UCSC Silicon Valley Extension

Advanced C Programming

Stacks

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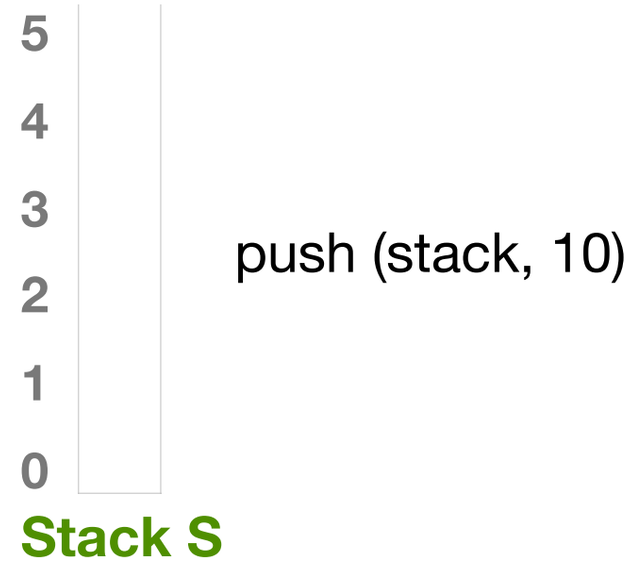
Overview

- Stacks
- Example
- Implementation using an array
- Applications

Example of stack



Example of stack

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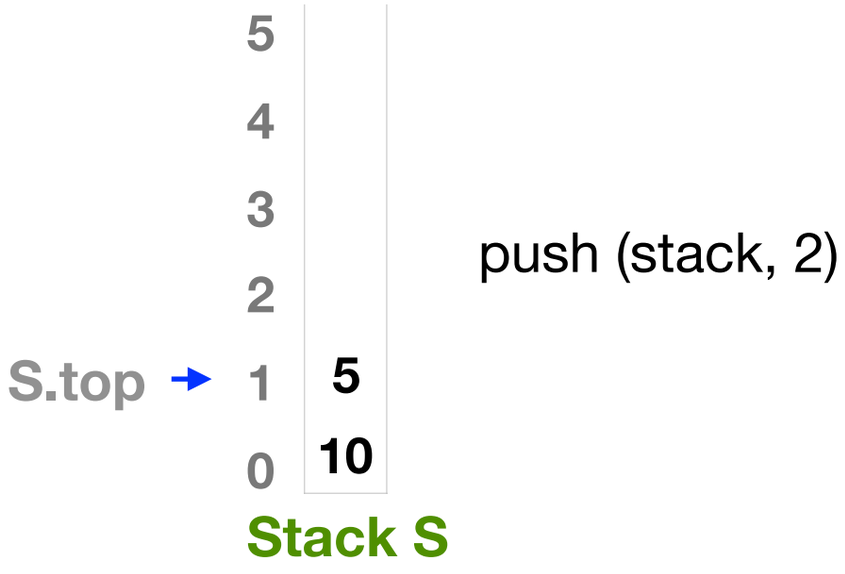
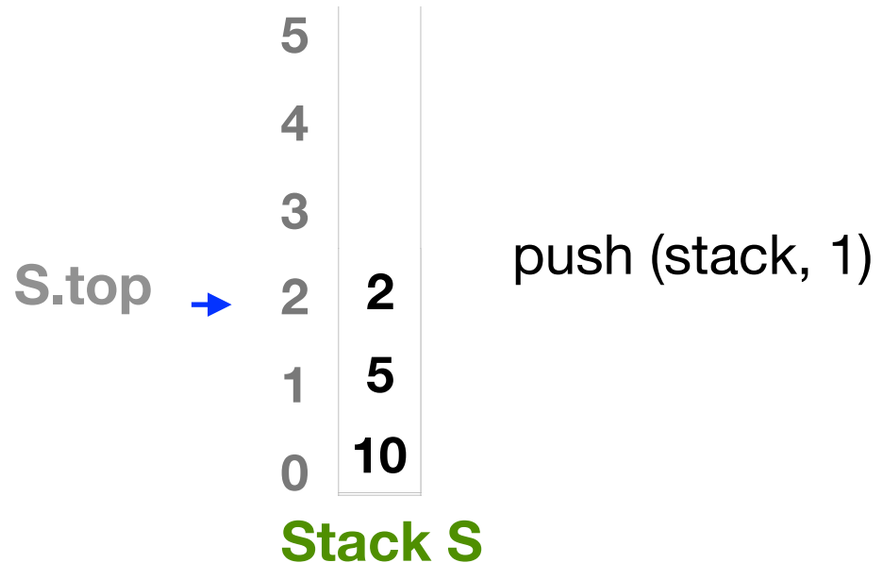
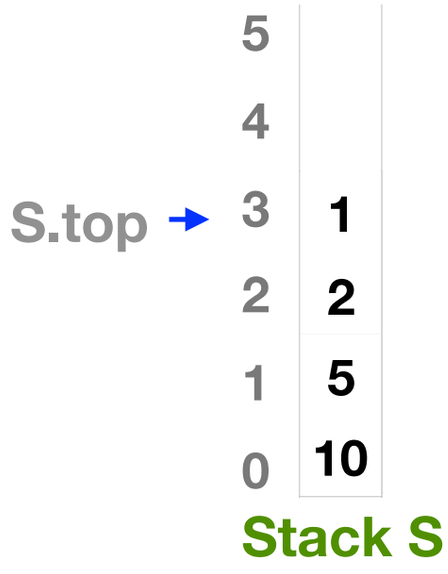


Example of stack

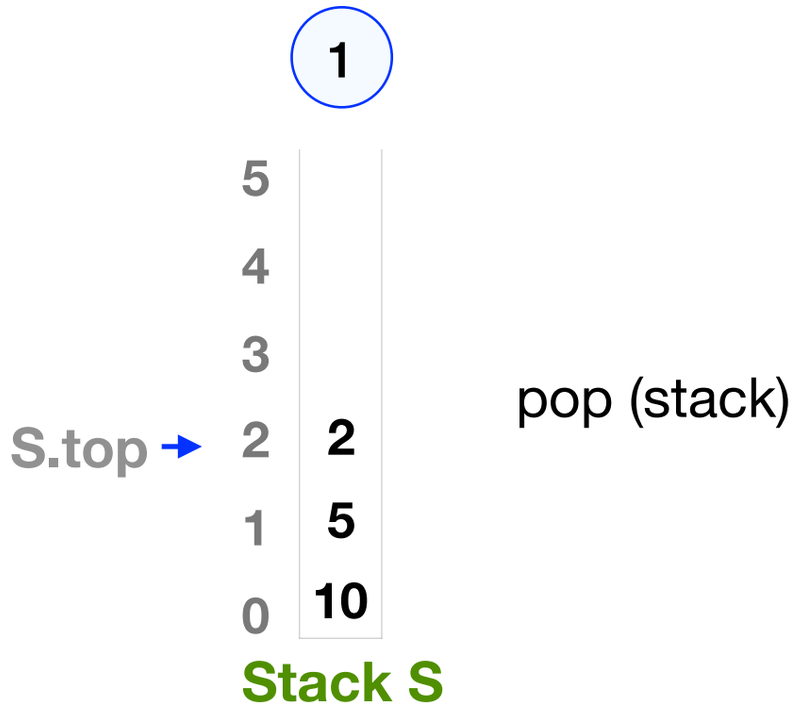


Example of stack

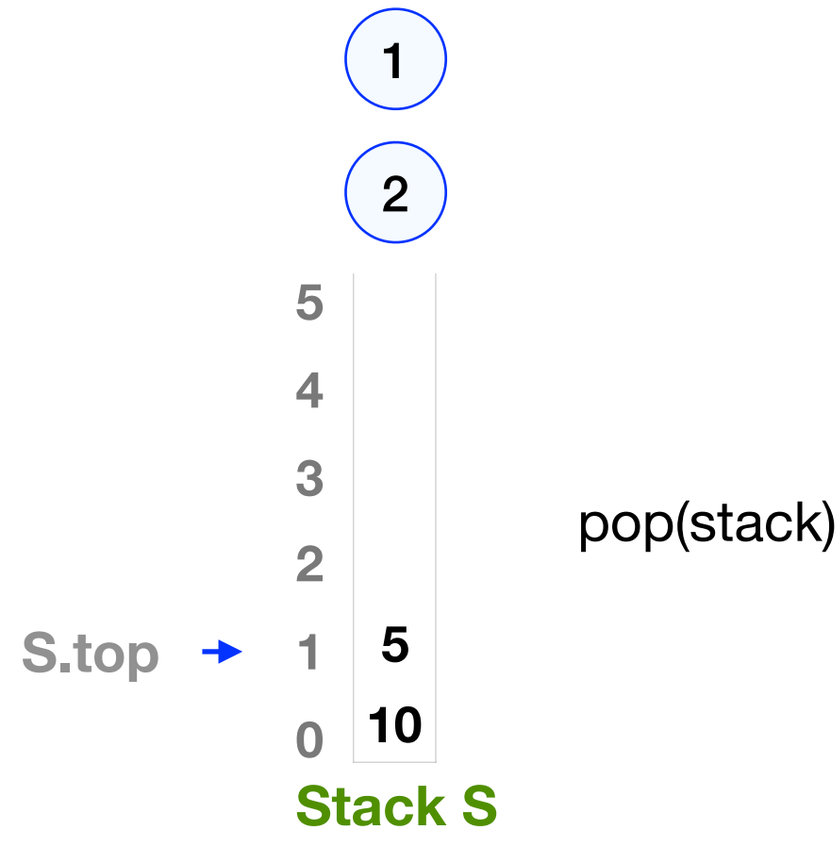


pop (stack)

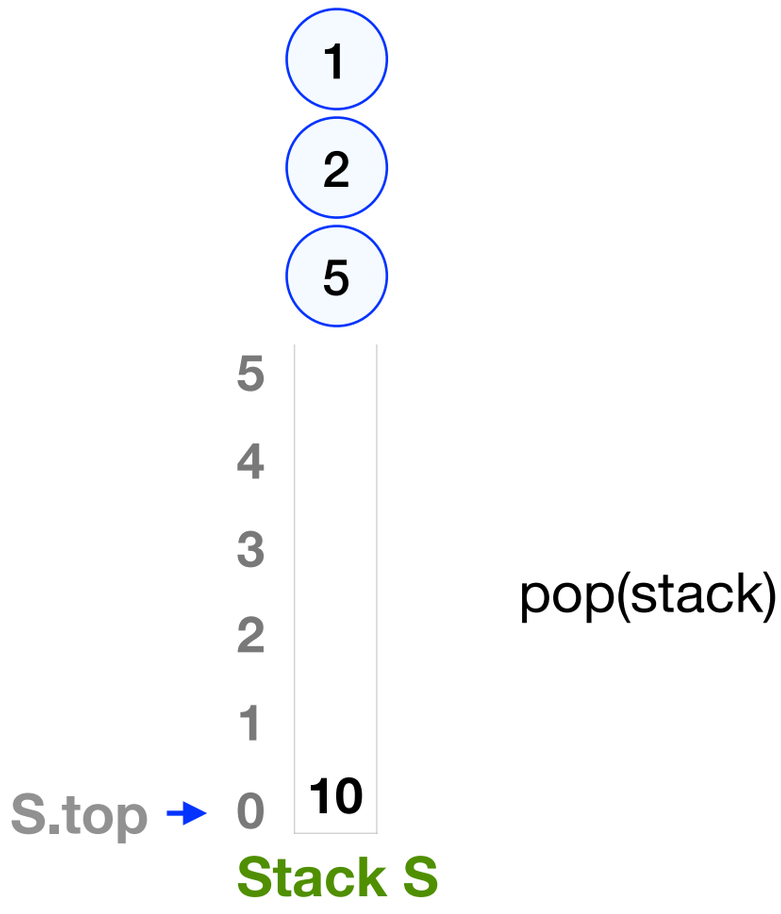
Example of stack



Example of stack

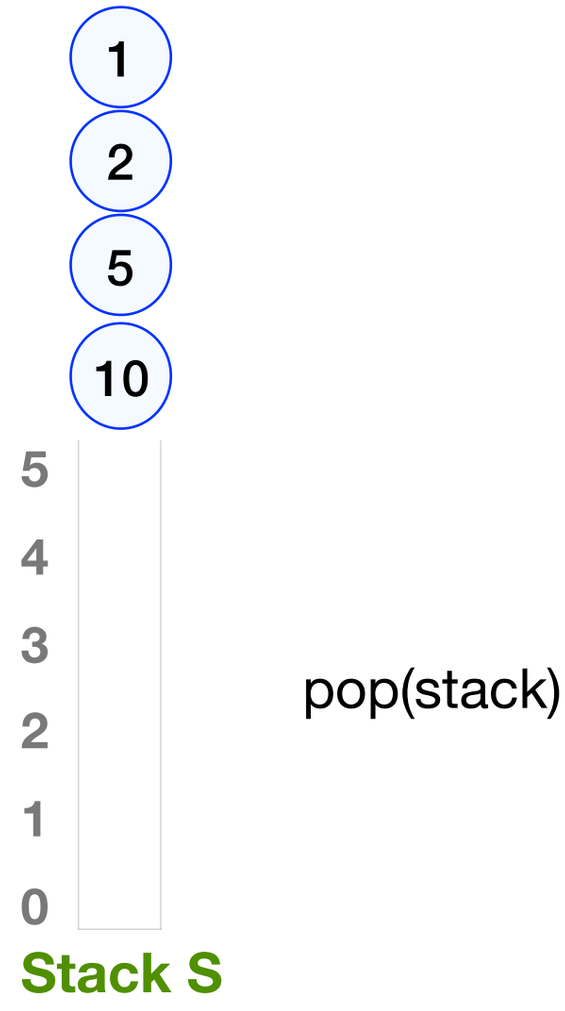


Example of stack



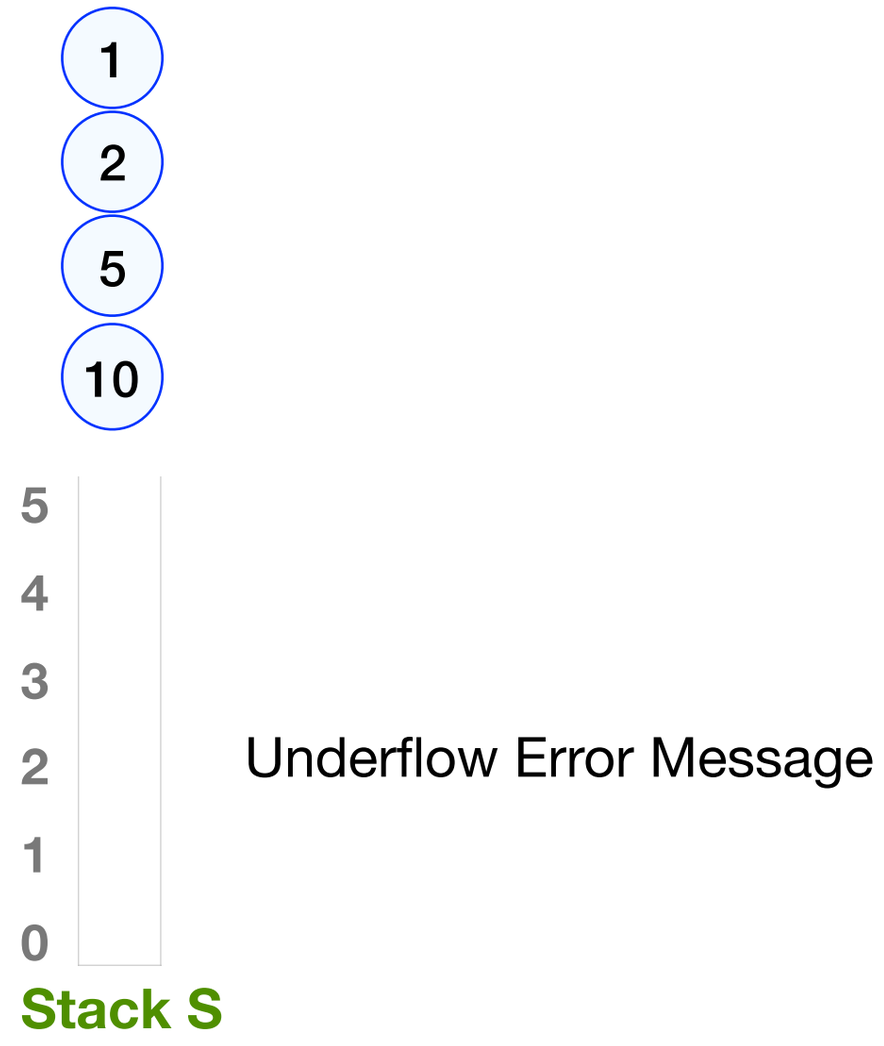
pop(stack)

Example of stack



pop(stack)

Example of stack



Stack pseudocode

Array based implementation:

```
push(S, value){
    if (isStackFull())
        Overflow Error;
    S.top = S.top + 1;
    S[top] = value;
}
```

```
pop(S){
      if (isStackEmpty()){
         Underflow Error;
      }
      S.top = S.top - 1;
}
```

```
isStackEmpty(S){
   if (S.top == -1)
       return true;

   return false;
}
```

```
top(S){
      if (isStackEmpty()){
         Underflow Error;
      }
      return S.top;
}
```

Time complexity = O(1)

Stack implementation using an array

```
//Stack/stack.c
#define MAX_SIZE  100

typedef struct data_t {
    int value;
} Data;

typedef struct Stack_t {
    int topIndex;
    int capacity;
    Data *data;
} Stack;
```

Stack implementation using an array

```
//Stack/stack.c
// push newData on stack
void push(Stack *stack, Data newData) {
    if (stack->topIndex == stack->capacity) {
        fprintf(stderr, "ERROR: Stack is filled to capacity");
        exit(EXIT_FAILURE);
    }
    stack->topIndex++;
    stack->data[stack->topIndex] = newData;
}

// pop stack (decrement stack pointer)
void pop(Stack *stack) {
    if (stack->topIndex == -1) {
        fprintf(stderr, "Stack is empty");
        exit(EXIT_FAILURE);
    }
    stack->topIndex--;
}
```

Stack implementation using an array

```
//Stack/stack.c
// return topmost item of stack
Data top(Stack *stack) {
    if (stack->topIndex == -1) {
        fprintf(stderr, "Stack is empty”);
        exit(EXIT_FAILURE);
    }

    return(stack->data[stack->topIndex]);
}

bool isEmpty(Stack *stack) {
    return (stack->topIndex == -1);
}
```

Check for memory leaks

- Use a tool to check for memory leaks.

- For example, for Linux systems, you can run valgrind on the command line for the executable Stack as:

- valgrind --tool=memcheck --leak-check=full --show-leak-kinds=all ./ Stack

Applications

- Used in function calls for storing arguments, temporary variables and return type while the function executes.
- Evaluating expressions
- During Depth first search
- The Java Virtual Machine has a stack-based architecture.