Reactors

31 October 2022
Where are we?
Where are we?
Traffic-light world
All traffic lights are the same size and position on the screen.
All traffic lights are the same size and position on the screen.

What distinguishes them?
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.
All traffic lights are the same size and position on the screen.

How do we get from one to the other?
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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data TrafficLight:
  ...
end
data TrafficLight:
  | green
  | yellow
  | red
end
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 |#
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Pyret has a mechanism for supporting interactive programs, called a **reactor**.

To use it, first write

```plaintext
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: red,
to-draw: draw-function,
  event-type: event-function
end
reactor:
  init: red,
  to-draw: 
    draw-light,  
    event-type: event-function
end
reactor:
  init: red,
  to-draw: draw-light,
  event-type: event-function
end

We haven’t written this; add it to our wishlist!
reactor:
    init: red,
    to-draw: draw-light,
    on-tick: next-light
end
reactor:
  init: red,
  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
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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) \(\rightarrow\) Image:
    doc: "Draw a circle of the given color, rendering a traffic light"
    ...
end

fun **next-light**(tl :: TrafficLight) \(\rightarrow\) TrafficLight:
    doc: "Produce the next light in the sequence green, yellow, red"
    ...
end
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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
Starter code:

tinyurl.com/2022-10-31-tl-starter
Code:

tinyurl.com/2022-10-31-td
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

\[ \text{lil-tree} = \text{branch}(\text{stick, stick}) \]

\[ \text{big-tree} = \text{branch(} \text{branch(} \text{stick, stick),} \text{branch(} \text{stick, stick))} \]

# Template

\[ \text{fun tree-fun(tree :: Tree) \to ...:\n  doc: "Tree template"\n  cases (Tree) tree:\n    | stick \to ...
    | branch(t1, t2) \to ...
  end\nwhere:\n  tree-fun(stick) is ...\n  tree-fun(lil-tree) is ...\n  tree-fun(big-tree) is ...\nend} \]
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"
cases (Tree) tree:
  | stick =>
      line(1, size, "black")
  | 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
        draw-tree-size(stick, size))
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.
Code:

tinyurl.com/2022-10-31-tree
One more reactor
Code:

tinyurl.com/2022-10-31-bounce
Acknowledgments

This lecture incorporates material from:

W. Daniel Hillis, *The Pattern on the Stone*
Marc Smith, Vassar College
Laney Strange, Northeastern University