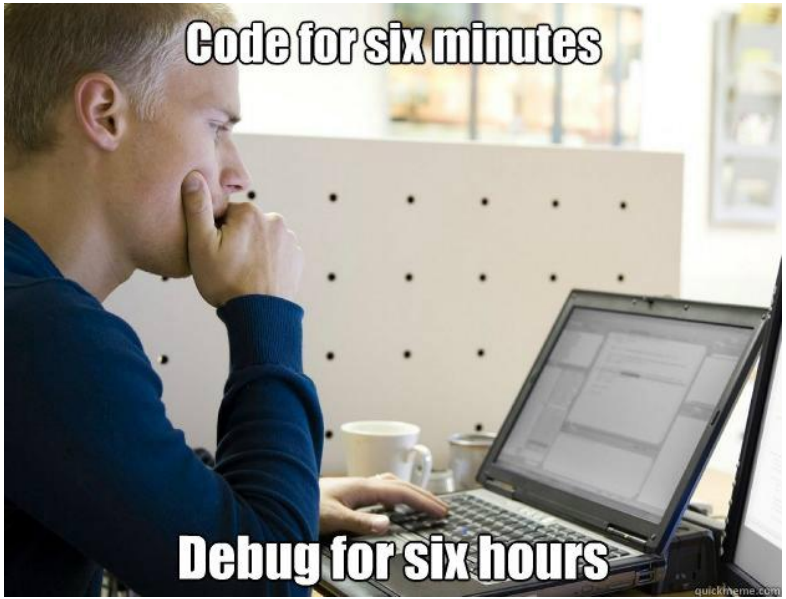
Clean Code

Boston University CS 506 - Lance Galletti

The Problem


Code for six minutes
Debug for six hours
quickmeme.com


99 little bugs in the code.
99 little bugs in the code.
Take one down, patch it around.
127 little bugs in the code...

The Problem

“Software Systems get replaced not when they wear out but when they crumble under their own weight because they have become too complex”

Why Does this Occur?

- english words + grammar != poetry
- Need analysis of the code itself - not just algorithms

Gems of Clean Code

- Structure
  - Before writing code ask “How will someone use this (or part of this) code?”. Minimize side effects
  - Do one thing
- Method
  - Top Down Approach
  - Bottom up Approach
  - Solve the problem first - then improve / refine
- General
  - Boring code is good code: keep it simple
  - Late Binding: start vague and refine (don’t commit to specificity)
  - Many functions with small bodies > one function with large body
  - Check soundness by reading your code before testing

Clean Code

'Clean code' by Robert C. Martin

Github Gist Summary of the Book:
https://gist.github.com/wojteklu/73c6914cc446146b8b533c0988cf8d29

A Look into Functional Programming

“Functional Programs are mathematical expressions that are evaluated and reasoned about much like ordinary mathematical functions. As a result, these expressions are simple to analyze and compose for large-scale programs”

- Combinators on Lists
- An example coding exercise

Combinators on Lists

xs = [1, 4, 9, 16, 25]

- map(xs, lam(x) => f(x)) = [f(1), f(4), f(9), f(16), f(25)]

  Ex:

  map(xs, lam(x) => x % 2) = [1, 0, 1, 0, 1]

- Foldleft - idea of consuming the list via an accumulator

  Ex:

  foldleft(xs, init, lam(x, acc) => f(x, acc))

  - acc = init
  - acc = f(1, acc)
  - acc = f(4, acc)
  - acc = f(9, acc)
  - acc = f(16, acc)
  - acc = f(25, acc)
  - Return acc

foldleft(xs, 0, lam(x, acc) => x + acc)

1. Acc = 0
2. Acc = 0 + 1 = 1
3. Acc = 1 + 4 = 5
4. Acc = 5 + 9 = 14
5. Acc = 14 + 16 = 30
6. Acc = 30 + 25 = 55
7. Return 55

Combinators on Lists

xs = [1, 4, 9, 16, 25] ys = [1, 2, 3, 4, 5]

- map2(xs, ys, lam(x, y) => f(x, y)) = [f(1, 1), f(4, 2), f(9, 3), f(16, 4), f(25, 5)]
  Ex:
  map2(xs, ys, lam(x, y) => x * y) = [1, 8, 27, 64, 125]
- Foldleft2 - consume both lists (like foldleft on zip)
  Ex: foldleft2(xs, ys, 1, lam(x, y, acc) => acc * (x / y))
  1. acc = 1
  2. acc = 1 * (1 / 1) = 1
  3. acc = 1 * (4 / 2) = 2
  4. acc = 2 * (9 / 3) = 6
  5. acc = 6 * (16 / 4) = 24
  6. acc = 24 * (25 / 5) = 120
  7. Return 120

Example: Max Path Sum

Starting at the top of the triangle and moving down to adjacent numbers below: Find the path from the root to a leaf with the maximum sum.

```
      3
    7   4
  2   4   6
8   5   9   3
```

Example: Max Path Sum

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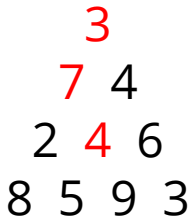

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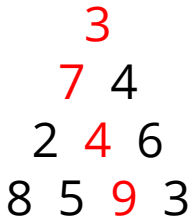

In the above example the max path sum in 3 + 7 + 4 + 9 = 23

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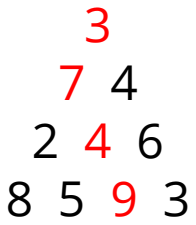


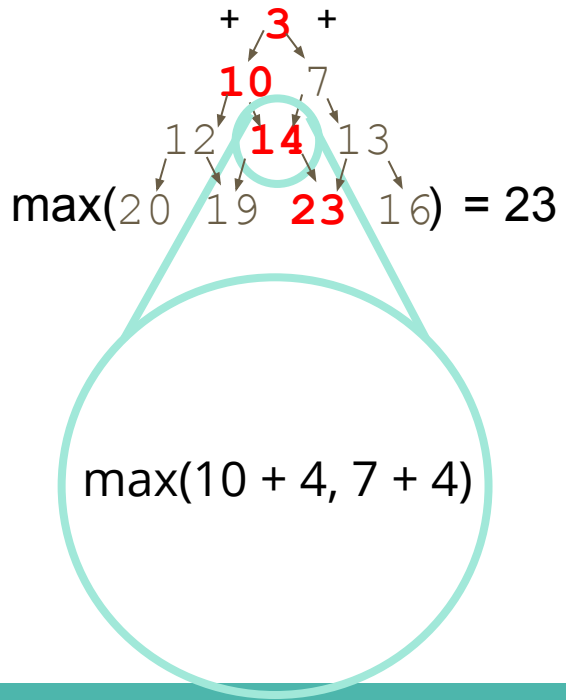
In the above example the max path sum in 3 + 7 + 4 + 9 = 23

Brute Force: Find all paths and get the max.

Source: https://projecteuler.net/problem=18

Example: Max Path Sum

Our Algorithm



Code Using Combinators

Triangle = list of lists. Can we use foldleft?

max(**foldleft**(triangle, [], **lam**(xs, acc) **=> myfold**(xs, acc)))

3
7 4
2 4 6
8 5 9 3

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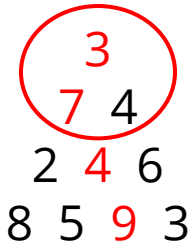

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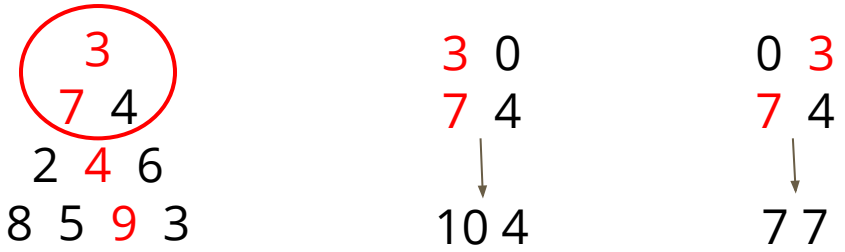

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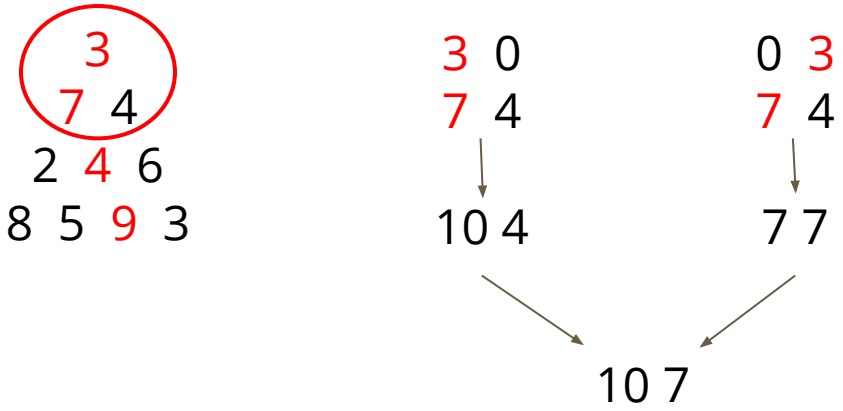

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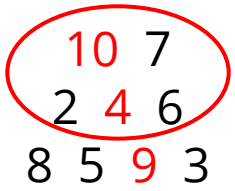

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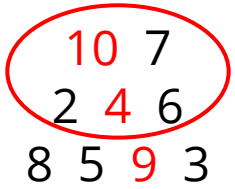

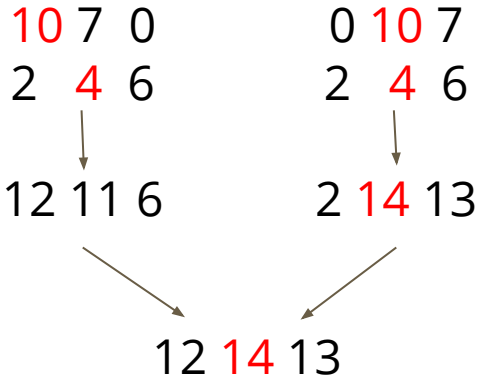

Code Using Combinators

Triangle = list of lists. Can we use foldleft?

max(**foldleft**(triangle, [], **lam**(xs, acc) **=>** **myfold**(xs, acc)))

myfold(xs, acc) :

```
    option1 = map2( [0, acc...], xs, lam(x, y) => x + y )
    option2 = map2( [acc..., 0], xs, lam(x, y) => x + y )
    return map2( option1, option2, lam(x, y) => if x > y then x else y )
```

Python Examples

myfolder
├── main.py
└── data.txt

main.py

```
nums = []
with open("../data.txt", "w+") as f:
  lines = f.readlines()
  for line in lines:
    nums += [int(x) for x in line.split(",")]

print(sum(nums))
```

data.txt

0,1,2,3,4

What is the output of this code?

a. Prints “10”
b. Raises an Error
c. Prints “0”

Python Examples

```
class Bank:
  def __init__(self, balance):
    self.balance = balance

  def is_overdrawn(self):
    return self.balance < 0

myBank = Bank(100)
if myBank.is_overdrawn :
  print("OVERDRAWN")
else:
  print("ALL GOOD")
```

What is the output of this code?

a. Prints “OVERDRAWN”
b. Prints “ALL GOOD”
c. Raises an Error

Python Examples

```
for i in range(4):
    print(i)
  i = 10
```

What is the output of this code?

a. Prints “0”
b. Prints “0 1 2 3”
c. Raises an Error

```
some_string = "what"
some_dict = {}
for i, some_dict[i] in enumerate(some_string):
    i = 10

print(some_dict)
```

What is the output of this code?

a. Prints “{}”
b. Prints “{0: 'w', 1: 'h', 2: 'a', 3: 't'}”
c. Raises an Error

https://book.pythontips.com/en/latest/enumerate.html

Python Examples

```
row = [""] * 3 # row i['', '', '']
board = [row] * 3
print(board) # [['', '', ''], ['', '', ''], ['', '', '']]
print(board[0]) # ['', '', '']
print(board[0][0]) # ''
board[0][0] = "X"
print(board)
```

What is the output of this code?

a. Prints “[['X', '', ''], ['', '', ''], ['', '', '']]”
b. Prints “[['', '', ''], ['', '', ''], ['', '', '']]”
c. Prints “[['X', '', ''], ['X', '', ''], ['X', '', '']]”

Python Examples

```
funcs = []
results = []
for x in range(3):
    def some_func():
        return x
    funcs.append(some_func)
    results.append(some_func())  # note the function call here

funcs_results = [func() for func in funcs]
print(results) # [0,1,2]
print(funcs_results)
```

What is the output of this code?

a. Prints “[0,1,2]”
b. Prints “[2,2,2]”
c. Prints “[]”
d. Raises an Error

Python Examples

You can find more such Python examples here [1]

[1] https://github.com/satwikkansal/wtfpython