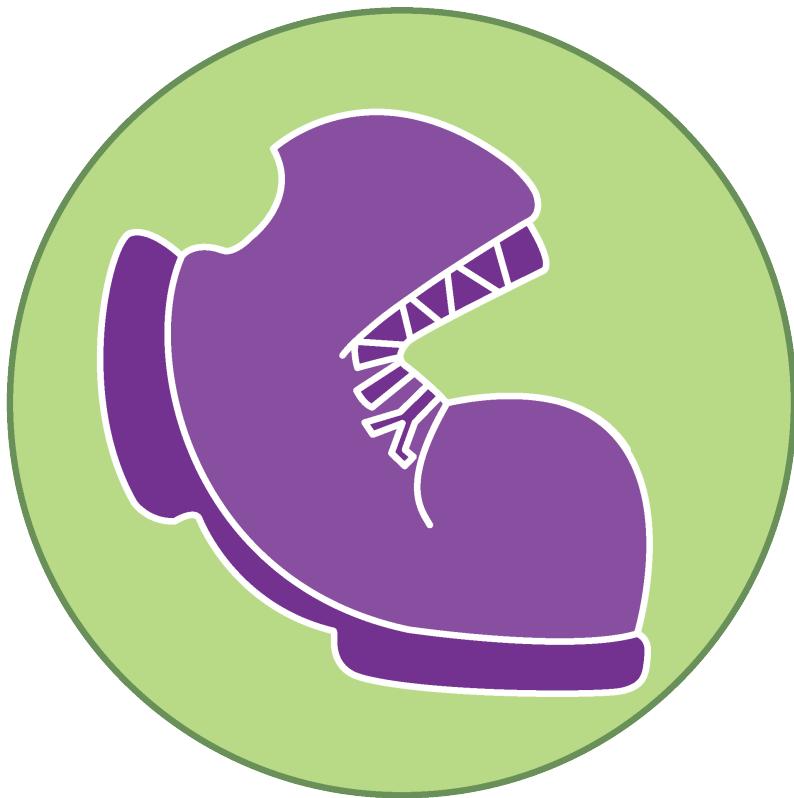


Name: _____



BOOTSTRAP:REACTIVE

www.bootstrapworld.org

Class: _____



Workbook v0.9

Brought to you by the Bootstrap team:

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Unit 1

	Racket Code	Pyret Code
Numbers	<pre>(define AGE 14) (define A-NUMBER 0.6) (define SPEED -90)</pre>	AGE = 14 A-NUMBER = 0.6 SPEED = -90 Two of your own: <hr/> <hr/>
Strings	<pre>(define CLASS "Bootstrap") (define PHRASE "Coding is fun!") (define A-STRING "2500")</pre>	CLASS = "Bootstrap" PHRASE = "Coding is fun!" A-STRING = "2500" Two of your own: <hr/> <hr/>

<i>Images</i>	<pre>(define SHAPE (triangle 40 "outline" "red")) (define OUTLINE (star 80 "solid" "green")) (define SQUARE (rectangle 50 50 "solid" "blue"))</pre>	<pre>SHAPE = triangle(40, "outline", "red") OUTLINE = star(80, "solid", "green") SQUARE = rectangle(50, 50, "solid", "blue")</pre> <p>One of your own:</p> <hr/>
<i>Booleans</i>	<pre>(define BOOL true) (define BOOL2 false)</pre>	<pre>BOOL = true</pre> <p>One of your own:</p> <hr/>
<i>Functions</i>	<pre>; double : Number -> Number ; Given a number, multiply by ; 2 to double it (EXAMPLE (double 5) (* 2 5)) (EXAMPLE (double 7) (* 2 7)) (define (double n) (* 2 n))</pre>	<pre># double :: Number -> Number # Given a number, multiply by # 2 to double it examples: double(5) is 2 * 5 double(7) is 2 * 7 end fun double(n): 2 * n end</pre>

Fast Functions!

Fill out the contract for each function, then try to write two examples and the definition by yourself.

double :: Number → Number
name domain range

examples:

double (5) is 2 * 5
double (7) is 2 * 7

end

fun double (n) :

2 * n

end

:: ->
name domain range

examples:

 () is

 () is

end

fun () :

end

Fast Functions!

Fill out the contract for each function, then try to write two examples and the definition by yourself.

_____ :: _____ → _____
name domain range

examples:

_____ (_____) is _____

_____ (_____) is _____

end

fun _____(_____):

end

_____ :: _____ -> _____
name domain range

examples:

_____ (_____) is _____

_____ (_____) is _____

end

fun _____(_____):

end

Fast Functions!

Fill out the contract for each function, then try to write two examples and the definition by yourself.

_____ :: _____ → _____
name domain range

examples:

_____ (_____) is _____

_____ (_____) is _____

end

fun _____ (_____) :

end

_____ :: _____ -> _____
name domain range

examples:

_____ (_____) is _____

_____ (_____) is _____

end

fun _____ (_____) :

end

Syntax and Style Bug Hunting: Pyret Edition

#1	<pre>SECONDS = (7) STRING = my string</pre>	
#2	<pre>SHAPE1 = circle(50 "solid" "blue") SHAPE2 = triangle(75, outline, yellow)</pre>	
#3	<pre># triple :: Number -> Number # Multiply a given number by # 3 to triple it examples: triple(5) = 3 * 5 triple(7) = 3 * 7 end</pre>	
#4	<pre>fun triple(n): 3 * n</pre>	
#5	<pre># ys :: Number -> Number # Given a number, create a solid # yellow star of the given size examples: ys(99) is star(99, "solid", "yellow") ys(33) is star(99, "solid", "yellow") ys(size): star(size "solid" "yellow") end</pre>	

Unit 2

Word Problem: double-radius

Write a function *double-radius*, which takes in a radius and a color. It produces an outlined circle of whatever color was passed in, whose radius is twice as big as the input.

Contract+Purpose Statement

Every contract has three parts:

_____ :: _____ → _____
name Domain Range

What does the function do?

Give Examples

Write examples of your function in action

examples :

_____ (_____)

the user types...

is _____
...which should become

_____ (_____)

the user types...

is _____
end ...which should become

Function

Circle the changes in the examples, and name the variables.

Write the code, copying everything that isn't circled, and using names where you find variables!

fun _____ (_____) : _____

end

Word Problem: double-width

Write a function *double-width*, which takes in a number (the length of a rectangle) and produces a rectangle whose width is twice the given length.

Contract+Purpose Statement

Every contract has three parts:

_____ :: _____ → _____
name Domain Range

What does the function do?

Give Examples

Write examples of your function in action

examples :

_____ (_____)

the user types...

is _____

...which should become

_____ (_____)

the user types...

is _____

...which should become

end

Function

Circle the changes in the examples, and name the variables.

Write the code, copying everything that isn't circled, and using names where you find variables!

fun _____ (_____) : _____

end

Word Problem: next-position

Write a function *next-position*, which takes in two numbers (an x and y-coordinate) and returns a DeliveryState, increasing the x-coordinate by 5 and decreasing the y-coordinate by 5.

Contract+Purpose Statement

Every contract has three parts:

_____ :: _____ → _____
name Domain Range

What does the function do?

Give Examples

Write examples of your function in action

examples:

_____ (_____)

the user types...

is _____
...which should become

_____ (_____)

the user types...

is _____
end ...which should become

Function

Circle the changes in the examples, and name the variables.

Write the code, copying everything that isn't circled, and using names where you find variables!

fun _____ (_____) :

end

Data Structure

A CakeType is a **flavor**, **layers**, & **is-iceCream**

data **CakeType**:

| **cake**(_____
| _____
| _____)

end

To make instances of this structure, I would write:

cake1 = _____

cake2 = _____

To access the fields of **cake2**, I would write:

Word Problem: taller-than

Write a function called *taller-than*, which consumes two CakeTypes, and produces true if the number of layers in the first CakeType is greater than the number of layers in the second.

Contract+Purpose Statement

_____ :: _____ → _____

Give Examples

Write examples of your function in action

examples :

_____ (_____)

the user types...

is _____

...which should become

_____ (_____)

the user types...

is _____

end

...which should become

Function

Circle the changes in the examples, and name the variables.

Write the code, copying everything that isn't circled, and using names where you find variables!

fun _____ (_____) : _____

end

Word Problem: will-melt

Write a function called *will-melt*, which takes in a CakeType and a temperature, and returns true if the temperature is greater than 32 degrees, AND the CakeType is an ice cream cake.

Contract+Purpose Statement

_____ :: _____ → _____

Give Examples

Write examples of your function in action

examples:

_____ (_____)

the user types...

is _____

...which should become

_____ (_____)

the user types...

is _____

...which should become

end

Function

Circle the changes in the examples, and name the variables.

Write the code, copying everything that isn't circled, and using names where you find variables!

fun _____ (_____) : _____

end

Vocabulary Practice

Below is a new structure definition:

data MediaType:

```
| book(  
|   title :: String,  
|   author :: String,  
|   pubyear :: Number)
```

end

an example book:

```
book1 = book("1984", "Orwell", 1949)
```

Fill in the blanks below with the vocabulary term that applies to each name. Here are the terms to choose from:

- | | |
|---------------|--------------|
| - contract | - example |
| - header | - field |
| - datatype | - instance |
| - constructor | - data block |
| - name | - purpose |

author is a _____

book is a _____

MediaType is a _____

book1 is a _____

title is a _____

data ... end is a _____

Unit 3

Identifying Animation Data Worksheet: Sunset

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

(worksheet continues on the next page)

Define the Data Structure

```
# a _____ State is _____  
  
data _____ State:  
| _____ ( _____  
| _____  
| _____  
| _____ )  
end
```

Make a sample instance for each sketch from the previous page:

_____ = _____

_____ = _____

_____ = _____

Word Problem: draw-state

Write a function called `draw-state`, which takes in a `SunsetState` and returns an image in which the sun (a circle) appears at the position given in the `SunsetState`. The sun should be behind the horizon (the ground) once it is low in the sky.

Contract+Purpose Statement

`draw-state` :: _____ → Image

Write an expression for each piece of your final image

SUN =	
GROUND =	
SKY =	

Write the `draw-state` function, using `put-image` to combine your pieces

fun _____(_____) :

end

Word Problem: next-state-tick

Write a function called *next-state-tick*, which takes in a *SunsetState* and returns a *SunsetState* in which the new x-coordinate is 8 pixels larger than in the given *SunsetState* and the y-coordinate is 4 pixels smaller than in the given *SunsetState*.

Contract+Purpose Statement

_____ :: _____ → _____

Give Examples

Write examples of your function in action

examples:

_____ (_____)

the user types...

is _____
...which should become

_____ (_____)

the user types...

is _____
end ...which should become

Function

Circle the changes in the examples, and name the variables.

Write the code, copying everything that isn't circled, and using names where you find variables!

fun _____ (_____) :

end

Identifying Animation Data Worksheet

Draw a sketch for three distinct moments of the animation

--	--	--

Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

(worksheet continues on the next page)

Define the Data Structure

```
# a _____ State is _____  
  
data _____ State:  
| _____ ( _____  
| _____  
| _____  
| _____ )  
end
```

Make a sample instance for each sketch from the previous page:

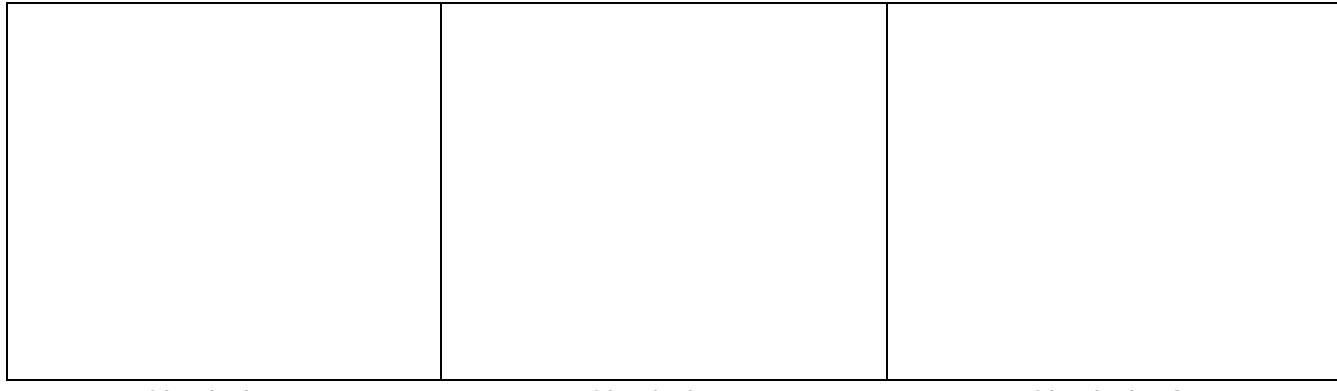
_____ = _____

_____ = _____

_____ = _____

Identifying Animation Data Worksheet

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

(worksheet continues on the next page)

Define the Data Structure

```
# a _____ State is _____  
  
data _____ State:  
| _____ ( _____  
| _____  
| _____  
| _____ )  
end
```

Make a sample instance for each sketch from the previous page:

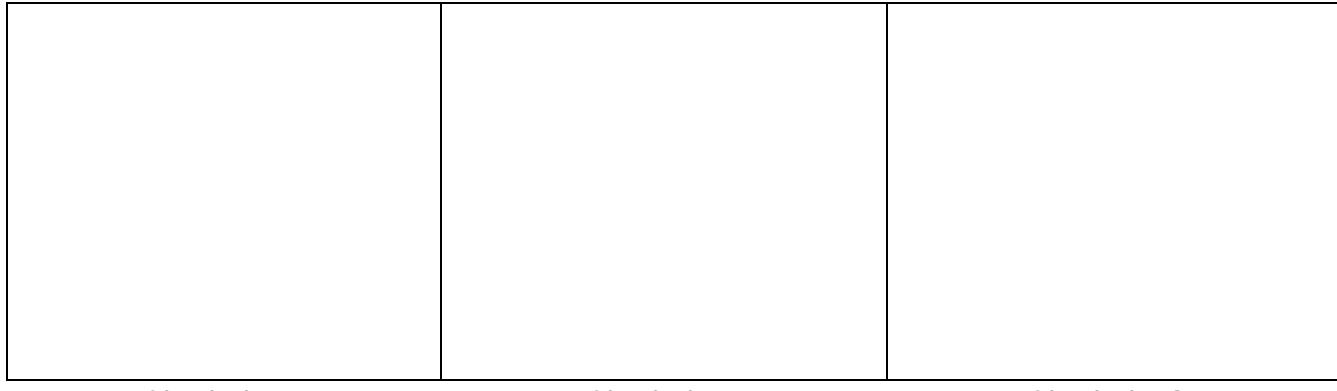
_____ = _____

_____ = _____

_____ = _____

Identifying Animation Data Worksheet

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

(worksheet continues on the next page)

Define the Data Structure

```
# a _____ State is _____  
  
data _____ State:  
| _____ ( _____  
| _____  
| _____  
| _____ )  
end
```

Make a sample instance for each sketch from the previous page:

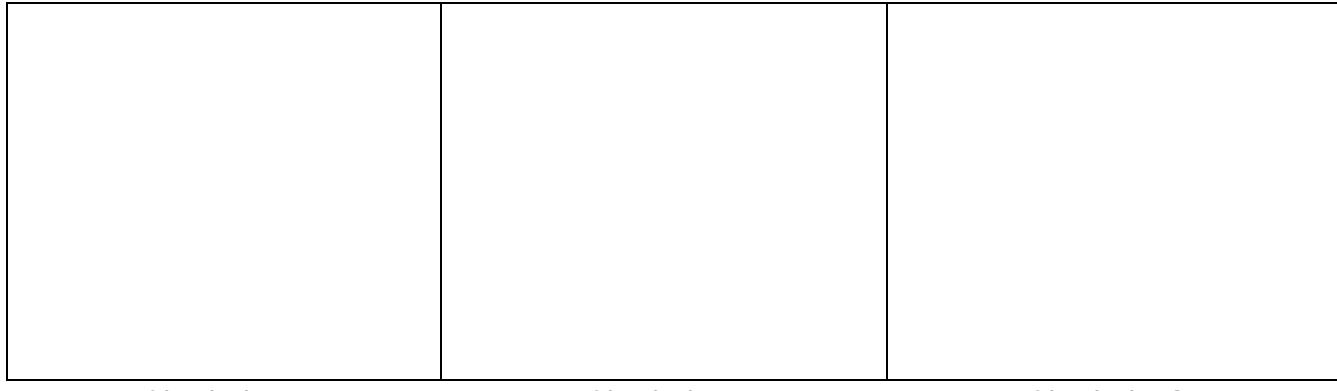
_____ = _____

_____ = _____

_____ = _____

Identifying Animation Data Worksheet

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

(worksheet continues on the next page)

Define the Data Structure

```
# a _____ State is _____  
  
data _____ State:  
| _____ ( _____  
| _____  
| _____  
| _____ )  
end
```

Make a sample instance for each sketch from the previous page:

_____ = _____

_____ = _____

_____ = _____

Unit 4

Word Problem: location

Write a function called *location*, which consumes a *DeliveryState*, and produces a String representing the location of a box: either “road”, “delivery zone”, “house”, or “air”.

Contract+Purpose Statement

_____ :: _____ → _____

Give Examples

examples :

_____ (_____) is _____

end

(worksheet continues next page)

Syntax and Style Bug Hunting: Piecewise Edition

	Buggy Code	Correct Code / Explanation
Round 1	<pre>fun piecewisefun(n): if (n > 0): n else: 0</pre>	
Round 2	<pre>fun cost(topping): if string-equal(topping, "pepperoni"): 10.50 else string-equal(topping, "cheese"): 9.00 else string-equal(topping, "chicken"): 11.25 else string-equal(topping, "broccoli"): 10.25 else: "That's not on the menu!" end end</pre>	
Round 3	<pre>fun absolute-value(a b): if a > b: a - b b - a end end</pre>	
Round 4	<pre>fun best-function(f): if string-equal(f, "blue"): "you win!" else if string-equal(f, "blue"): "you lose!" else if string-equal(f, "red"): "Try again!" else: "Invalid entry!" end end</pre>	

Animation Extension Worksheet

Describe the goal of your change: what new feature or behavior will it add to your animation?

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

Make a To-Do List, and check off each as "Done" when you finish each one.

Component	When is there work to be done?	To-Do	Done
Data Structure	If any new field(s) were added, changed or removed	<input type="checkbox"/>	<input type="checkbox"/>
draw-state	If something is displayed in a new way or position	<input type="checkbox"/>	<input type="checkbox"/>
next-state-tick	If the Data Structure changed, or the animation happens automatically	<input type="checkbox"/>	<input type="checkbox"/>
next-state-key	If the Data Structure changed, or a keypress triggers the animation	<input type="checkbox"/>	<input type="checkbox"/>
reactor	If either next-state function is new	<input type="checkbox"/>	<input type="checkbox"/>

Make a sample instance for each sketch from the previous page:

_____ = _____

_____ = _____

_____ = _____

Write at least one NEW example for one of the functions on your To-Do list

If you have another function on your To-Do list , write at least one NEW example

Word Problem: draw-sun

Write a function called `draw-sun`, which consumes a `SunsetState`, and produces an image of a sun (a solid, 25 pixel circle), whose color is "yellow", when the sun's y-coordinate is greater than 225, "orange", when its y-coordinate is between 150 and 225, and "red" otherwise.

Contract+Purpose Statement

_____ :: _____ → _____

Give Examples

examples :

_____ (_____) is _____

_____ (_____) is _____

_____ (_____) is _____

end

(worksheet continues next page)

Unit 5

Animation Extension Worksheet

Describe the goal of your change: what new feature or behavior will it add to your animation?

Decrease the cat's hunger level by 2 and sleep level by 1 on each tick.

Draw a sketch for three distinct moments of the animation, focusing on the new behavior



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

Make a To-Do List, and check off each as "Done" when you finish each one.

Component	When is there work to be done?	To-Do	Done
Data Structure	If any new field(s) were added, changed or removed	<input type="checkbox"/>	<input type="checkbox"/>
draw-state	If something is displayed in a new way or position	<input checked="" type="checkbox"/>	<input type="checkbox"/>
next-state-tick	If the Data Structure changed, or the animation happens automatically	<input type="checkbox"/>	<input type="checkbox"/>
next-state-key	If the Data Structure changed, or a keypress triggers the animation	<input type="checkbox"/>	<input type="checkbox"/>
reactor	If either next-state function is new	<input type="checkbox"/>	<input type="checkbox"/>

Make a sample instance for each sketch from the previous page:

FULLPET = pet(100, 100)

MIDPET = pet(50, 75)

LOSEPET = pet(0, 0)

Write at least one NEW example for one of the functions on your To-Do list

next-state-tick(FULLPET) is pet(FULLPET.hunger - 2, FULLPET.sleep - 1)

next-state-tick(MIDPET) is pet(MIDPET.hunger - 2, MIDPET.sleep - 1)

next-state-tick(LOSEPET) is LOSEPET

If you have another function on your To-Do list , write at least one NEW example

Animation Extension Worksheet

Describe the goal of your change: what new feature or behavior will it add to your animation?

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

Make a To-Do List, and check off each as "Done" when you finish each one.

Component	When is there work to be done?	To-Do	Done
Data Structure	If any new field(s) were added, changed or removed	<input type="checkbox"/>	<input type="checkbox"/>
draw-state	If something is displayed in a new way or position	<input type="checkbox"/>	<input type="checkbox"/>
next-state-tick	If the Data Structure changed, or the animation happens automatically	<input type="checkbox"/>	<input type="checkbox"/>
next-state-key	If the Data Structure changed, or a keypress triggers the animation	<input type="checkbox"/>	<input type="checkbox"/>
reactor	If either next-state function is new	<input type="checkbox"/>	<input type="checkbox"/>

Make a sample instance for each sketch from the previous page:

_____ = _____

_____ = _____

_____ = _____

Write at least one NEW example for one of the functions on your To-Do list

If you have another function on your To-Do list , write at least one NEW example

Animation Extension Worksheet

Describe the goal of your change: what new feature or behavior will it add to your animation?

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

Make a To-Do List, and check off each as "Done" when you finish each one.

Component	When is there work to be done?	To-Do	Done
Data Structure	If any new field(s) were added, changed or removed	<input type="checkbox"/>	<input type="checkbox"/>
draw-state	If something is displayed in a new way or position	<input type="checkbox"/>	<input type="checkbox"/>
next-state-tick	If the Data Structure changed, or the animation happens automatically	<input type="checkbox"/>	<input type="checkbox"/>
next-state-key	If the Data Structure changed, or a keypress triggers the animation	<input type="checkbox"/>	<input type="checkbox"/>
reactor	If either next-state function is new	<input type="checkbox"/>	<input type="checkbox"/>

Make a sample instance for each sketch from the previous page:

_____ = _____

_____ = _____

_____ = _____

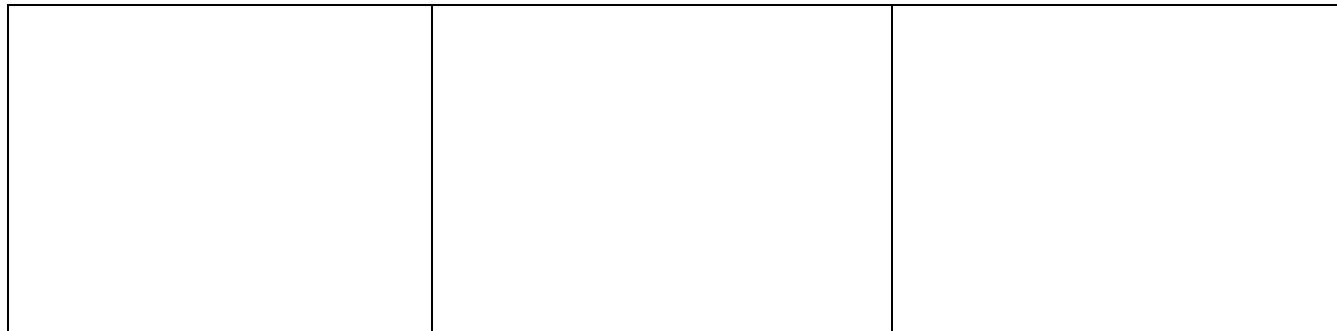
Write at least one NEW example for one of the functions on your To-Do list

If you have another function on your To-Do list , write at least one NEW example

Build Your Own Animation

Animation Design Worksheet

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

Make a To-Do List, and check off each as “Done” when you finish each one.

Component	When is there work to be done?	To-Do	Done
Data Structure	If any new field(s) were added, changed or removed	<input type="checkbox"/>	<input type="checkbox"/>
draw-state	If something is displayed in a new way or position	<input type="checkbox"/>	<input type="checkbox"/>
next-state-tick	If the Data Structure changed, or the animation happens automatically	<input type="checkbox"/>	<input type="checkbox"/>
next-state-key	If the Data Structure changed, or a keypress triggers the animation	<input type="checkbox"/>	<input type="checkbox"/>
reactor	If either next-state function is new	<input type="checkbox"/>	<input type="checkbox"/>

Define the Data Structure

a _____ **State** is _____

data _____ **State**:

| _____ (_____

_____)

end

Make a sample instance for each sketch from the previous page:

_____ = _____

_____ = _____

_____ = _____

Write an example for one of the functions on the previous page:

Collision

Distance:

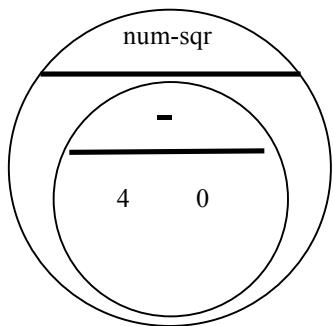
The Player is at (4, 2) and the Target is at (0, 5).

Distance takes in the player's x, player's y, character's x and character's y.

Use the formula below to fill in the EXAMPLE:

$$\sqrt{(4 - 0)^2 + (2 - 5)^2}$$

Convert it into a Circle of Evaluation. (We've already gotten you started!)



Convert it into Pyret code:

Word Problem: distance

Write a function `distance`, which takes FOUR inputs:

- `px`: The x-coordinate of the player
- `py`: The y-coordinate of the player
- : The x-coordinate of another game character
- : The y-coordinate of another game character

It should return the distance between the two, using the Distance formula:

$$\text{Distance}^2 = (px - cx)^2 + (py - cy)^2$$

Contract+Purpose Statement

_____ :: _____ -> _____

Give Examples

Write examples of your function in action

examples:

_____ (_____)

is _____

_____ (_____)

is _____

end

Function

fun _____(_____):

end

Word Problem: is-collision

Write a function *is-collision*, which takes FOUR inputs:

- px: The x-coordinate of the player
- py: The y-coordinate of the player
- cx: The x-coordinate of another game character
- cy: The y-coordinate of another game character

It should return true if the coordinates of the player are within **50 pixels** of the coordinates of the other character. Otherwise, false.

Contract+Purpose Statement

_____ :: _____ -> _____

Give Examples

Write examples of your function in action

examples:

_____ (_____)

is _____

_____ (_____)

is _____

end

Function

fun _____ (_____) :

end

DESIGN RECIPE

Contract+Purpose Statement

Every contract has three parts:

_____ :: _____ -> _____
name Domain Range

What does the function do?

Give Examples

Write examples of your function in action

examples:

_____ (_____)
the user types...

is _____
...which should become

_____ (_____)
the user types...

is _____
...which should become

end

Function

Circle the changes in the examples, and name the variables.

fun _____ (_____) :

end

DESIGN RECIPE

Contract+Purpose Statement

Every contract has three parts:

_____ :: _____ -> _____
name Domain Range

What does the function do?

Give Examples

Write examples of your function in action

examples:

_____ (_____)
the user types...

is _____
...which should become

_____ (_____)
the user types...

is _____
...which should become

end

Function

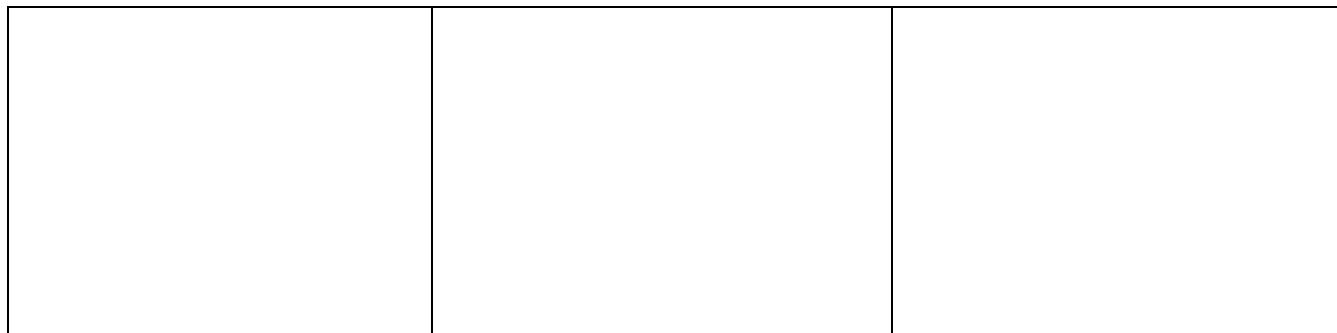
Circle the changes in the examples, and name the variables.

fun _____ (_____) :

end

Animation Design Worksheet

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

Make a To-Do List, and check off each as “Done” when you finish each one.

Component	When is there work to be done?	To-Do	Done
Data Structure	If any new field(s) were added, changed or removed	<input type="checkbox"/>	<input type="checkbox"/>
draw-state	If something is displayed in a new way or position	<input type="checkbox"/>	<input type="checkbox"/>
next-state-tick	If the Data Structure changed, or the animation happens automatically	<input type="checkbox"/>	<input type="checkbox"/>
next-state-key	If the Data Structure changed, or a keypress triggers the animation	<input type="checkbox"/>	<input type="checkbox"/>
reactor	If either next-state function is new	<input type="checkbox"/>	<input type="checkbox"/>

Define the Data Structure

a _____ **State** is _____

data _____ **State**:

| _____ (_____

_____)

end

Make a sample instance for each sketch from the previous page:

_____ = _____

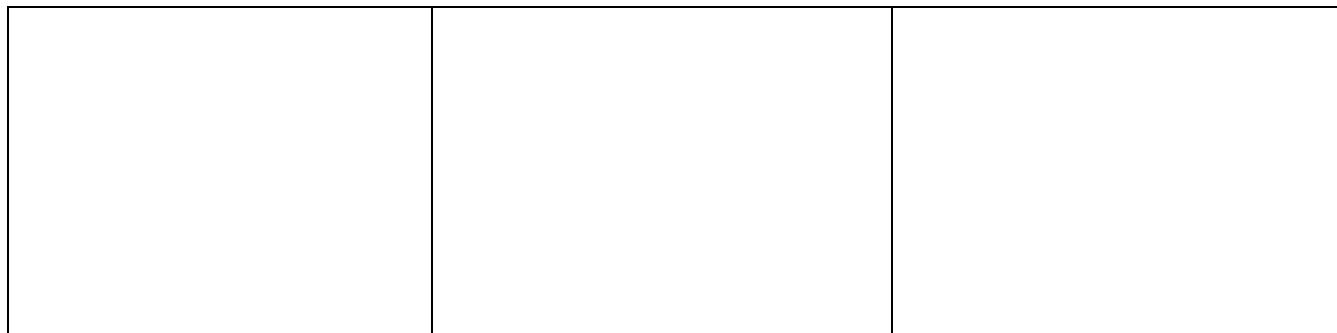
_____ = _____

_____ = _____

Write an example for one of the functions on the previous page:

Animation Design Worksheet

Draw a sketch for three distinct moments of the animation



Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

What fields do you need to represent the things that change?

Field name (dangerX, score, playerIMG...)	Datatype (Number, String, Image, Boolean...)

Make a To-Do List, and check off each as “Done” when you finish each one.

Component	When is there work to be done?	To-Do	Done
Data Structure	If any new field(s) were added, changed or removed	<input type="checkbox"/>	<input type="checkbox"/>
draw-state	If something is displayed in a new way or position	<input type="checkbox"/>	<input type="checkbox"/>
next-state-tick	If the Data Structure changed, or the animation happens automatically	<input type="checkbox"/>	<input type="checkbox"/>
next-state-key	If the Data Structure changed, or a keypress triggers the animation	<input type="checkbox"/>	<input type="checkbox"/>
reactor	If either next-state function is new	<input type="checkbox"/>	<input type="checkbox"/>

Define the Data Structure

a _____ **State** is _____

data _____ **State**:

| _____ (_____

_____)

end

Make a sample instance for each sketch from the previous page:

_____ = _____

_____ = _____

_____ = _____

Write an example for one of the functions on the previous page:

Animation Design Worksheet

Draw a sketch for three distinct moments of the animation

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Sketch A

Sketch B

Sketch C

What things are changing?

Thing	Describe how it changes

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Write an example for one of the functions on the previous page:

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_____ = _____

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Write at least one NEW example for one of the functions on your To-Do list

If you have another function on your To-Do list , write at least one NEW example

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Contracts

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