



Computational Structures in Data Science



UC Berkeley EECS
Lecturer
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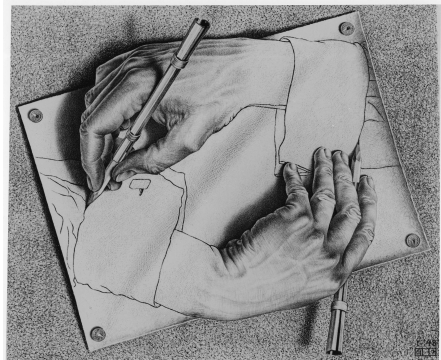
Lecture 5: Recursion



October 7, 2019 <http://ics88.org>

1

MC Escher "Drawing Hands" 1948



2

Administrative Issues

- Midterm Next Week!
- 7-9pm, Dwinelle 155

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3

Computational Concepts Toolbox

- Data type: values, literals, operations,
 - e.g., int, float, string
- Expressions, Call expression
- Variables
- Assignment Statement
- Sequences: tuple, list
 - indexing
- Data structures
- Tuple assignment
- Call Expressions
- Function Definition Statement
- Conditional Statement
- Iteration:
 - data-driven (list comprehension)
 - control-driven (for statement)
 - while statement
- Higher Order Functions
 - Functions as Values
 - Functions with functions as argument
 - Assignment of function values
- Higher order function patterns
 - Map, Filter, Reduce
- Recursion

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4

Today: Recursion

re·cur·sion
/ri'kərZHən/ ⓘ

noun MATHEMATICS LINGUISTICS

the repeated application of a recursive procedure or definition.

- a recursive definition.
- plural noun: recursions

re·cur·sive
/ri'kərsiv/ ⓘ

adjective

characterized by recurrence or repetition, in particular.

- MATHEMATICS LINGUISTICS
 - relating to or involving the repeated application of a rule, definition, or procedure to successive results.
- COMPUTING
 - relating to or involving a program or routine of which a part requires the application of the whole, so that its explicit interpretation requires in general many successive executions.

- Recursive function calls itself, directly or indirectly

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5

Why Recursion?

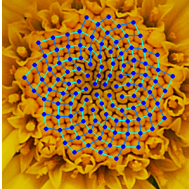
- "After Abstraction, Recursion is probably the 2nd biggest idea in this course"
- "It's tremendously useful when the problem is self-similar"
- "It's no more powerful than iteration, but often leads to more concise & better code"
- "It embodies the beauty and joy of computing"

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6

Why Recursion? More Reasons

- Recursive structures exist (sometimes hidden) in nature and therefore in data!
- It's mentally and sometimes computationally more efficient to process recursive structures using recursion.



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7

7

Function Review

- A function cannot...
 - A) have a function as argument
 - B) define a function within itself
 - C) return a function
 - D) call itself
 - E) None of the above.



Solution:
E) A, B, C, D are all possible!

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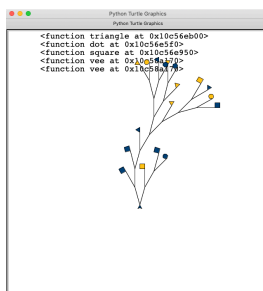
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8

8

Demo Time

- See a randomly recursive fractal



9

9

Recursion

- Recursion is...
 - A) Less powerful than a for loop
 - B) As powerful as a for loop
 - C) As powerful as a while loop
 - D) More powerful than a while loop
 - E) Just different but equally powerful as a for loop AND a while loop



Solution:
E) Different – it reads differently, but you can solve any problem with one of these techniques. (Some tools are better suited for some jobs though.)

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10

10

So far I feel...

- I "get" vee and countdown
 - A) I am totally lost
 - B) It's confusing, but I kinda get it
 - C) Starting to make sense...
 - D) I get it, but have questions
 - E) No questions at all!



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11

11