CMPU 101 § 3 · Computer Science I

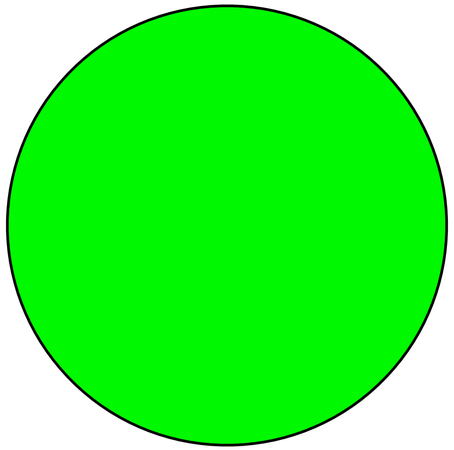
Reactors

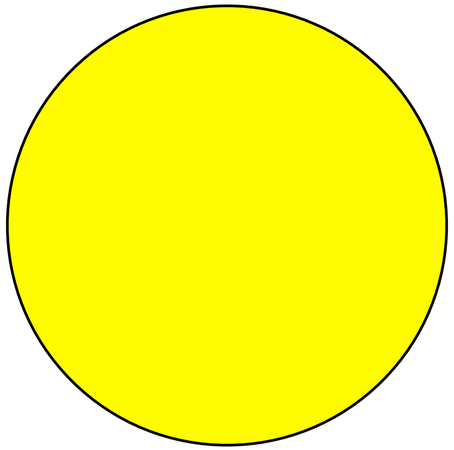
31 October 2022

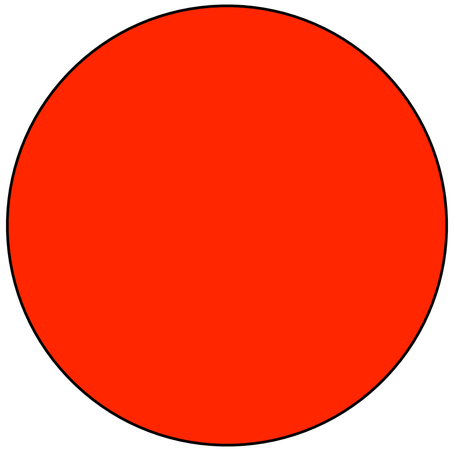
🎃

Where are we?

Where are we?
Traffic-light world







All traffic lights are the same size and position on the screen.

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What distinguishes them?

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What distinguishes them?

Asking this helps us think about ***data***

All traffic lights are the same size and position on the screen.

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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***

Data

Data definition

Examples

Template

Functions

Signature

Docstring

Examples

Body

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Body

```
data TrafficLight:
  ...
end
```

```
data TrafficLight:
   | green
   | yellow
   | red
end
```

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```
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
```

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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

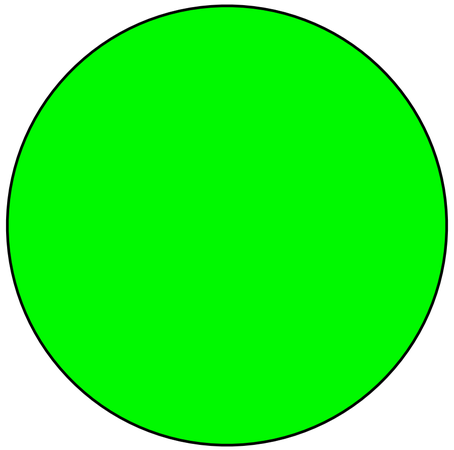
```
include reactors
```

```
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
```

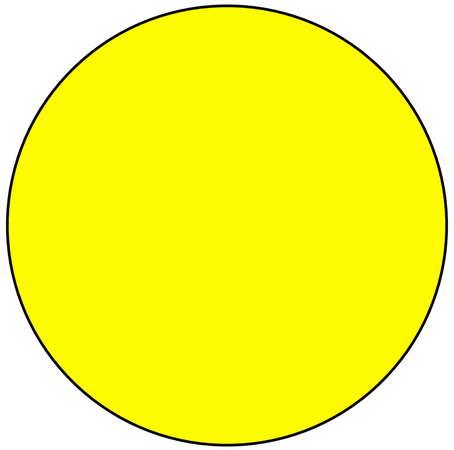
Less nuclear reactor; more person-that-reacts to something.

`reactor` puts all the pieces together to start things going.

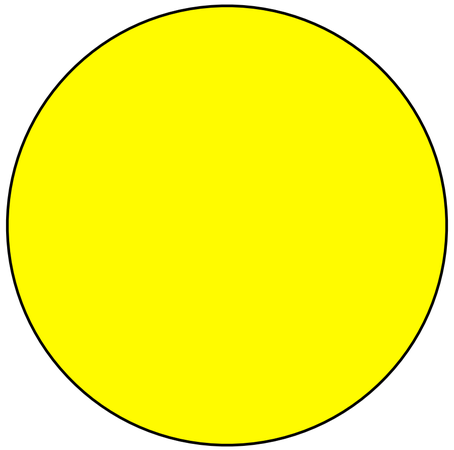


initial state

some event happens…



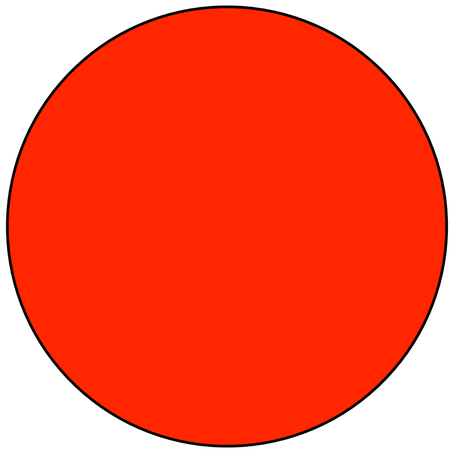
next state



~~*next state*~~

now the current state

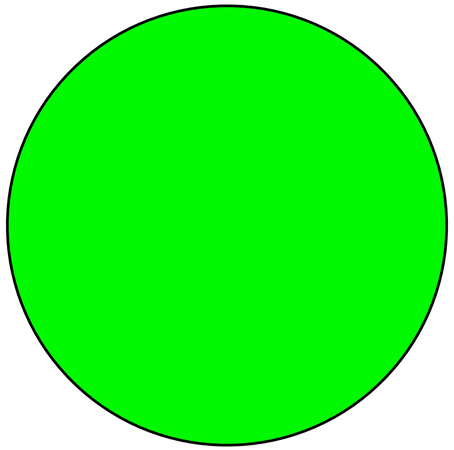
some event happens…



~~*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...
```

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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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Body

```
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
```

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Body

```
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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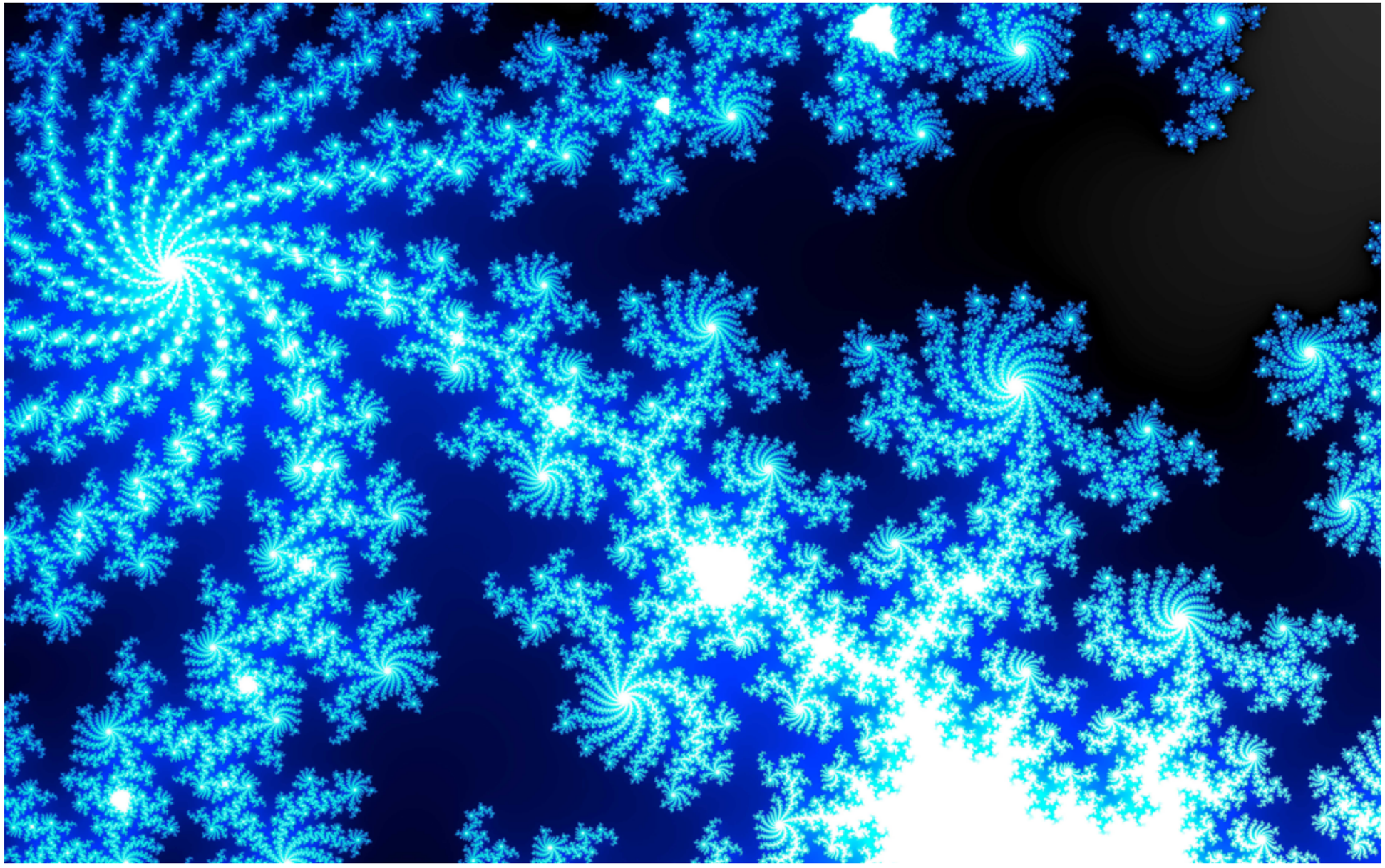
Starter code:

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

Code:

tinyurl.com/2022-10-31-tl

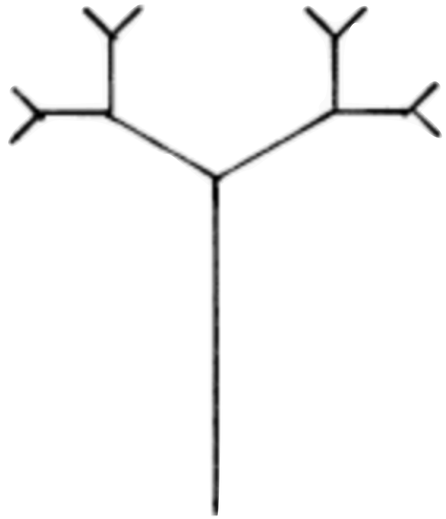
Fractal tree



How can we draw a tree?

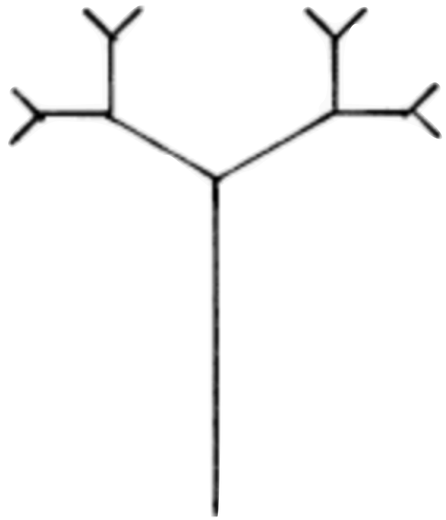
A big tree is a stick with two smaller trees on top;

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) => ...
  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"
  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


DVD
VIDEO

Acknowledgments

This lecture incorporates material from:

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