

Name: \_\_\_\_\_



# **BOOTSTRAP**

**www.bootstrapworld.org**

**Student Workbook**

Class: \_\_\_\_\_

# Bootstrap Units

<b>01</b>	Videogames and Coordinate Planes	<b>06</b>	Comparing Functions
<b>02</b>	Contracts, Strings, and Images	<b>07</b>	Conditional Branching
<b>03</b>	Intro to Definitions	<b>08</b>	Collision Detection
<b>04</b>	Design Recipe	<b>09</b>	Prepping for Launch
<b>05</b>	Game Animation	<b>10</b>	Additional Material

# 01 Videogames and Coordinate Planes



# Lesson 1

Reverse-Engineering: How does NinjaCat work?

## Finding Coordinates



The coordinates for the PLAYER (NinjaCat) are: ( \_\_\_\_\_ , \_\_\_\_\_ )  
x-coordinate      y-coordinate

The coordinates for the DANGER (Dog) are: ( \_\_\_\_\_ , \_\_\_\_\_ )

The coordinates for the TARGET (Ruby) are: ( \_\_\_\_\_ , \_\_\_\_\_ )

# Our Videogame

Created by (write your names): \_\_\_\_\_

## Background

Our game takes place in: \_\_\_\_\_  
(space? the desert? a mall?)

## The Player

*The player is a \_\_\_\_\_.*

The player moves only up and down.

## The Target

*Your player GAINS points when they hit the target.*

*The Target is a \_\_\_\_\_.*

The Target moves only to the left and right.

## The Danger

*Your player LOSES points when they hit the danger.*

*The Danger is a \_\_\_\_\_.*

The Danger moves only to the left and right.

## Circle of Evaluation Practice

**Time: 5 minutes**

Don't forget to use the computer's symbols for things like multiply and divide!

<b>Math</b>	<b>Circle of Evaluation</b>	<b>Pyret Code</b>
$5 \times 10$		
$8 + (5 \times 10)$		
$(8 + 2) - (5 \times 10)$		
$\frac{5 \times 10}{8 - 2}$		

# 02 Contracts, Strings, and Images



# Circles Competition

Time: 5 minutes

<b>Math</b>	<b>Circle of Evaluation</b>	<b>Pyret Code</b>
Round 1 $(3 * 7) - (1 + 2)$		
Round 2 $3 - (1 + 2)$		
Round 3 $3 - (1 + (5 * 6))$		
Round 4 $(1 + (5 * 6)) - 3$		

# 03

## Intro to Definitions



## Fast Functions

# \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name domain range

examples:

\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_  
\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_

end

fun \_\_\_\_\_ ( \_\_\_\_\_ ) : \_\_\_\_\_ end

# \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name domain range

examples:

\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_  
\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_

end

fun \_\_\_\_\_ ( \_\_\_\_\_ ) : \_\_\_\_\_ end

# \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name domain range

examples:

\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_  
\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_

end

fun \_\_\_\_\_ ( \_\_\_\_\_ ) : \_\_\_\_\_ end

## Fast Functions

# \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name domain range

examples:

\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_  
\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_

end

fun \_\_\_\_\_ ( \_\_\_\_\_ ) : \_\_\_\_\_ end

# \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name domain range

examples:

\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_  
\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_

end

fun \_\_\_\_\_ ( \_\_\_\_\_ ) : \_\_\_\_\_ end

# \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name domain range

examples:

\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_  
\_\_\_\_\_ ( \_\_\_\_\_ ) is \_\_\_\_\_

end

fun \_\_\_\_\_ ( \_\_\_\_\_ ) : \_\_\_\_\_ end

# 04 Design Recipe

1 Contract

2 Example

3 Definition

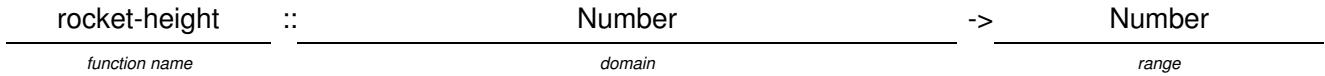


# Word Problem: rocket-height

**Directions:** A rocket blasts off, traveling at 7 meters per second. Write a function called 'rocket-height' that takes in the number of seconds that have passed since the rocket took off, and which produces the height of the rocket at that time.

# **Contract and Purpose Statement**

*Every contract has three parts...*



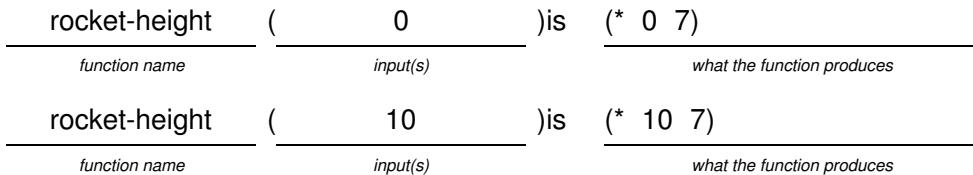
```
# Produce height of rocket after given number of seconds
```

*what does the function do?*

## Examples

*Write some examples, then circle and label what changes...*

## examples:



end

## Definition

*Write the definition, given variable names to all your input values....*

function name      variables

*what the function does with those variables*

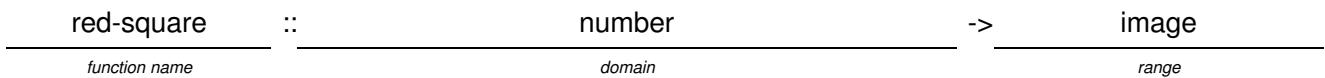
end

# Word Problem: red-square

**Directions:** Use the Design Recipe to write a function 'red-square', which takes in a number (the side of the square) and outputs a solid red rectangle whose length and width are the same size.

## Contract and Purpose Statement

Every contract has three parts...



# Produce rectangle with given number as width and height

*what does the function do?*

## Examples

Write some examples, then circle and label what changes...

examples:

red-square	(	4	) is	(rectangle 4 4 "solid" "red")
function name		input(s)		what the function produces
red-square	(	12	) is	(rectangle 12 12 "solid" "red")

end

## Definition

Write the definition, given variable names to all your input values...

fun	red-square	(	size	) :
function name			variables	
			what the function does with those variables	

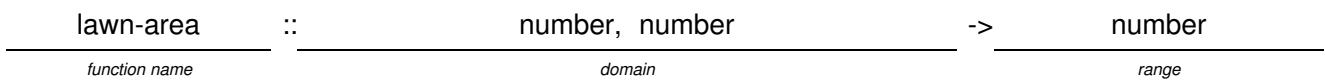
end

## Word Problem: lawn-area

**Directions:** Use the Design Recipe to write a function 'lawn-area', which takes in the width and length of a lawn, and returns the area of the lawn. (Don't forget: area = length \* width!)

### Contract and Purpose Statement

Every contract has three parts...



# Produce area of lawn with given length and width

*what does the function do?*

### Examples

Write some examples, then circle and label what changes...

examples:

lawn-area	(	10, 20	) is	(* 10 20)
<i>function name</i>		<i>input(s)</i>		<i>what the function produces</i>
lawn-area	(	50, 5	) is	(* 50 5)
<i>function name</i>		<i>input(s)</i>		<i>what the function produces</i>

end

### Definition

Write the definition, given variable names to all your input values...

fun	lawn-area	(	length, width	) :
<i>function name</i>			<i>variables</i>	
			<i>(* length width)</i>	

*what the function does with those variables*

end

# target



# danger



## 05 Game Animation

## Word Problem: update-danger

**Directions:** Use the Design Recipe to write a function 'update-danger', which takes in the danger's x-coordinate and y-coordinate and produces the next x-coordinate, which is 50 pixels to the left.

# Contract and Purpose Statement

*Every contract has three parts...*

`update-danger` :: Number, Number -> Number

*function name*

## Number, Number

->

## Number

### *domain*

*range*

# Produce new coordinate by subtracting 50 from the x-coordinate (the first parameter)

*what does the function do?*

## Examples

*Write some examples, then circle and label what changes...*

## examples:

update-danger ( 100, 200 ) is (- 100 50)

*function name*

*input(s)*

*what the function produces*

update-danger ( 35, 200 ) is (- 35 50)

*function name*

*input(s)*

*what the function produces*

end

## Definition

*Write the definition, given variable names to all your input values...*

fun update-danger (x, y):

[update](#) [cancel](#)

x, y

( - 50)

[About the Section](#) | [Contact Us](#) | [Section Home](#)

end

## Word Problem: update-target

**Directions:** Write a function 'update-target', which takes in the target's x-coordinate and y-coordinate and produces the next x-coordinate, which is 50 pixels to the right.

### Contract and Purpose Statement

Every contract has three parts...

update-target :: Number, Number -> Number  
function name domain range

# Produce new coordinate by adding 50 to the given number

what does the function do?

### Examples

Write some examples, then circle and label what changes...

examples:

update-target ( 0, 120 ) is (+ 0 50)  
function name input(s) what the function produces

update-target ( 20, 240 ) is (+ 20 50)  
function name input(s) what the function produces

end

### Definition

Write the definition, given variable names to all your input values...

fun update-target ( x, y ):  
function name variables

(+ x 50)  
what the function does with those variables

end



**“safe-left?”**

## 06 Comparing Functions

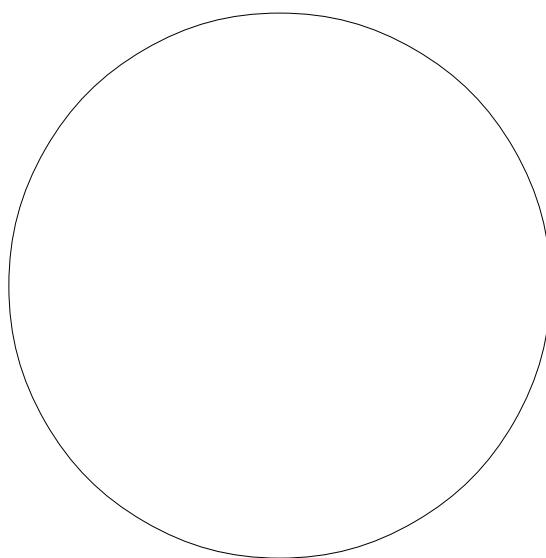
## DESIGN RECIPE

Sam is in a  $640 \times 480$  yard. How far he can go to the left and right before he's out of sight?

1. A piece of Sam is still visible on the left as long as...  $x > -50$  \_\_\_\_\_

2. A piece of Sam is still visible on the right as long as... \_\_\_\_\_

3. Draw the Circle of Evaluation for these two expressions in the circles below:



## Word Problem: is-safe-left

**Directions:** Use the Design Recipe to write a function 'is-safe-left', which takes in an x-coordinate and checks to see if the x-coordinate is greater than -50

### Contract and Purpose Statement

Every contract has three parts...

is-safe-left	::	Number	->	Boolean
function name		domain		range

# Determine whether given number is greater than -50

*what does the function do?*

### Examples

Write some examples, then circle and label what changes...

examples:

is-safe-left	(	25	) is	( $25 > -50$ )
function name		input(s)		<i>what the function produces</i>
is-safe-left	(	-51	) is	( $-51 > -50$ )

function name      input(s)      what the function produces

end

### Definition

Write the definition, given variable names to all your input values...

fun	is-safe-left	(	x	):
function name			variables	
( $x > -50$ )				<i>what the function does with those variables</i>

end

# Word Problem: is-safe-right

**Directions:** Use the Design Recipe to write a function 'is-safe-right', which takes in an x-coordinate and checks to see if the x-coordinate is less than 690.

## Contract and Purpose Statement

Every contract has three parts...

is-safe-right	::	number	->	boolean
function name		domain		range

# Determine whether given number is less than 690

*what does the function do?*

## Examples

Write some examples, then circle and label what changes...

examples:

is-safe-right	(	100	)is	(< 100 690)
function name		input(s)		<i>what the function produces</i>
is-safe-right	(	820	)is	(< 820 690)
function name		input(s)		<i>what the function produces</i>

end

## Definition

Write the definition, given variable names to all your input values...

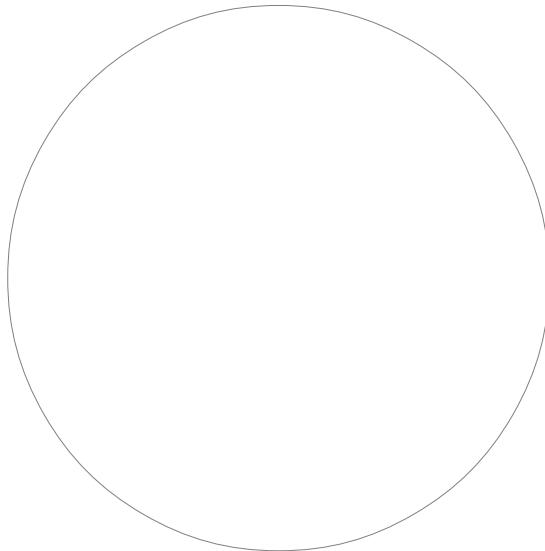
fun	is-safe-right	(	x	):
function name			variables	
(< x 690)				<i>what the function does with those variables</i>

end

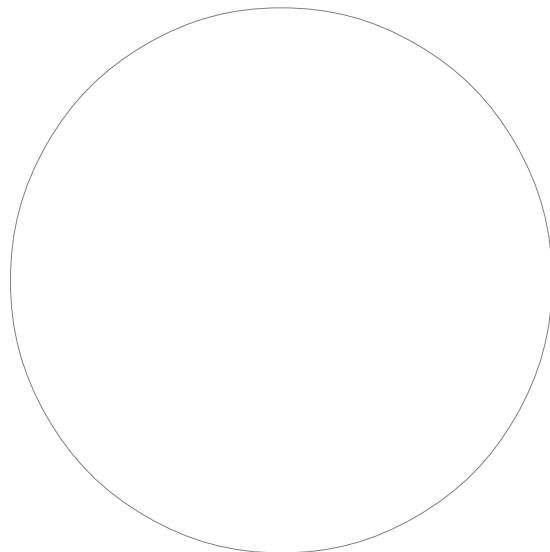
and / or

**Write the Circles of Evaluation for these statements, and then convert them to Pyret**

1. Two is less than five, and zero is equal to six.



2. Two is less than four or four is equal to six.



# Word Problem: is-onscreen

**Directions:** Use the Design Recipe to write a function 'is-onscreen', which takes in an x- and y-coordinate and checks to see if Sam is safe on the left AND safe on the right.

## Contract and Purpose Statement

Every contract has three parts...

is-onscreen	::	Number, Number	->	Boolean
function name		domain		range

# Sam is on the screen if his x-coordinate is safe on the left and safe on the right.

*what does the function do?*

## Examples

Write some examples, then circle and label what changes...

examples:

is-onscreen	(	10	)is	(is-safe-left (10) and is-safe-right (10))
function name		input(s)		<i>what the function produces</i>
is-onscreen	(	-15	)is	(is-safe-left (-15) and is-safe-right (-15))

function name

input(s)

*what the function produces*

end

## Definition

Write the definition, given variable names to all your input values...

fun	is-onscreen	(	x	):
function name		variables		
<u>(is-safe-left? (x) and is-safe-right (x))</u>				

*what the function does with those variables*

end

# 07 Conditional Branching



# Word Problem: cost

**Directions:** Luigi's Pizza has hired you as a programmer. They offer Pepperoni (\$10.50), Cheese (\$9.00), Chicken (\$11.25) and Broccoli (\$10.25). Write a function called "cost" which takes in the name of a topping and outputs the cost of a pizza with that topping.

## Contract and Purpose Statement

Every contract has three parts...

cost	::	string	->	number
function name		domain		range

# Produce cost of a pizza with given topping

*what does the function do?*

## Examples

Write some examples, then circle and label what changes...

examples:

cost	(	"pepperoni"	)is	10.5
function name		input(s)		<i>what the function produces</i>
cost	(	"cheese"	)is	9
function name		input(s)		<i>what the function produces</i>
cost	(	"chicken"	)is	11.25
function name		input(s)		<i>what the function produces</i>
cost	(	"broccoli"	)is	10.25
function name		input(s)		<i>what the function produces</i>
cost	(	"space-pizza"	)is	1000000
function name		input(s)		<i>what the function produces</i>

end

## Definition

Write the definition, given variable names to all your input values...

fun cost (topping):  
function name                   variables

ask:

|(string-equal ("pepperoni" topping)) then: 10.5

|(string-equal ("cheese" topping)) then: 9

|(string-equal ("chicken" topping)) then: 11.25

|(string-equal ("broccoli" topping)) then: 10.25

|otherwise: 1000000

end

end

# Word Problem: update-player

**Directions:** Write a function called "update-player", which takes in the player's x-coordinate and y-coordinate, and the name of the key pressed, and returns the new y-coordinate.

## Contract and Purpose Statement

Every contract has three parts...

update-player	::	Number, Number, String	->	Number
function name		domain		range
# Produce new y-coordinate depending on key press				what does the function do?

## Examples

Write some examples, then circle and label what changes...

examples:

update-player	( 100, 320, "up" )	is	( + 320 20 )
function name	input(s)		what the function produces
update-player	( 200, 100, "up" )	is	( + 100 20 )
function name	input(s)		what the function produces
update-player	( 300, 320, "down" )	is	( - 320 20 )
function name	input(s)		what the function produces
update-player	( 400, 100, "down" )	is	( - 100 20 )
function name	input(s)		what the function produces

end

## Definition

Write the definition, given variable names to all your input values...

fun update-player ( y, key ):

function name variables

ask:

|(string-equal ("up" key)) then: ( + y 20 )

|(string-equal ("down" key)) then: ( - y 20 )

|otherwise: y

end

end

# 08 Collision Detection

# collision



distance

# Word Problem: line-length

**Directions:** Write a function called 'line-length', which takes in two numbers and returns the \*positive difference\* between them. It should always subtract the smaller number from the bigger one, and if they are equal it should return zero.

## Contract and Purpose Statement

Every contract has three parts...

line-length	::	Number, Number	->	Number
function name		domain		range

# Produce positive difference between two given numbers

*what does the function do?*

## Examples

Write some examples, then circle and label what changes...

examples:

line-length	(	10, 5	) is	(10 - 5)
function name		input(s)		what the function produces
line-length	(	2, 8	) is	(8 - 2)

end

## Definition

Write the definition, given variable names to all your input values...

fun line-length ( a, b ):

function name variables

ask:

|(a > b) then: (a - b)

|(a < b) then: (b - a)

end

end

## The Distance Formula (an example)

The distance between the points  $(0, 0)$  and  $(4, 3)$  is given by:

$$\sqrt{(line-length\ 4\ 0)^2 + (line-length\ 3\ 0)^2}$$

---

Turn the formula above into a Circle of Evaluation. (We've already gotten you started!)



---

Convert the Circle of Evaluation into Pyret code:

## Word Problem: distance

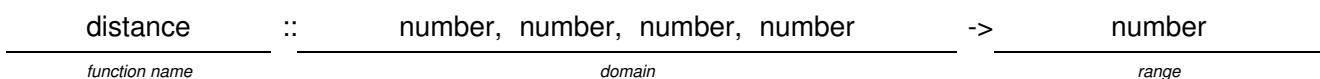
**Directions:** Write a function "distance", which takes FOUR inputs:

- *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 the distance between the two, using the Distance formula. (HINT: look at what you did on the previous page!)*

# Contract and Purpose Statement

## *Every contract has three parts...*



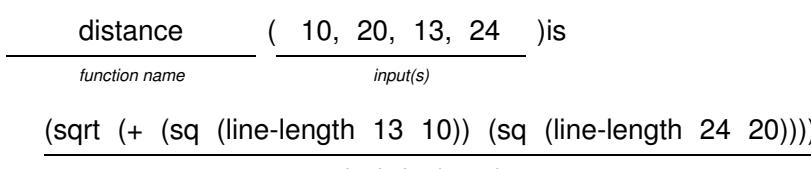
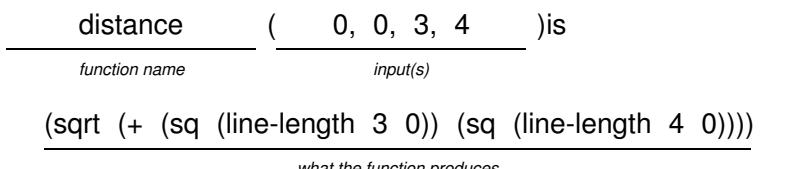
```
# Produce distance between two points with given coordinates
```

*what does the function do?*

## Examples

*Write some examples, then circle and label what changes...*

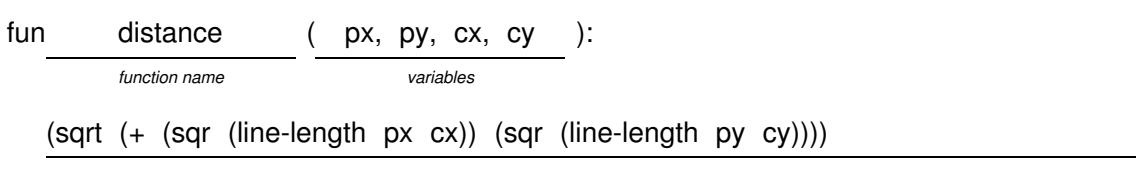
## examples:



end

## Definition

*Write the definition, given variable names to all your input values.*



end

## Word Problem: is-collision

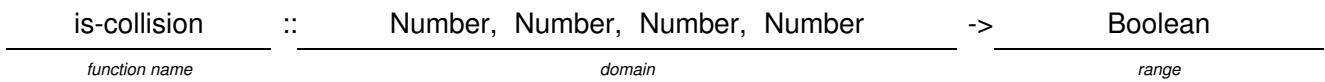
**Directions:** Write a function "is-collision", which takes FOUR inputs:

- *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

*Are the coordinates of the player within 50 pixels of the coordinates of the other character?*

# **Contract and Purpose Statement**

## *Every contract has three parts...*



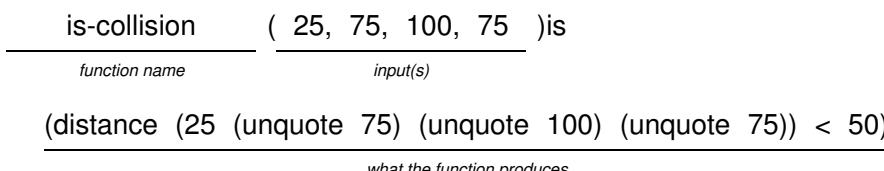
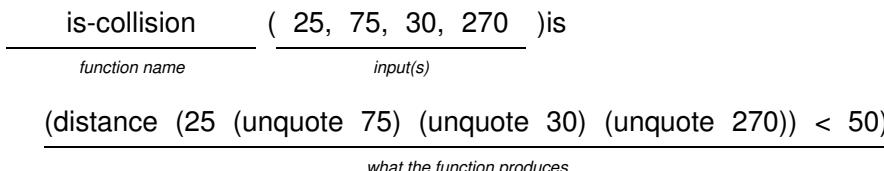
```
# Is the Player (px, py) within 50 pixels of another Character (cx, cy)?
```

*what does the function do?*

## Examples

*Write some examples, then circle and label what changes...*

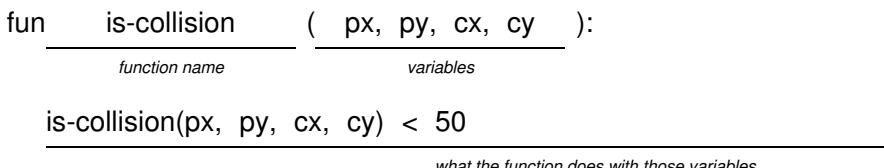
## examples:



end

## Definition

*Write the definition, given variable names to all your input values....*



end



## 09 Presentation Preparation



# Lesson 9

Catchy Intro:

---

---

---

Name, Age, Grade:

---

Game Title:

---

---

---

---

Back Story:

---

---

---

---

Characters:

---

---

---

---

Explain a piece of your code:

---

---

---

---



## Presentation Feedback

For each question, circle the answer that fits best.

Was the introduction catchy?      No way!      A little.      Definitely!

Did they talk about their characters?    No way!      A little.      Definitely!

Did they explain the code well?    No way!      A little.      Definitely!

Did they speak slowly enough?    No way!      A little.      Definitely!

Did they speak loudly enough?    No way!      A little.      Definitely!

Were they standing confidently?    No way!      A little.      Definitely!

Did they make eye contact?    No way!      A little.      Definitely!

## Presentation Feedback

For each question, circle the answer that fits best.

Was the introduction catchy?      No way!      A little.      Definitely!

Did they talk about their characters?    No way!      A little.      Definitely!

Did they explain the code well?    No way!      A little.      Definitely!

Did they speak slowly enough?    No way!      A little.      Definitely!

Did they speak loudly enough?    No way!      A little.      Definitely!

Were they standing confidently?    No way!      A little.      Definitely!

Did they make eye contact?    No way!      A little.      Definitely!

# Word Problem: red-shape

**Directions:** Write a function called "red-shape", which takes in the name of a shape and draws that shape (solid and red). Add an otherwise clause that produces a sensible output.

## Contract and Purpose Statement

Every contract has three parts...

red-shape	::	string	->	image
function name		domain		range

# Create a solid red shape of the given kind

*what does the function do?*

## Examples

Write some examples, then circle and label what changes...

examples:

red-shape	(	"circle"	)is	(circle 50 "solid" "red")
function name		input(s)		<i>what the function produces</i>
red-shape	(	"triangle"	)is	(tri 50 "solid" "red")
function name		input(s)		<i>what the function produces</i>
red-shape	(	"rectangle"	)is	(rect 99 9 "solid" "red")
function name		input(s)		<i>what the function produces</i>
red-shape	(	"star"	)is	(star 50 "solid" "red")
function name		input(s)		<i>what the function produces</i>
red-shape	(	"garbanzo"	)is	(square 50 "solid" "red")
function name		input(s)		<i>what the function produces</i>

end

## Definition

Write the definition, given variable names to all your input values...

```
fun red-shape (shape):  
    function name           variables  
  
    ask:  
    |("circle" == shape)      then:(circle (50 "solid" "red"))  
  
    |("triangle" == shape)    then:(triangle (50 "solid" "red"))  
  
    |("rectangle" == shape)   then:(rect (99 9 "solid" "red"))  
  
    |("star" == shape)        then:(star (50 "solid" "red"))  
  
    |otherwise:(text 20 "???" "red")  
  
end  
end
```

## Translating into Algebra

### Value Definitions

Pyret Code	Algebra
<code>x = 10</code>	$x = 10$
<code>y = x * 2</code>	$y = x^2$
<code>z = x / y</code>	
<code>w = num-sqrt(num-sqr(x) + 1)</code>	
<code>days = (age * 12) * 30</code>	
<code>y = (v * x) + x0</code>	
<code>y = ((0.5 * a) * num-sqr(x)) + y0</code>	

### Function Definitions

Pyret Code	Algebra
<pre>fun area(length, width):     length * width end</pre>	$\text{area}(\text{length}, \text{width}) = \text{length} * \text{width}$
<pre>fun circle-area(radius):     pi * radius end</pre>	
<pre>fun distance(x1, y1, x2, y2):     num-sqrt(         num-sqr(x1 - x2)         + num-sqr(y1 - y2)     ) end</pre>	

# Design Recipe

A rocket is flying from Earth to Mars at 80 miles per second. Write a function that describes the distance  $D$  that the rocket has traveled, as a function of time  $t$ .

## I. Contract+Purpose Statement

Every contract has three parts:

# D : \_\_\_\_\_ -> \_\_\_\_\_  
name Domain Range  
# \_\_\_\_\_  
*What does the function do?*

## II. Give Examples

Write an example of your function for some sample inputs

D( 1 ) is \_\_\_\_\_  
Use the function here What should the function produce?  
D( 2 ) = is \_\_\_\_\_  
Use the function here What should the function produce?  
D(    ) is \_\_\_\_\_  
Use the function here What should the function produce?  
is \_\_\_\_\_  
Use the function here What should the function produce?

## III. Definition

Write the function, giving variable names to all your input values.

fun D(    ) : \_\_\_\_\_ end

# Design Recipe

A rocket is traveling from Earth to Mars at 80 miles per second. Write a function that describes the **time** the rocket has been traveling, as a function of **distance**.

## I. Contract+Purpose Statement

Every contract has three parts:

# \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name Domain Range  
# \_\_\_\_\_  
*What does the function do?*

## II. Give Examples

Write an example of your function for some sample inputs

**is**  
Use the function here      What should the function produce?  
  
**is**  
Use the function here      What should the function produce?  
  
**is**  
Use the function here      What should the function produce?  
  
**is**  
Use the function here      What should the function produce?

## III. Definition

Write the function, giving variable names to all your input values.

fun ( ) : end

# Design Recipe

A rocket leaves Earth, headed for Mars at 80 miles per second. **At the exact same time**, an asteroid leaves Mars traveling towards Earth, moving at 70 miles per second. If the distance from the Earth to Mars is 50,000,000 miles, how long will it take for them to meet?

## I. Contract+Purpose Statement

Every contract has three parts:

## **II. Give Examples**

Write an example of your function for some sample inputs

**is**  
Use the function here      What should the function produce?

**is**  
Use the function here      What should the function produce?

is Use the function here      What should the function produce?

**is** \_\_\_\_\_  
Use the function here. What should the function produce?

### III Definition

iii. Definition Write the function, giving variable names to all your input values.

fun ( ) : end

# Design Recipe

## I. Contract+Purpose Statement

## Every contract has three parts:

## **II. Give Examples**

Write an example of your function for some sample inputs

---

**is**

Use the function here      What should the function produce?

is Use the function here What should the function produce?

**is**  
Use the function here      What should the function produce?

**is**

---

Use the function here      What should the function produce?

### **III. Definition**

Write the function, giving variable names to all your input values.

fun ( ) : end

# Design Recipe

## I. Contract+Purpose Statement

Every contract has three parts:

## **II. Give Examples**

Write an example of your function for some sample inputs

**is**  
Use the function here      What should the function produce?

---

Use the function here      What should the function produce?

**is**      Use the function here      What should the function produce?

**is**  
Use the function here      What should the function produce?

**III. Definition**  
Write the function, giving variable names to all your input values.

### **III. Definition**

Write the function, giving variable names to all your input values.

fun ( ) : end

## Contracts

## Contracts