Implementation of DFS:

(Main):
1. Set \( \text{explored}[v] = 0 \) for all \( v \neq s \).
2. Call \( \text{DFS}(s) \):

\[
\text{DFS}(u): \quad \text{explored}[u] = 1; \quad \text{print}(u);
\]

for each \( (u, v) \in E \):

\[
\text{if} \quad \text{explored}[v] = 0 \quad \text{DFS}(v) \quad \text{Add} \ (u,v) \text{ to DFS tree}
\]

end if
end for

Example:

![Graph Diagram]

Output = 1, 2, 3, 4

(see page 93 for a stack-based non-recursive implementation of DFS)

(Statement (3.13) on page 94 shows that the runtime of DFS is \( O(m+n) \) if the graph is given by adj lists, \( O(n^2) \) if the graph is given by an adj matrix.

Applications of BFS/DFS:

(Solved exercise 2 on page 95 of textbook).
Input: an undirected graph $G=(V,E)$
   $a, b, c, d \in V$
   an integer $r \geq 0$.

Story: Two robots $X$ and $Y$. The robots can only move one at a time.
   $X$ wants to go from $a$ to $c$.
   $Y$ wants to go from $b$ to $d$.
   If distance $(x, y) \leq r$, the robots interfere.

Output: Either
   "No solution!"
   A valid schedule.

Examples.

How do we solve this problem using BFS/DFS?

Solution: 

1. Build a graph $H$ where each node $(x, y)$ corresponds to:
   - robot $X$ is at $x$
   - robot $Y$ is at $y$
   - distance $(x, y) > 0$.

2. Add an edge in $H$ between
   - $(x, y)$ and $(x, y')$ if $(y, y')$ exists in $G$
   - $(x, y)$ and $(x', y)$ if $(x, x')$ exists in $G$.

3. Run BFS/DFS and check if $(a, b)$ can reach $(c, d)$ in $H$.

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 3 4 5 6</td>
</tr>
</tbody>
</table>

$X = 1, ~ C = 3, ~ b = 4, ~ d = 6$.

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$X = 1, ~ C = 3, ~ b = 4, ~ d = 6$.

$X$ can reach $(c, y)$ in $H$.

$Y$ can reach $(x, y)$ in $H$.

$X$ and $Y$ can reach $(c, d)$ in $H$.

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Solution: 

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3. Run BFS/DFS and check if $(a, b)$ can reach $(c, d)$ in $H$.

$X$ can reach $(c, d)$ in $H$.

$Y$ can reach $(x, y)$ in $H$.

$X$ and $Y$ can reach $(c, d)$ in $H$.