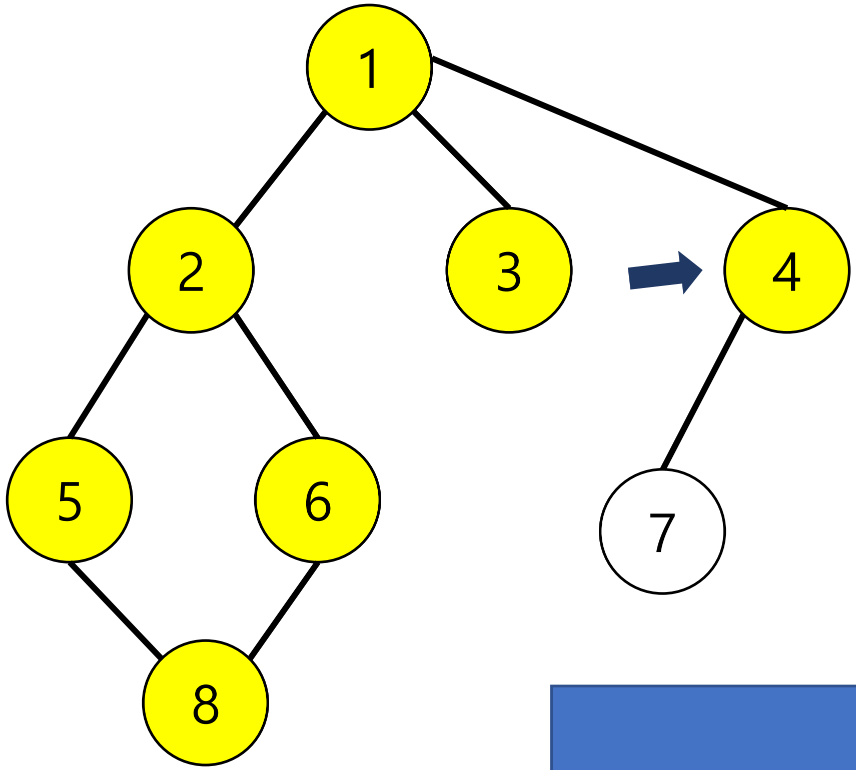

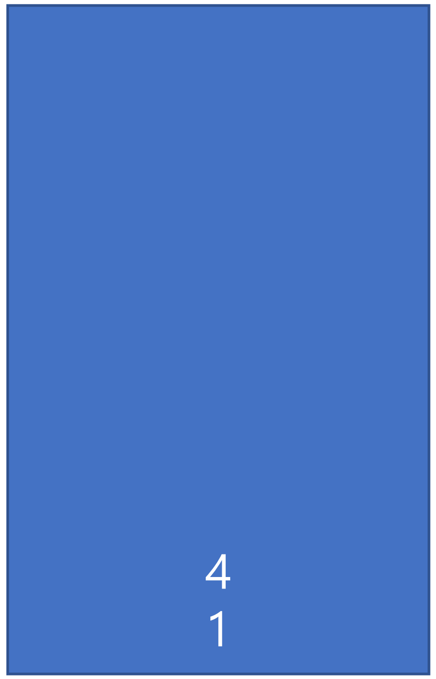

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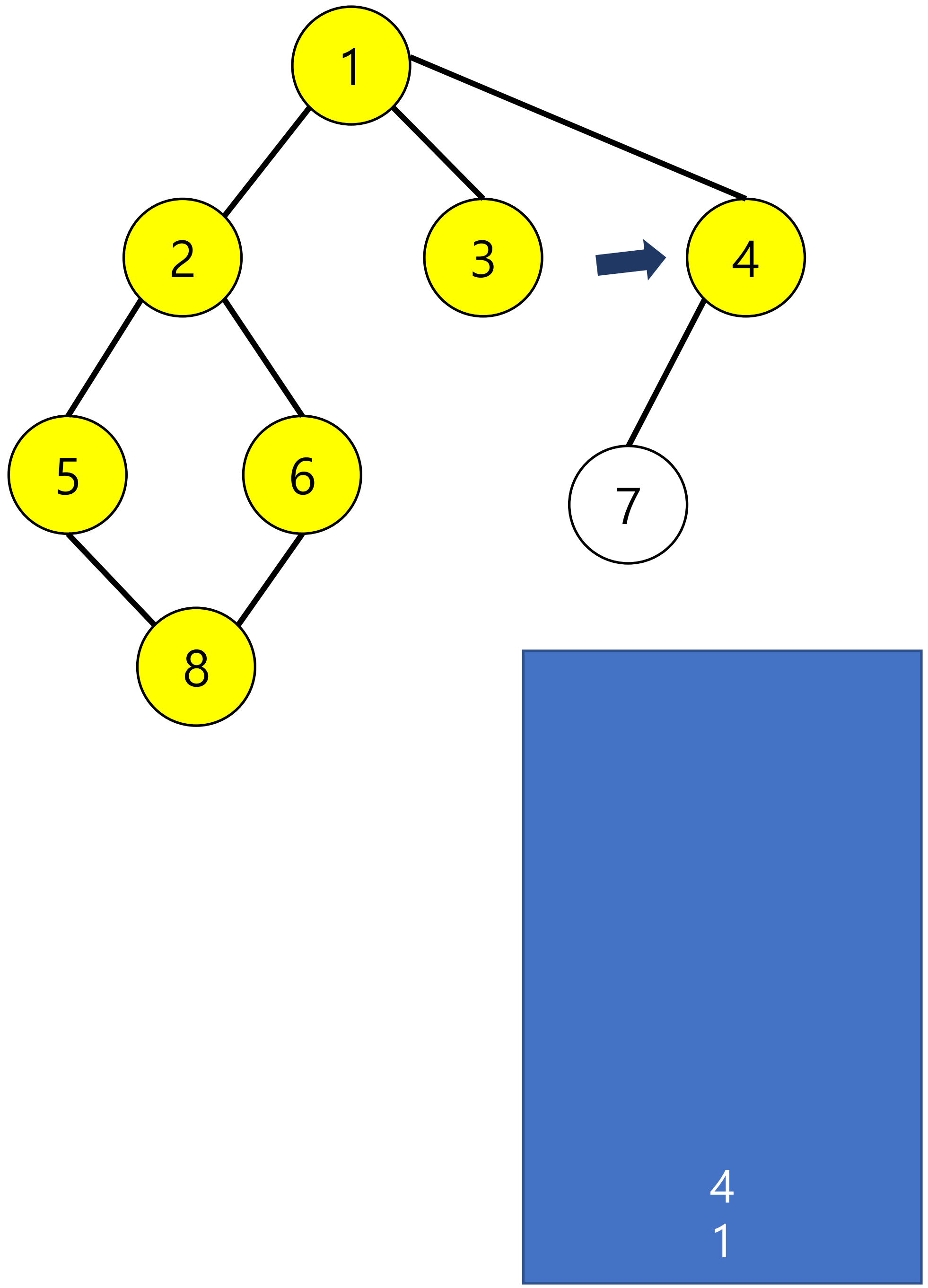

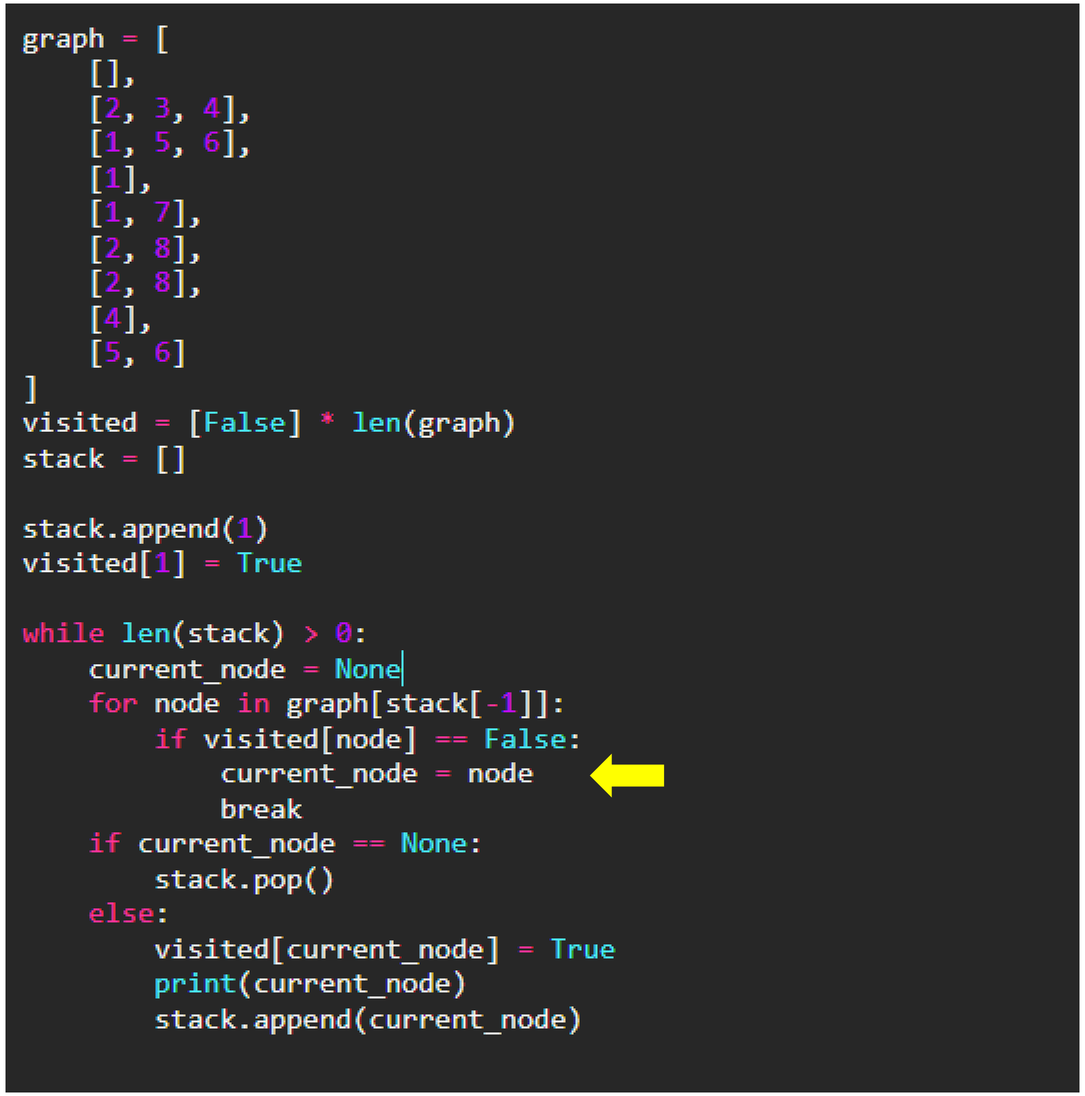

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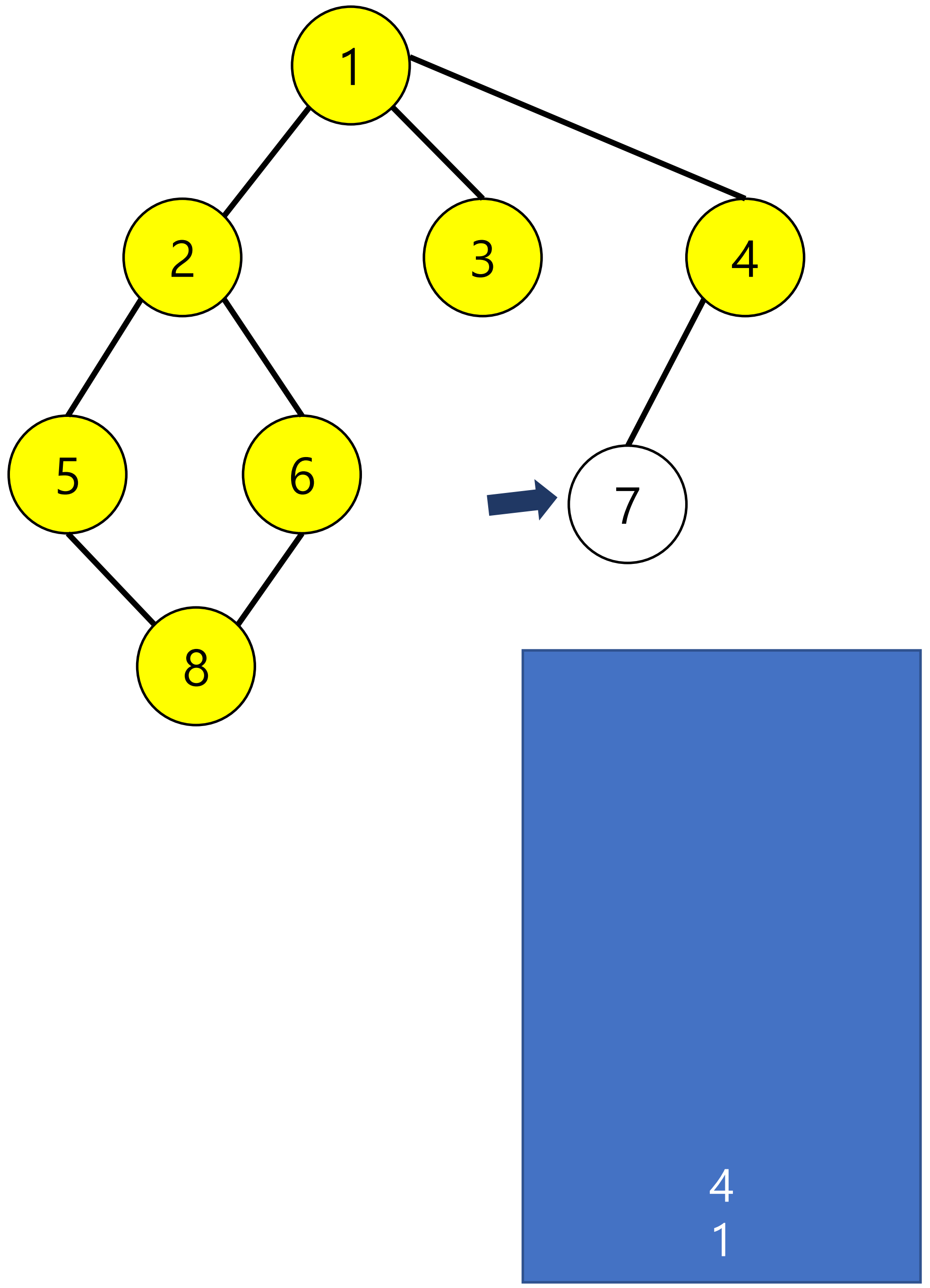

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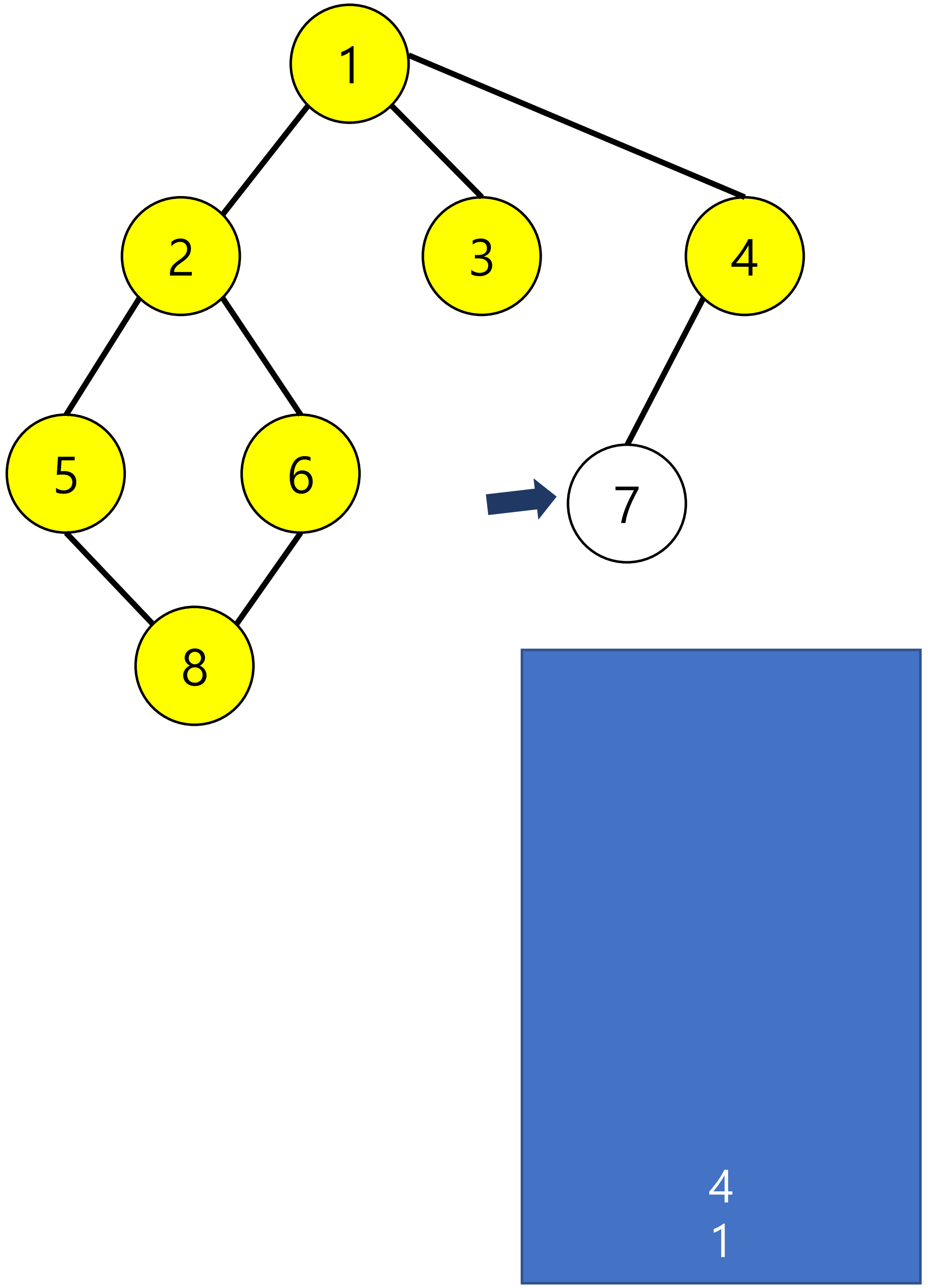

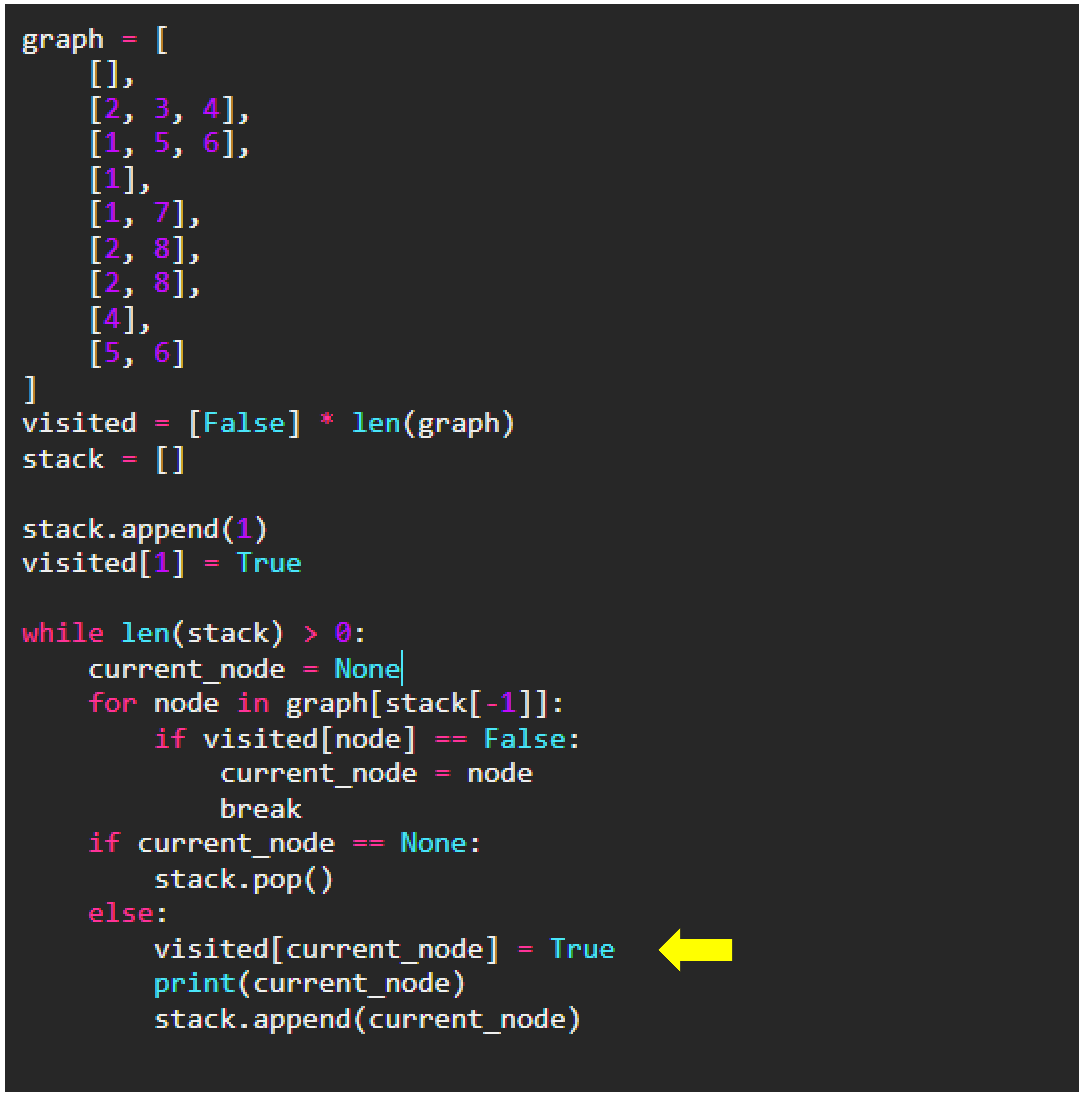

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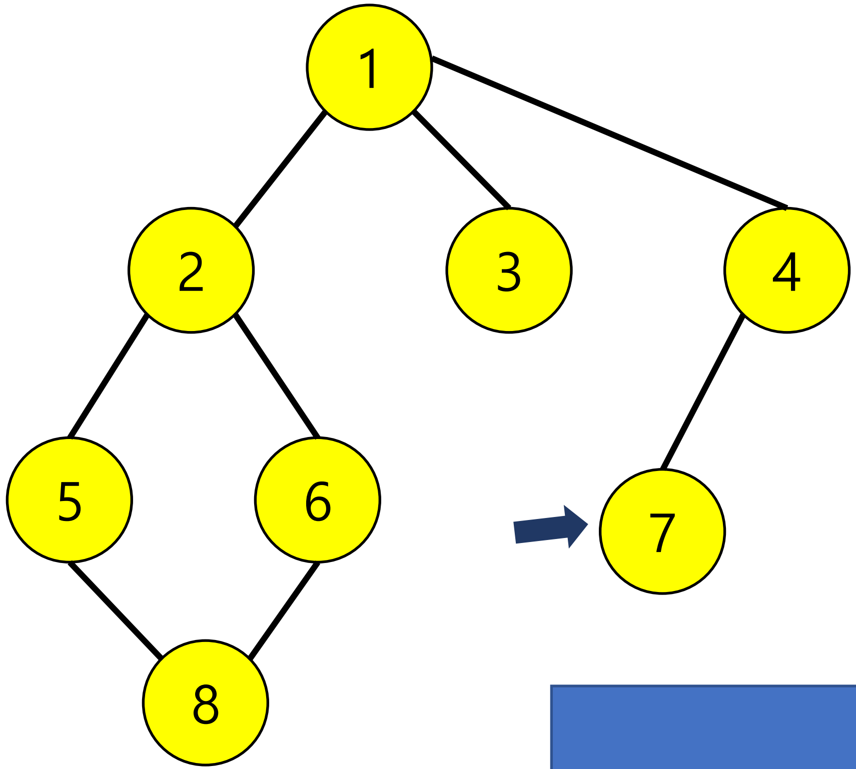

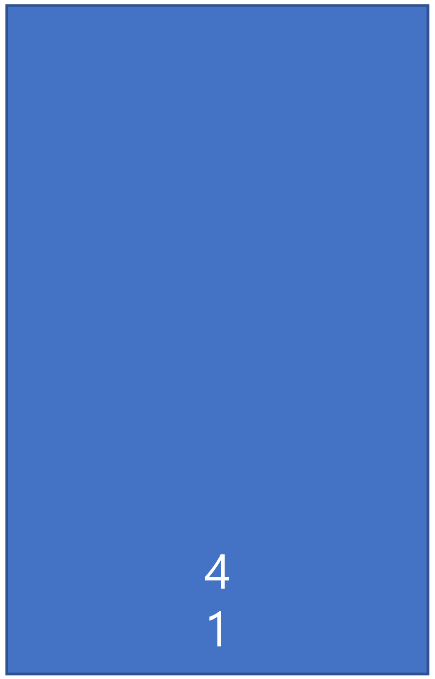

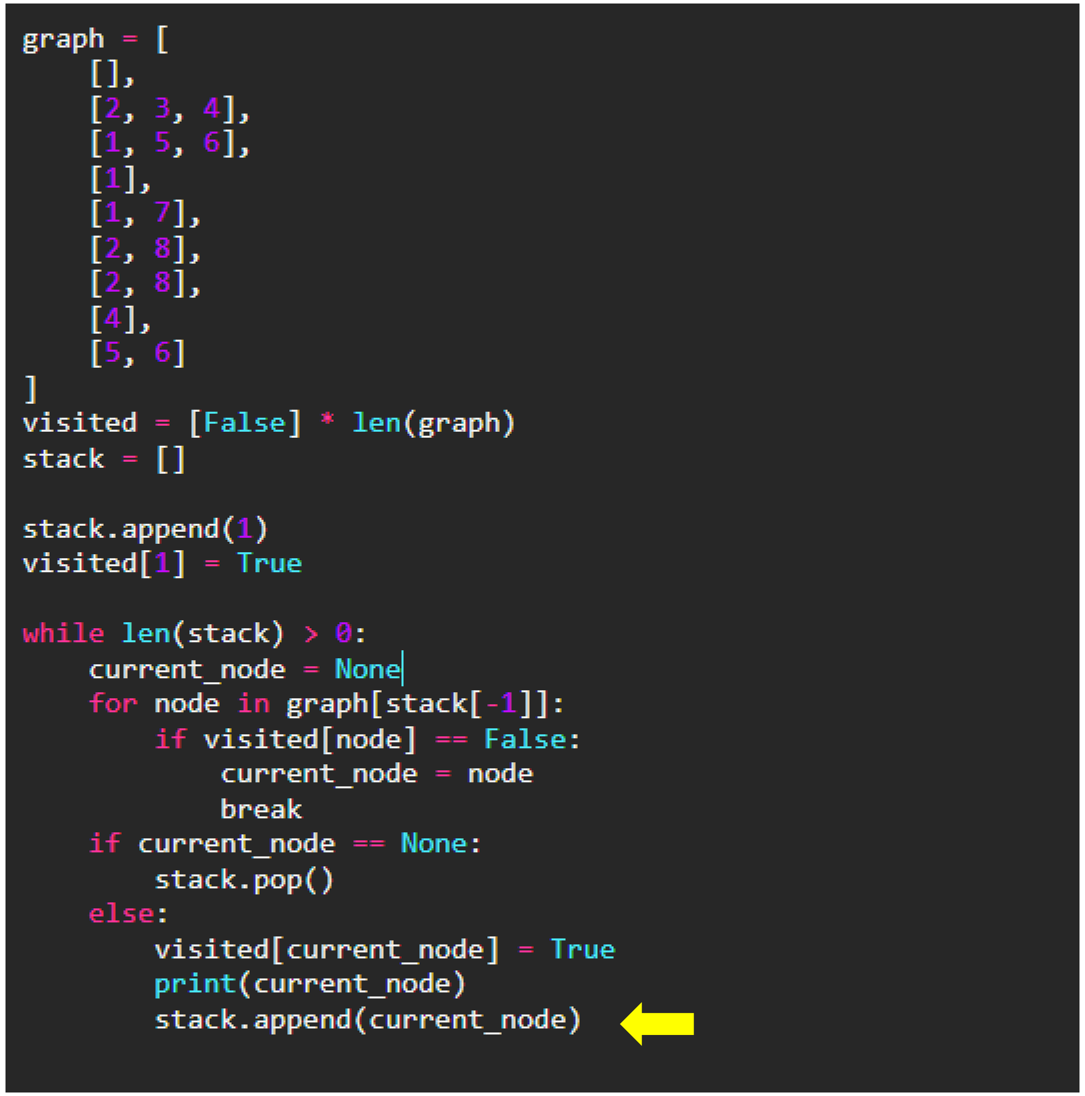

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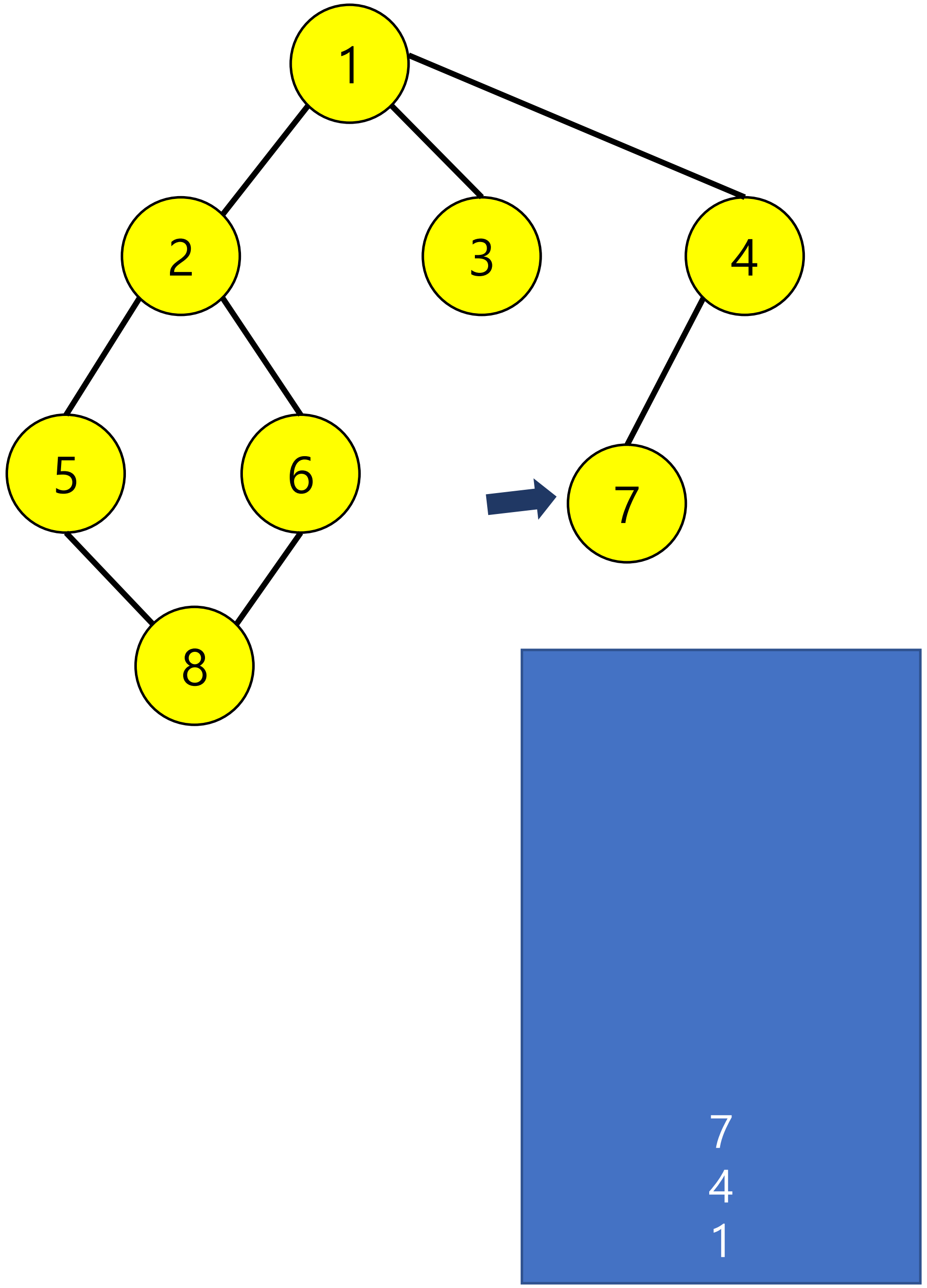

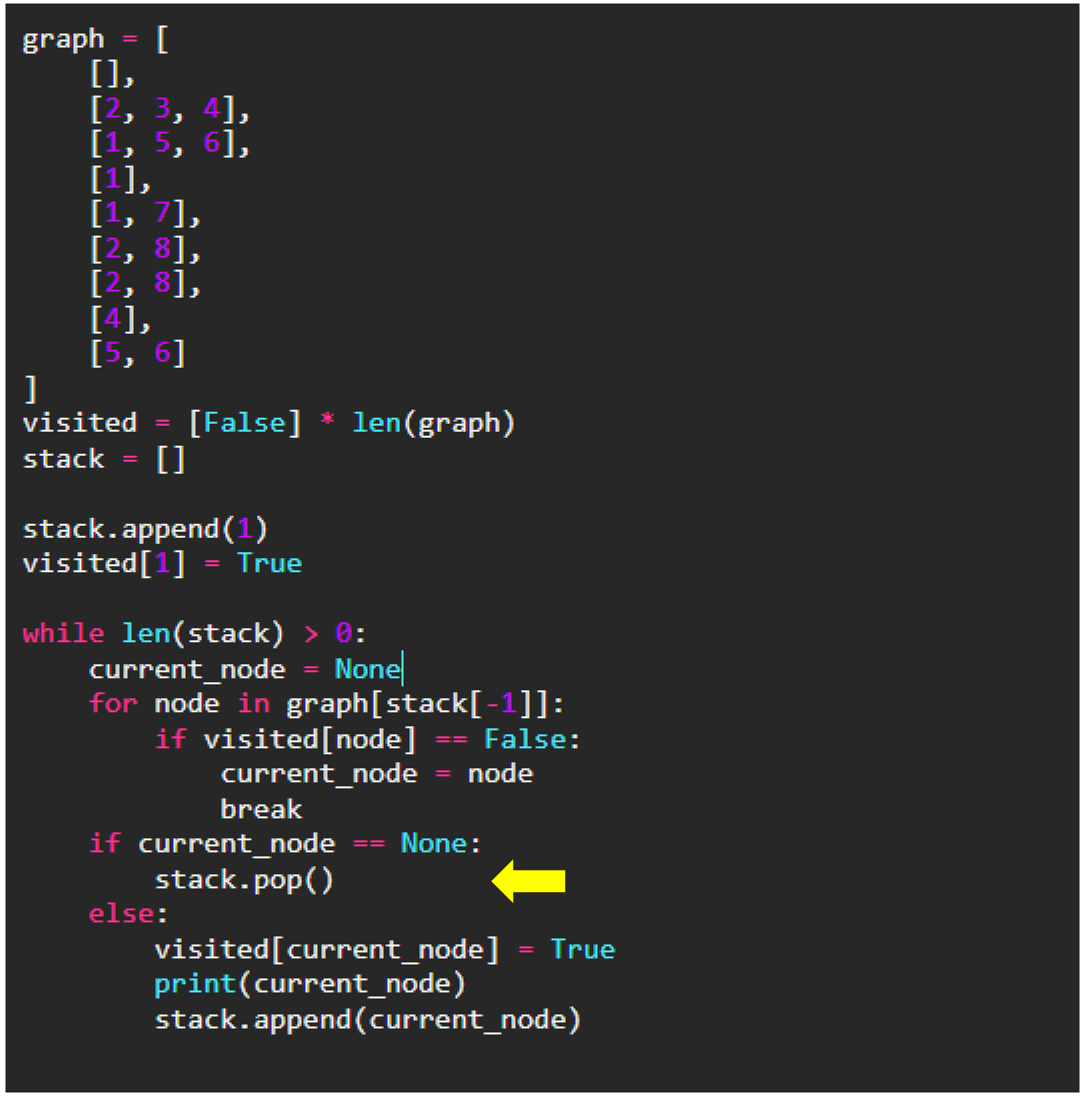

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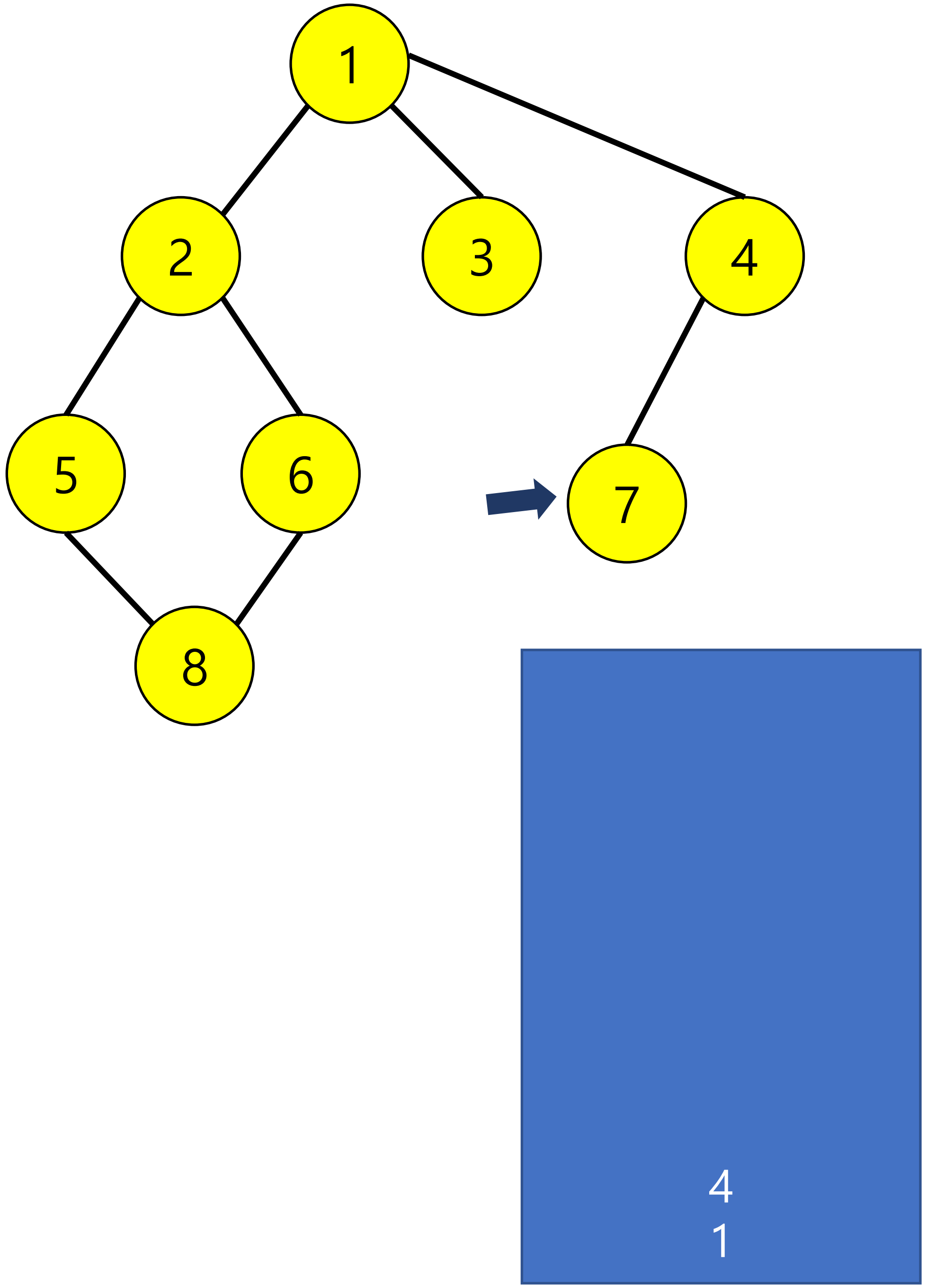

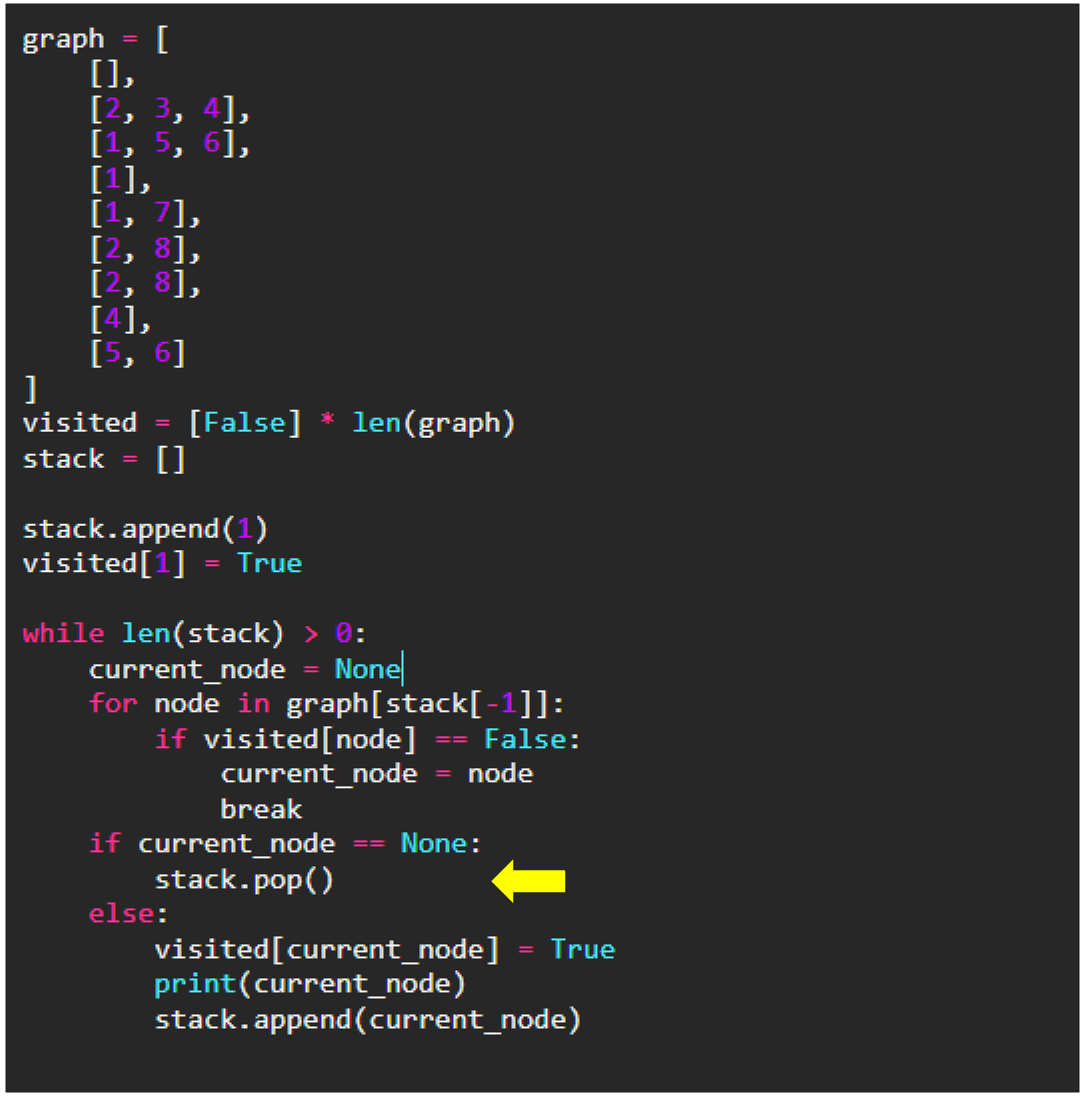

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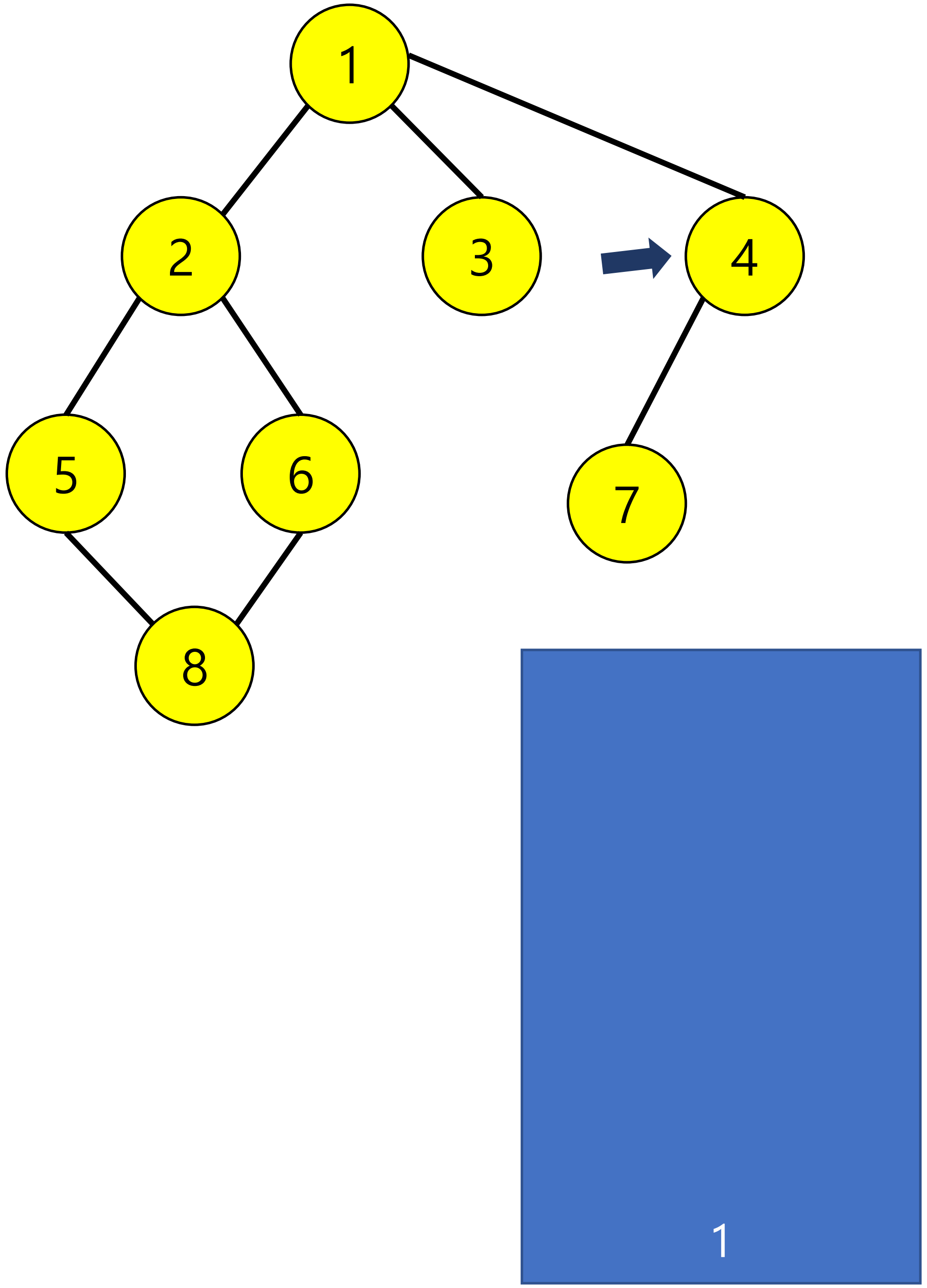
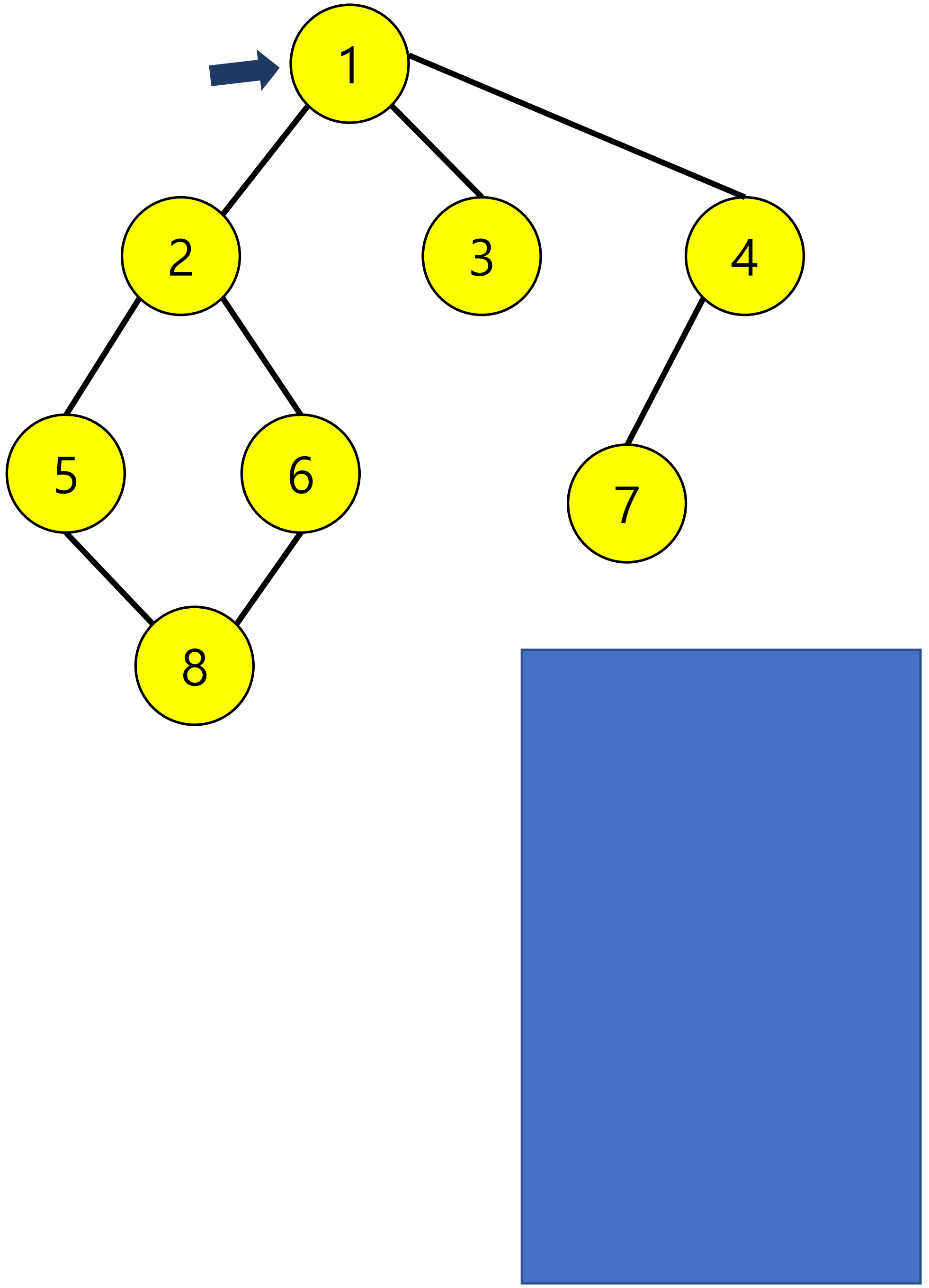


```
graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
    [4],
    [5, 6]
]
visited = [False] * len(graph)
stack = []

stack.append(1)
visited[1] = True

while len(stack) > 0:
    current_node = None
    for node in graph[stack[-1]]:
        if visited[node] == False:
            current_node = node
            break
    if current_node == None:
        stack.pop()
    else:
        visited[current_node] = True
        print(current_node)
        stack.append(current_node)
```



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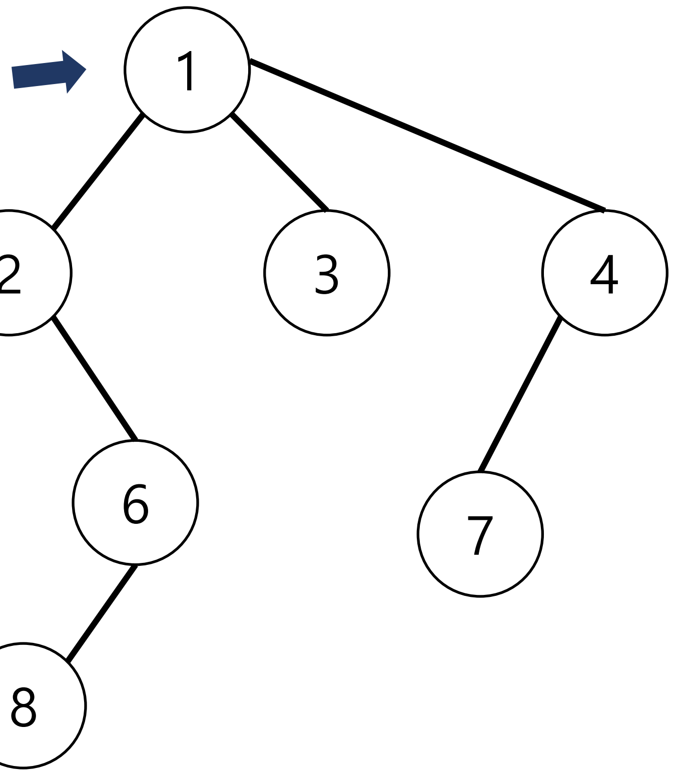
graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
    [4],
    [5, 6]
]

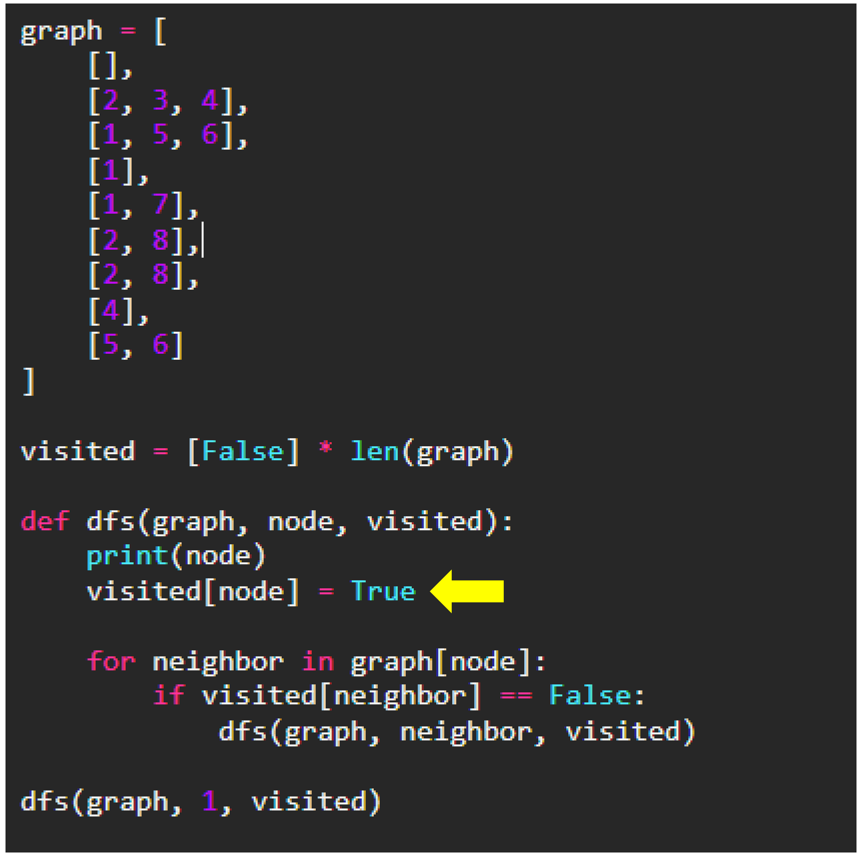
visited = [False] * len(graph)

def dfs(graph, node, visited):
    print(node)
    visited[node] = True

    for neighbor in graph[node]:
        if visited[neighbor] == False:
            dfs(graph, neighbor, visited)

dfs(graph, 1, visited)
```





```
graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
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    [2, 8],
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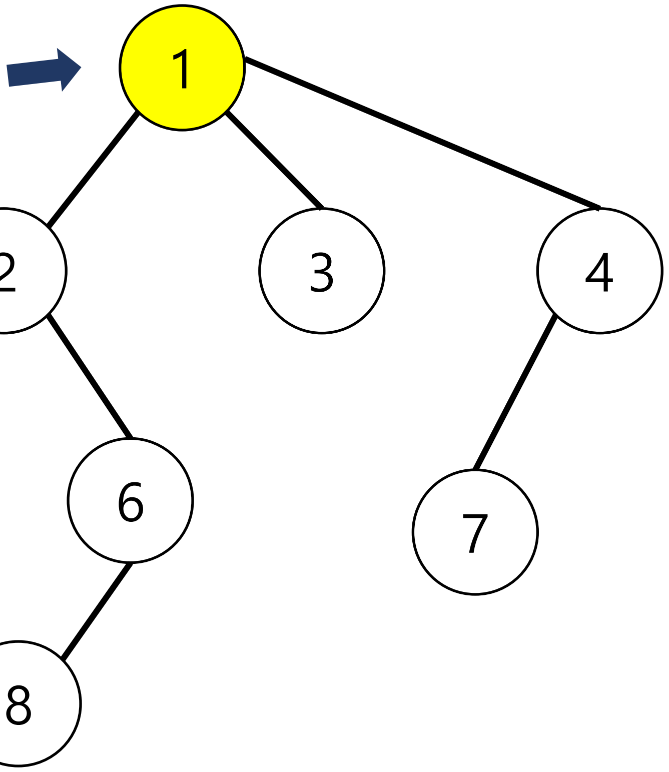

```
graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
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    visited[node] = True

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        if visited[neighbor] == False:
            dfs(graph, neighbor, visited)

dfs(graph, 1, visited)
```
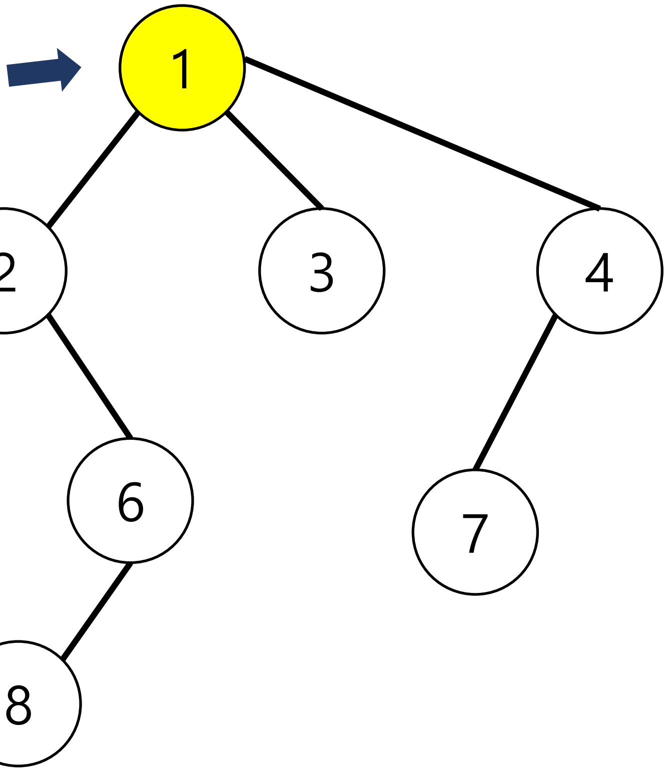
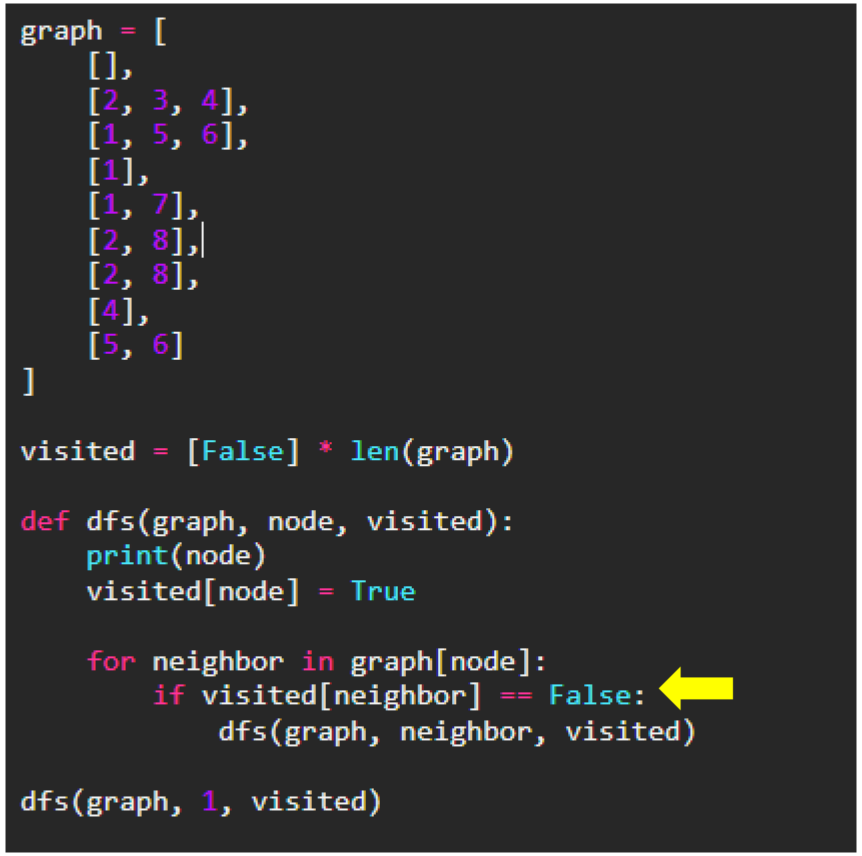

```
for(i=0;i<graph[node].length;i++)
    neighbor = graph[node][i];
```





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    [],
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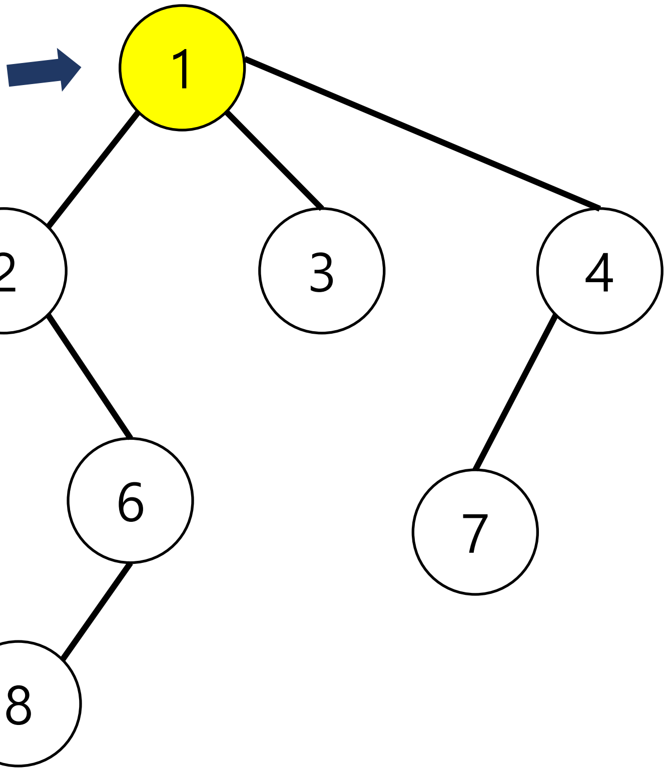
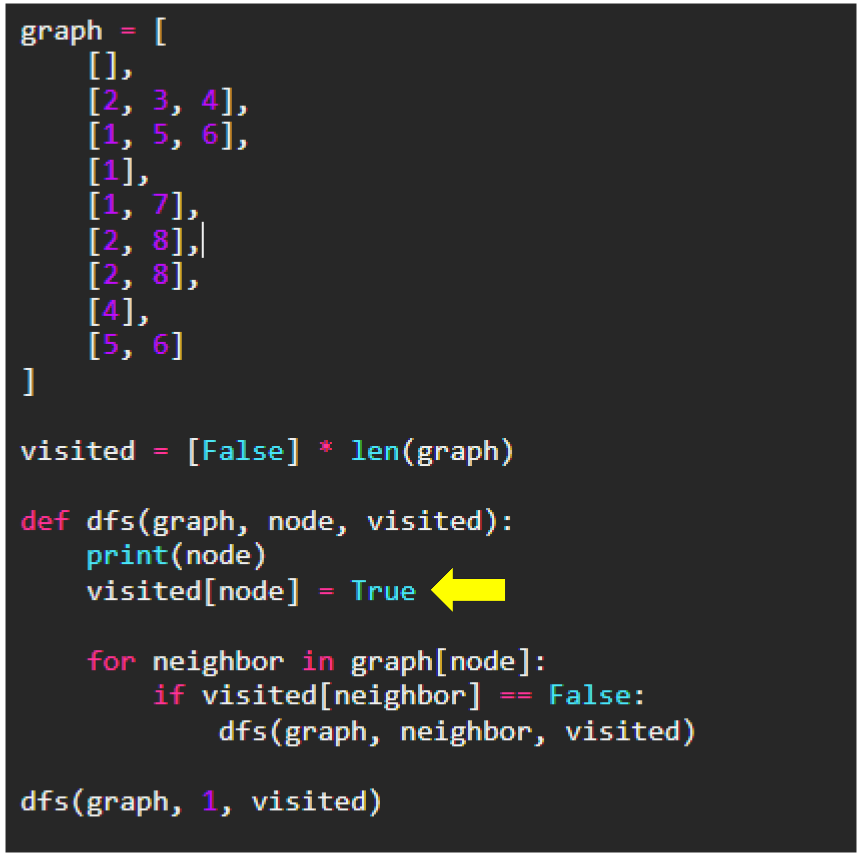


neighbor = 3
neighbor = 4



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    [],
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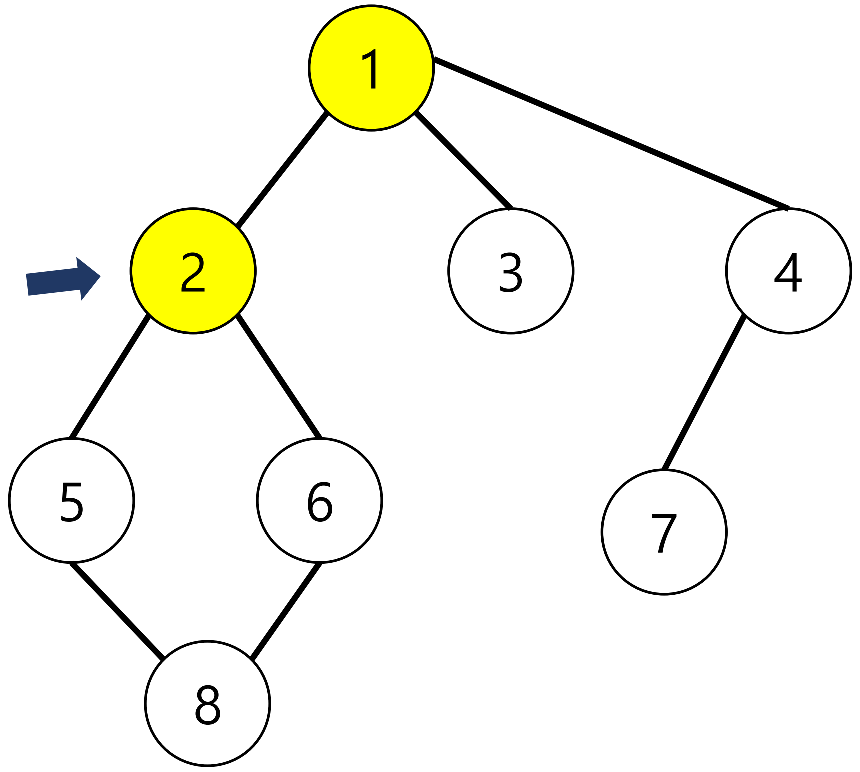
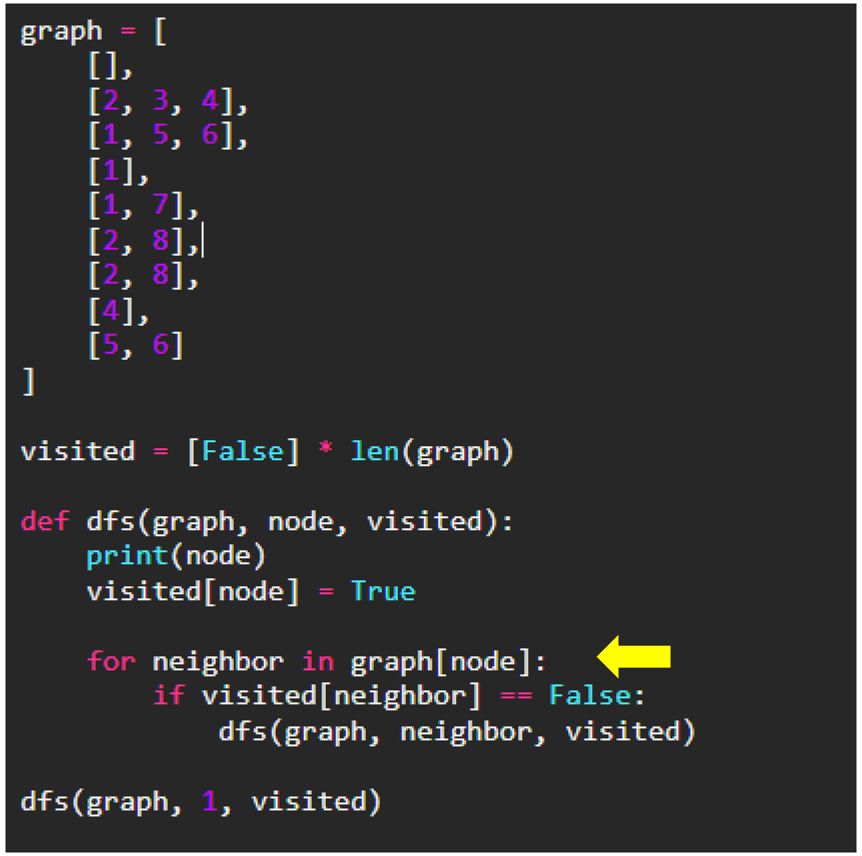


neighbor = 3
neighbor = 4



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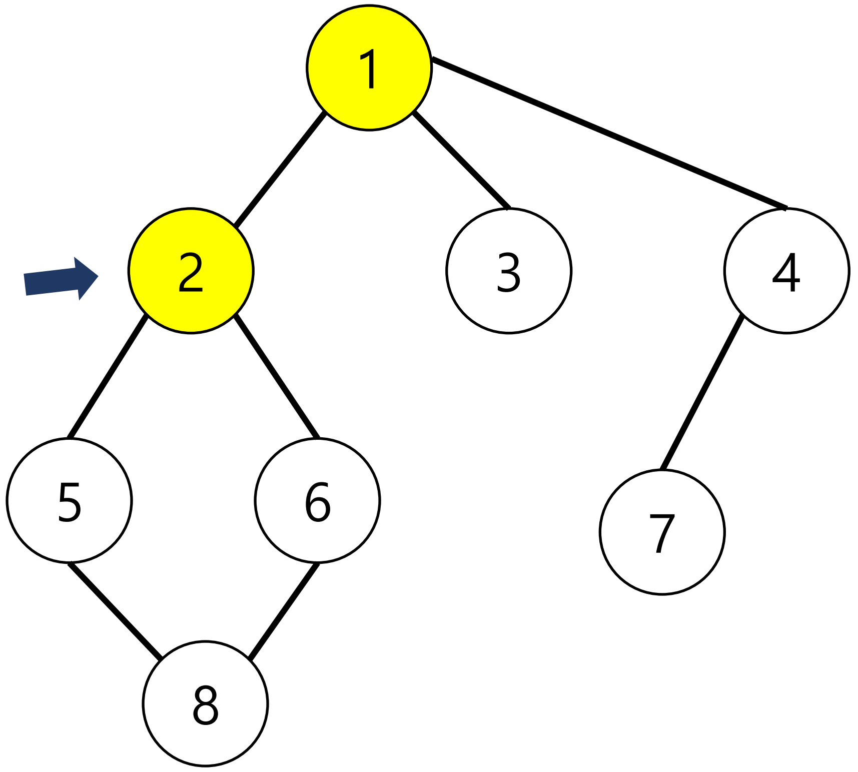
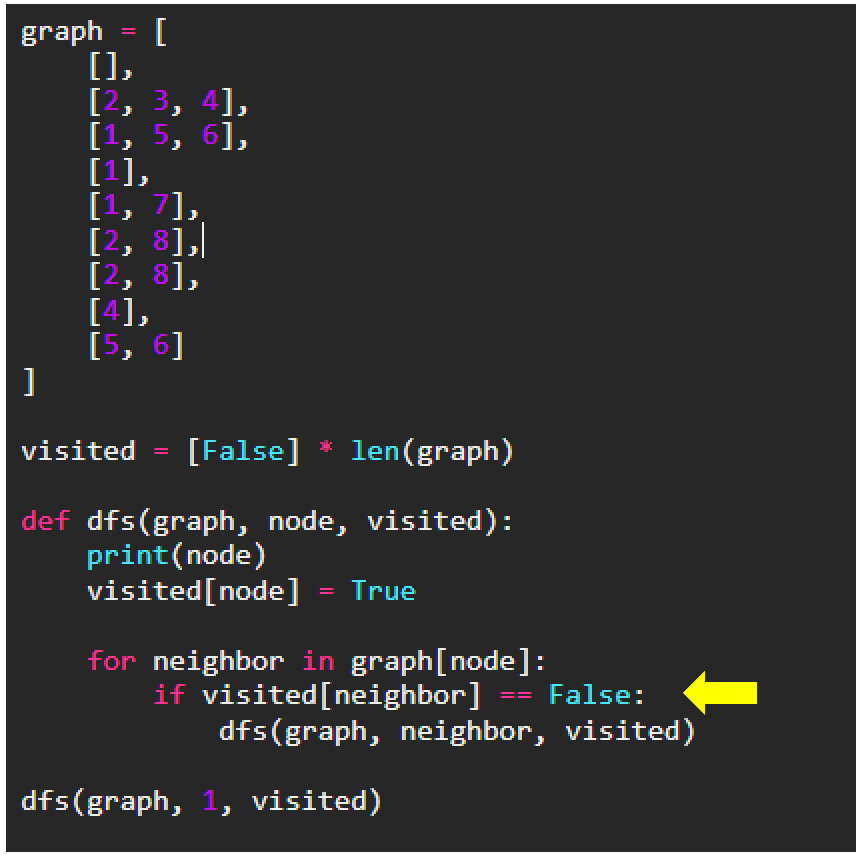


neighbor = 3
neighbor = 4



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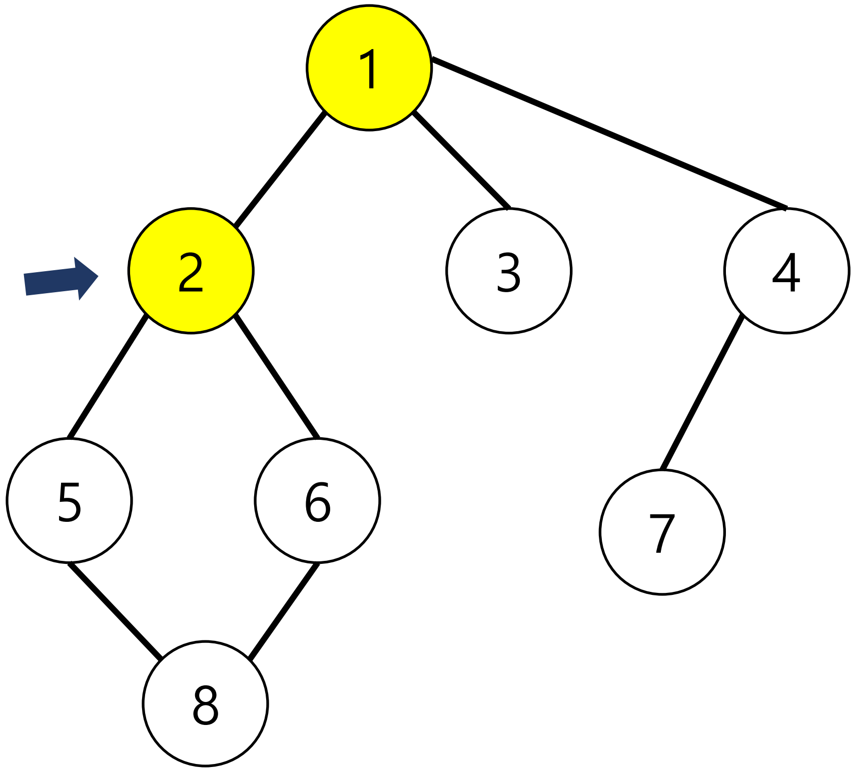
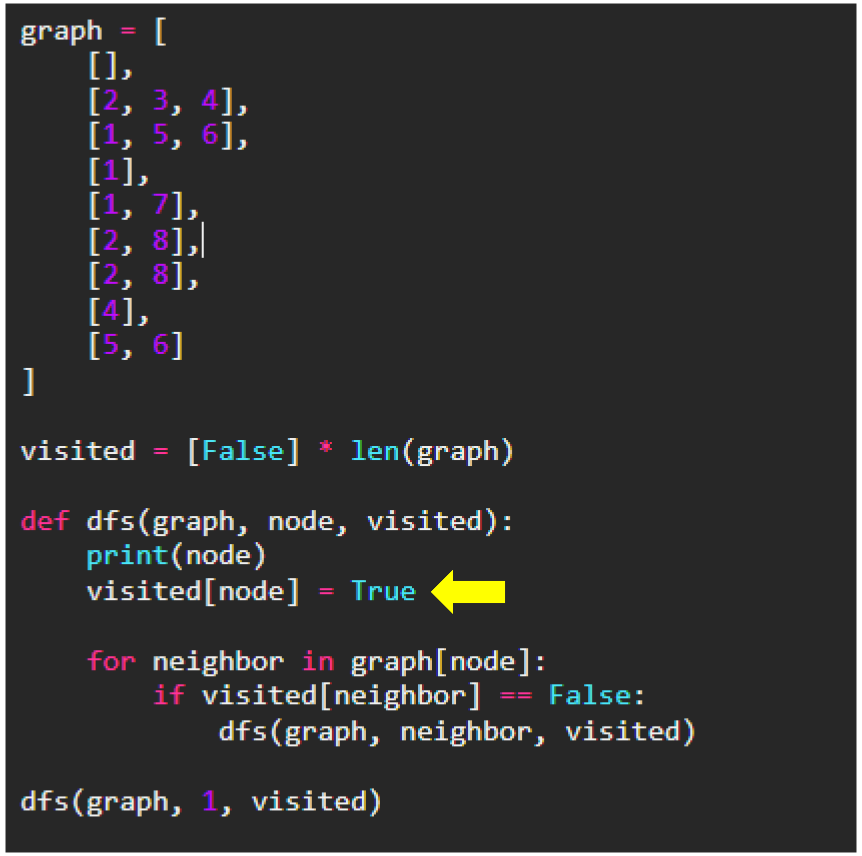


neighbor = 3
neighbor = 4
neighbor = 6



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    [],
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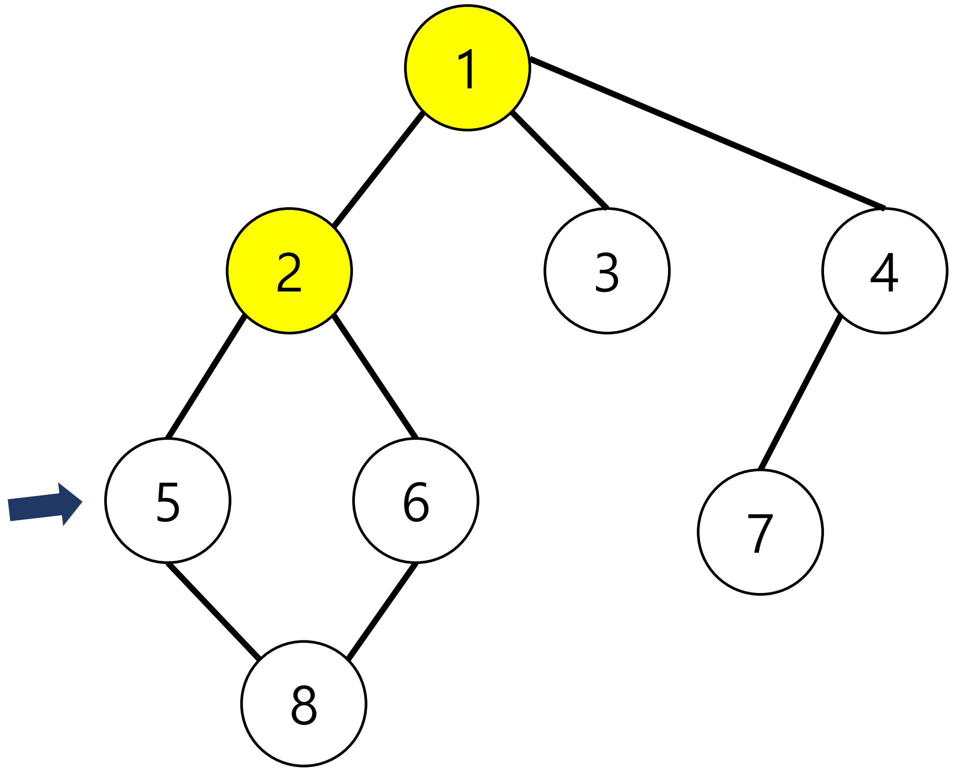

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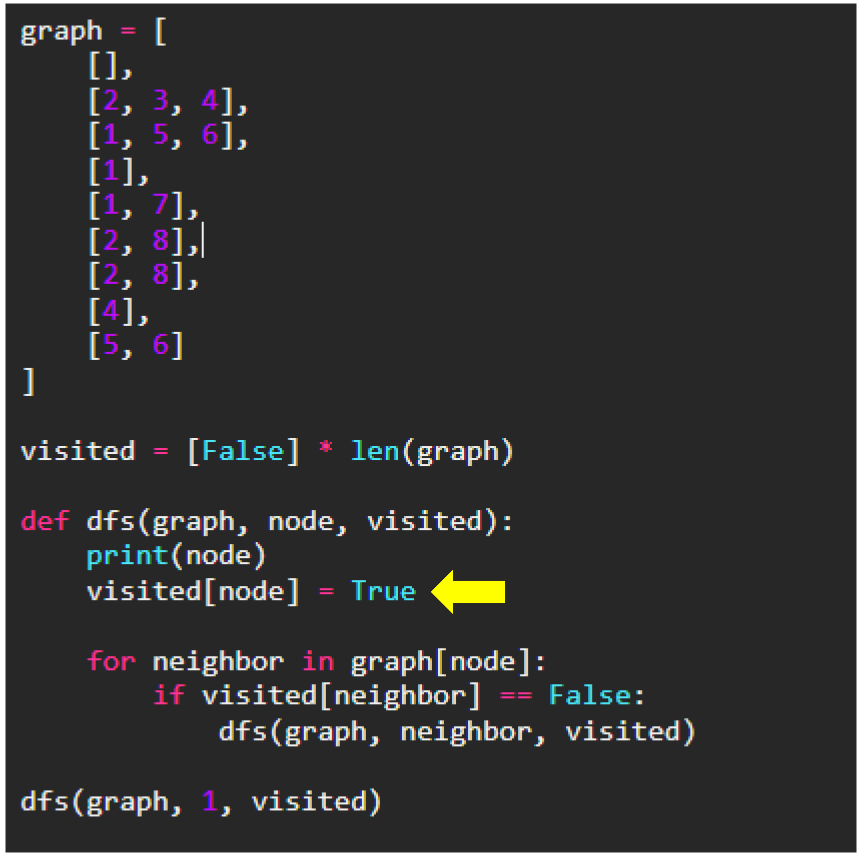
neighbor = 6



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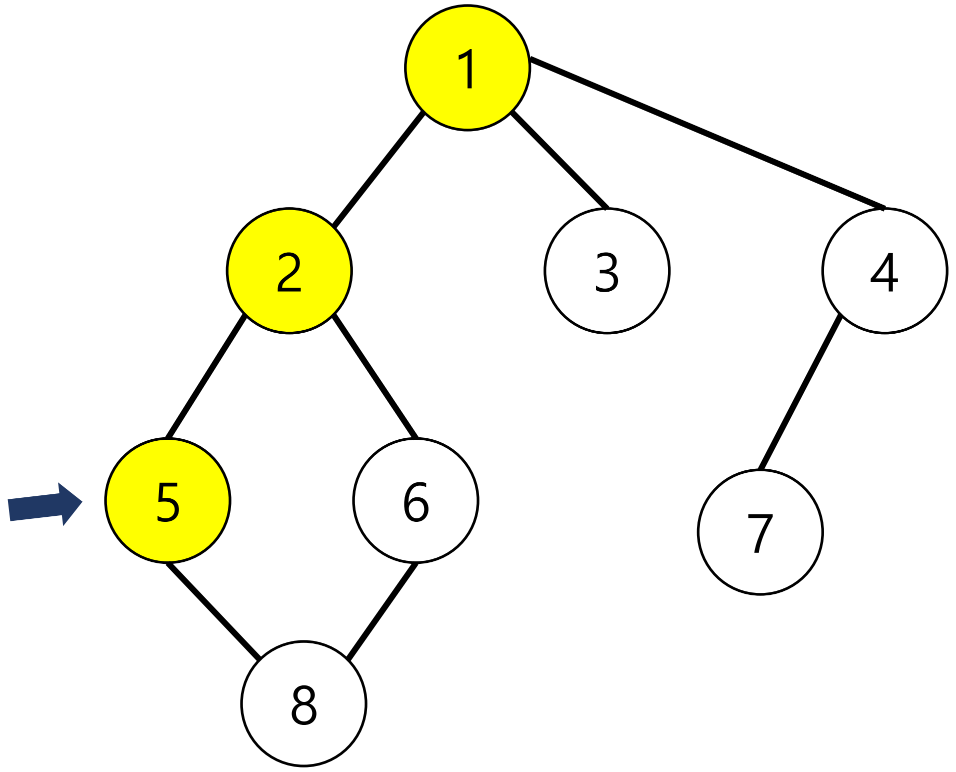

neighbor = 3
neighbor = 4
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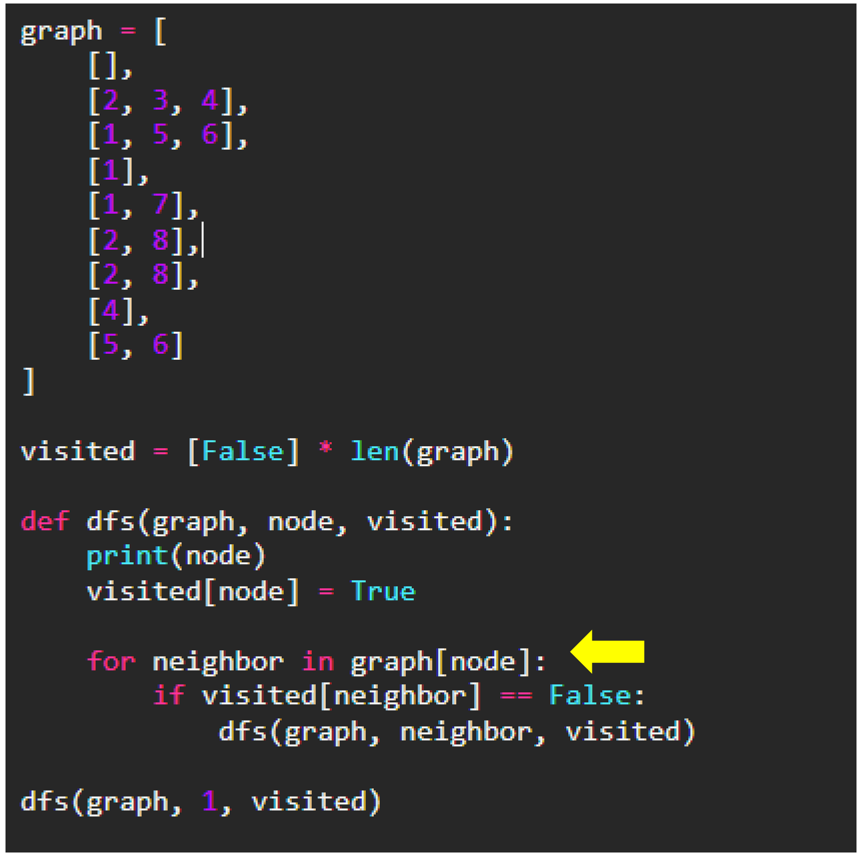

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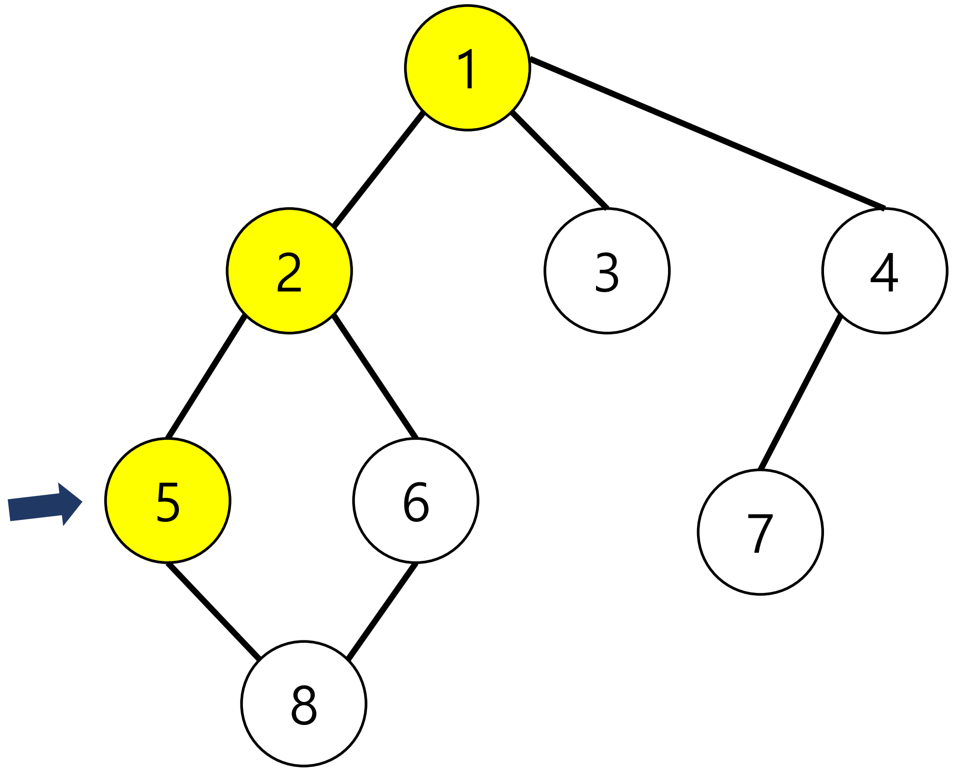

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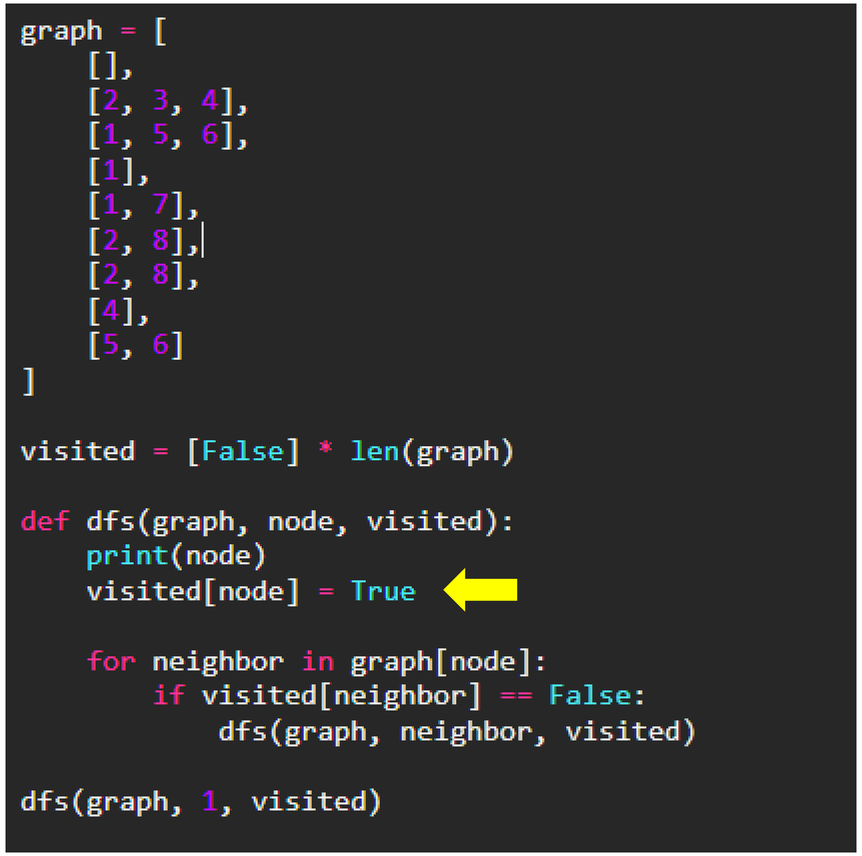

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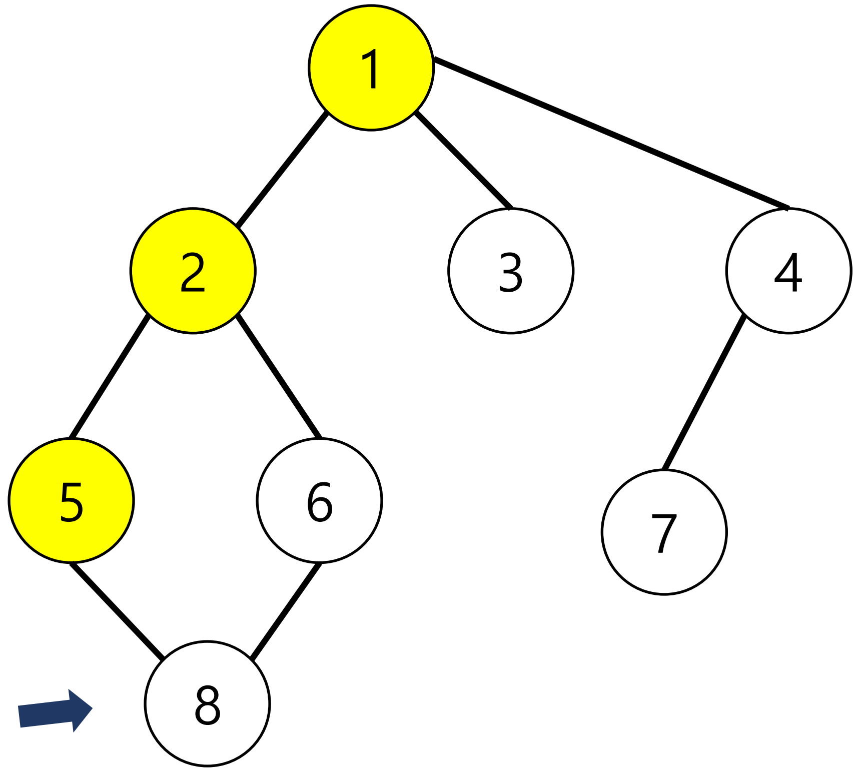
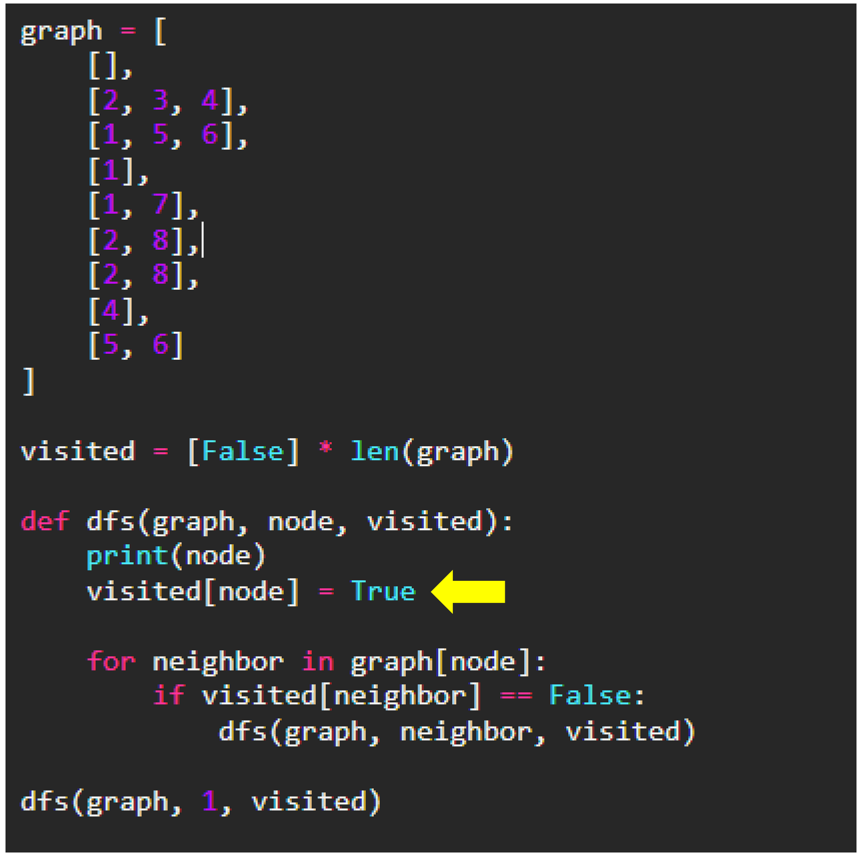


neighbor = 3
neighbor = 4
neighbor = 6



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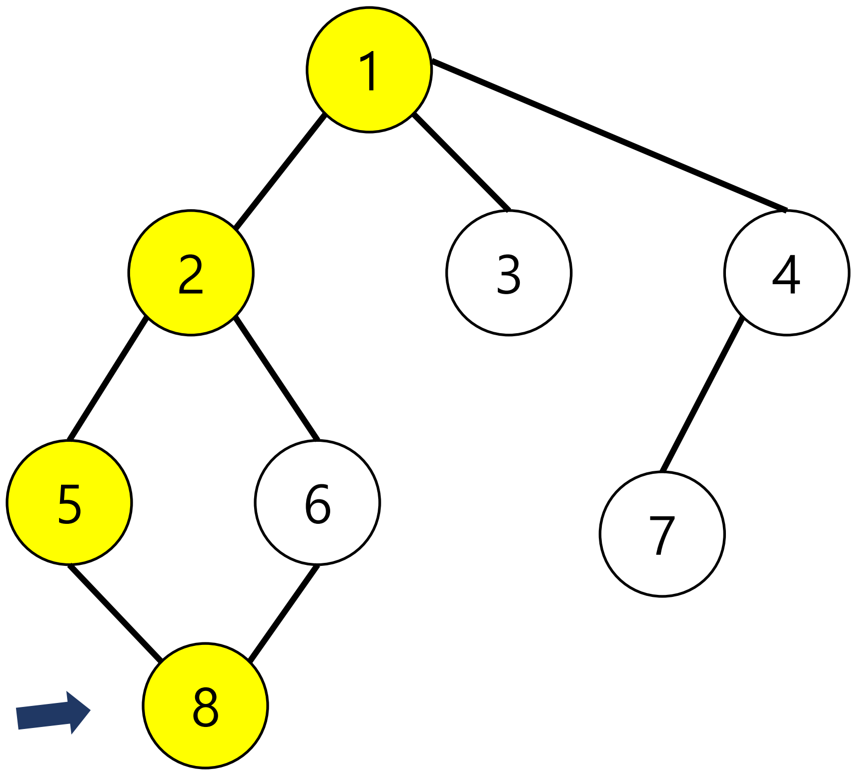

neighbor = 3
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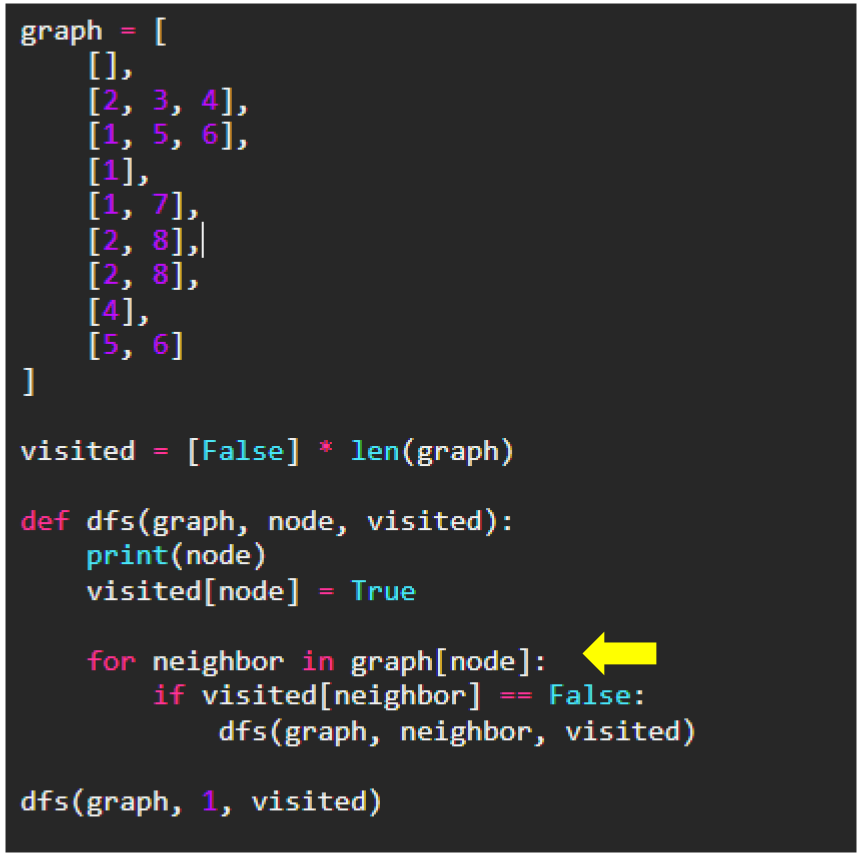

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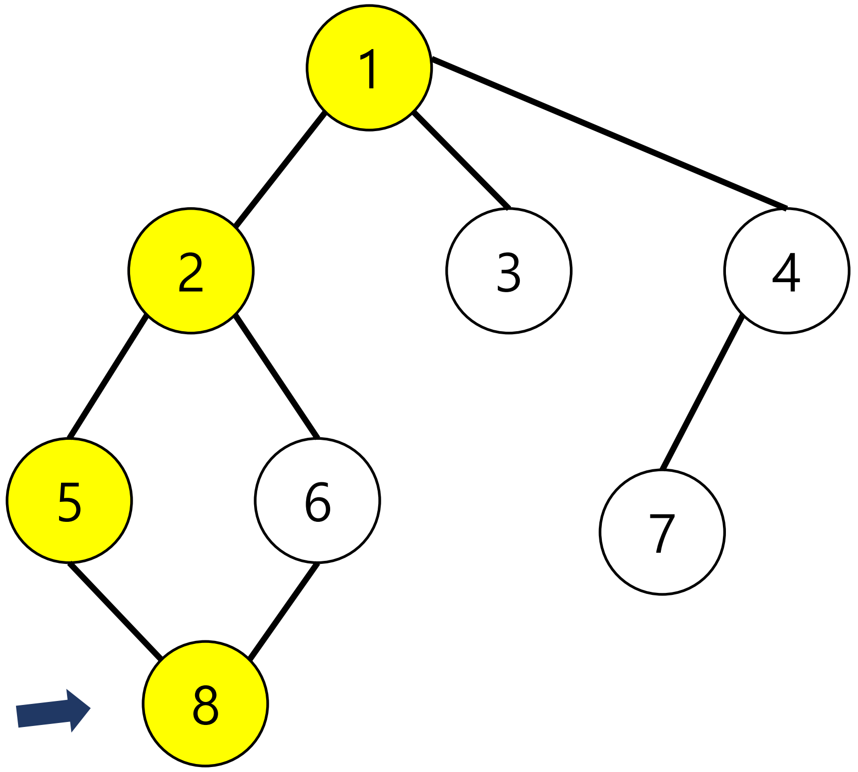

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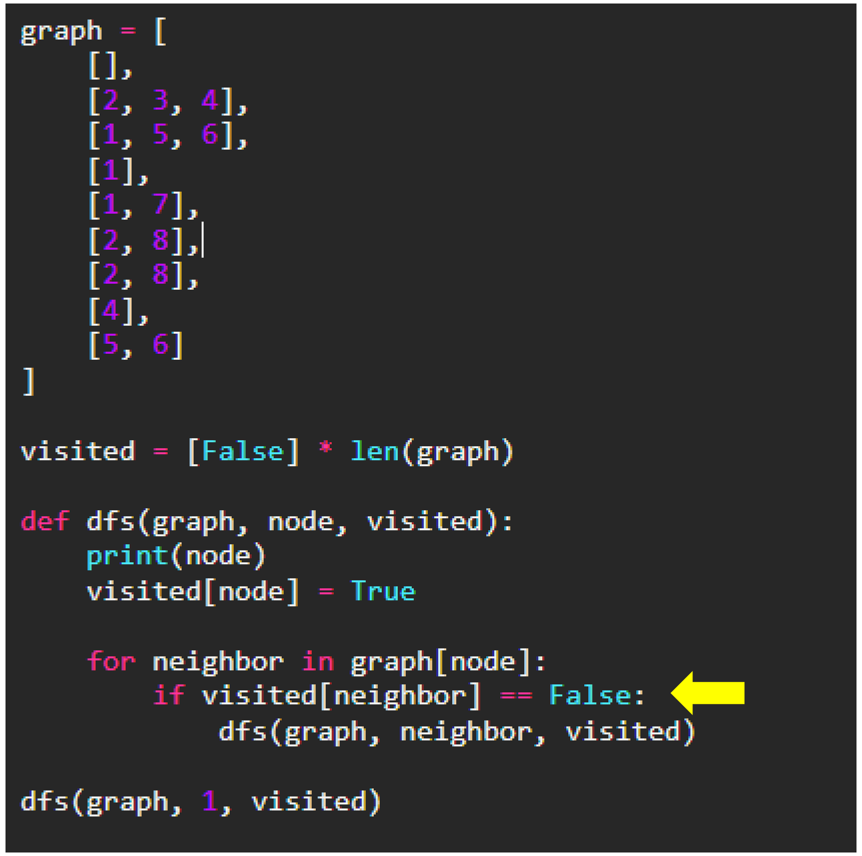

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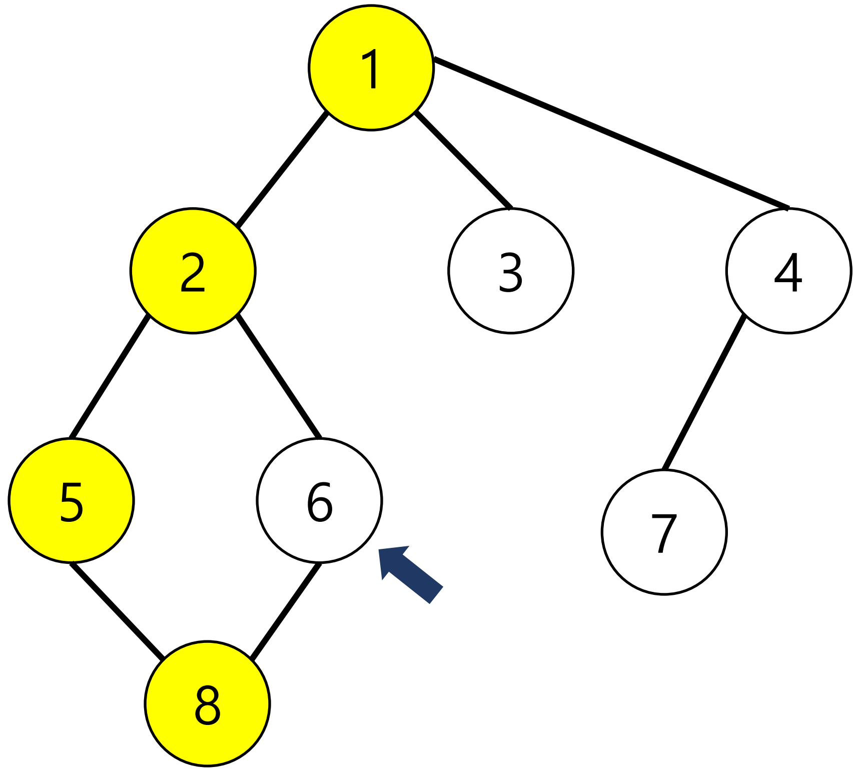
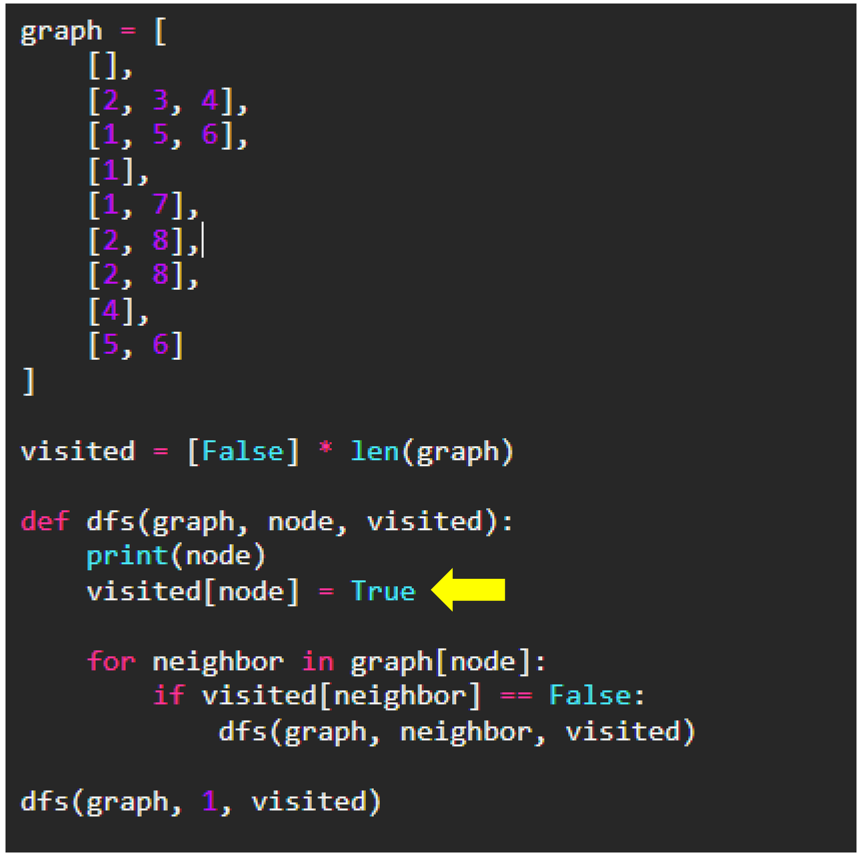


neighbor = 3
neighbor = 4
neighbor = 6



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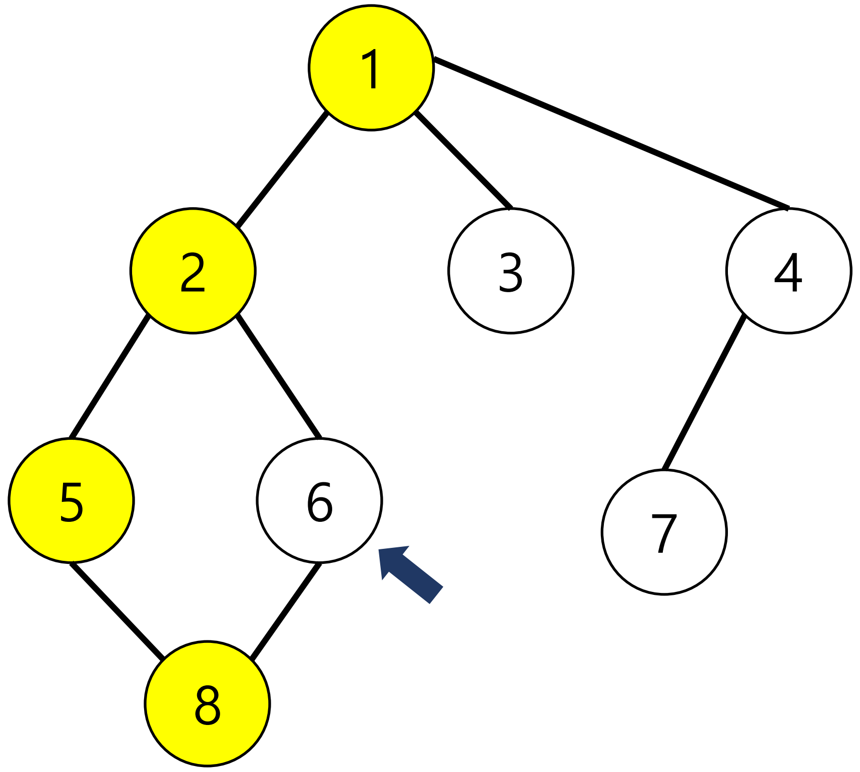

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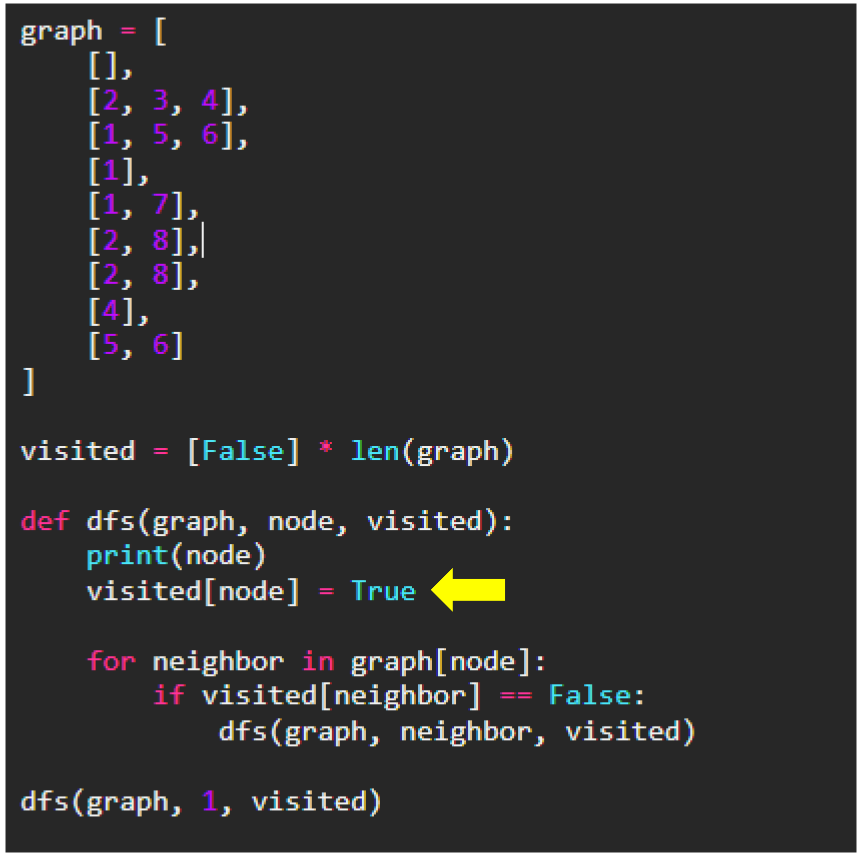

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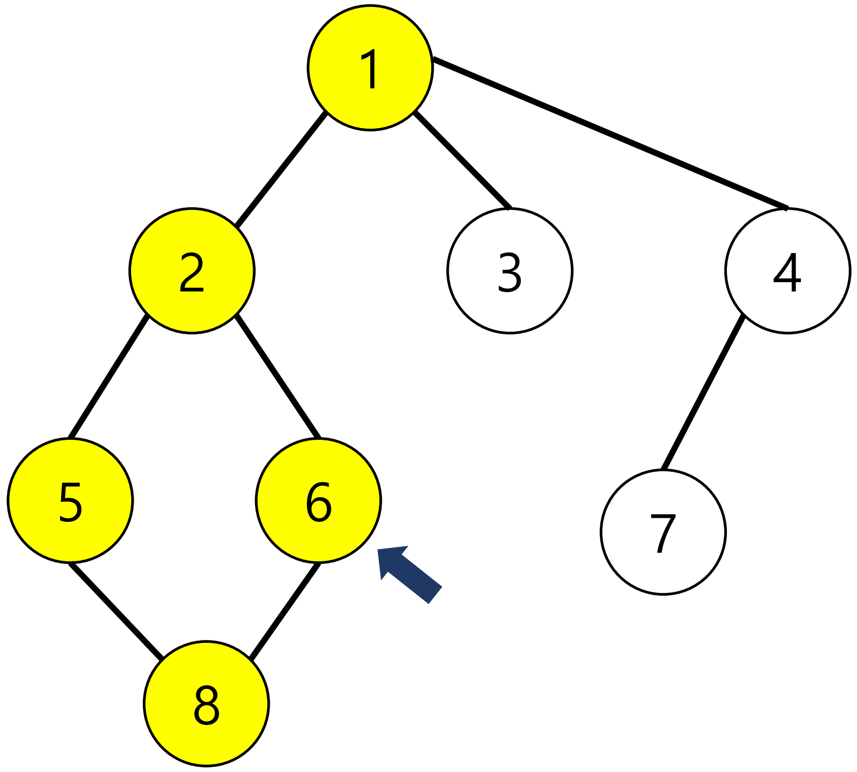

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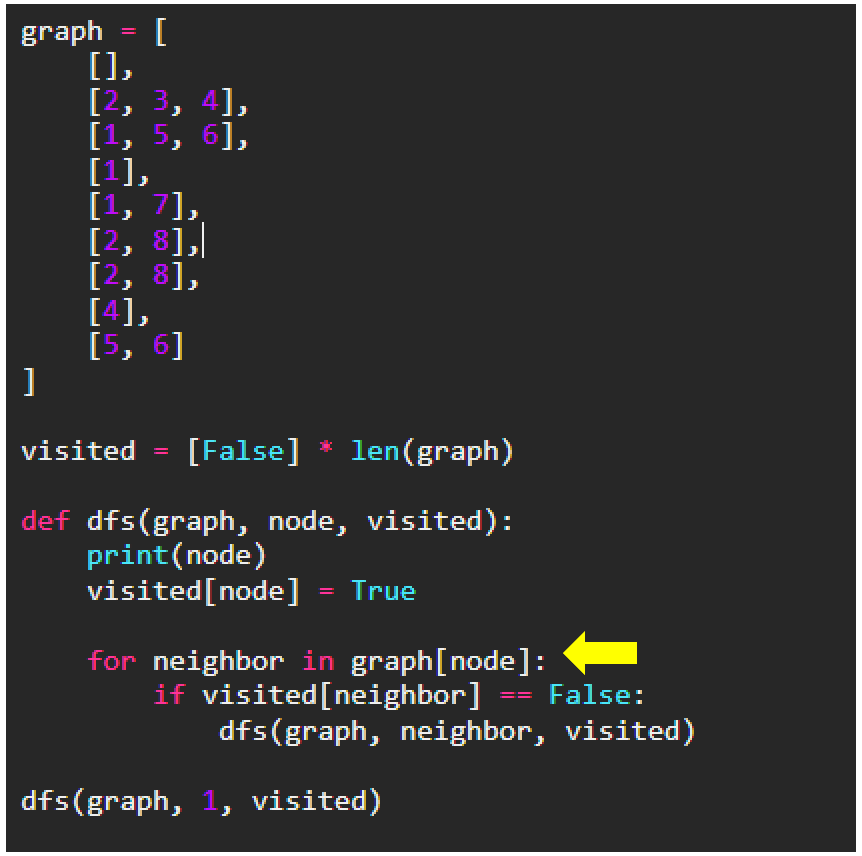

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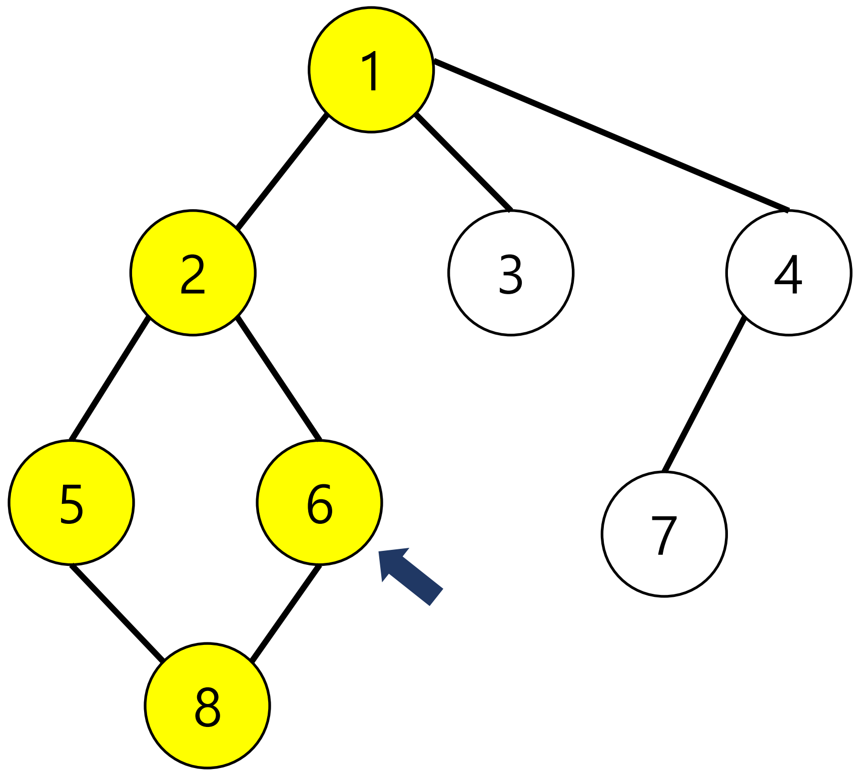

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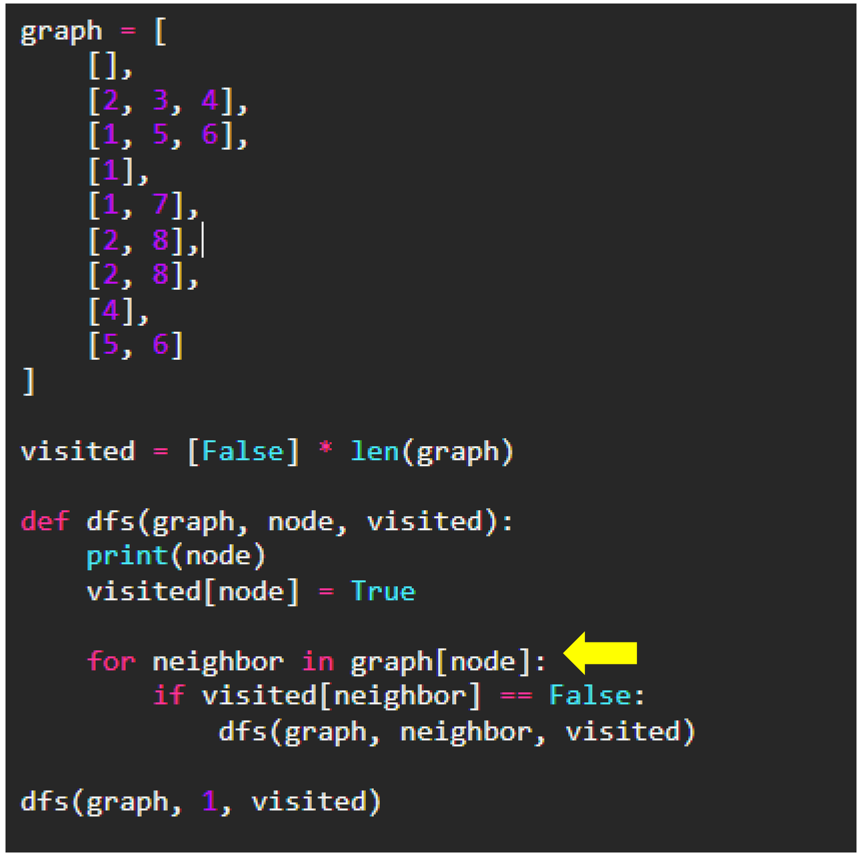

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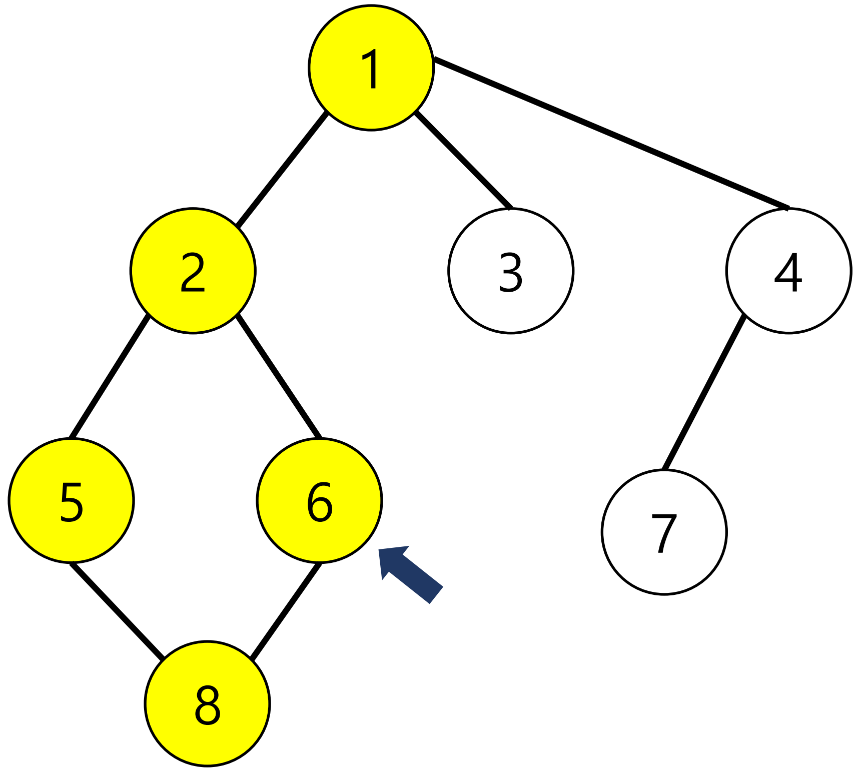

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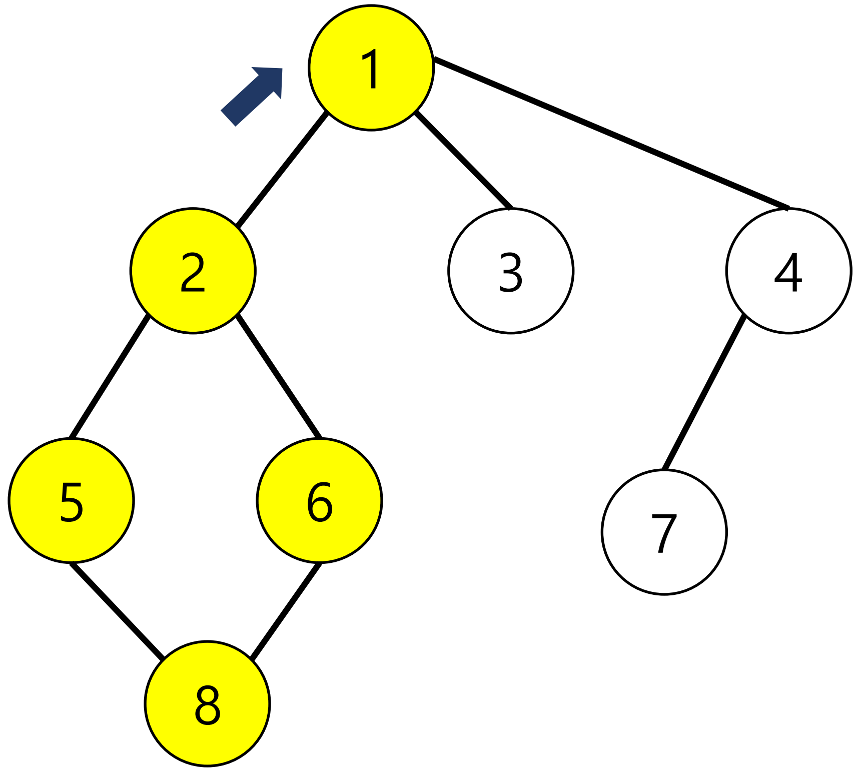

neighbor = 3
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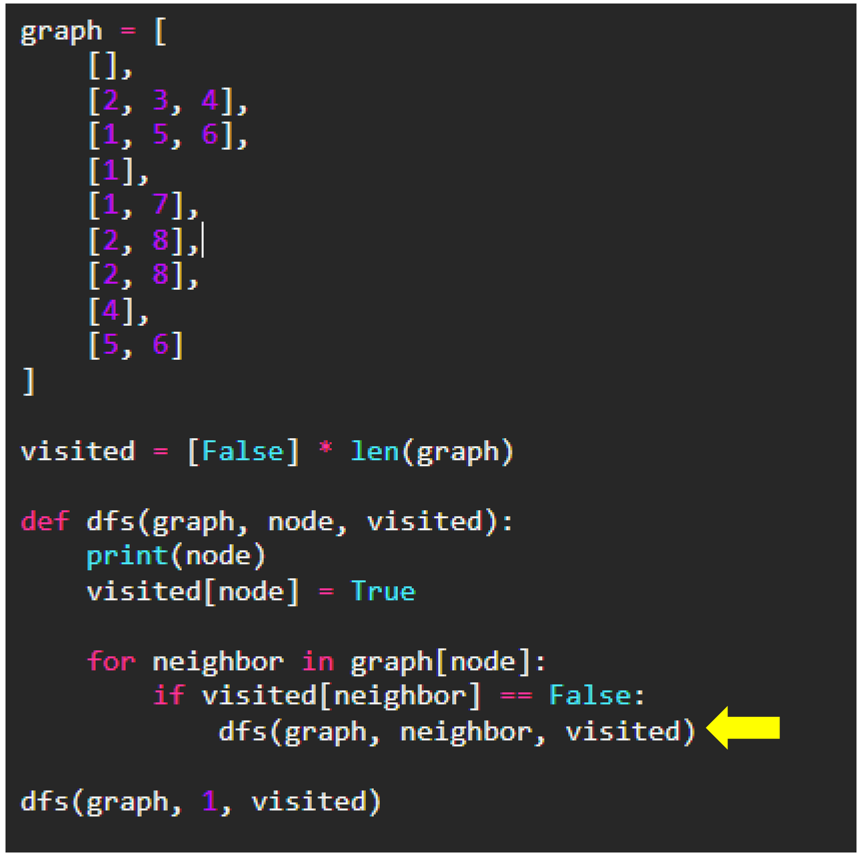

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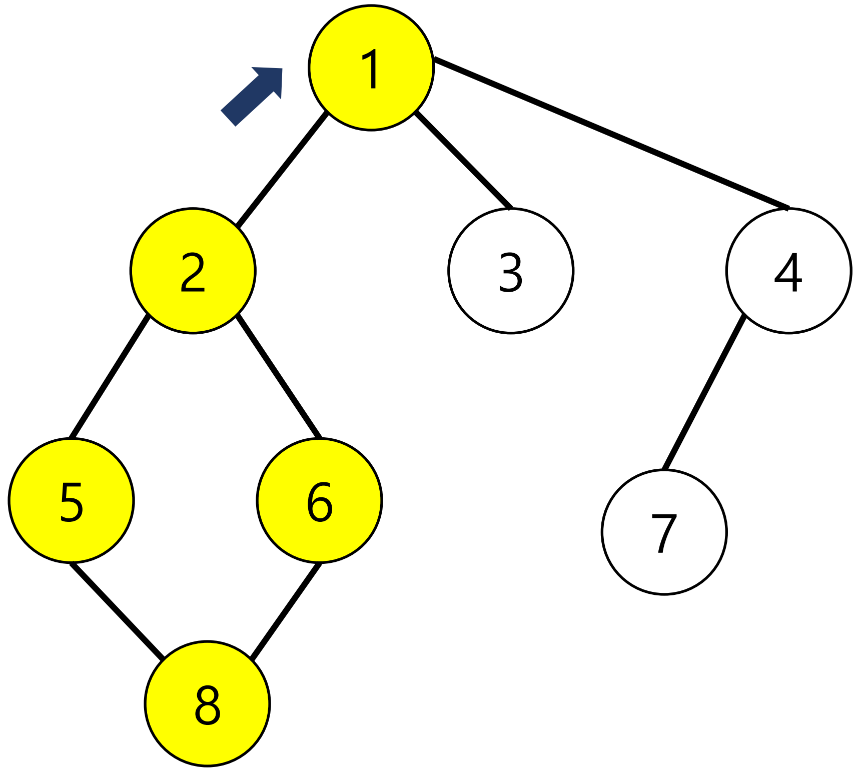

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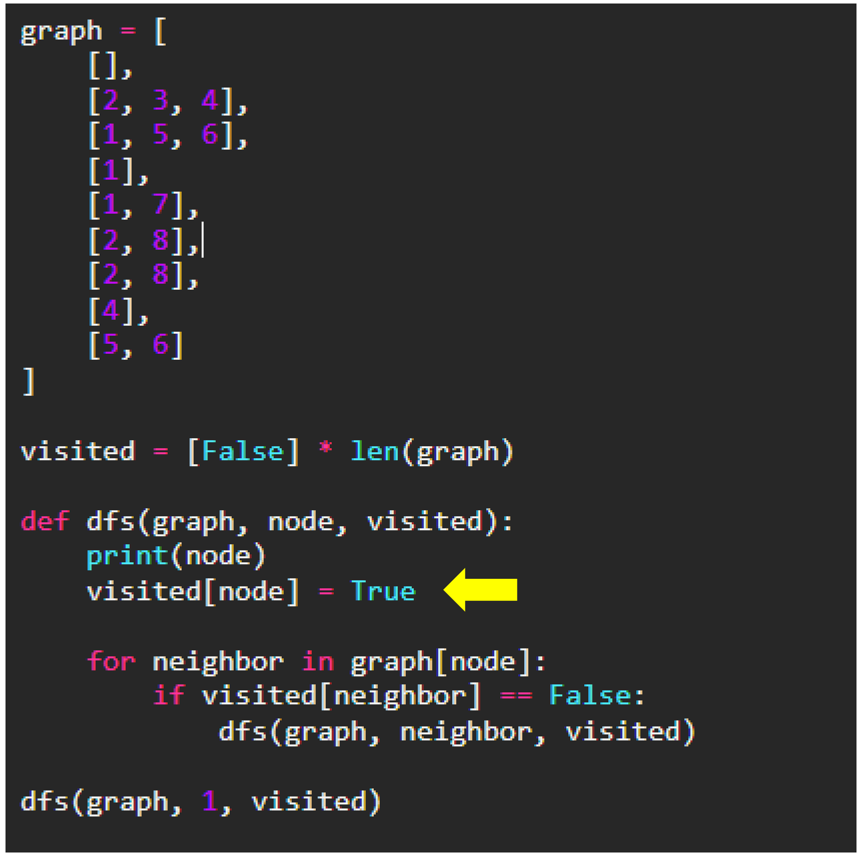

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dfs(graph, 1, visited)
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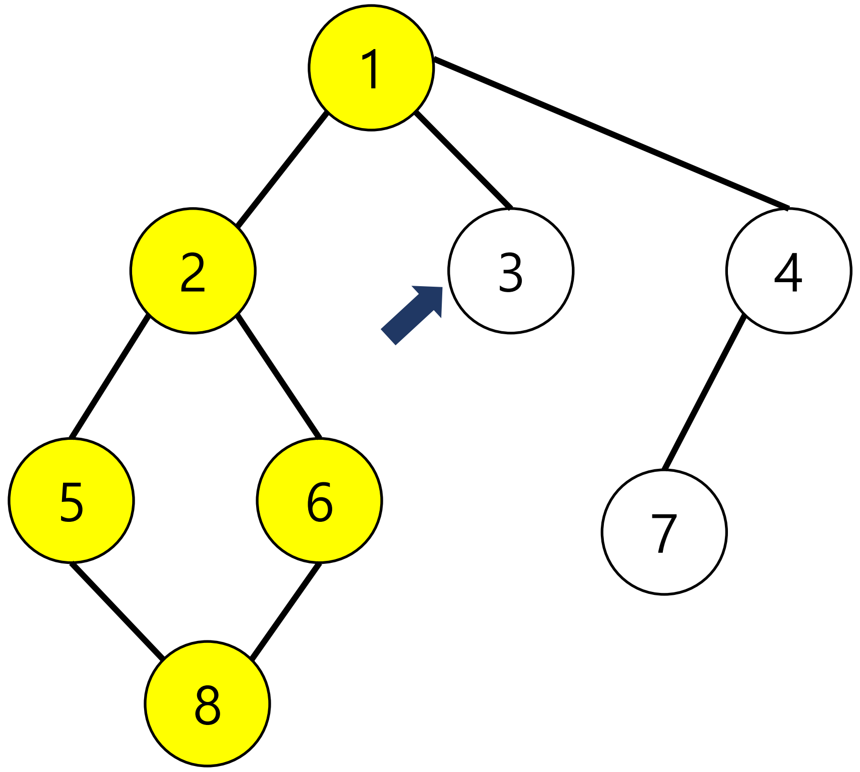
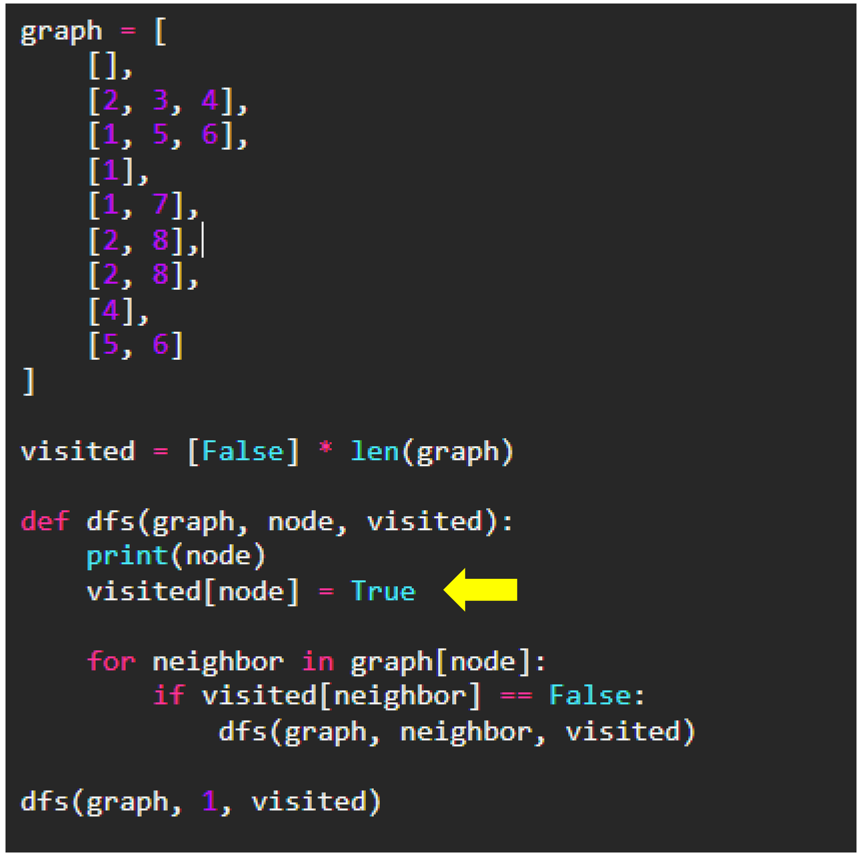


neighbor = 4



```
graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
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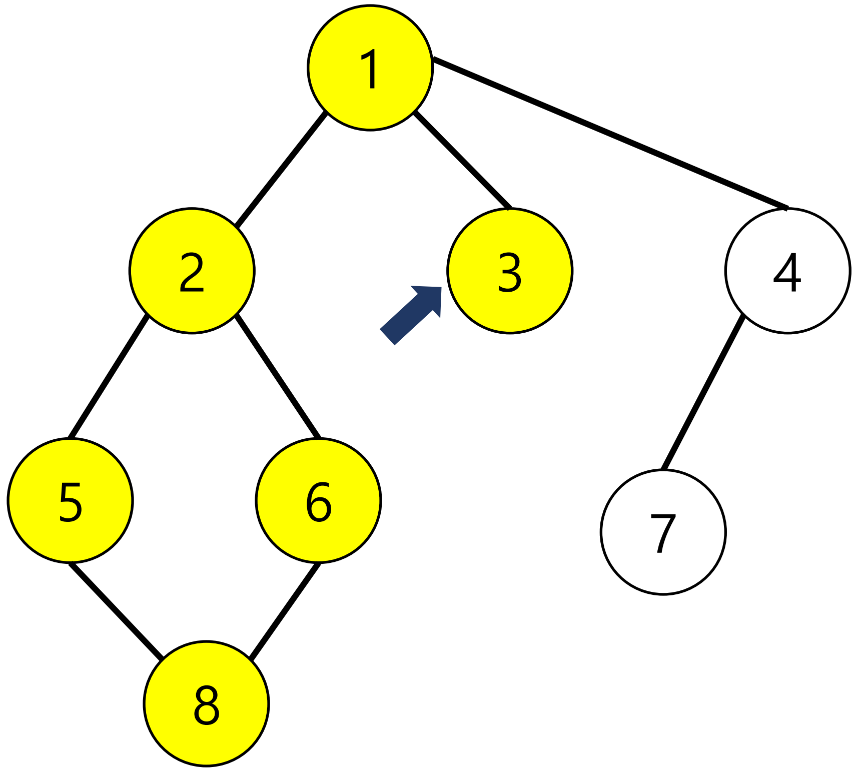
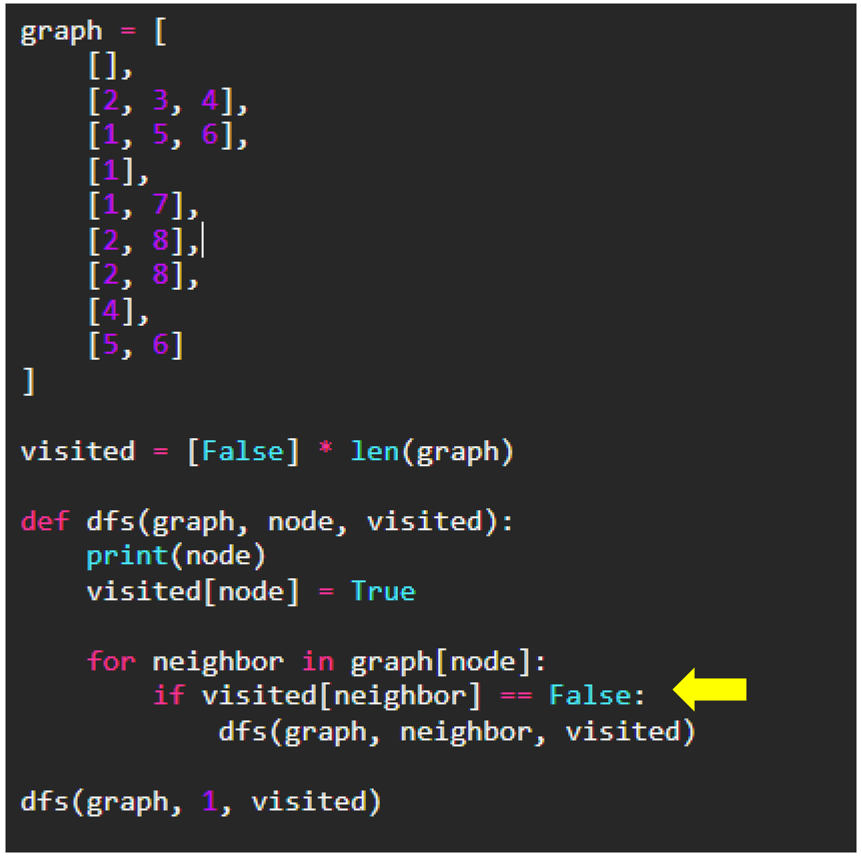


neighbor = 4



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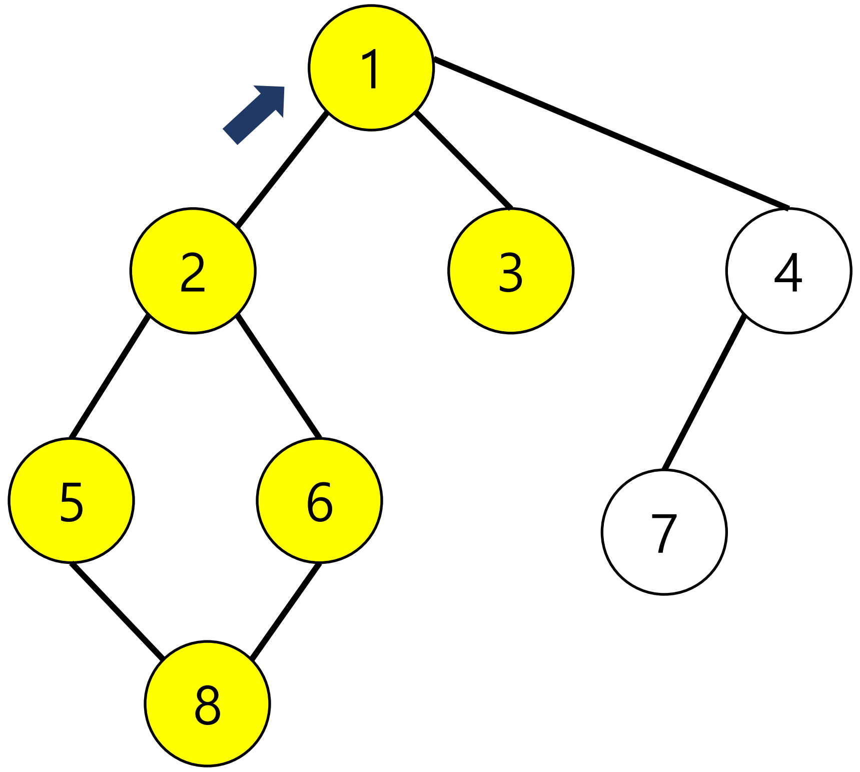

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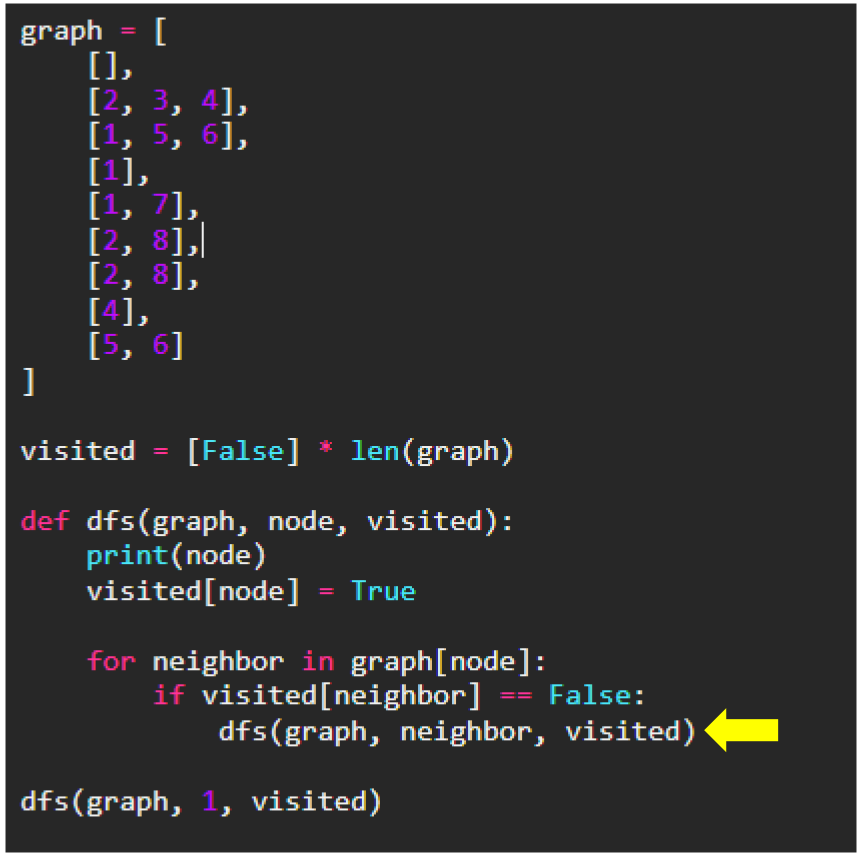

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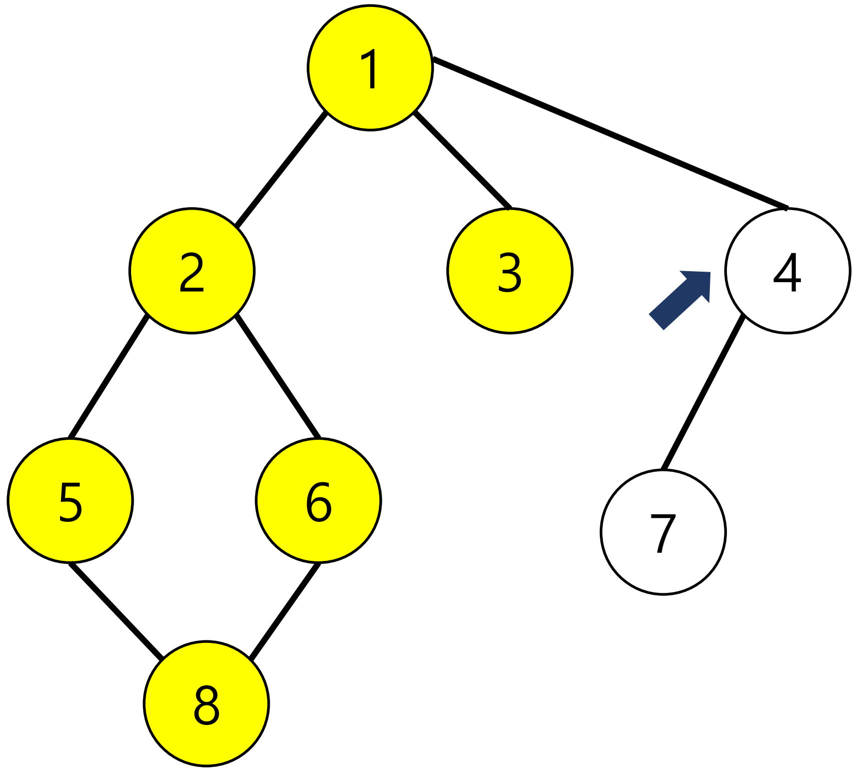

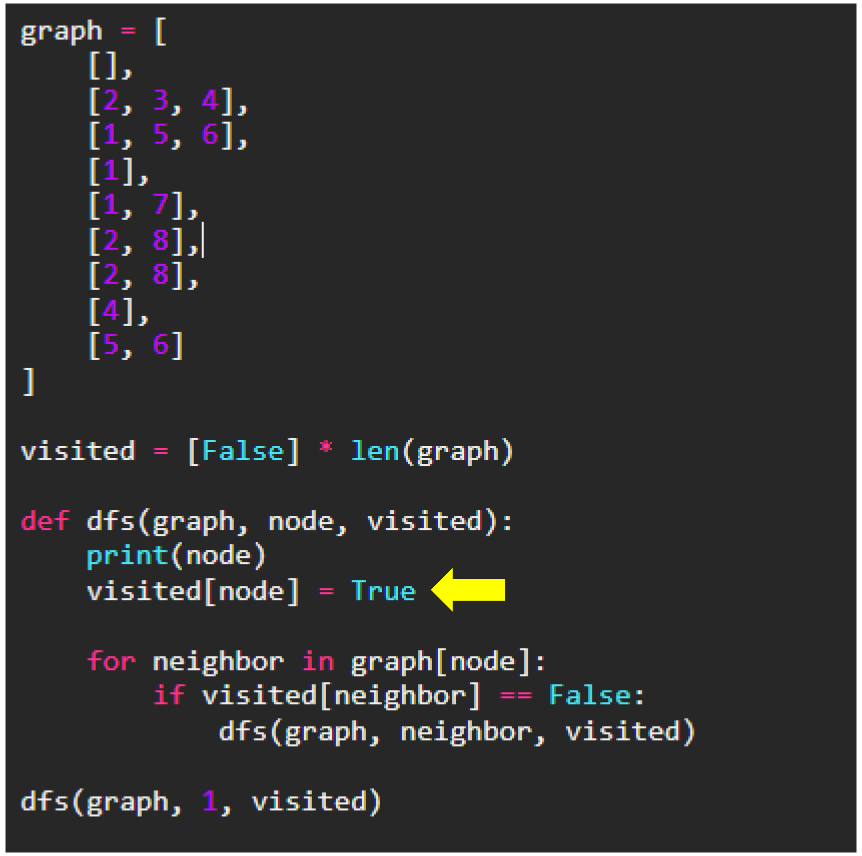

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    [1],
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    [2, 8],|
    [2, 8],
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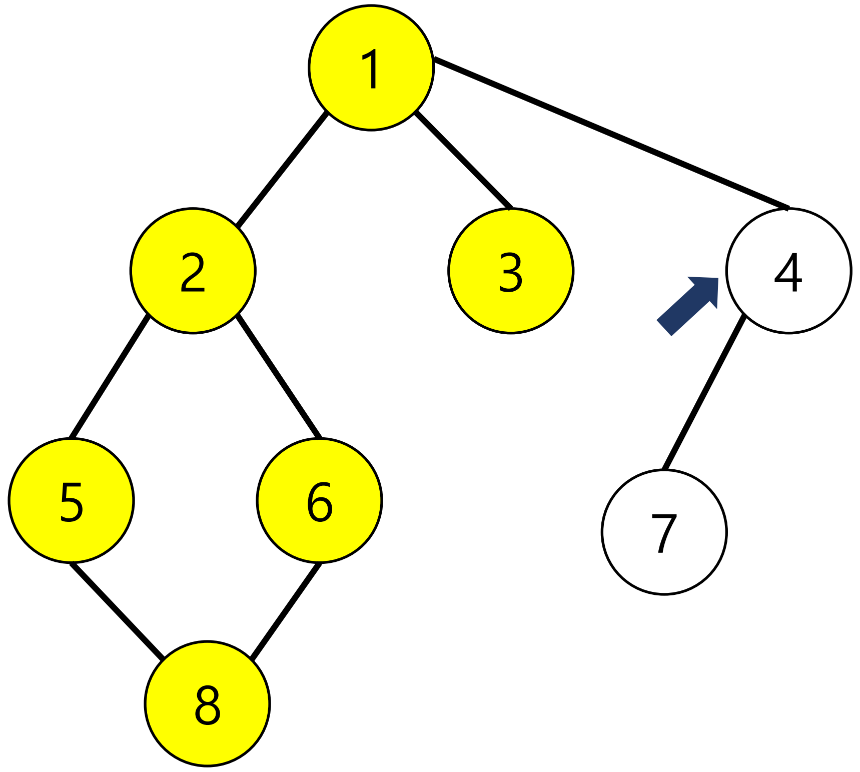

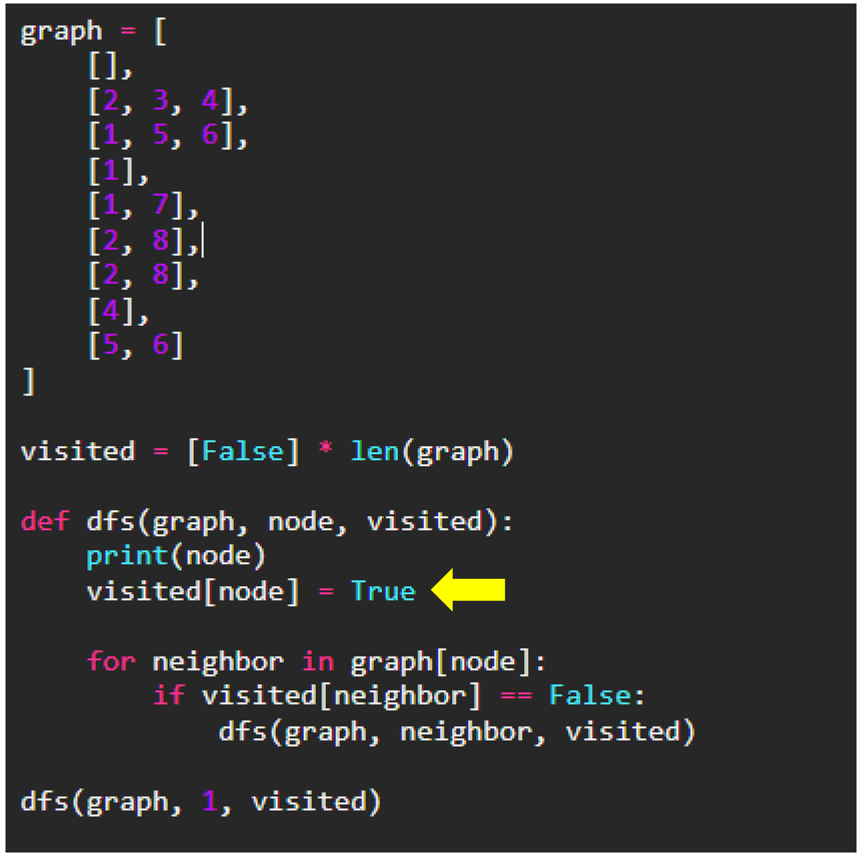

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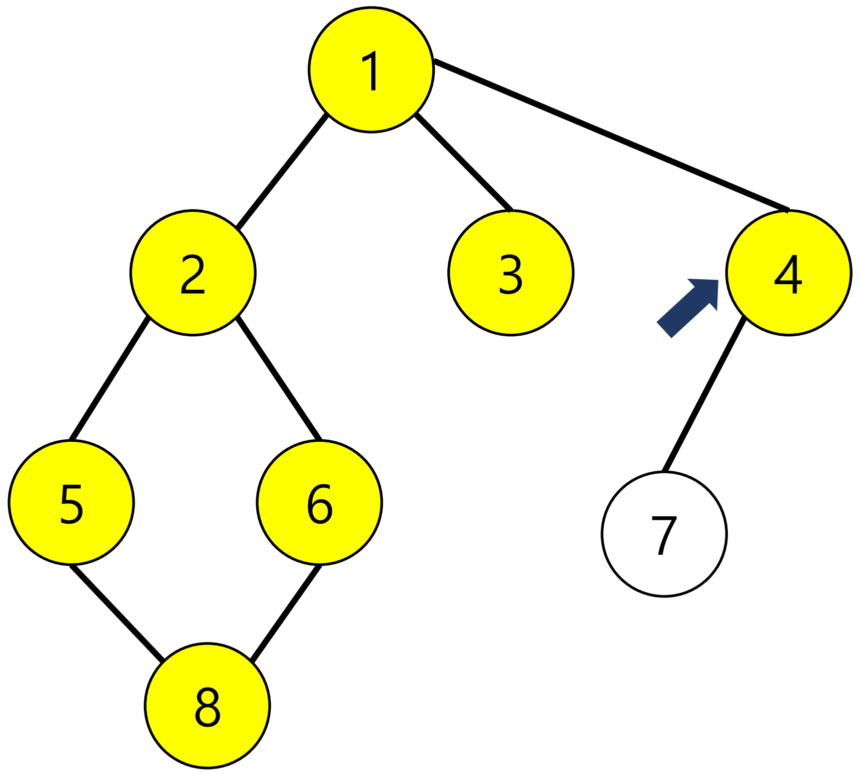

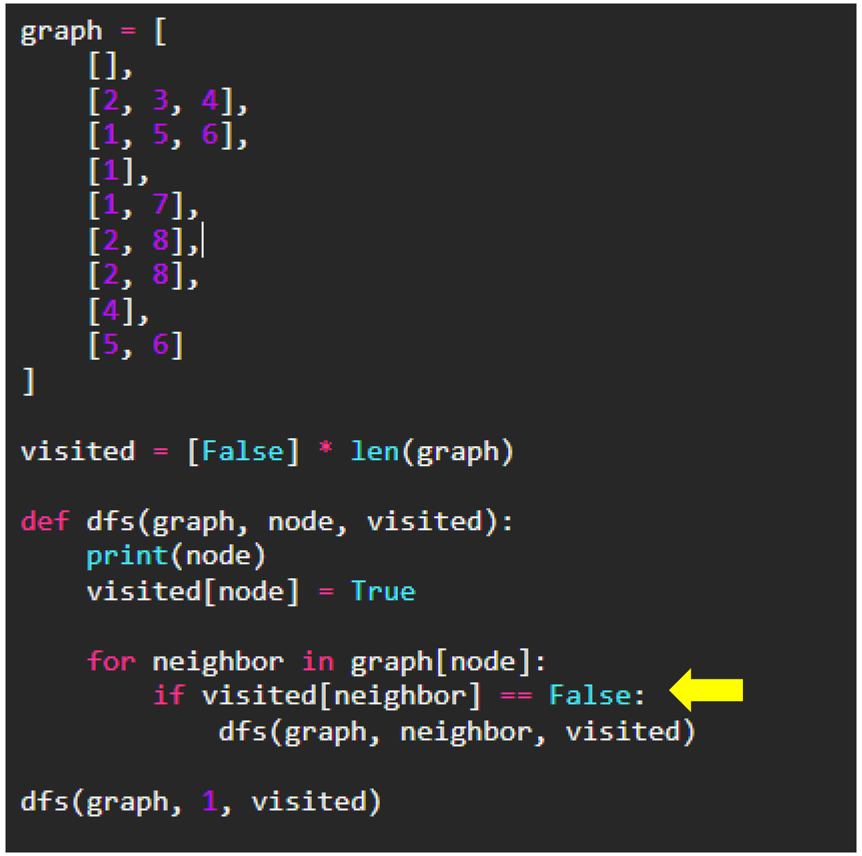

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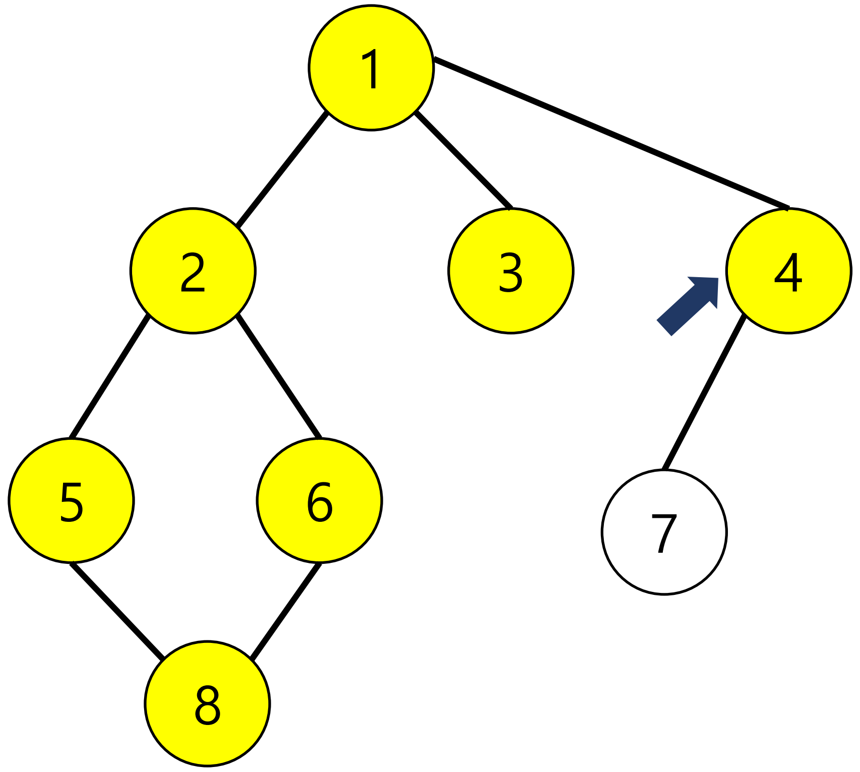

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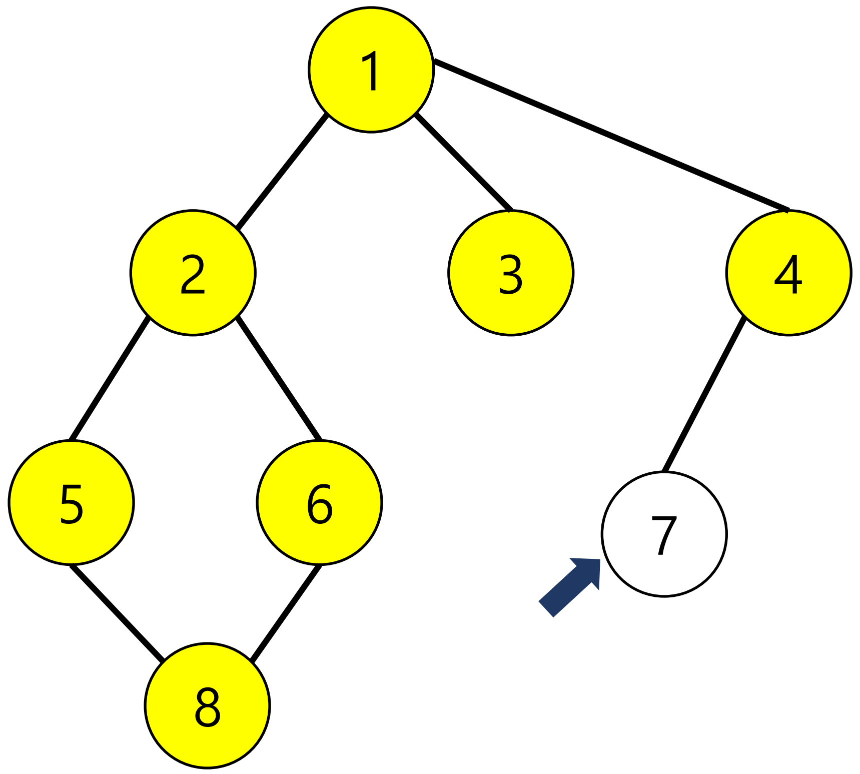

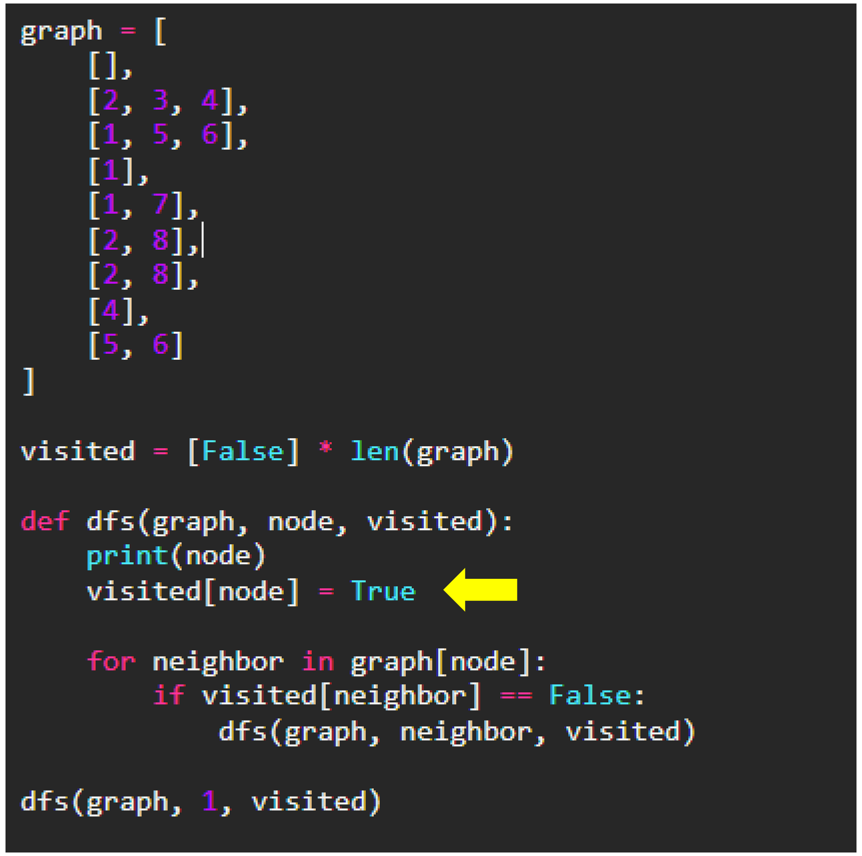
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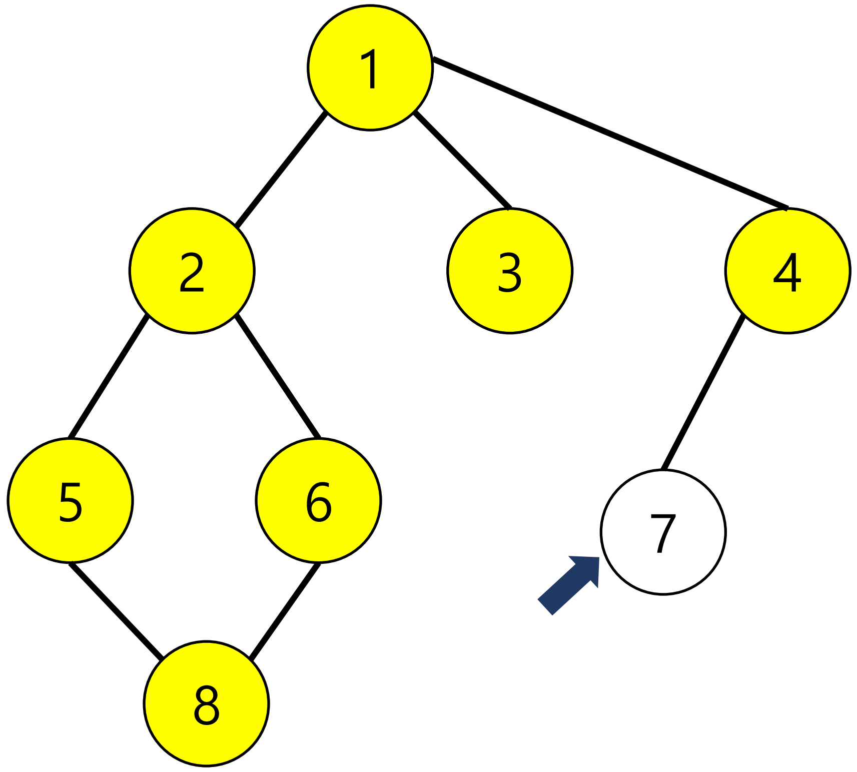

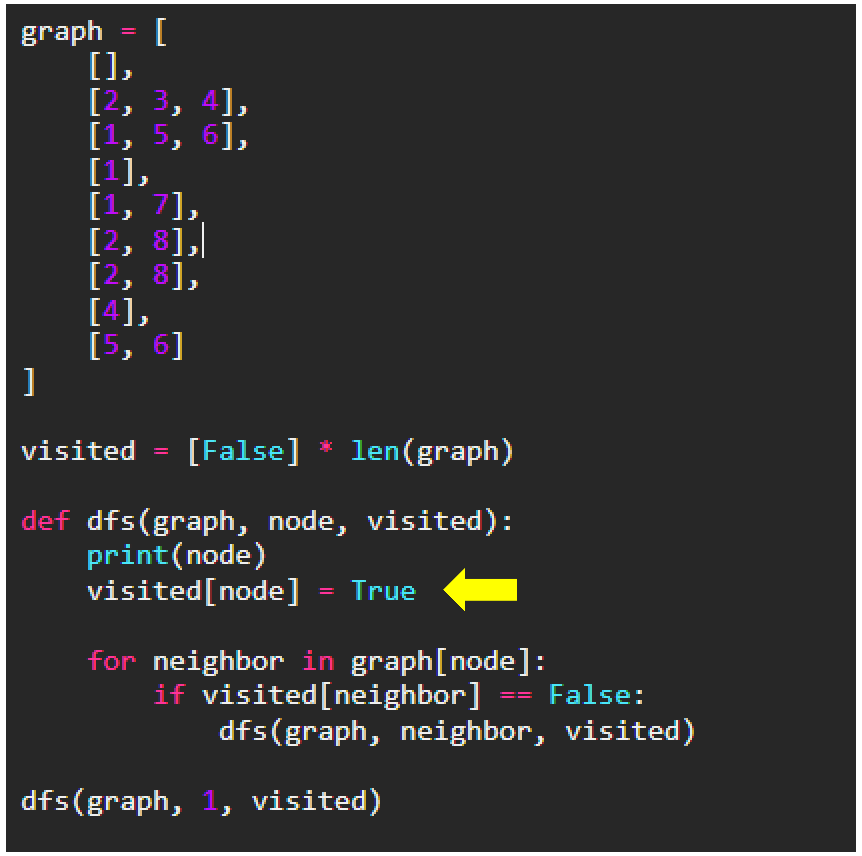

```
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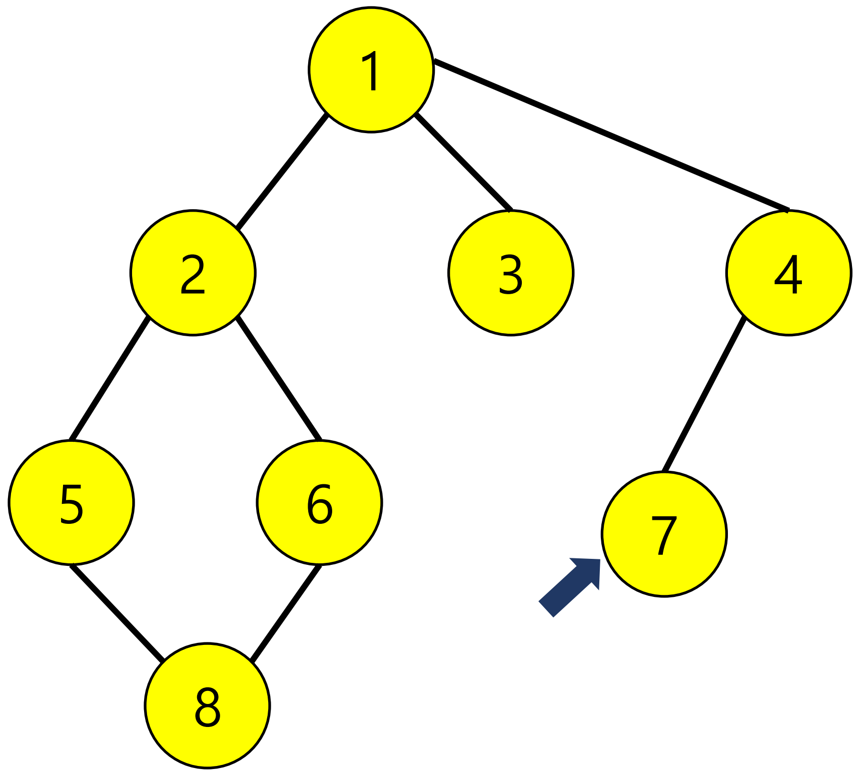


BFS 너비 우선 탐색

‘큐‘ 자료구조를 사용한 그래프 탐색 알고리즘

현재 노드와 가까운(인접) 노드를 우선적으로 넓게 탐색하는 방식

1. 루트 노드를 큐에 넣고 방문처리한다.
2. 큐를 Deque하고, Deque한 노드의 방문하지 않은 모든 인접 노드를 큐에 넣고 방문 처리한다.
3. 2단계를 더 이상 수행할 수 없을 때 까지 반복한다.

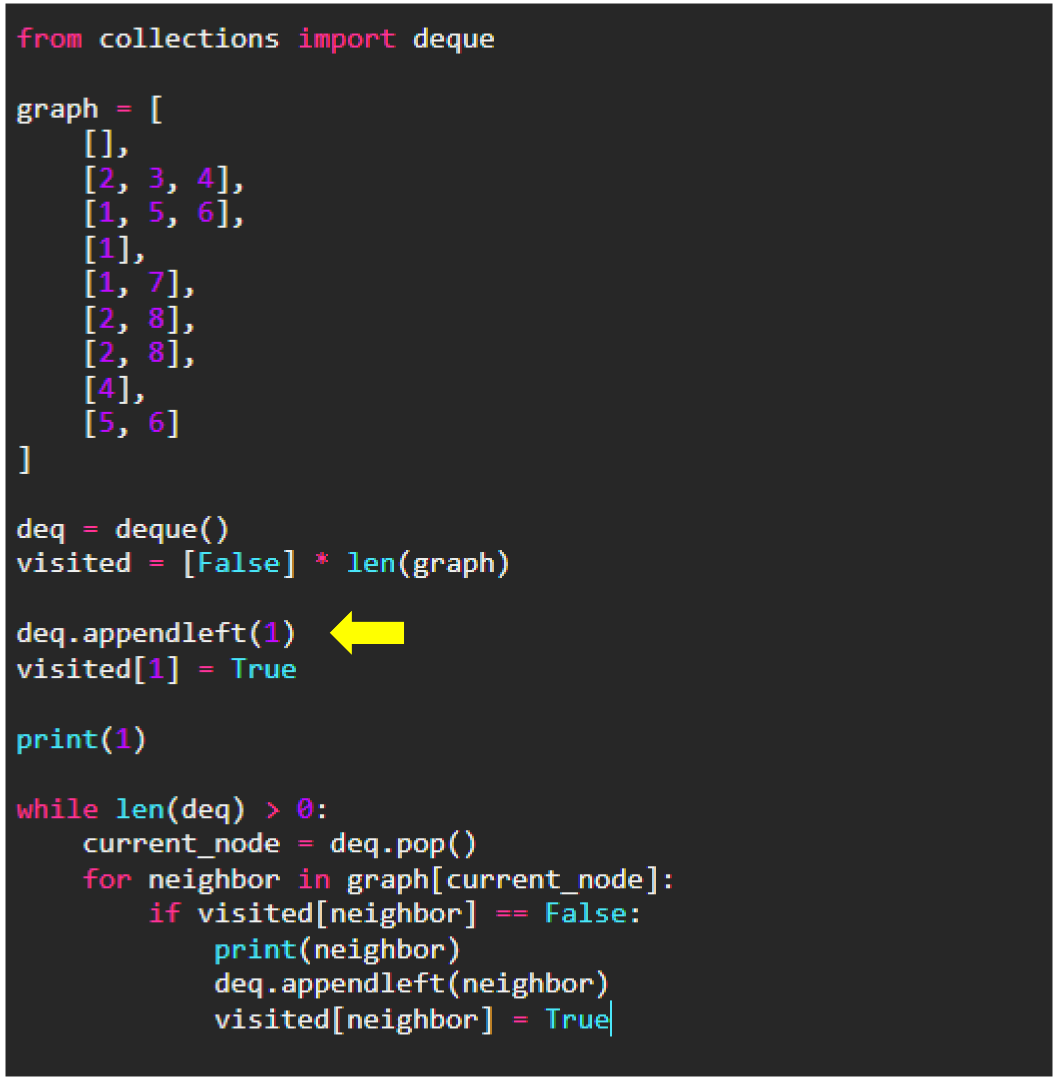
BFS 너비 우선 탐색

장점

- 노드의 수가 적고 깊이가 얕은 경우 빠르게 동작할 수 있음
- 출발 노드에서 목표 노드까지의 최단 길이 경로를 보장한다.

단점

- 최악의 경우 모든 노드에 대한 정보를 저장할 공간을 요구한다.



```
from collections import deque

graph = [
    [],
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    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
    [4],
    [5, 6]
]

deq = deque()
visited = [False] * len(graph)

deq.appendleft(1)
visited[1] = True

print(1)

while len(deq) > 0:
    current_node = deq.pop()
    for neighbor in graph[current_node]:
        if visited[neighbor] == False:
            print(neighbor)
            deq.appendleft(neighbor)
            visited[neighbor] = True
```

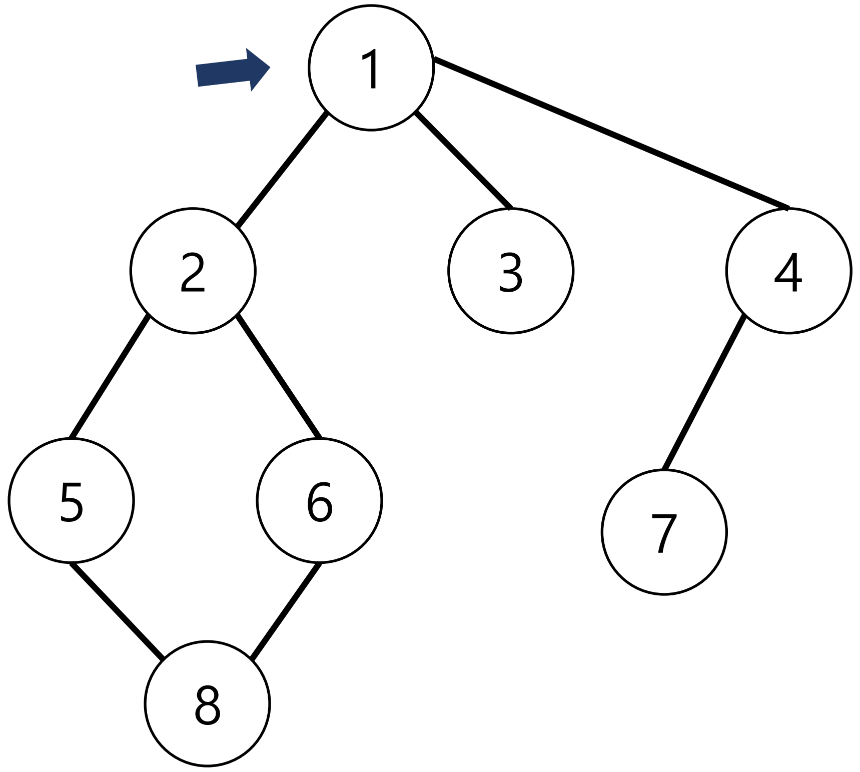

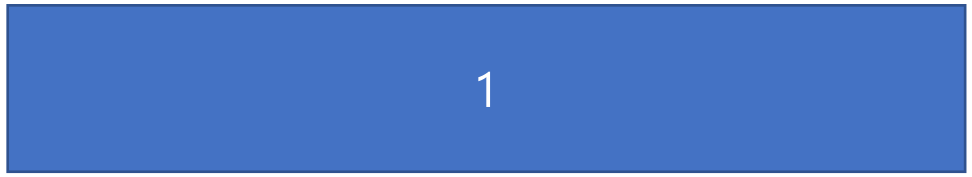

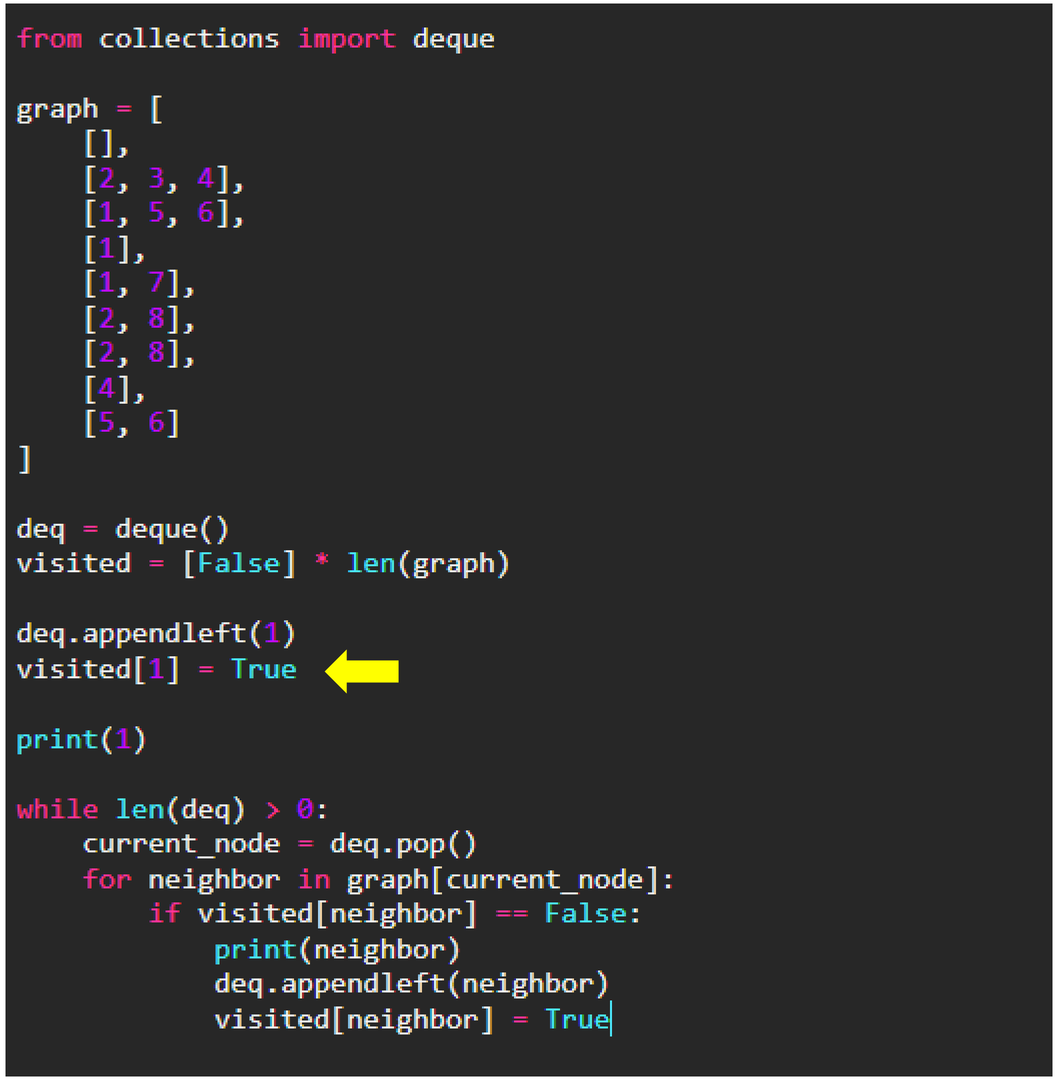

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from collections import deque

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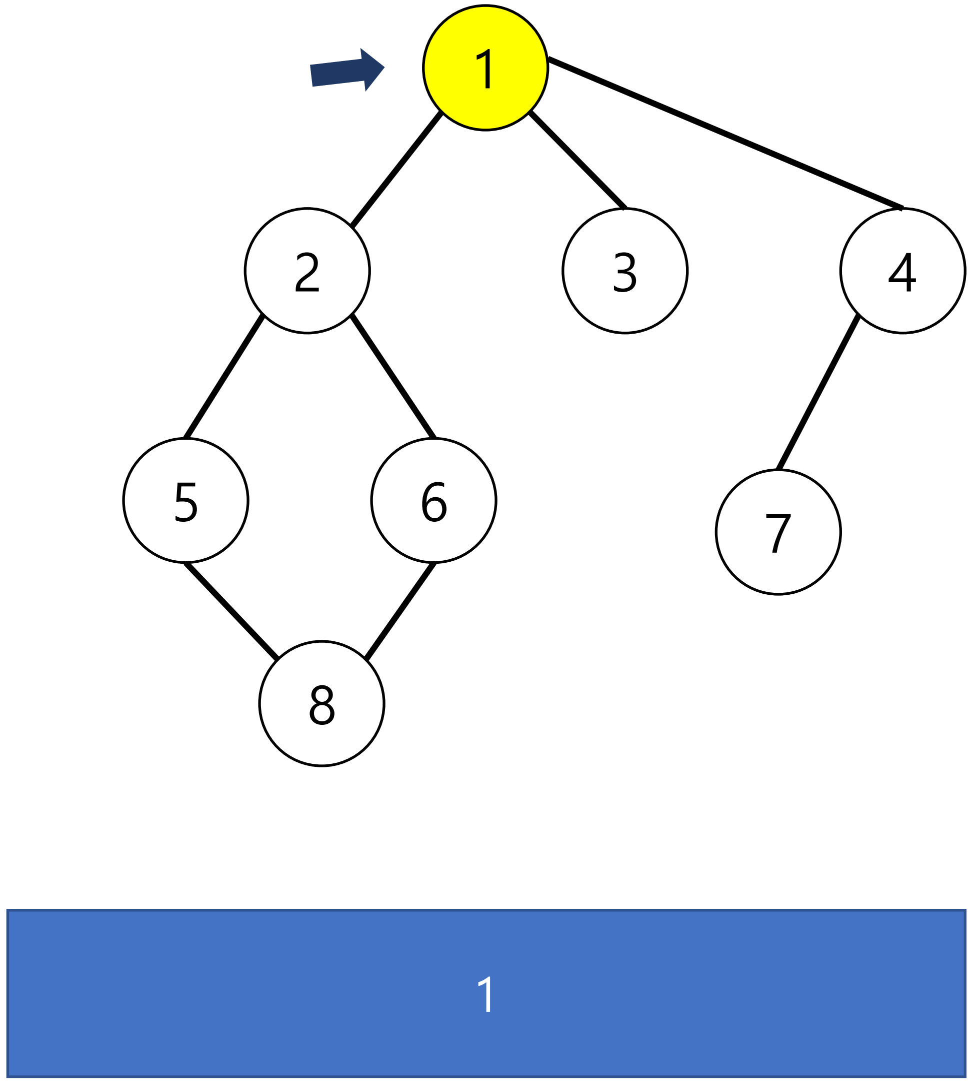

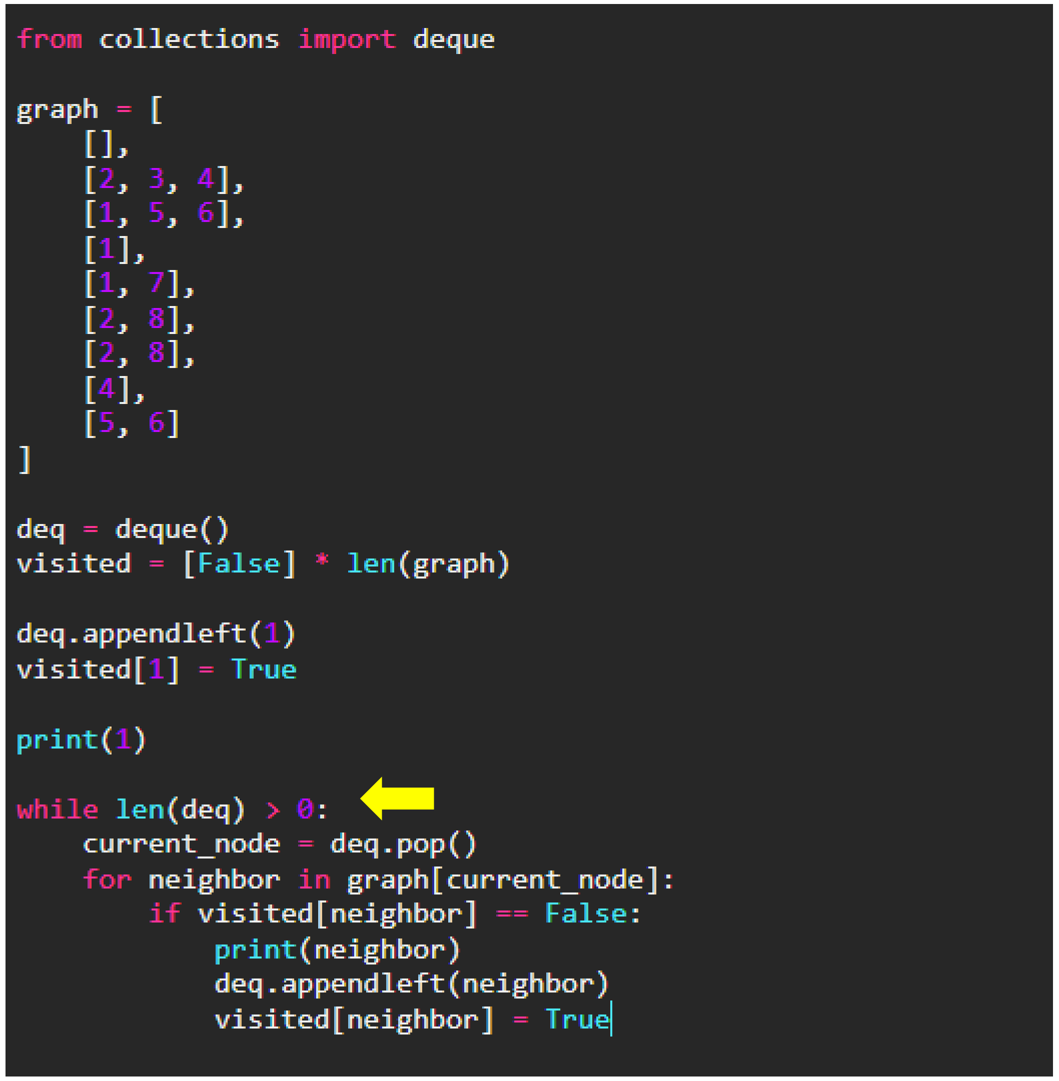

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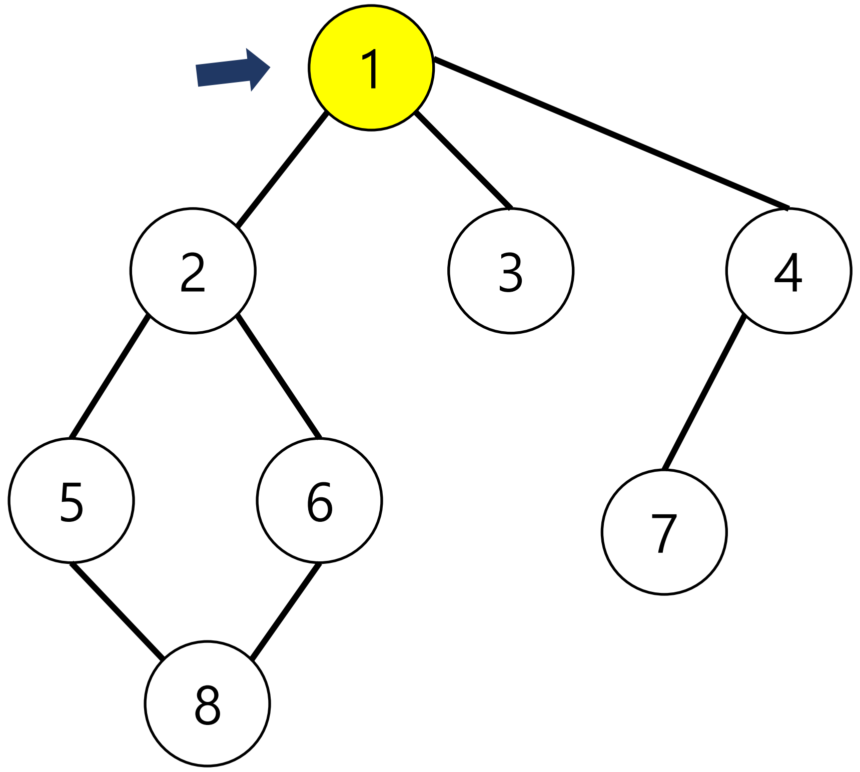

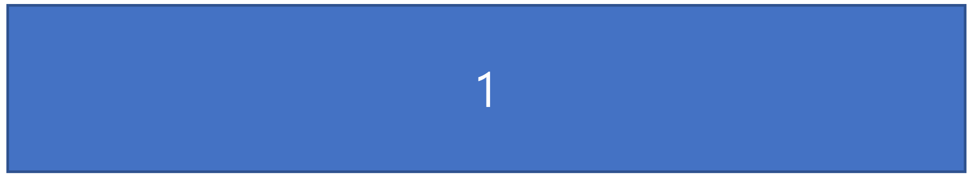

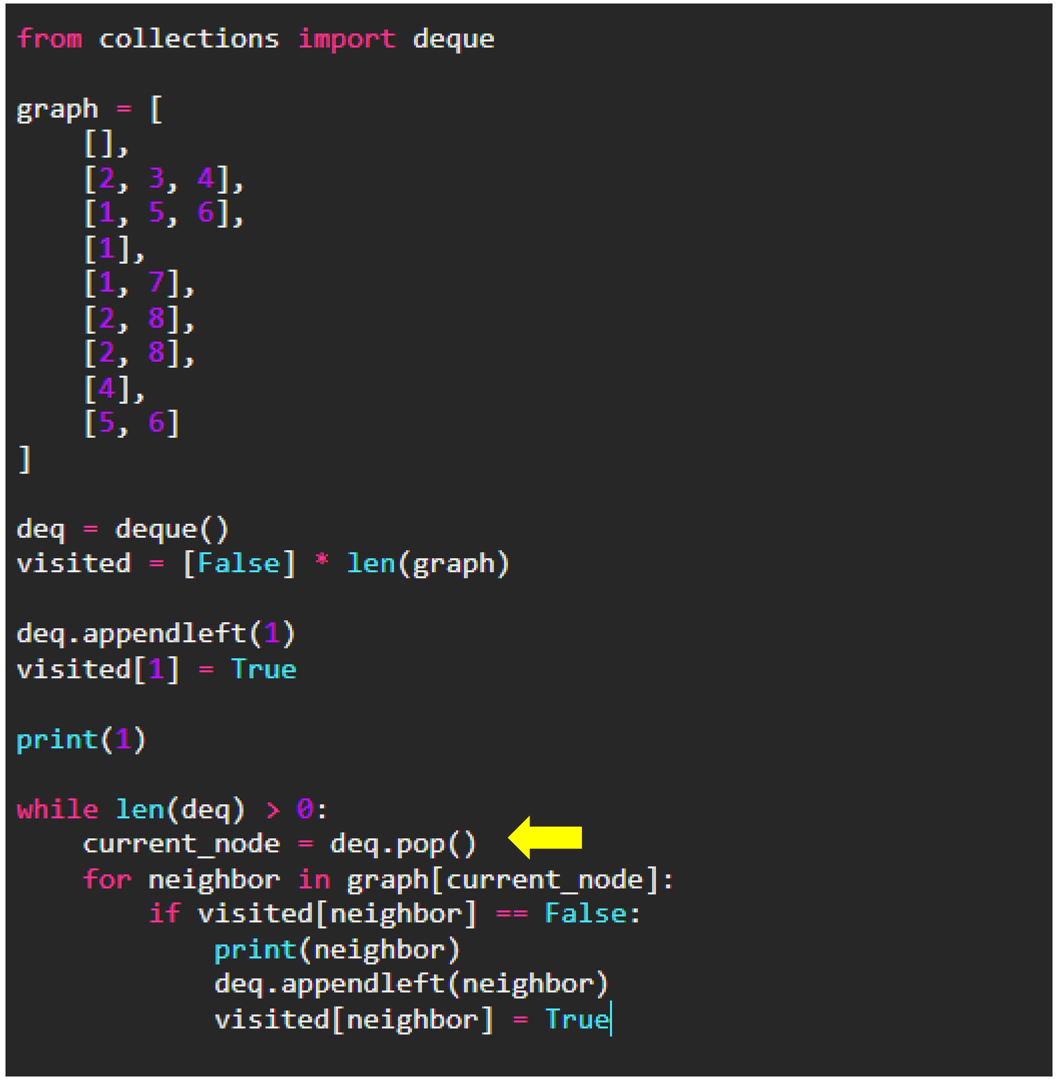

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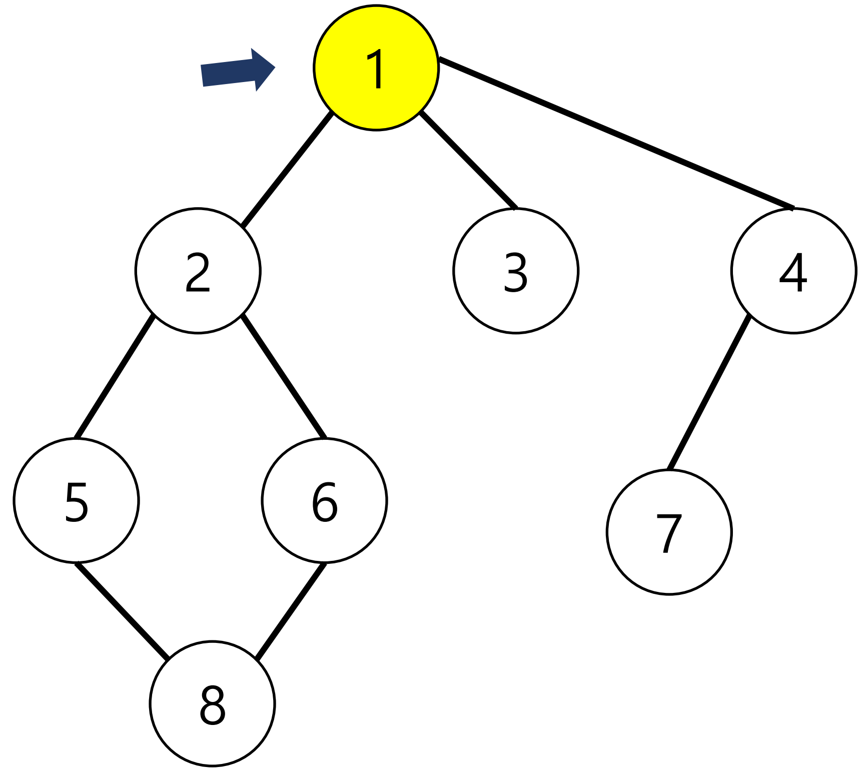

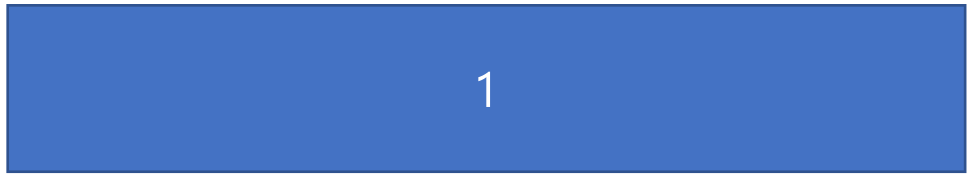

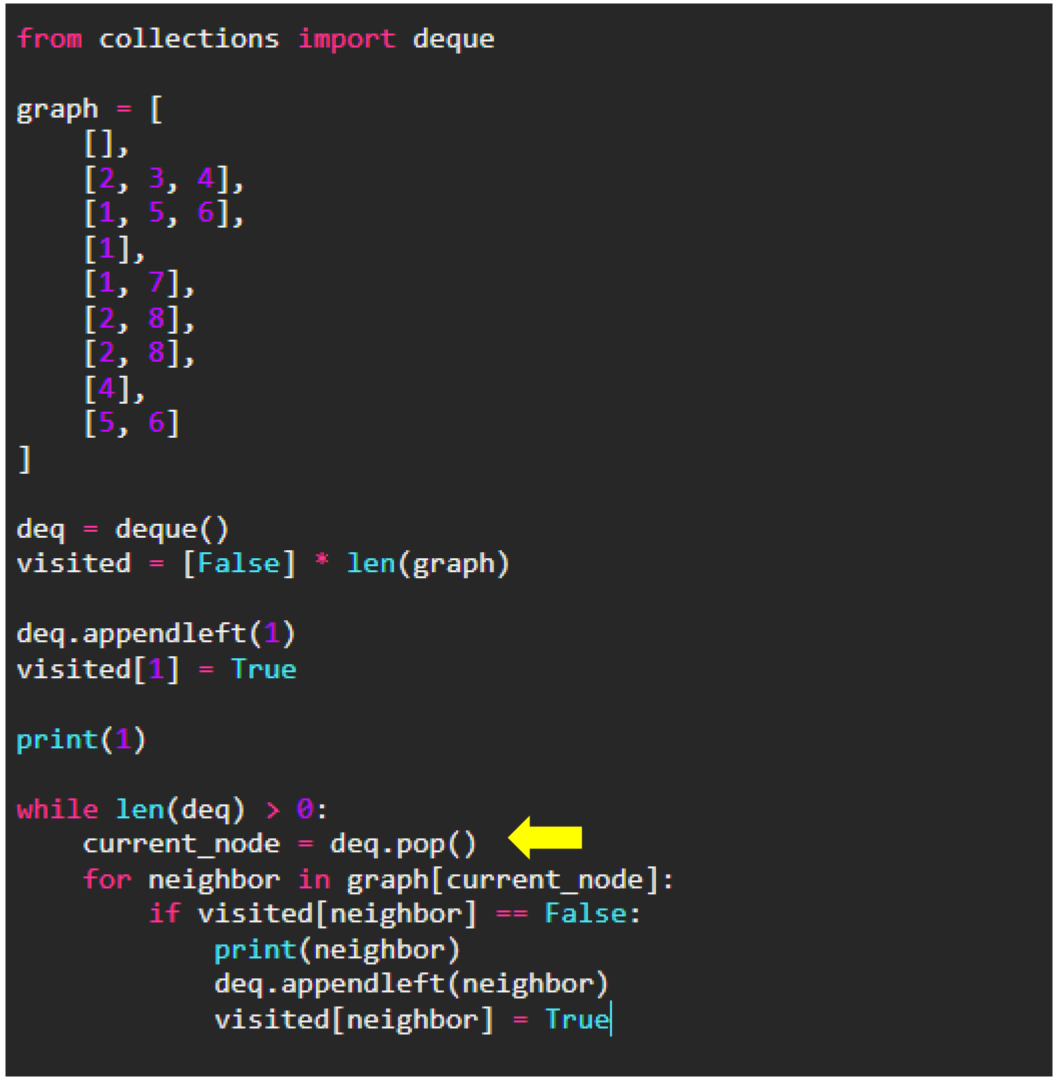

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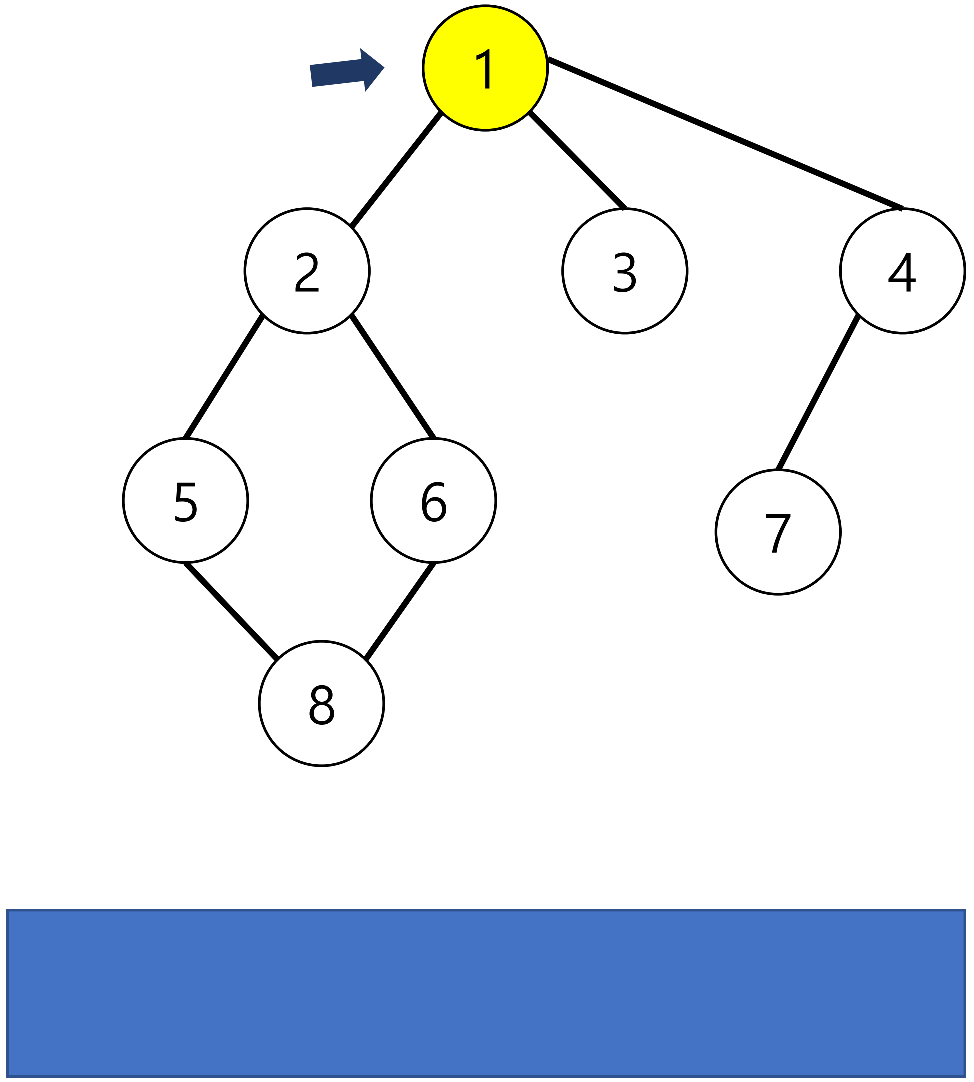

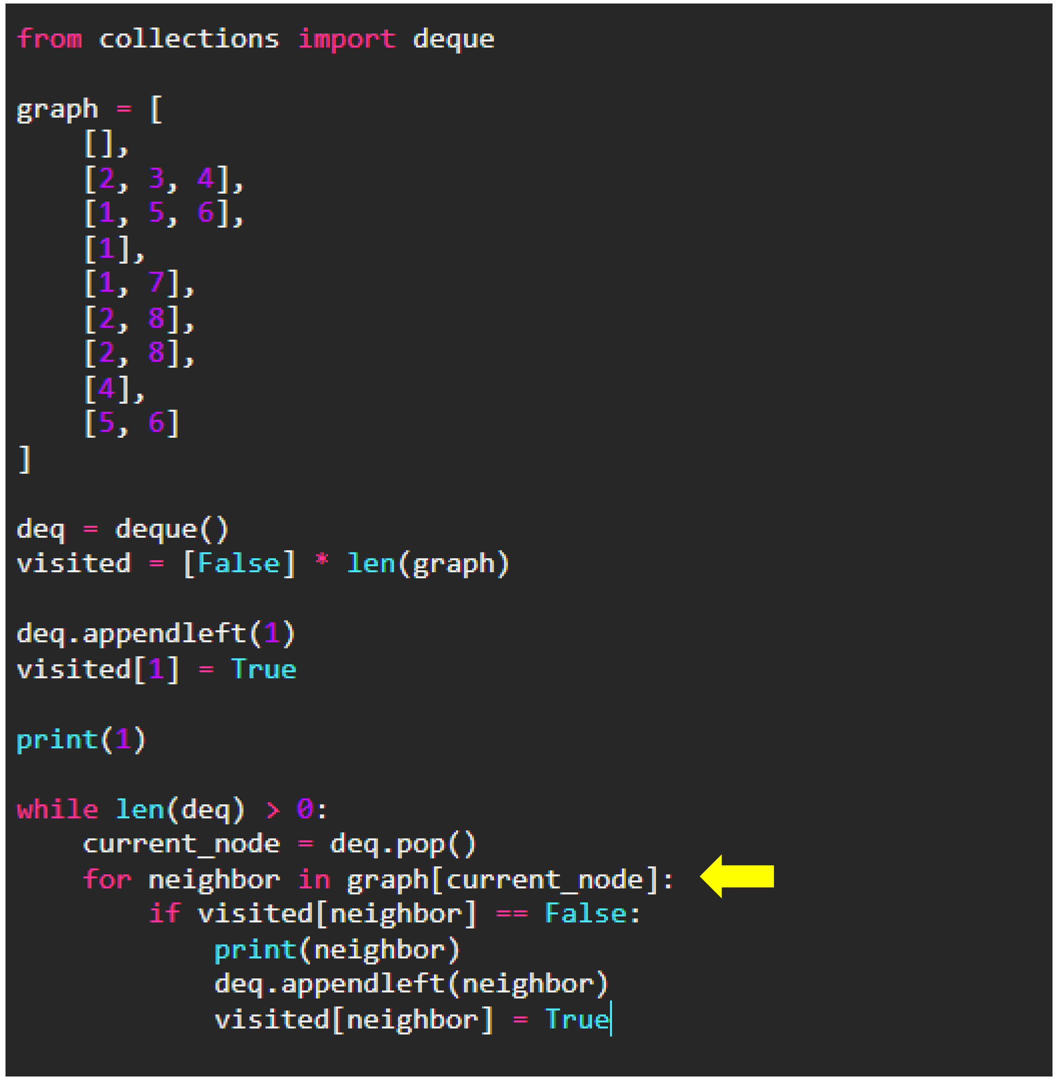
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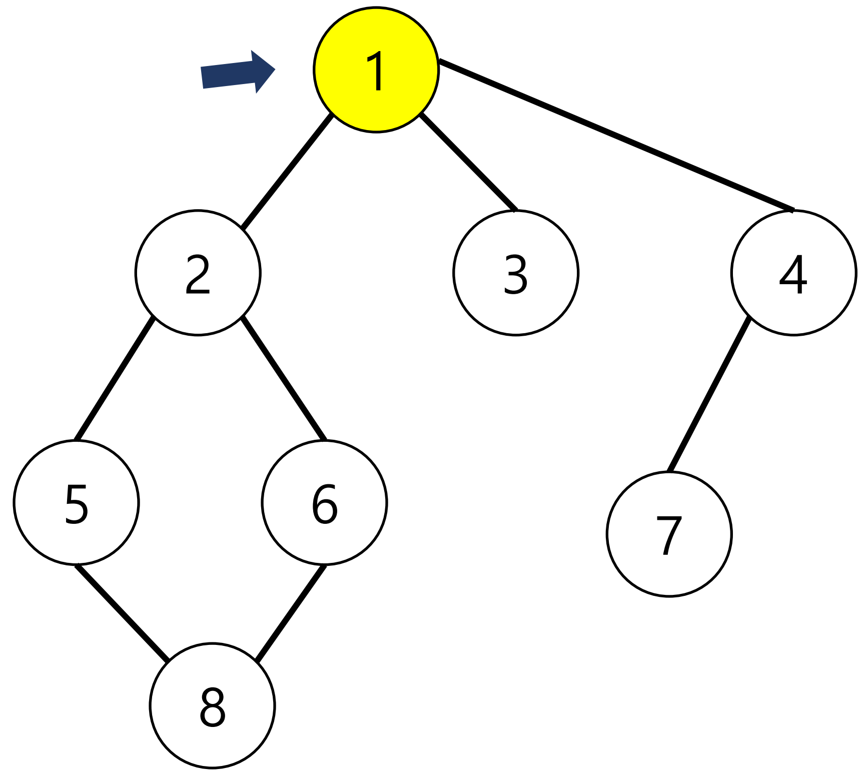

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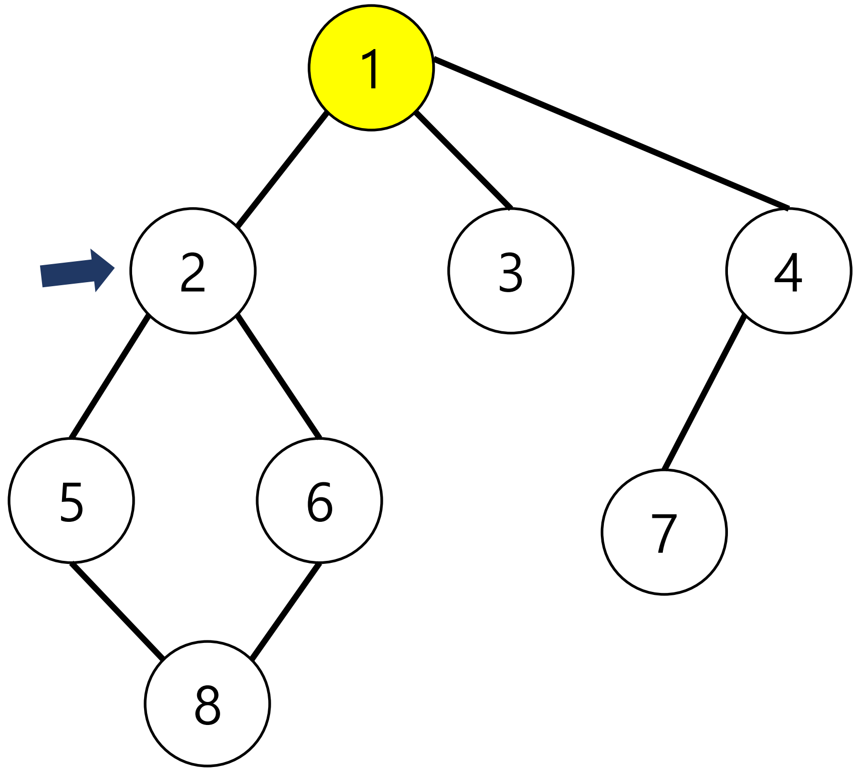

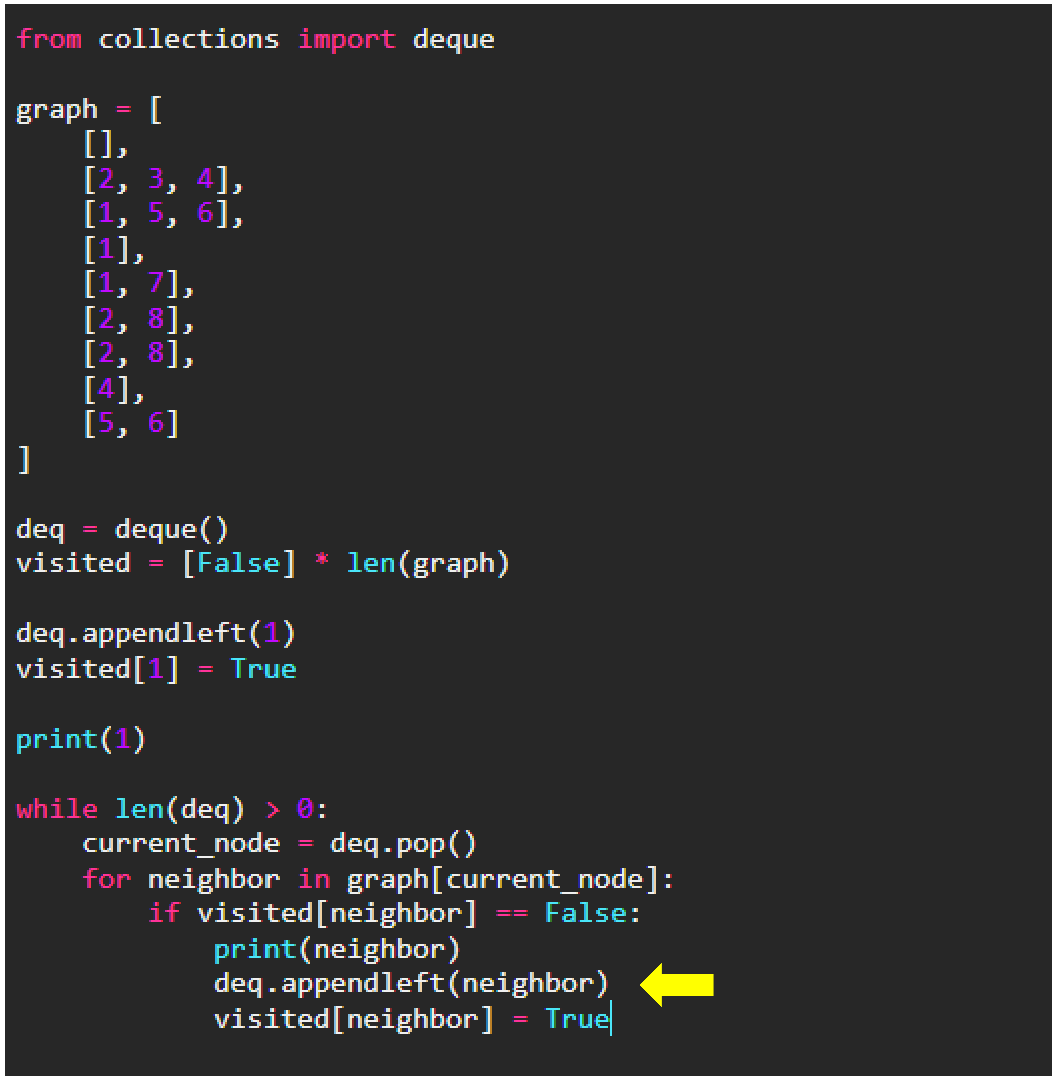

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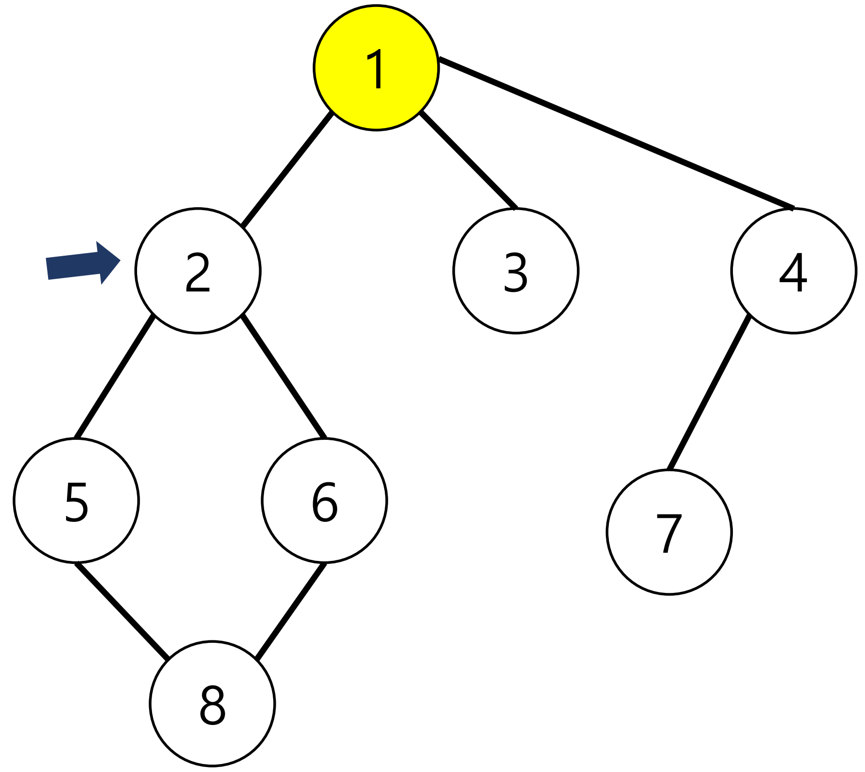

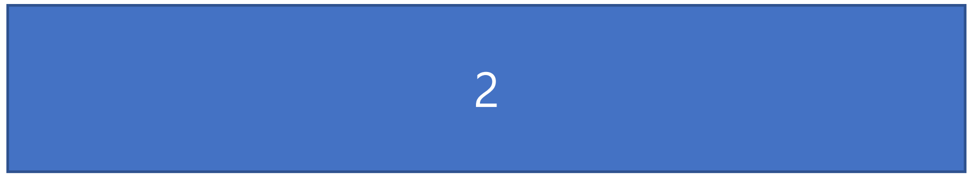

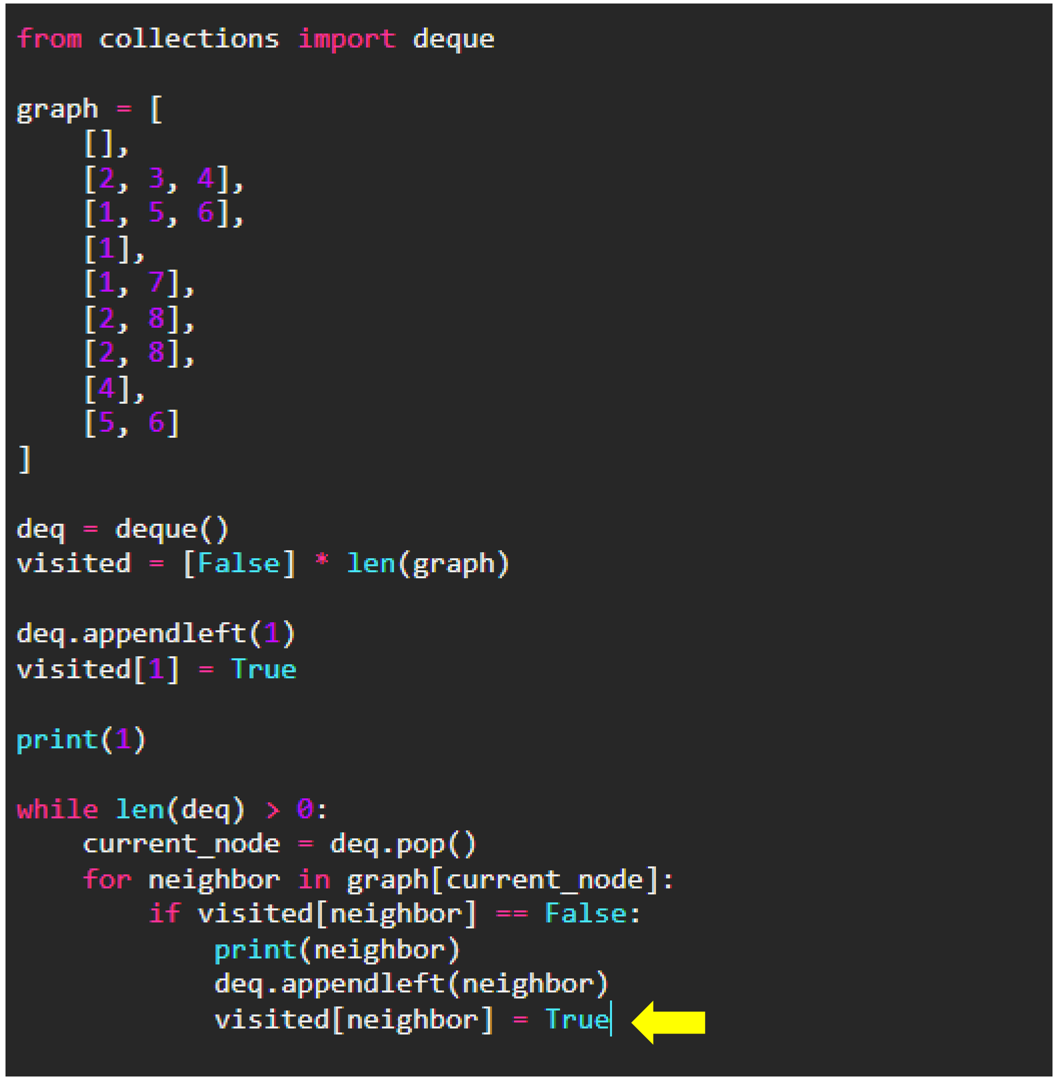

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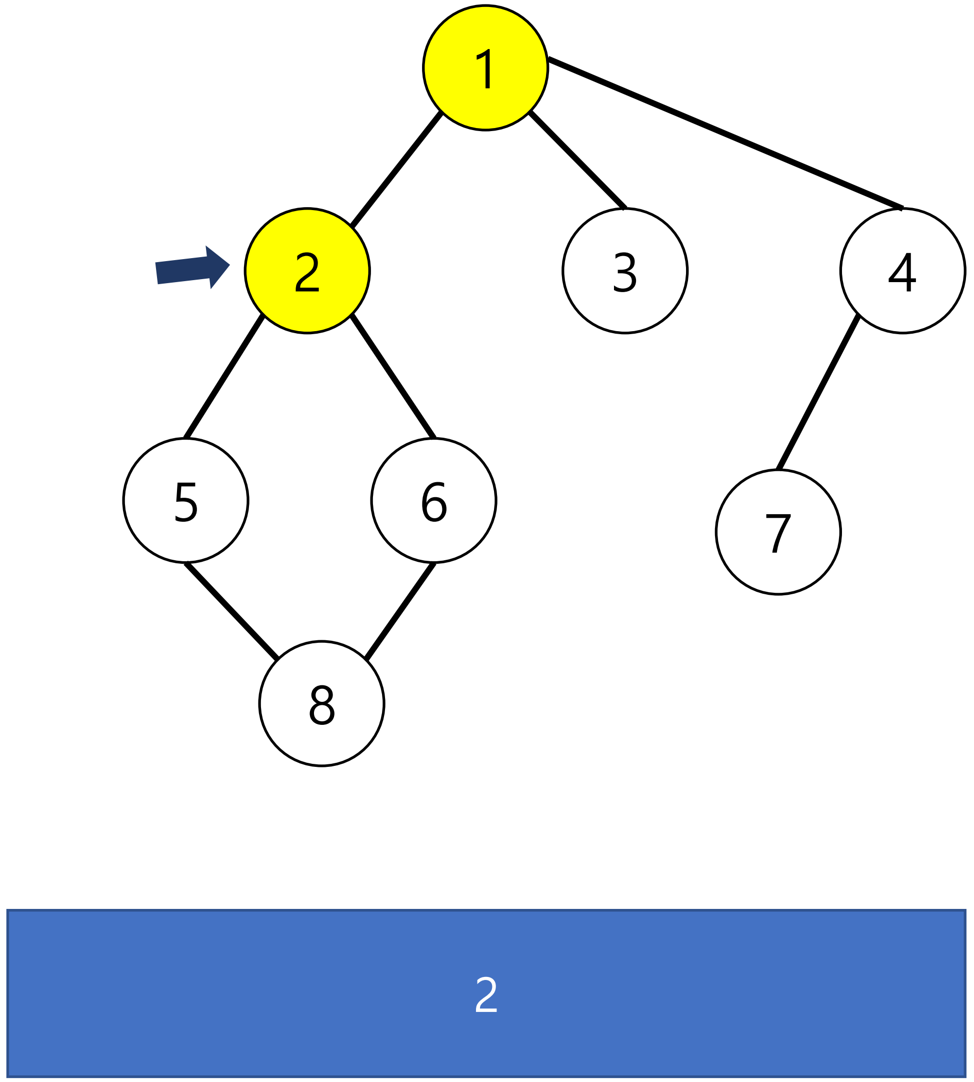

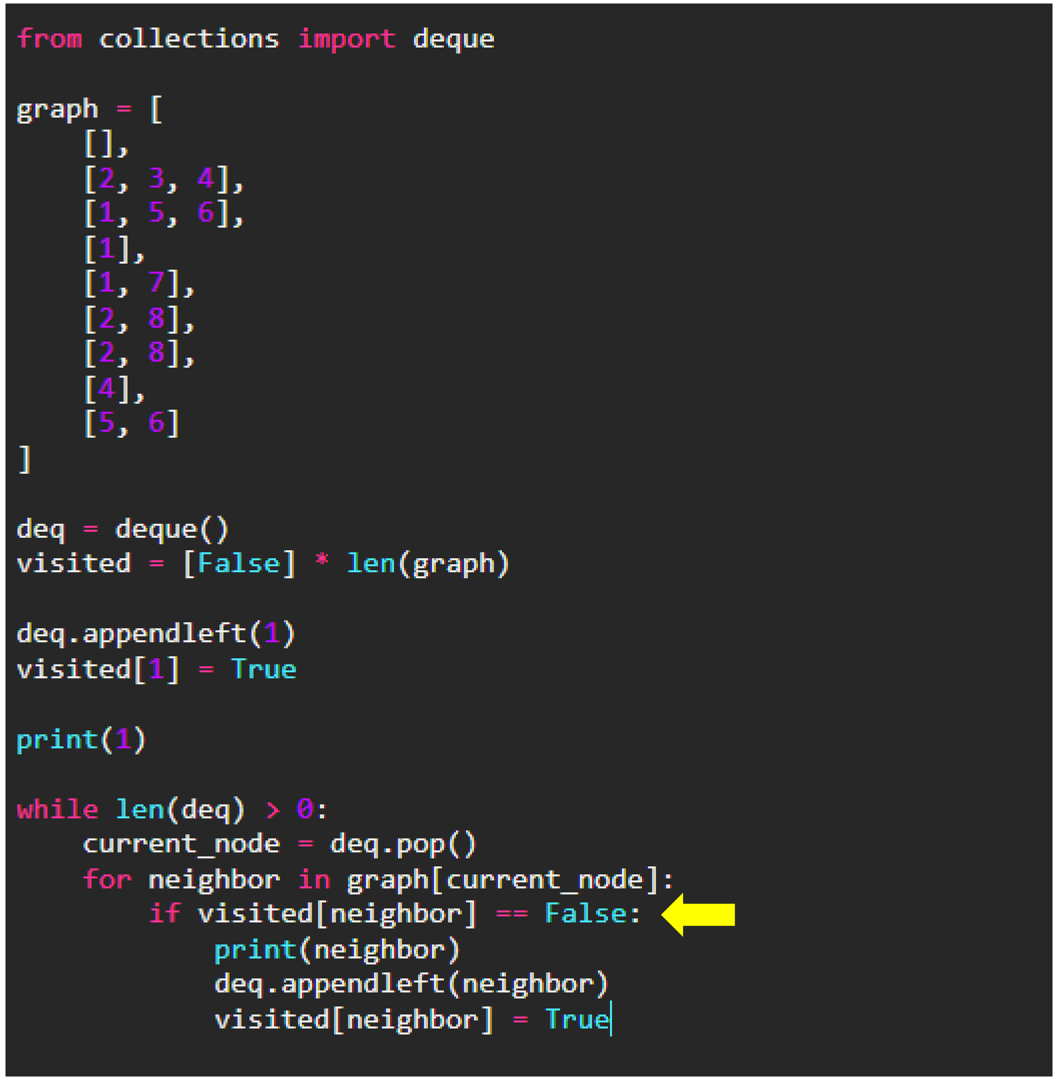

```
from collections import deque

graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
    [4],
    [5, 6]
]

deq = deque()
visited = [False] * len(graph)

deq.appendleft(1)
visited[1] = True

print(1)

while len(deq) > 0:
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            deq.appendleft(neighbor)
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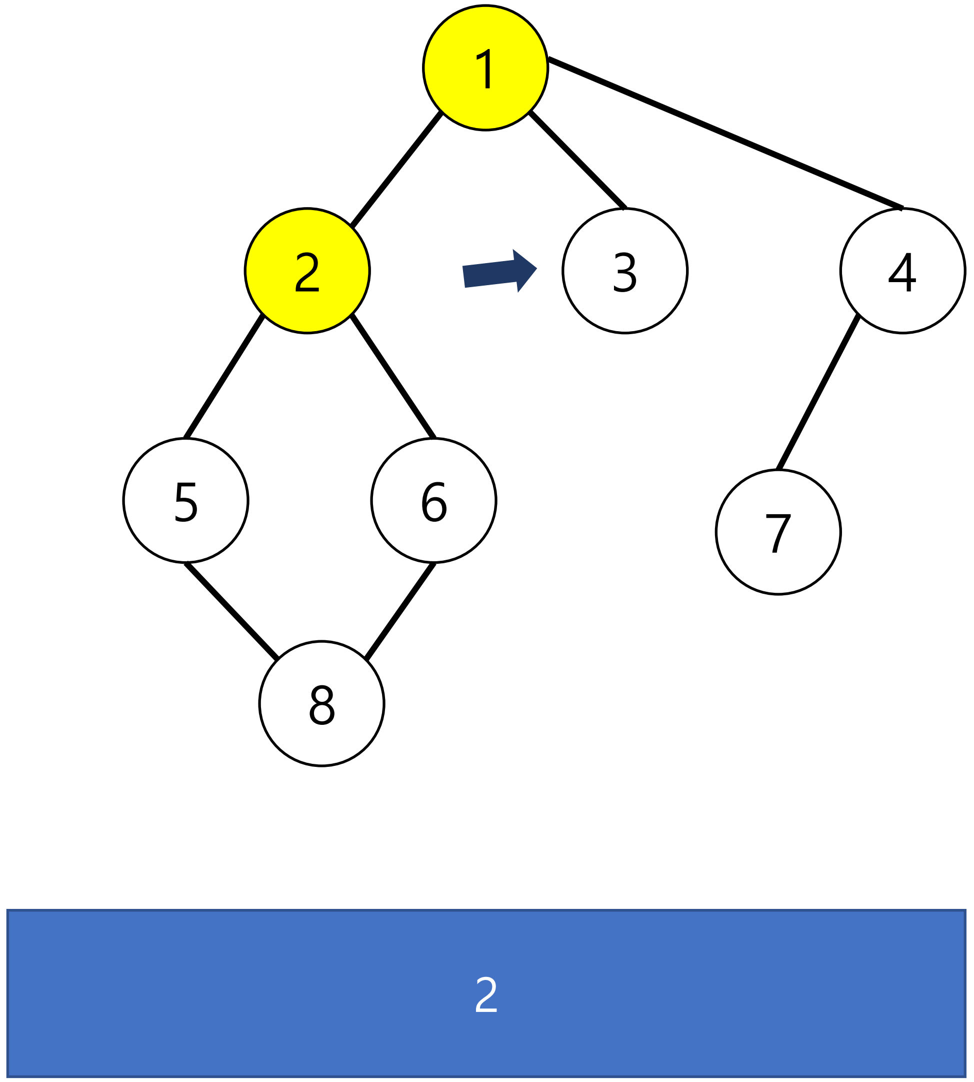

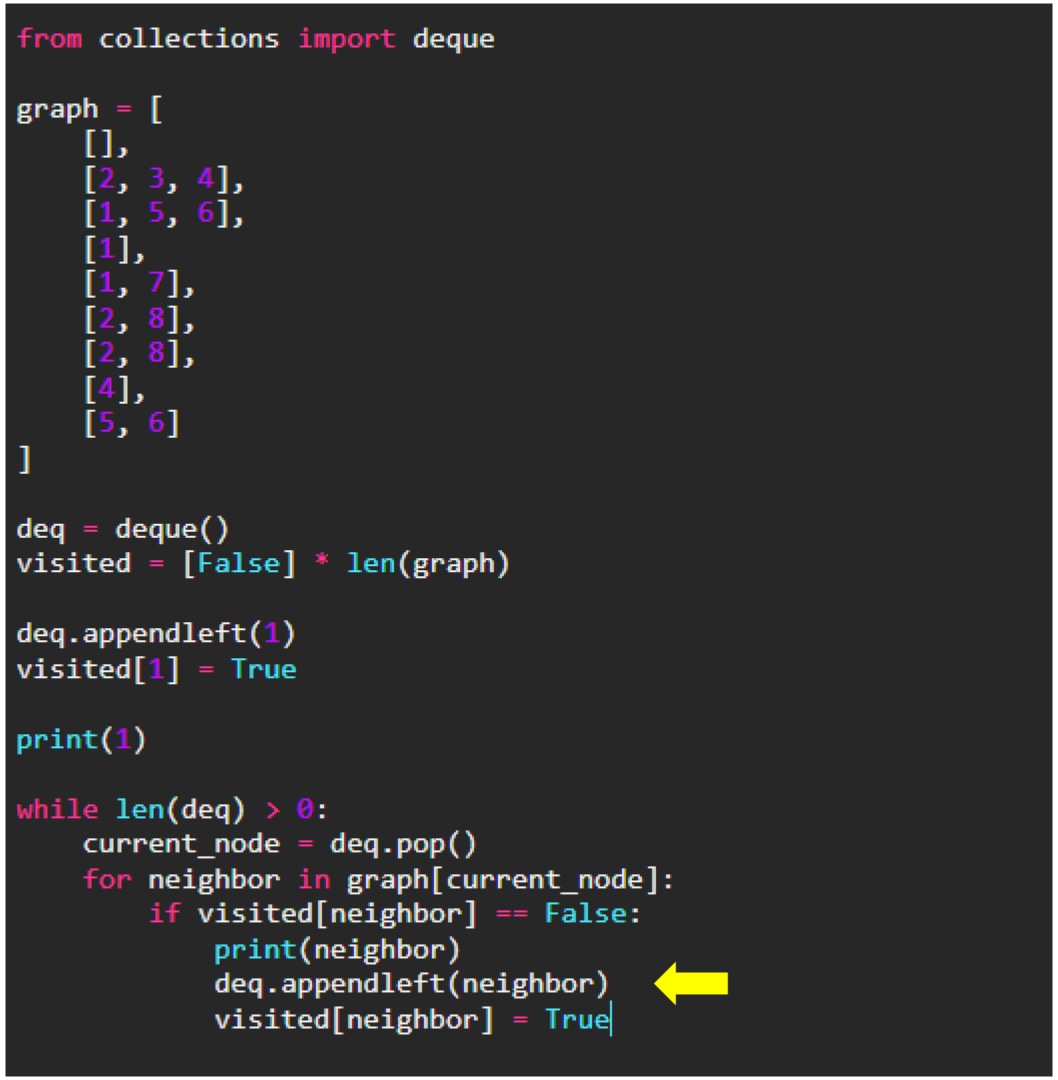

```
from collections import deque

graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
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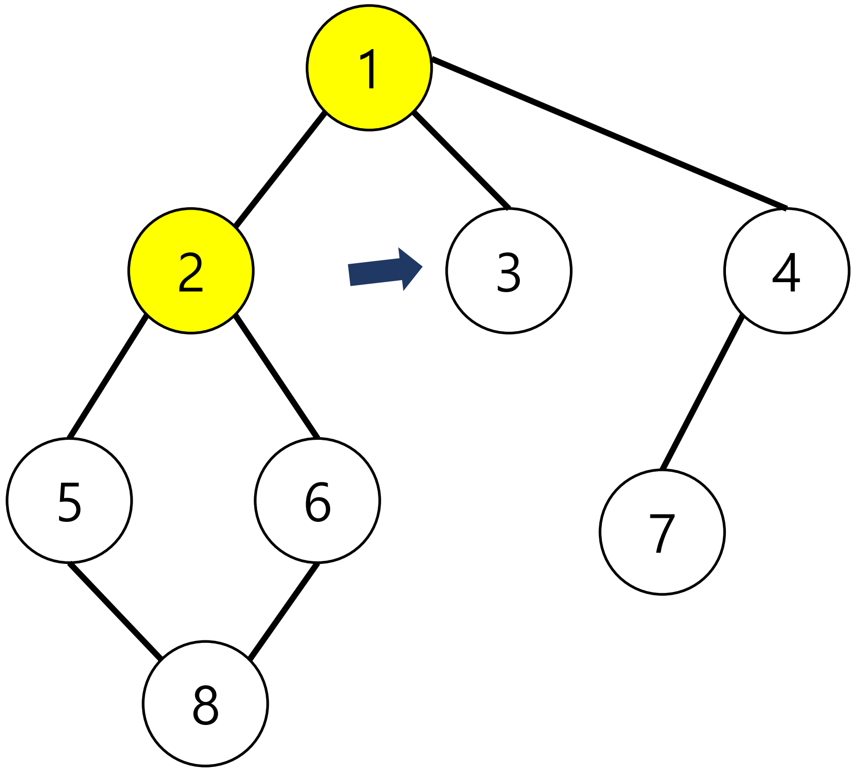

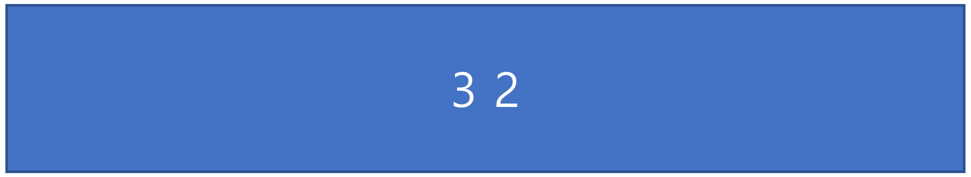

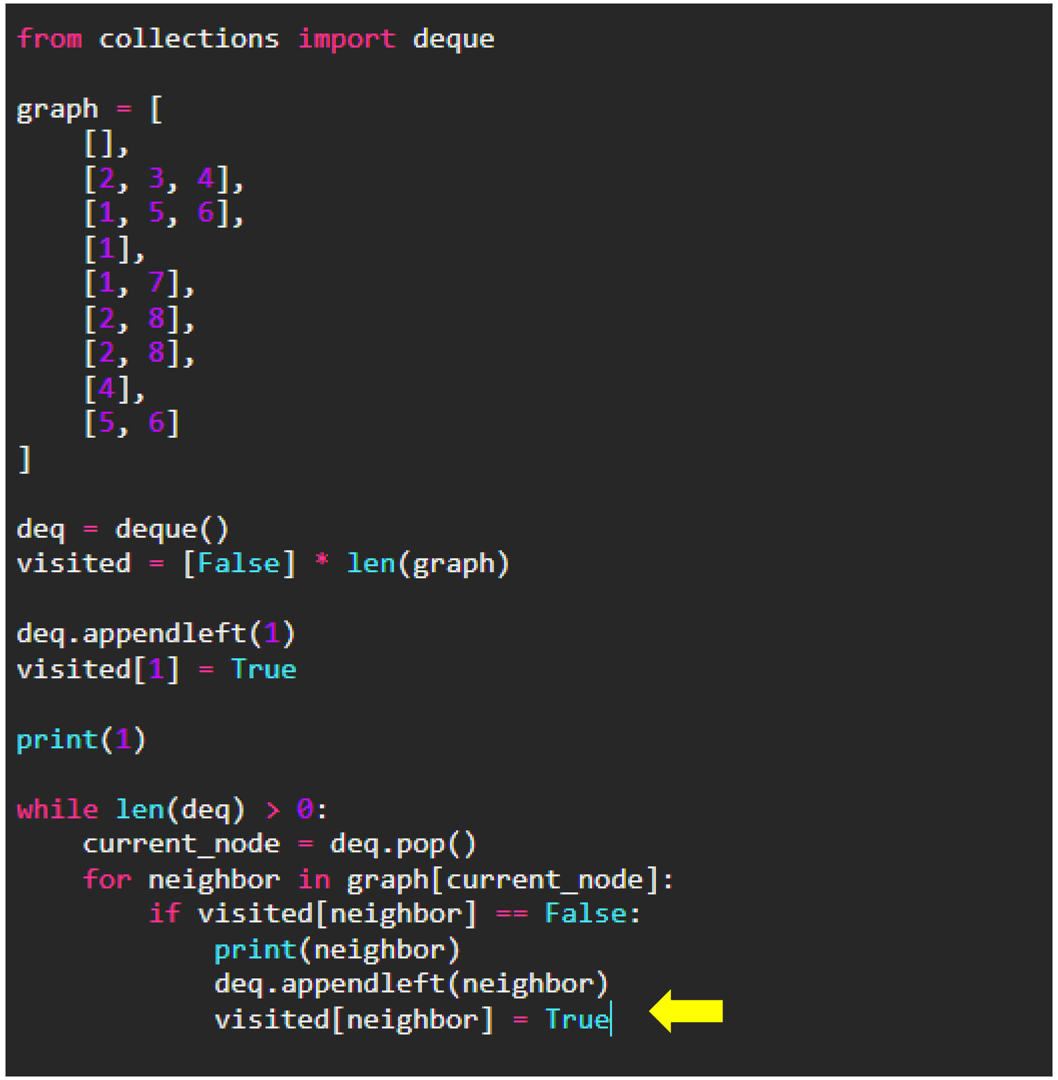

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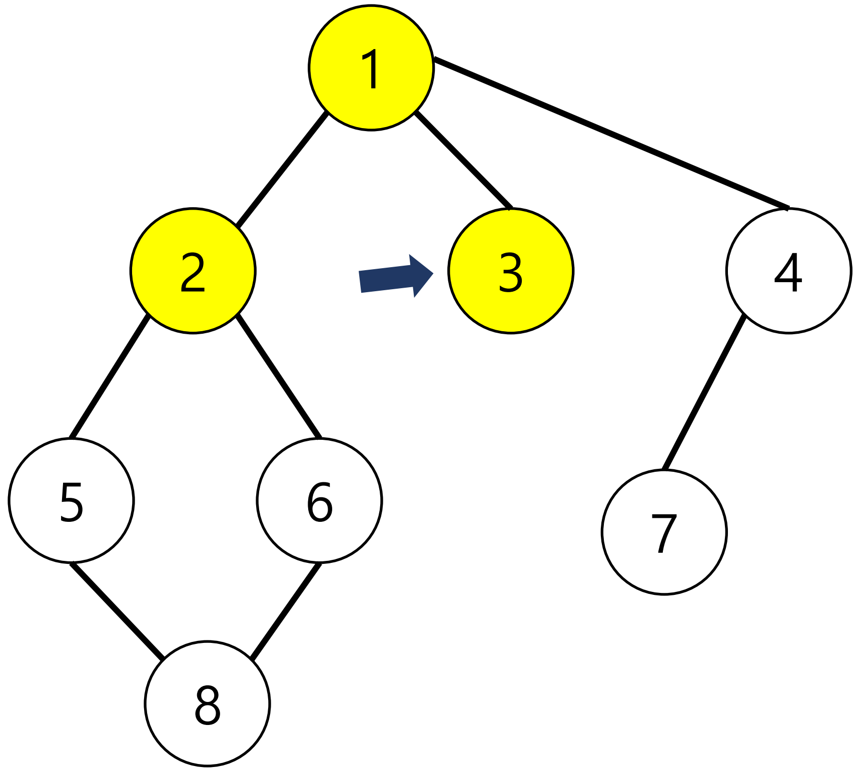
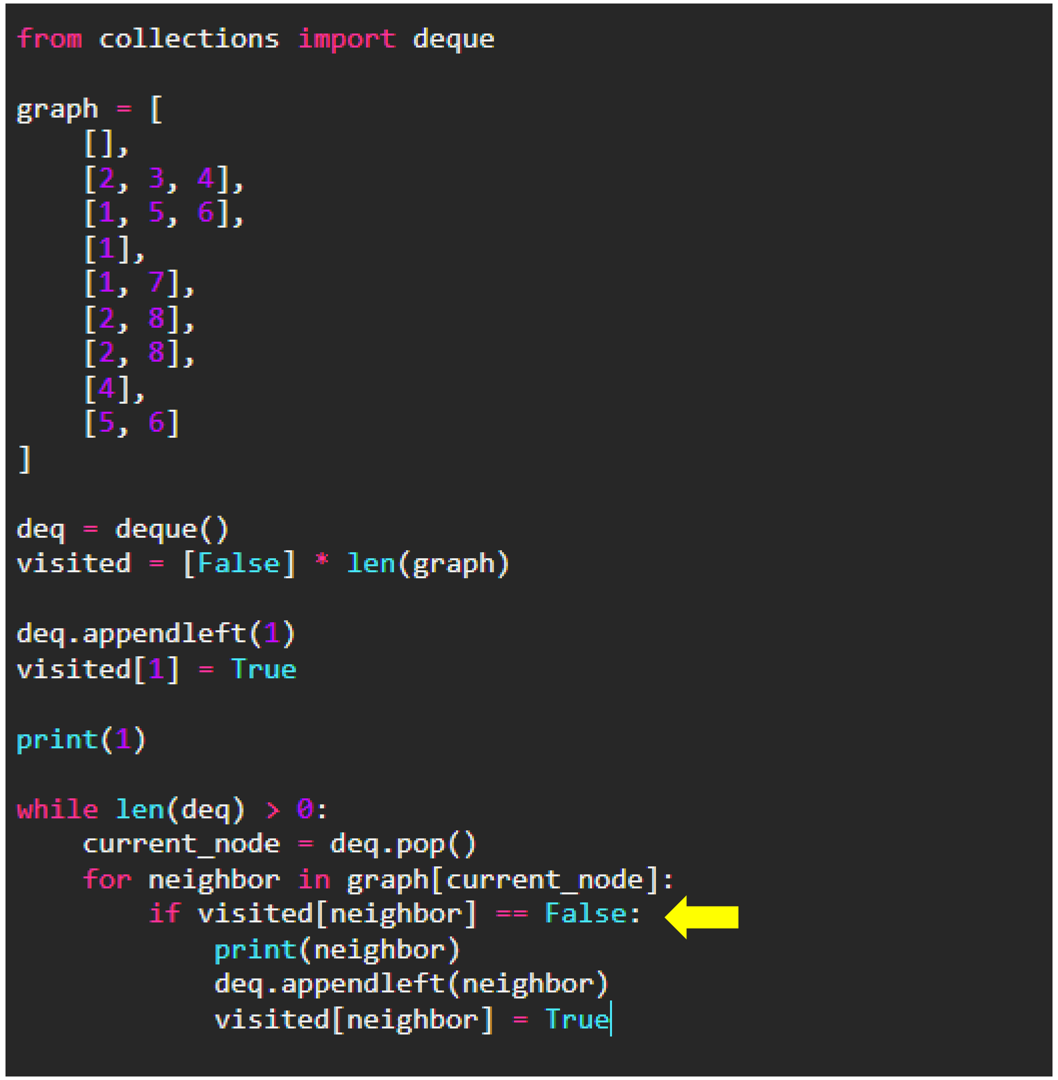


3 2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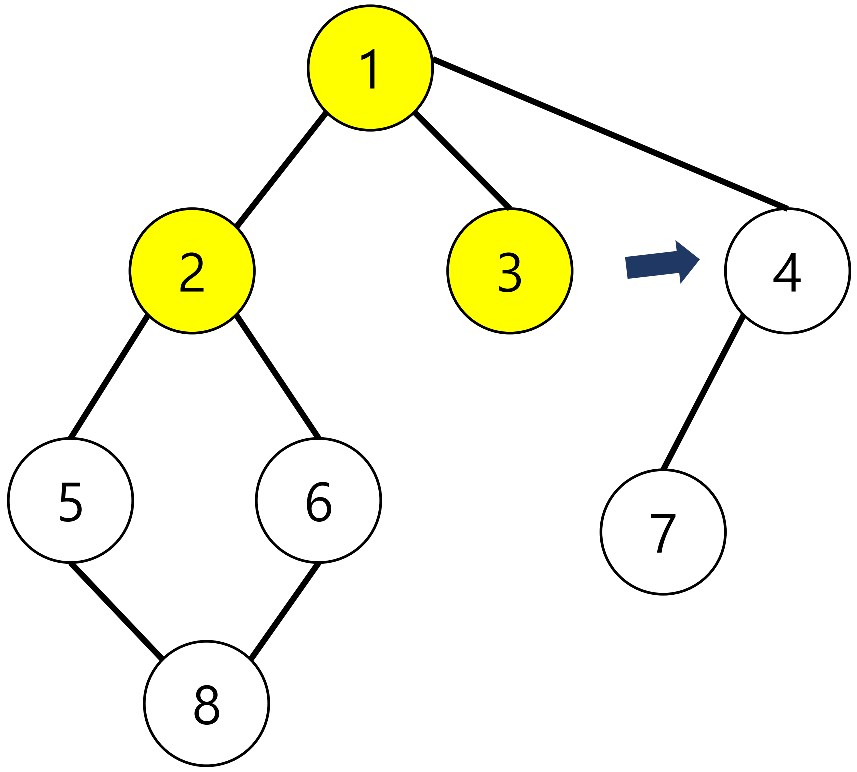
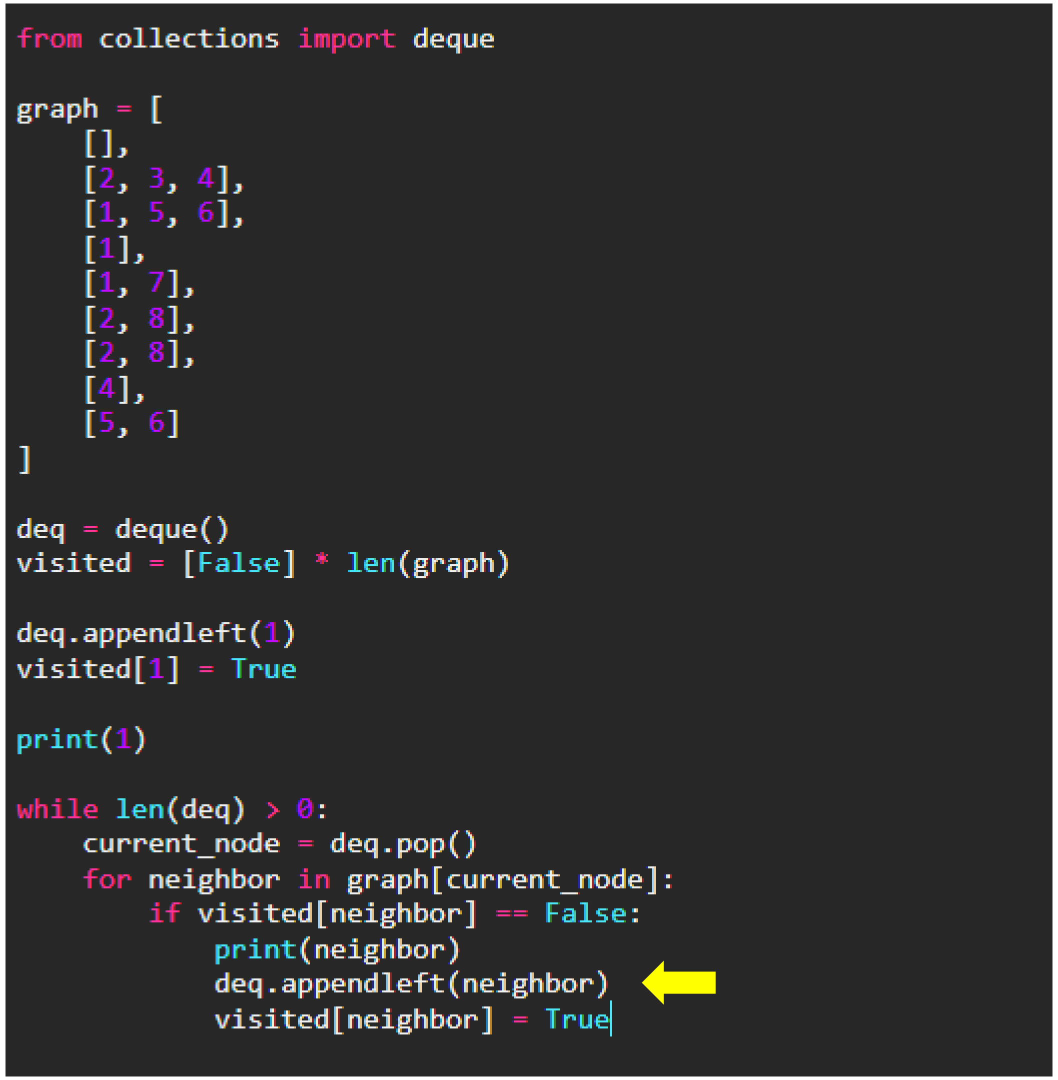


3 2



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    [],
    [2, 3, 4],
    [1, 5, 6],
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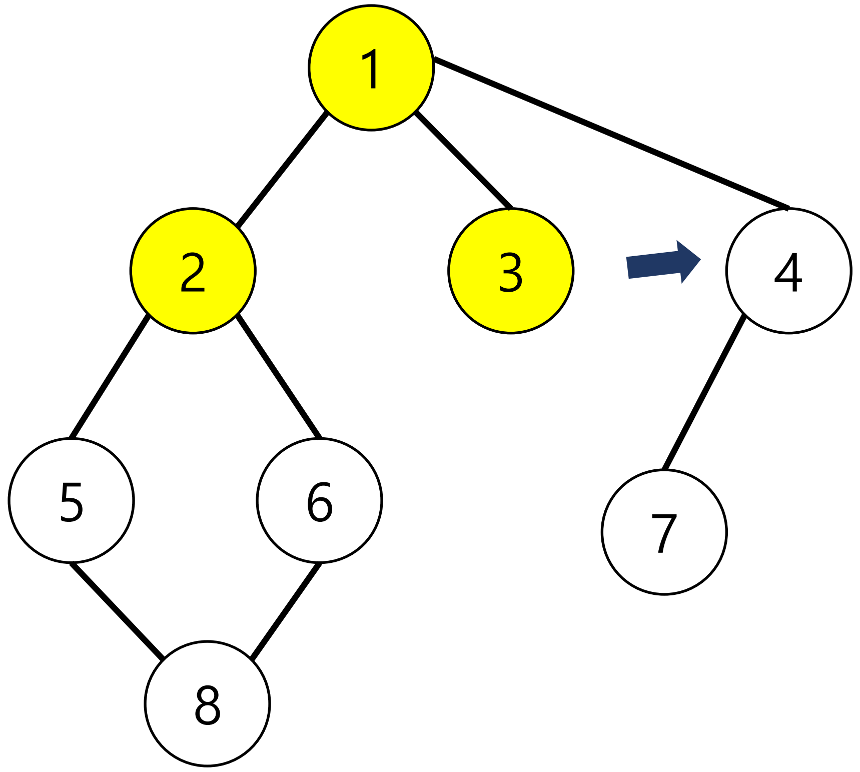
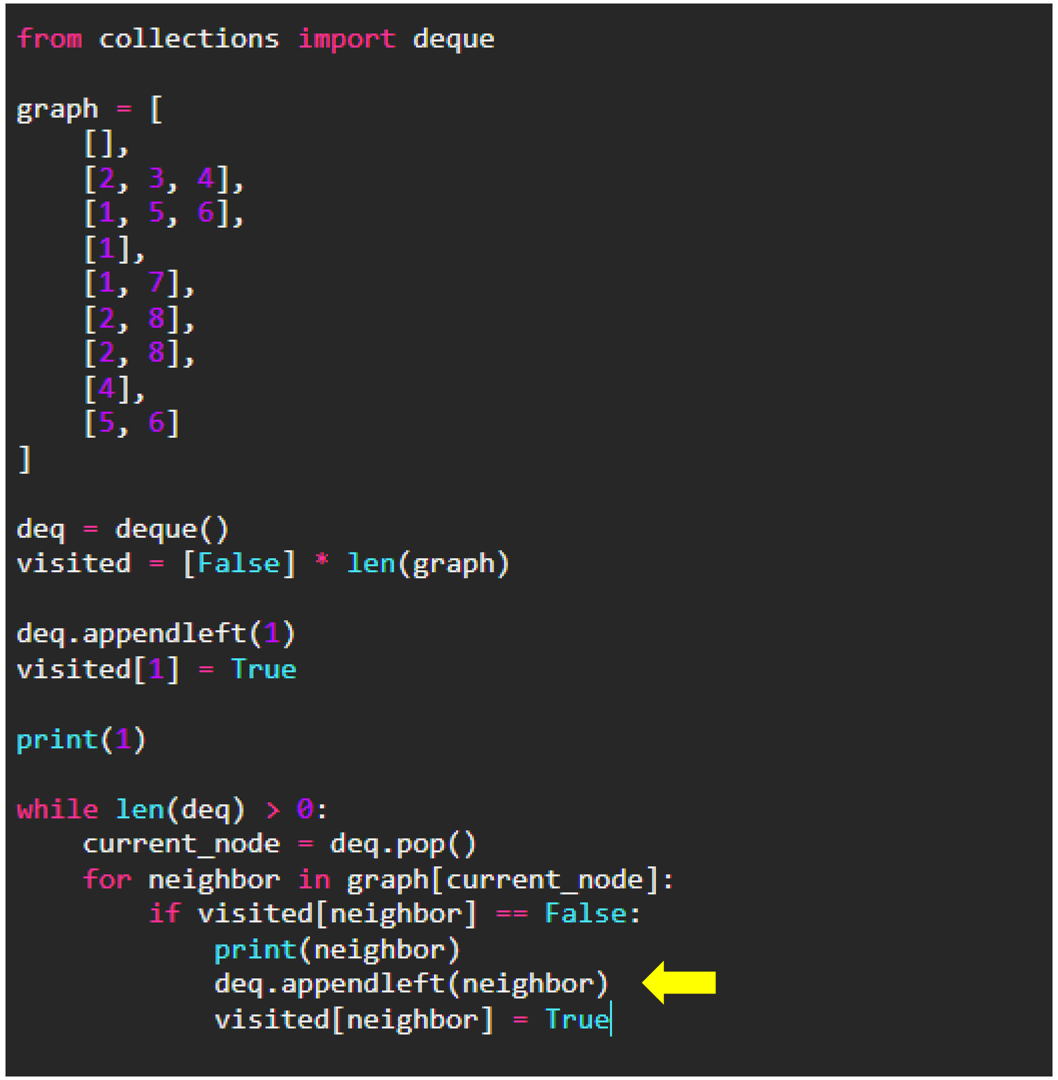


3 2



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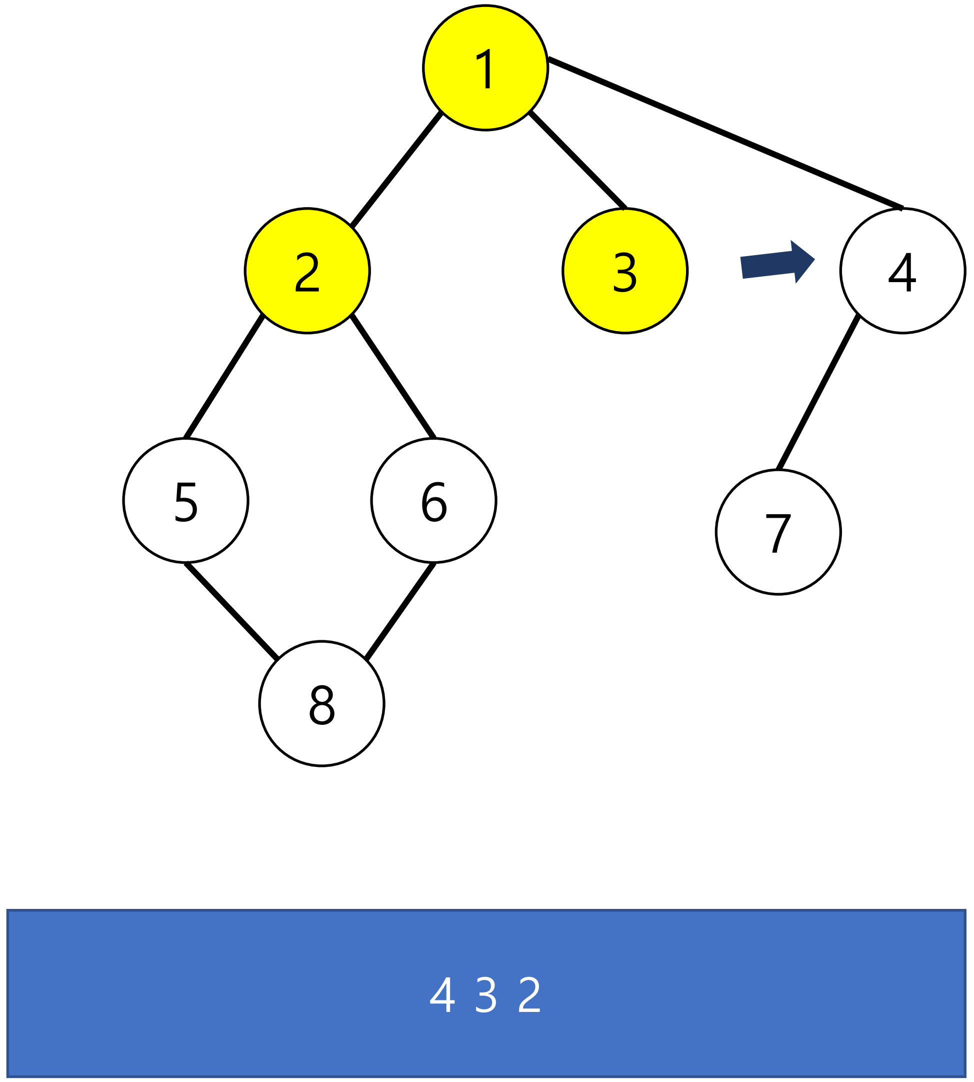

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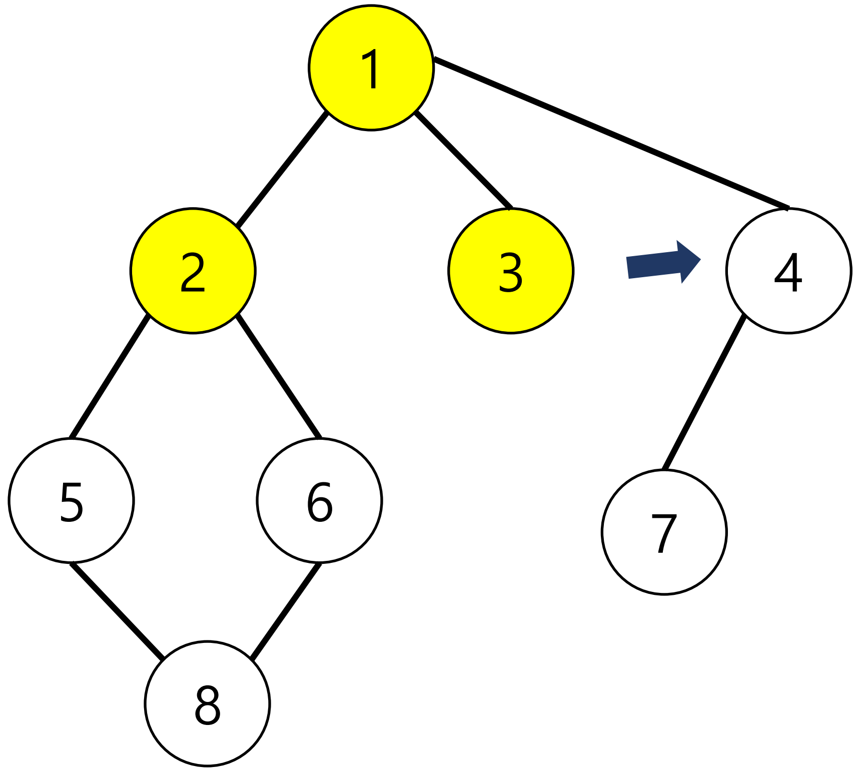
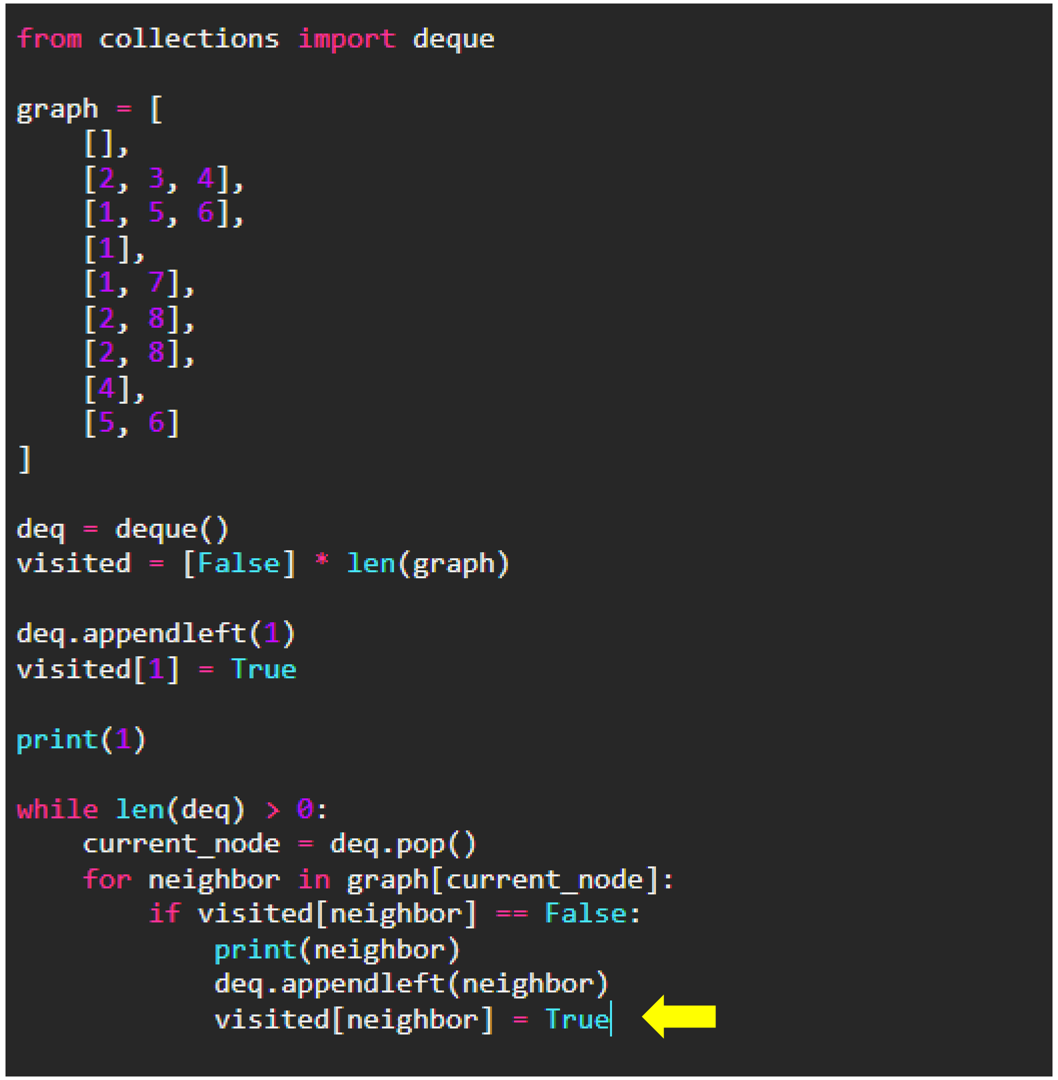


4 3 2



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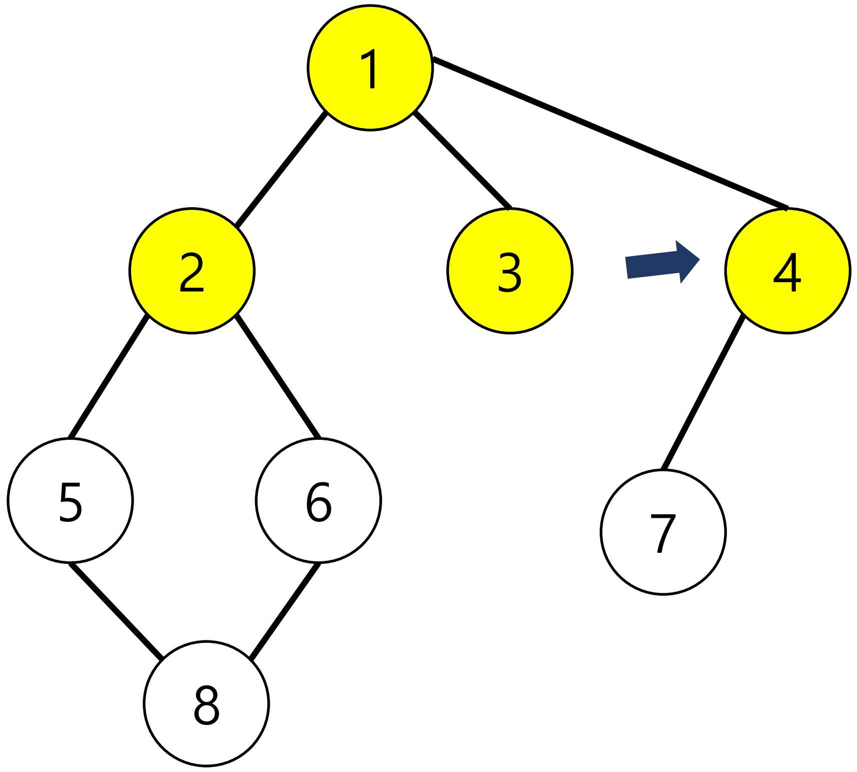

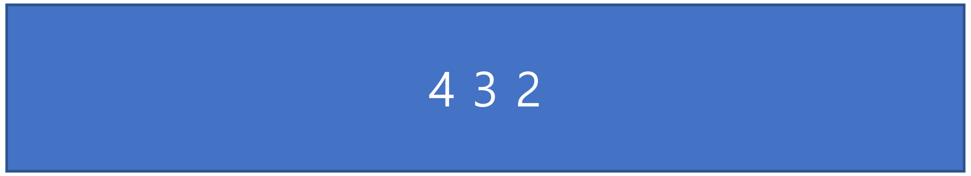

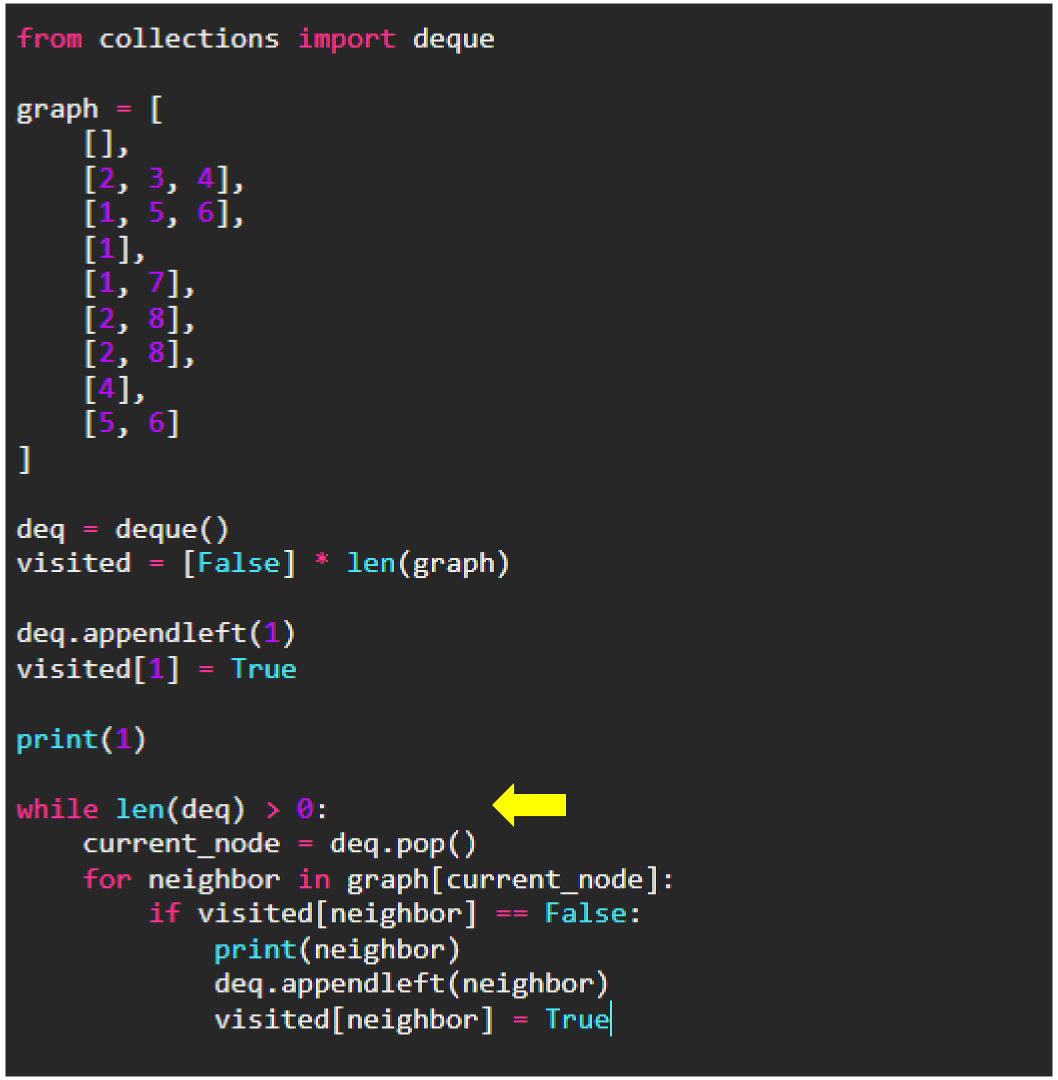

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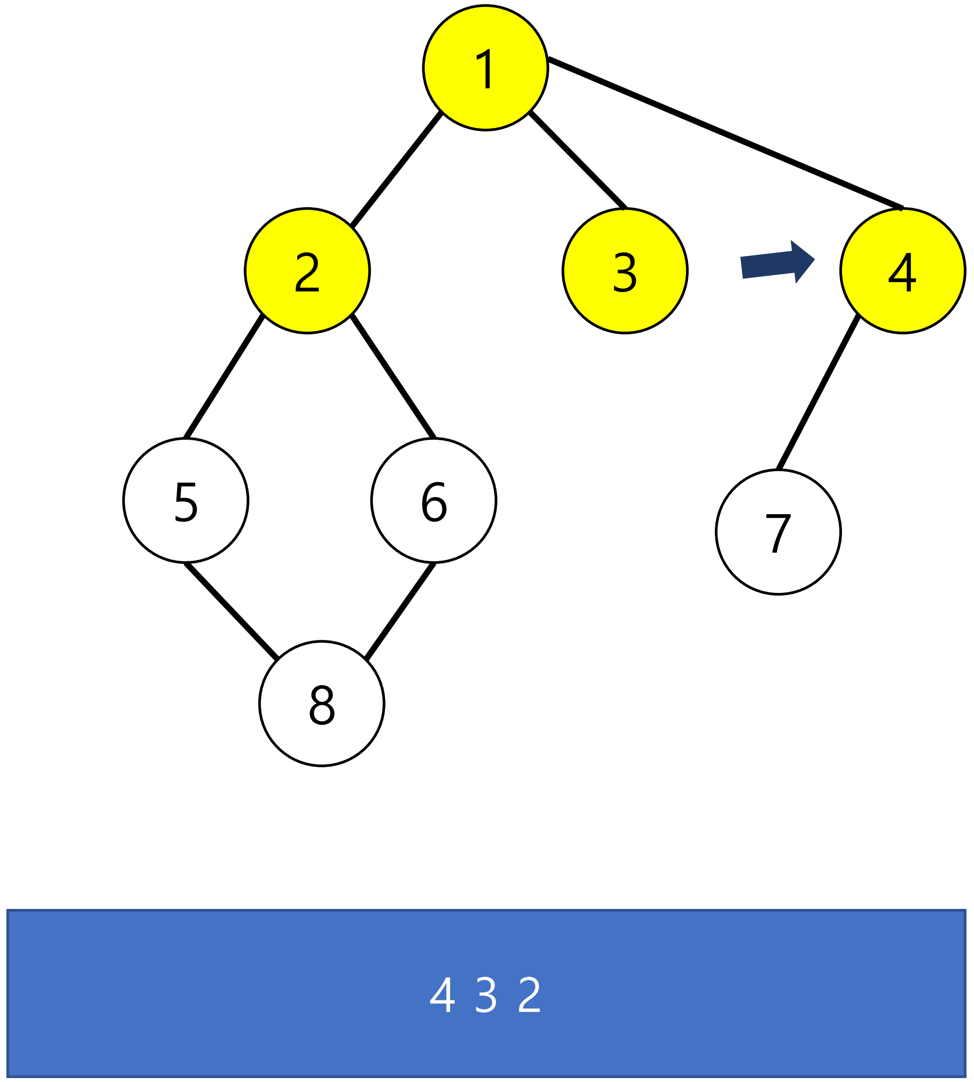

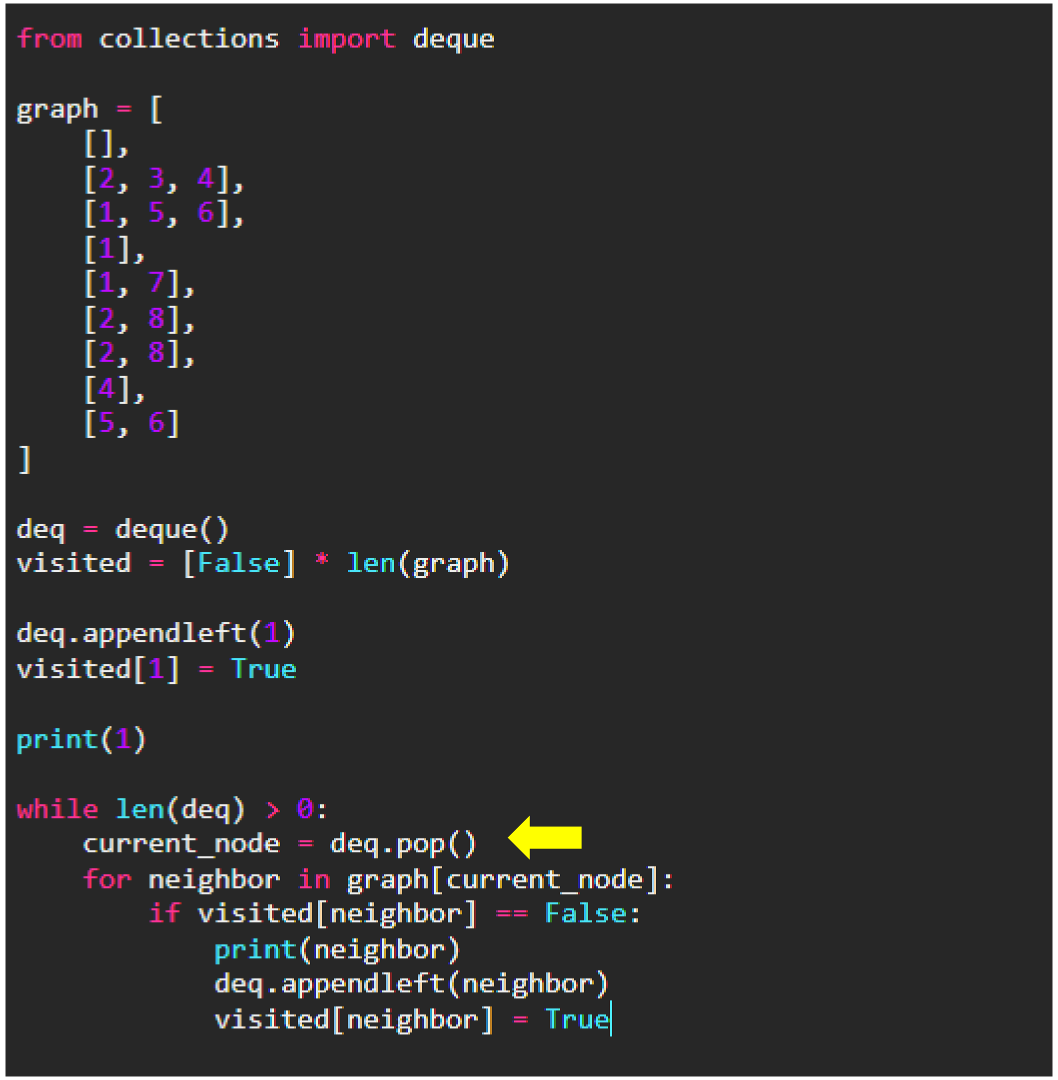

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    [],
    [2, 3, 4],
    [1, 5, 6],
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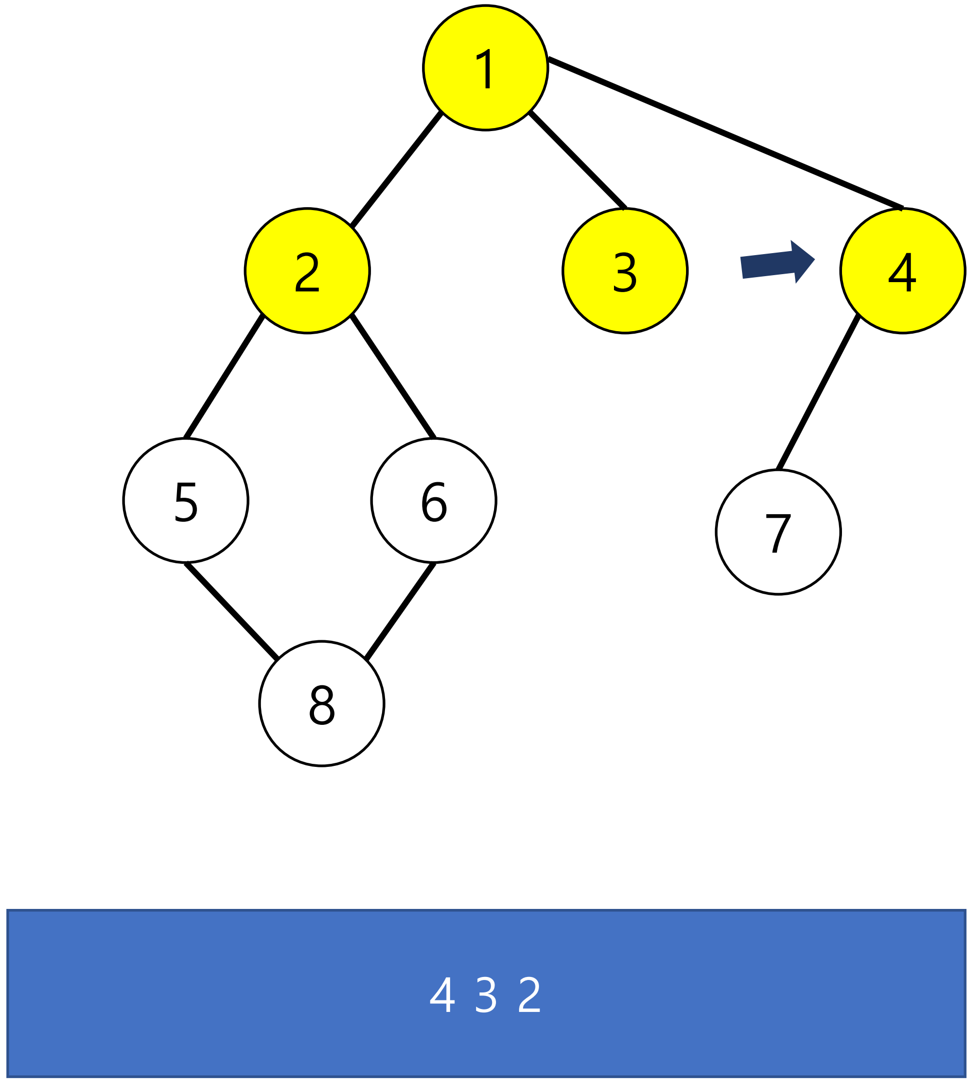

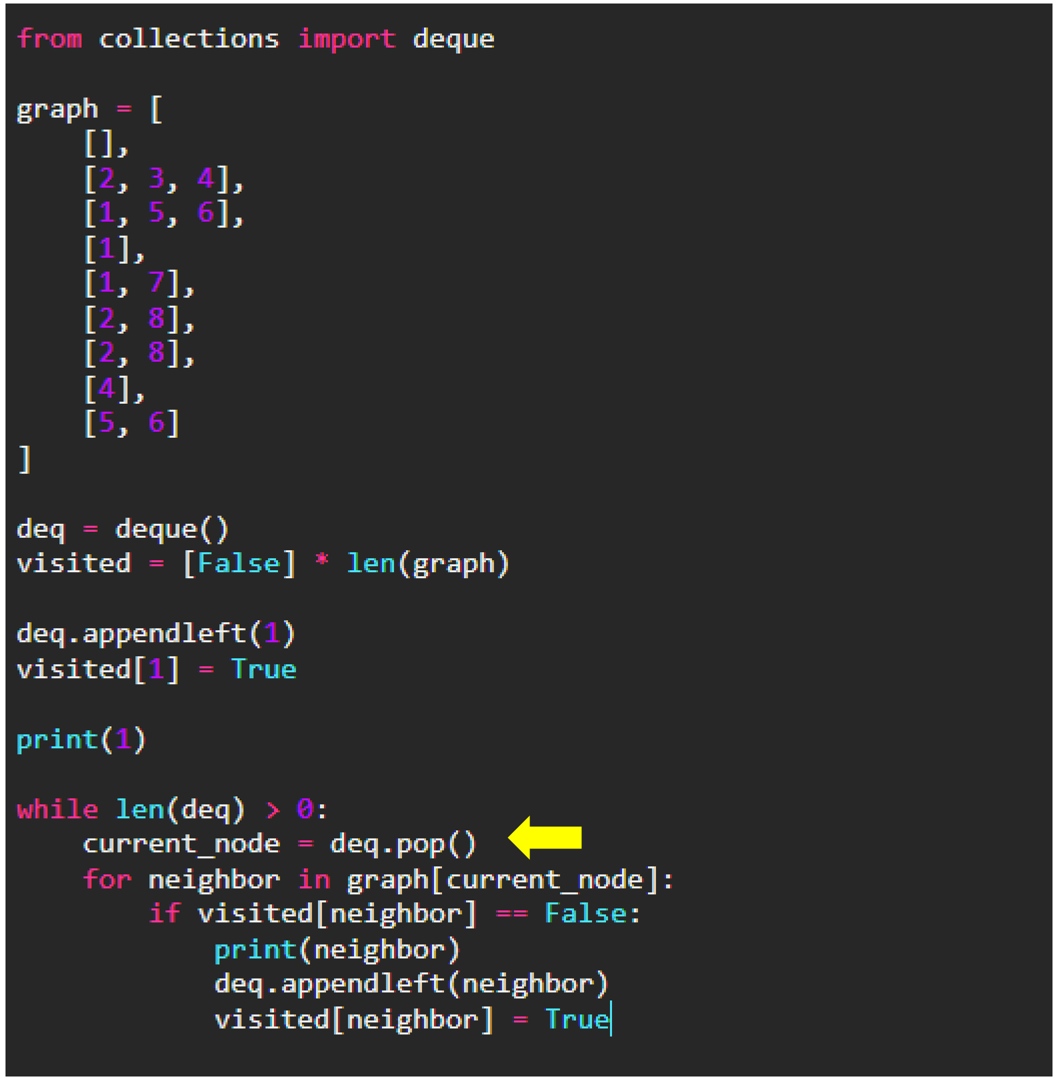

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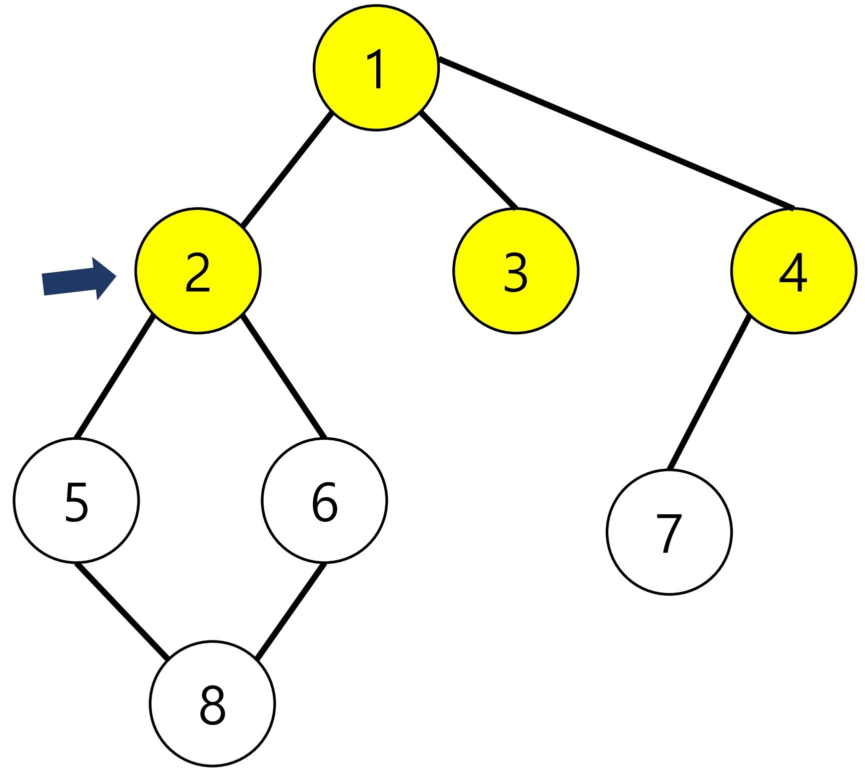

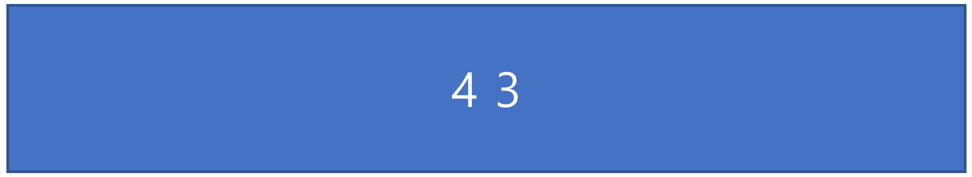

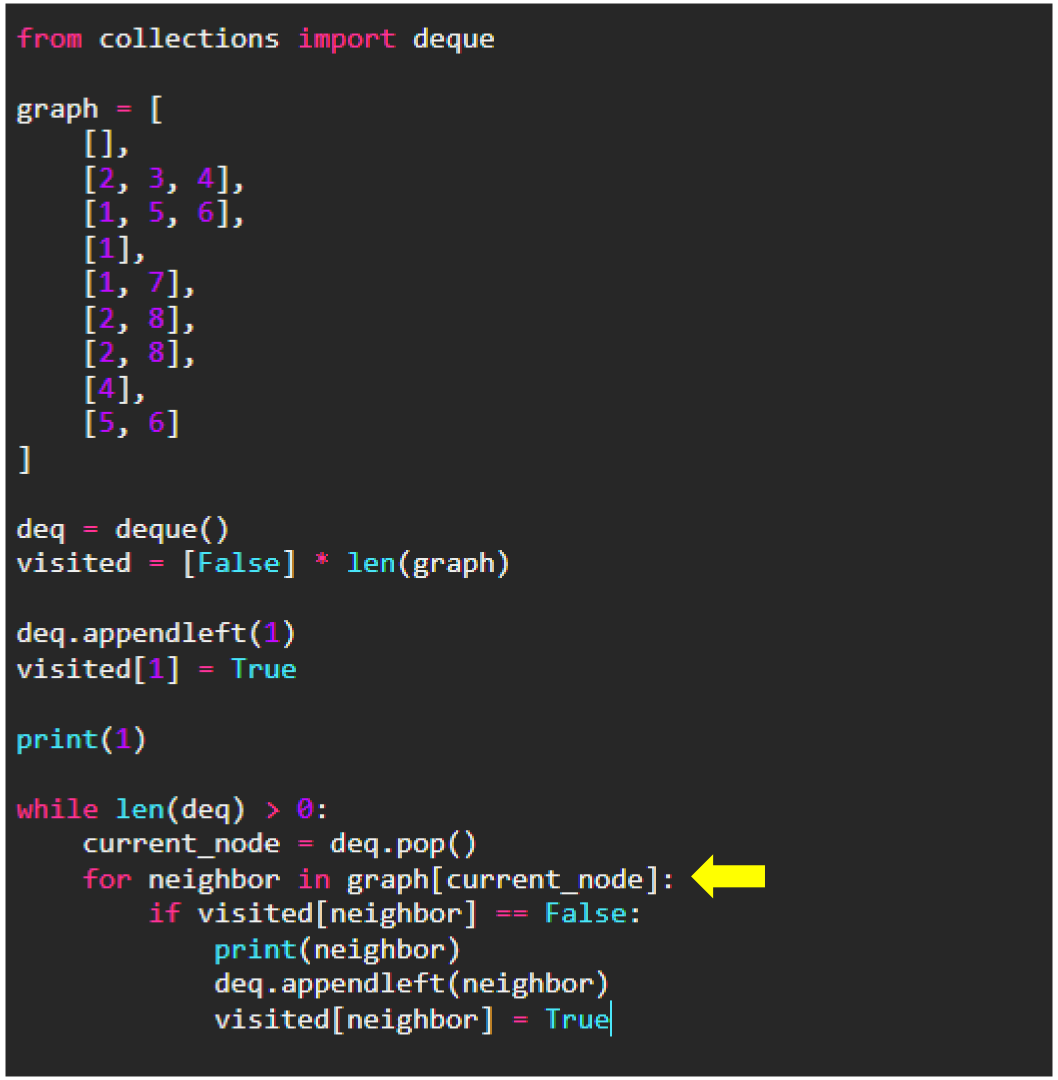

```python
from collections import deque

graph = [
    [],
    [2, 3, 4],
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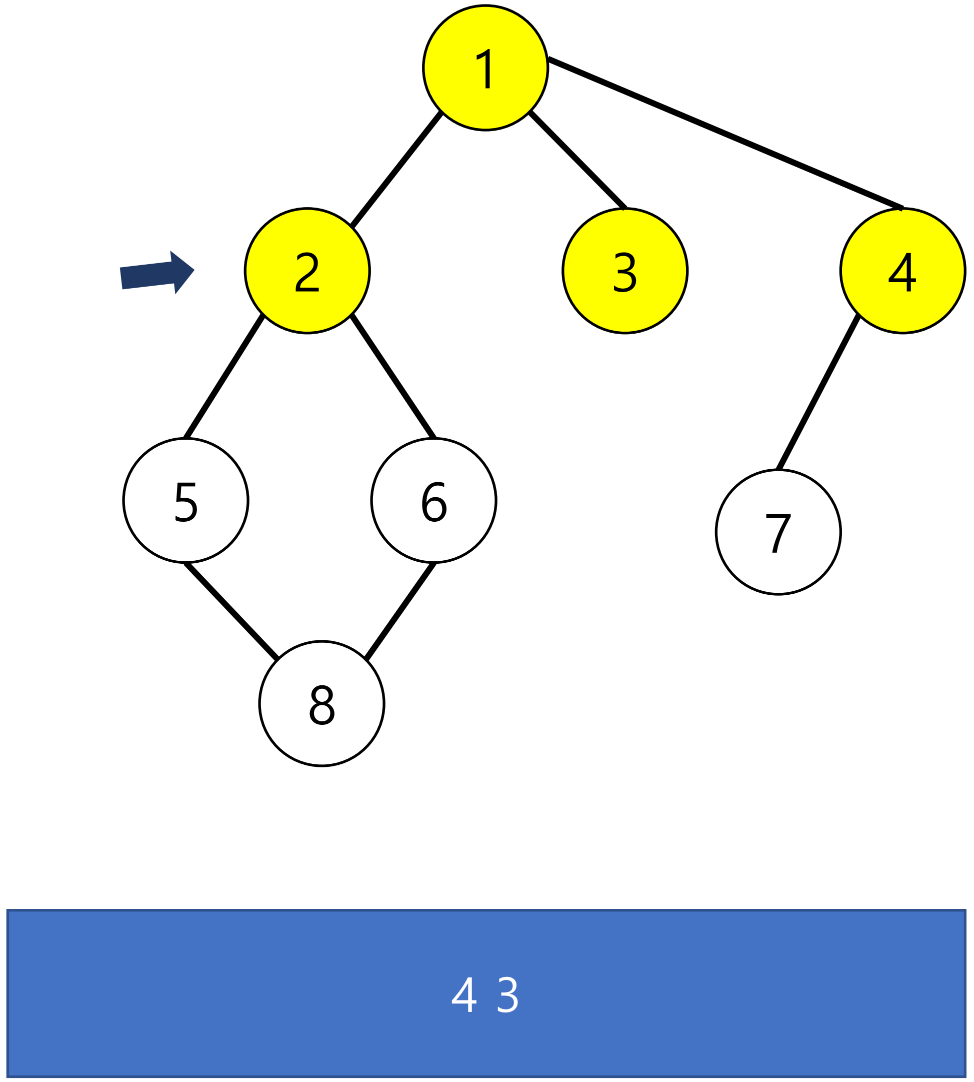

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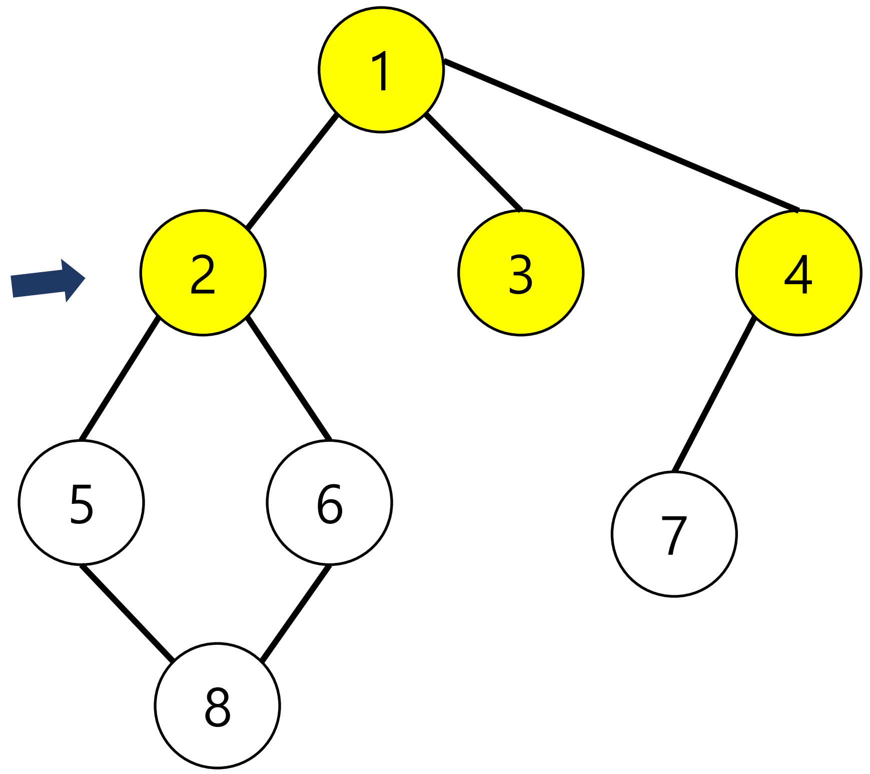
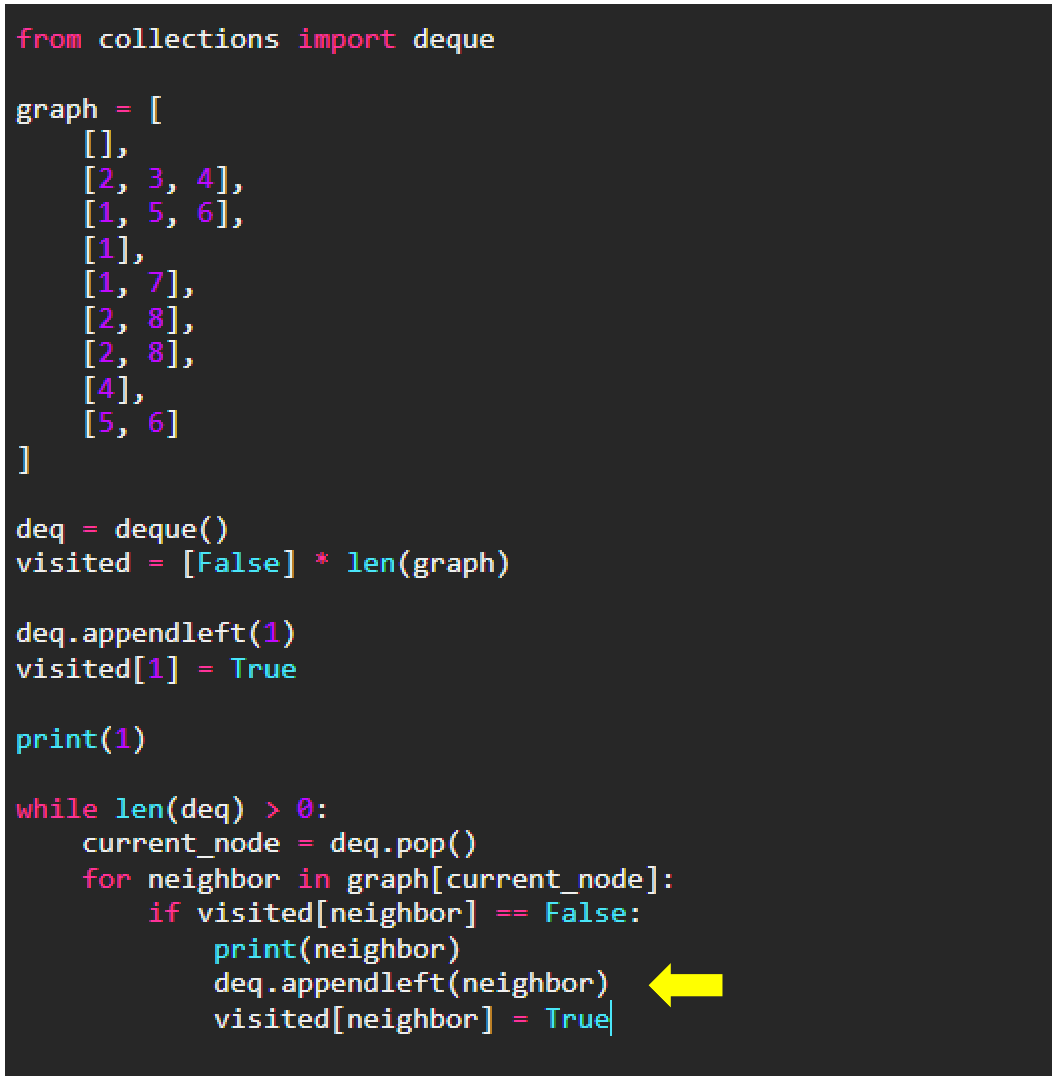


4 3



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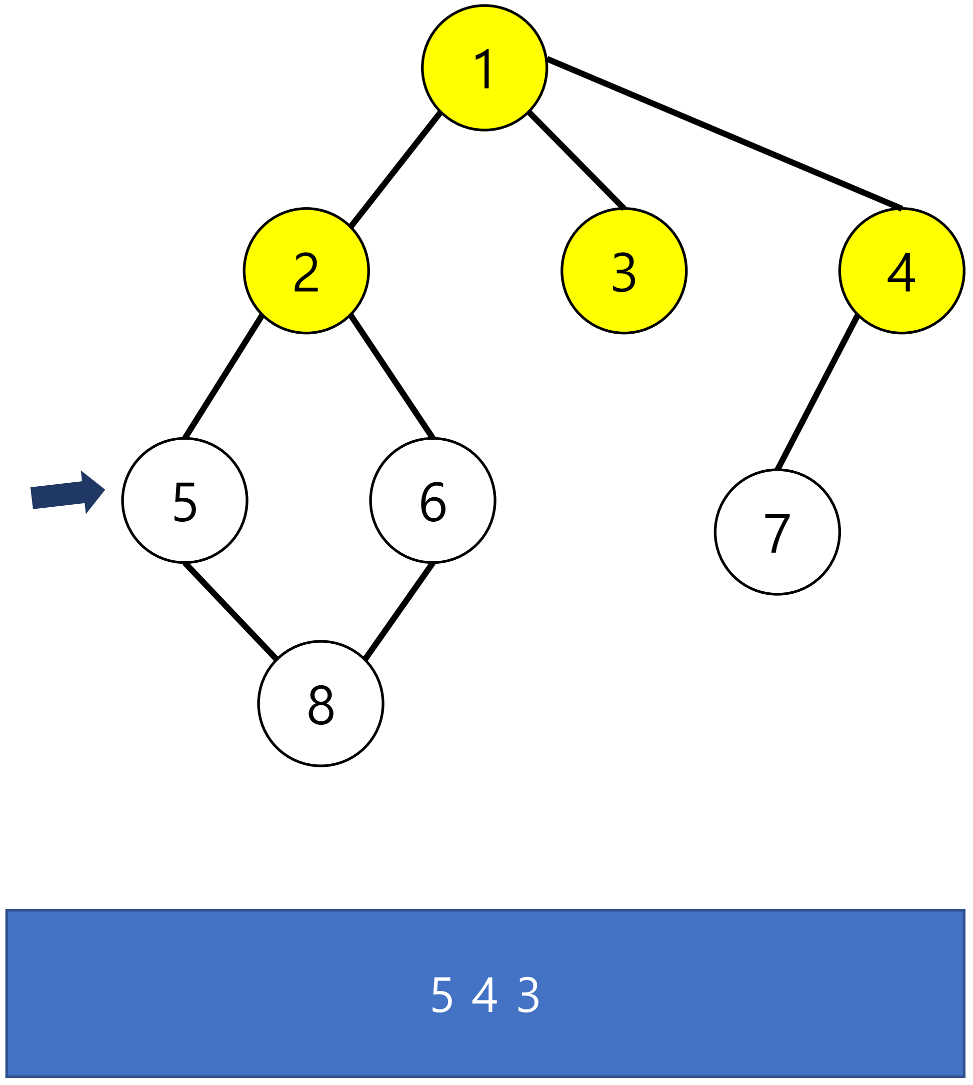

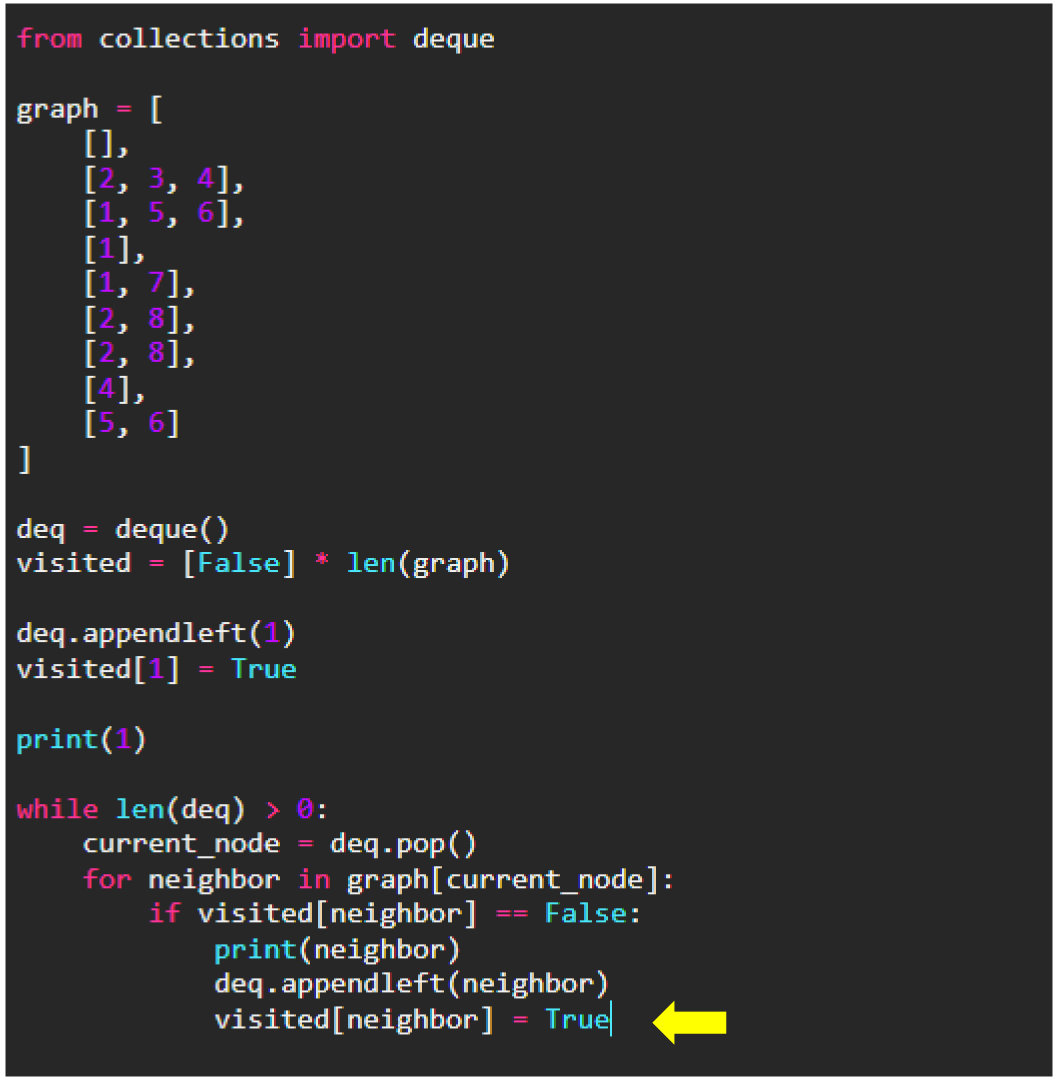

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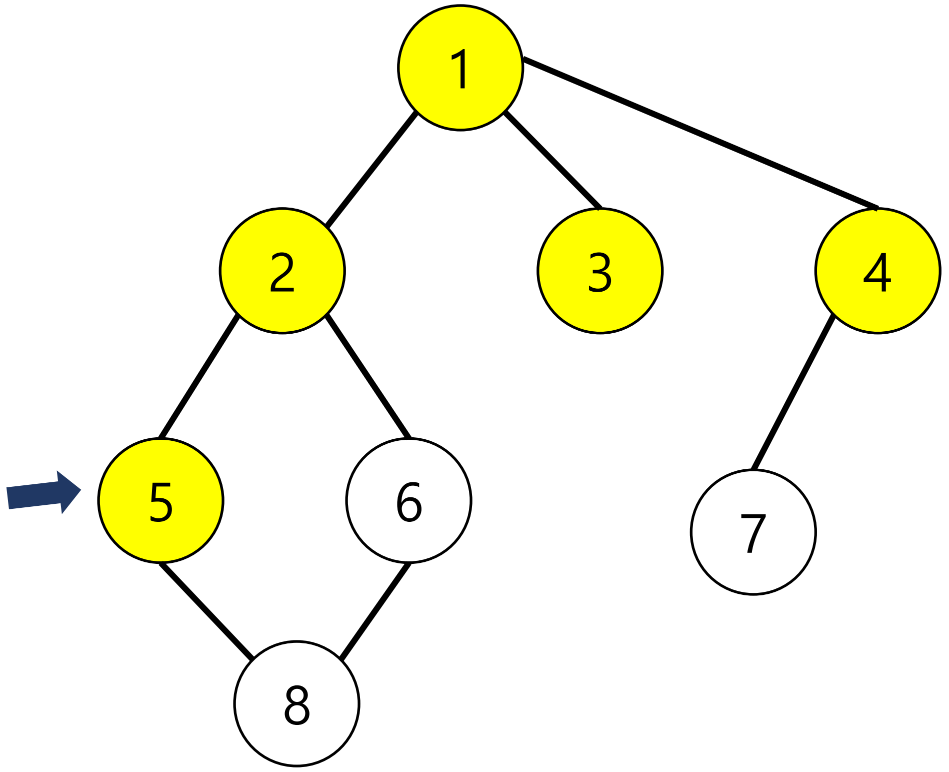

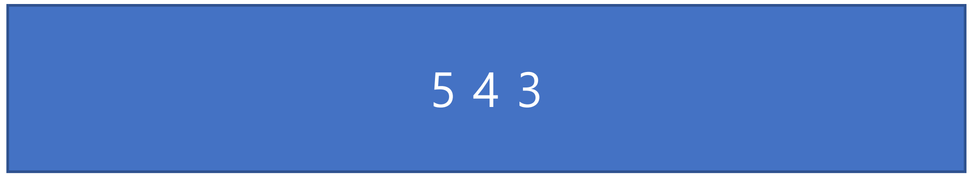

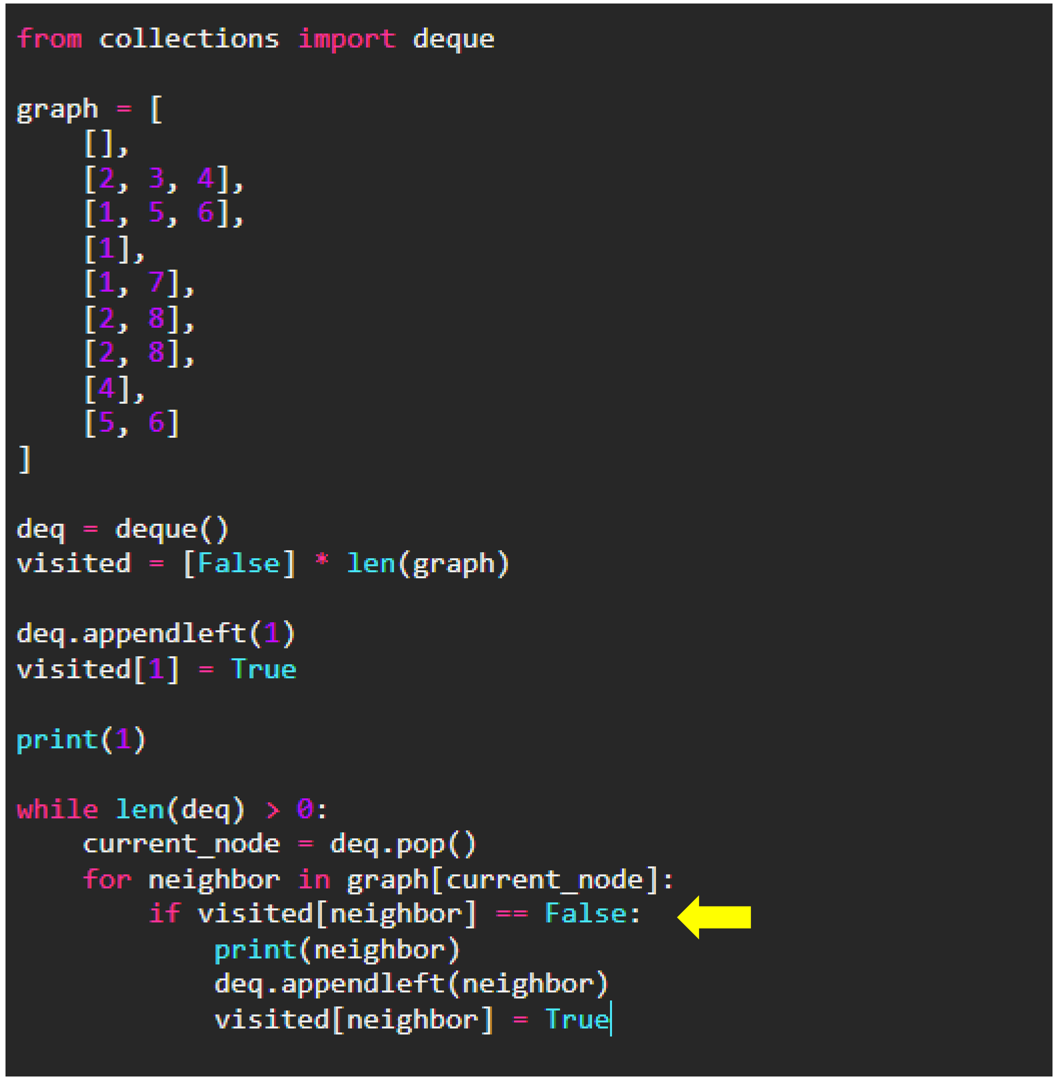

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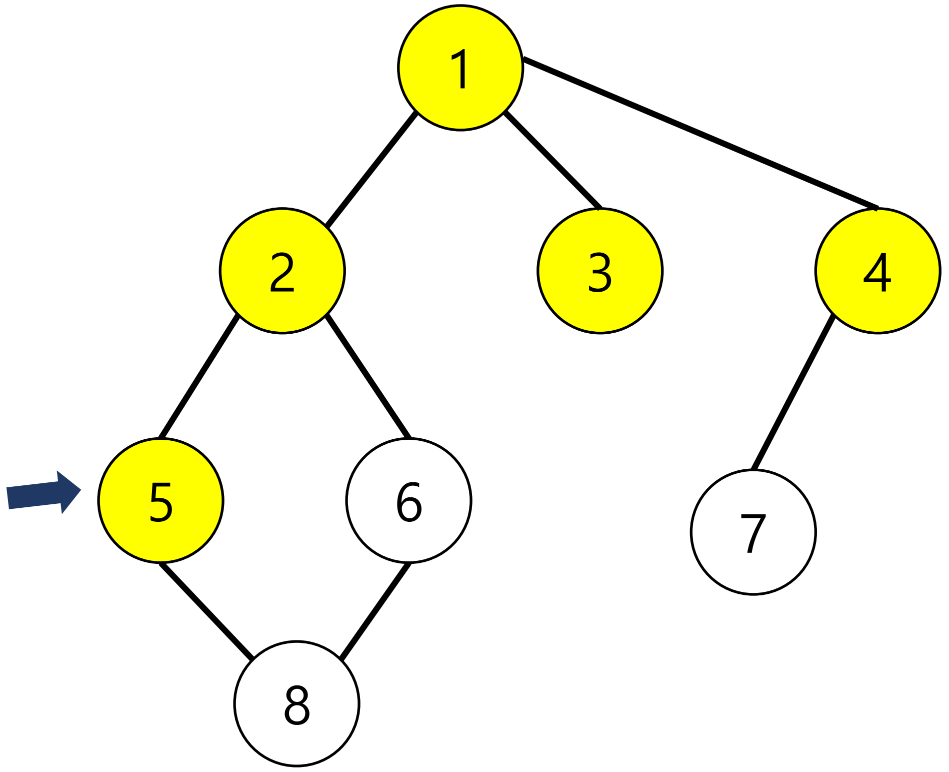

5 4 3

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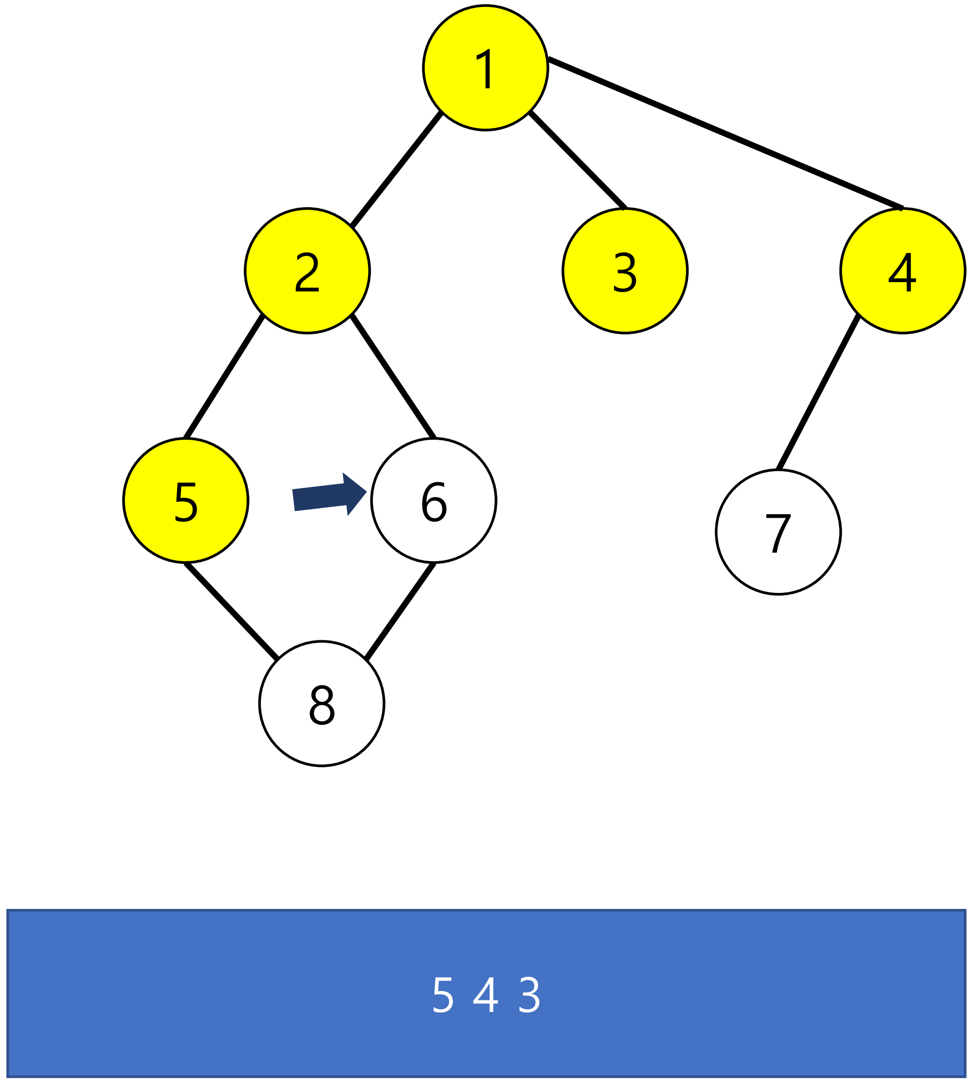

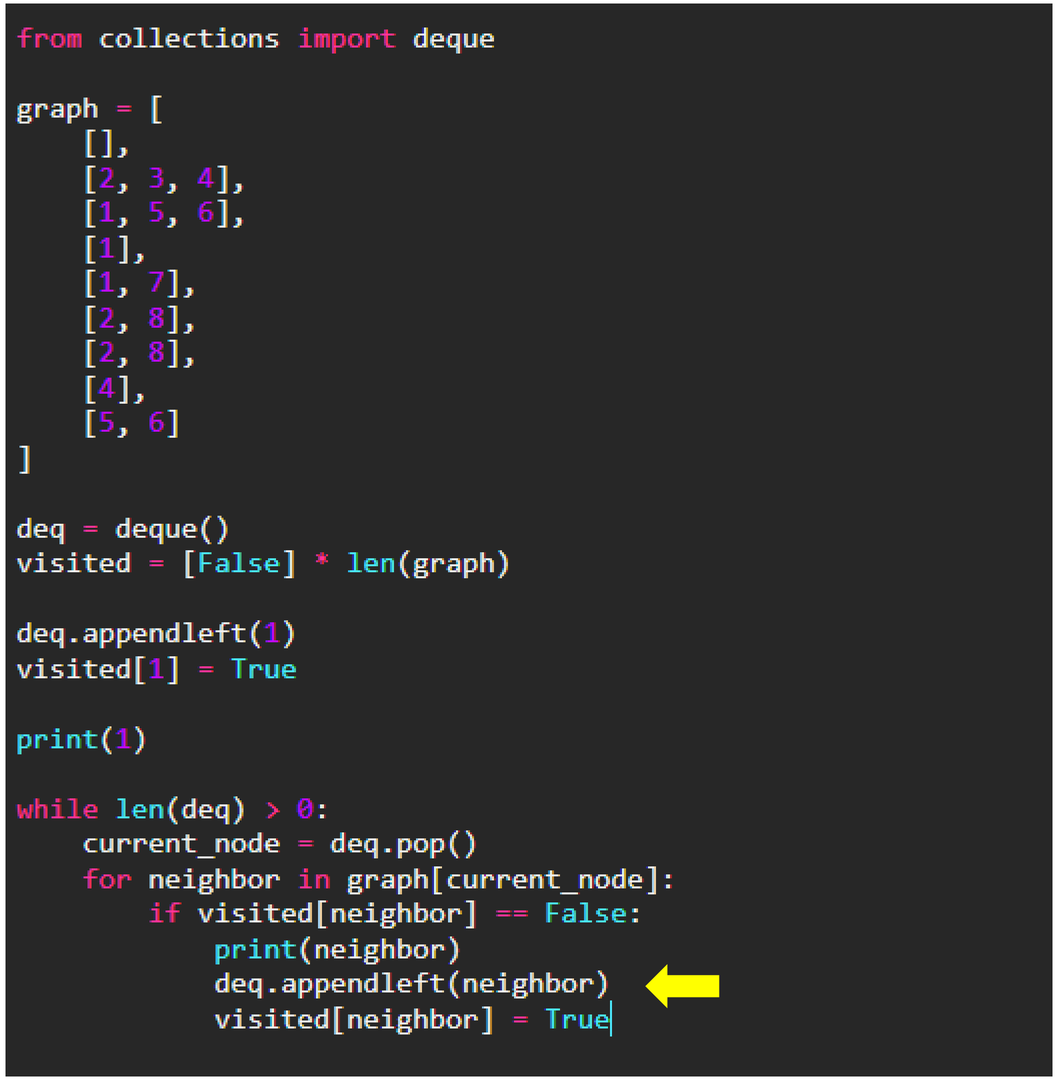

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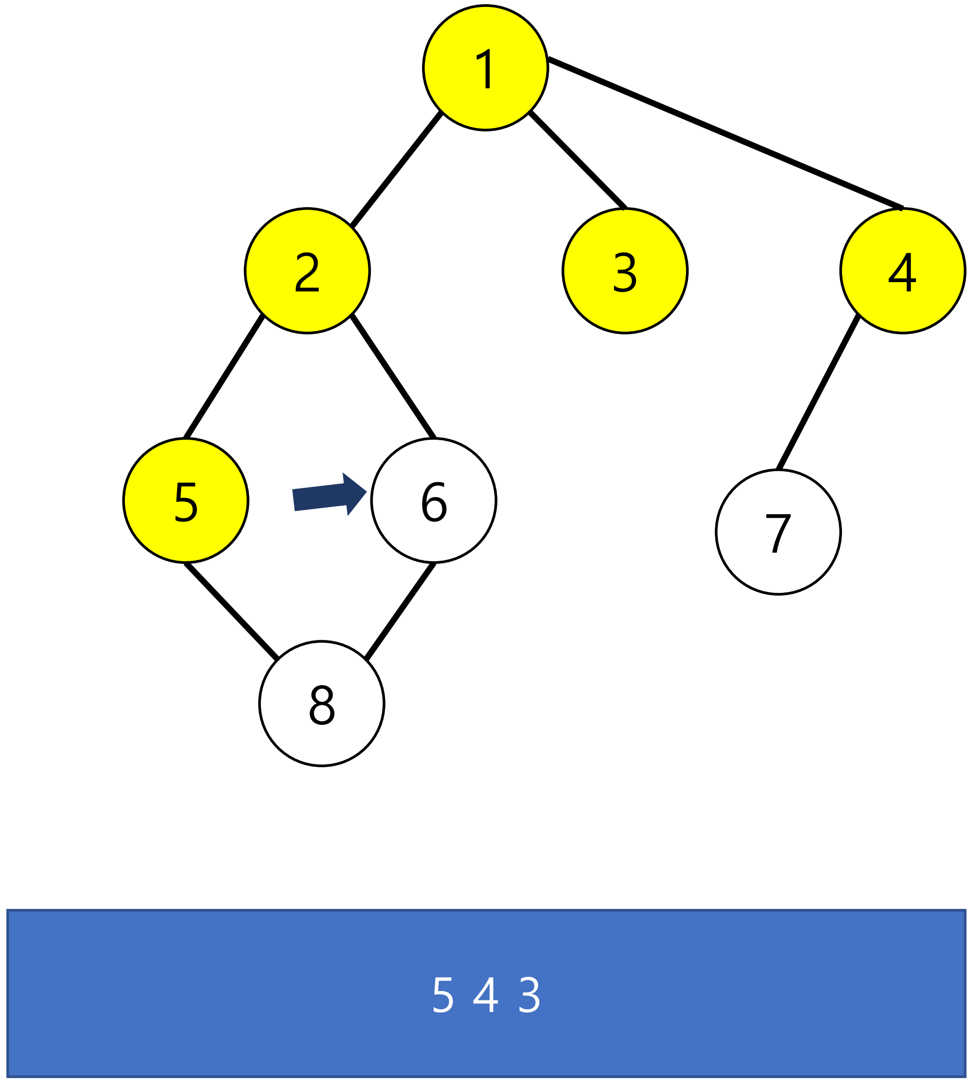

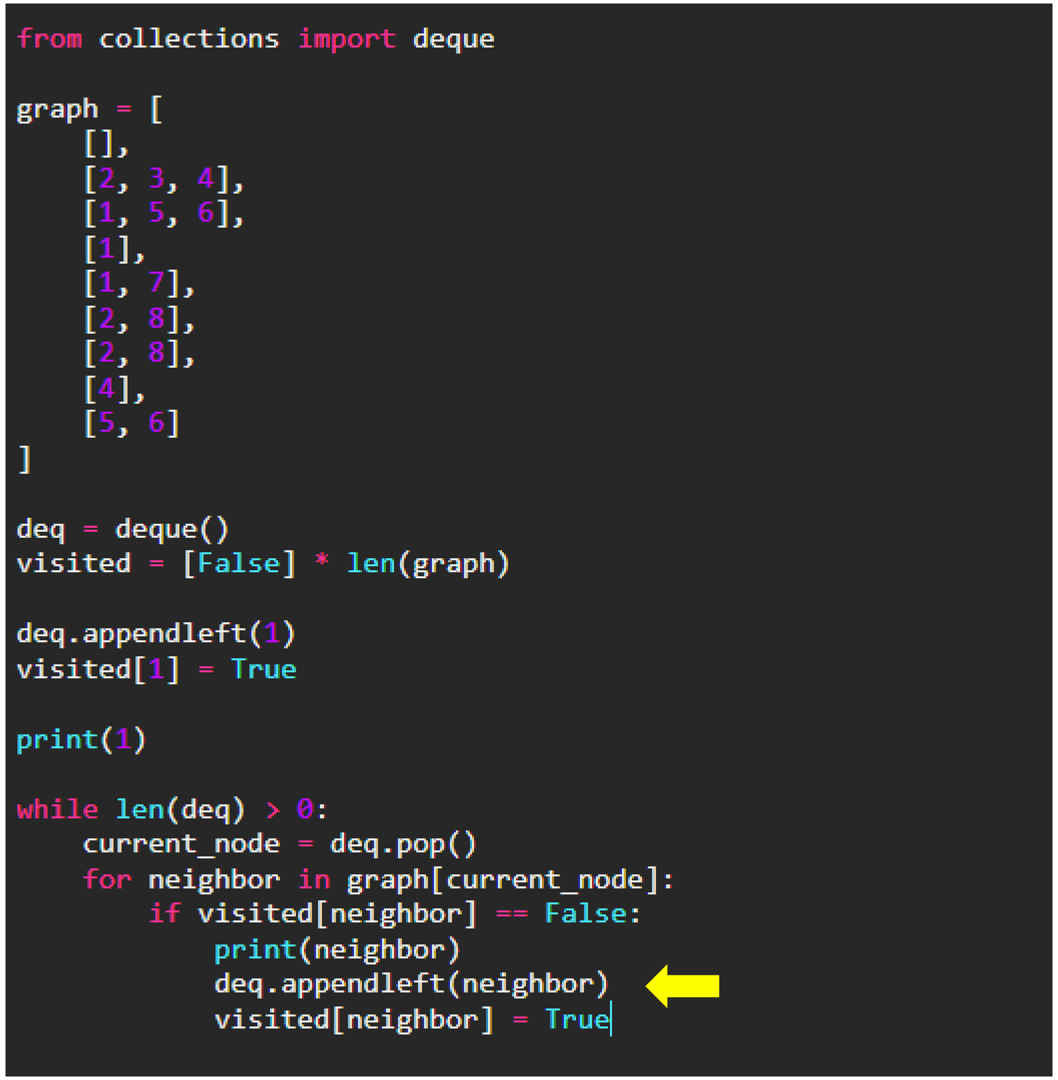

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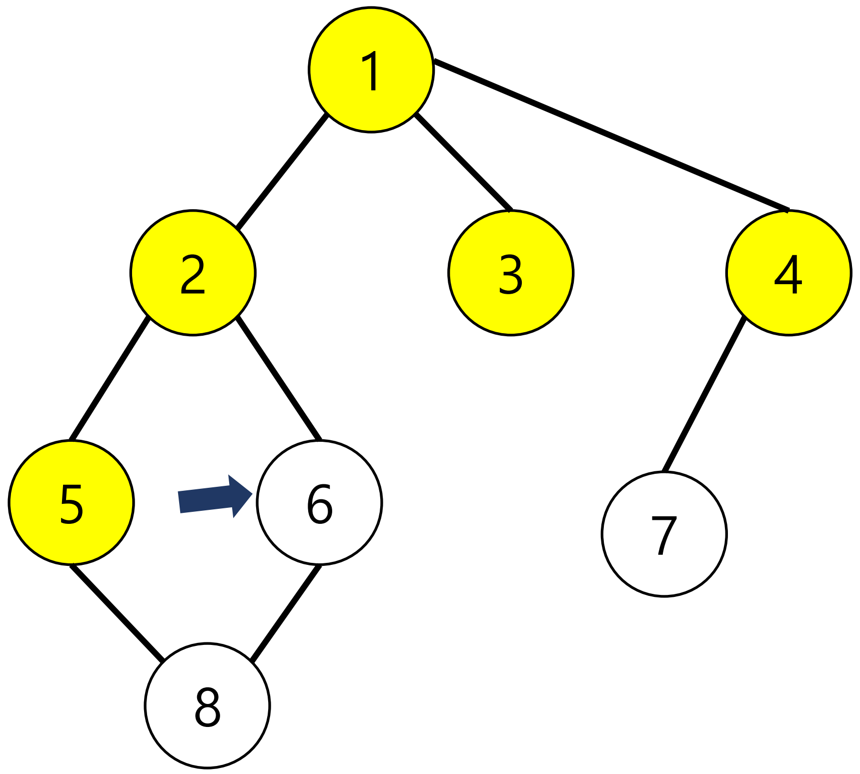
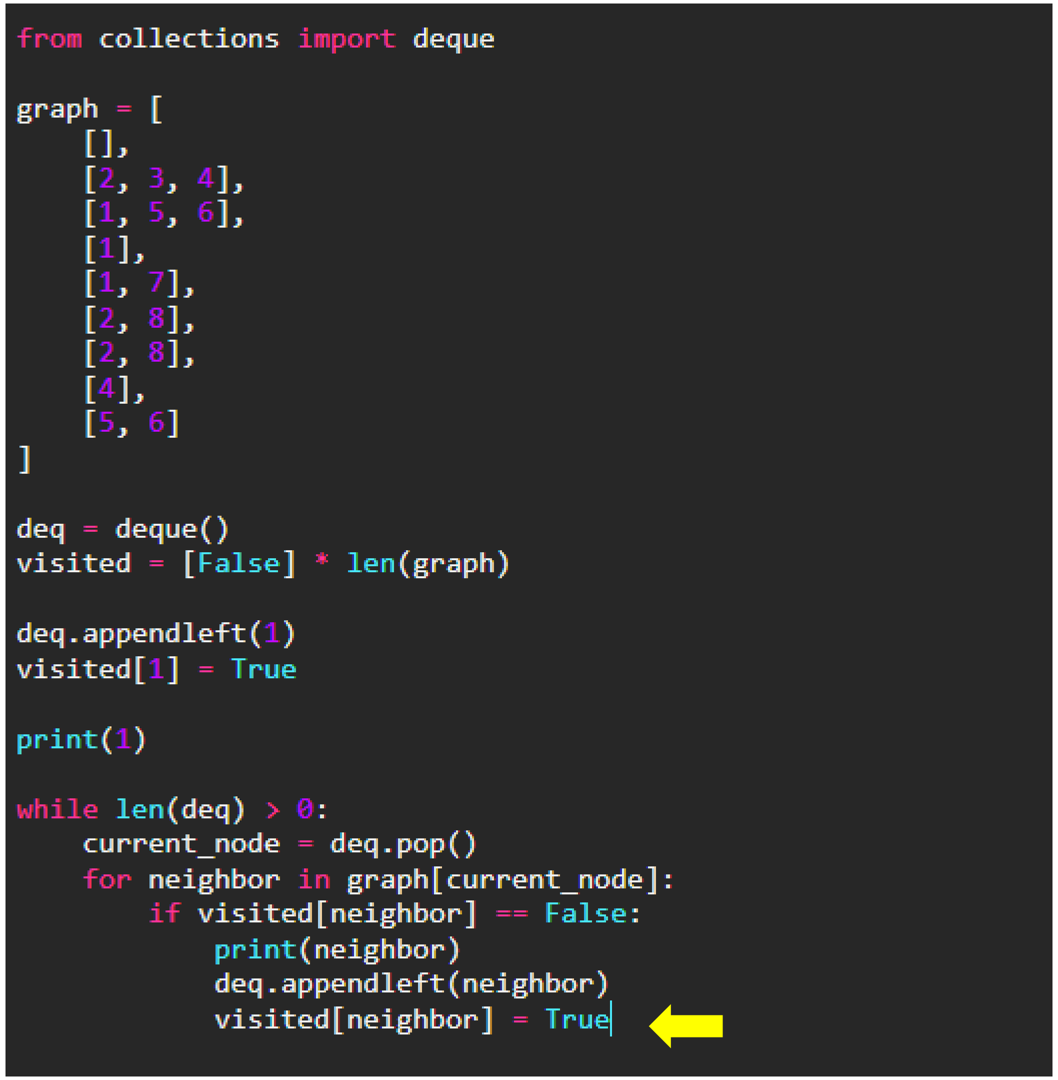


6 5 4 3



```python
from collections import deque

graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
    [4],
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]

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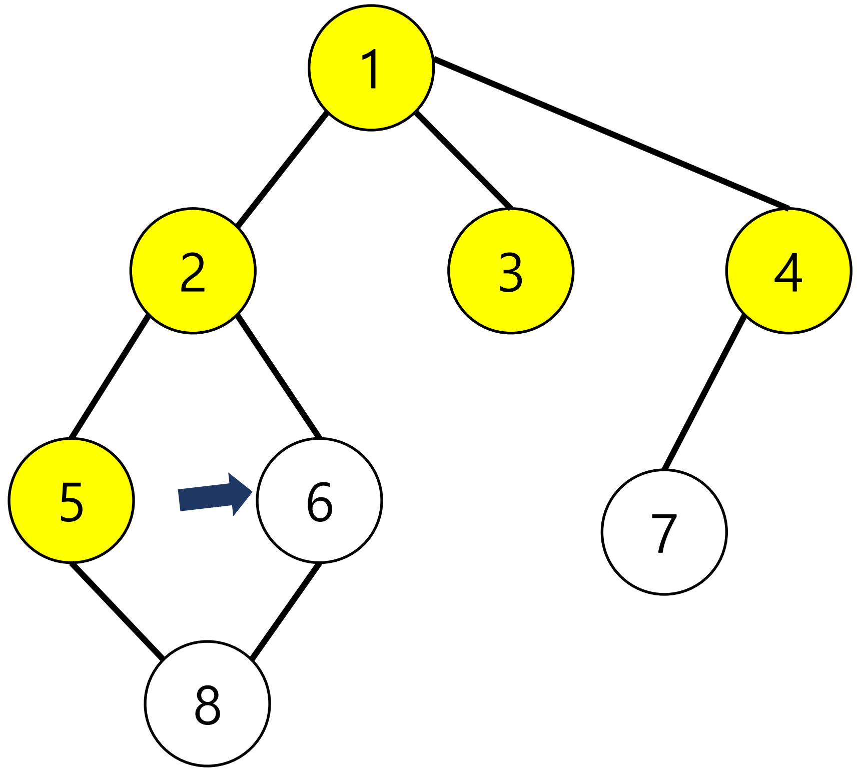
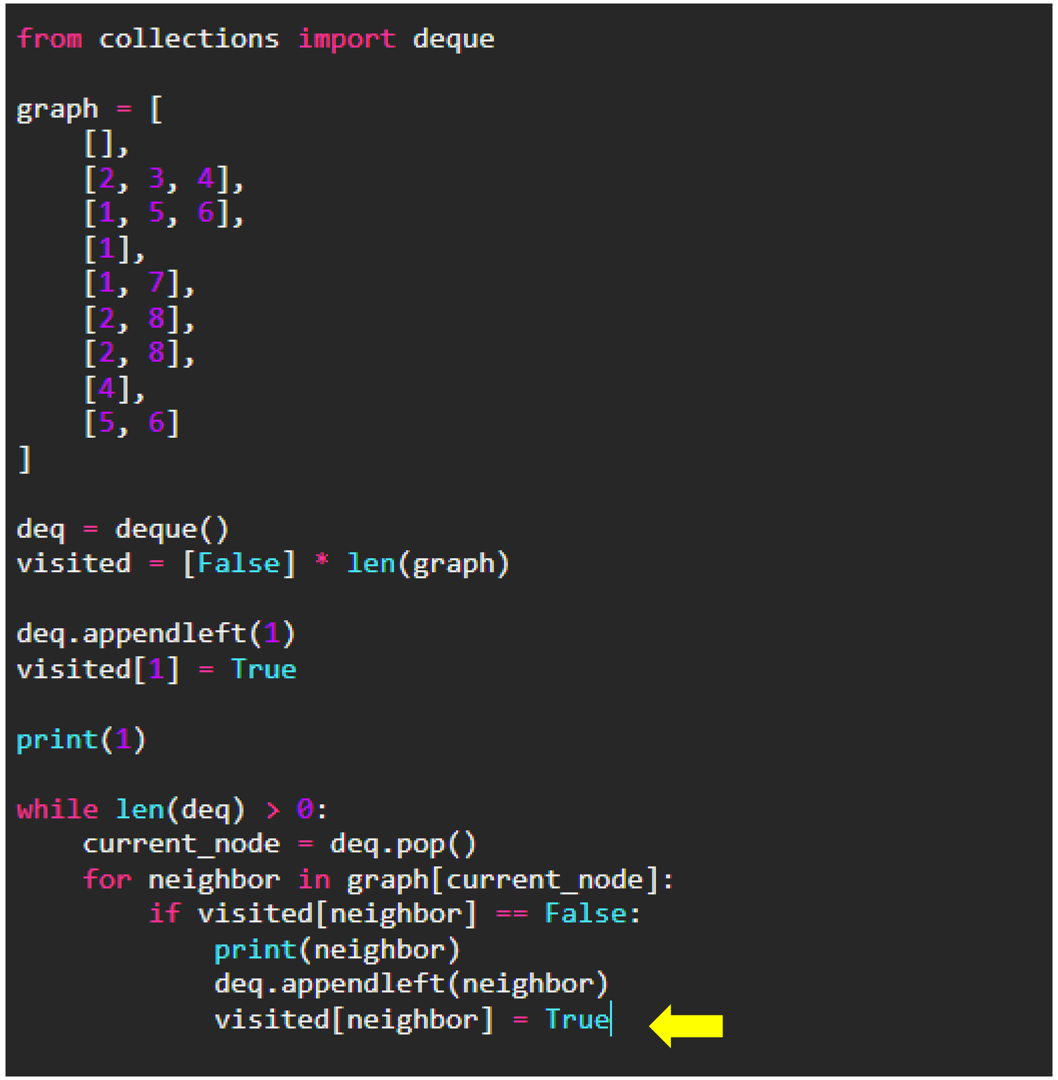


6 5 4 3



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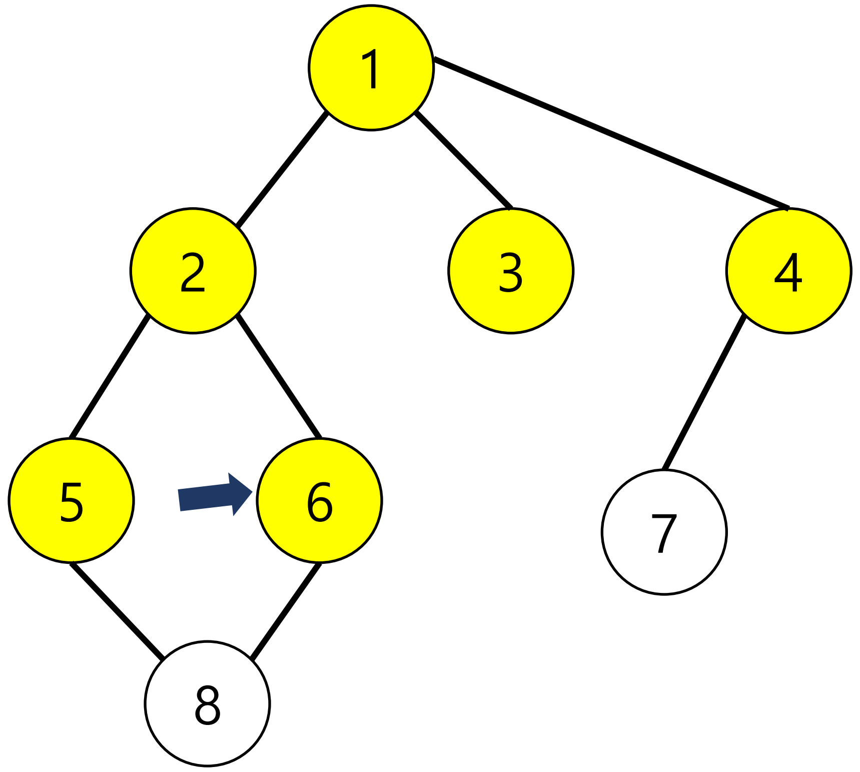
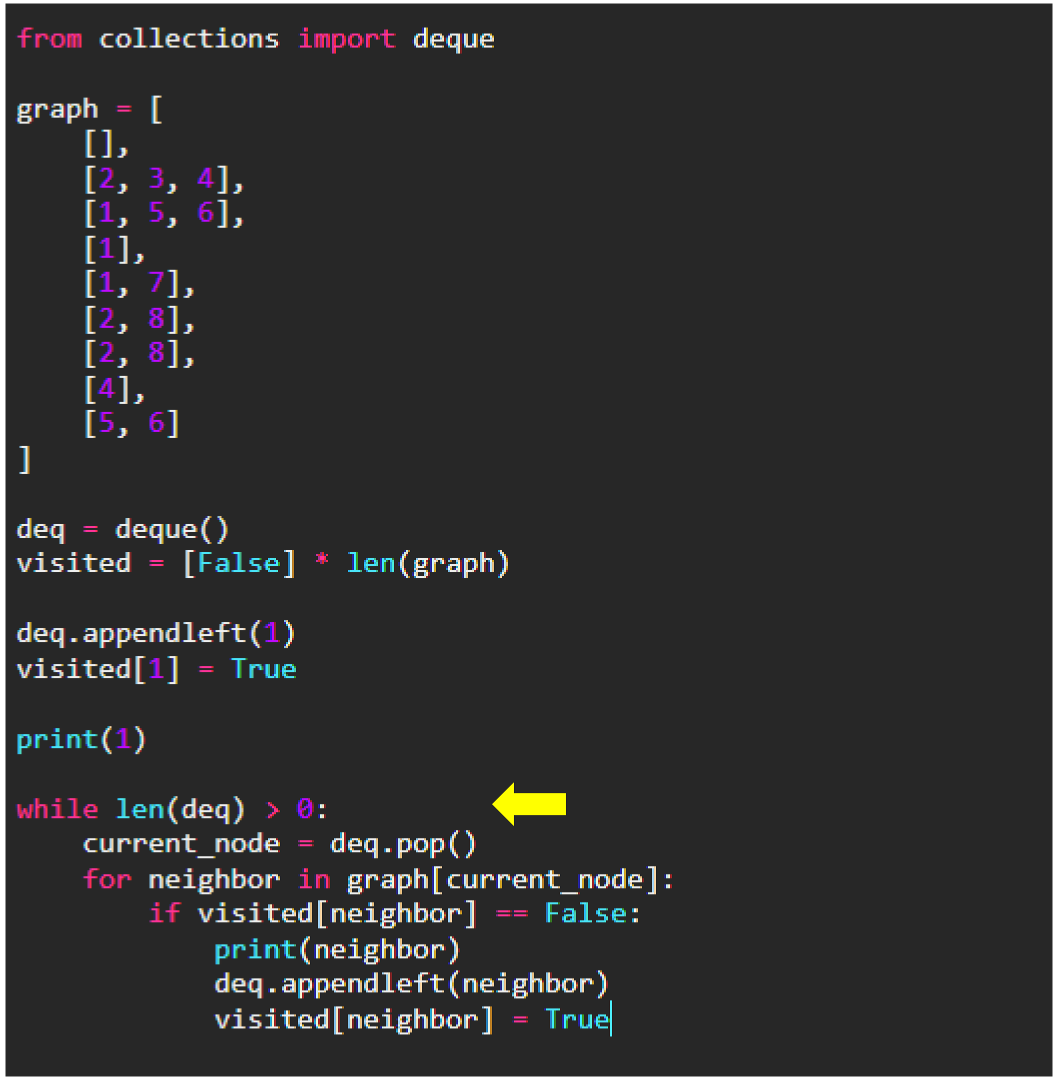


6 5 4 3



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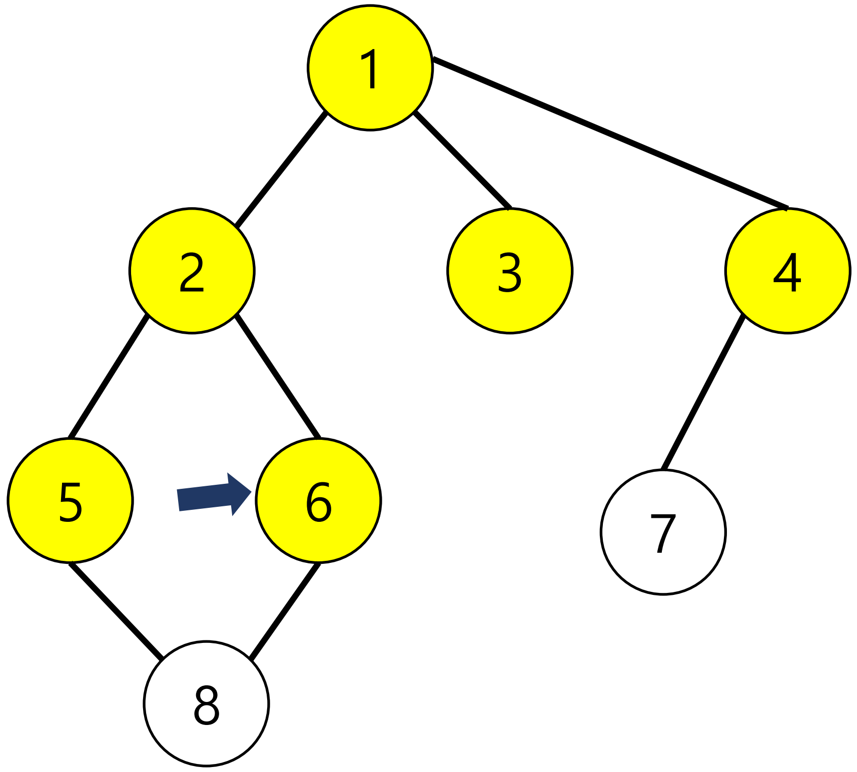
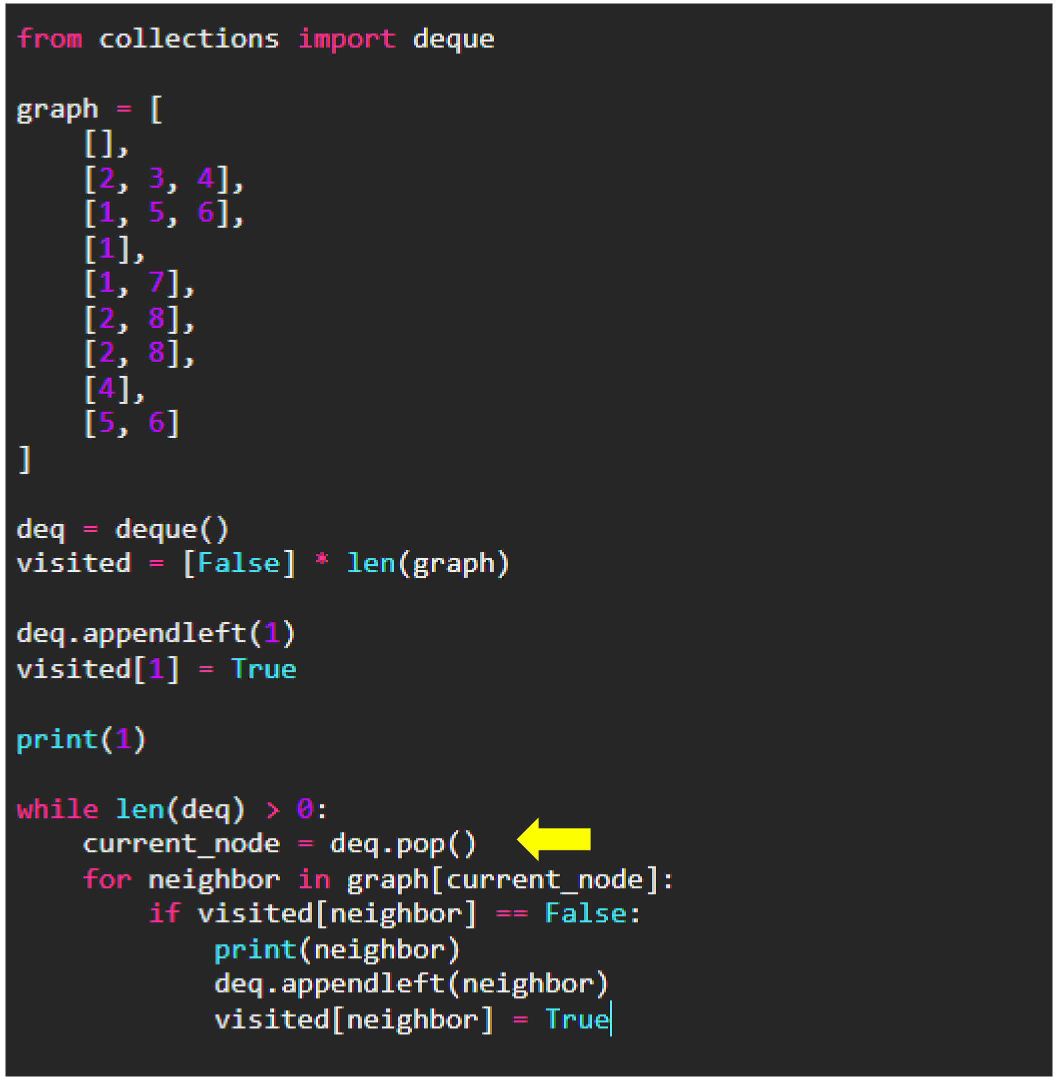


6 5 4 3



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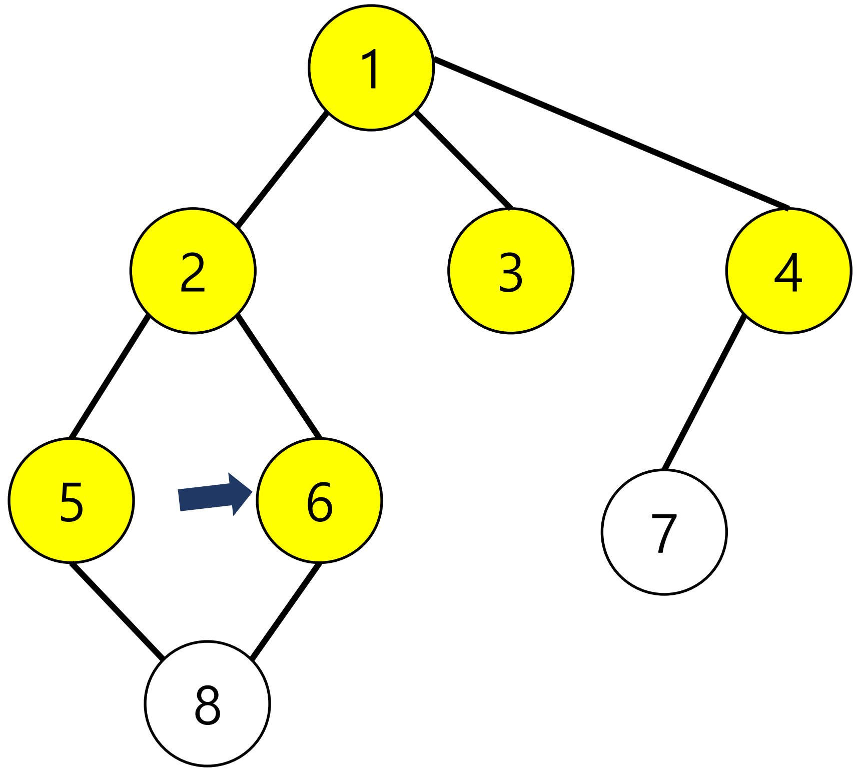

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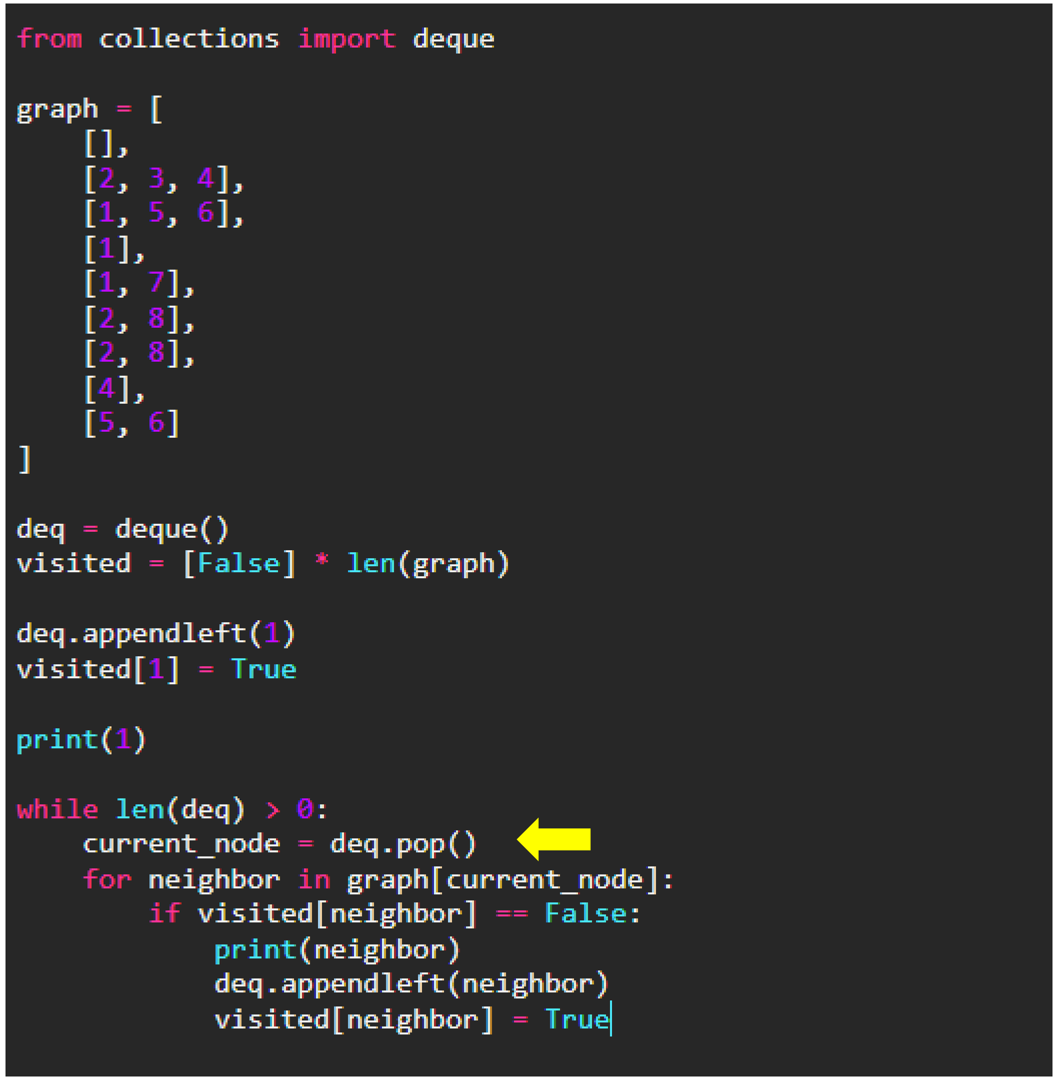

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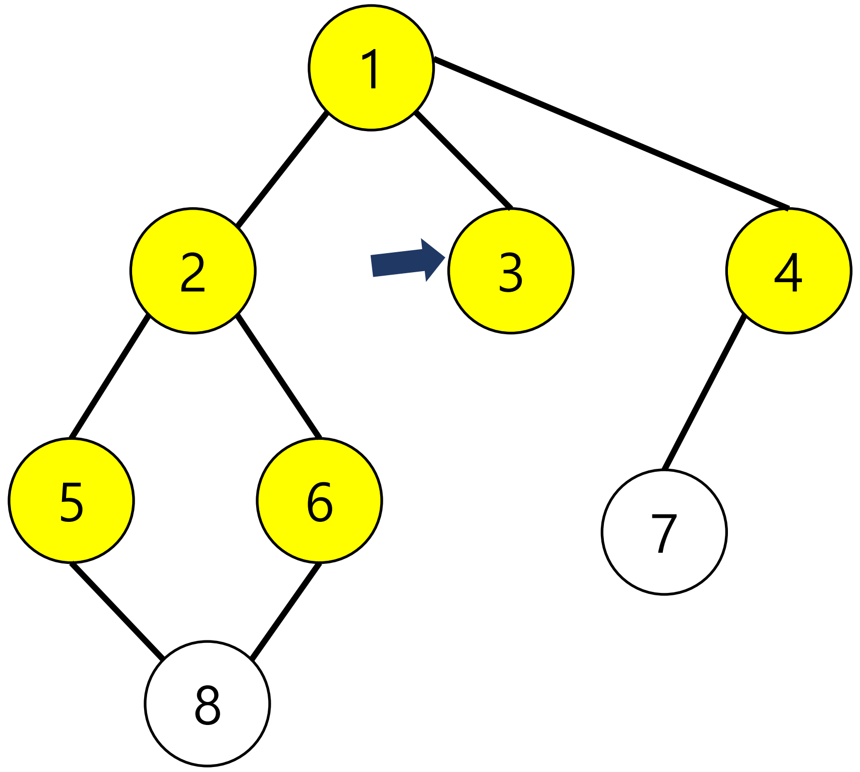

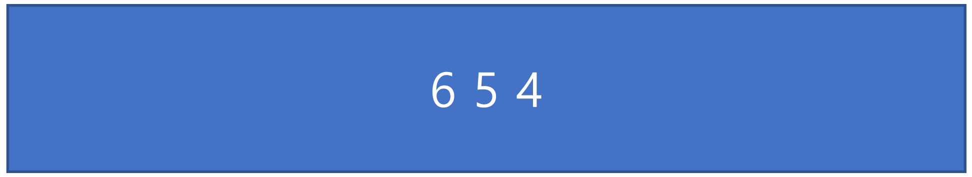

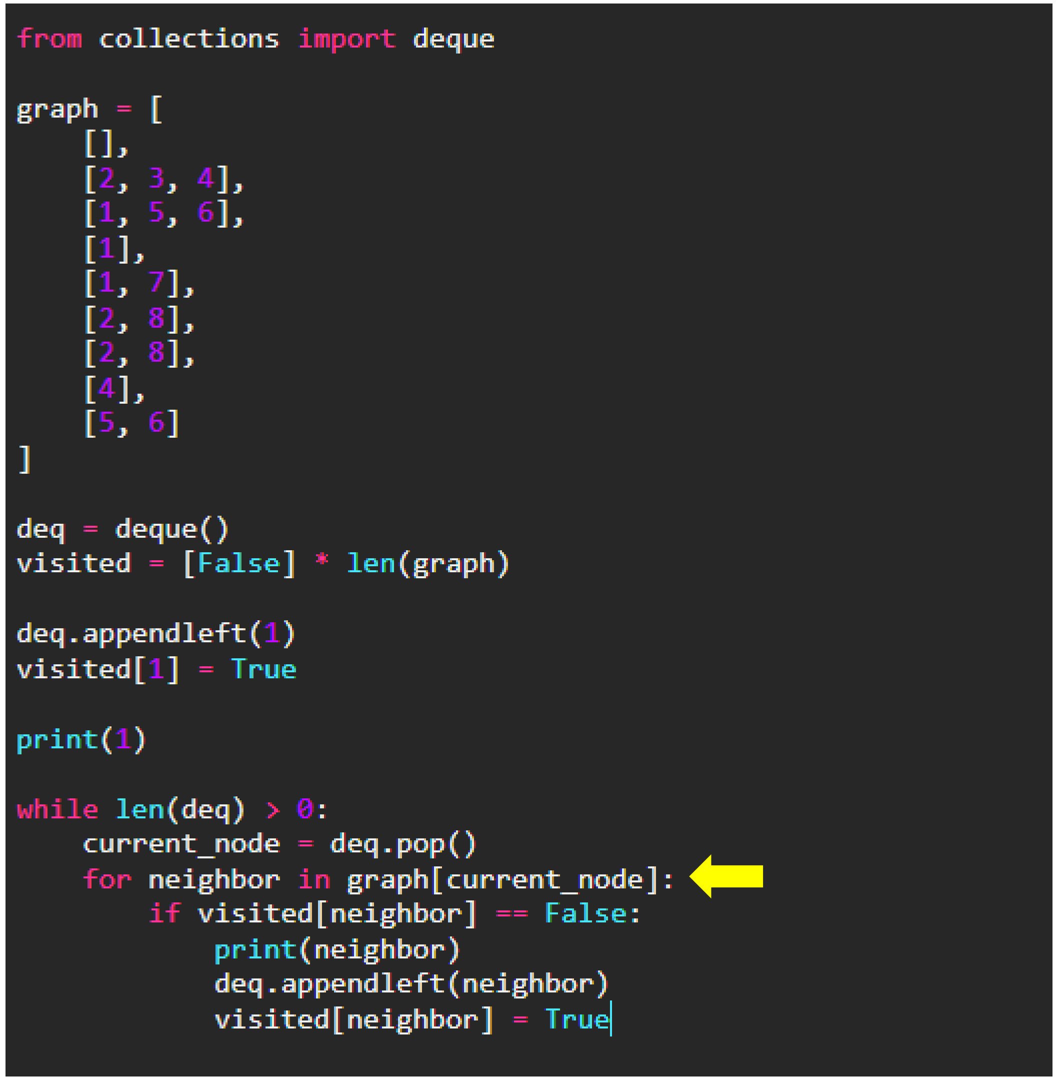

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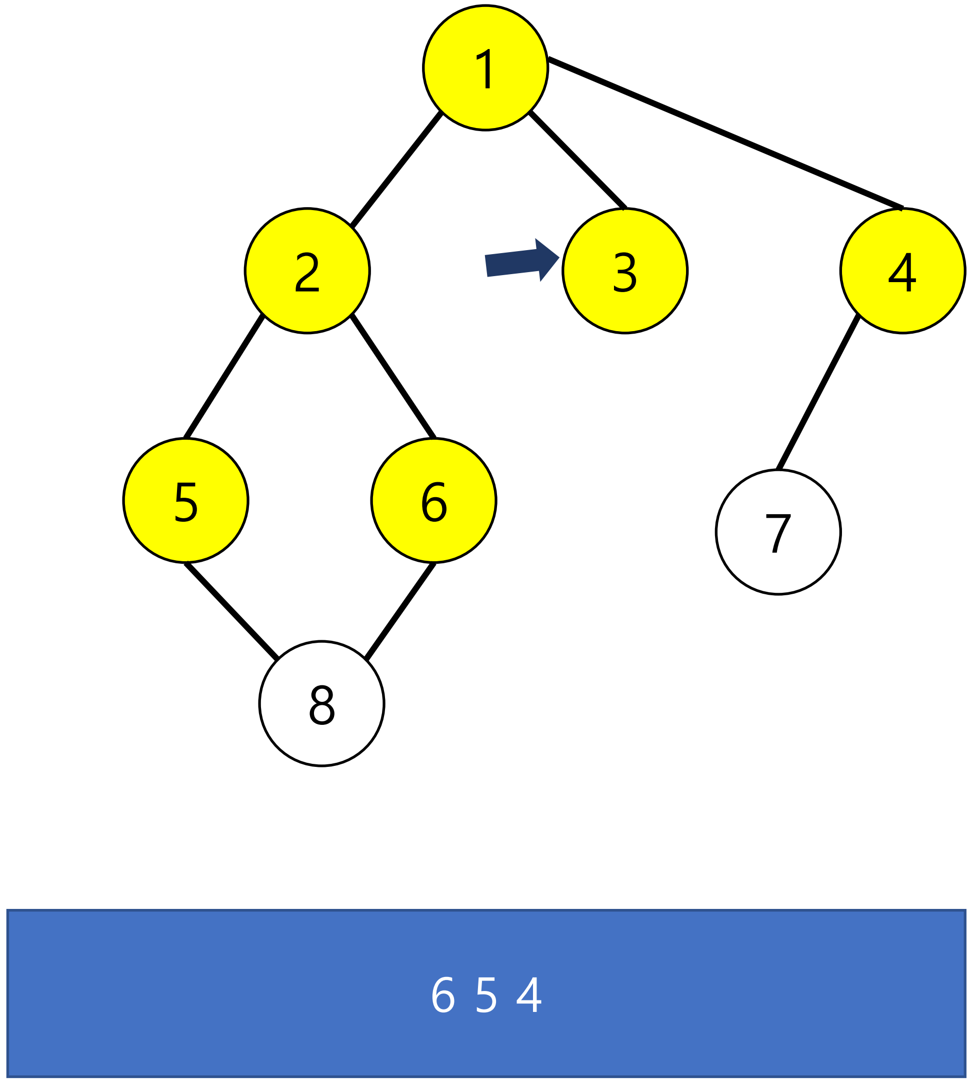

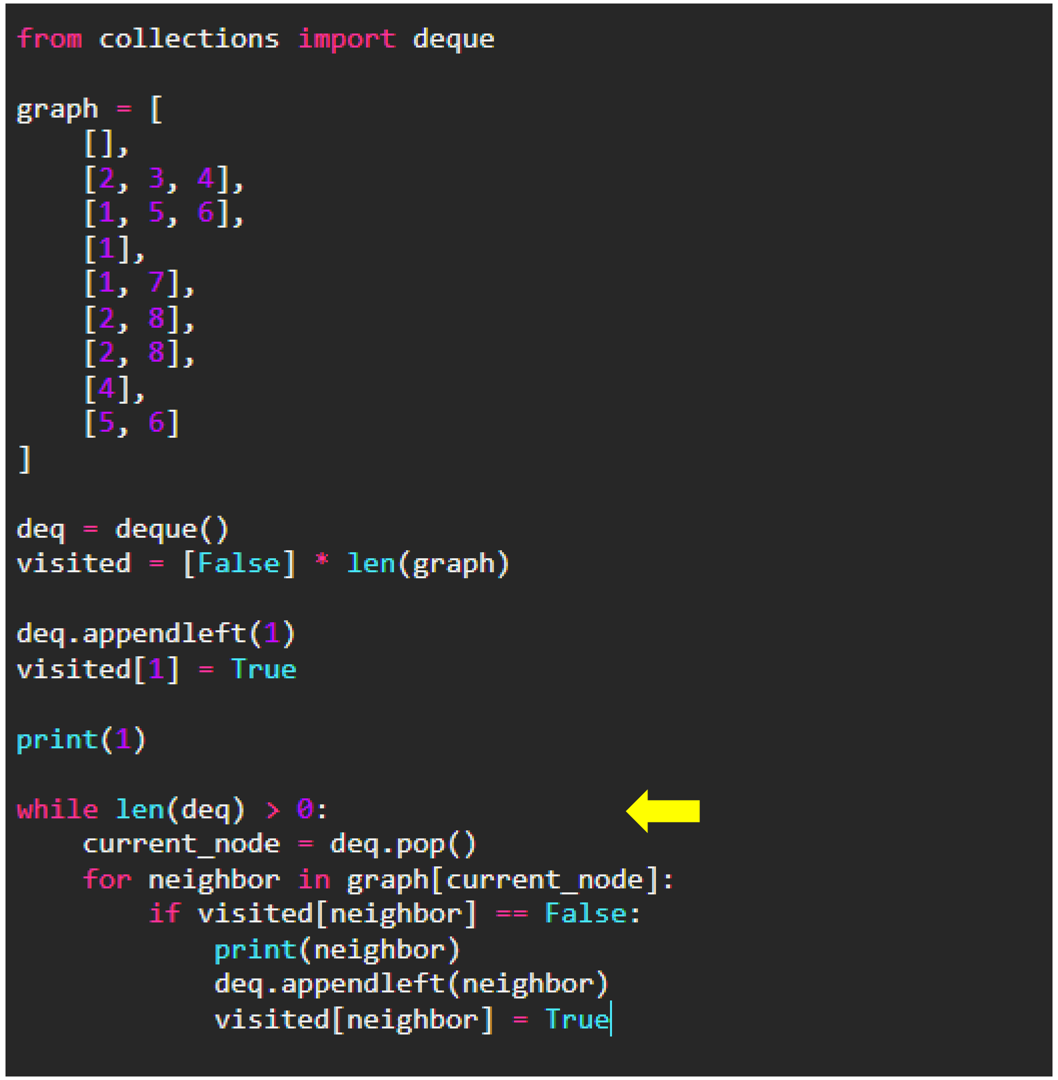

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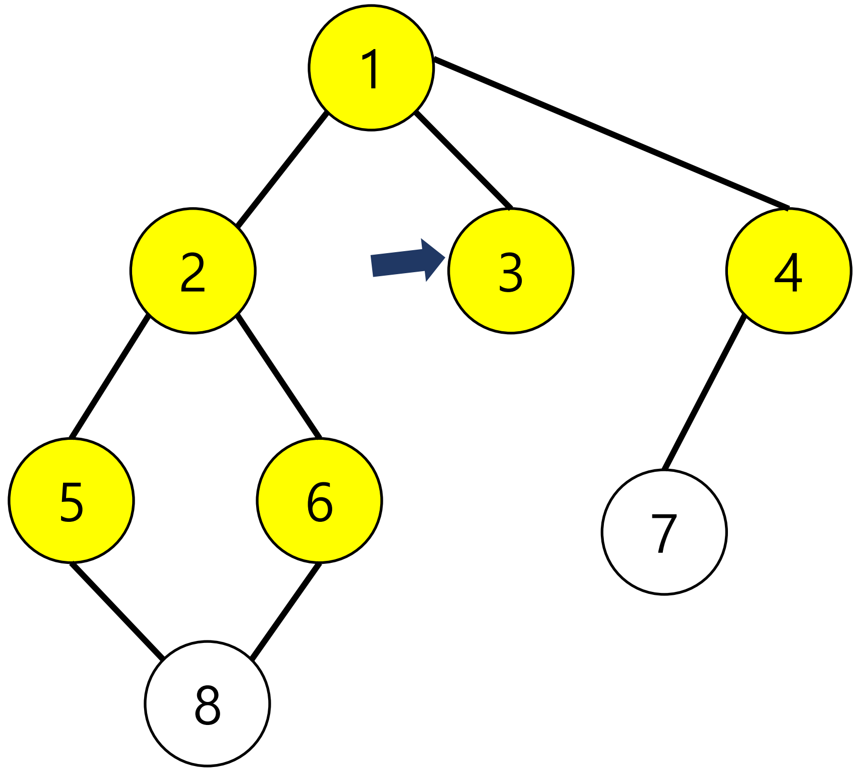

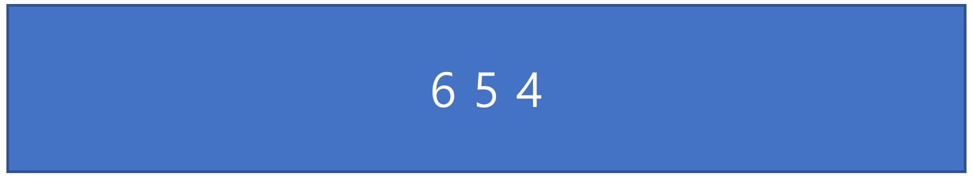

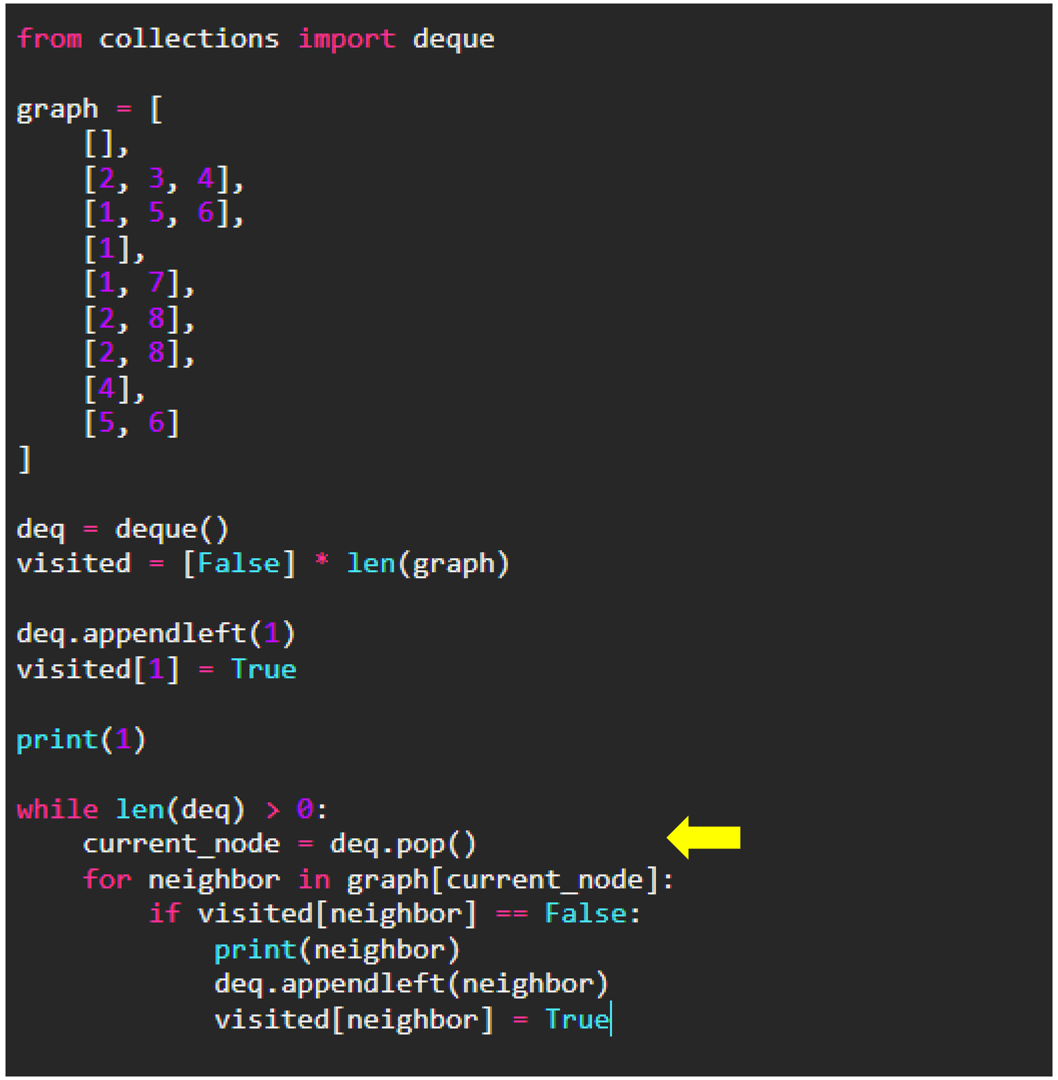

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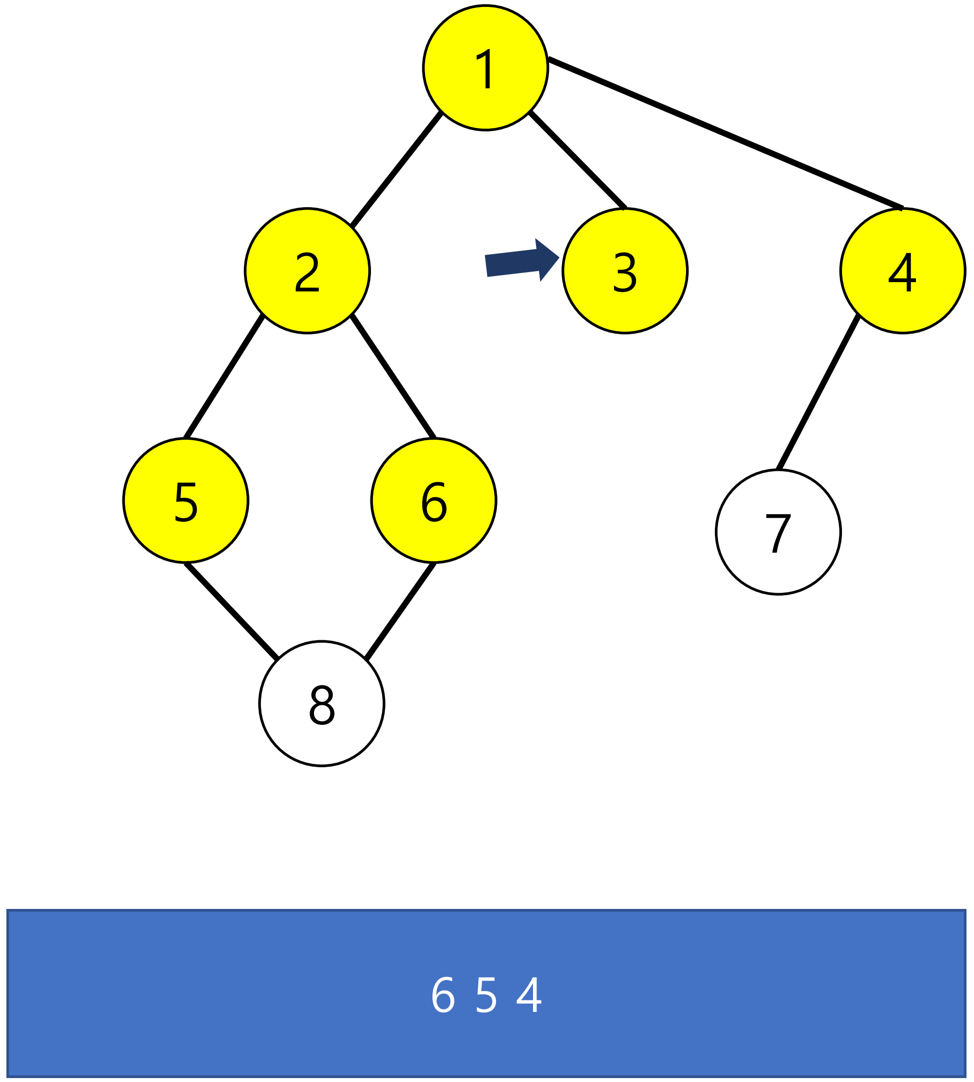

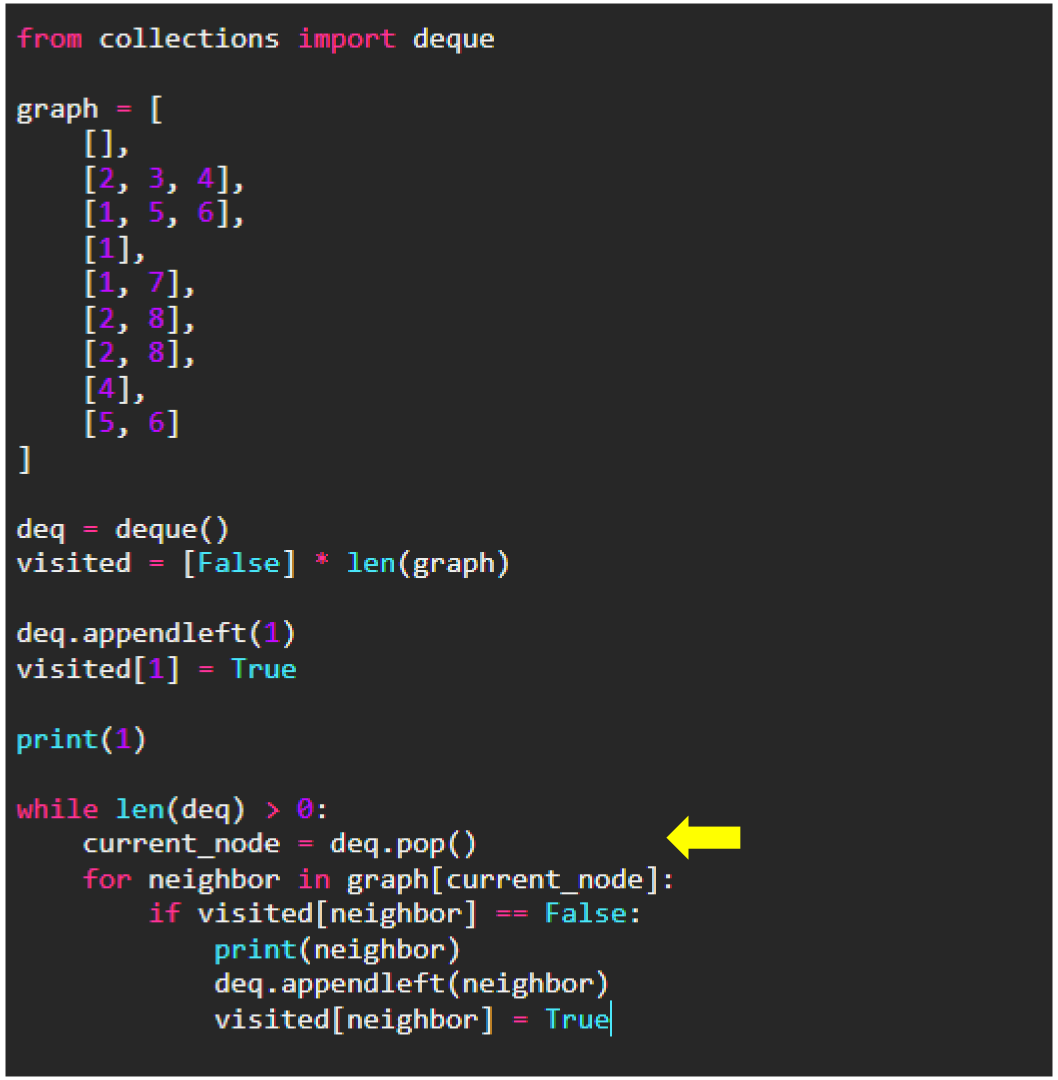

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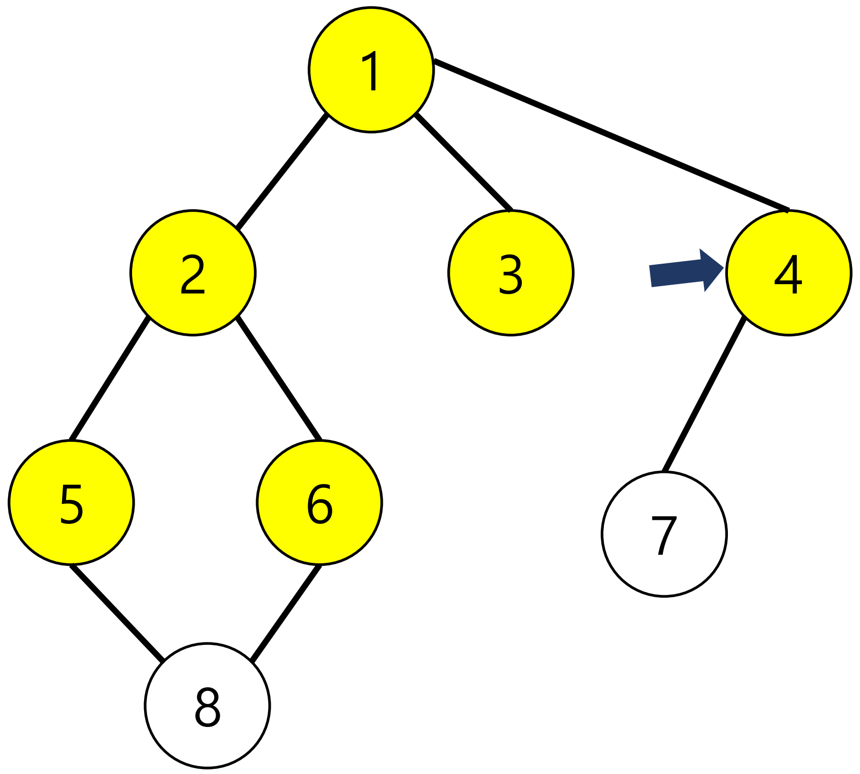
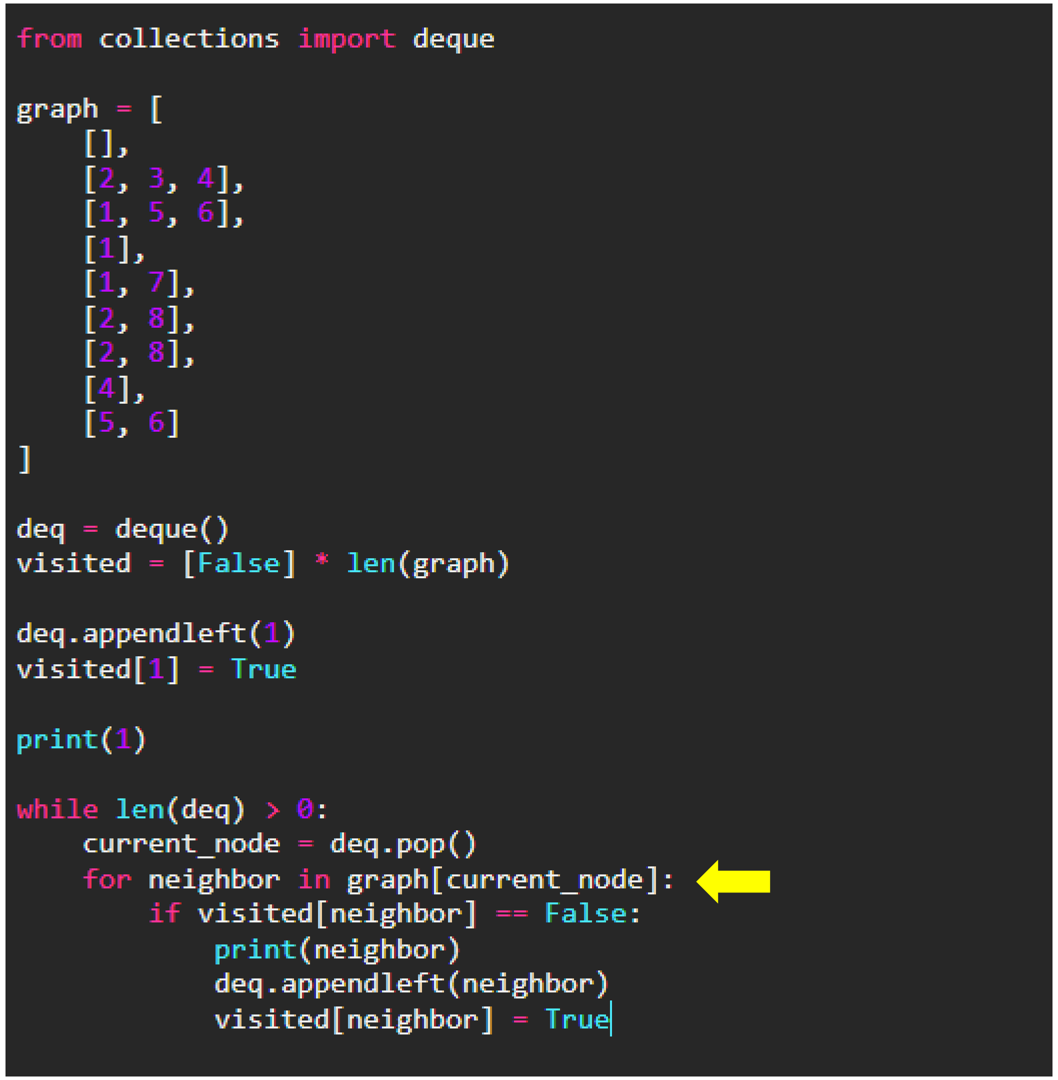


6 5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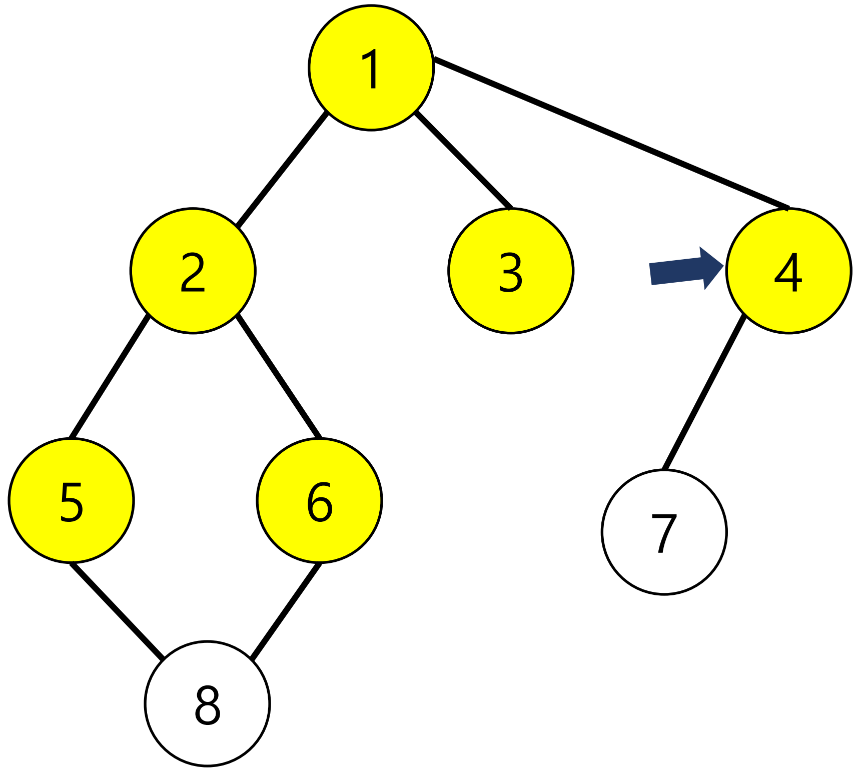

6 5

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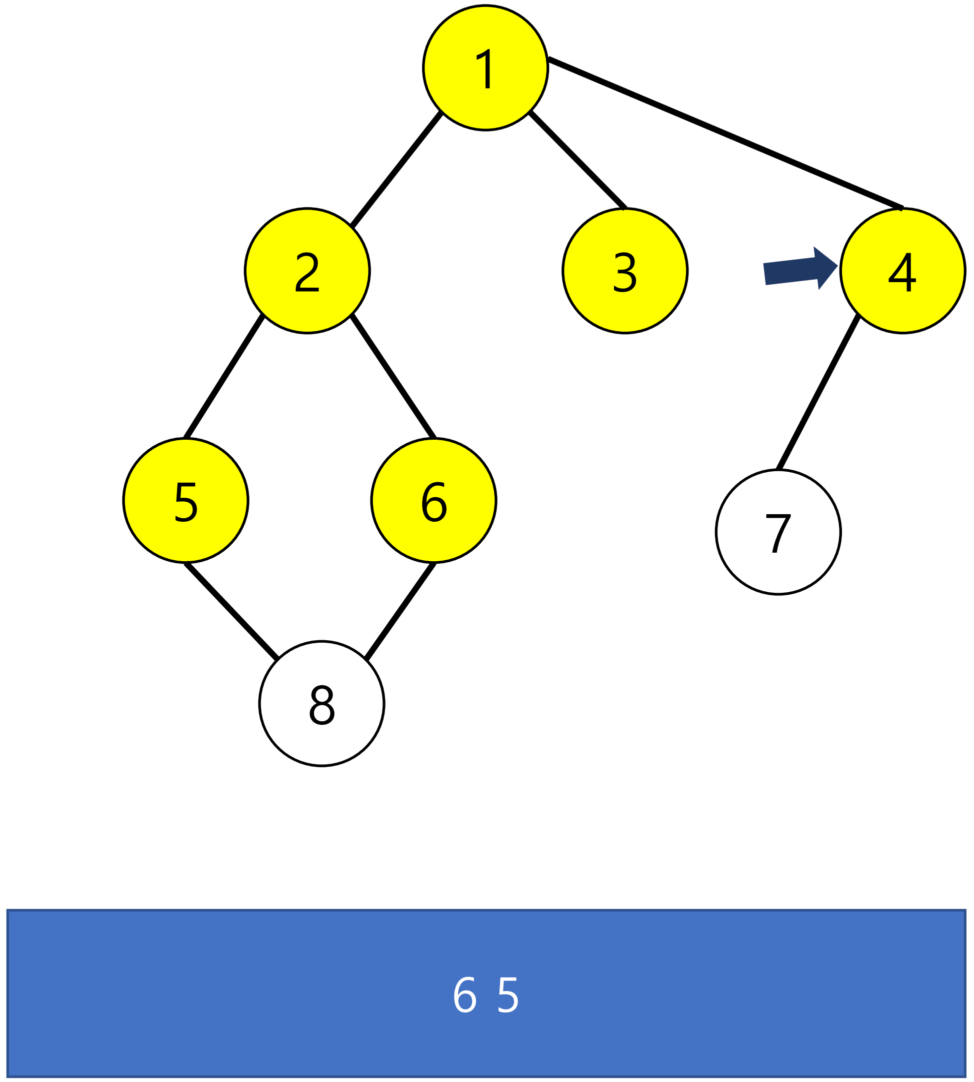

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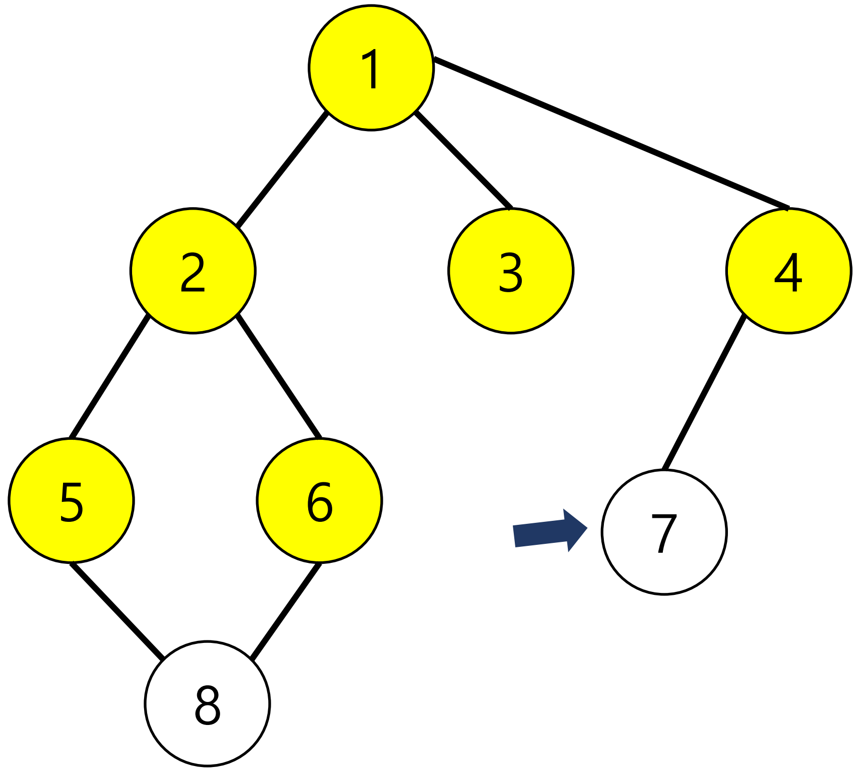
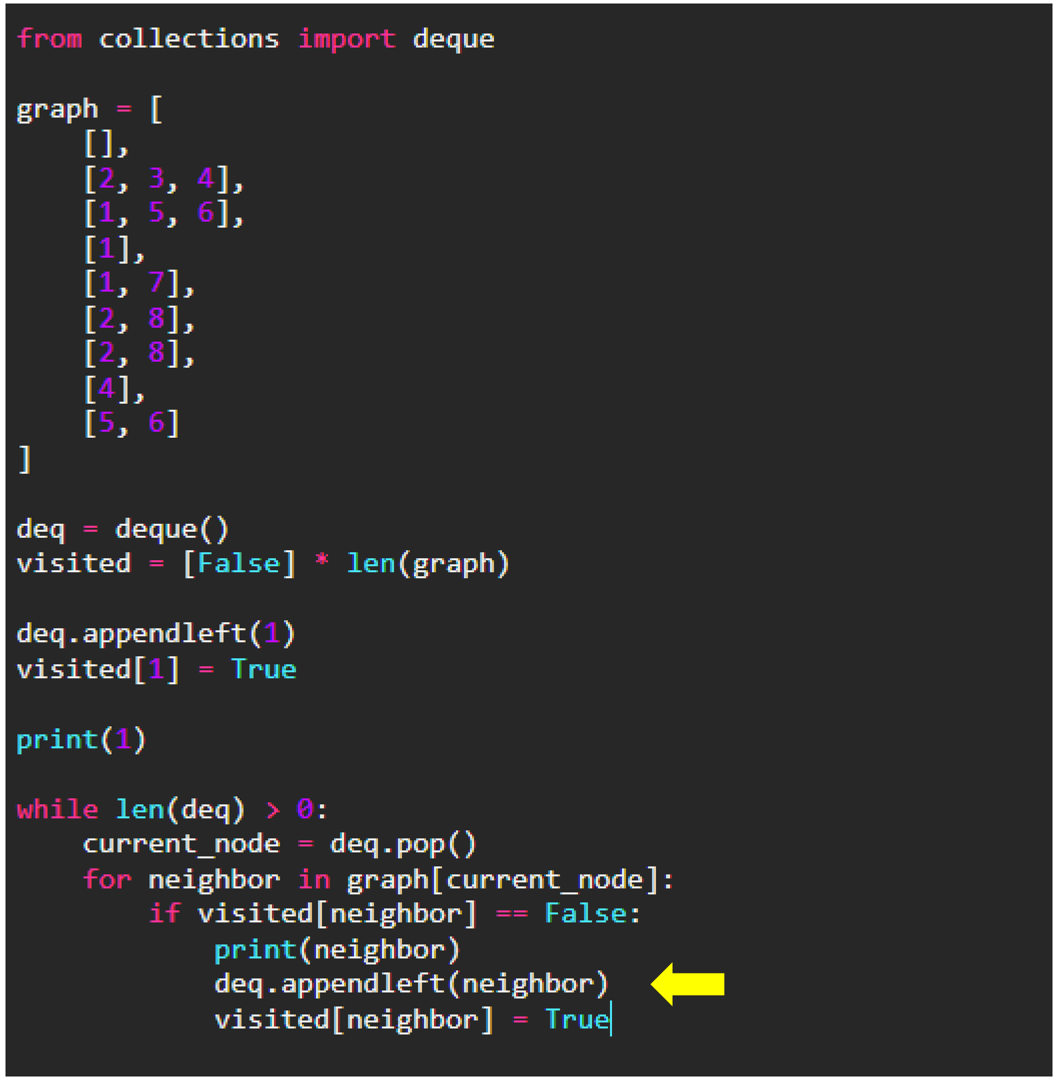


6 5



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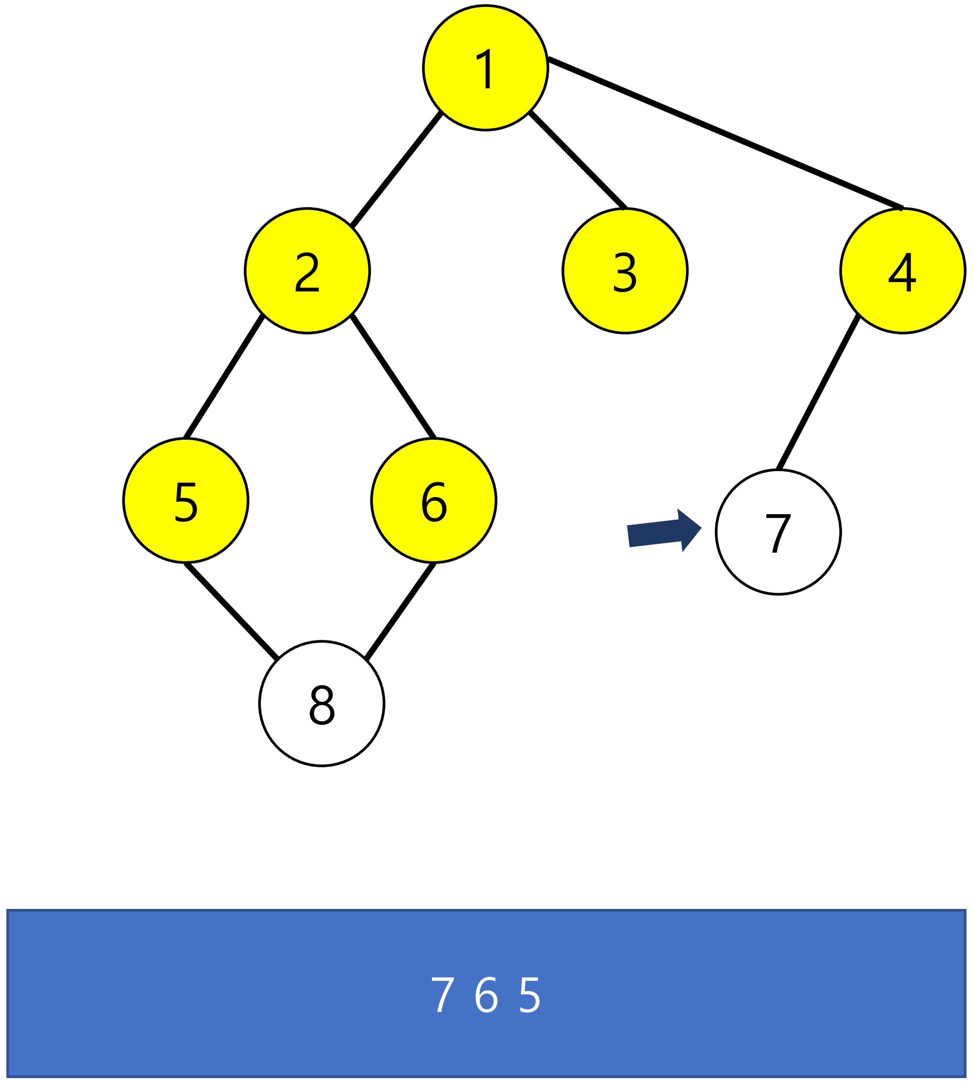

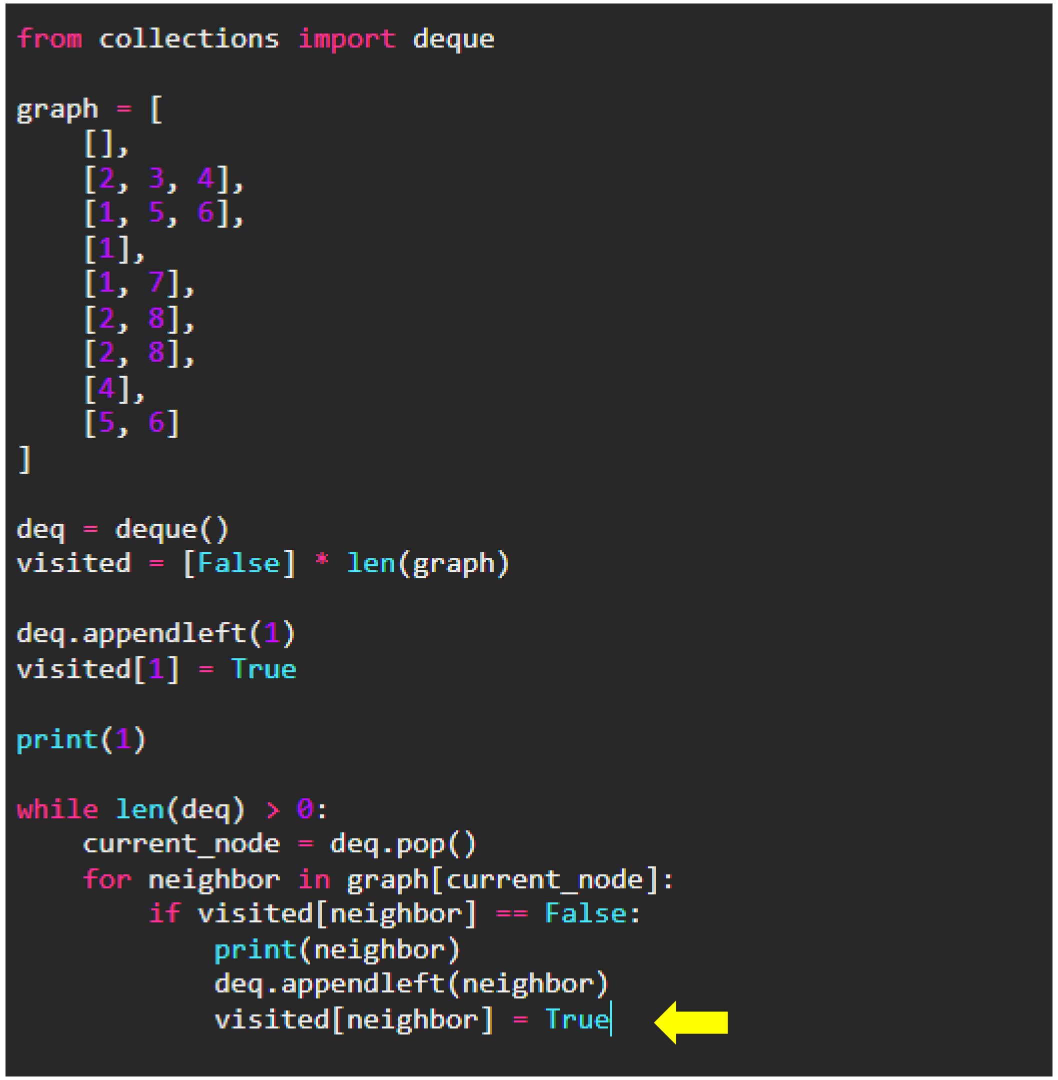

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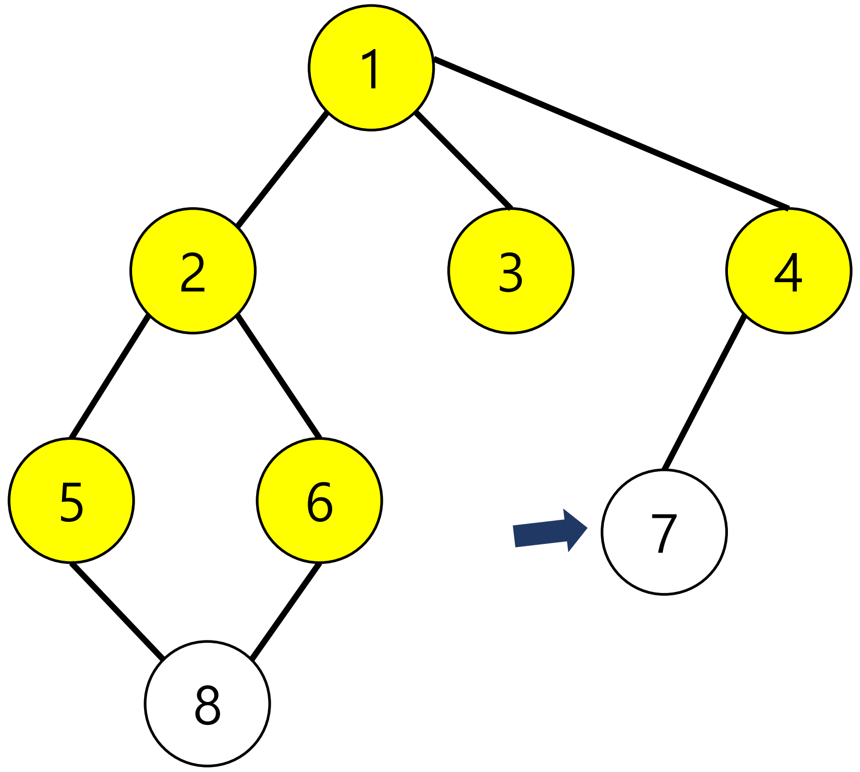

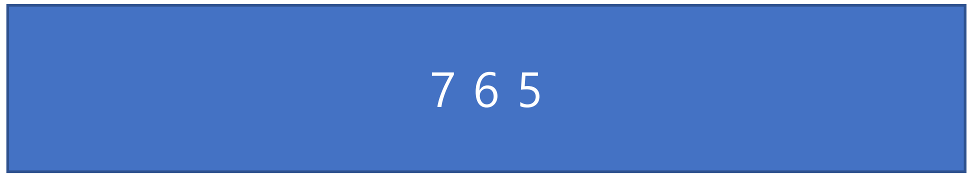

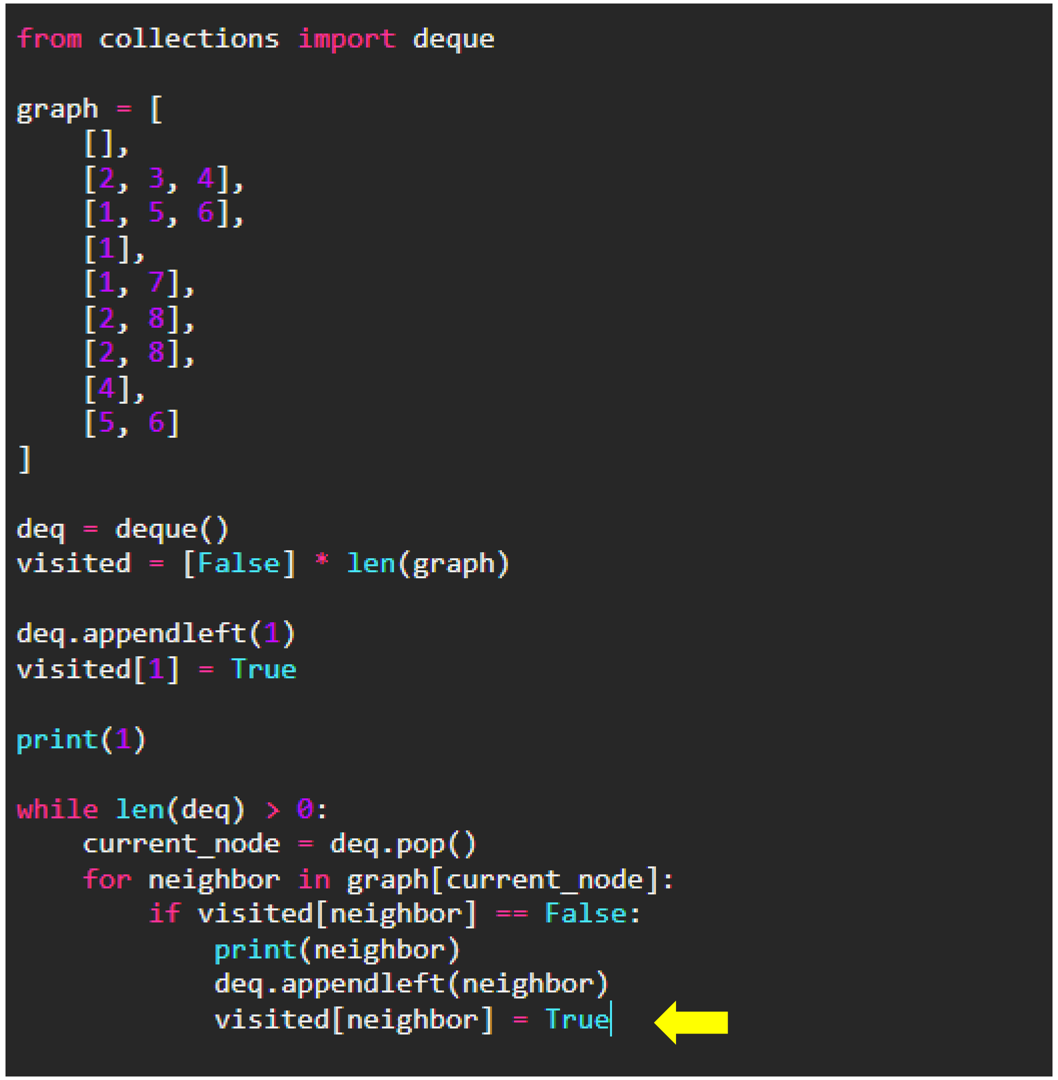

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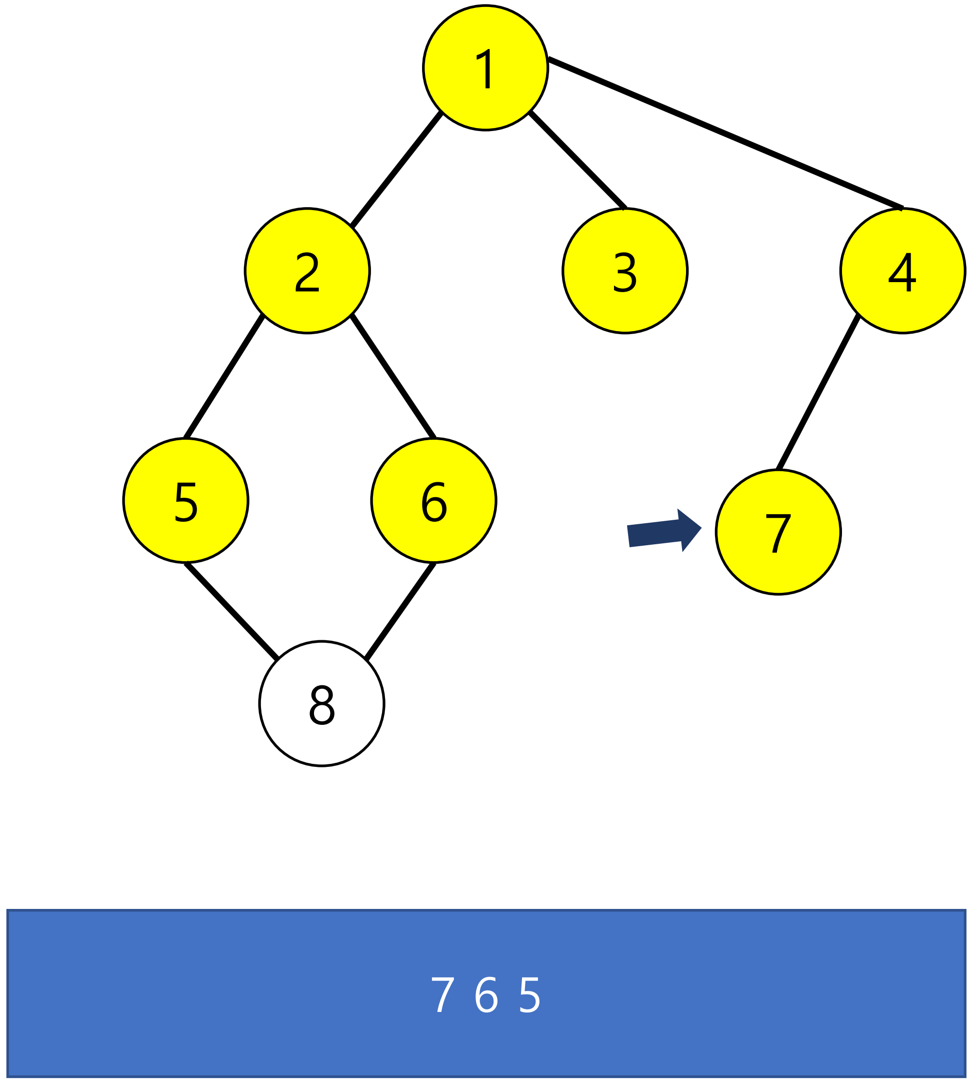

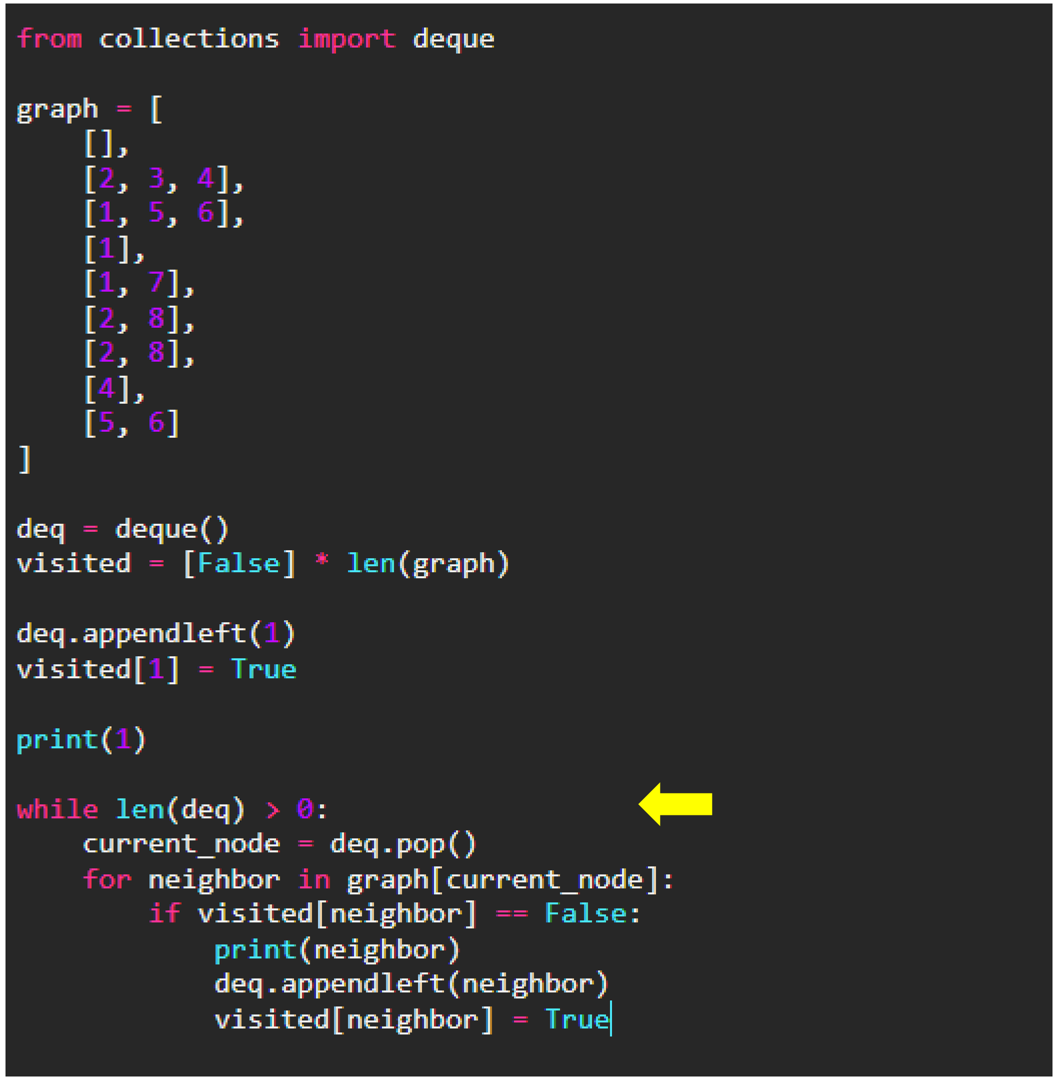

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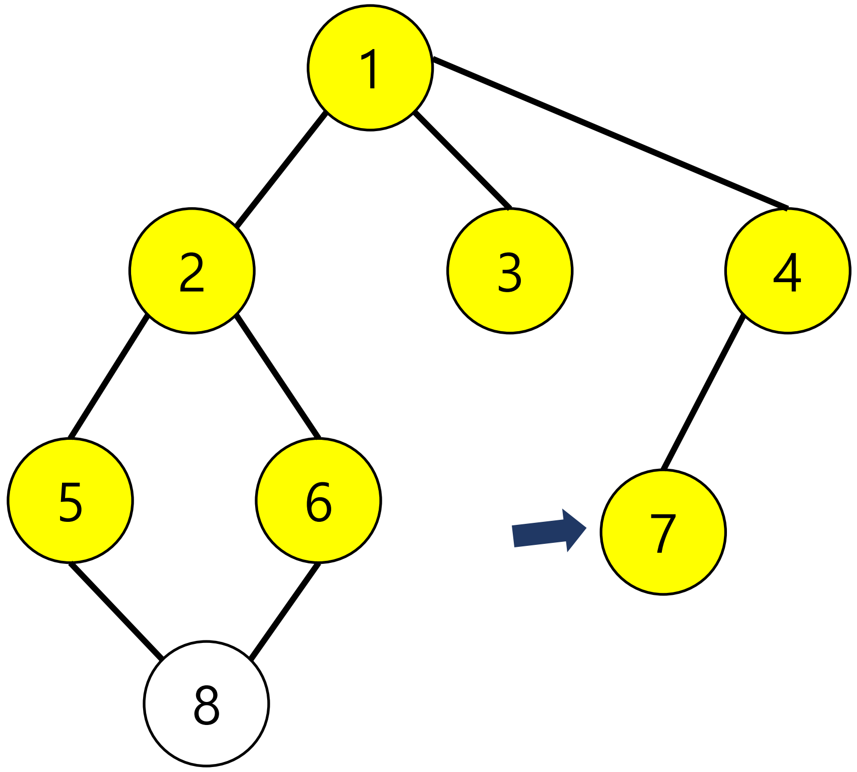

7 6 5

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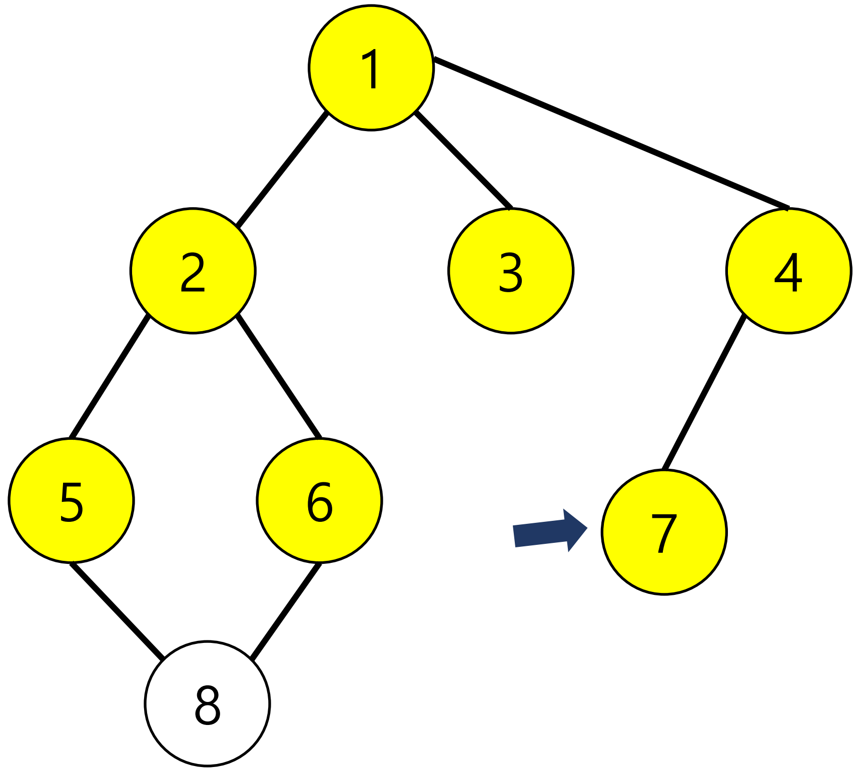

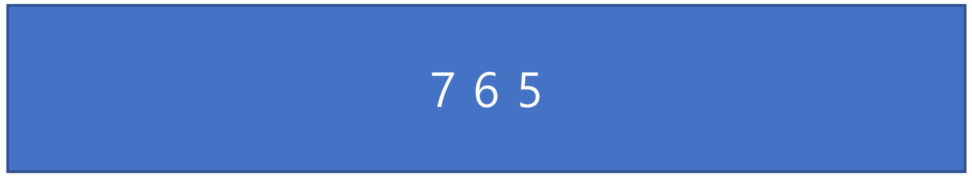

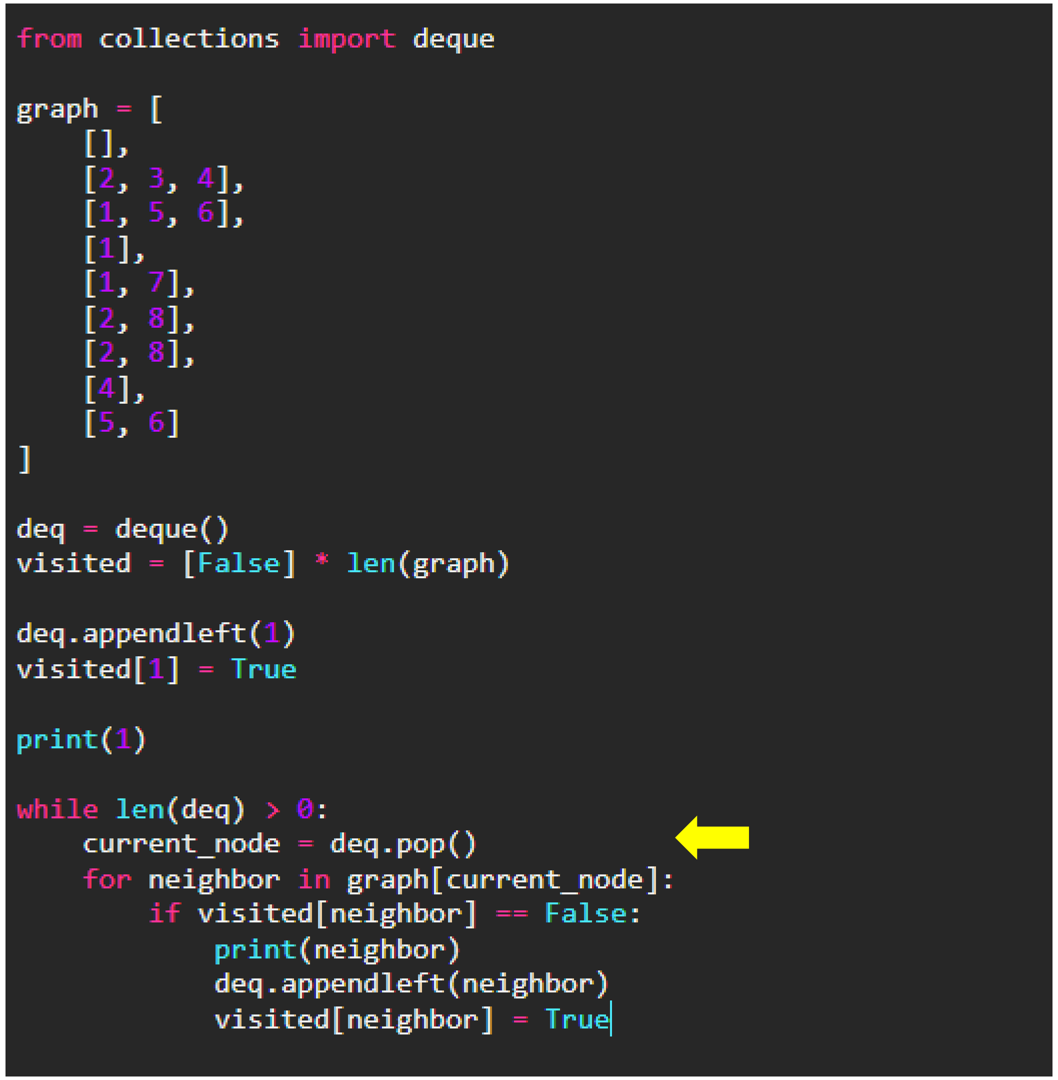

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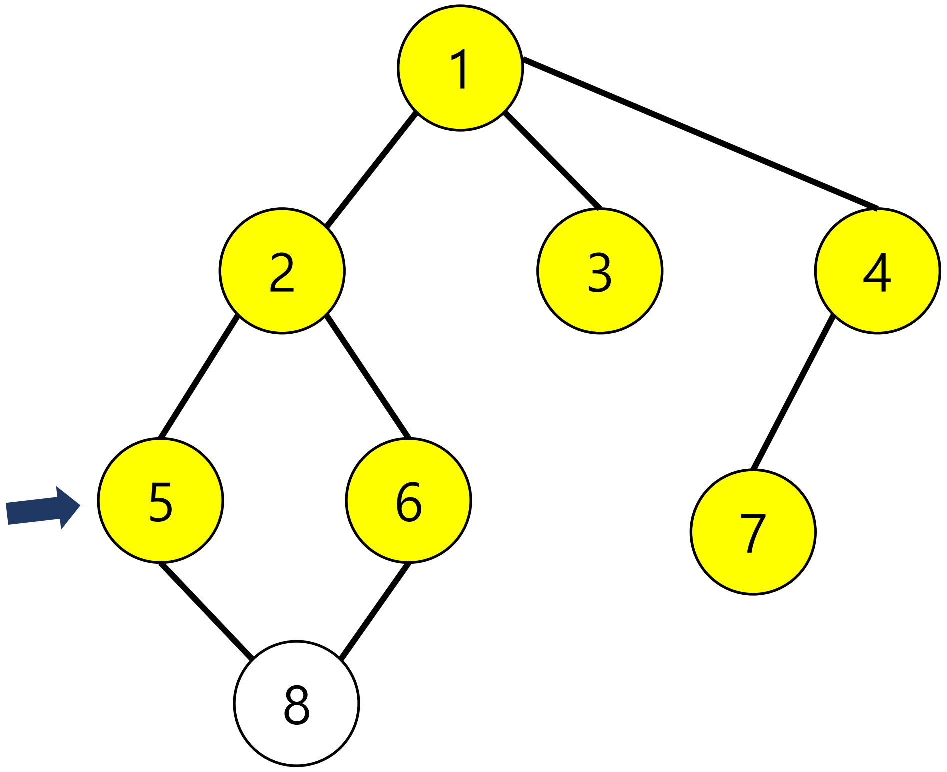

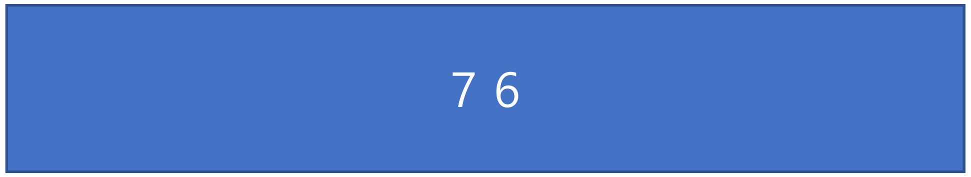

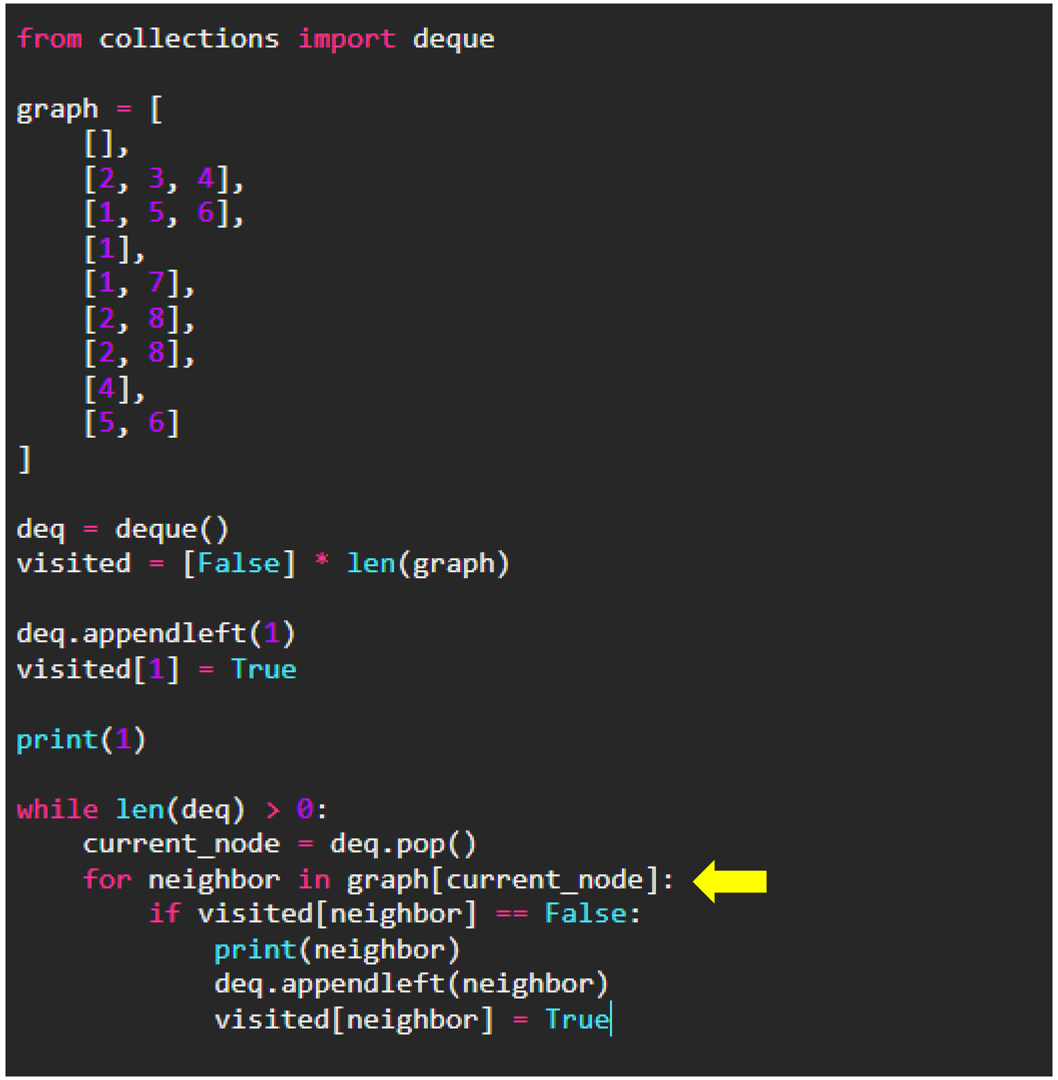

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visited[1] = True

print(1)

while len(deq) > 0:
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    for neighbor in graph[current_node]:
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            print(neighbor)
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            visited[neighbor] = True
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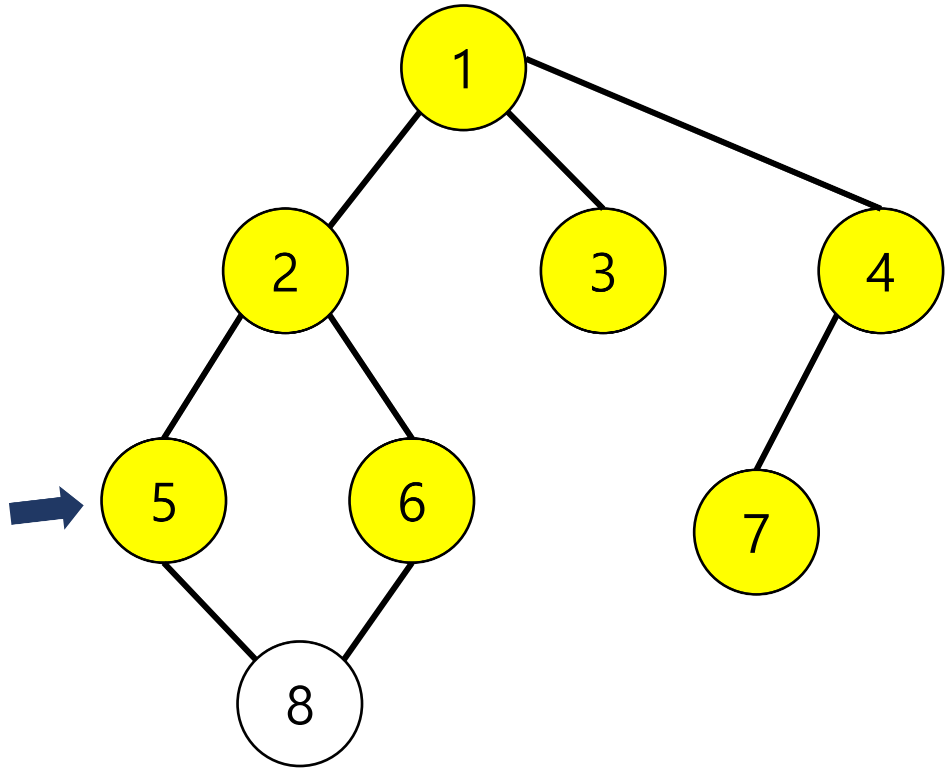

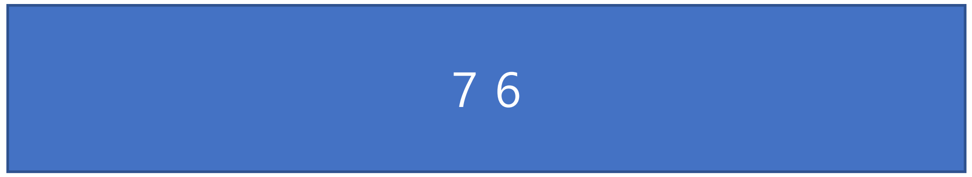

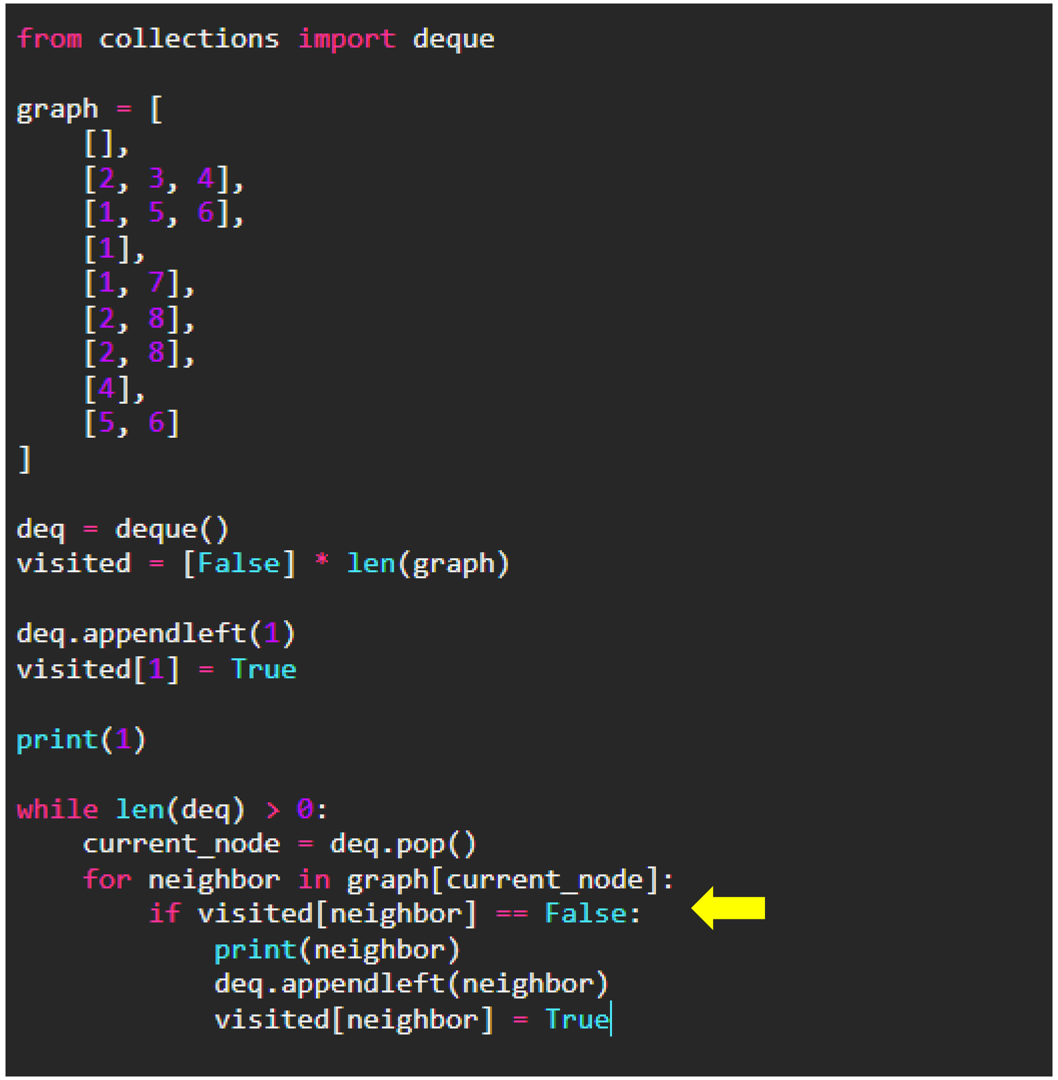

```python
from collections import deque

graph = [
    [],
    [2, 3, 4],
    [1, 5, 6],
    [1],
    [1, 7],
    [2, 8],
    [2, 8],
    [4],
    [5, 6]
]

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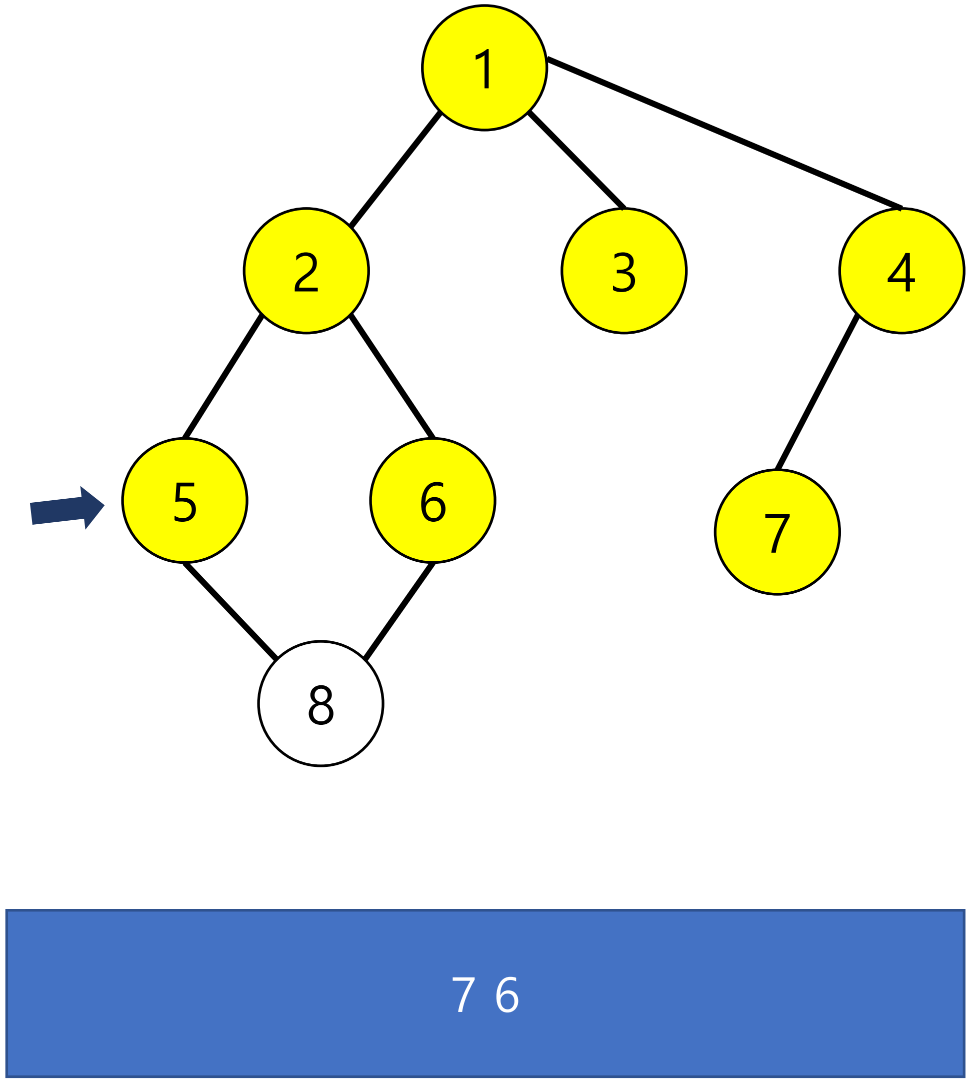

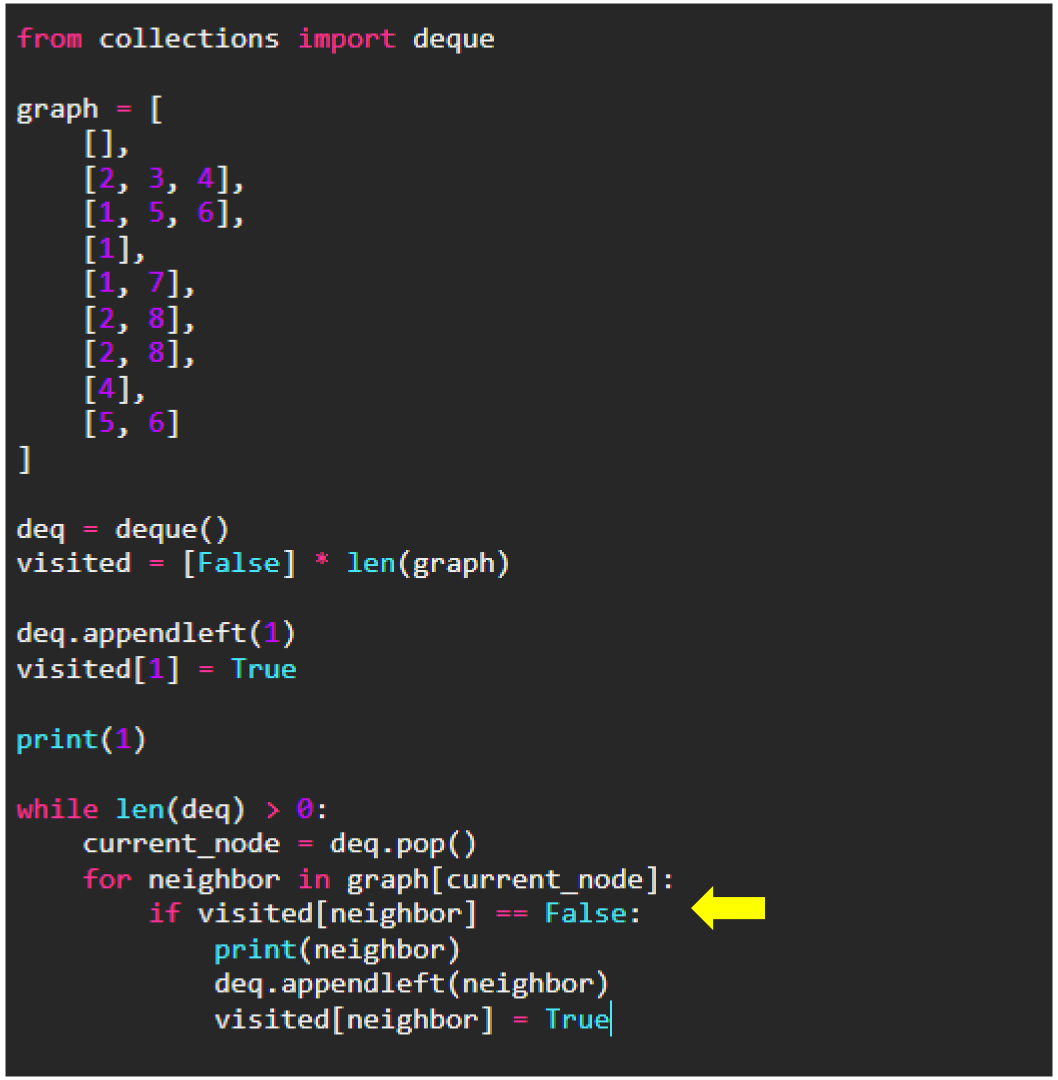

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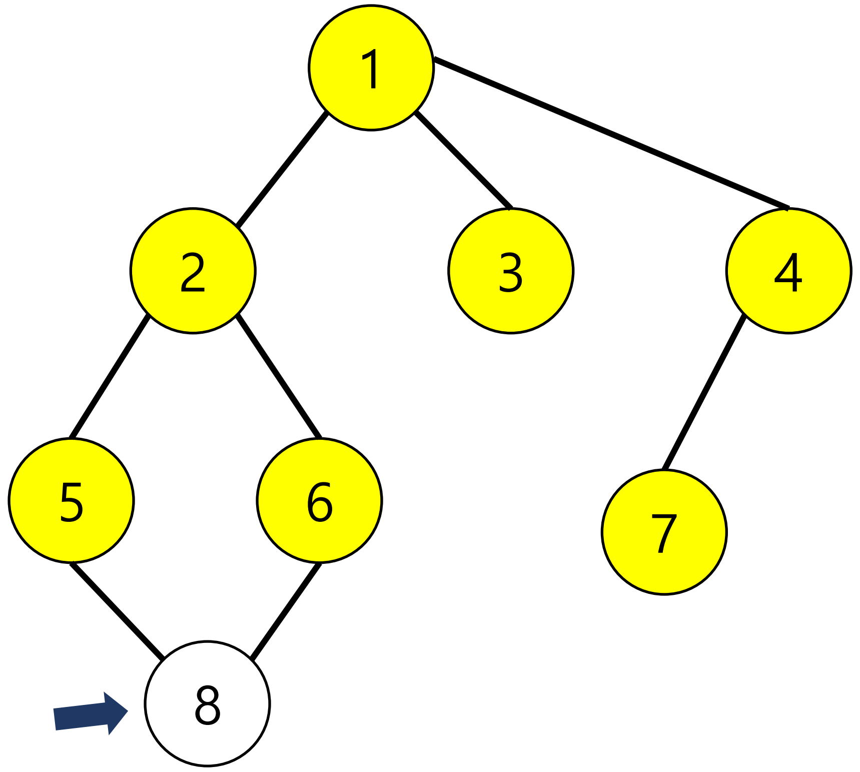
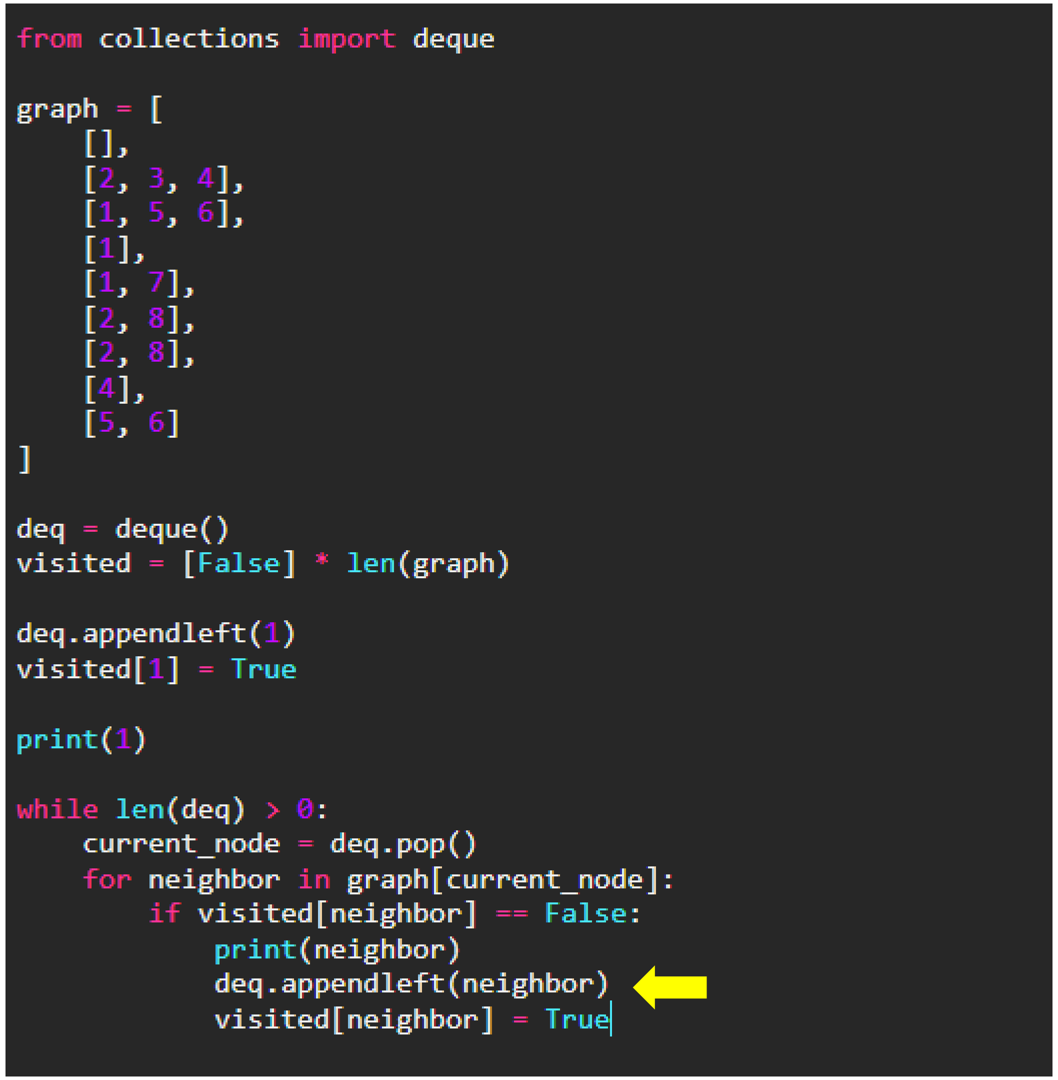


7 6



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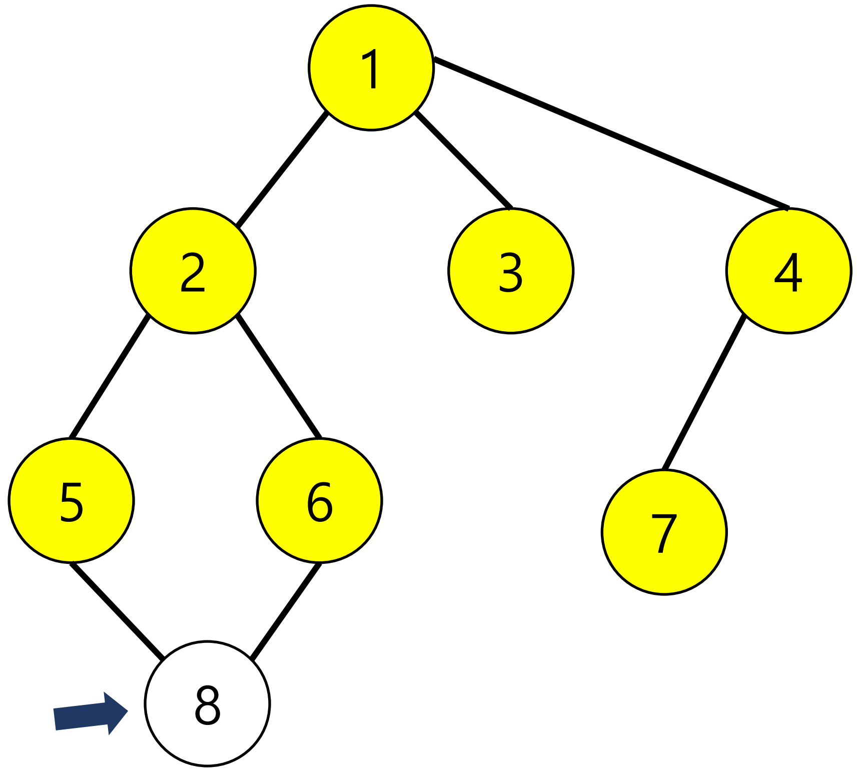

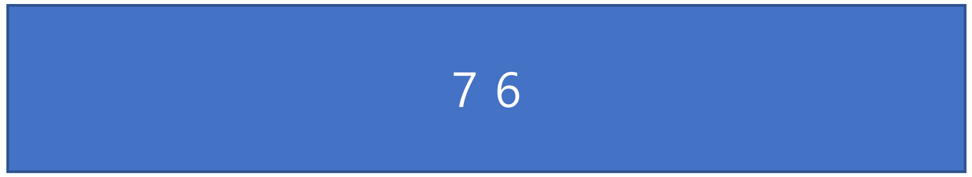

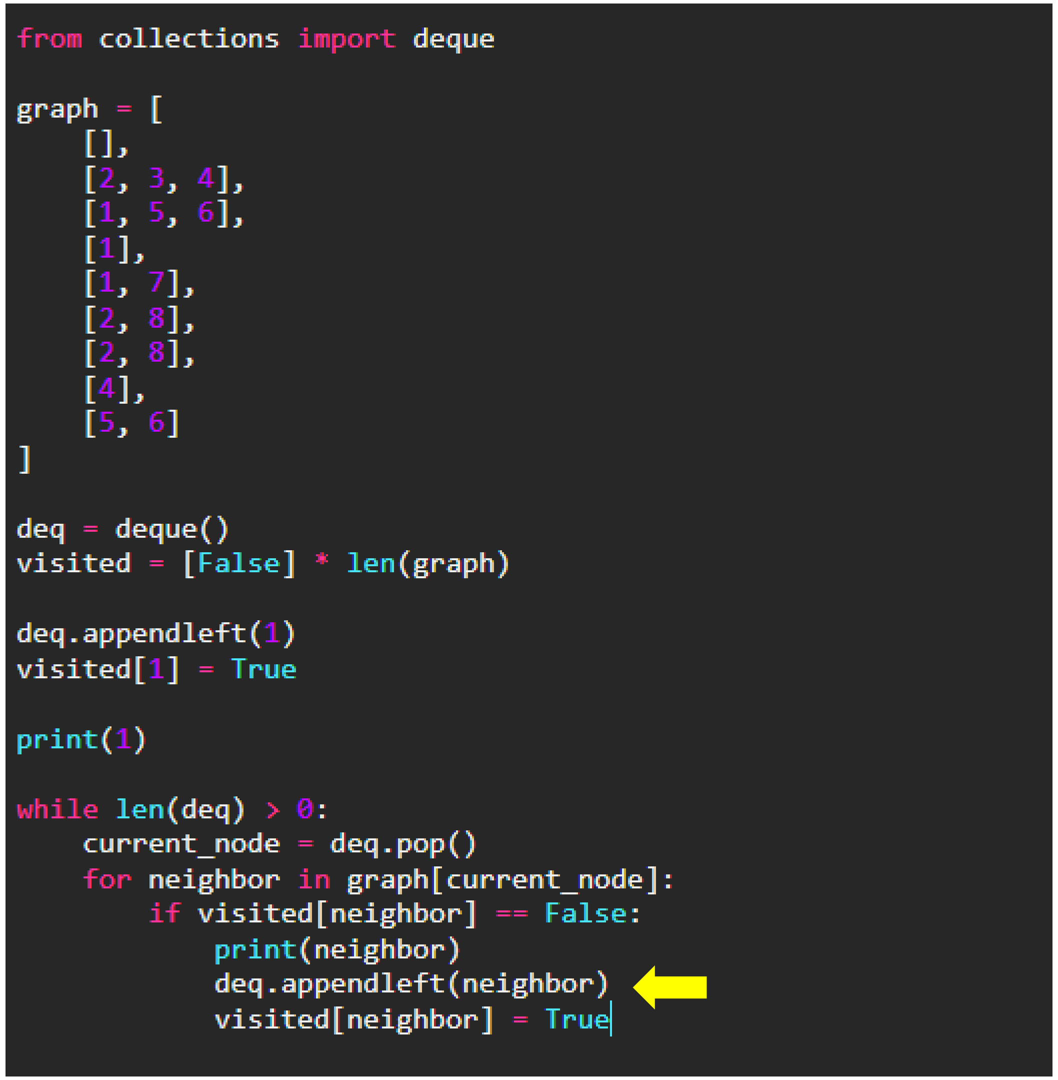

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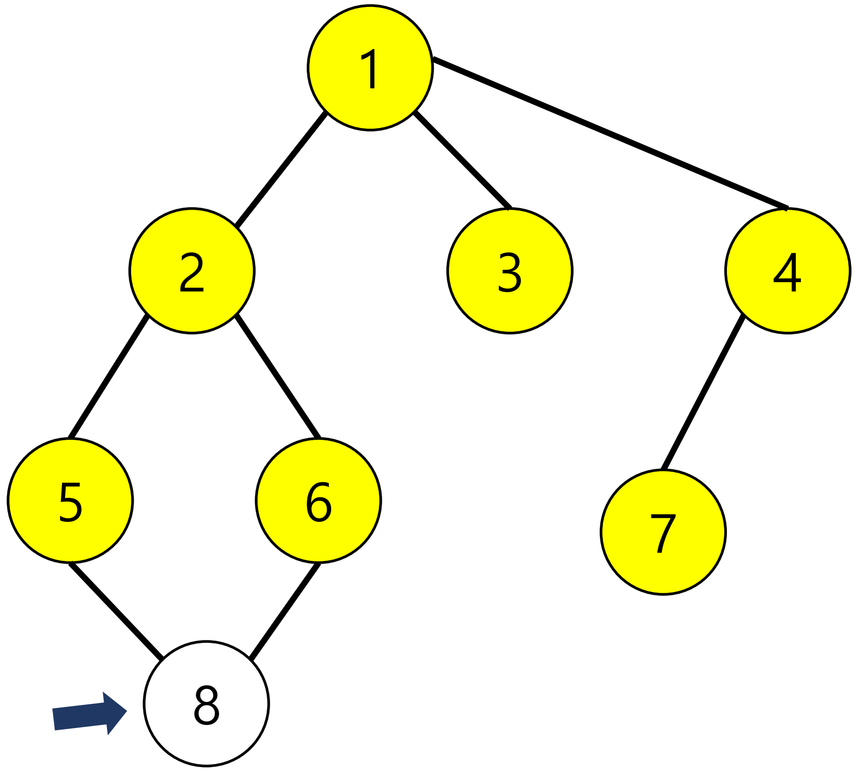

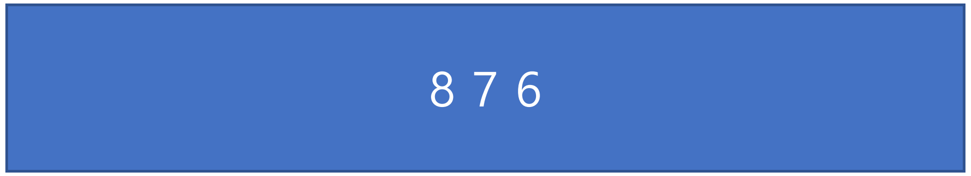

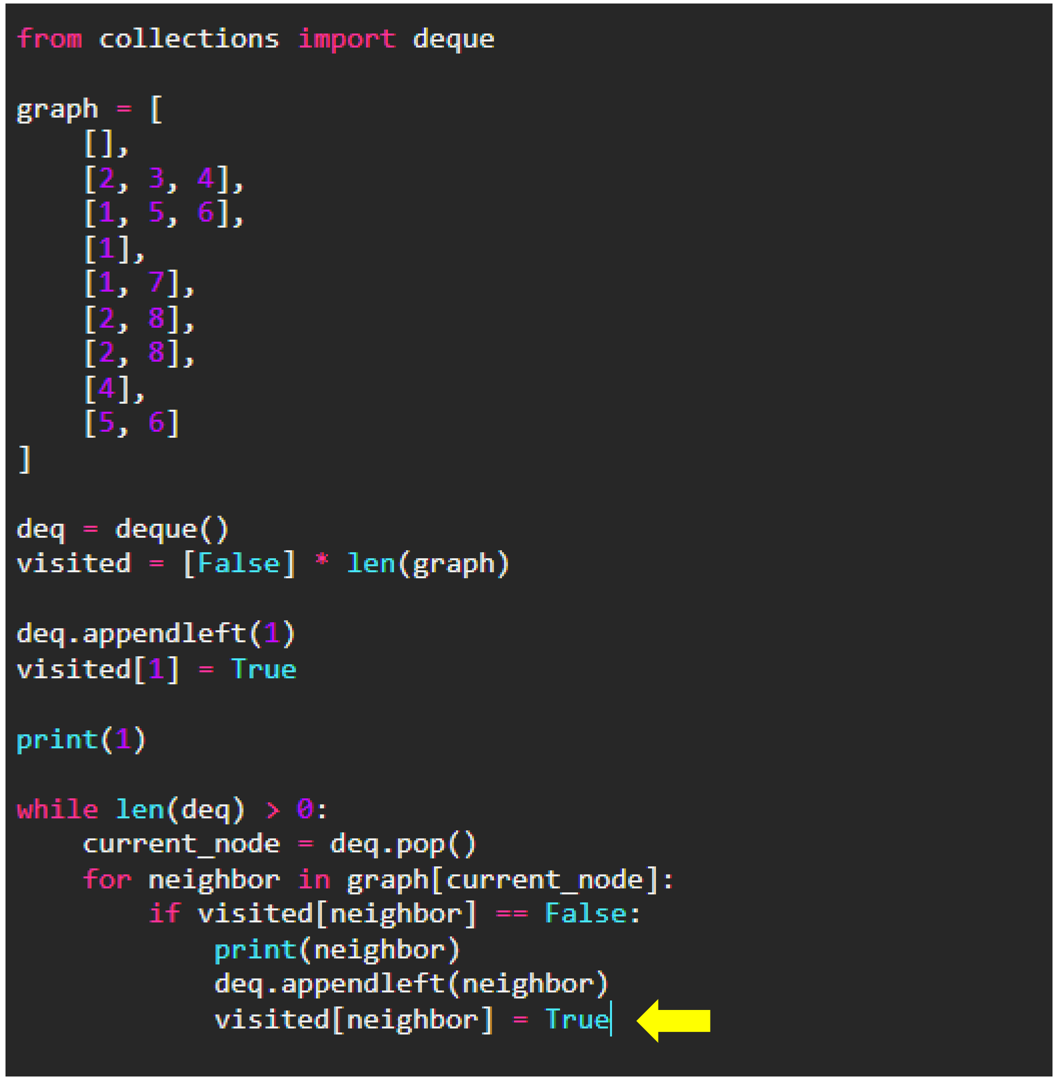
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    [],
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    [2, 8],
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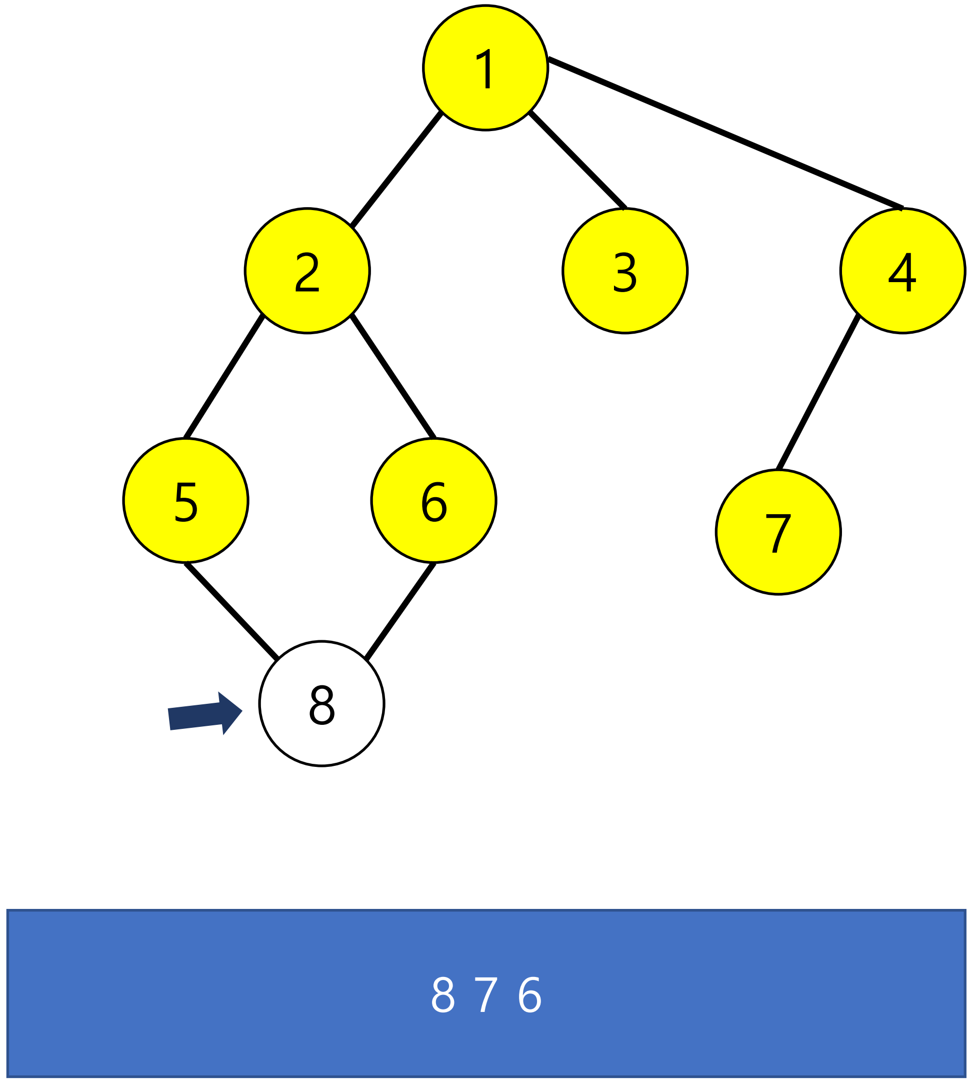

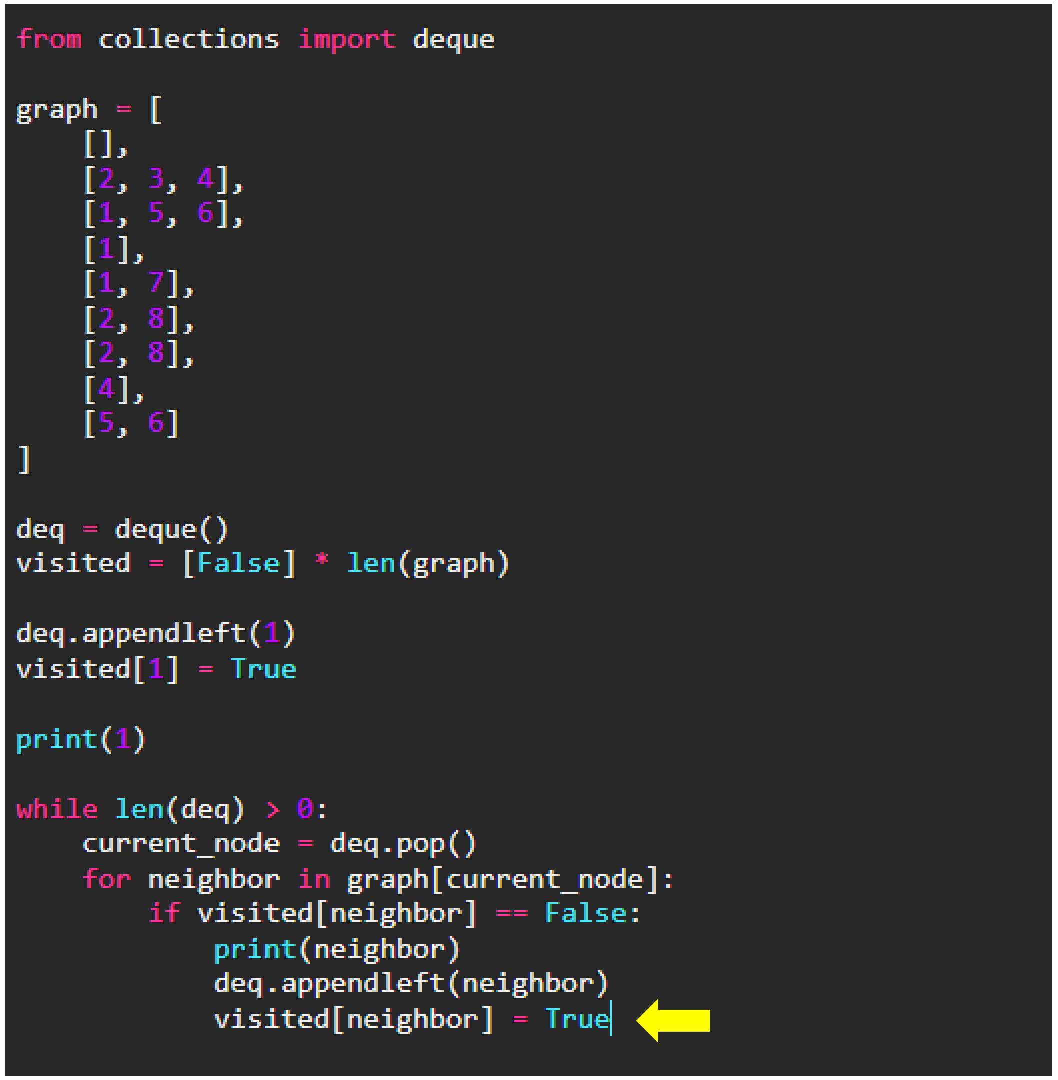

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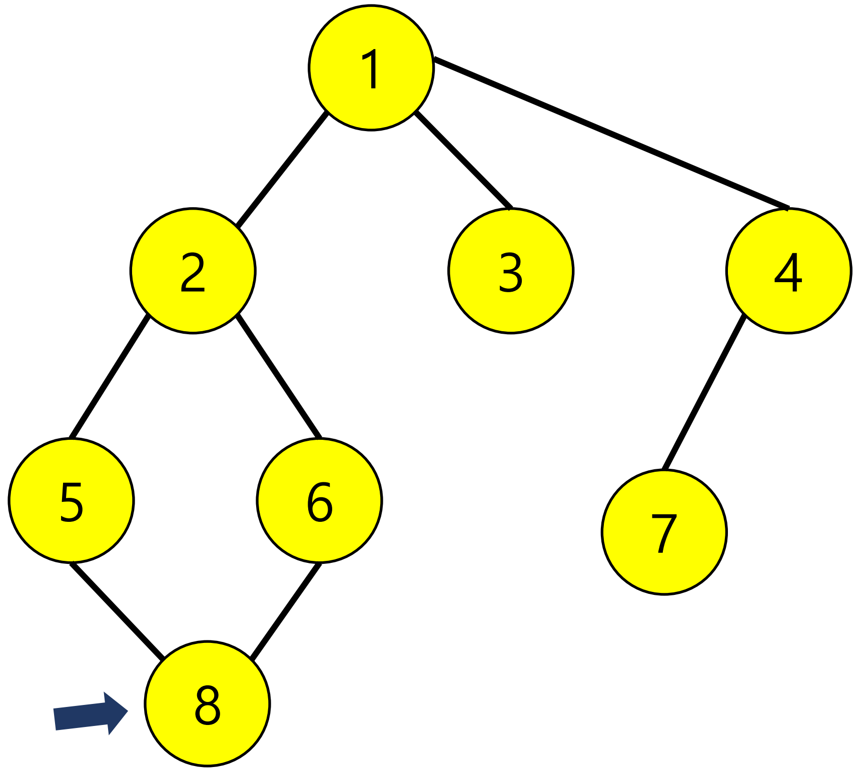

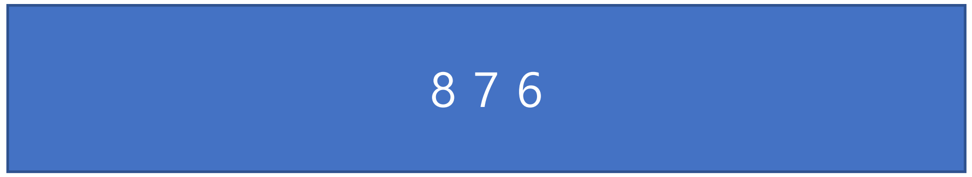

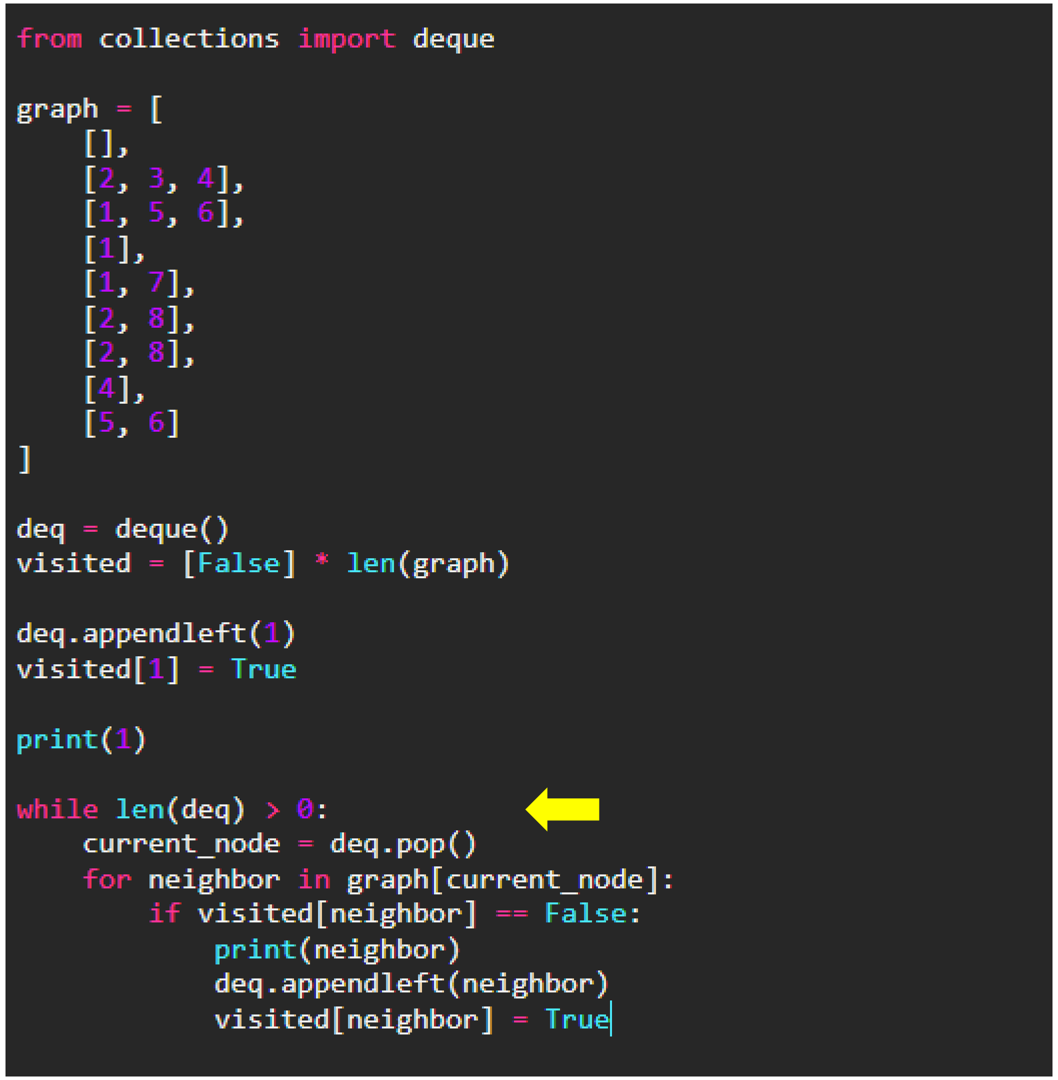

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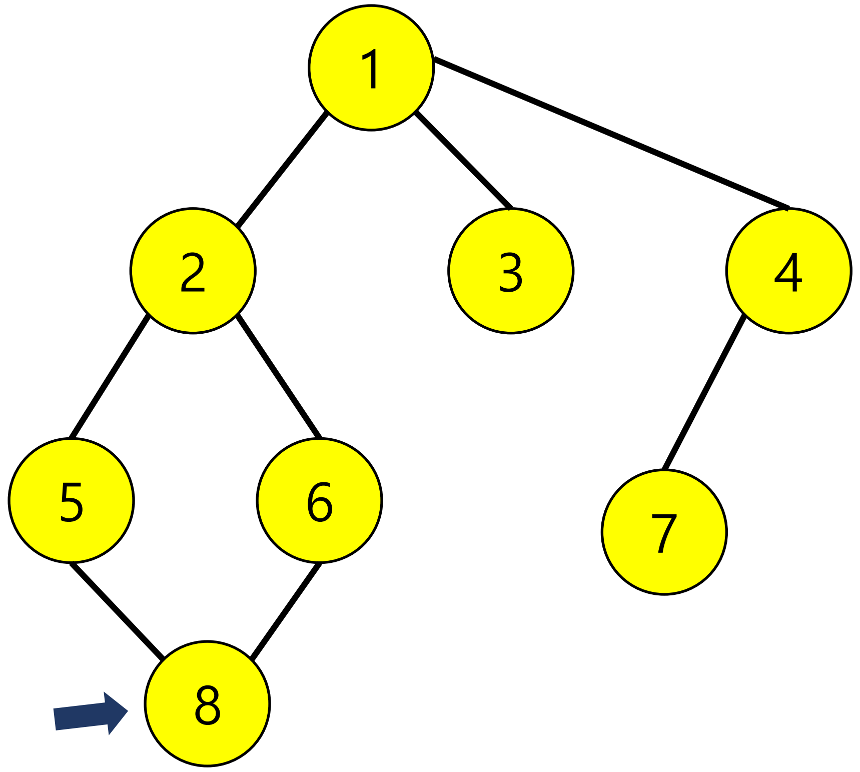

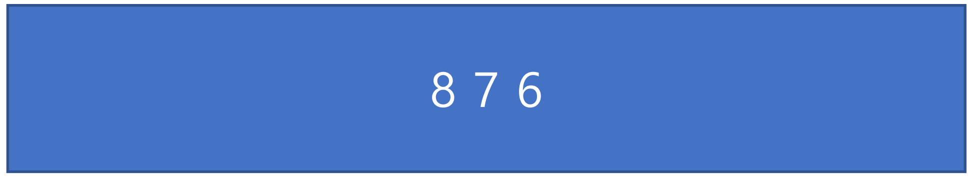

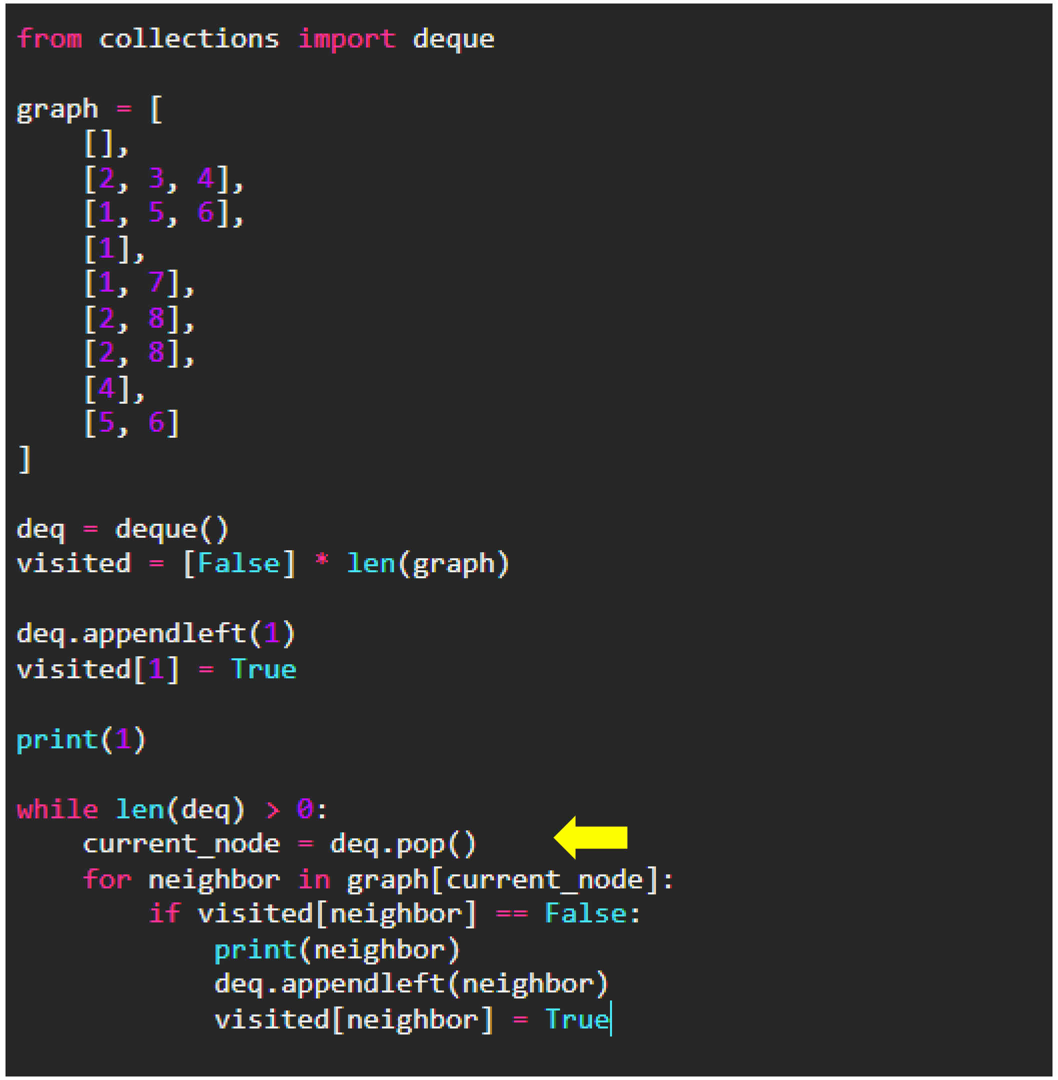

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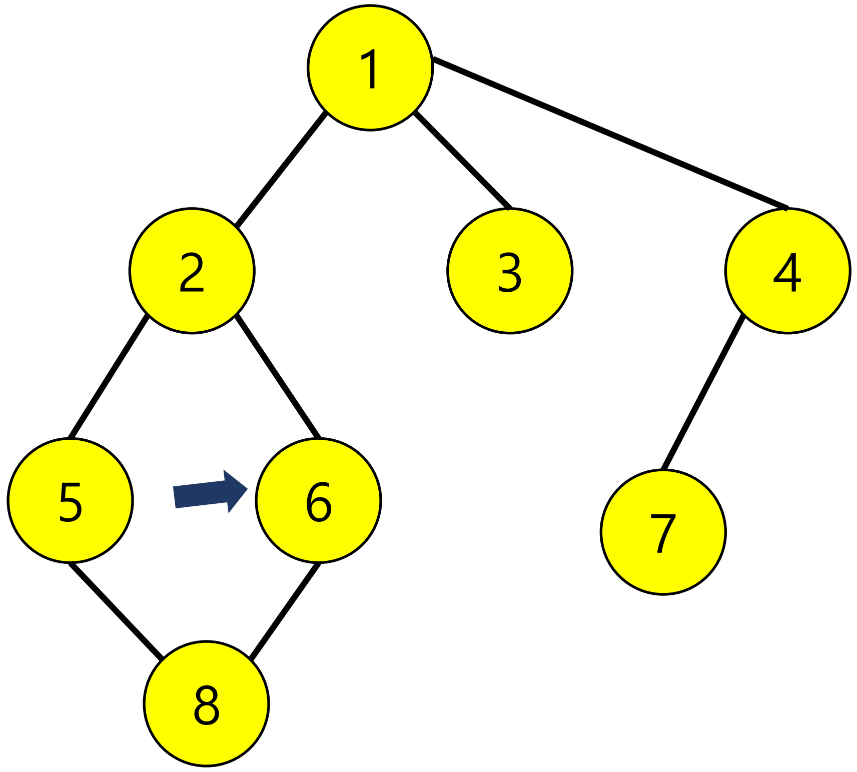

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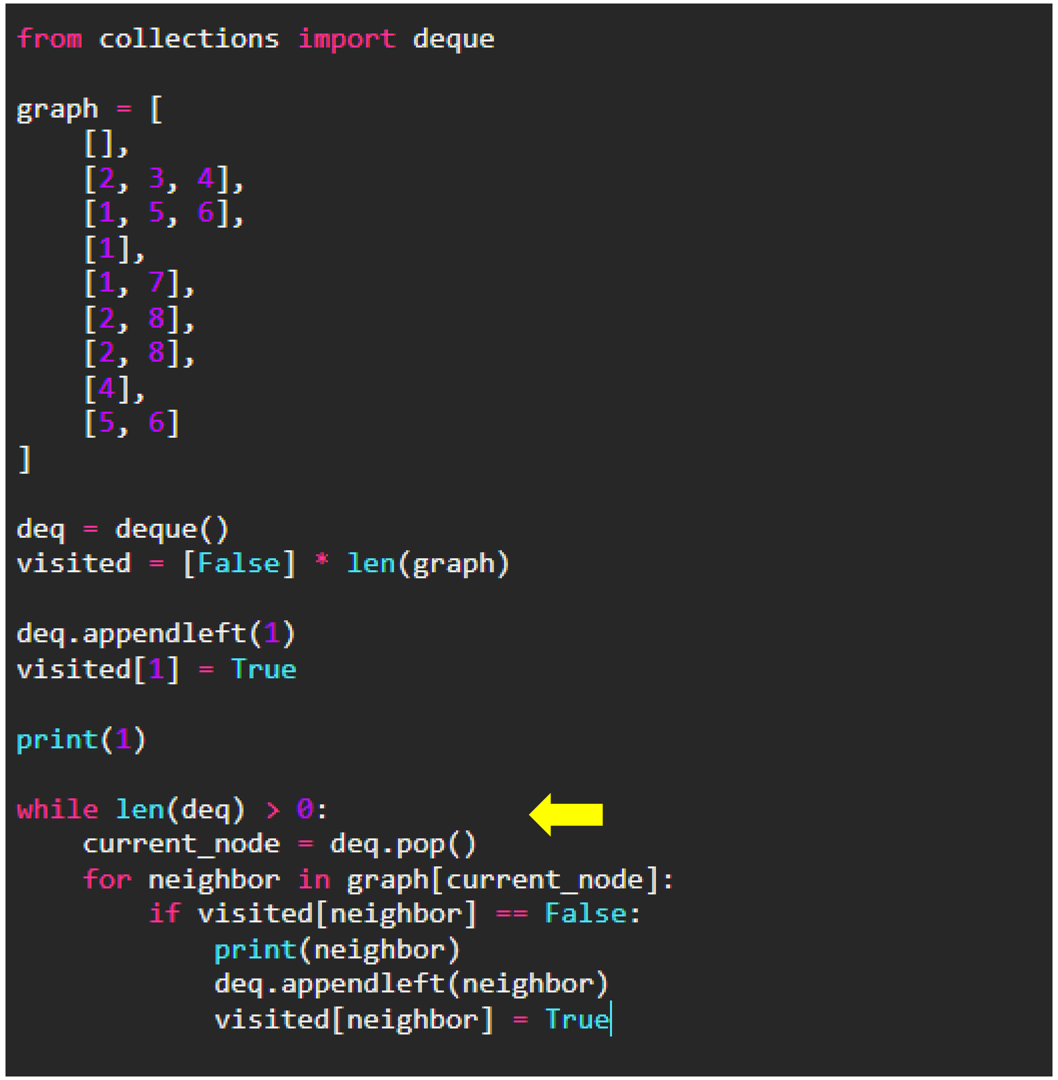

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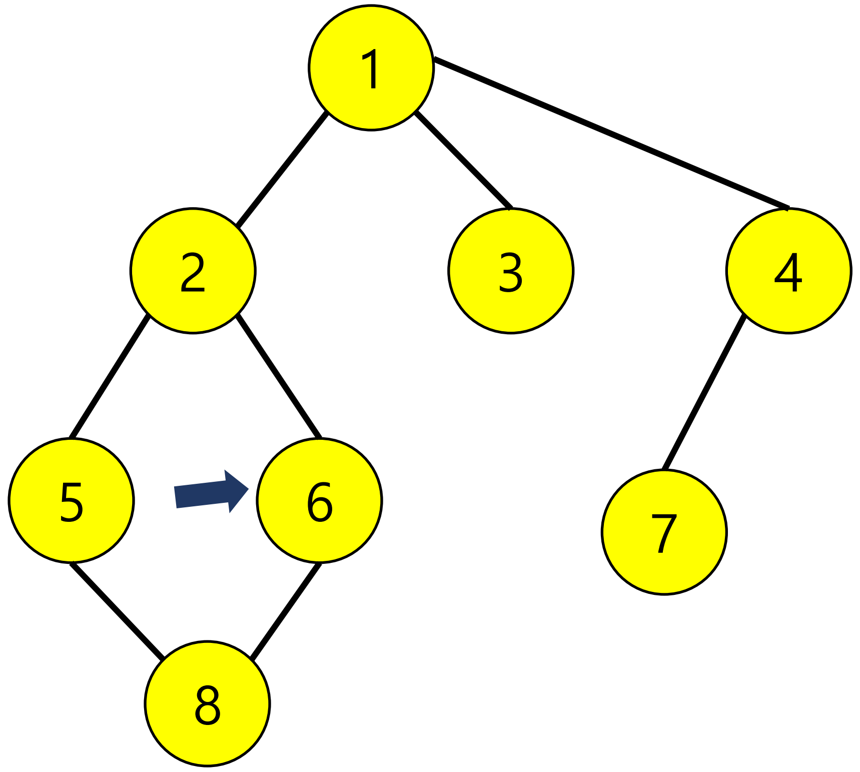

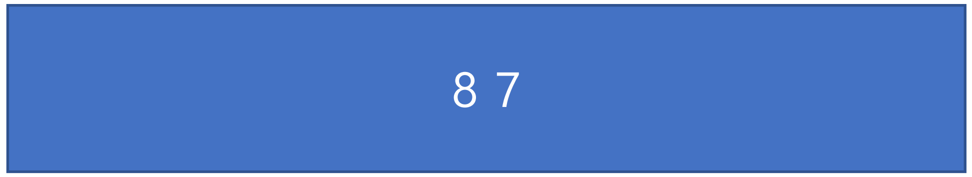

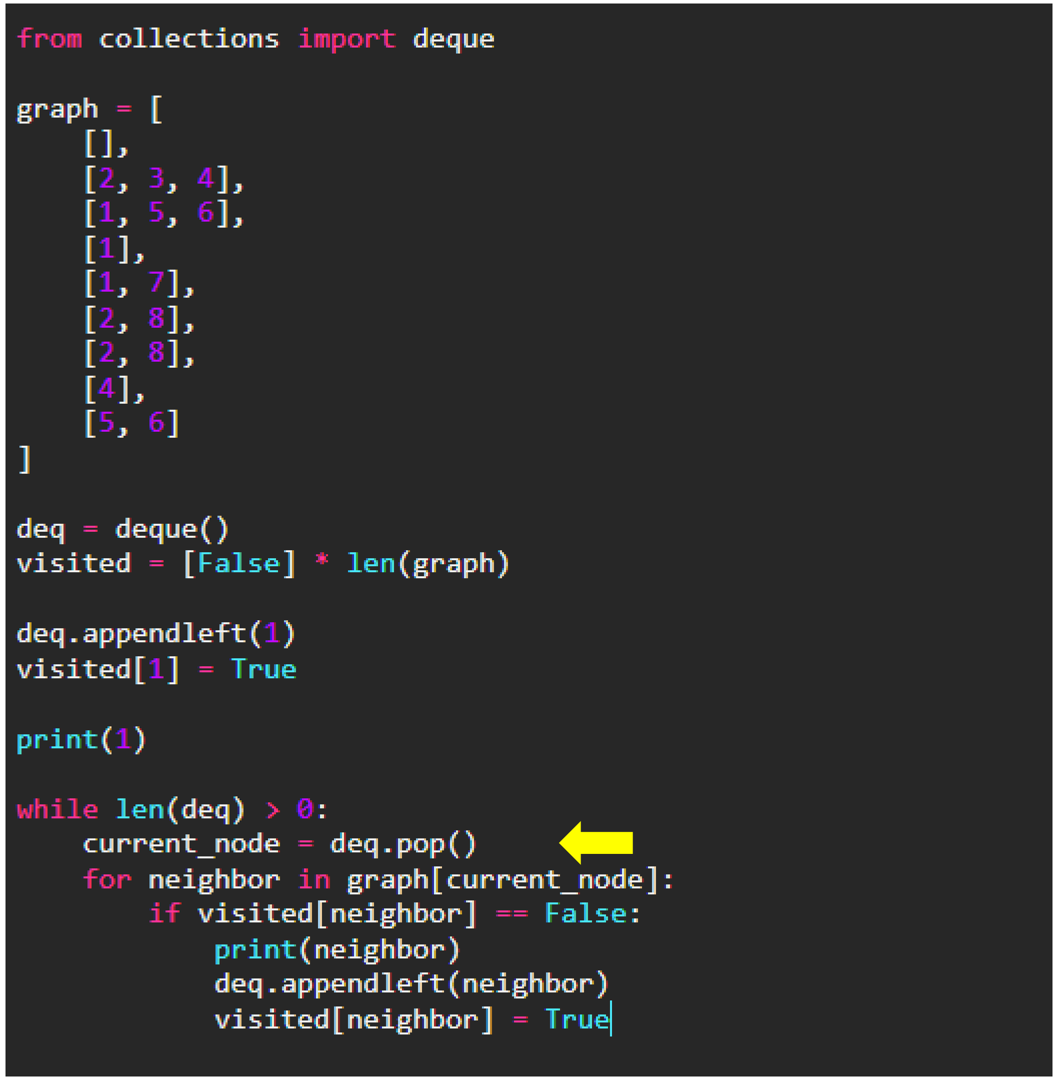

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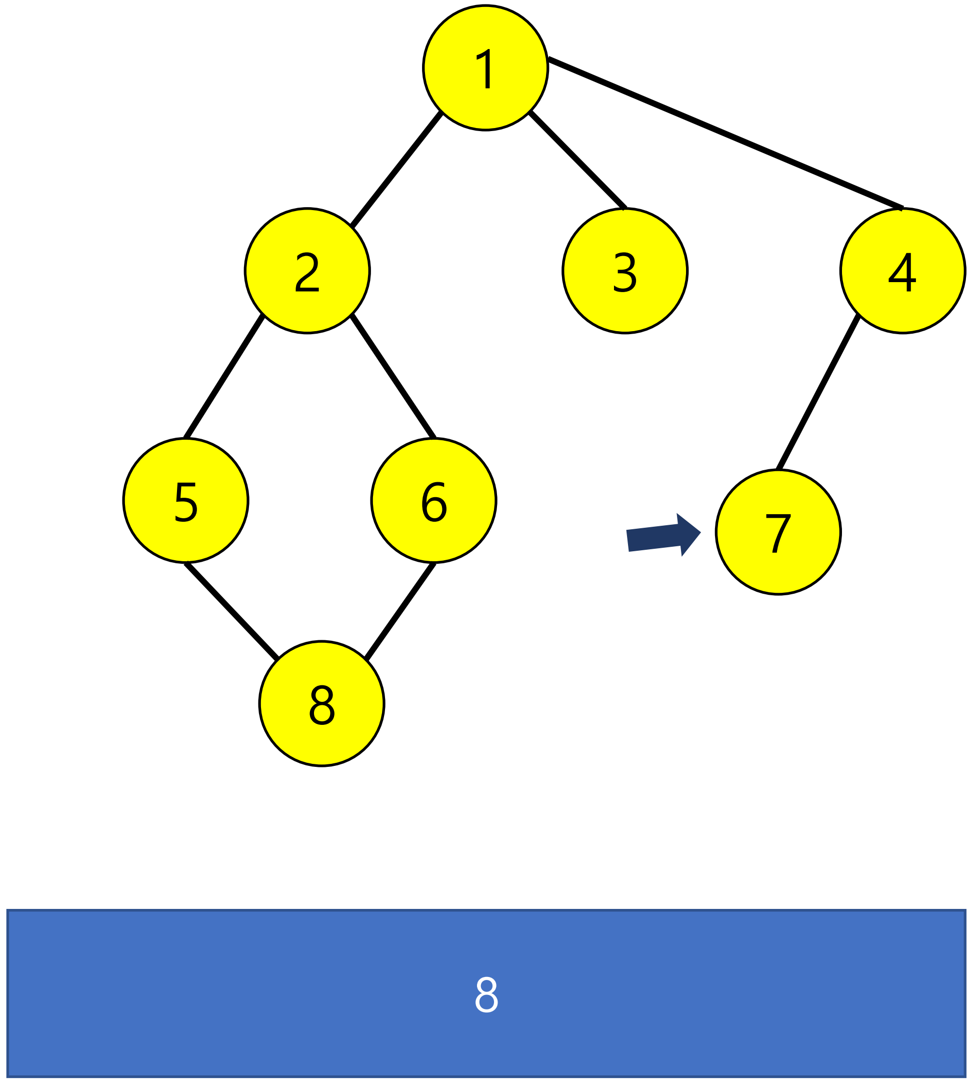

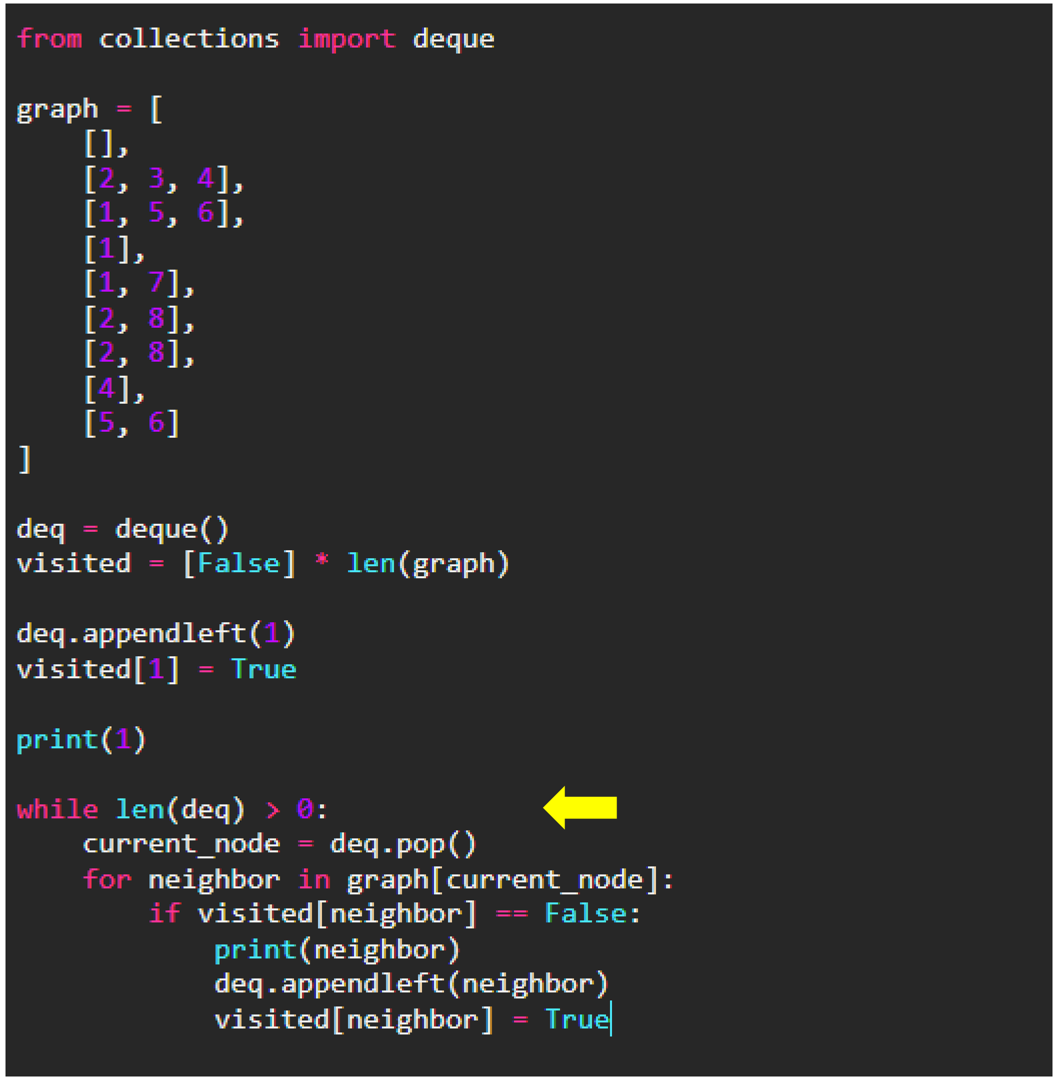

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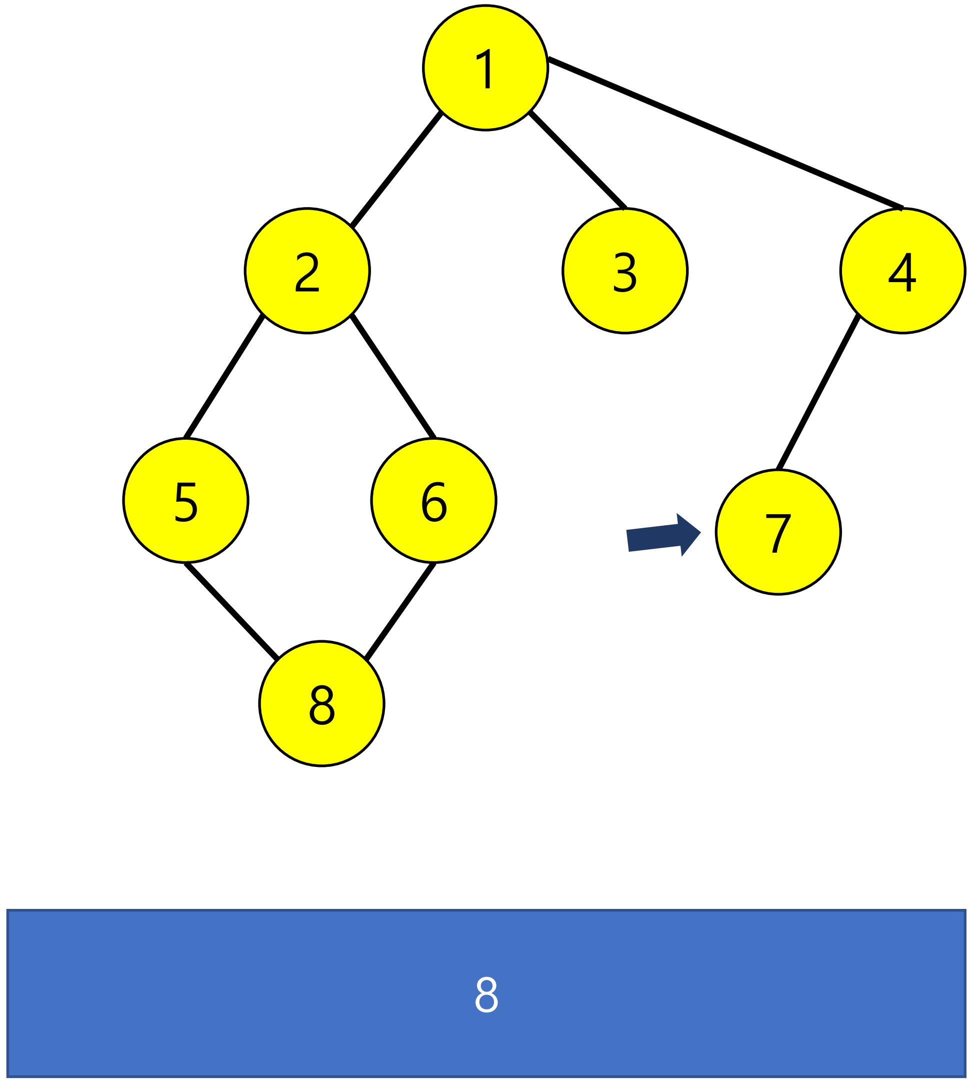

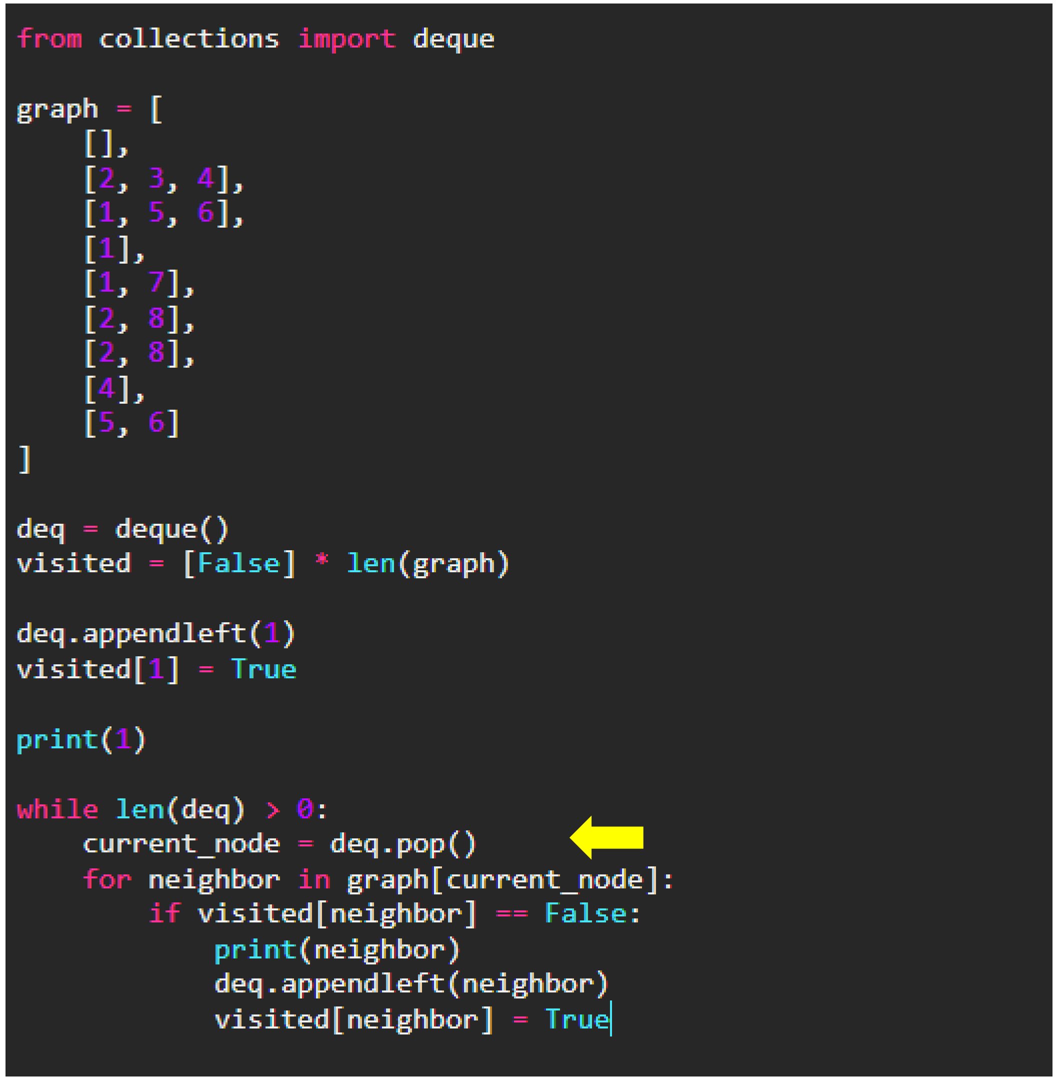

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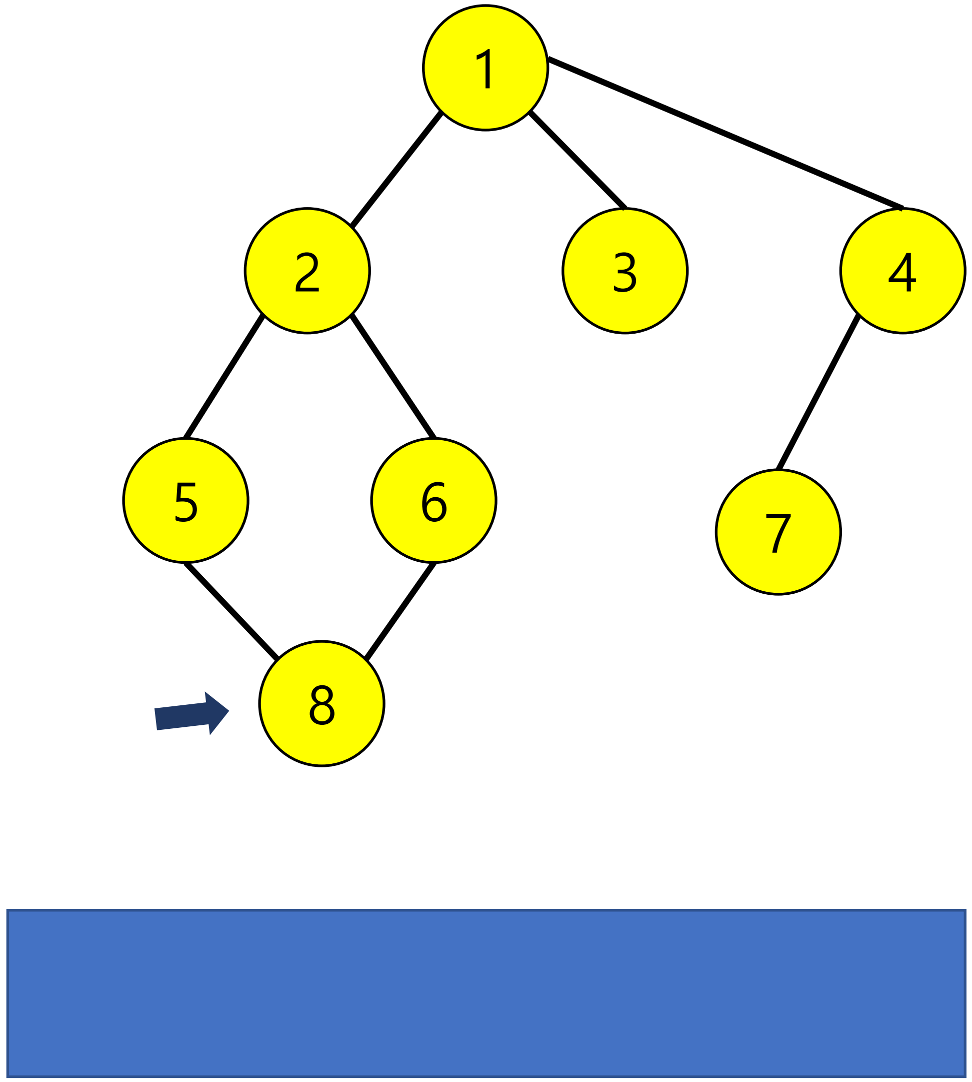

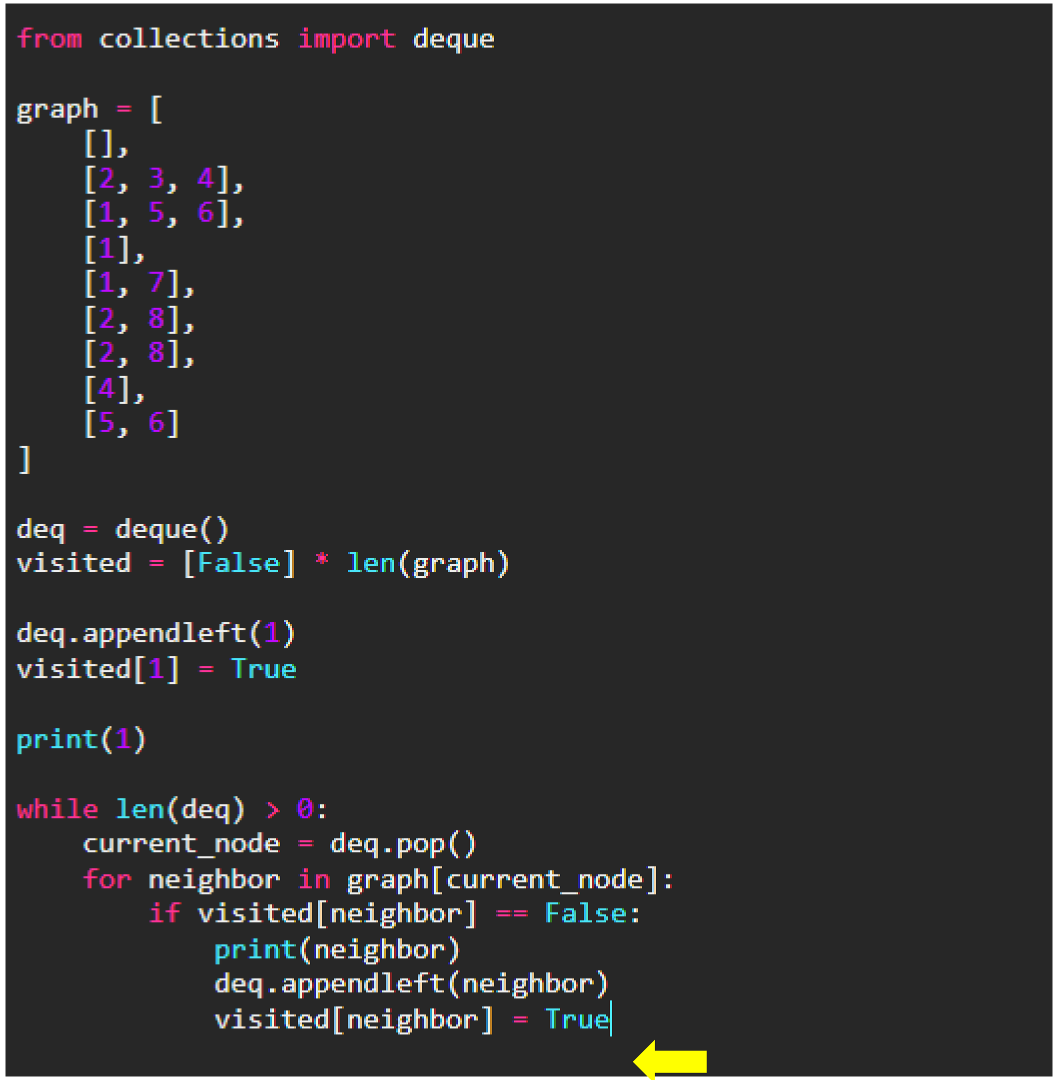

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