

Name: _____



BOOTSTRAP

www.bootstrapworld.org

Student Workbook

Class: _____

Bootstrap Units

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

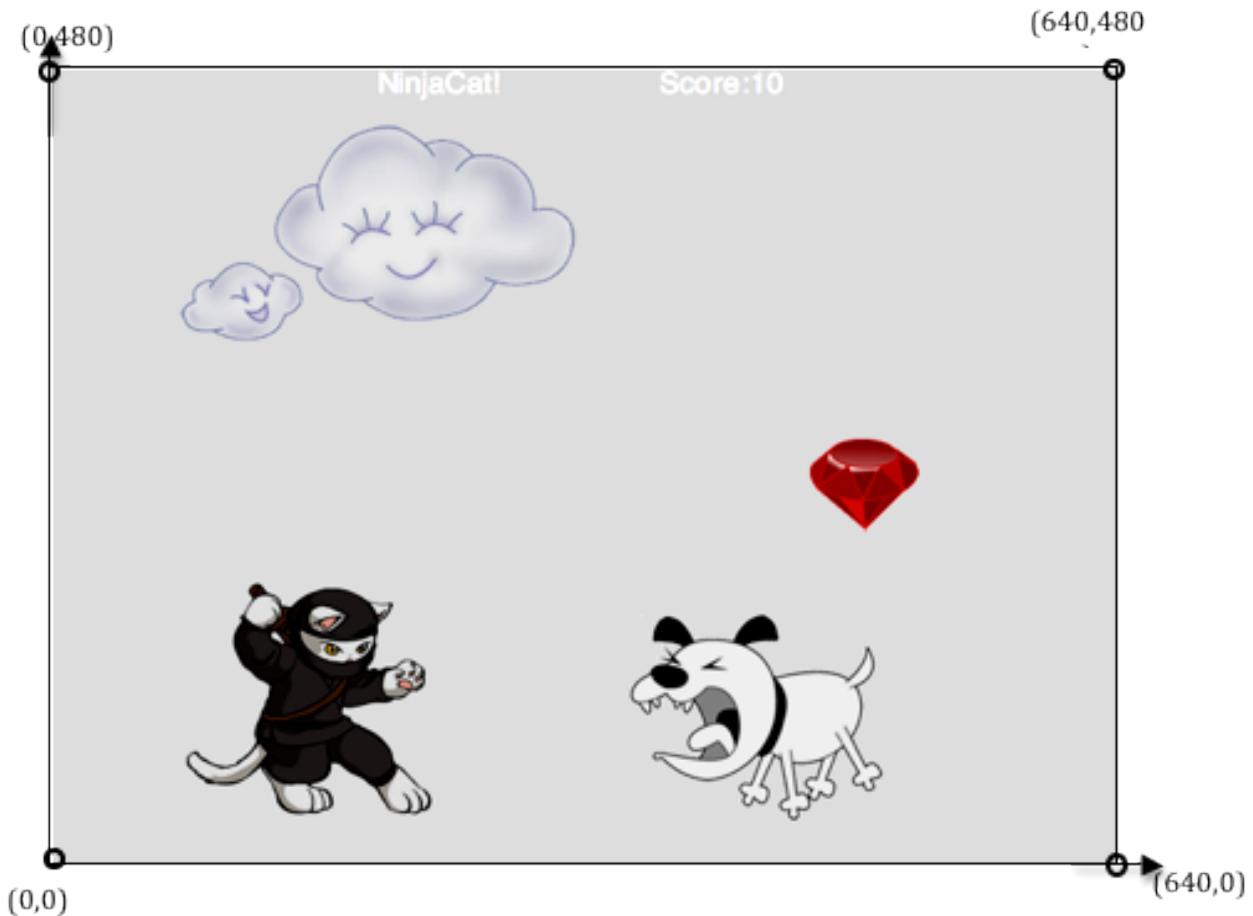
01 Videogames and Coordinate Planes



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!

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

02 Contracts, Strings, and Images



Circles Competition minutes

Time: 5

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

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

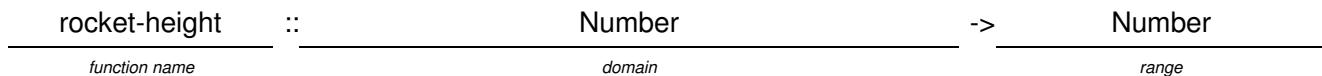


Word Problem: rocket-height

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...



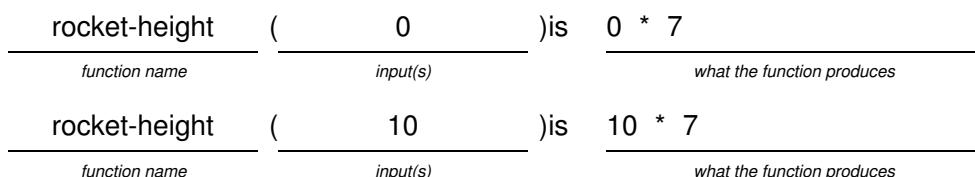
```
# Produce height of rocket after given number of seconds
```

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...

red-square	::	Number	->	Image
function name		domain		range

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)		<i>what the function produces</i>
red-square	(12) is	rectangle(12, 12, "solid", "red")

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

end

Definition

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

fun red-square (size):

function name *variables*

rectangle(size, size, "solid", "red")

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...

lawn-area	::	Number, Number	->	Number
function name		domain		range
# 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
function name		input(s)		what the function produces
lawn-area	(50, 5) is	50 * 5

end

Definition

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

fun	lawn-area	(length, width):
function name			variables	
length * width				
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 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):
function name variables
x - 50
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...

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

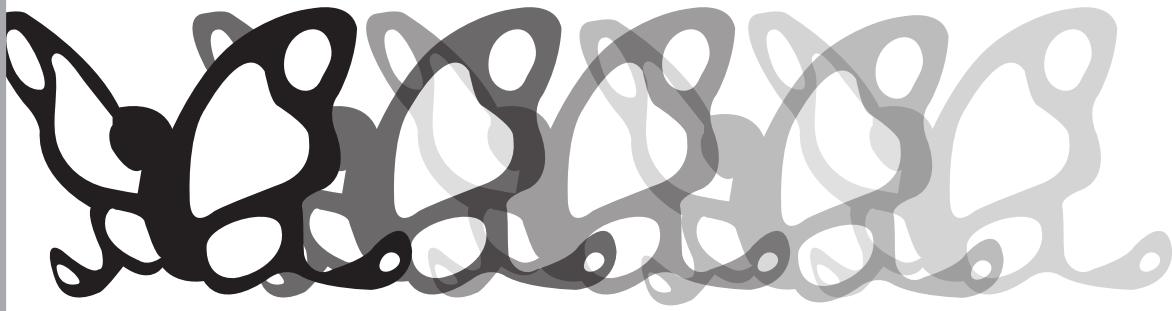
Definition

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

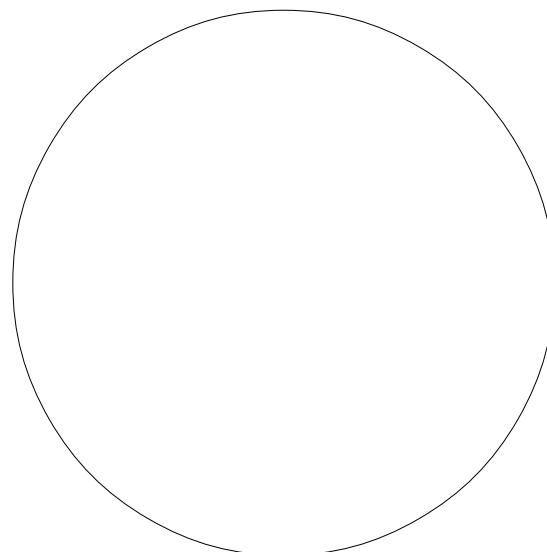
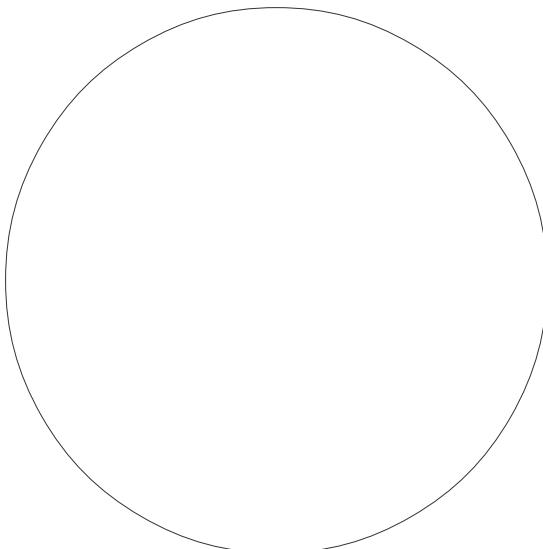
DESIGN RECIPE

Sam is in a 640 x 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)		<i>what the function produces</i>

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...

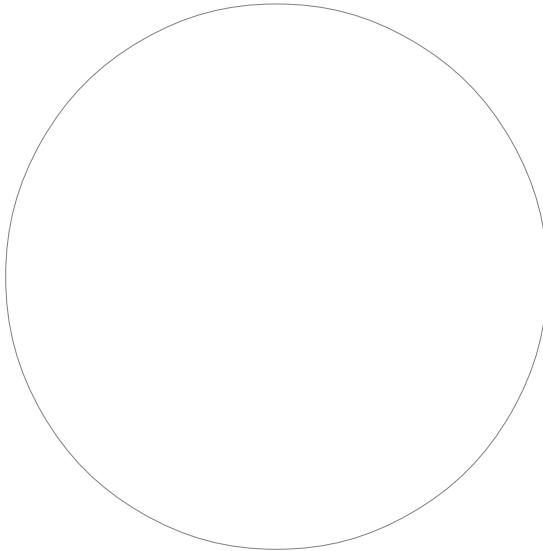
fun	is-safe-right	(x):
function name			variables	
x	<	690		<i>what the function does with those variables</i>

end

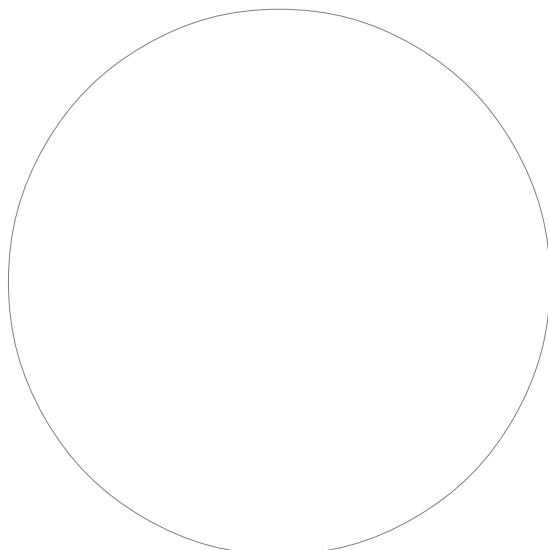
and / or

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)		<i>what the function produces</i>

end

Definition

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

fun	is-onscreen	(x):
function name		variables		
is-safe-left(x)	and	is-safe-right(x)		

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  
  
    if "pepperoni" == topping : 10.5  
    else "cheese" == topping : 9  
    if  
    else "chicken" == topping : 11.25  
    if  
    else "broccoli" == topping : 10.25  
    if  
    else: 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	(100, 320, "down") is	320 + 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  
  
    if string-equal("up", key) : y + 20  
  
    else string-equal("down", key) : y - 20  
    if  
    else: y  
  
end  
end
```

08 Collision Detection

collision



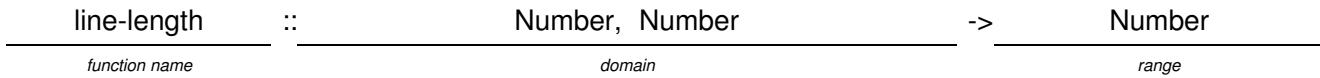
distance

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...



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	
<i>function name</i>		<i>input(s)</i>		<i>what the function produces</i>	
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*
if a > b : a - b
else: b - a

end

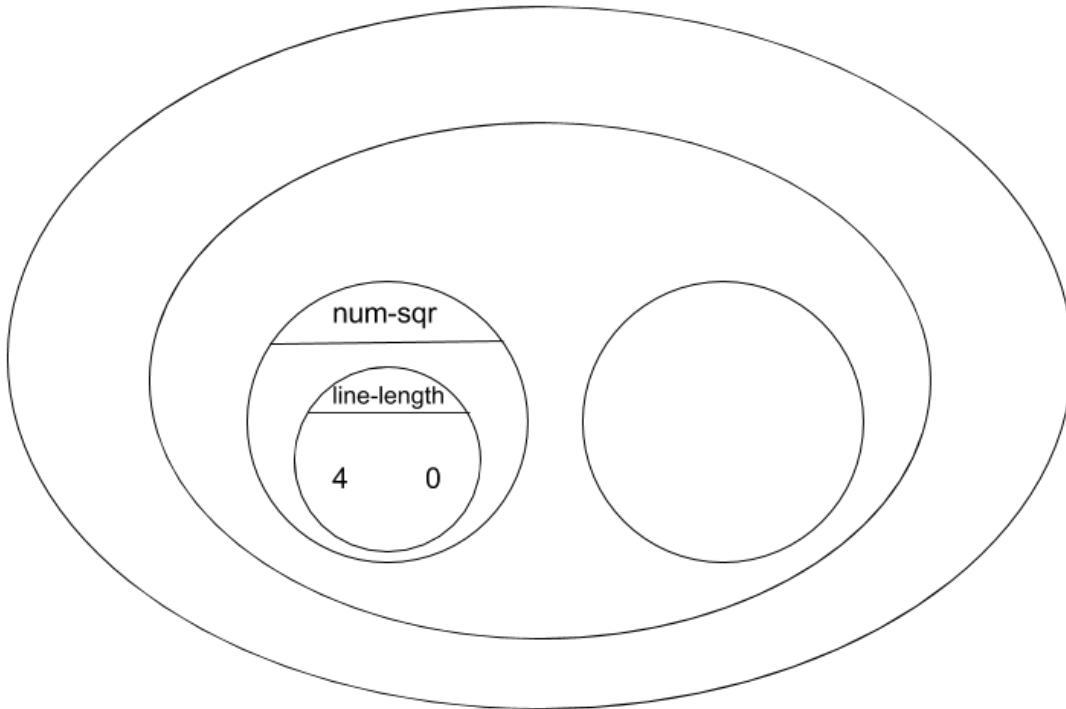
end

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

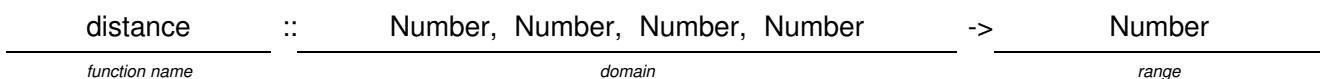
Directions: Write a function "distance", which takes FOUR inputs:

- *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...



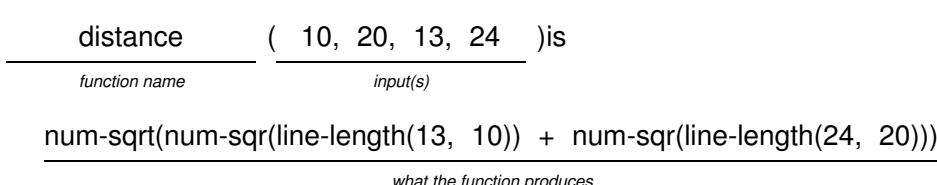
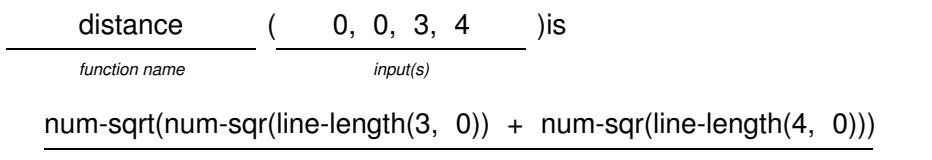
```
# Produce distance between two points with given coordinates
```

what does the function do?

Examples

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

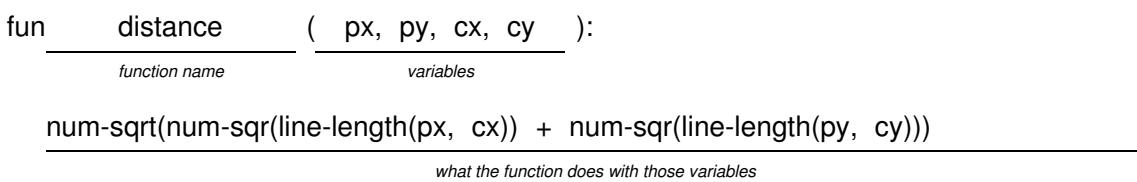
examples:



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-collision	::	Number, Number, Number, Number	->	Boolean
<i>function name</i>		<i>domain</i>		<i>range</i>

```
# 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:

<u>is-collision</u>	(25, 75, 30, 270)	is	distance(25, 75, 30, 270) < 50
<i>function name</i>	<i>input(s)</i>		<i>what the function produces</i>
<u>is-collision</u>	(25, 75, 100, 75)	is	distance(25, 75, 100, 75) < 50
<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      is-collision      ( px, py, cx, cy ):
```

function name *variables*

distance(px, py, cx, cy) < 50

what the function does with those variables

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	triangle(50, "solid", "red")
function name		input(s)		<i>what the function produces</i>
red-shape	("rectangle")is	rectangle(5, 1, "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	text("???", 20, "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  
    if "circle" == shape      :circle(50, "solid", "red")  
    else "triangle" == shape :triangle(50, "solid", "red")  
    if  
    else "rectangle" == shape :rectangle(9, "solid", "red")  
    if  
    else "star" == shape     :star(50, "solid", "red")  
    if  
    else:text(20, "???", "red")  
  
end  
end
```

Translating into Algebra

Value Definitions

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

Function Definitions

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

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.

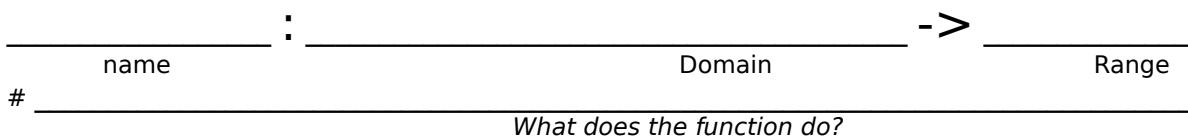
fun D() :
end

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:



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:

_____ : _____ -> _____
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.

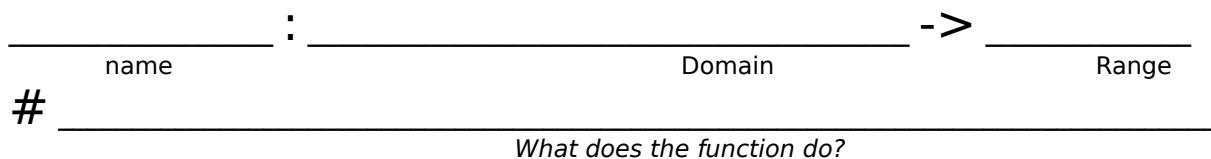
fun ():
end

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

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

fun ():
end

Contracts

Contracts