We're underway …

# Following Lightbot

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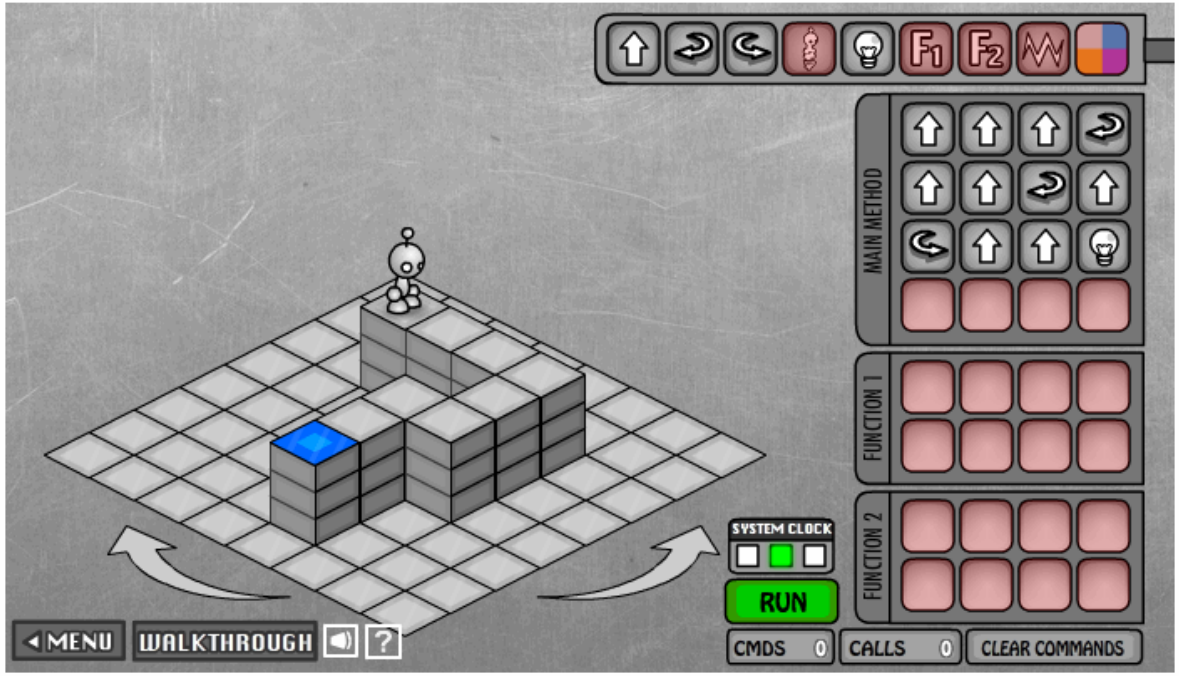
# As Experienced Lightbot Hackers …

- What are you doing in Lightbot?




- Commanding a robot through a "blocks world"
- Programming is **commanding** an agent

# A Lightbot 2.0 "Computation"

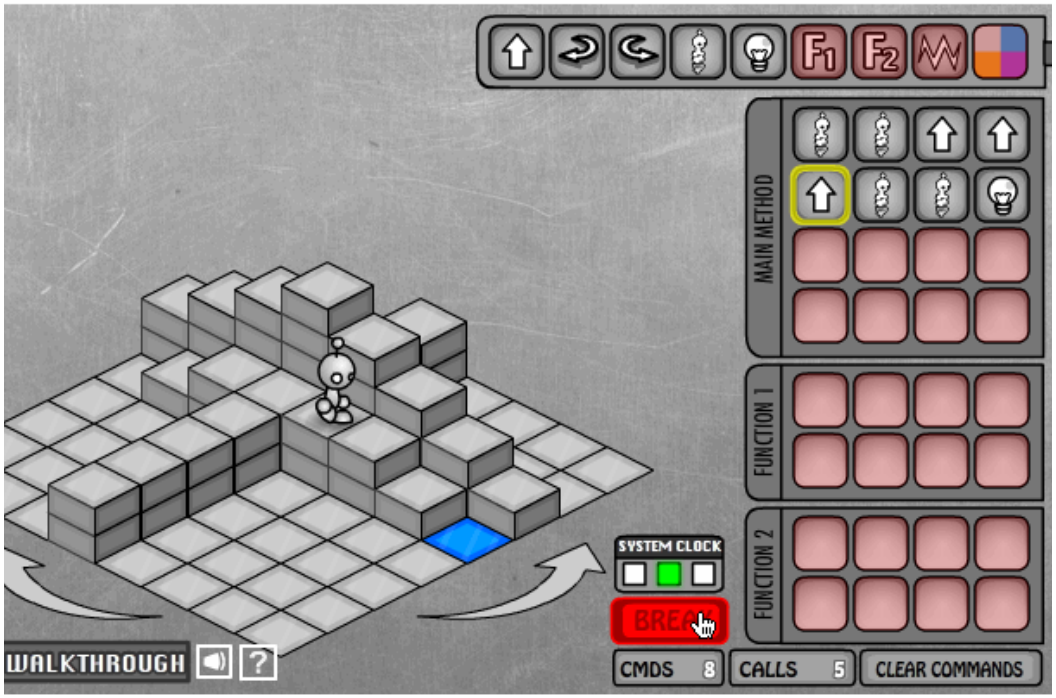
Just Do It!

# Agent, Instructions, Intent

- When you are commanding (programming), you direct an agent (by instructions) to a goal
  - The **agent** is usually a computer, but it can be a person, or other device (animated robot?)
  - The agent follows the commands a/k/a **instructions**, flawlessly, and mindlessly, doing only what it is asked
  - The program implements **human intent** – you are trying to get the robot to the Blue Tile goal – it's the point of your instructions

# Sequencing

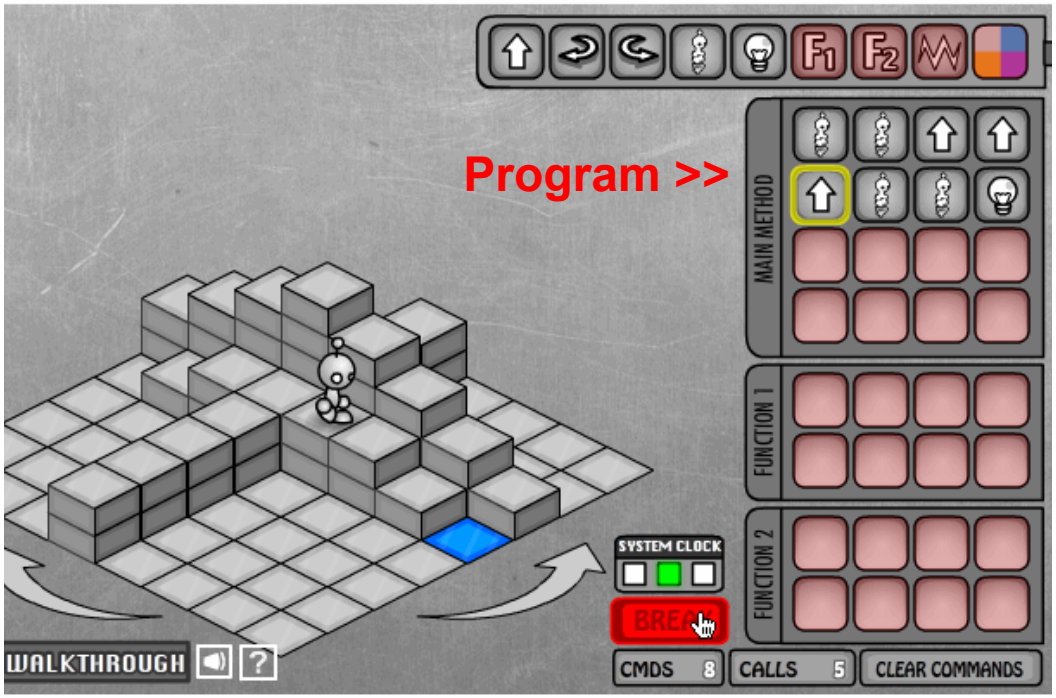
- Instructions are *given* in sequence, i.e. in order
- They are *followed* in sequence, i.e. in order
  - YOU give the instructions … it's called **programming**
  - The AGENT follows them … it's called **executing** or **running** the program




  - A **program counter** marks the agent's place

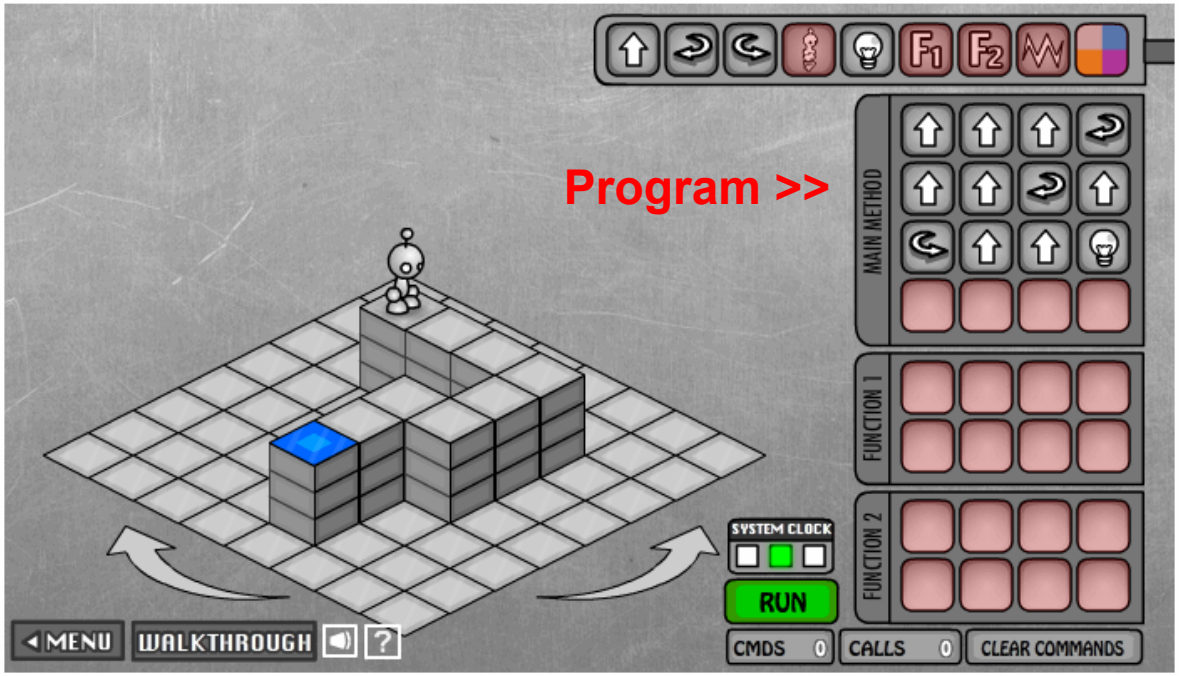
# Order of Events

- The instructions are programmed *ahead of time*
- They are executed *later*, w/o programmer's intervention
  - Each instruction makes *progress* towards the goal
  - The instructions *must be right* and sufficient to achieve the goal



# Point of View

- Programming REQUIRES you to take the *agent's point of view* … it's a essential idea



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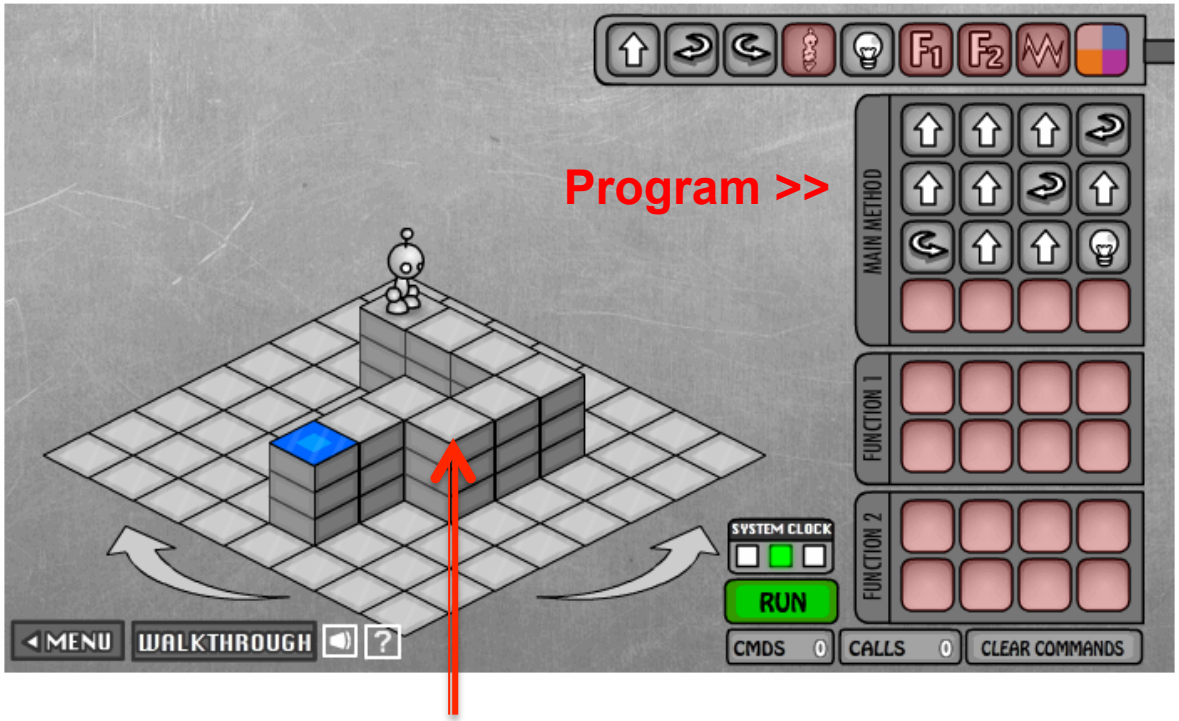
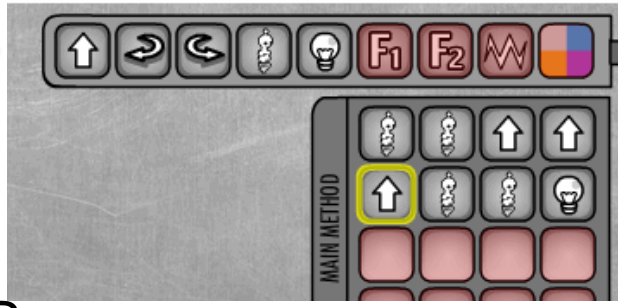



From this cell, a turn is required … R or L?

# Limited Instruction 'Repertoire'

- The number and type of instructions is always limited – you need a solution using only them
  - Instructions …
    - The agent can do only certain things … nothing else
    - The Lightbot's instructions 
    - There is no JUMP_3

    … Lightbot's even tougher than normal programming b/c in some LB games, some instructions are unavailable … but it's a game!
    - Execute the instructions one-at-a-time



# An Amazing Fact …

- The limited repertoire is a fact of *all* computing, but how limited?
- A computer's circuitry (the hardware) has very few instructions … usually about 100, and many are just different versions of the same idea: **`add_2_bytes`**, **`add_2_ints`**, **`add_2_decimal_numbers`**, etc.

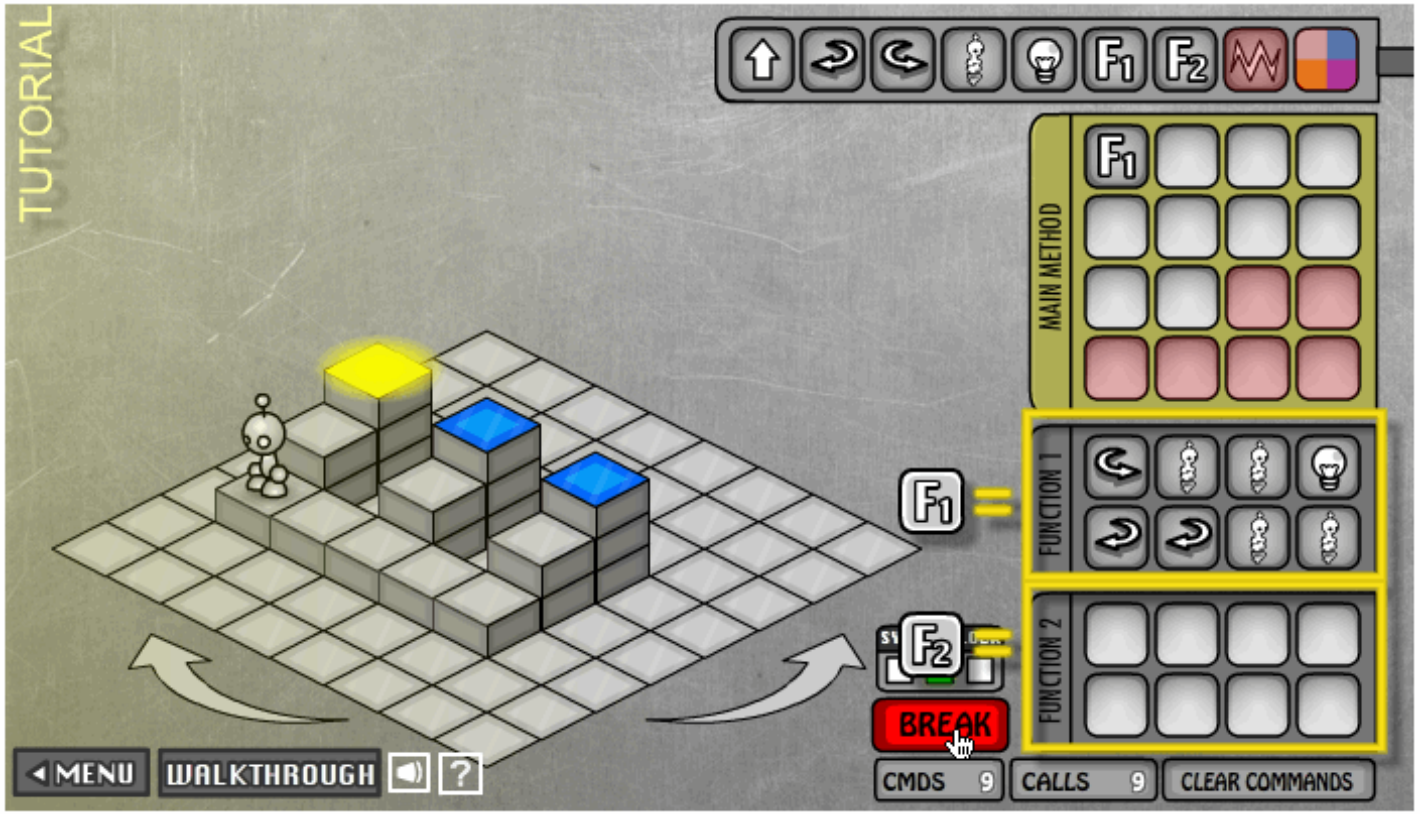
In theory, a computer with only 6 instructions could compute all known computations

# If that were the end of the story

- Programming would be amazingly tedious if all programming had to use only the basic instructions – I mean REALLY REALLY tedious
  - No one would be a programmer no matter how much it paid
  - Apps as we know them would not exist
  - BTW programming was like this in the beginning
    - This is why they are called the "bad old days"
- Luckily, there are **functions**

# Functions Package Computation

- We make new instructions using functions!



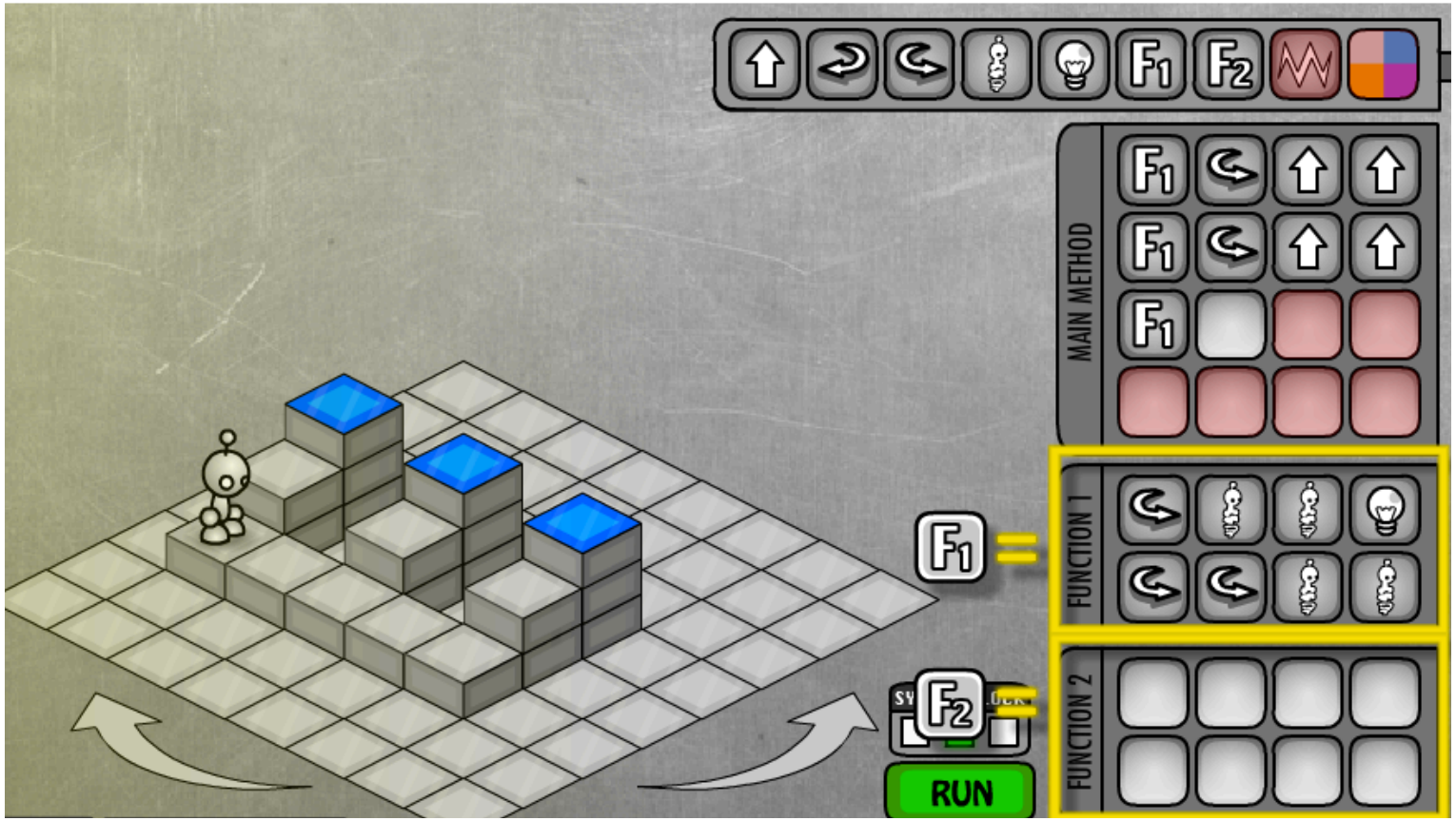

- F1( ) packages actions: E.G. "process a riser"

# Functions Package Computation

Just Do It!

# F1( ), A Process a Riser Instruction

- We have a new instruction: Process_A_Riser




- **Call** the function to use the new instruction

# It's BIG!

- Functions may seem "obvious" but they are a HUGE idea …
- They allow us to solve problems by first creating some useful instructions, and then using them to get the agent to do our work
- Sweet!