Reactors

1 March 2023
Where are we?
Where are we?
Traffic-light world
All traffic lights are the same size and position on the screen.

What distinguishes them?

Asking this helps us think about data.
All traffic lights are the same size and position on the screen.

How do we get from one to the other?

Asking this helps us think about functions.
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- **Example**:

  - **Signature**
  - **Examples**
  - **Body**
data TrafficLight:
    ...
end
data TrafficLight:
    | green
    | yellow
    | red
end
Data

Data definition

Examples

Template

Functions

Signature

Docstring

Examples

Body
data TrafficLight:
  | green
  | yellow
  | red
end

TL–GREEN = green
TL–YELLOW = yellow
TL–RED = red

For this data definition, the examples are so trivial we can skip them, but you saw in lab on Friday how helpful it can be to have examples when you have a lot of possibilities!
data TrafficLight:
| green  
| yellow 
| red    
end
Data

Data definition
Examples
Template

Functions

Signature
Docstring
Examples
Body
data TrafficLight:
  |
  | green
  |
  | yellow
  |
  | red
end
data TrafficLight:
  | green
  | yellow
  | red
end

fun trafficlight-fun(tl :: TrafficLight) -> ...:
 | #
data TrafficLight:
    | green
    | yellow
    | red
end

fun trafficlight-fun(tl :: TrafficLight) -> ...
    doc: "TrafficLight template"
    cases (TrafficLight) tl:
        | green => ...
        | yellow => ...
        | red => ...
end

where:
    trafficlight-fun(green) is ...
    trafficlight-fun(yellow) is ...
    trafficlight-fun(red) is ...
end
Data

Data definition
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Signature
Docstring
Examples
Body
Pyret has a mechanism for supporting interactive programs, called a **reactor**.

To use it, first write

```python
include reactors
```
reactor:
  init: initial-state
  to-draw: draw-function
    event-type: event-function
end
reactor:
  init: initial-state
  to-draw: draw-function
  event-type: event-function
end
Less nuclear reactor; more person-that-reacts to something.
reactor puts all the pieces together to start things going.
initial state
some event happens…
next state
next state

now the current state
some event happens…
next state

now the current state
some event happens…
next state

now the current state
reactor:
  init: initial-state,
  to-draw: draw-function,
  event-type: event-function
end
reactor:
  init: green,
  to-draw: draw-function,
  event-type: event-function
end
reactor:
  init: green,
  to-draw: draw-light,
  event-type: event-function
end

We haven’t written this; add it to our wishlist!
reactor:
  init: green,
  to-draw: draw-light,
  on-tick: next-light
end

Another function for the wishlist!
So far...

# TrafficLight data
# - definition
# - examples
# - template

# define reactor

# Wishlist:
# - fun draw-light...
# - fun next-light...
Data

Data definition
Examples
Template

Functions

Signature
Docstring
Examples
Body
fun draw-light(tl :: TrafficLight) -> Image:
  ...
end
fun draw-light(tl :: TrafficLight) -> Image:
  ...
end

fun next-light(tl :: TrafficLight) -> TrafficLight:
  ...
end
fun draw-light(tl :: TrafficLight) -> Image:
    doc: "Draw a circle of the given color, rendering a traffic light"
    ...
end

fun next-light(tl :: TrafficLight) -> TrafficLight:
    ...
end
fun draw-light(tl :: TrafficLight) → Image:
  doc: "Draw a circle of the given color, rendering a traffic light"
  ...
end

fun next-light(tl :: TrafficLight) → TrafficLight:
  doc: "Produce the next light in the sequence green, yellow, red"
  ...
end
fun **draw-light** (tl :: TrafficLight) -> Image:
  doc: "Draw a circle of the given color, rendering a traffic light"
  ...
where:
  draw-light(green) is circle(20, "solid", "green")
  draw-light(yellow) is circle(20, "solid", "yellow")
  draw-light(red) is circle(20, "solid", "red")
end

fun **next-light** (tl :: TrafficLight) -> TrafficLight:
  doc: "Produce the next light in the sequence green, yellow, red"
  ...
end
fun draw-light(tl :: TrafficLight) -> Image:
  doc: "Draw a circle of the given color, rendering a traffic light"
  ...
where:
  draw-light(green) is circle(20, "solid", "green")
  draw-light(yellow) is circle(20, "solid", "yellow")
  draw-light(red) is circle(20, "solid", "red")
end

fun next-light(tl :: TrafficLight) -> TrafficLight:
  doc: "Produce the next light in the sequence green, yellow, red"
  ...
where:
  next-light(green) is yellow
  next-light(yellow) is red
  next-light(red) is green
end
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Shrinking circle world
Fractal tree
How can we draw a tree?
A big tree is a stick with two smaller trees on top; but a little tree is just a stick.
A big tree is a stick with two smaller trees on top; but a little tree is just a stick.

data Tree:
  | stick
  | branch(t1 :: Tree, t2 :: Tree)
end
To finish this data definition, we should add examples and a template function.
# Examples

lil-tree = branch(stick, stick)

big-tree =
    branch(
        branch(stick, stick),
        branch(stick, stick))

# Template

fun tree-fun(tree :: Tree) -> ...:
    doc: "Tree template"
    cases (Tree) tree:
        | stick => ...
        | branch(t1, t2) => ... tree-fun(t1) ... tree-fun(t2) ...
    end

where:
    tree-fun(stick) is ...
    tree-fun(lil-tree) is ...
    tree-fun(big-tree) is ...

end
How can we draw a Tree?
fun draw-tree-size(tree :: Tree, size :: Number) -> Image:
  doc: "Draw a tree based on a line of the specified size"
  stick-tree = line(1, size, "black")
  cases (Tree) tree:
    | stick =>
      # A small tree is just a stick
      stick-tree
    | branch(t1, t2) =>
      # A branch is
      above(
        # Two smaller trees
        beside(
          rotate(45,
            draw-tree-size(t1, size / 2)),
          rotate(-45,
            draw-tree-size(t2, size / 2))),
        # Above a stick
        stick-tree)
  end
end
TREE-SIZE = 400

fun draw-tree(tree :: Tree) -> Image:
    doc: "Draw a tree (and its subtrees)"
    draw-tree-size(tree, TREE-SIZE)
end
Now, let’s use a reactor to animate the recursion of the fractal, starting from the simplest tree and working toward a full, leafy one.
One more reactor
Acknowledgments

This lecture incorporates material from:

W. Daniel Hillis, *The Pattern on the Stone*
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