Functions And Abstraction

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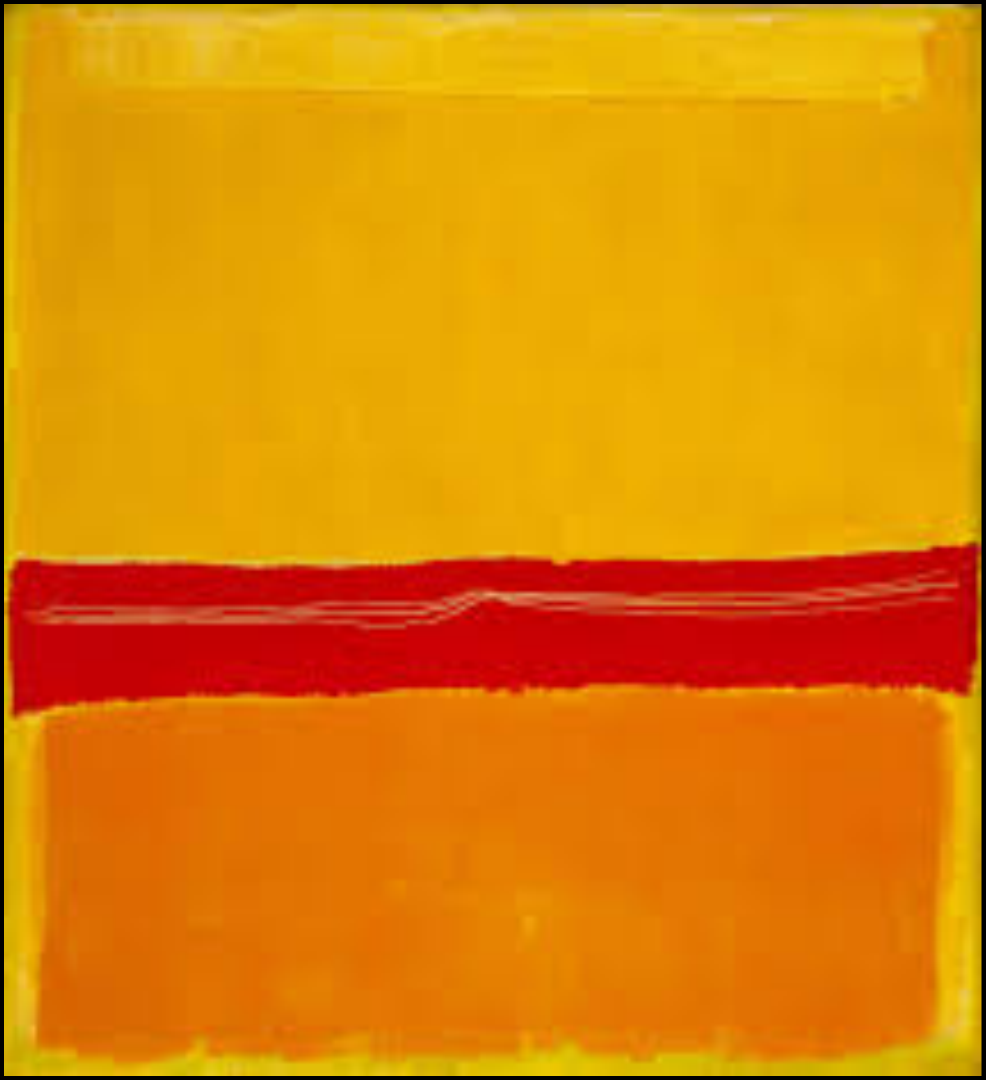
Abstraction … it's all "idea"



No. 5/No. 22

Mark Rothko

In CS We Abstract A Lot …

- *Abstraction* is the act of recognizing and then removing an idea or concept or process from a situation.

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  - "A fox saw some juicy grapes growing on a fence. He tried and tried to reach them, but failed. Finally, he walked away, saying 'They were probably sour'"
- Extract an idea – one failing to get something they want, often claims in the end it's no good.
  - Abstracting – separate relevant from irrelevant
  - Recast the idea in more general terms

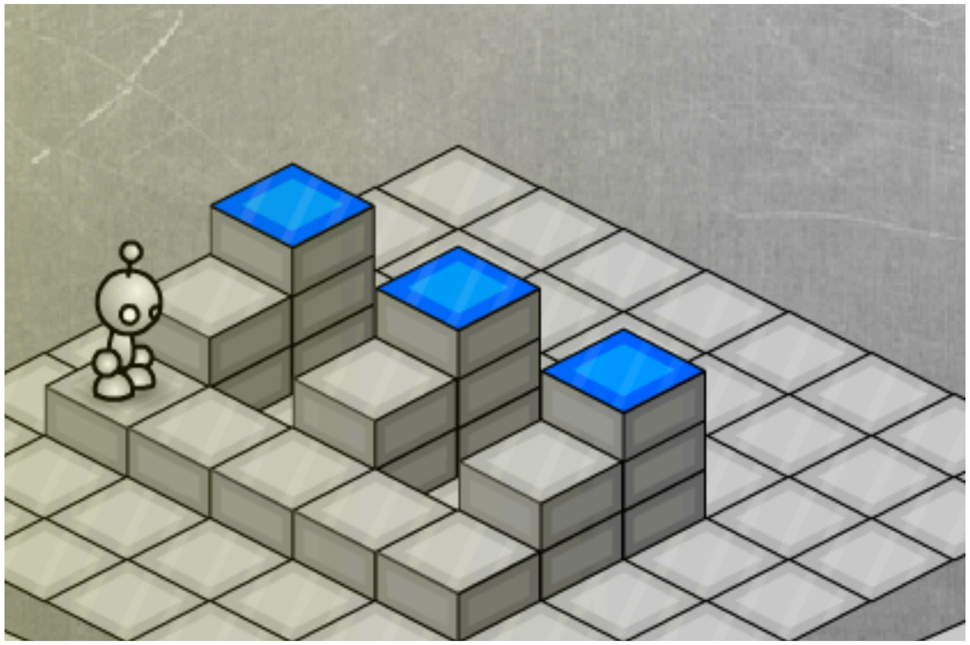
Recall last time …

- We discussed Functions last time, a seemingly “obvious” idea …
- They allow us to solve problems by first creating a useful über instruction, and then applying it to simplify our work
- Let’s recall how they work …

The Function Becomes A Concept

- Because we noticed "process a riser," as an action we needed to do (more than once) we think of the programming task as

```
Process a riser
Move to next riser
Process a riser
Move to next riser
Process a riser
```



Abstracting Finds "Concept

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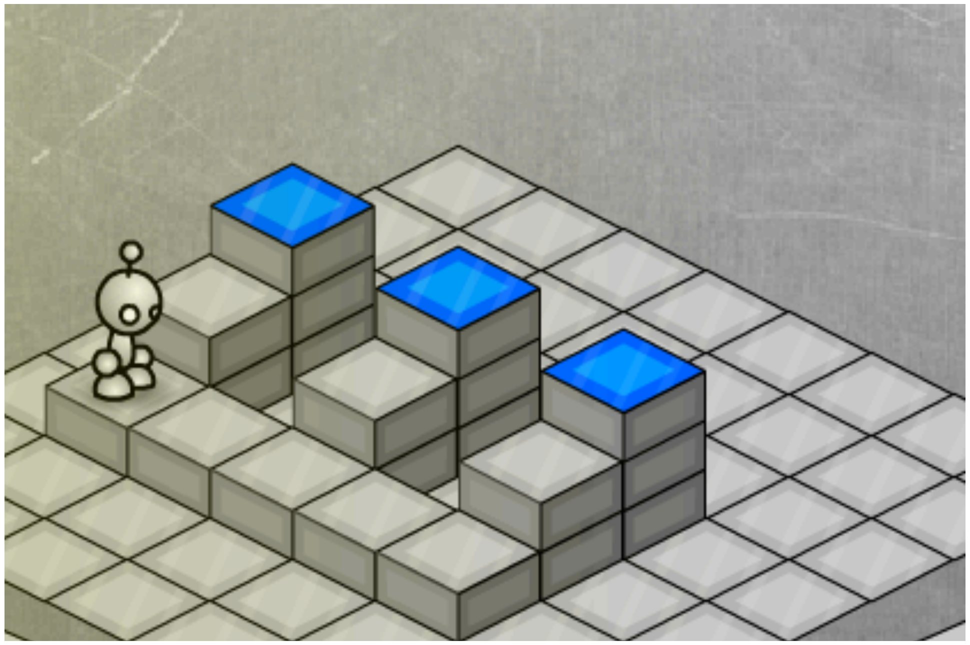
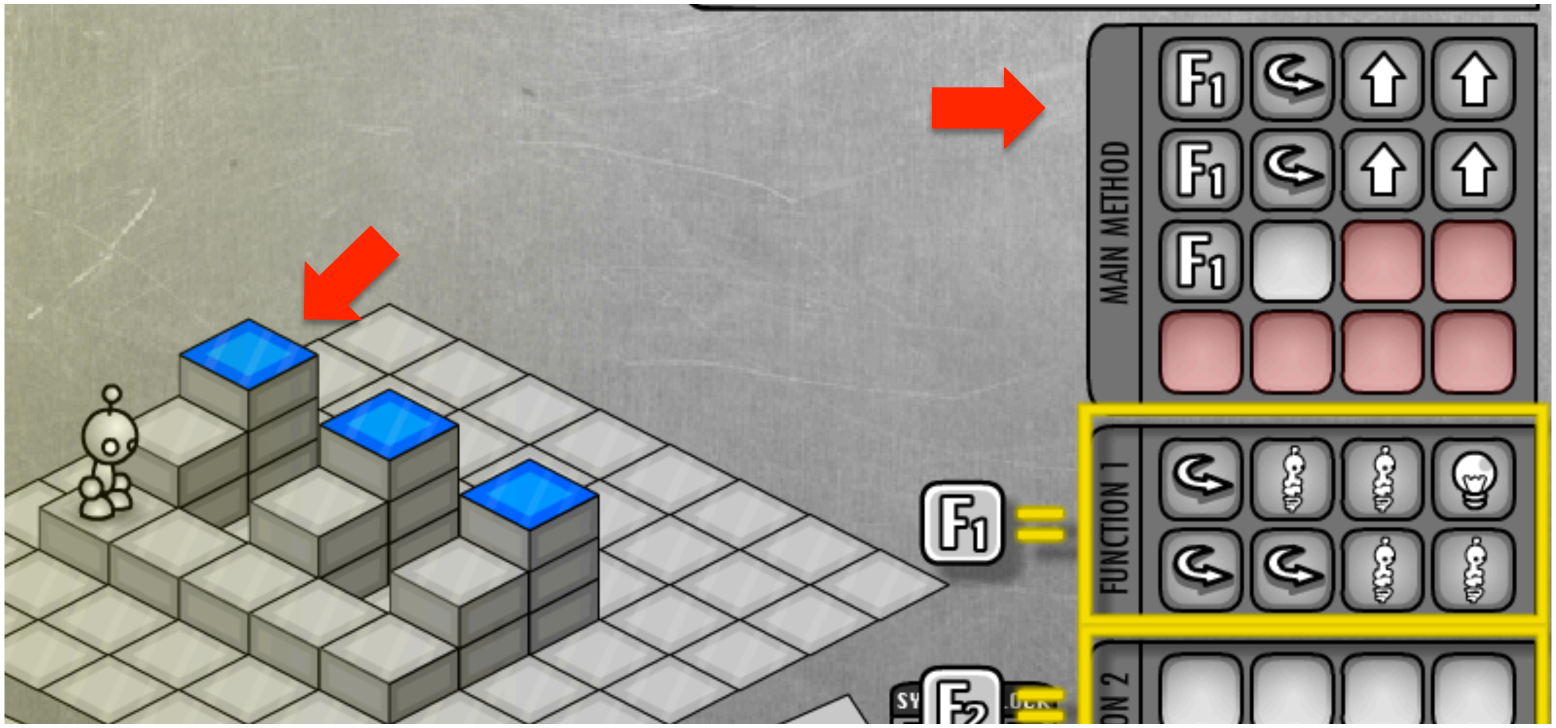


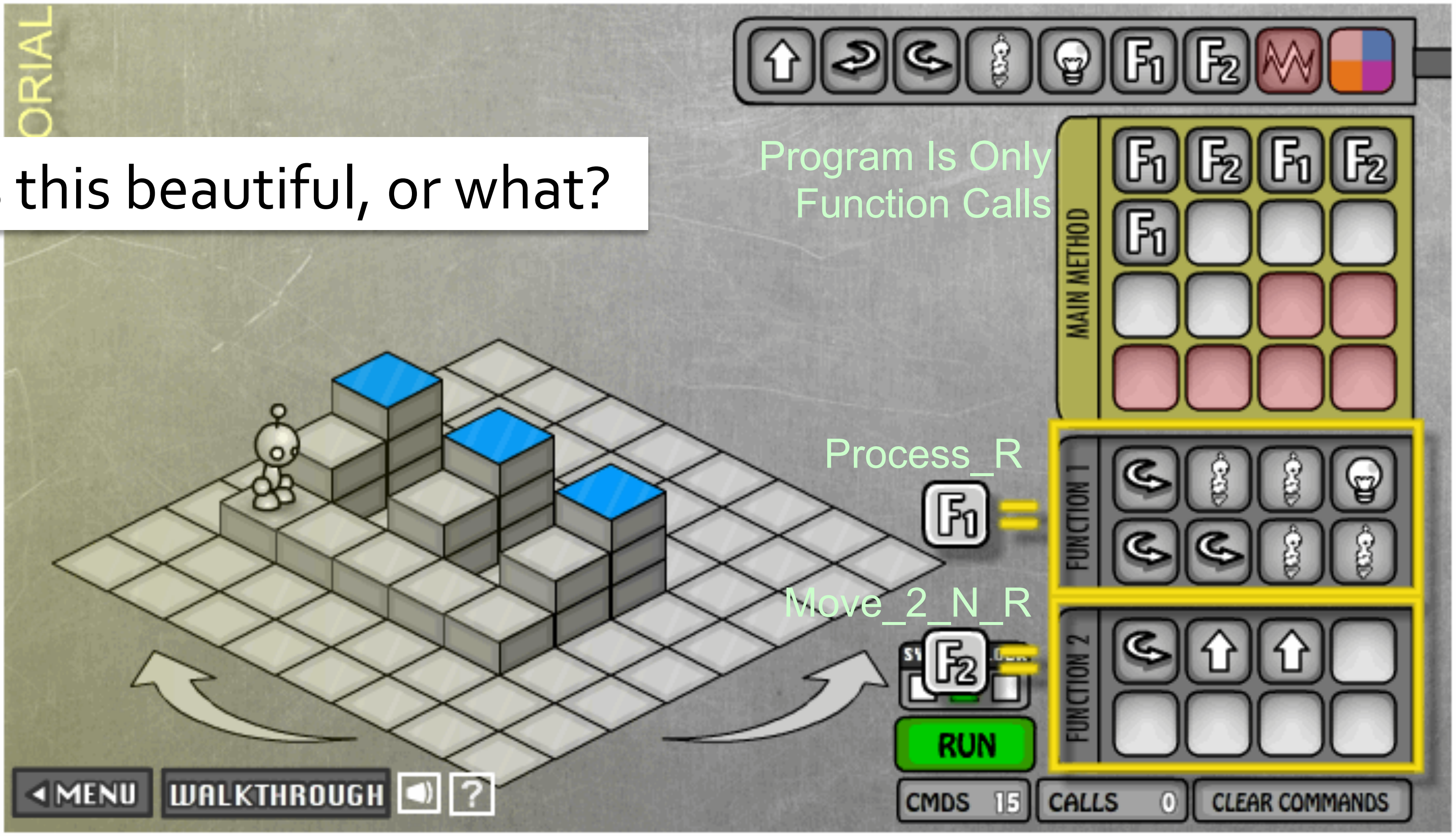
- Abstracting!
- Simplifies: reduce to 5 conceptual steps rather than 21

Noticing Conceptual "Units"

- We can "see" abstractions in the problem (riser picture) or in the solution (instruction pattern) … where we find them doesn't matter



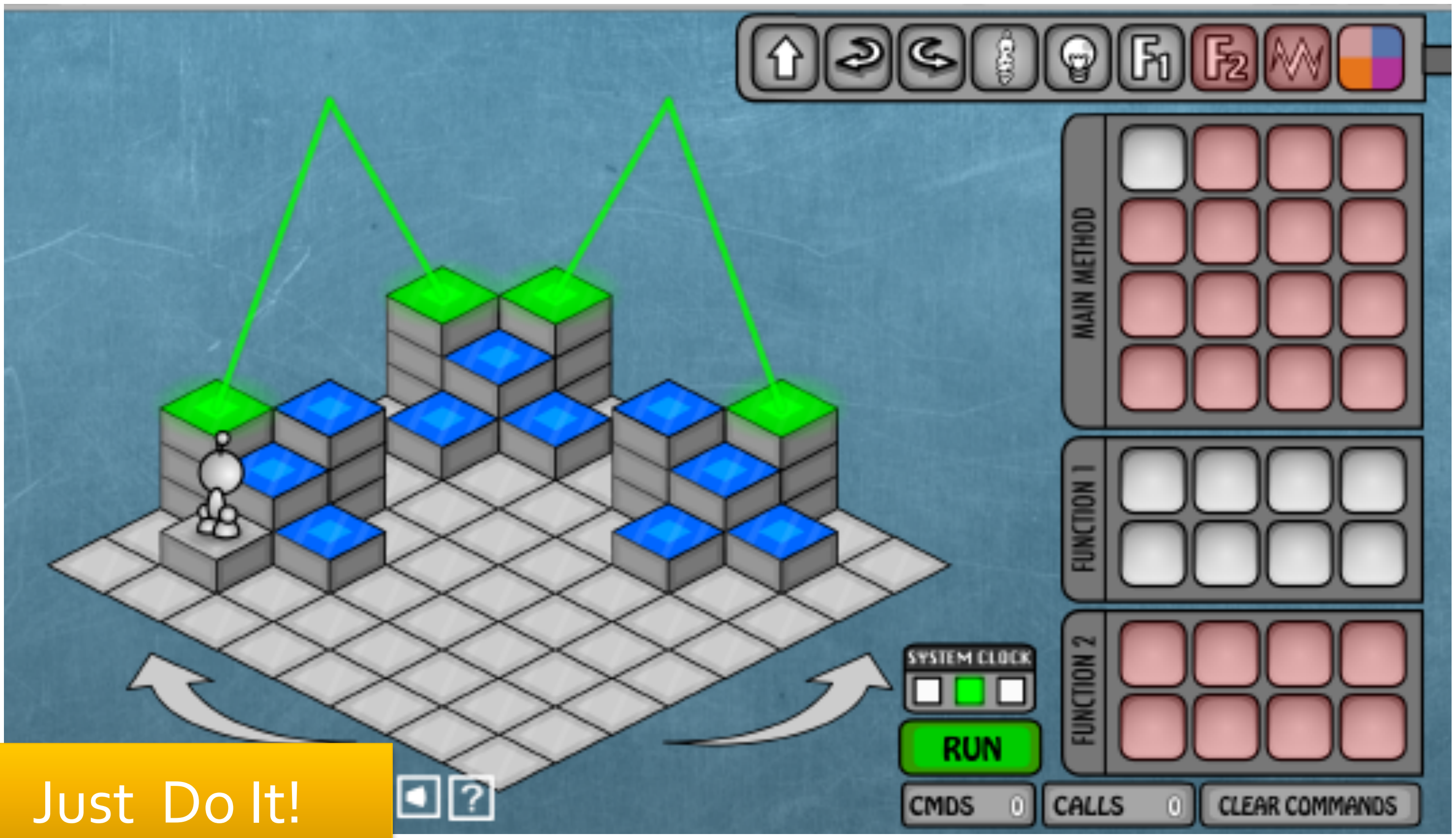
A Five Instruction Program



Is this beautiful, or what?

Recursion Also Applies Abstraction

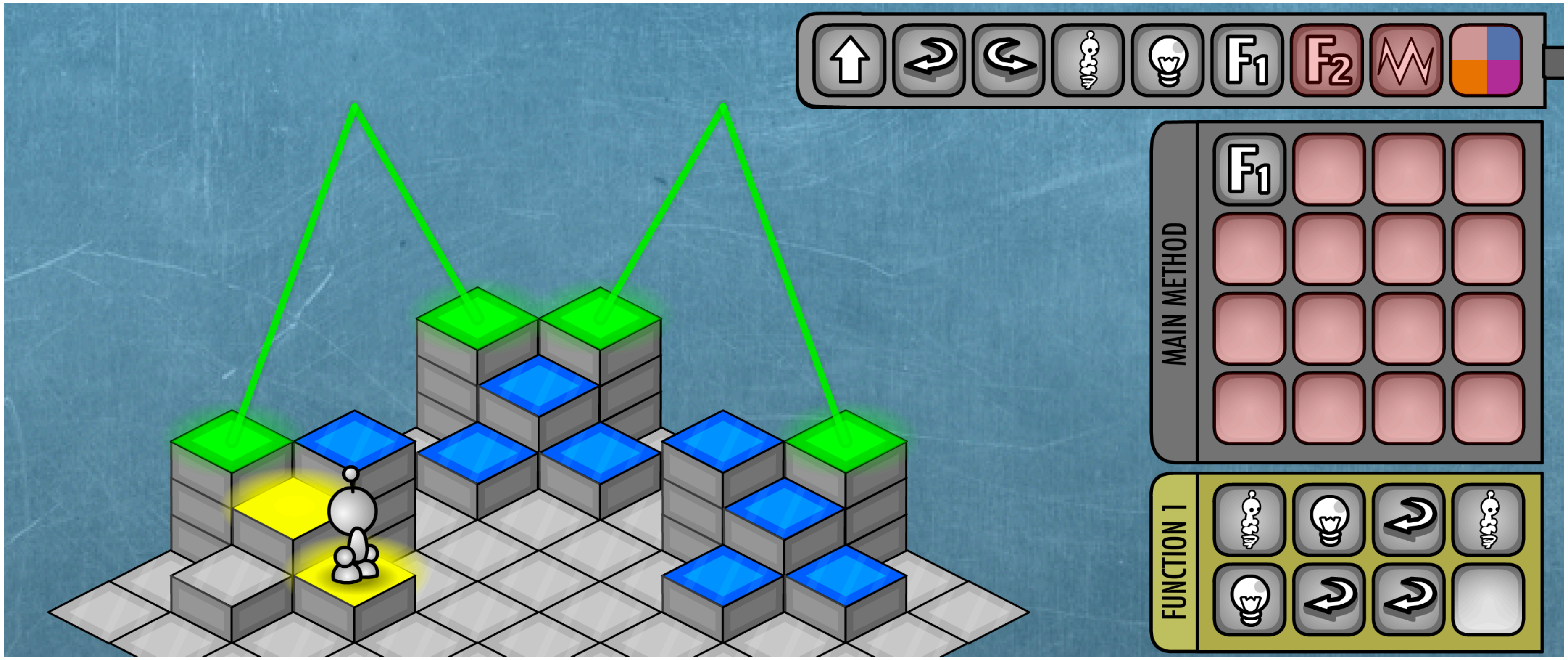
- A "conceptual unit" – that is, the abstraction – might apply again, immediately



Just Do It!

2-Step Process

- The abstraction may be a little difficult to name … let’s call it 2-step-right



Abstraction …

- Formulating blocks of computation as a "concept" is **functional abstraction** [A better definition in a moment]
- What we did just now is important …
  - We spotted a coherent (to us) part of the task
  - We solved it using a sequence of instructions
  - We put the solution into a function "package", gave it a name, "process a riser," and thus created a new thing, a concept, something we can talk about & use
  - Then we used it to solve something more complicated … and then we did it again!

Abstracting

- Collecting operations together and giving them a name is *functional abstraction*
  - The operations perform a coherent activity or action – they become a *concept* in our thinking
  - The operations accomplish a goal that is useful – and typically – is needed over and over again
  - *Functions* implement functional abstraction: 3 parts
    - A name
    - A definition (instruction seq), frequently called a "body"
    - Parameters –stuff inside the parentheses, covered later

process_A_riser( )

People Abstract All The Time

- Functional abstractions in which you are the agent, but someone taught you:
  - Parallel parking
  - Backstroke in swimming
- Functional abstractions you recognized and in which you are the agent
  - Doing a load of laundry
  - Making your favorite {sandwich, pizza, cookies, …}
- Others?

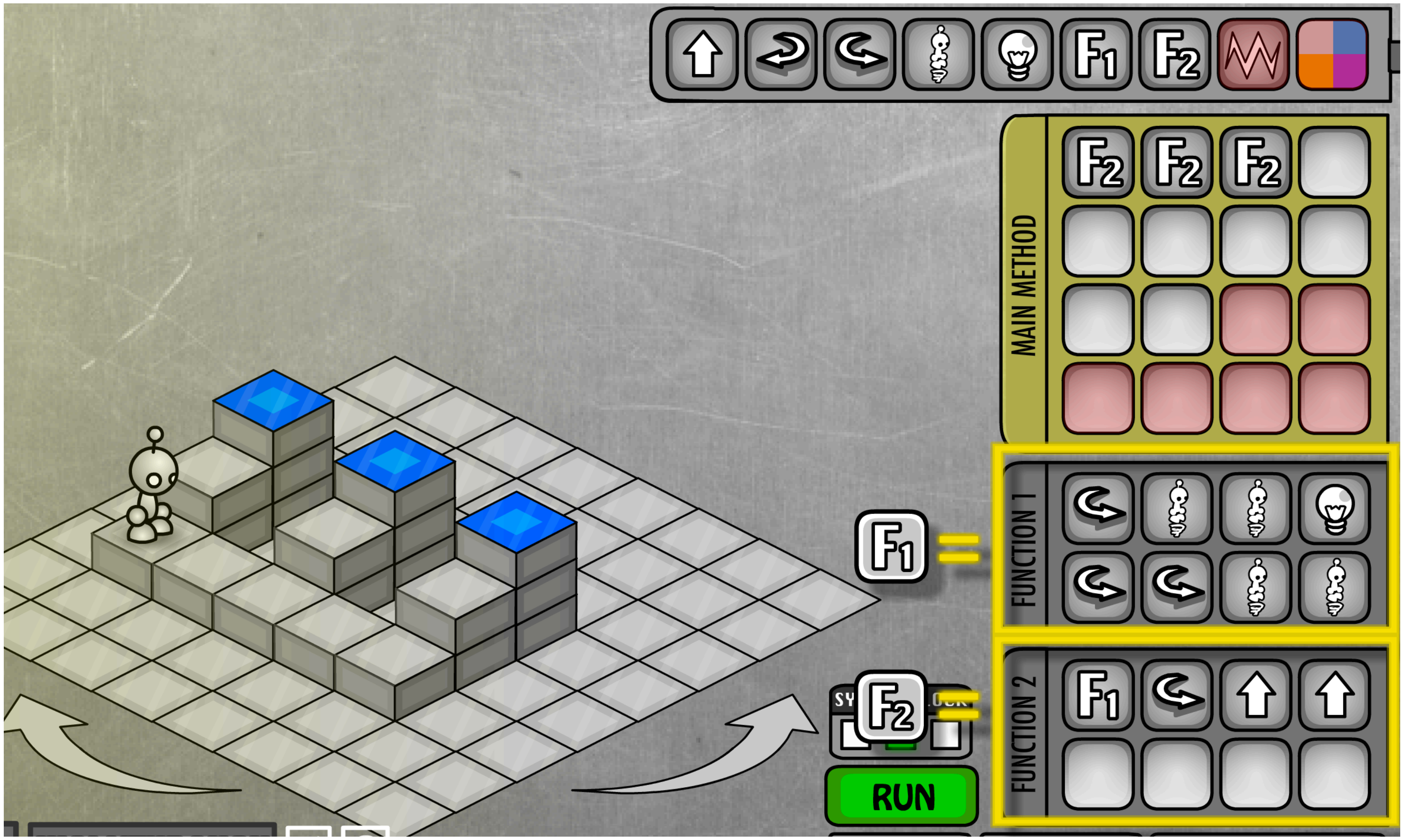
No “Correct” Way To Abstract

- We have abstracted “process a riser” and “move to the next riser” as components of a solution
- As concepts, they are packaged into functions
- Maybe you thought of this in a different way
- That is, there can be other “coherent” parts of a solution

Just Do It!

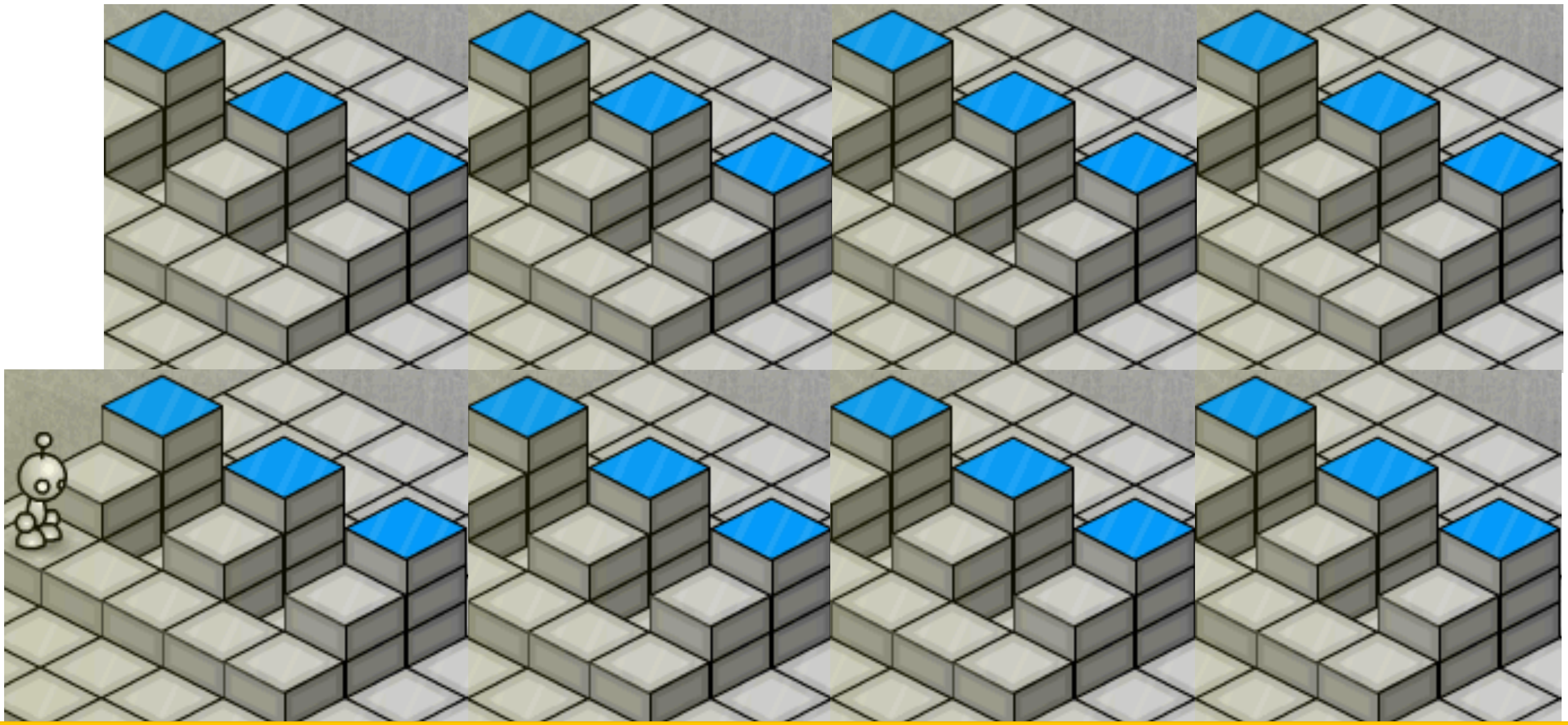
The Function Is Just The Packaging

- Another way to use abstraction



Keep On Using Abstraction …

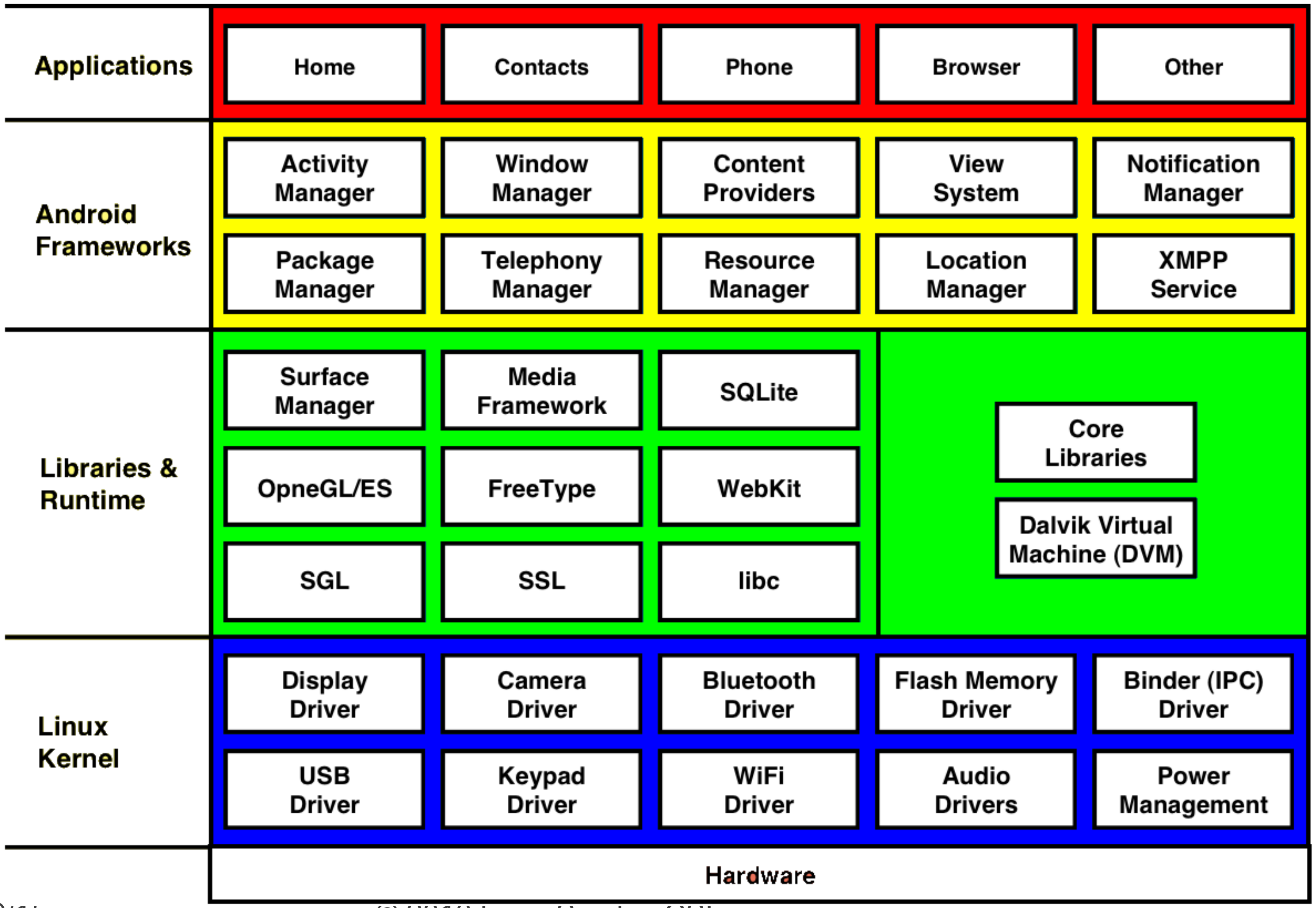
- If M.C. Escher handed us a problem … what would we do?



It only simplifies our **thinking**; the bot still does all the work

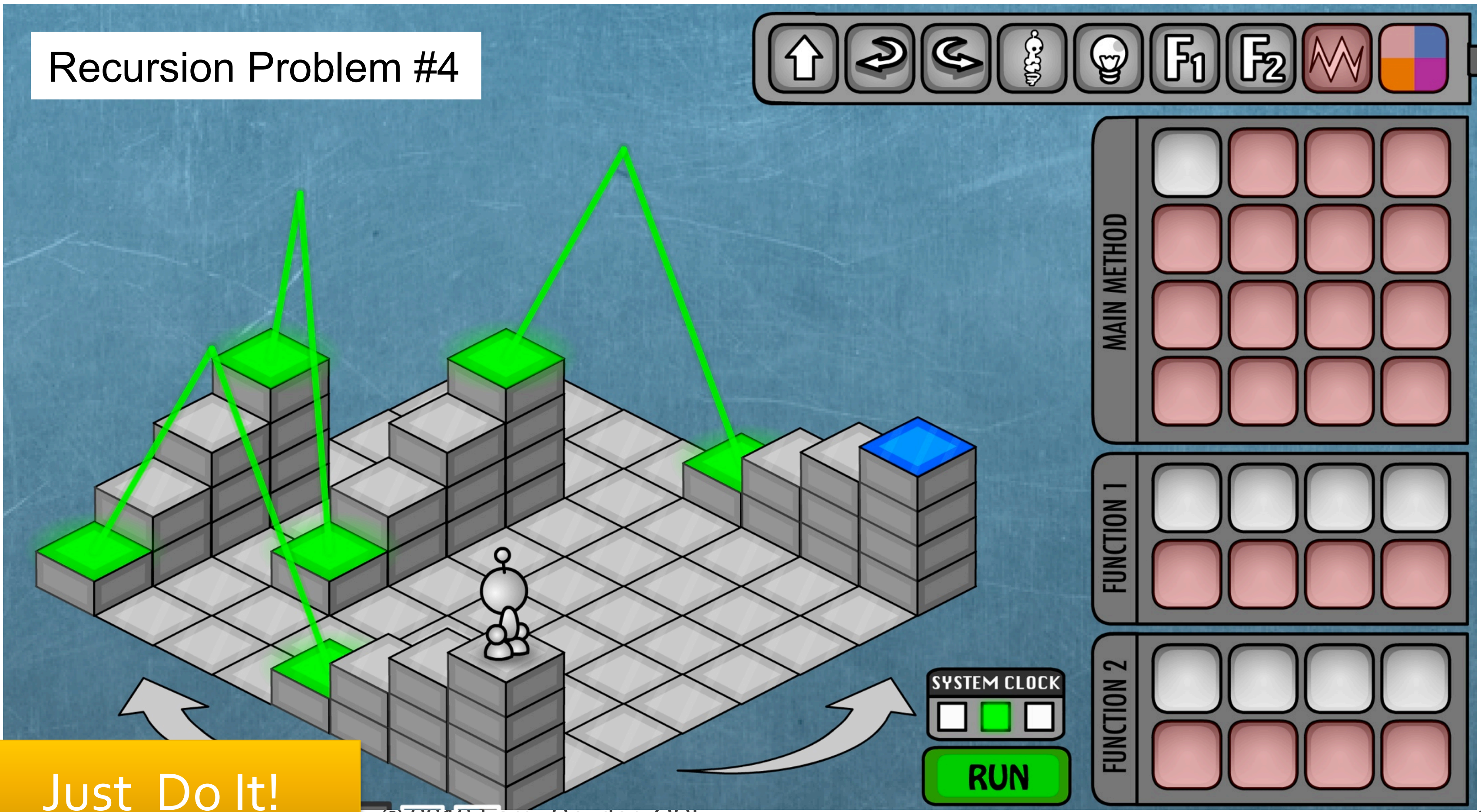
How Useful Is This Idea

- Say "Hi" to Android's Software Stack



Abstraction For Problem Solving

- Abstraction is a big deal because it enables you do decompose or breakdown problems



Just Do It!

Summarizing Abstraction

- Abstraction is a "thinking tool" you use everyday … in this class you will consciously apply it in programming & problem solving

- Functional Abstraction – the process of spotting a concept, "packaging" it as a function (at least in your own mind) and using it to solve some tougher problem – is ready to help when the problem is "so confusing"!

Prepping Is Nearly Over

- Today’s assignment covers functional abstraction … and then we’re ready to go!