Stacks

Stack

- Last in First Out

```
#include <stack>
// Stack operations
stack<T> stackExample;
stackExample.push();
stackExample.pop();
stackExample.top();
stackExample.empty();
stackExample.size();
// with constructor & destructor
```

Stack Model - LIFO

- The top allows access to the top of the "Stack" - Any list implementation could be used to make a stack - Operating on one end - Vector/List ADTs - push_front()/pop_front() - push_back()/pop_back()

Stack Uses

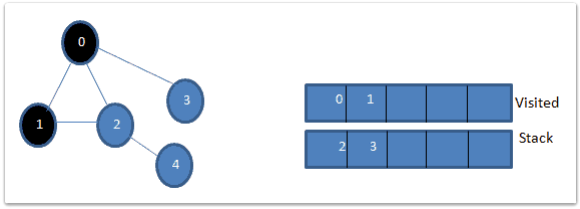
- Depth-first search/backtracking - Evaluating postfix expressions - Converting infix to postfix - Function calls (runtime stack) - Recursion

Runtime Stack

- Static - Executable code - Global variables - Stack - Push for each function call - Pop for each function return - Local variables - Heap - Dynamically allocated memories - new and delete

Depth First Expanded

- If there is an unlisted neighbor go there - Retreat along the path to find unlisted neighbor, it cannot go deeper - If there is a path from start to goal, DFS finds one such path - Discover a path from **start** to the goal - Start from Node start stop if Node reaches goal



> *Keep Going Deeper*

```
// Depth First Search
DFS() {
stack<location> S;
//Mark the start location as visited
        S.push(start);
        while (!S.empty()) {
                t = S.top();
                if (t == goal) Success(S);
                if (// t has unvisited neighbors) {
                        //Choose an unvisited neighbor n
                        // mark n visited;
                        S.push(n);
                } else {
                        BackTrack(S);
                }
        }
        Failure(S);
}

/*
                        Another Implementation Of DFS
  ____________________________________________________
*/
```

```
BackTrack(S) {
        while (!S.empty() && S.top() has no unvisited neighbors) {
                S.pop();
        }
}

Success(S) {
        // print success
        while (!S.empty()) {
                output(S.top());
                S.pop();
        }
}

Failure(S) {
        // print failure
        while (!S.empty()) {
                S.pop();
        }
}
```

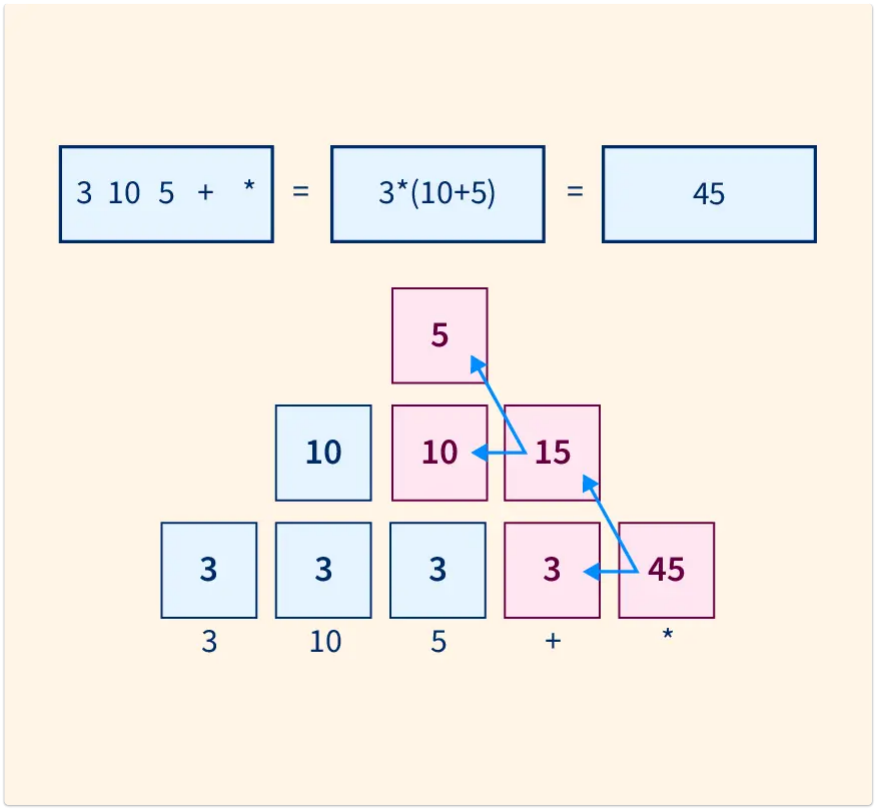
Postfix Expressions

- Use a stack of tokens - Repeat - If operand, push onto the stack - If operator - pop operands off the stack - evaluate operator on operands - push the result onto the stack - Until expression is read - Return top of the stack

```
Evaluate(postfix expression) {

        // use stack of tokens;
        while(// expression is not empty) {
                t = next token;
                if (t is operand) {
                        // push onto the stack
                } else {
                        // pop operands for t off stack
                        // evaluate t on these operands
                        // push the result onto the stack
                }
        }
        // return top of stack
}
```

Postfix Visualized


3 10 5 + *
=
3*(10+5)
=
45
5
10
10
15
3
3
3
3
45
3
10
5
+
*