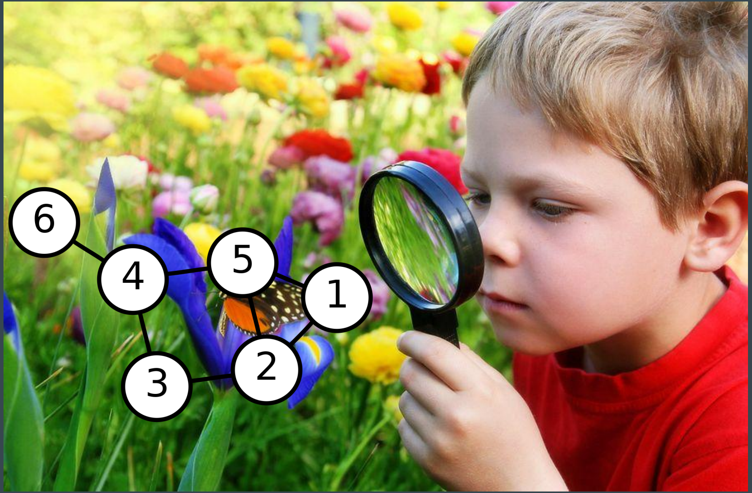
Graph Theory 2

Graph traversal :
BFS and DFS

Graph traversal

What is it ?

-> A method to explore a graph from a given node (every node accessible)



Purpose ?

- Quickly explore the graph (useful for some problems).
- Foundation for more advanced algorithms (we'll see this in the following weeks).

Big notions used

- **Visited/unvisited:**

To explore the graph optimally (a node is explored only once) we need to keep track of which node has been already visited

- **Main data structure:**

The data structure used to keep track on which node will be visited next.

- **Additional data structure:**

May be used to keep track of various informations depending on the context

Two algorithm for the price of one:

BFS	DFS
Breadth-first search	Depth-first search
-	-
Explore first the nearest nodes from the current position	Go as deep as you can and backtrack when you're in a dead end
FIFO - Queue	LIFO - Stack

A small demonstration

BFS

DFS

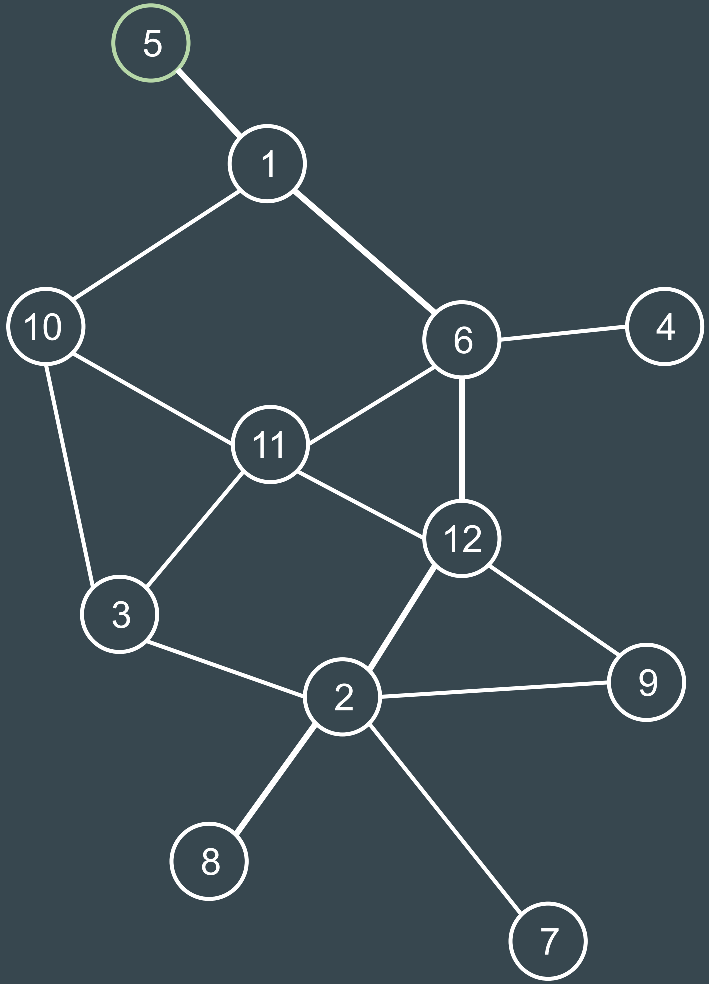
BFS

```
BFS(G, start):
     let q be a queue
     add start to the queue
     set every node of G to unvisited
     set start to visited

     while q is not empty:
      current is the next node from q

      for every node $a_i$ adjacent to current:
          if $a_i$ is visited: skip
          set $a_i$ to visited
          put $a_i$ in q
```

Complexity : O(E+V)



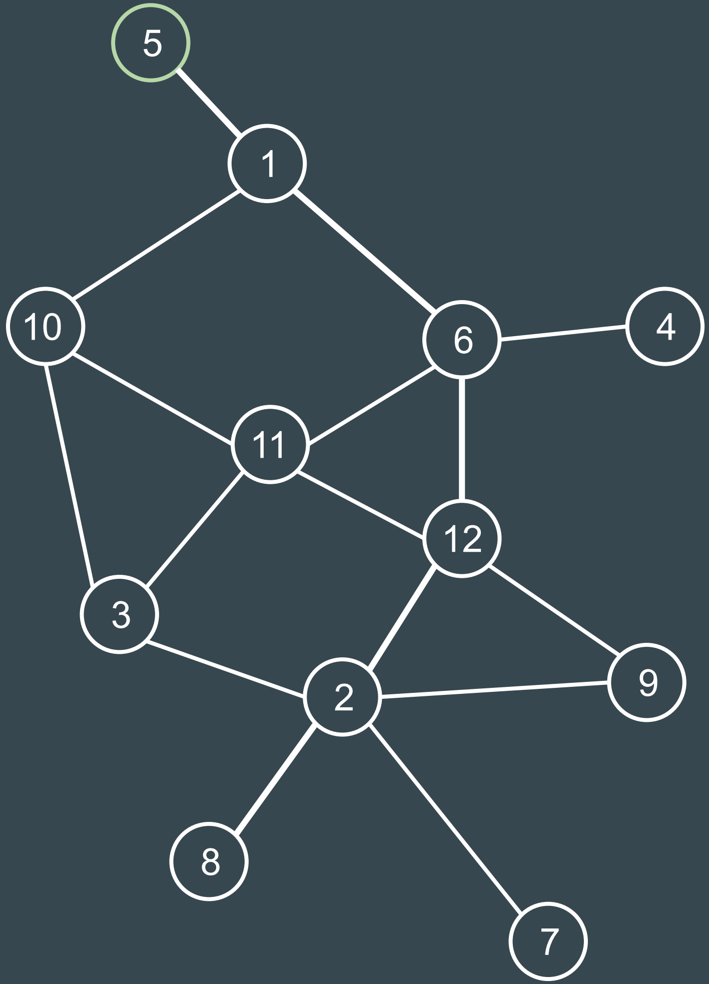
DFS

```
DFS(G, start):
    let s be a stack
    add start to the stack
    set every node of G to unvisited
    set start to visited

    while s is not empty:
     current is the next node from s

     for every node $a_i$ adjacent to current:
         if $a_i$ is visited: skip
         set $a_i$ to visited
         put $a_i$ in s
```

Complexity : O(E+V)



Why two variants ?

BFS

- Find the shortest path between two nodes when the edges’ weights are equals

DFS

- Possibility to implement a recursive version
- Give the topological order of the node in an oriented graph (which can be useful for some shortest path application)

Credits

More resources:

- DFS : https://en.wikipedia.org/wiki/Depth-first_search
- BFS : https://en.wikipedia.org/wiki/Breadth-first_search
- Cours de 3IF : https://moodle.insa-lyon.fr/pluginfile.php/436811/mod_resource/content/1/cours.pdf

Slides: Sebastien Goll for INSAlgo