Lightbot and Functions

CSE 120 Winter 2017

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Administrivia

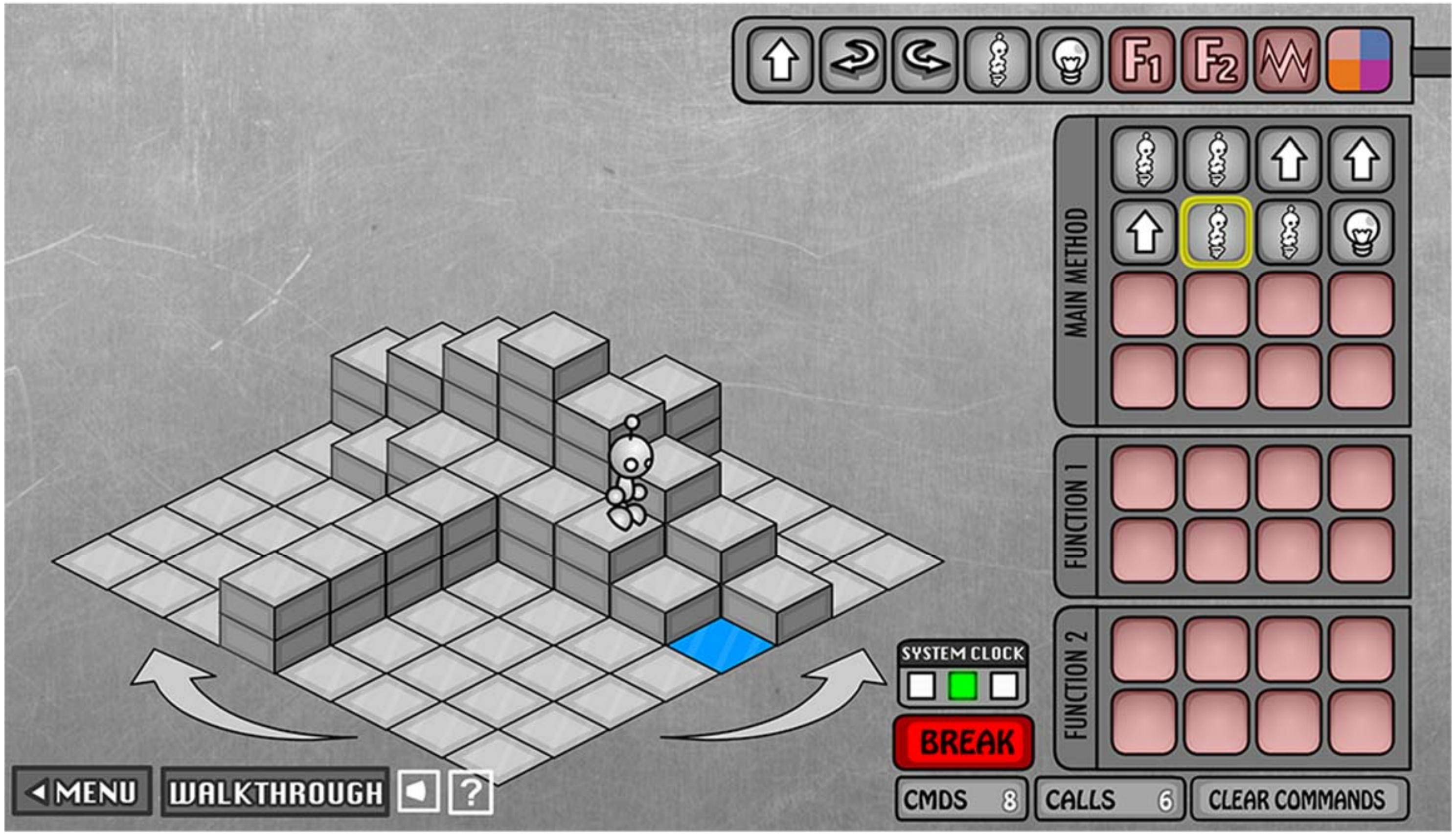
- Check-in
  - How is Exploring Lightbot going? (due tonight)
  - How is your portfolio setup going? (due Friday)
    - Sorry that we are not teaching you HTML/CSS
  - Any questions on course navigation?

- Reading Check 1 is on Canvas and due in the 24 hours preceding your Thursday lab
  - 20 minutes, short answer

- Personal Values assignment due Sunday (4/2)

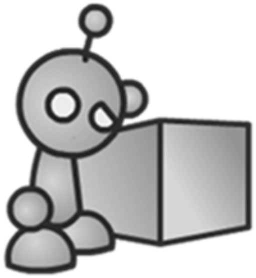
As Experienced Lightbot Players…

- What are you doing in Lightbot?
  - Commanding a robot through a world of blocks and switches



As Experienced Lightbot Players…

- What are you doing in Lightbot?
  - Commanding a robot through a world of blocks and switches
- Programming is *commanding* an *agent*
  - In this case, the agent is a robot
  - The agent is usually a computer, but could be a person or other device



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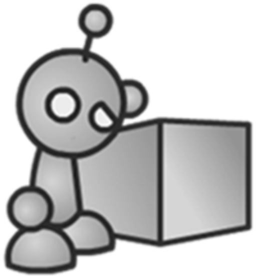
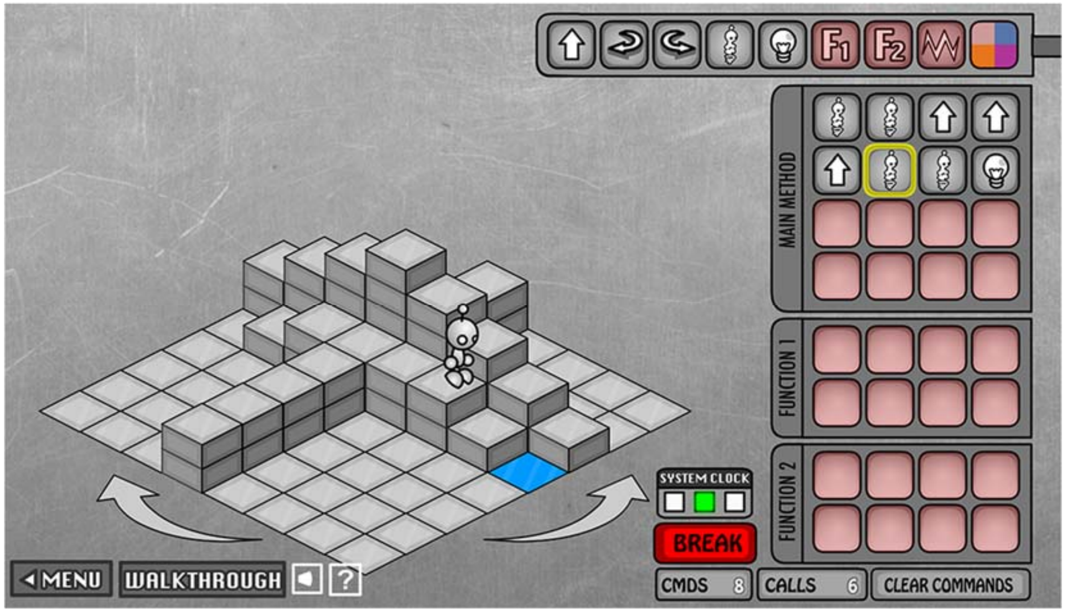


- Direct an agent to a *goal* by giving it *instructions*
  - The agent follows the instructions flawlessly and mindlessly
  - The trick is to find the right instructions to match your *intent*

Order of Instructions

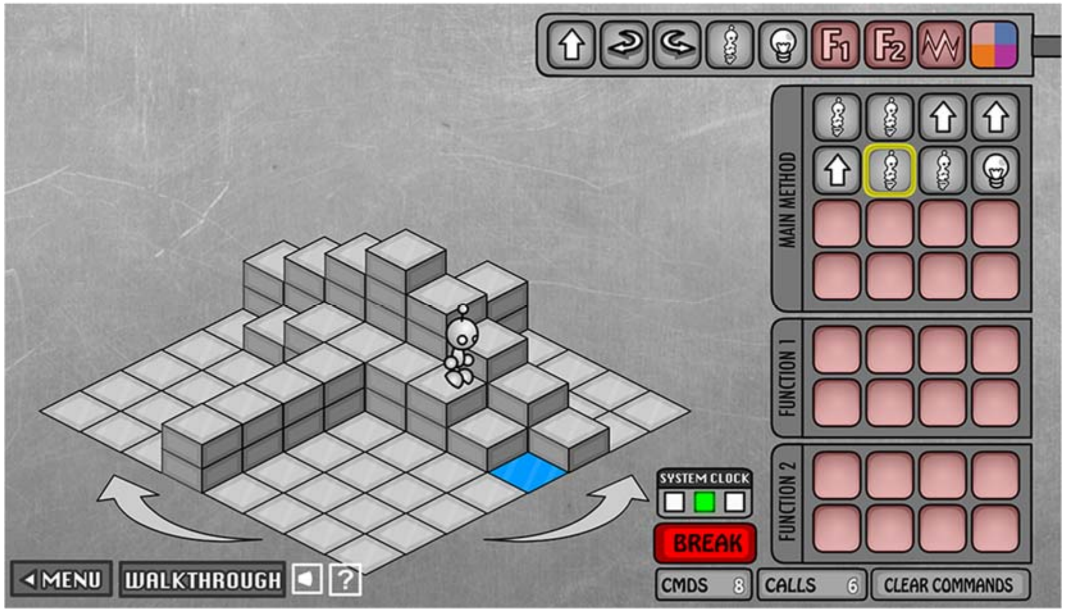
- Instructions are given in order (*i.e.* in a sequence)
  - The 1st instruction is completed, then the 2nd, then the 3rd, …

- *You* issue the instructions and the agent follows them
  - When the agent is following your instructions, this is called **executing the program**, or **running the program**



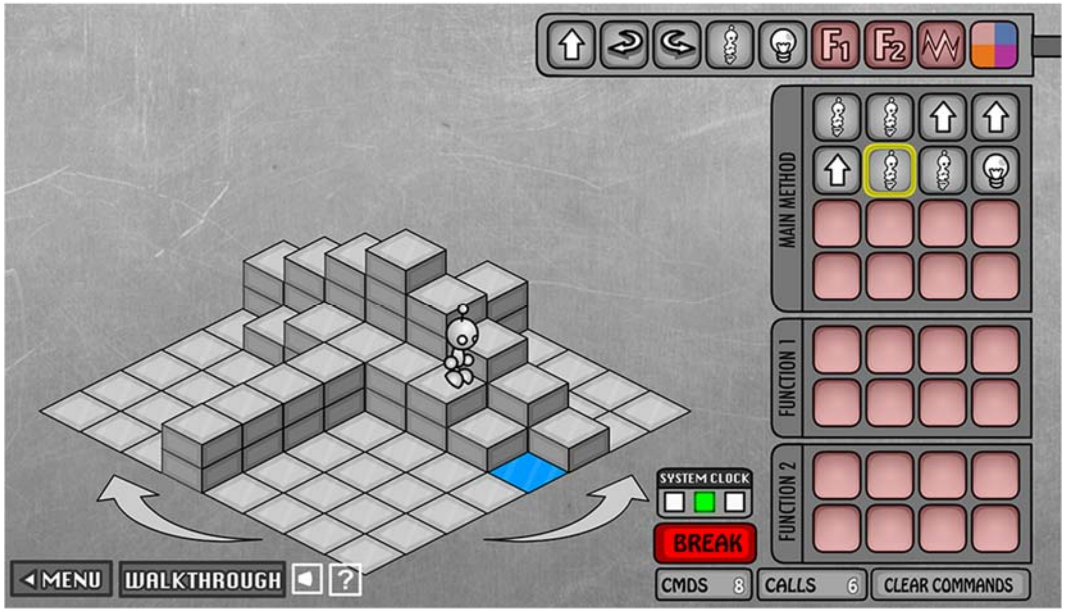
Order of Events

- The instructions are programmed *ahead of time*, and then executed *later*
  - The programmer cannot intervene until the program has finished executing or is terminated prematurely
- The instructions must be correct in order for the agent to achieve its goal



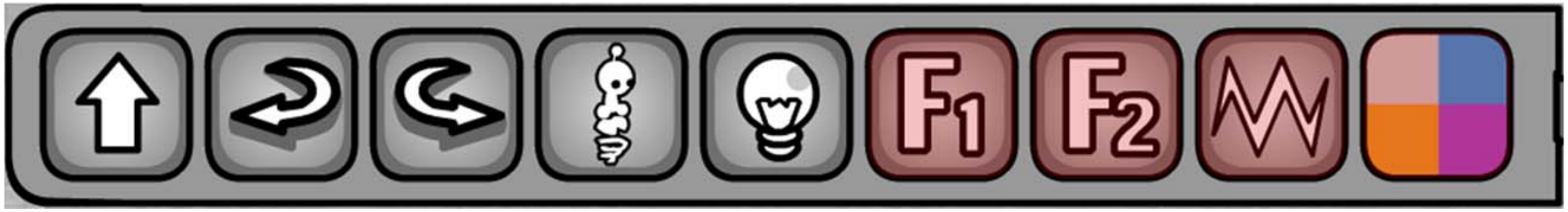
Point of View

- Programming requires you to take the agent’s point of view
  - Because it is a sequence of instructions, you must account for everything that happened before (*i.e.* trace the program)
  - There is usually an indication of where you are currently in the program (sometimes called a *program counter*)



Limited Instructions

- The number and type of instructions is always limited



  - The agent can only do certain pre-defined actions

- The agent can only execute one instruction at a time
  - Must learn how to specify complex tasks using just these simple actions

Limited Instructions

- Limited instructions is a reality of *all* computing
- A computer's hardware/circuitry can only execute a small number of instructions – usually about 100
  - Many are just different versions of the same idea

Amazing Fact:

In theory, a computer with just SIX instruction types could compute all known computations!

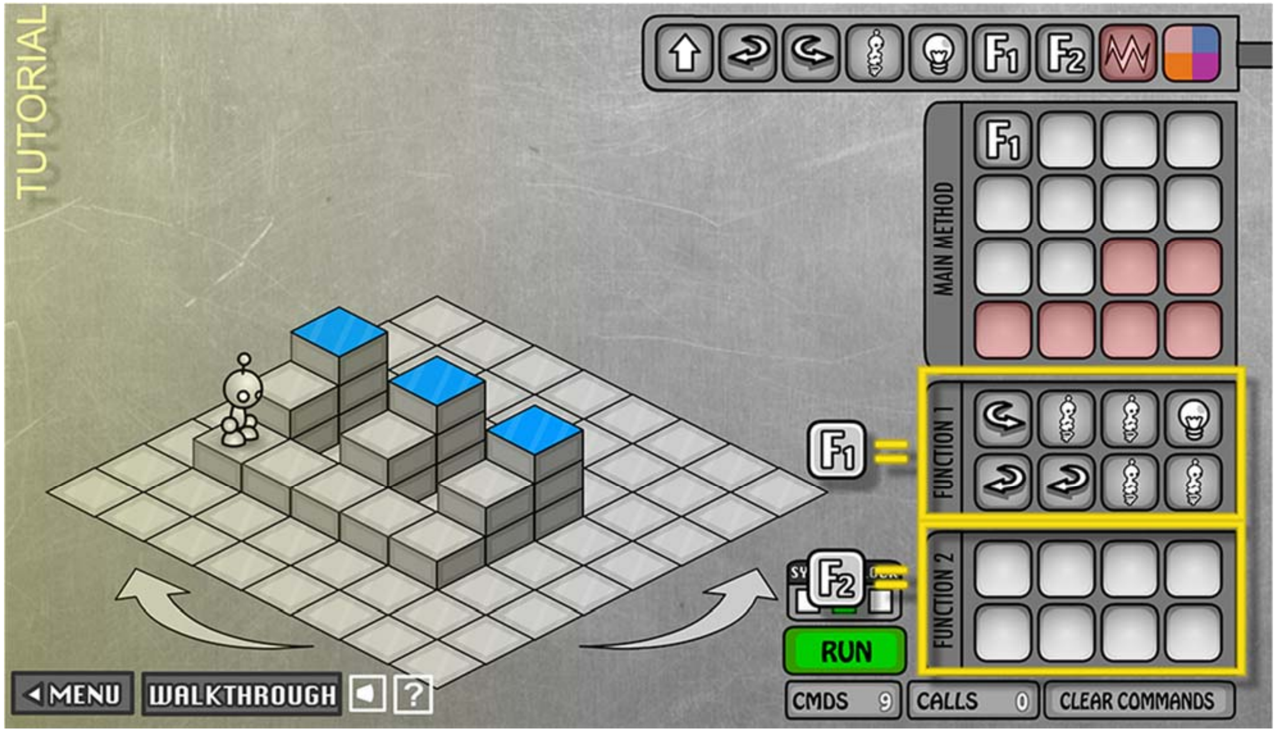
Back in Reality

- Programming would be amazingly tedious if you could only use the basic instructions
  - No one would be a programmer no matter how much it paid!
  - The amazing applications we see today would not exist

- The early days of programming were like this
  - Tedious and error-prone

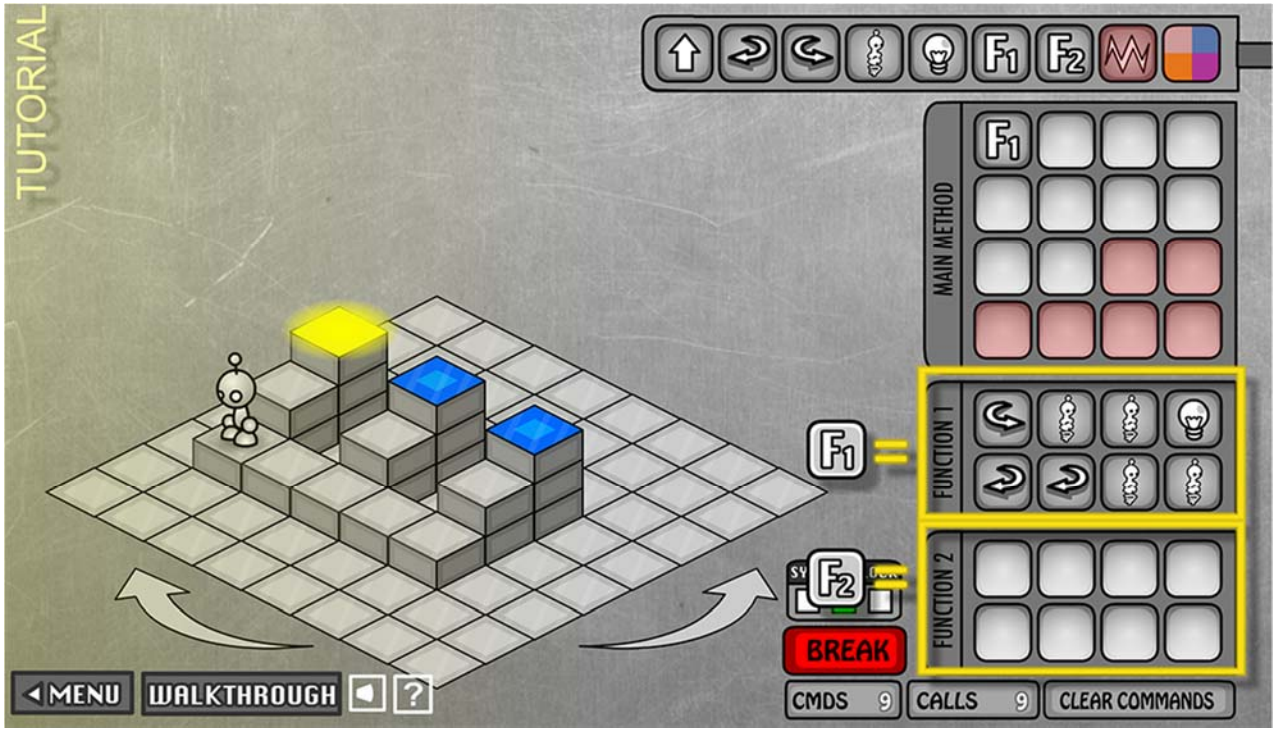
Solution: Functions!

- Functions allow us to create new, more complex instructions for our agents
  - Below, F1 is a function to "process a riser"
  - We can call a function by name (F1) to execute its instructions



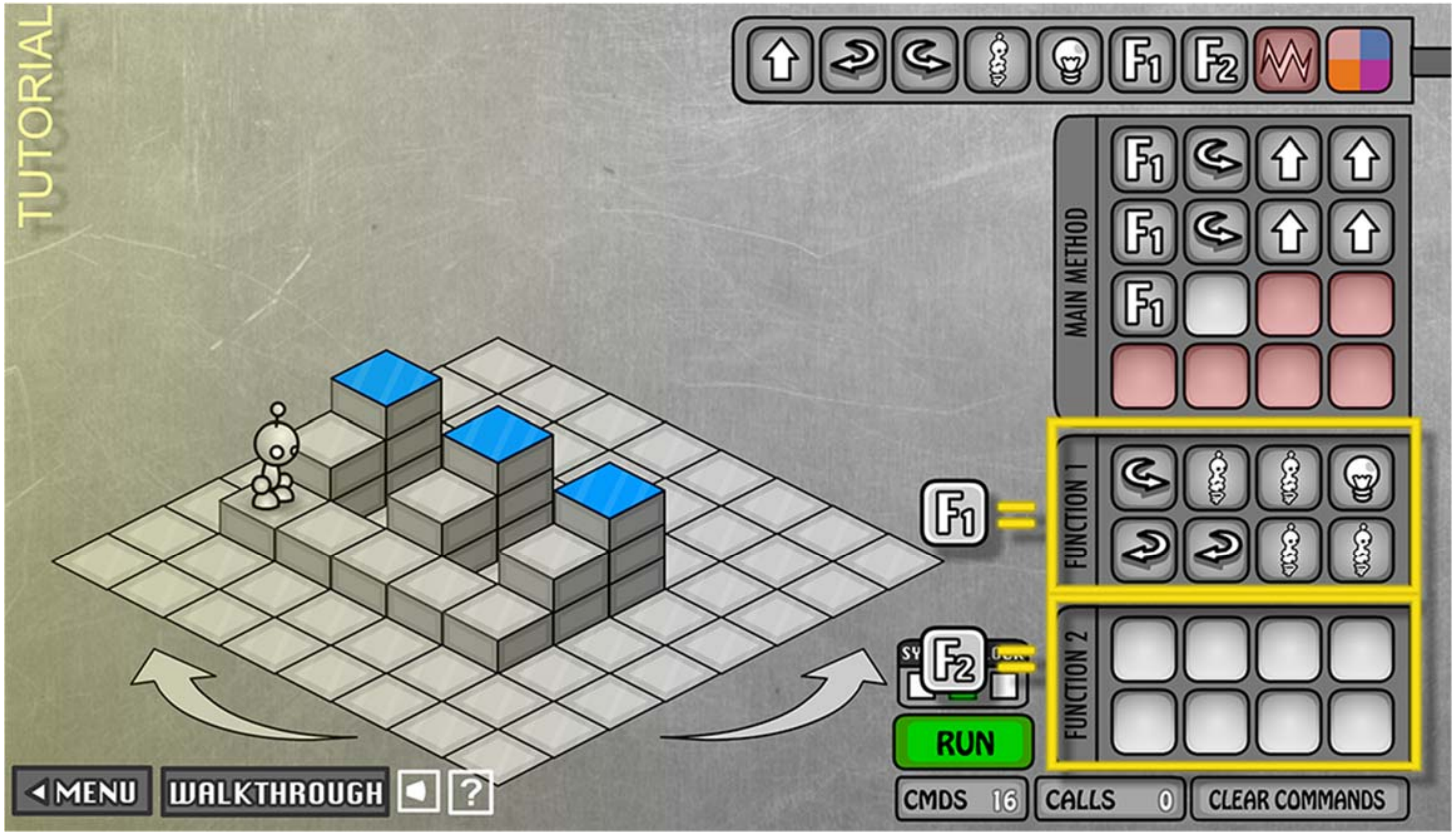
Choosing Functions

- The goal is to break down a complex problem into smaller/simpler ones
- Look for common patterns
  - "Process a riser" looks like a useful sub-problem because there are three of them [DEMO]



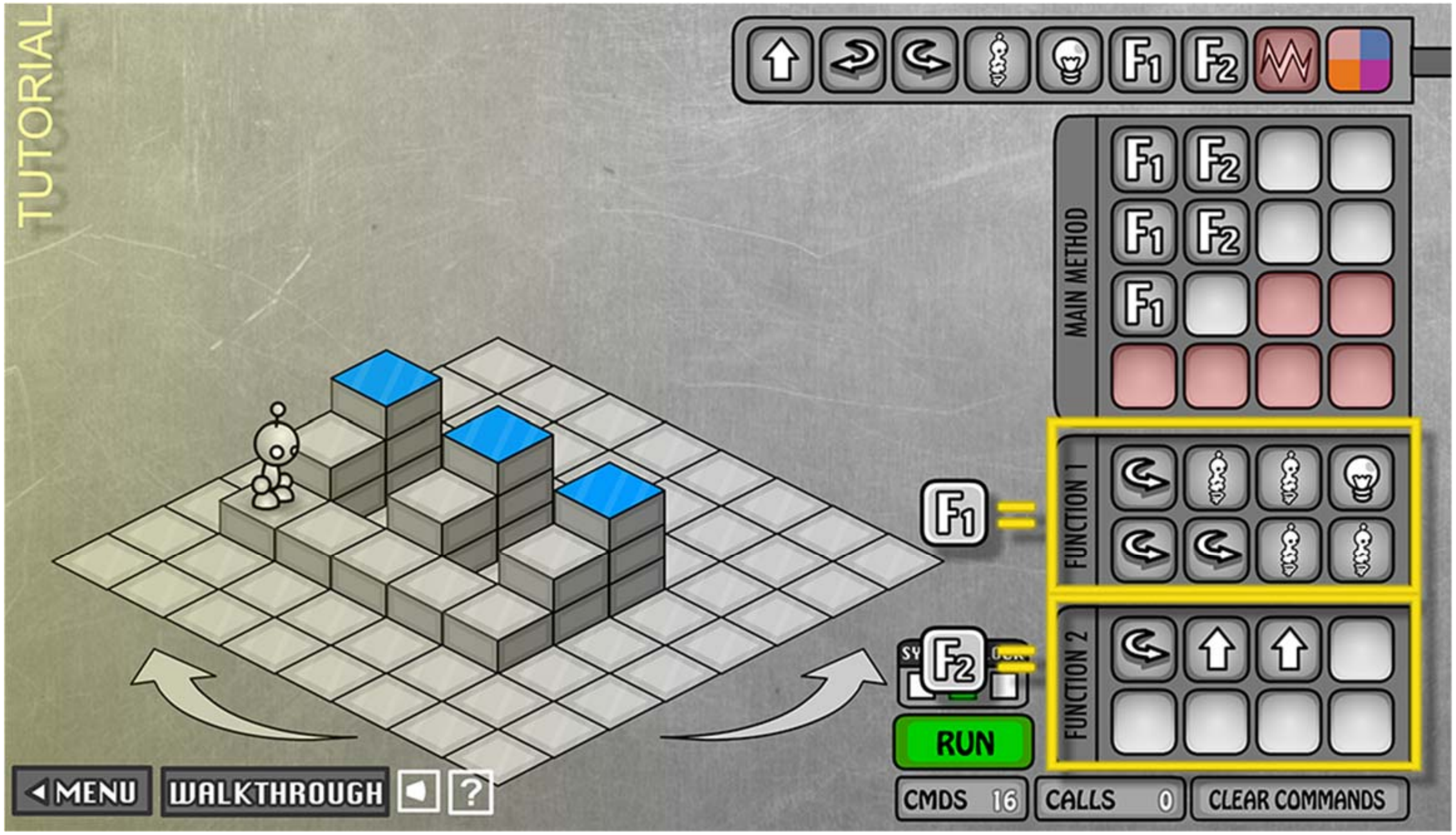
Choosing Functions

- One possible solution is shown below:
  - 17 commands, 29 calls



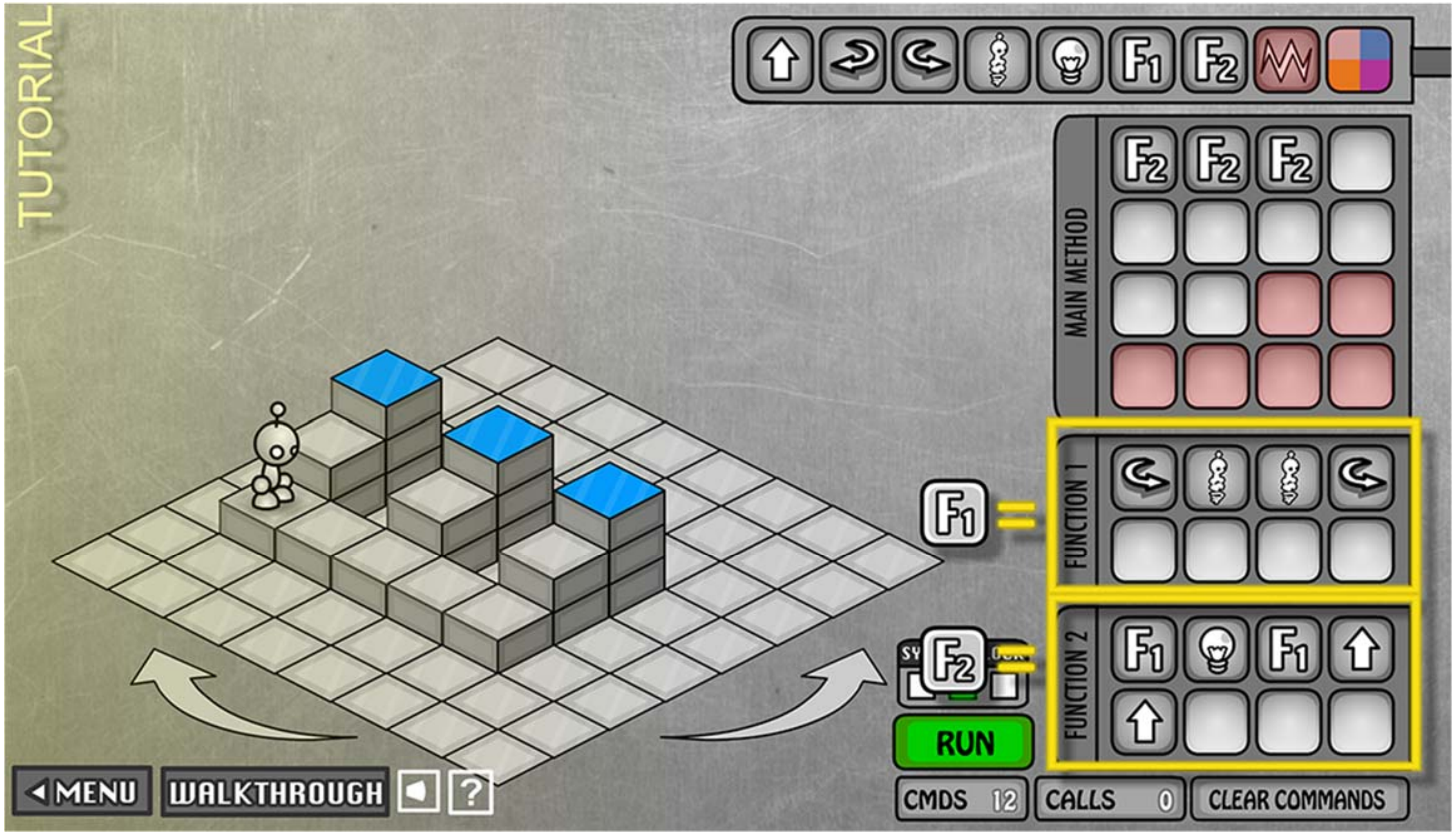
Choosing Functions

- Modified solution is shown below:
  - Now F2 is a function to "move to next riser"
  - 16 commands, 31 calls



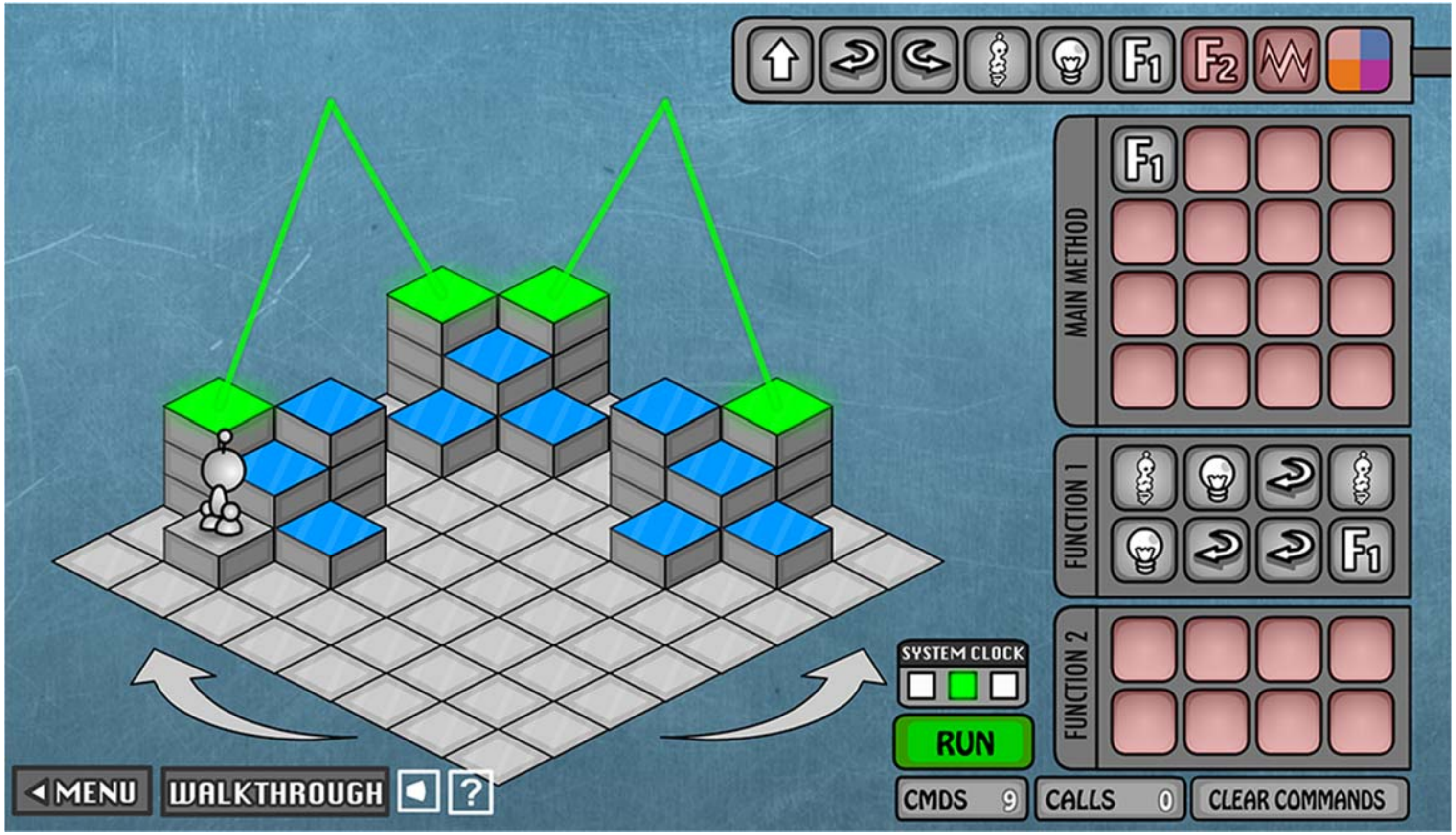
Choosing Functions

- Yet another solution shown below:
  - F1 is “traverse steps”, F2 is “process riser and move to next”
  - 12 commands, 35 calls



Recursion

- Special case where a function calls itself
  - "Conceptual unit" might apply again, immediately
  - More about this later in the course



Peer Instruction Question

- Which of the following statements is TRUE?
  - Vote at http://PollEv.com/justinh

A. An agent can learn new instructions

B. It is the agent's fault if the goal is not achieved

C. All ways to decompose a problem into functions are equally good

D. None of the above

E. We're lost…

Functions Summary

- Functions may seem “obvious” to you, but they are a foundational idea of computer science
    - Abstraction in action!

- *Functional abstraction* helps us solve problems:
    - Reduce complexity: identify and solve a coherent activity or action (sub-problem) that can be reused
    - Associate these sub-problems with intuitive names
    - Solve the whole problem by composing functions

- There is no “correct” way to abstract!

Looking Forward

- Continue to explore the concept of programming in the realm of Lightbot
  - Now symbolically – not restricted by computer or clicking

- Symbolic Lightbot
  - Start in lab tomorrow, due Friday (3/31)
  - Use handwritten symbols for instructions

- Lightbot Functions
  - Create functions using handwritten symbols

```
F.turnaround()  R,R.
```