UC Berkeley EECS
Lecturer SOE
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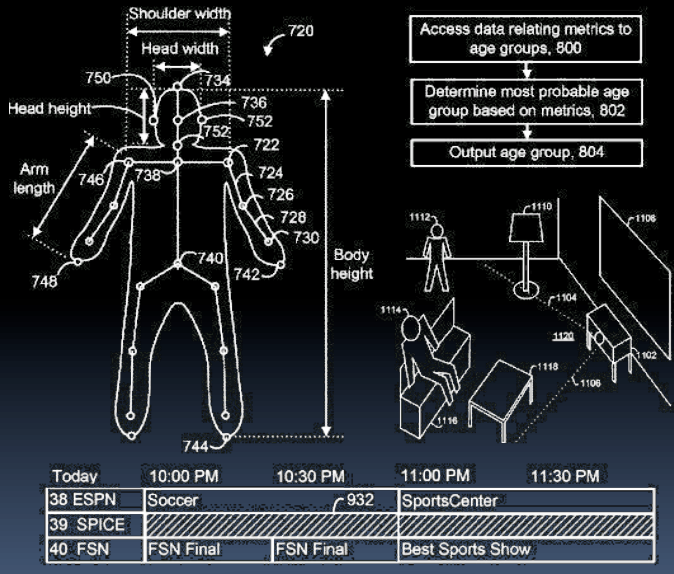
CS10
The Beauty and Joy of Computing

Lecture #11 : Recursion II

2011-10-10

KINECT COULD ESTIMATE AGE!

Microsoft filed a patent that proposed to use the 3D depth camera to estimate the age of the viewer (height, head-width to shoulder-width, torso length to overall height), and automatically restrict access to content. Tech-savvy kids usu override controls, we're told.

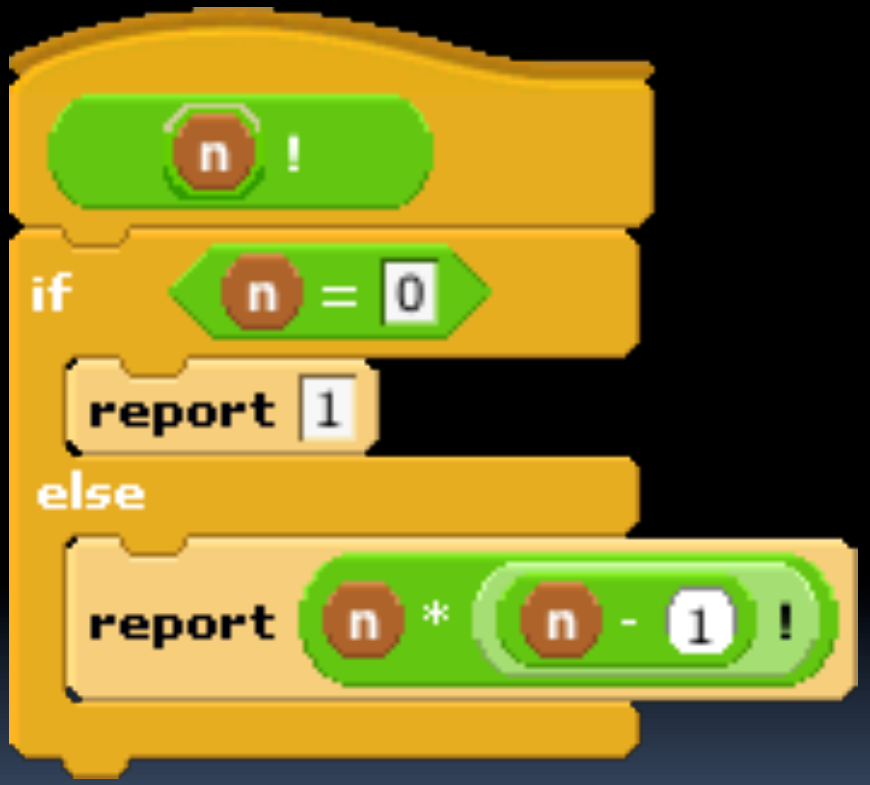


www.geekwire.com/2011/microsoft-idea-kinect-body-scans-estimate-age-automate-parental-controls

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…
  - "Little people", or "subcontractor" 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)

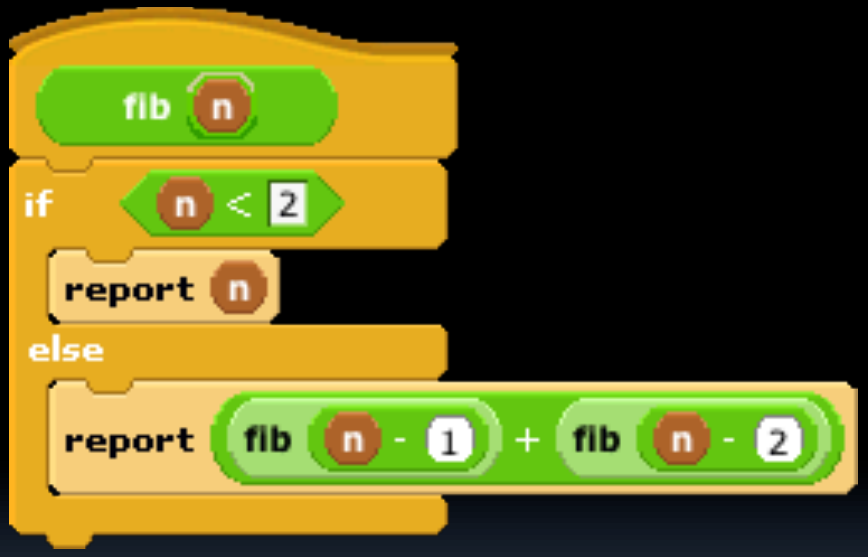
en.wikipedia.org/wiki/Fibonacci_number
www.ics.uci.edu/~eppstein/161/960109.html

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)

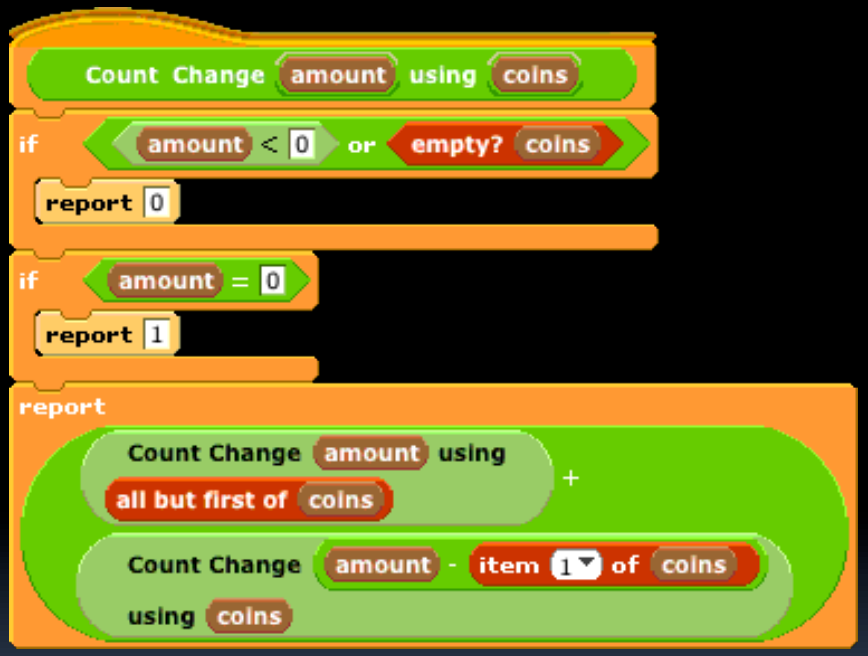
Order of growth of # of calls of fib(n)

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)

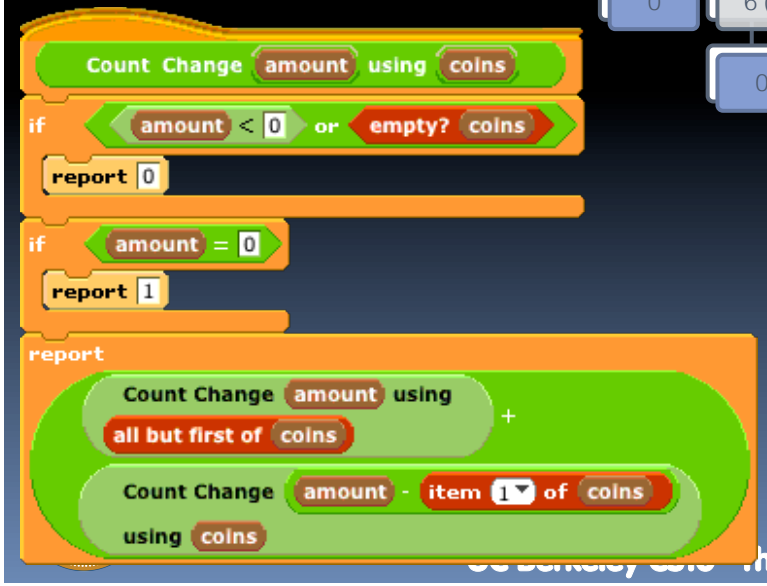
- Given coins {50, 25, 10, 5, 1} how many ways are there of making change?
  - 5: 2 (N,5 P)
  - 10
    - 4 (D, 2N, N 5P, 10P)
  - 15
    - 6 (DN,D5P,3N,2N5P,1N10P, 15P)
  - 100?



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

← Skip Coin

Use Coin →



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, and one way to separate good from great

Menger Cube by Dan Garcia