

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



**BOOTSTRAP**  
[www.bootstrapworld.org](http://www.bootstrapworld.org)

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



Workbook v2.0

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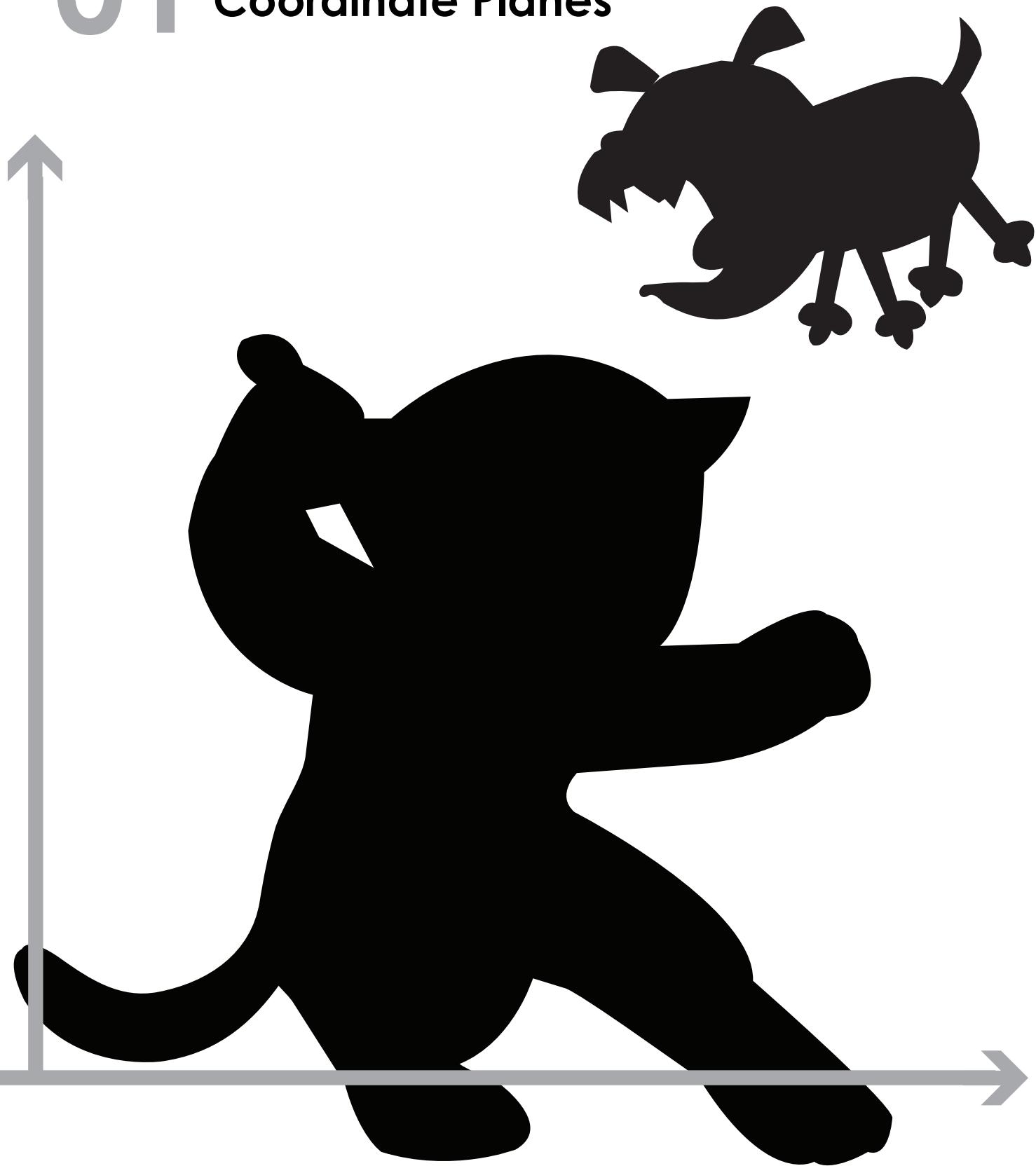
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# Bootstrap Units

<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>

## Game Parts - NinjaCat!



The coordinates for the PLAYER (NinjaCat) are: ( \_\_\_\_\_ , \_\_\_\_\_ )  
\_\_\_\_\_

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.

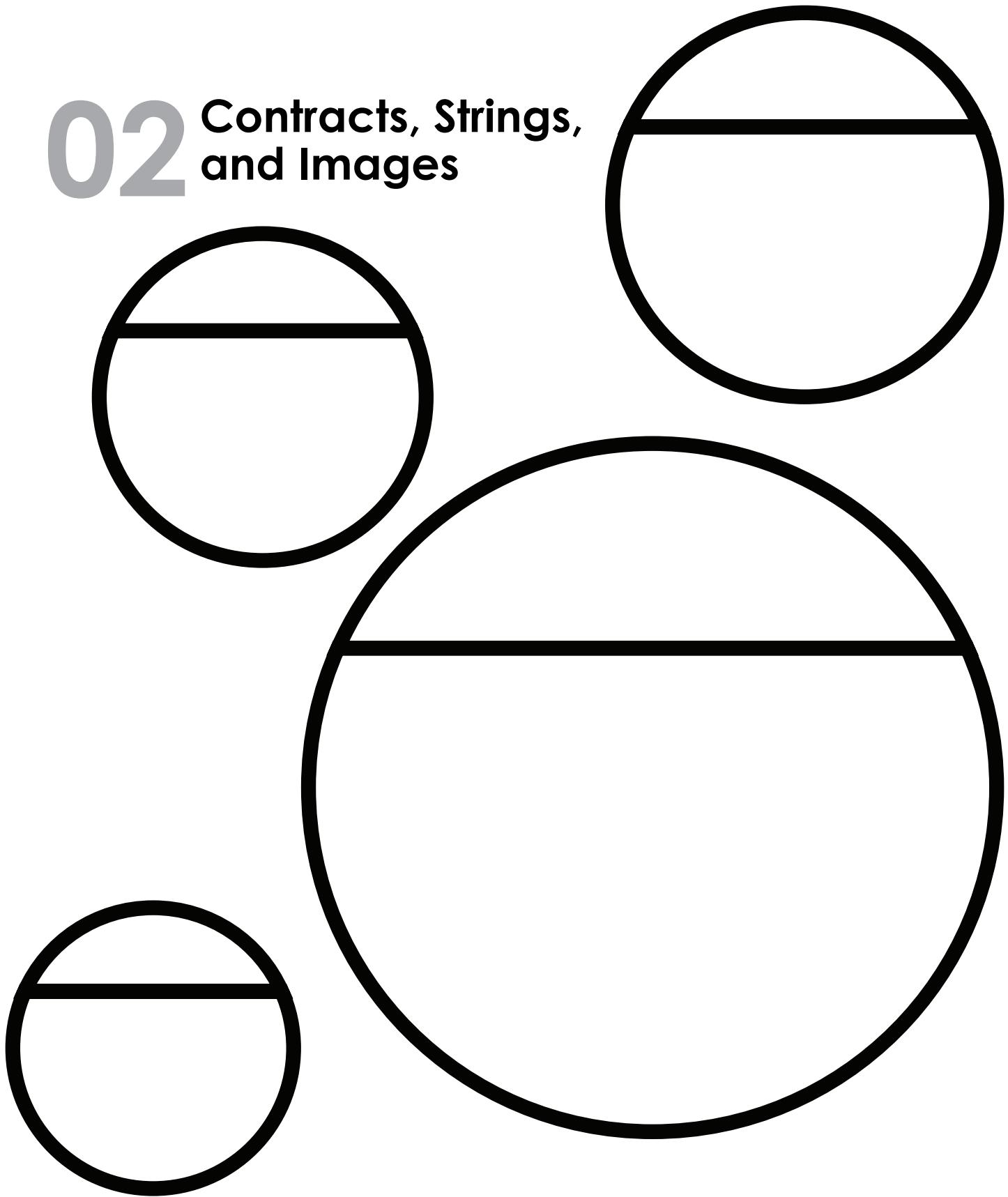
## Circle of Evaluation Practice!

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>Racket 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



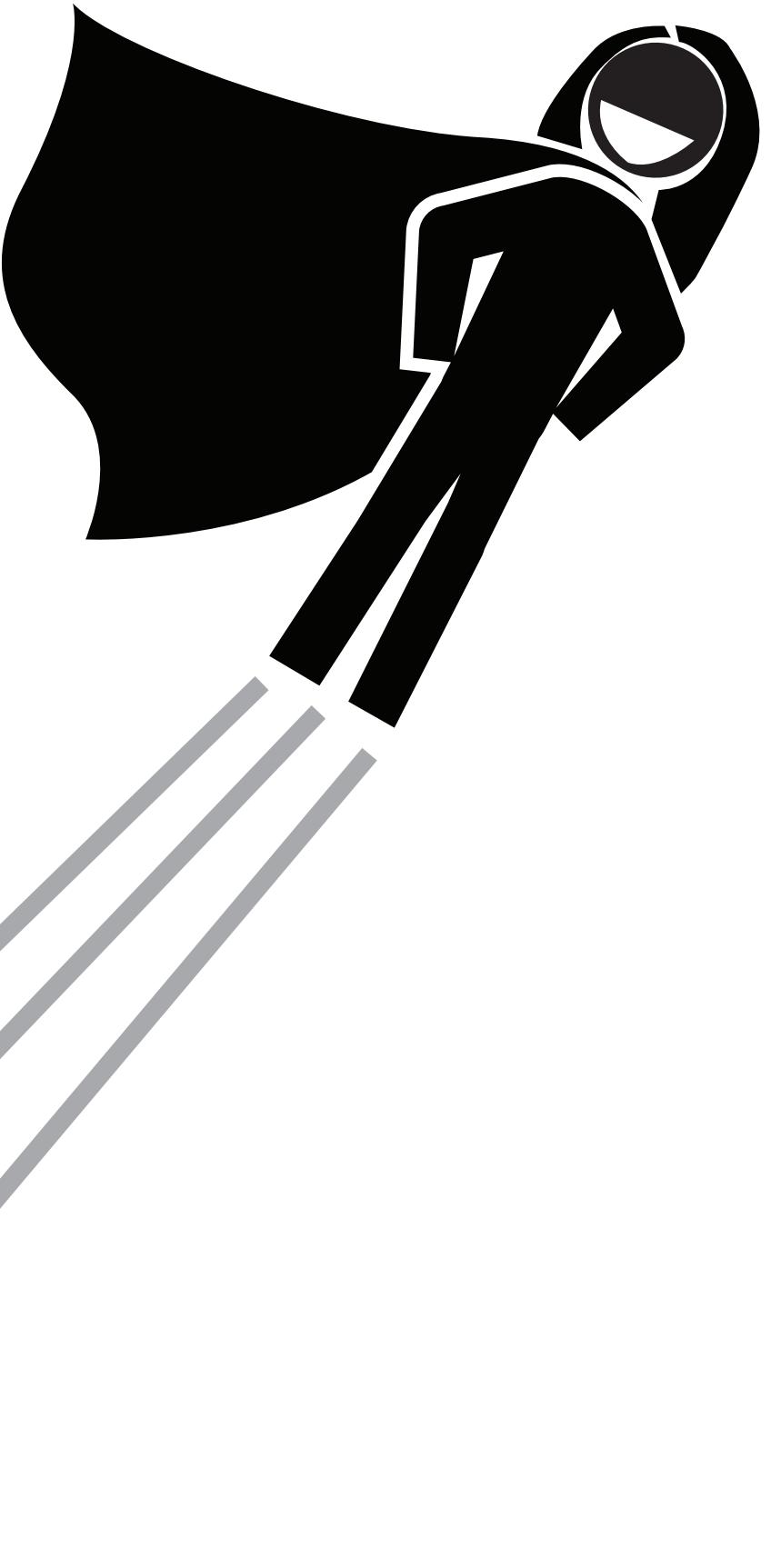
## Circles Competition

Time: 5 minutes

	<i>Math</i>	<i>Circle of Evaluation</i>	<i>Racket Code</i>
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

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

(define ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

; \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_

name

domain

range

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

(define ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

; \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_

name

domain

range

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

(define ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

; \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_

name

domain

range

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

(define ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_)

## Fast Functions!

;	_____	:	_____	->	_____
	name		domain		range

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )  
(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )  
(define ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )

;	_____	:	_____	->	_____
	name		domain		range

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )  
(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )  
(define ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )

;	_____	:	_____	->	_____
	name		domain		range

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )  
(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )  
(define ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )

;	_____	:	_____	->	_____
	name		domain		range

(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )  
(EXAMPLE ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )  
(define ( \_\_\_\_\_    \_\_\_\_\_ ) \_\_\_\_\_ )

# Lesson 4

# 04 Design Recipe

1 Contract

2 Example

3 Definition

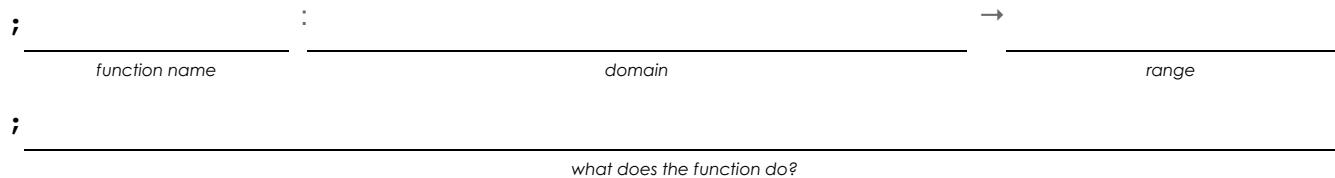


## Word Problem: rocket-height

**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 ...



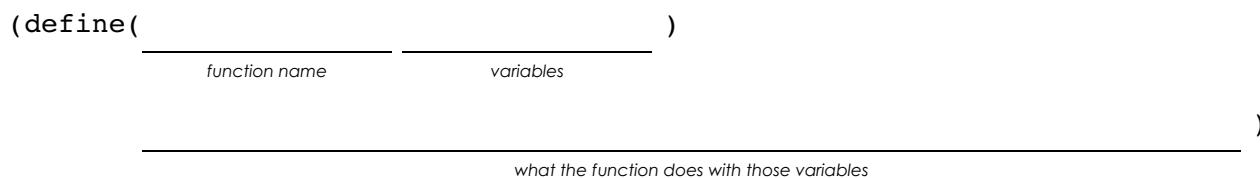
### Examples

Write some examples of your function in action...



### Definition□

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

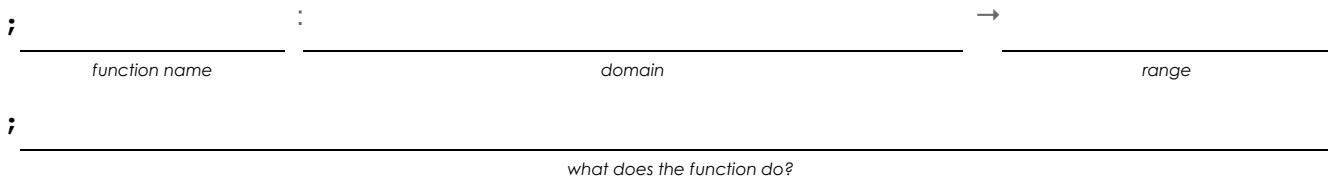


## Word Problem: red-square

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

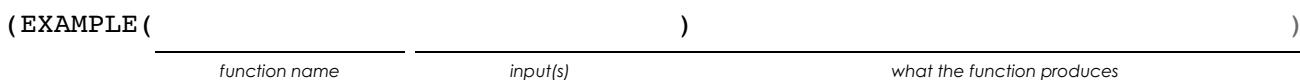
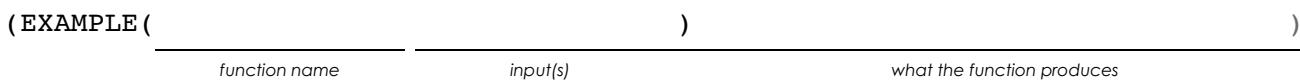
# Contract and Purpose Statement

*Every contract has three parts ...*



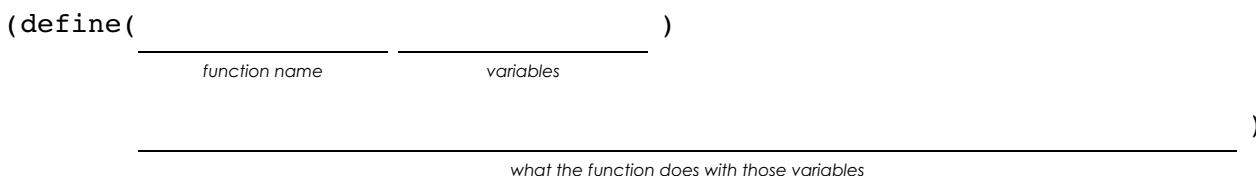
## Examples

*Write some examples of your function in action...*



## Definition □

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

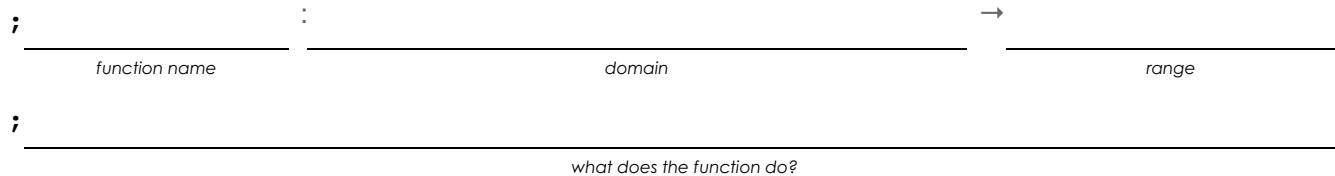


## Word Problem: yard-area

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

### Contract and Purpose Statement

Every contract has three parts ...



### Examples

Write some examples of your function in action...

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

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

### Definition□

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

(define( )  
function name variables  
what the function does with those variables

# target



# danger



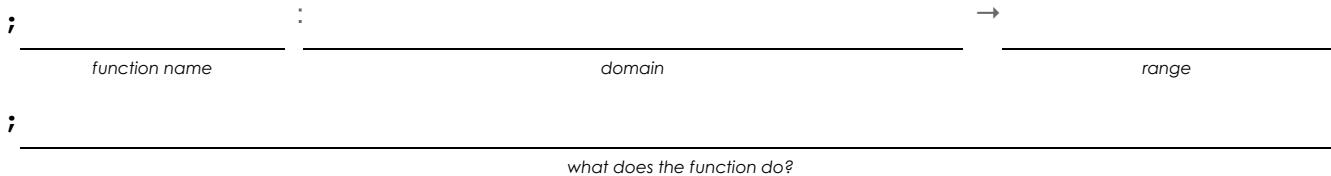
## 05 Game Animation

# Word Problem: update-danger

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

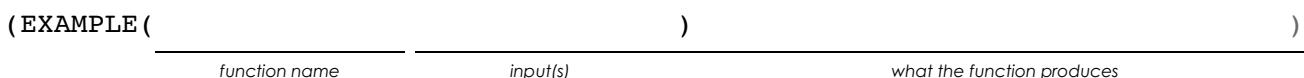
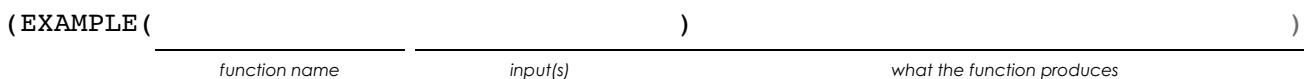
## Contract and Purpose Statement

Every contract has three parts ...



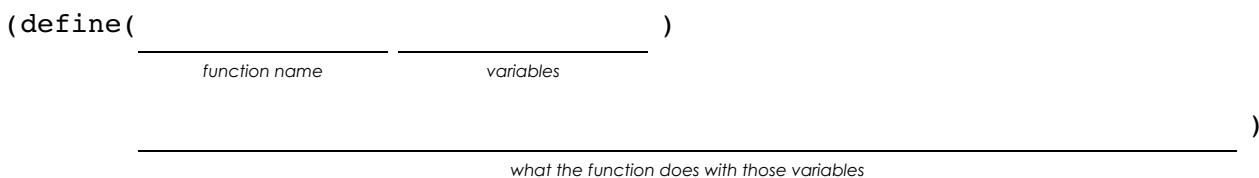
## Examples

Write some examples of your function in action...



## Definition□

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

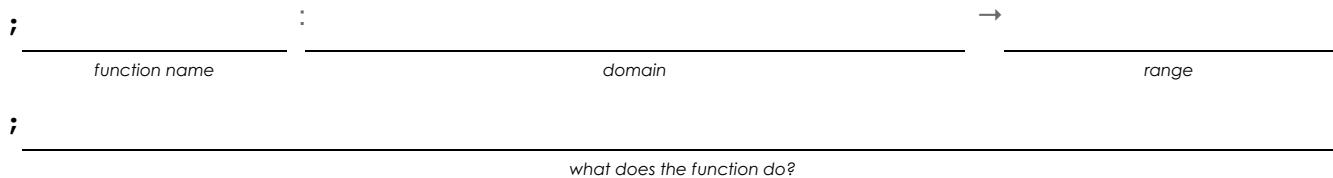


# Word Problem: update-target

**Directions:** Write a function 'update-target', which takes in the target's x-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 of your function in action...

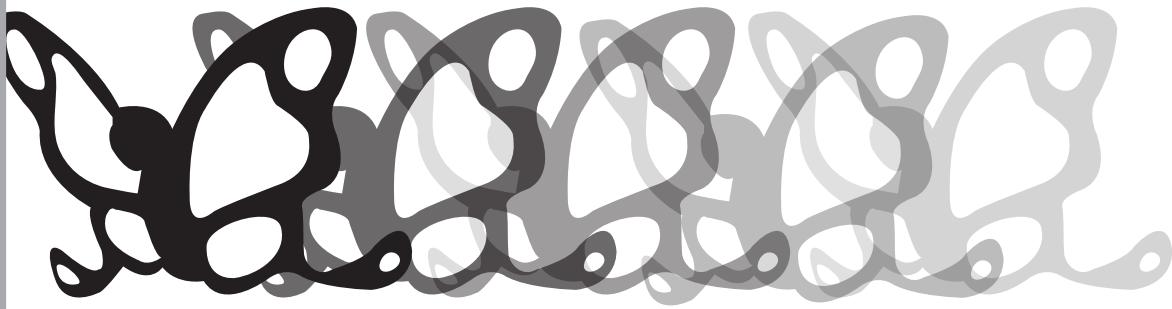
(EXAMPLE( \_\_\_\_\_ )  
function name      input(s)      what the function produces

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

## Definition□

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

(define( \_\_\_\_\_ )  
function name      variables  
                        )  
                        )  
what the function does with those variables



**“safe-left?”**

## 06 Comparing Functions

## Protecting Sam

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

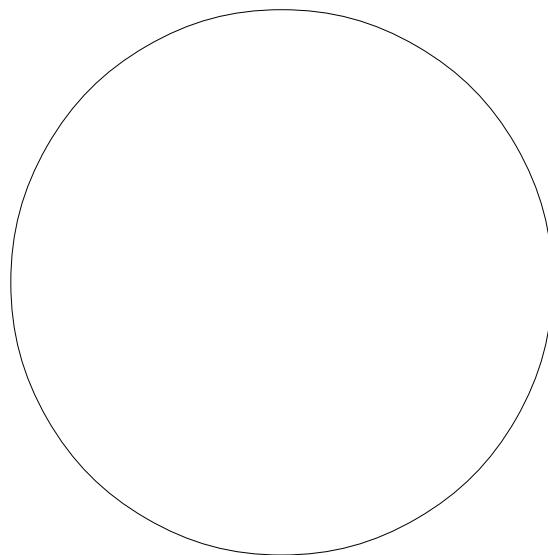
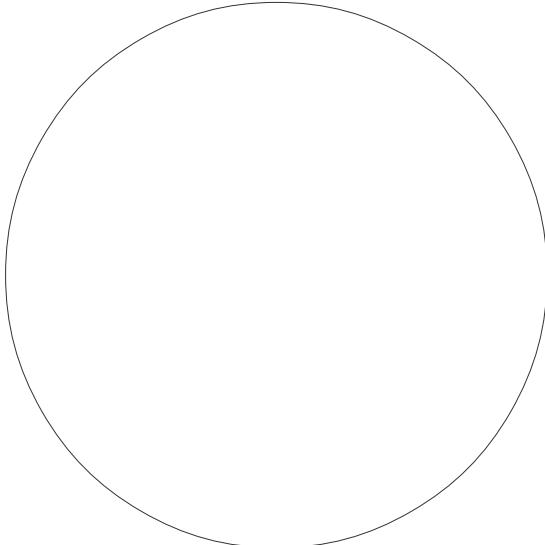
1. A piece of Sam is still visible on the left as long as...

$$(> \quad x \quad -50)$$

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

$$\underline{\hspace{10cm}}$$

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

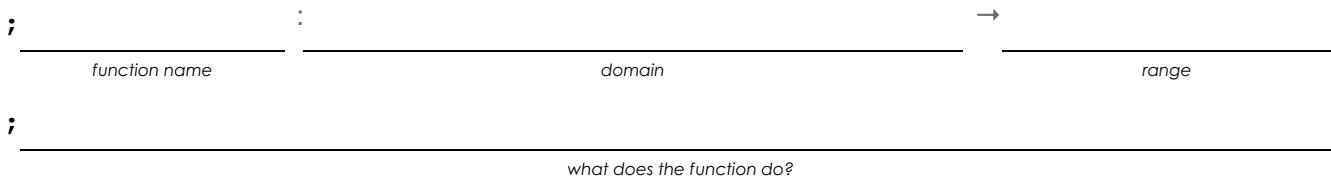


## Word Problem: safe-left?

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

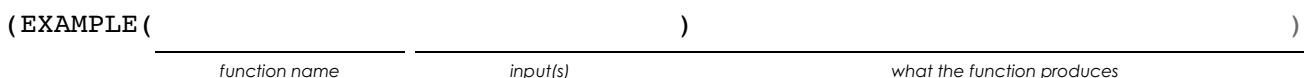
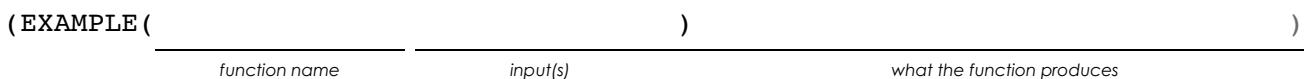
### Contract and Purpose Statement

Every contract has three parts ...



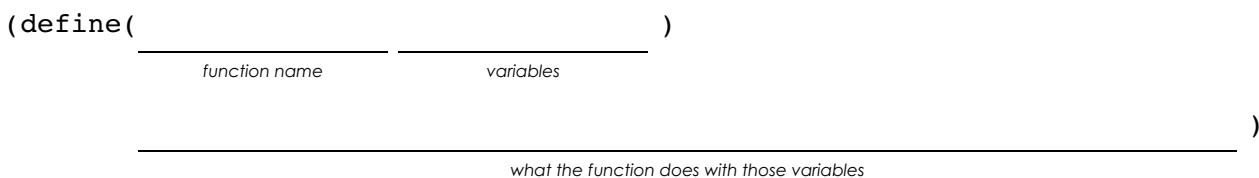
### Examples

Write some examples of your function in action...



### Definition□

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

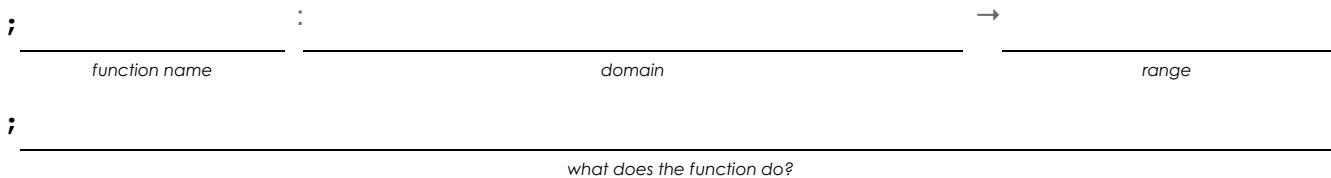


# Word Problem: safe-right?

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

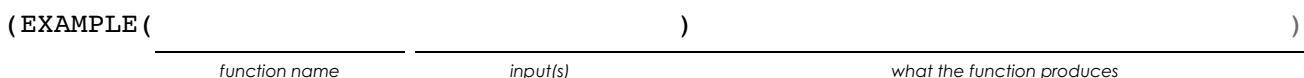
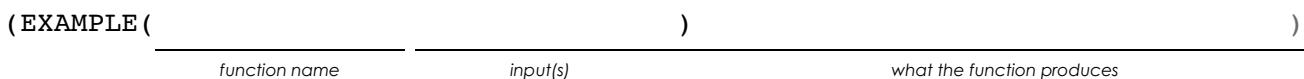
## Contract and Purpose Statement

Every contract has three parts ...



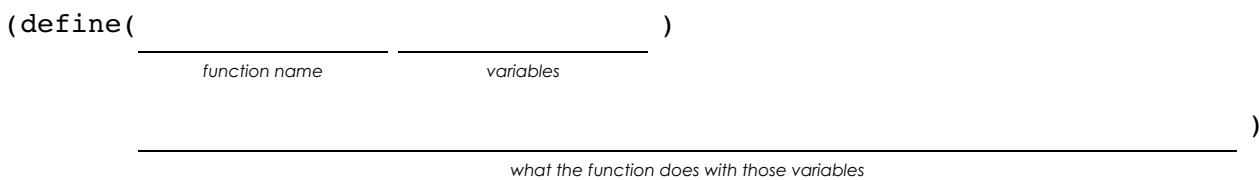
## Examples

Write some examples of your function in action...



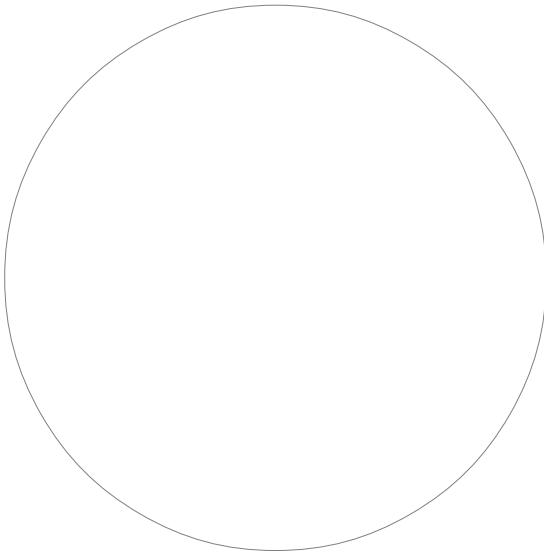
## Definition□

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

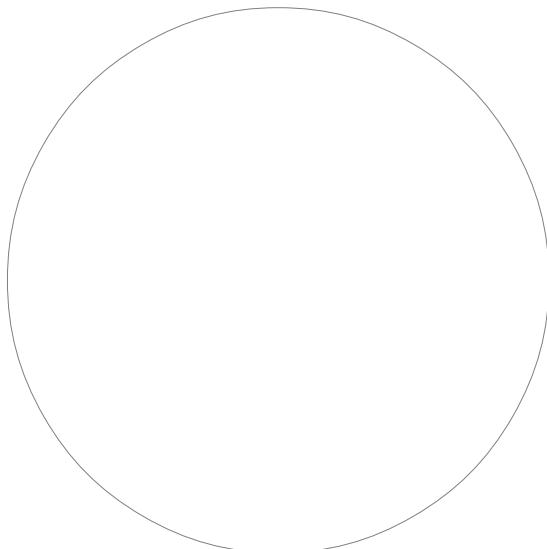


**Write the Circles of Evaluation for these statements, and then convert them to Racket**

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



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

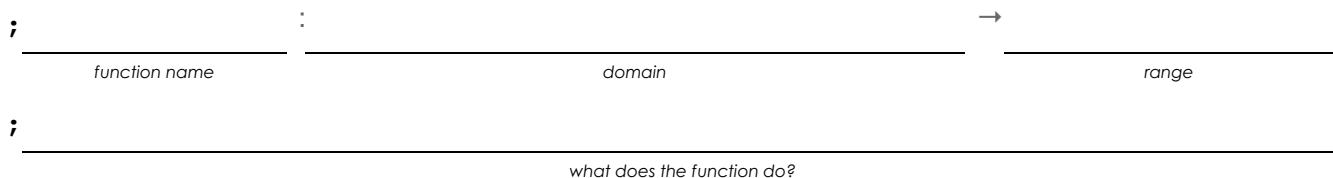


## Word Problem: onscreen?

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

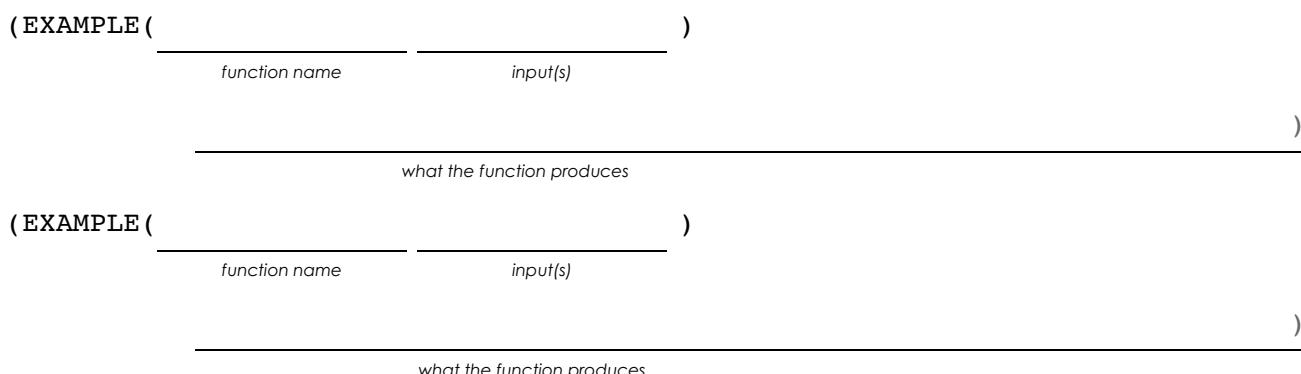
### Contract and Purpose Statement

Every contract has three parts ...



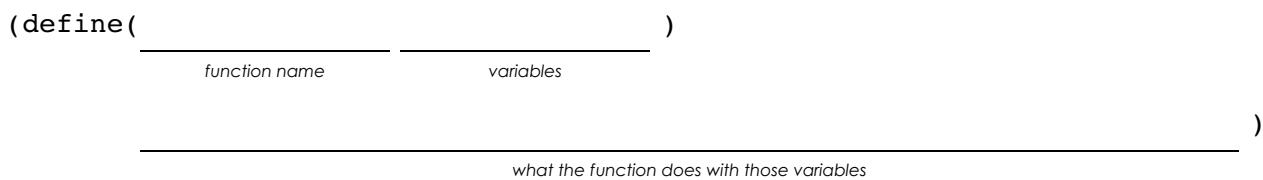
### Examples

Write some examples of your function in action...

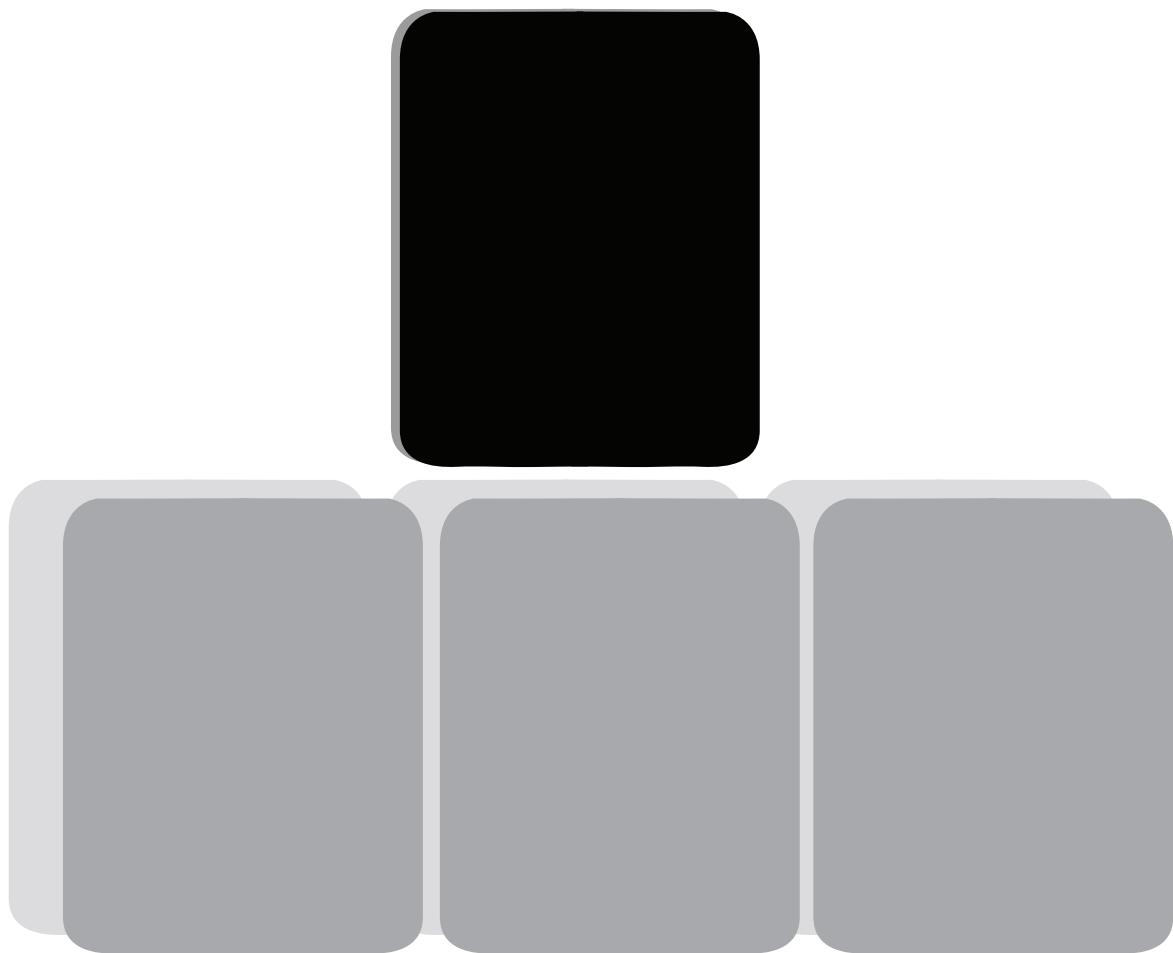


### Definition□

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



# 07 Conditional Branching

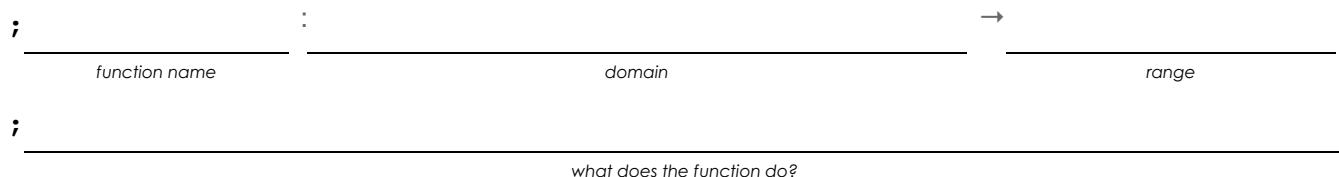


# Word Problem: cost

**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 of your function in action...

(EXAMPLE(	cost	"pepperoni"	)
function name	input(s)	what the function produces	
(EXAMPLE(		)	)
function name	input(s)	what the function produces	
(EXAMPLE(		)	)
function name	input(s)	what the function produces	
(EXAMPLE(		)	)
function name	input(s)	what the function produces	

## Definition□

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

(define(

function name variables )

(

[ ]

[ ]

[ ]

[ ]

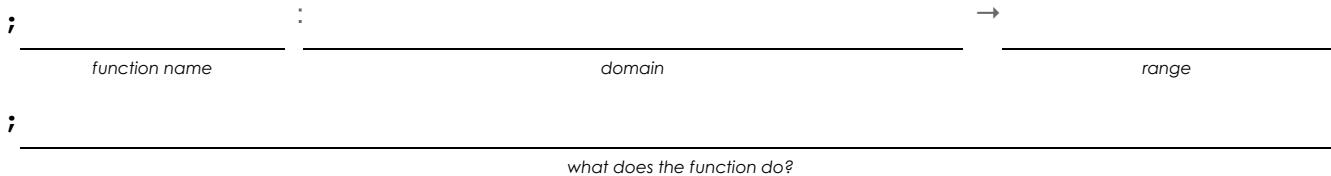
[ ]) )

# Word Problem: update-player

**Directions:** Write a function called `update-player`, which takes in the player's 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 of your function in action...

(EXAMPLE(	update-player	128 "up"	)
	function name	input(s)	what the function produces
(EXAMPLE(	update-player	128 "down"	)
	function name	input(s)	what the function produces
(EXAMPLE(		)	)
	function name	input(s)	what the function produces
(EXAMPLE(		)	)
	function name	input(s)	what the function produces

## Definition□

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

(define( \_\_\_\_\_ ) )

function name variables

( \_\_\_\_\_

[ \_\_\_\_\_ ]

[ \_\_\_\_\_ ]

[ \_\_\_\_\_ ] ))

# 08 Collision Detection

# collision



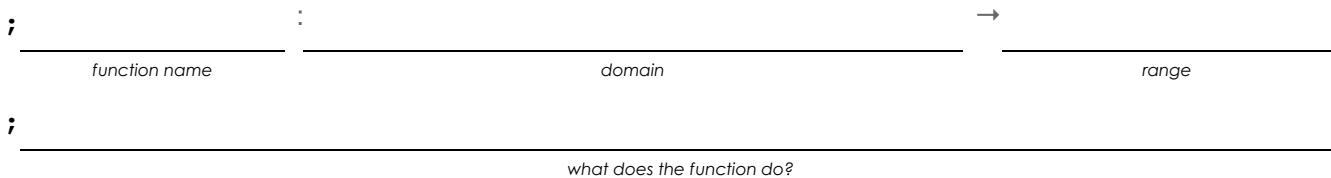
distance

## Word Problem: line-length

**Directions:** Write a function called 'line-length', which takes in two numbers and returns the difference between them. It should always subtract the smaller number from the bigger one.

### Contract and Purpose Statement

Every contract has three parts ...



### Examples

Write some examples of your function in action...

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

### Definition□

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

(define( \_\_\_\_\_ )  
function name variables  
( \_\_\_\_\_  
[ \_\_\_\_\_ ]  
[ \_\_\_\_\_ ] ))

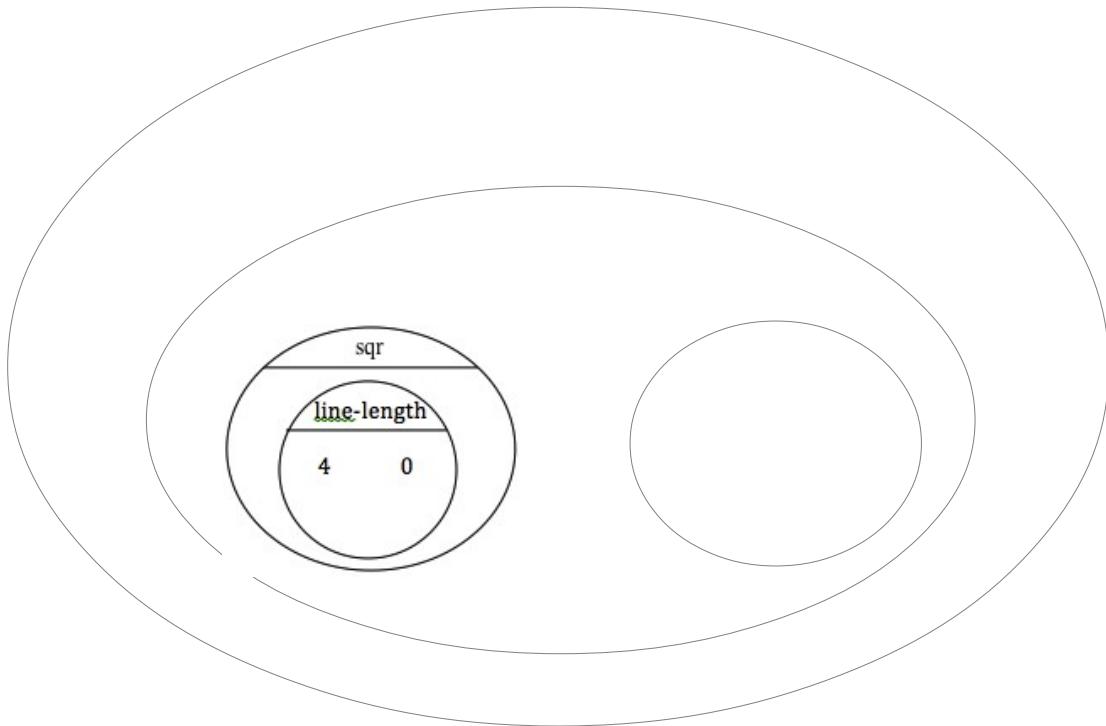
## The Distance Formula, with Numbers

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

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

---

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



---

Convert the Circle of Evaluation into Racket code:

# Word Problem: distance

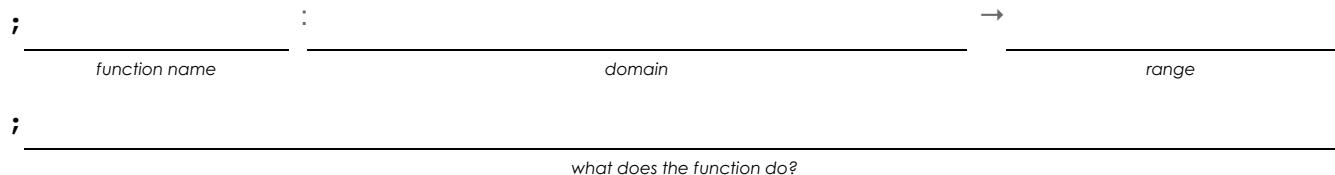
**Directions:** Write a function *distance*, which takes FOUR inputs:

- *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!)

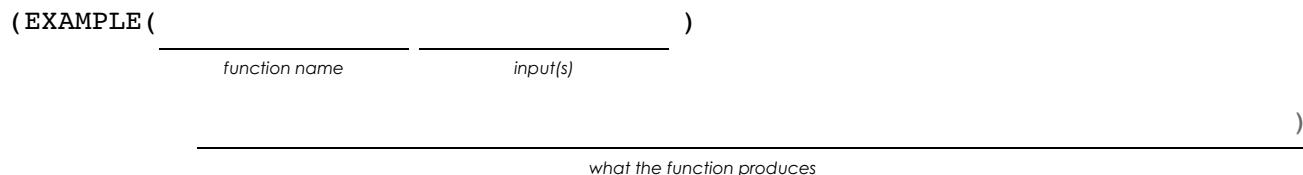
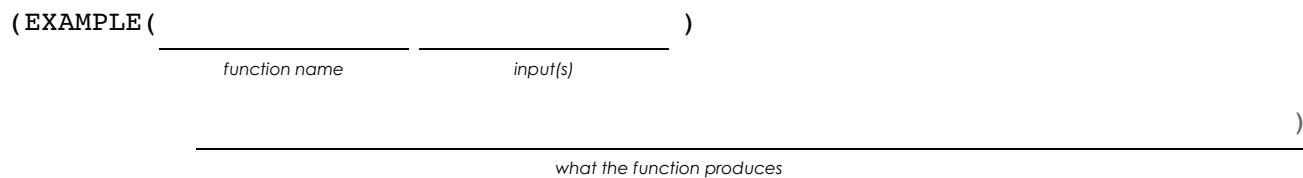
## Contract and Purpose Statement

Every contract has three parts ...



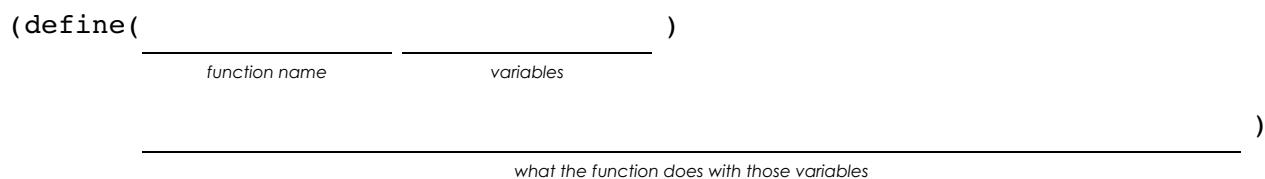
## Examples

Write some examples of your function in action...



## Definition□

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



## Word Problem: collide?

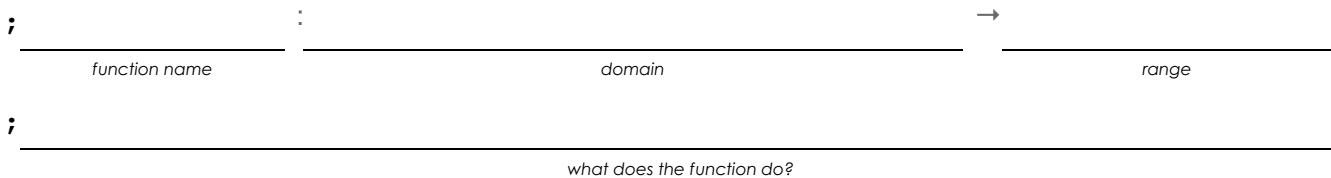
**Directions:** Write a function `collide?`, which takes FOUR inputs:

- `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?

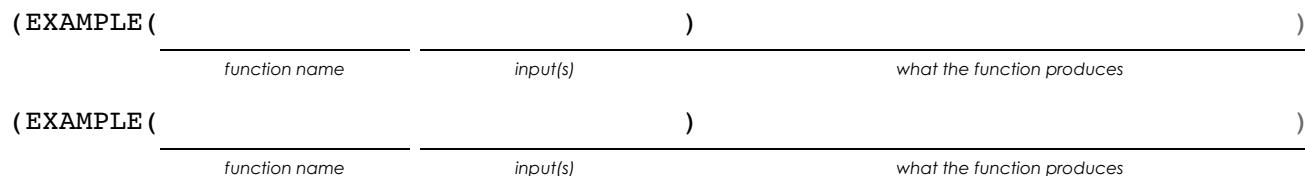
### Contract and Purpose Statement

Every contract has three parts ...



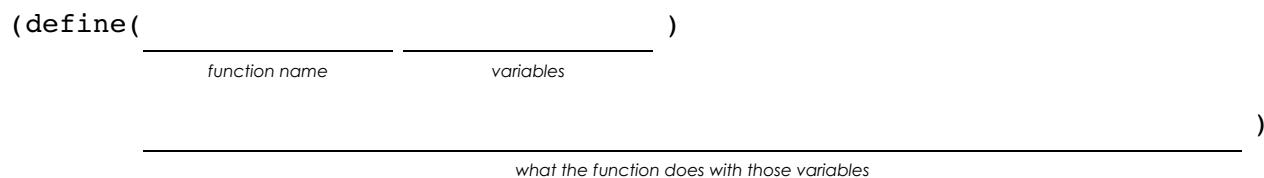
### Examples

Write some examples of your function in action...



### Definition□

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





## 09 Presentation Preparation



# Lesson 9

Catchy Intro:

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---

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!

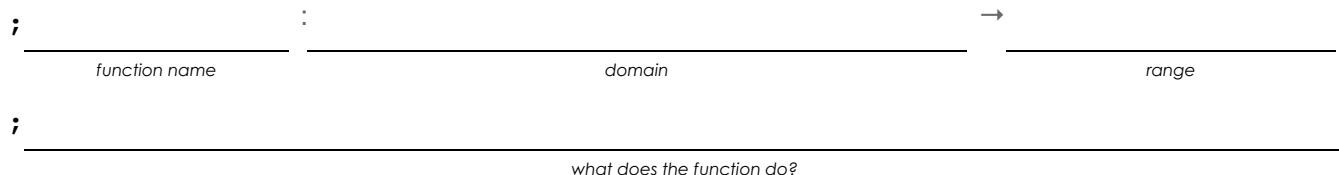
Did they make eye contact?      No way!      A little.      Definitely!

## Word Problem: red-shape

**Directions:** Write a function called `red-shape`, which takes in the name of a shape ('circle', 'triangle', 'star', or 'rectangle'), and draws that shape. All shapes should be solid and red, and can be whatever size you choose.

### Contract and Purpose Statement

Every contract has three parts ...



### Examples

Write some examples of your function in action...

(EXAMPLE(	red-shape	"circle"	)	(circle 50 "solid" "red")	)
	function name	input(s)		what the function produces	
(EXAMPLE(			)		)
	function name	input(s)		what the function produces	
(EXAMPLE(			)		)
	function name	input(s)		what the function produces	

### Definition□

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

(define(		)
	function name	variables
(		
[		(circle 50 "solid" "red")
[		]
[		]
[		]
[		) ) )

## Translating into Algebra

Values: Translate the Racket Code into Algebra	
Racket Code	Algebra
(define x 10)	$x = 10$
(define y (* x 2))	$y = x^2$
(define z (+ x y))	
(define age 14)	
(define months (* age 12))	
(define days (* months 30))	
(define hours (* days 24))	
(define minutes (* hours 60))	
Functions: Translate the Racket Code into Algebra	
(define (double x) (* x 2))	$\text{double}(x) = x^2$
(define (area length width) (* length width))	$\text{area}(\text{length}, \text{width}) = \text{length} * \text{width}$
(define (circle-area radius) (* pi (sq radius)))	
(define (distance x1 y1 x2 y2) (sqrt (+ (sq (- x1 x2)) (sq (- y1 y2))))	

# Word Problem

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

## II. Give Examples

Write an example of your function for some sample inputs

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

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

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

= \_\_\_\_\_  
Use the function here                          What should the function produce?

## III. Definition

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

$D( \quad ) =$  \_\_\_\_\_

# Word Problem

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

## II. Give Examples

Write an example of your function for some sample inputs

=  
Use the function here    What should the function produce?  
  
=  
Use the function here    What should the function produce?  
  
=  
Use the function here    What should the function produce?  
  
=

Use the function here

What should the function produce?

III. Definition

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

=

# Word Problem

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

## II. Give Examples

Write an example of your function for some sample inputs

=	
Use the function here	What should the function produce?
=	
Use the function here	What should the function produce?
=	
Use the function here	What should the function produce?
=	
Use the function here	What should the function produce?

## III. Definition

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

=

# Word Problem

## I. Contract+Purpose Statement

Every contract has three parts:

; \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name Domain Range

## II. Give Examples

Write an example of your function for some sample inputs

=	
Use the function here	What should the function produce?
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Use the function here	What should the function produce?
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Use the function here	What should the function produce?

## III. Definition

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

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# Word Problem

## I. Contract+Purpose Statement

Every contract has three parts:

; \_\_\_\_\_ : \_\_\_\_\_ -> \_\_\_\_\_  
name Domain Range

## II. Give Examples

Write an example of your function for some sample inputs

=  
Use the function here                                  What should the function produce?  
  
=  
Use the function here                                  What should the function produce?  
  
=  
Use the function here                                  What should the function produce?  
  
=

## III. Definition

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

=

# Contracts

## Contracts