

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

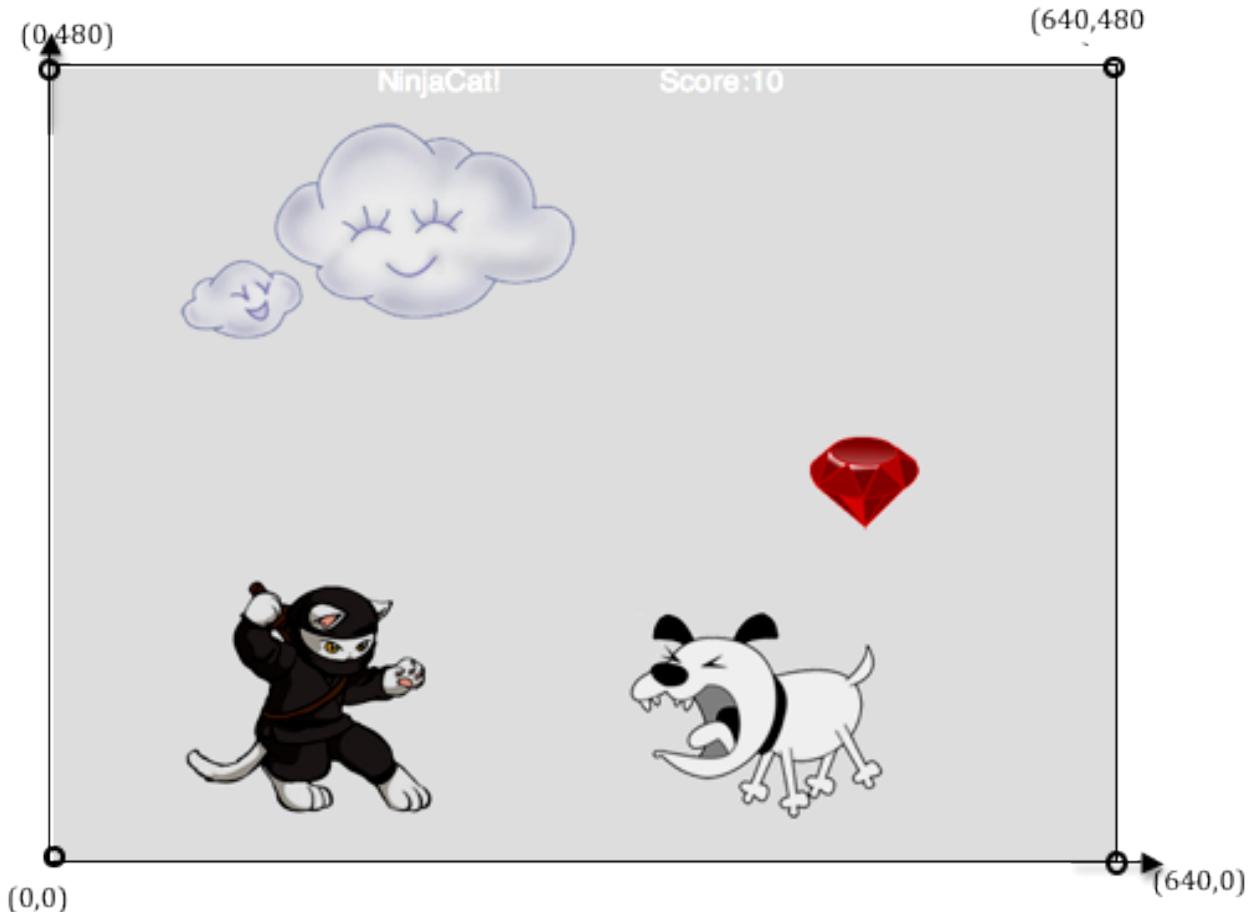


# Lesson 1

**Reverse-Engineering: How does NinjaCat work?**

Thing in the game...	What changes about it?	More specifically...
<i>cloud</i>	<i>position</i>	<i>x-coordinate</i>
Cat	Position	X,y coordinates
Ruby	Position	x-coordinate
Dog	Position	Y-coordinate
Score	Value	
Background	Nothing	

## Finding Coordinates



The coordinates for the PLAYER (NinjaCat) are:

( 150 , 50 )

*x-coordinate    y-coordinate*

The coordinates for the DANGER (Dog) are:

( 450 , 50 )

The coordinates for the TARGET (Ruby) are:

( 550 , 250 )

# Our Videogame

Created by (write your names): \_\_\_\_\_  
Ellie and Danny

## Background

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

## The Player

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

The player moves only up and down.

## The Target

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

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

The Target moves only to the left and right.

## The Danger

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

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

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>
$5 \times 10$		$5 * 10$
$8 + (5 \times 10)$		$8 + (5 * 10)$
$(8 + 2) - (5 \times 10)$		$(8+2) - (5 * 10)$
$\frac{5 \times 10}{8 - 2}$		$(5 * 10) / (8 - 2)$

# 02 Contracts, Strings, and Images



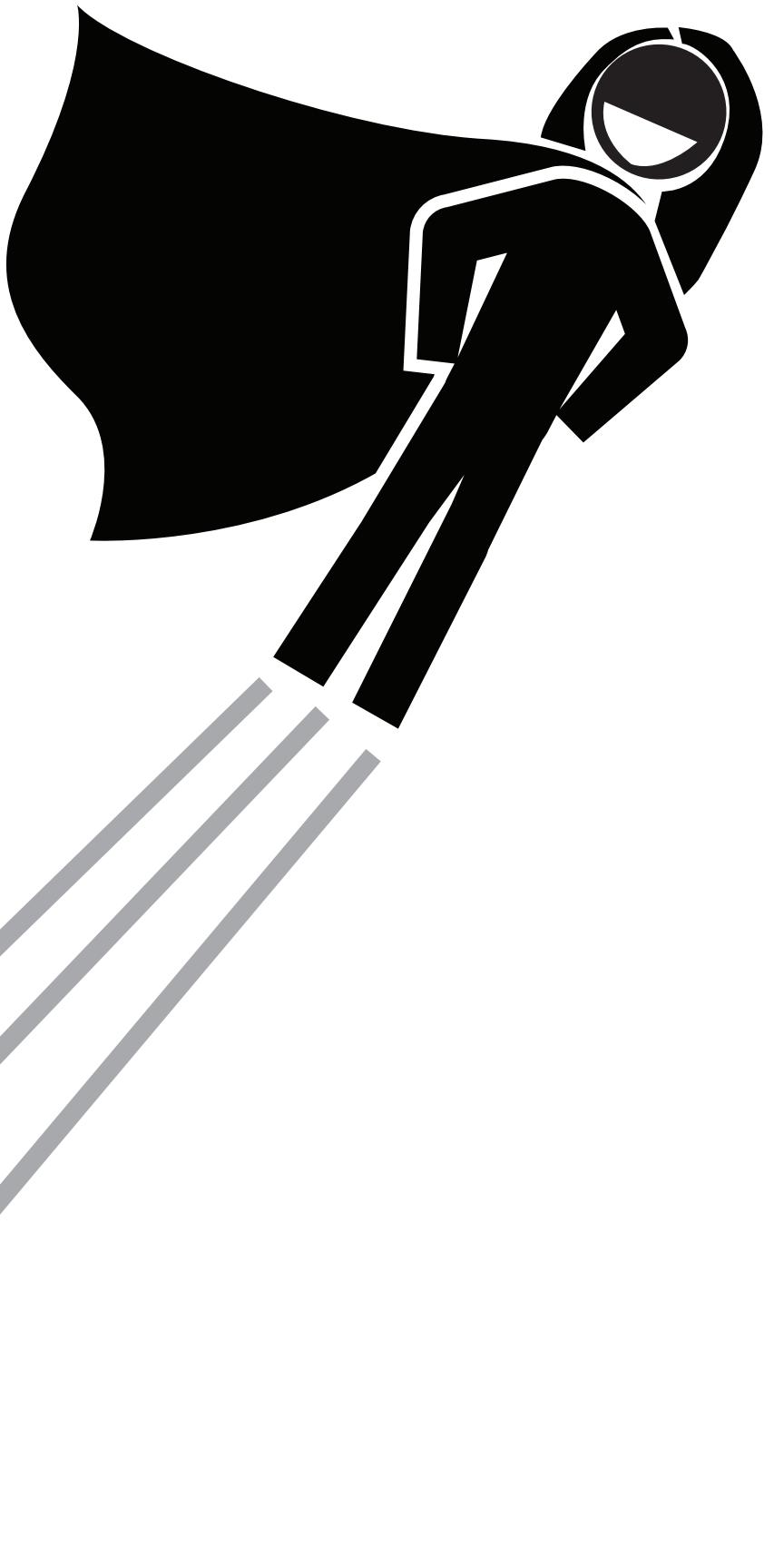
# Circles Competition minutes

Time: 5

	<b>Math</b>	<b>Circle of Evaluation</b>	<b>Pyret Code</b>
Round 1	$(3 \times 7) - (1 + 2)$	A circle divided into three horizontal sections by two horizontal lines. The top section contains a minus sign (-). The middle section contains a multiplication sign (*). The bottom section contains a plus sign (+). Inside the circle, there are two smaller circles. The left small circle contains the numbers 3 and 7. The right small circle contains the numbers 1 and 2.	$(3 * 7) - (1 + 2)$
Round 2	$3 - (1 + 2)$	A circle divided into three horizontal sections by two horizontal lines. The top section contains a minus sign (-). The middle section contains a plus sign (+). The bottom section is empty. Inside the circle, there are two smaller circles. The left small circle contains the number 3. The right small circle contains the numbers 1 and 2.	$3 - (1 + 2)$
Round 3	$3 - (1 + (5 \times 6))$	A circle divided into three horizontal sections by two horizontal lines. The top section contains a minus sign (-). The middle section contains a plus sign (+). The bottom section contains a multiplication sign (*). Inside the circle, there are three smaller circles. The leftmost small circle contains the number 3. The middle small circle contains the number 1. The rightmost small circle contains the numbers 5 and 6.	$3 - (1 + (5 * 6))$
Round 4	$(1 + (5 \times 6)) - 3$	A circle divided into three horizontal sections by two horizontal lines. The top section contains a minus sign (-). The middle section contains a plus sign (+). The bottom section contains a multiplication sign (*). Inside the circle, there are three smaller circles. The leftmost small circle contains the number 1. The middle small circle contains the numbers 5 and 6. The rightmost small circle contains the number 3.	$(1 + (5 * 6)) - 3$

# 03

## Intro to Definitions



## Fast Functions

#	gt	:	Number	->	Image
	name		domain		range

examples:

gt	(	7	)	is	triangle(7, "solid", "green")
gt	(	500	)	is	triangle(500, "solid", "green")

end

fun gt ( size ) : triangle( size, "solid", "green") end

#	bc	:	Number	->	Image
	name		domain		range

examples:

gt	(	19	)	is	circle(19, "solid", "blue")
gt	(	43	)	is	circle(43, "solid", "blue")

end

fun bc ( size ) : circle( size, "solid", "blue") end

#	dot	:	String	->	Image
	name		domain		range

examples:

dot	(	"blue"	)	is	circle(20, "solid", "blue")
dot	(	"red"	)	is	circle(20, "solid", "red")

end

fun dot ( color ) : circle( 20, "solid", color) end

## Fast Functions

#	g	:	Number	->	Number
	name		domain		range

examples:

g ( 10 ) is  $20 * 10$   
g ( 23 ) is  $20 * 23$

end

fun g ( q ):  $20 * q$  end

#	h	:	Number	->	Number
	name		domain		range

examples:

h ( 10 ) is  $10 / 2$   
h ( 15 ) is  $15 / 2$

end

fun h ( x ):  $x / 2$  end

#	_____	:	_____	->	_____
	name		domain		range

examples:

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

end

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

# 04 Design Recipe

1 Contract

2 Example

3 Definition

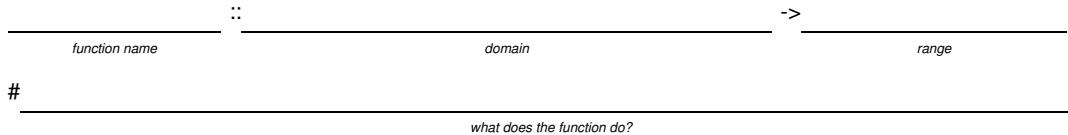


## Word Problem: rocket-height

**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...



### Examples

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

examples:



end

### Definition

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



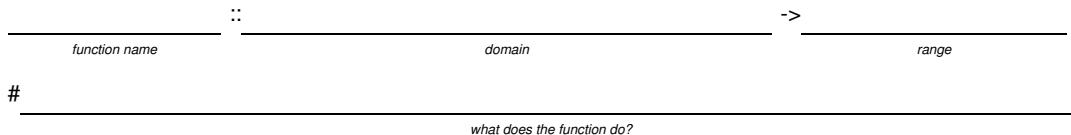
end

## Word Problem: 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

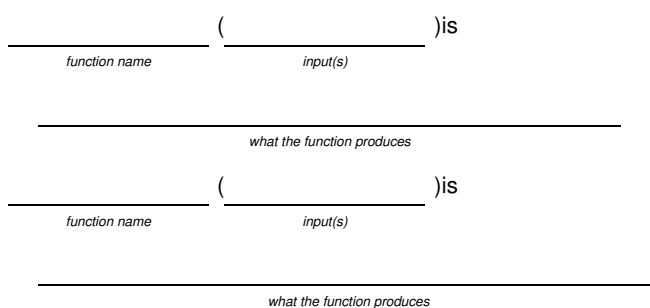
Every contract has three parts...



### Examples

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

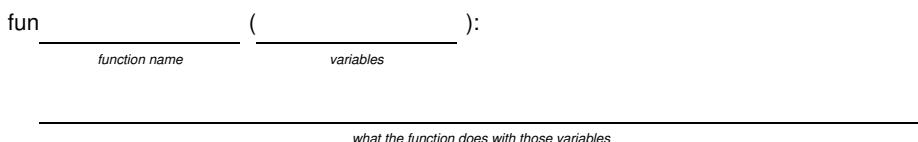
examples:



end

### Definition

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



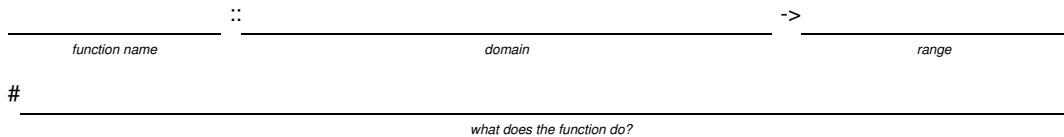
end

## Word Problem: 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

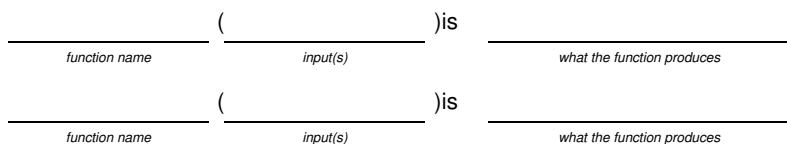
Every contract has three parts...



### Examples

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

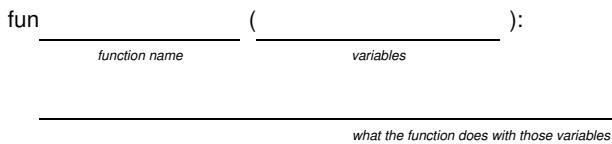
examples:



end

### Definition

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



end

# target



# danger



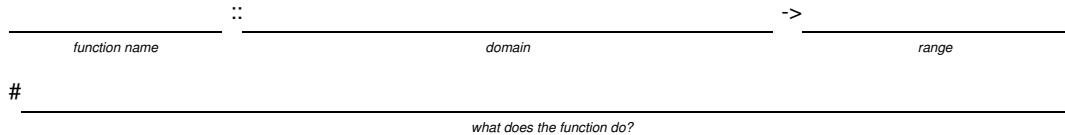
## 05 Game Animation

## 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

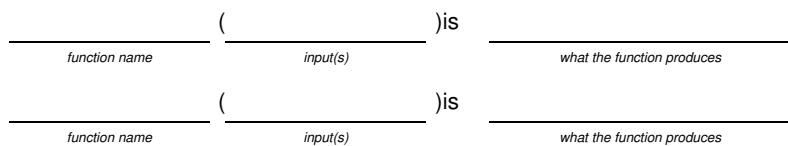
Every contract has three parts...



### Examples

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

examples:



end

### Definition

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

fun \_\_\_\_\_ ( \_\_\_\_\_ x, y \_\_\_\_\_ ):  
function name                            variables

\_\_\_\_\_ what the function does with those variables

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...



### Examples

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

examples:



end

### Definition

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

fun \_\_\_\_\_ ( \_\_\_\_\_ ):  
  function name                   variables

\_\_\_\_\_  
  what the function does with those variables

end



**“safe-left?”**

## 06 Comparing Functions

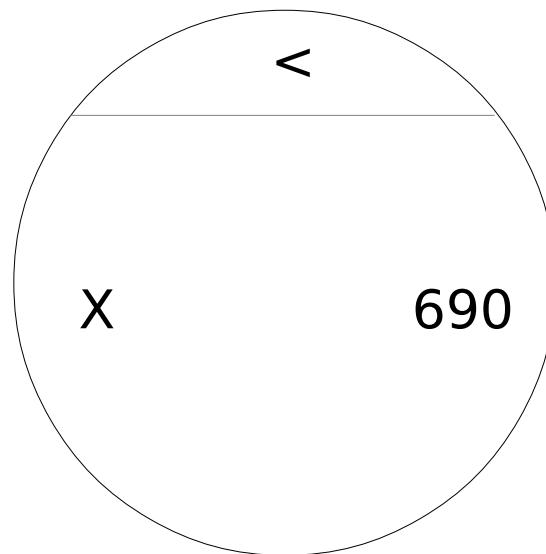
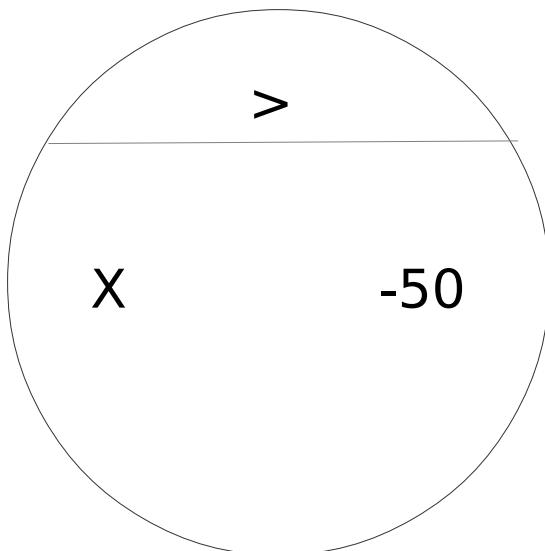
## DESIGN RECIPE

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...  $x < 690$  \_\_\_\_\_

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...



### Examples

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

examples:



end

### Definition

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

fun ( variables ):  
function name

what the function does with those variables

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

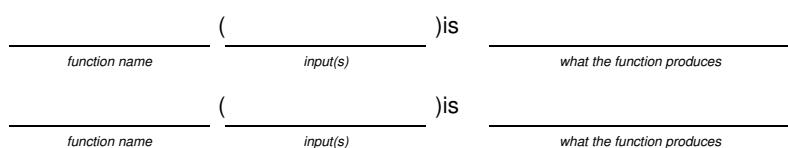
Every contract has three parts...



### Examples

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

examples:



end

### Definition

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

fun ( variables ):  
function name

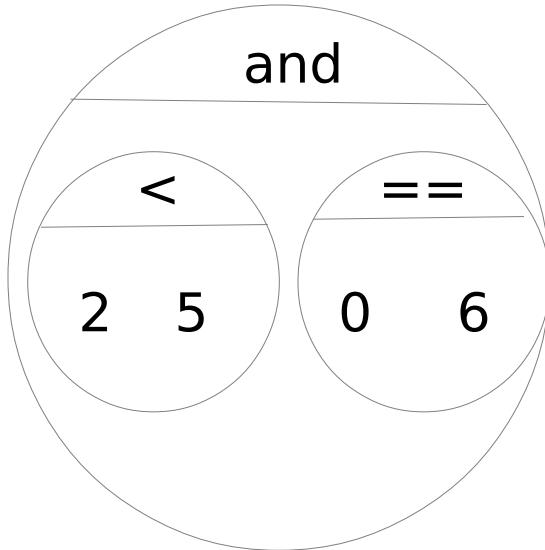
what the function does with those variables

end

and / or

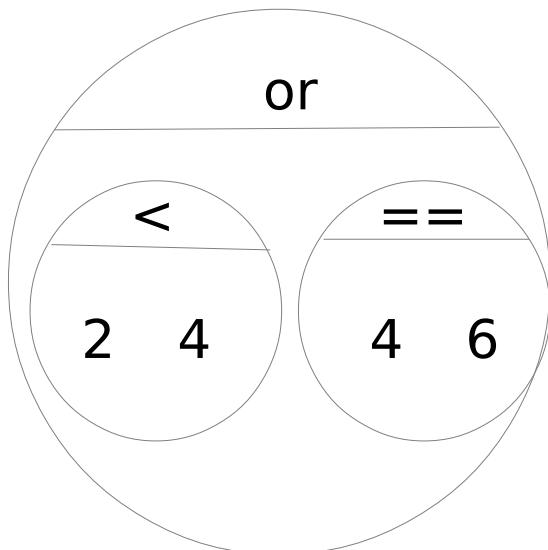
Write the Circles of Evaluation for these statements, and then convert them to Pyret

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



**(2 < 5) and (0 == 6)**

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



**(2 < 4) or (4 == 6)**

## 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

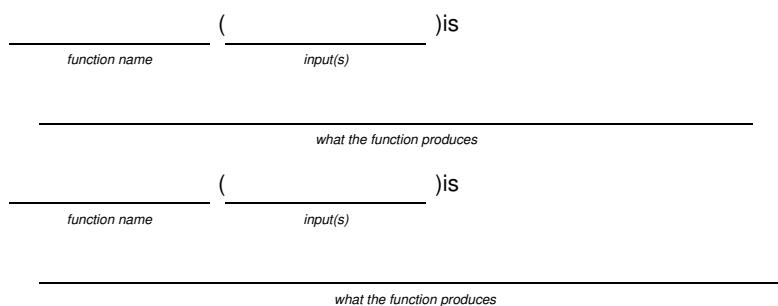
Every contract has three parts...



### Examples

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

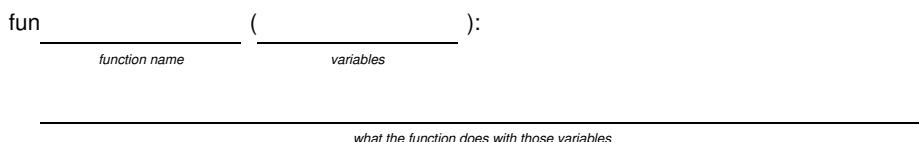
examples:



end

### Definition

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



end

# 07 Conditional Branching

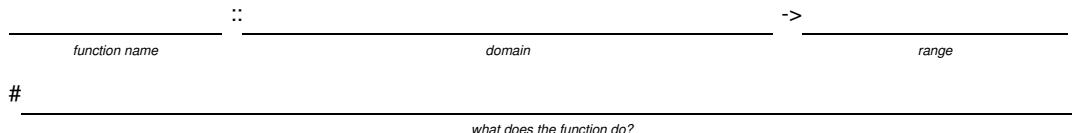


## Word Problem: cost

**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...



### Examples

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

examples:

cost	( _____ ) is	what the function produces
function name	input(s)	
_____	( _____ ) is	what the function produces
function name	input(s)	
_____	( _____ ) is	what the function produces
function name	input(s)	
_____	( _____ ) is	what the function produces
function name	input(s)	

end

### Definition

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

fun \_\_\_\_\_ ( \_\_\_\_\_ ):  
function name variables

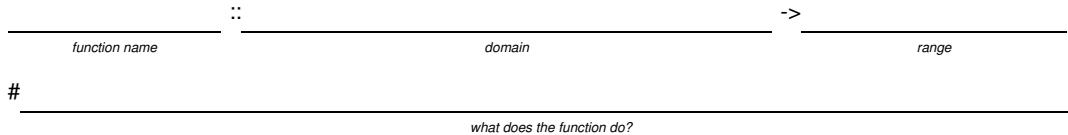
if \_\_\_\_\_ :  
if  
else \_\_\_\_\_ :  
if  
else \_\_\_\_\_ :  
if  
else:  
else:  
  
end  
end

## 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...



### Examples

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

examples:

update-player ( 100, 320, "up" ) is \_\_\_\_\_  
function name                    input(s)                    what the function produces

update-player ( 200, 100, "up" ) is \_\_\_\_\_  
function name                    input(s)                    what the function produces

( \_\_\_\_\_ ) is \_\_\_\_\_  
function name                    input(s)                    what the function produces

( \_\_\_\_\_ ) is \_\_\_\_\_  
function name                    input(s)                    what the function produces

end

### Definition

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

fun \_\_\_\_\_ ( \_\_\_\_\_ ):  
function name                    variables

if \_\_\_\_\_ : \_\_\_\_\_

else \_\_\_\_\_ : \_\_\_\_\_

if

else: \_\_\_\_\_

end

end

# 08 Collision Detection

# collision



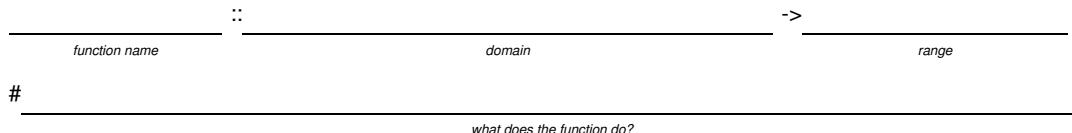
distance

## 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...



### 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	
function name		input(s)		what the function produces	

end

### Definition

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

fun \_\_\_\_\_ ( \_\_\_\_\_ ):  
function name                          variables  
if \_\_\_\_\_ : \_\_\_\_\_

else: \_\_\_\_\_

end

end

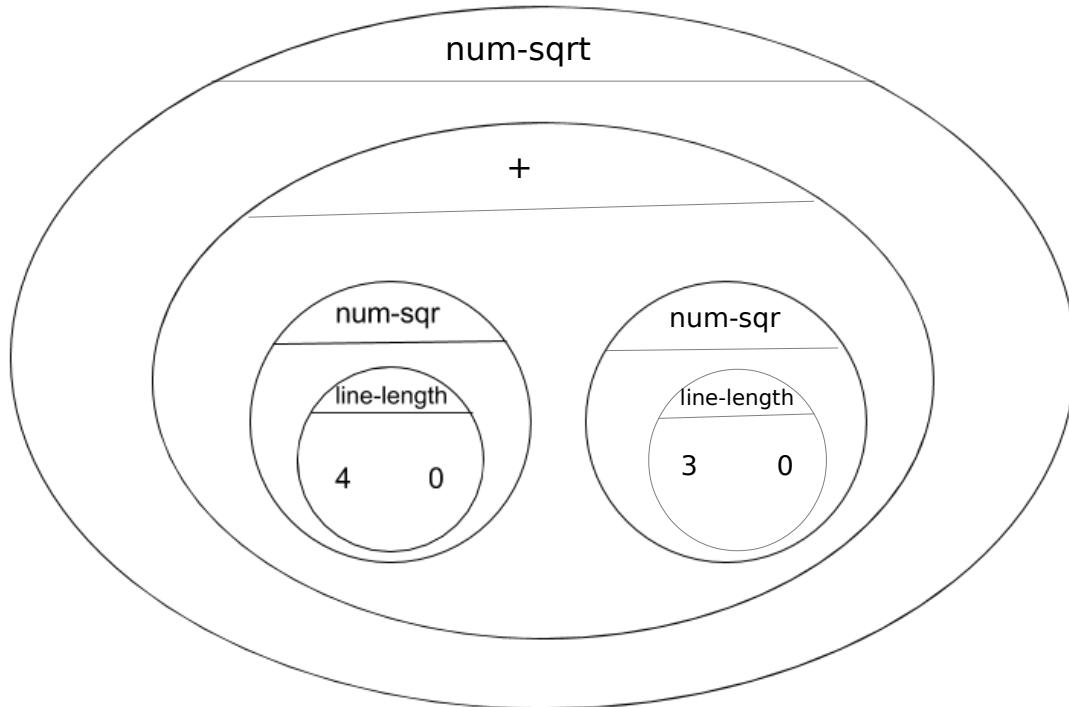
## The Distance Formula (an example)

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

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

---

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



---

Convert the Circle of Evaluation into Pyret code:

**num-sqrt(num-sqr(line-length(4, 0)) + (num-sqr(line-length(3, 0))))**

## 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...

::	->		
function name		domain	range
#	<i>what does the function do?</i>		

### Examples

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

examples:

function name	(	)is
	input(s)	
<hr/> <i>what the function produces</i>		
function name	(	)is
	input(s)	
<hr/> <i>what the function produces</i>		

end

### Definition

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

fun	function name	(	variables	):
<hr/> <i>what the function does with those variables</i>				

end

## Word Problem: is-collision

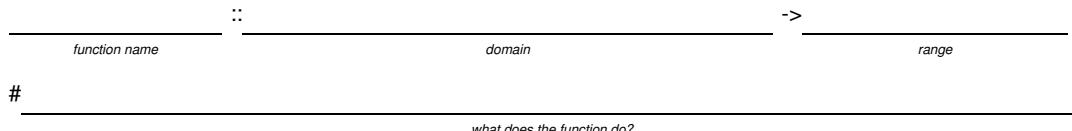
**Directions:** Write a function "is-collision", which takes FOUR inputs:

- 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

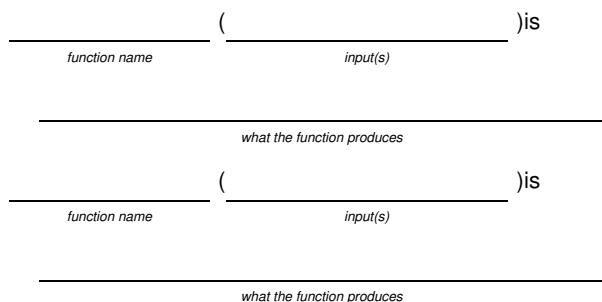
Every contract has three parts...



### Examples

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

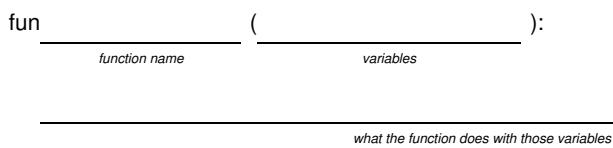
examples:



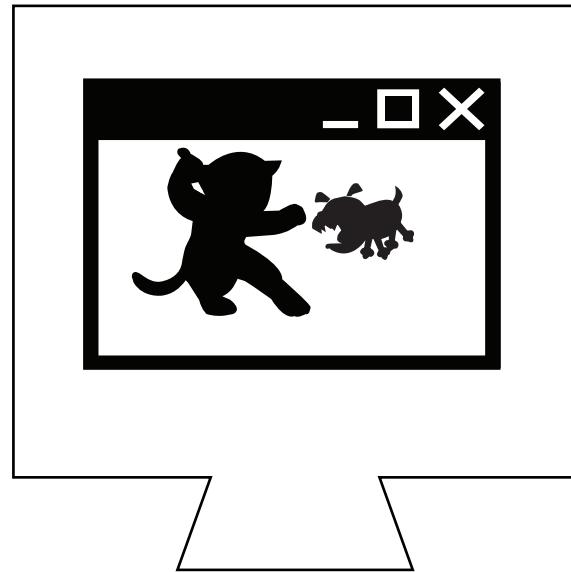
end

### Definition

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



end



## 09 Presentation Preparation



# Lesson 9

Catchy Intro: Feel like you never get enough to eat? So does Leo. Come catch your prey,

---

and escape the zookeeper!

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---

Name, Age, Grade: Elliee Programmer, 12, 7<sup>th</sup> grade

---

Game Title: Run for your Supper

---

Back Story: One day, a young lion was sitting in his cage. He saw an escaped gazelle come

---

running past. It was lunch time, and he was hungry, so he leapt out to catch food. He has

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to run fast to grab food and escape the evil zookeeper.

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Characters: Player: Leo the lion.

---

Danger: Zoe Zookeeper.

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Target: Gary Gazelle

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Explain a piece of your code: My update-danger function takes in the current x coordinate of the gazelle, and adds 50 to it. This moves the gazelle 50 pixels to the right.

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## 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!

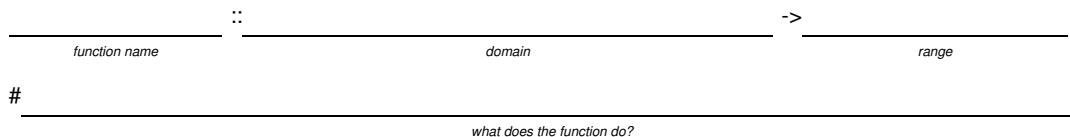
Did they make eye contact?      No way!      A little.      Definitely!

## 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...



### Examples

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

examples:

( \_\_\_\_\_ )is  
function name input(s)

\_\_\_\_\_  
what the function produces

( \_\_\_\_\_ )is  
function name input(s)

\_\_\_\_\_  
what the function produces

( \_\_\_\_\_ )is  
function name input(s)

\_\_\_\_\_  
what the function produces

( \_\_\_\_\_ )is  
function name input(s)

\_\_\_\_\_  
what the function produces

( \_\_\_\_\_ )is  
function name input(s) \_\_\_\_\_  
what the function produces

end

## Definition

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

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

function name

variables

if \_\_\_\_\_ :

\_\_\_\_\_

else \_\_\_\_\_ :

if \_\_\_\_\_

\_\_\_\_\_

else \_\_\_\_\_ :

if \_\_\_\_\_

\_\_\_\_\_

else \_\_\_\_\_ :

if \_\_\_\_\_

\_\_\_\_\_

else:

end

end

## Translating into Algebra

### Value Definitions

Pyret Code	Algebra
<code>x = 10</code>	$x = 10$
<code>y = x * 2</code>	$y = x \cdot 2$
<code>z = x / y</code>	$z = x \div y$
<code>w = num-sqrt(num-sqr(x) + 1)</code>	$w = \sqrt{x^2 + 1}$
<code>days = (age * 12) * 30</code>	$\text{days} = (\text{age} \cdot 12) \cdot 30$
<code>y = (v * x) + x0</code>	$y = (v \cdot x) + x_0$
<code>y = ((0.5 * a) * num-sqr(x)) + y0</code>	$y = (0.5 \cdot a) \cdot x^2 + y_0$

### Function Definitions

Pyret Code	Algebra
<pre>fun area(length, width):     length * width end</pre>	$\text{area}(\text{length}, \text{width}) = \text{length} \cdot \text{width}$
<pre>fun circle-area(radius):     pi * num-sqr(radius) end</pre>	$\text{circle-area}(\text{radius}) = \pi \cdot \text{radius}^2$
<pre>fun distance(x1, y1, x2, y2):     num-sqrt(         num-sqr(x1 - x2)         + num-sqr(y1 - y2)     ) end</pre>	$\text{distance}(x_1, y_1, x_2, y_2) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$

# 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:

<u>D</u>	:	<u>Number</u>	->	<u>Number</u>
name		Domain		Range
# Given a number of seconds, produces the height of a rocket moving at 80mi/s	What does the function do?			

## II. Give Examples

Write an example of your function for some sample inputs

$$D(1) \text{ is } 80 * 1$$

Use the function here                          What should the function produce?

$$D(2) \text{ is } 80 * 2$$

Use the function here                          What should the function produce?

$$D(14) \text{ is } 80 * 14$$

Use the function here                          What should the function produce?

$$D(100) \text{ is } 80 * 100$$

Use the function here                          What should the function produce?

## III. Definition

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

```
fun D( time ) : 80 * time  
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:

	<b>time</b>	:	<b>Number</b>	->	<b>Number</b>
		name		Domain	Range
#	Given the distance traveled, produce the time traveled if moving at 80mi/s			What does the function do?	

## II. Give Examples

Write an example of your function for some sample inputs

**time(0)** is **0 / 80**

Use the function here    What should the function produce?

**time(10)** is **10 / 80**

Use the function here    What should the function produce?

**time(200)** is **200 / 80**

Use the function here    What should the function produce?

**time(560)** is **560 / 80**

Use the function here    What should the function produce?

## III. Definition

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

```
fun time (distance) : distance / 80
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:

<b>collide</b>	:	<b>Number</b>	->	<b>Number</b>
name		Domain		Range

# Given the distance between a rocket (moving at 80mi/sec) & asteroid (70mi/sec), when will they collide?  
*What does the function do?*

## II. Give Examples

Write an example of your function for some sample inputs

**collide(0)** is **0 / 150**

Use the function here    What should the function produce?

**collide(2000)** is **2000 / 150**

Use the function here    What should the function produce?

**collide(5000)** is **5000 / 150**

Use the function here    What should the function produce?

**collide(15000)** is **15000 / 150**

Use the function here    What should the function produce?

## III. Definition

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

**fun collide ( distance ): distance / 150**  
**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:

collide	:	Number	->	Number
name			Domain	Range
# Given the distance between a rocket (moving at 80mi/sec) & asteroid (70mi/sec), when will they collide?				<i>What does the function do?</i>

## II. Give Examples

Write an example of your function for some sample inputs

**collide(0)** is **0 / 150**

Use the function here    What should the function produce?

**collide(2000)** is **2000 / 150**

Use the function here    What should the function produce?

**collide(5000)** is **5000 / 150**

Use the function here    What should the function produce?

**collide(15000)** is **15000 / 150**

Use the function here    What should the function produce?

## III. Definition

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

**fun collide ( distance ): distance / 150**  
**end**

## Contracts

## Contracts