The Beauty and Joy of Computing

Lecture #10 Recursion II

UC Berkeley
EECS Lecturer
Pierce Vollucci

PUBLIC TO PRIVATE FORUMS IN CHINA

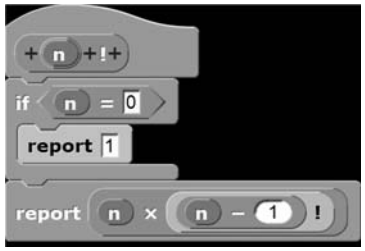
Censorship and detainment for many posters on China's public forum Weibo (like Twitter) has led to it's descent with the rise of a competitor: WeChat (like Facebook) which is more private in it's postings. Effects on freedom of speech and social activism is still to be seen.

http://www.nytimes.com/2014/07/05/world/asia/an-online-shift-in-china-muffles-an-open-forum.html?ref=technology

How the Computer Works … n!

- **Factorial(n) = n!**
  Inductive definition:
  - **n! = 1 , n = 0**
  - **n! = n * (n-1)!, n > 0**
- **Let's act it out…**
  - **"contractor" model**
  - **5!**

n	n!
0	1
1	1
2	2
3	6
4	24
5	120



Order of growth of # of calls of n!

a) Constant
b) Logarithmic
c) Linear
d) Quadratic
e) Exponential

(source: FallingFifth.com)

en.wikipedia.org/wiki/Fibonacci_number
www.ics.uci.edu/~eppstein/161/960109.html

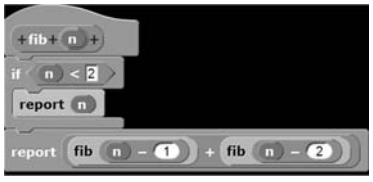
How the Computer Works … fib(n)

- **Inductive definition:**
  - **fib(n) = n , n < 2**
  - **fib(n) = fib(n-1)+fib(n-2), n > 1**

$$F(n) := \begin{cases} 0 & \text{if } n = 0; \\ 1 & \text{if } n = 1; \\ F(n-1) + F(n-2) & \text{if } n > 1. \end{cases}$$

- **Let's act it out…**
  - **"contractor" model**
  - **fib(5)**

n	fib(n)
0	0
1	1
2	1
3	2
4	3
5	5



Leonardo de Pisa aka, Fibonacci

Let's now: trace… (gif from Ybungalobill@wikimedia)

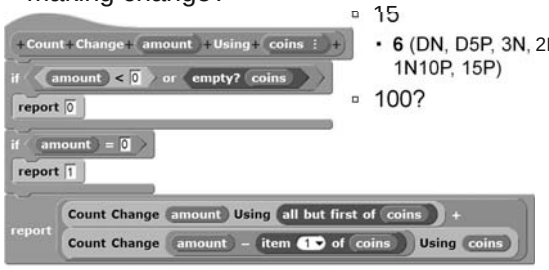
Order of growth of # of calls of fib(n)

a) Constant
b) Logarithmic
c) Linear
d) Quadratic
e) Exponential

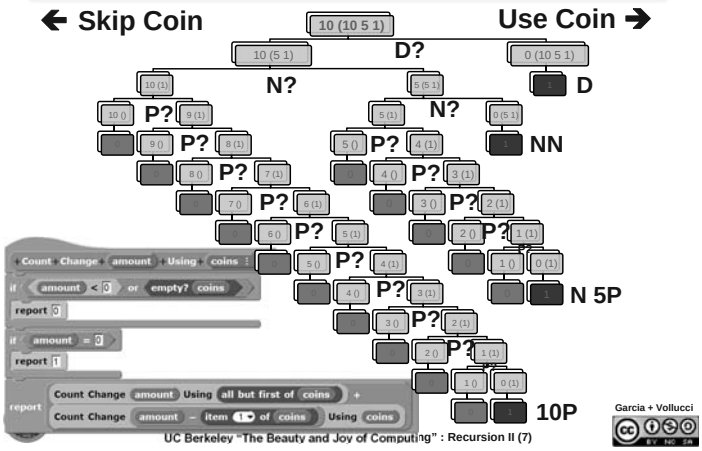
Chimney of Turku Energia, Turku, Finland featuring Fibonacci sequence in 2m high neon lights. By Italian artist Mario Merz for an environmental art project. (Wikipedia)

Counting Change (thanks to BH)

- Given coins {50, 25, 10, 5, 1} how many ways are there of making change?
  - 5
    - **2** (N, 5P)
  - 10
    - **4** (D, 2N, N5P, 10P)
  - 15
    - **6** (DN, D5P, 3N, 2N5P, 1N10P, 15P)
  - 100?



Call Tree for "Count Change 10 (10 5 1)"



"I understood Count Change"

a) Strongly disagree
b) Disagree
c) Neutral
d) Agree
e) Strongly agree

img4.joyreactor.com/pics/post/drawing-recursion-girl-275624.jpeg

Summary

- It's important to understand the machine model
- It's often the cleanest, simplest way to solve many problems
  - Esp those recursive in nature!
- Recursion is a very powerful idea, often separates good from great (you're great!)

Menger Cube by Dan Garcia