


Quest (half quiz half test) in 7 days!



CS10 : The Beauty and Joy of Computing

**Lecture #4
Functions**



2012-06-21

**UC Berkeley EECS
Summer Instructor
Ben Chun**

DUOLINGO OPEN TO THE PUBLIC

Luis von Ahn wants to translate the whole web into every major language. Duolingo is doing it using a GWAP! You get points for completing language lessons, and also for translating text from the web. They claim people learn as well as with Rosetta Stone, but Duolingo is free.

<http://nyti.ms/Lee58T>

Enrollment – everyone IS in

Course: COMPUTER SCIENCE 10 P 001 LEC ([course website](#))
 Course Title: The Beauty and Joy of Computing ([catalog description](#))
 Location: HJW17th 4-5P, 306 SODA
 Instructor: CHUN, B
 Status/Last Changed: _____
 Course Control Number: 28405 [View Books](#)
 Units/Credits: 4
 Session Dates: 06/18-08/10/12
 Summer Fees: UC Undergraduate \$1,624.00, UC Graduate \$2,040.00, Visiting \$1,660.00
 Note: Also: GARCIA, D D
 Enrollment on 06/19/12: Limit:90 Enrolled: Waitlist:0 11 Seats:91
Click here for info. [View course restrictions](#)

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Generalization (in CS10) REVIEW

- You are going to learn to write functions, like in math class:

$$y = \sin(x)$$

- sin is the function
- x is the input
- It returns a single value, a number



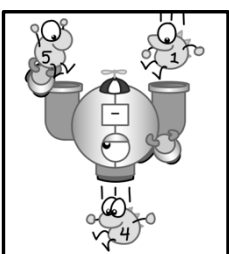
"Function machine" from *Simply Scheme* (Harvey)

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Function basics

- Functions take in 0 or more inputs and return exactly 1 output
- The same inputs **MUST** yield same outputs.
 - Output function of input only
- Other rules of functions
 - No state (prior history)
 - No mutation (no variables get modified)
 - No side effects (nothing else happens)




CS Illustrated function metaphor

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Which is NOT a function?

- a) to
- b)
- c)
- d)
- e)



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More Terminology (from Math)

- Domain**
 - The "class" of input a function accepts
- Examples**
 - Sqrt of
 - Positive numbers
 - Length of
 - Sentence, word, number
 - _ < _
 - Both: Sentence, word, number
 - _ and _
 - Booleans
 - Letter _ of _
 - Number from 1 to input length
 - Sentence, word, number

- Range**
 - All the possible return values of a function
- Examples**
 - Sqrt of
 - Non-negative numbers
 - Length of
 - Non-negative integer
 - _ < _
 - Boolean (true or false)
 - _ and _
 - Boolean (true or false)
 - Letter _ of _
 - Letter

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Types of input (there are more)

Sentences	<ul style="list-style-type: none"> spaces, $N \geq 0$ E.g., CS 10 is great
Word	<ul style="list-style-type: none"> Length ≥ 1, no spaces Cal, 42, CS10
Character	<ul style="list-style-type: none"> Length = 1 E.g., A, 3, #
Digit	<ul style="list-style-type: none"> 0-9 only E.g., 7

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Why functions are great!



- If a function only depends on the information it gets as input, then nothing else can affect the output.
 - It can run on any computer and get the same answer.
- This makes it incredibly easy to parallelize functions.
 - Functional programming is a great model for writing software that runs on multiple systems at the same time.



Datacenter

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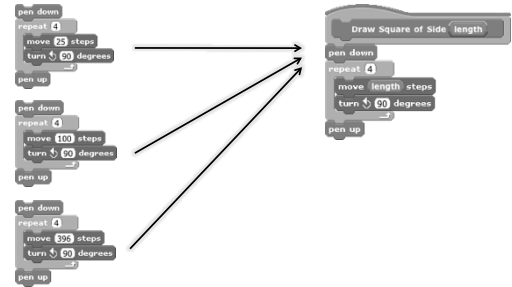
Scratch → BYOB (Build Your Own Blocks)

- Scratch**
 - Invented @ MIT
 - Maintained by MIT
 - Huge community
 - Sharing via Website
 - No functions ☹️
 - Scratch 2.0 in Flash
 - No iOS devices. ☹️
 - scratch.mit.edu
- BYOB (to be "S !")**
 - Based on Scratch code
 - Maintained by jens & Cal
 - Growing community
 - No sharing (yet) ☹️
 - Functions! ☺️ ... "Blocks"
 - BYOB 4.0 in HTML5
 - All devices ☺️
 - byob.berkeley.edu

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Why use functions? (1)



The power of generalization!


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Why use functions? (2)

They can be composed together to make even more magnificent things.


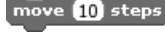


They are literally the building blocks of almost everything that we create when we program.

We call the process of breaking big problems down into smaller tasks functional decomposition



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Types of Blocks

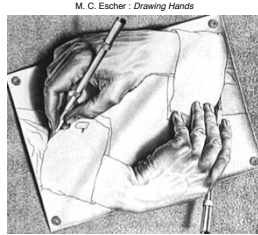
- Command**
 - No outputs
 - Used for side-effects

- Reporter (Often a Function)**
 - Any type of output
- Predicate (Function)**
 - Boolean output
 - (true or false)

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Quick Preview: Recursion

Recursion is a technique for defining functions that use themselves to complete their own definition.

We will spend a lot of time on this.



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Functional Programming Summary

Computation is the evaluation of functions

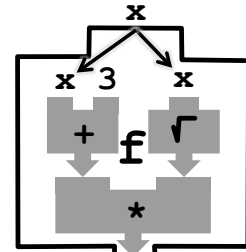
$$f(x) = (x+3) * \sqrt{x}$$

- Plugging pipes together
- Each pipe, or function, has exactly 1 output
- Functions can be input!

Features

- No state
 - E.g., variable assignments
- No mutation
 - E.g., changing variable values
- No side effects

Need BYOB not Scratch



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