Stack

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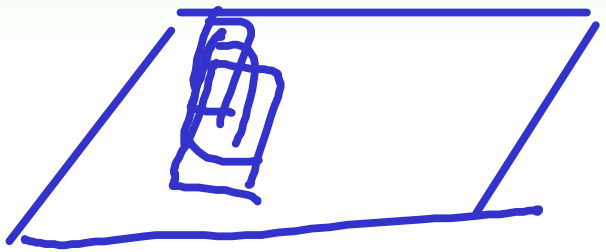
Intuition

Stack



mimic: “pile of documents” on your desk

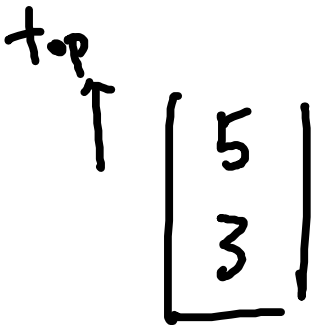
Stack: Last-In-First-Out (LIFO)

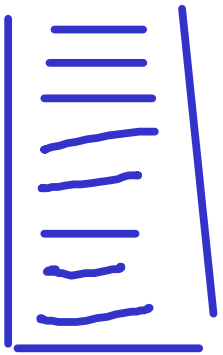
Stack

(constant-time) operations:

- `insertTop(data)`, often called `push(data)`
- `removeTop()`, often called `pop()`
- `getTop()`, often called `peek()`

—LIFO: 擠電梯， 洗盤子





push 3
push 5
pop -> 5

very restricted data structure, but important for computers
—will discuss some cases later

A Simple Application: Parentheses Balancing

- in C, the following characters show up in pairs: (), [], {}, ""

```
good:  {xxx(xxxxxx)xxxxx"xxxx"x}
bad:   {xxx(xxxxxx}xxxxx"xxxx"x}
```

- the LISP programming language

```
(append (pow (* (+ 3 5) 2) 4) 3)
```

how can we check parentheses balancing?

Stack Solution to Parentheses Balancing

inner-most parentheses pair $\Longrightarrow$ top-most plate

'(': 堆盤子上去；')': 拿盤子下來

Parentheses Balancing Algorithm

for each *c* in the input **do**
  if *c* is a left character
    push *c* to the stack
  else if *c* is a right character
    pop *d* from the stack and check if match
  end if
end for

many more sophisticated use in compiler design (will see some)

System Stack

- recall: function call ⇔ 拿新的草稿紙來算
- old (original) scrap paper: temporarily not used, 可以壓在下面

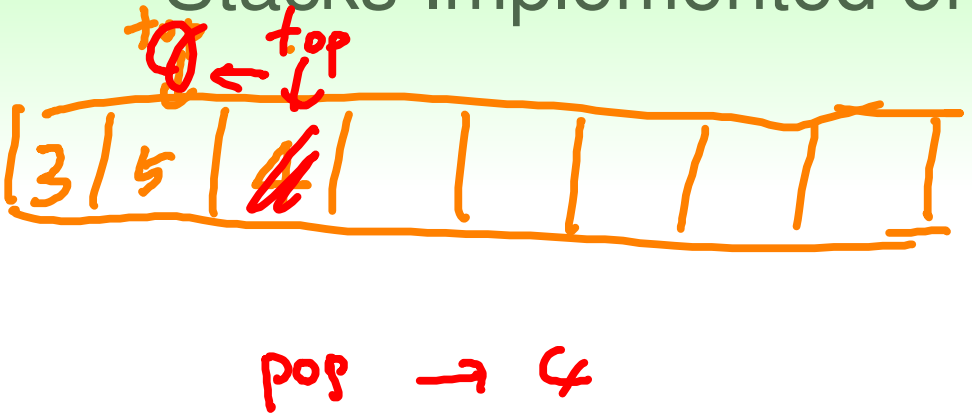
System Stack: 一疊草稿紙, each paper (stack frame) contains

- return address: where to return to the previous scrap paper
- local variables (including parameters): to be used for calculating within this function
- previous frame pointer: to be used when escaping from this function

some related issues: security attack?

Implementation

Stacks Implemented on Array



usually: (growable) consecutive array and push/pop at `end-of-array`

Stacks Implemented on Linked List

usually: singly linked list and push/pop at `head`

Stack in STL

```
1  stack< int , vector<int> > s_on_array;
2  stack< int , list<int> > s_on_array;
```

implemented as container adapter