

Bootstrap

+ computing creatively
+ thriving mathematically

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



Contracts



Make sure to write down all contracts for each function that you learn so you can easily go back and find them in the future.

Name	Domain	Range	Example
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	



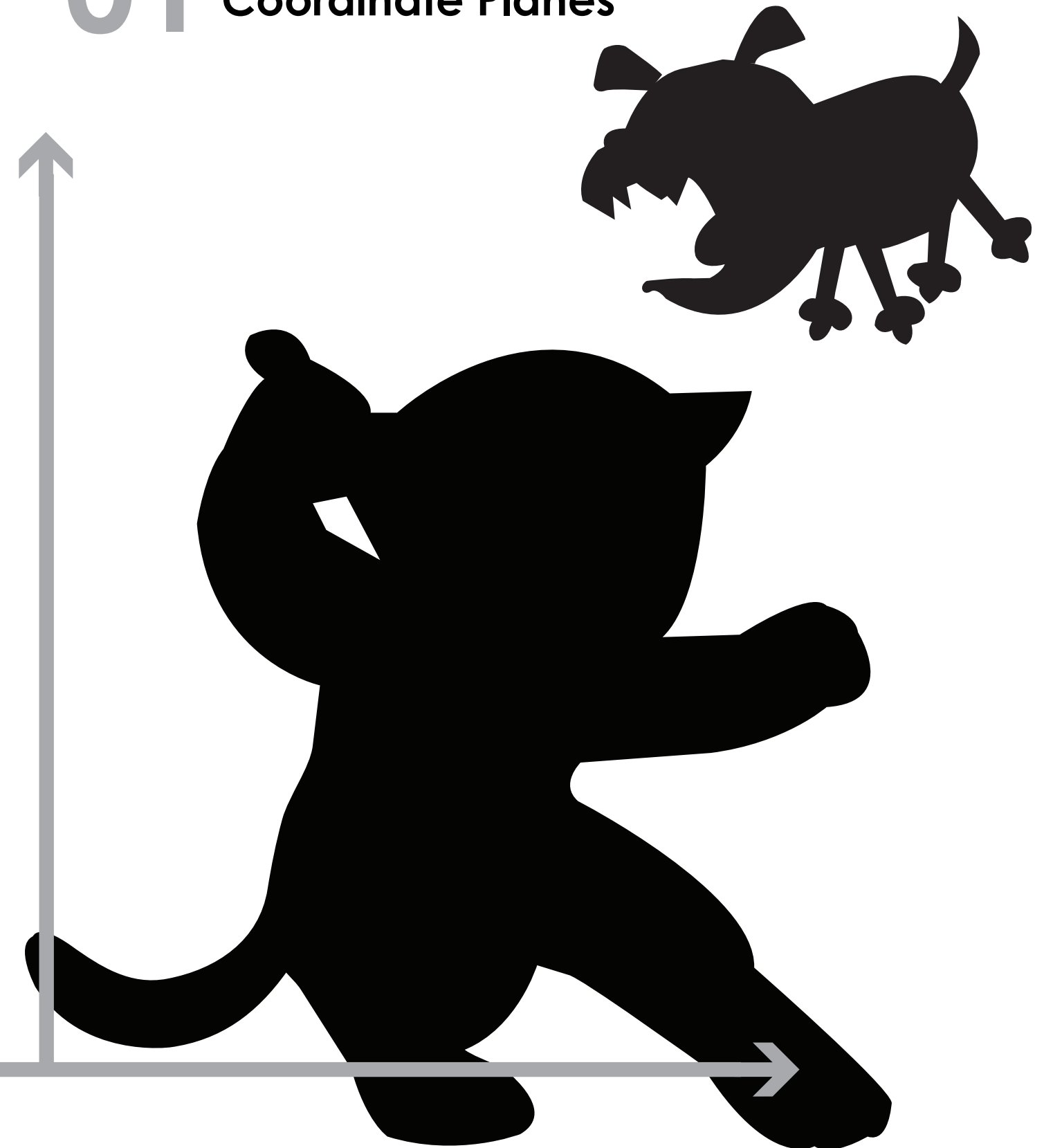
Contracts



Make sure to write all of your contracts that you learn so you can easily go back and find them in the future.

Name	Domain	Range	Example
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	
	:	↑	

01 Videogames and Coordinate Planes



Ninja Cat Video Game

Element in the game

Name each element in the game Ninja Cat.

cloud

What changes?

Write how the element changes while the game is played.

position

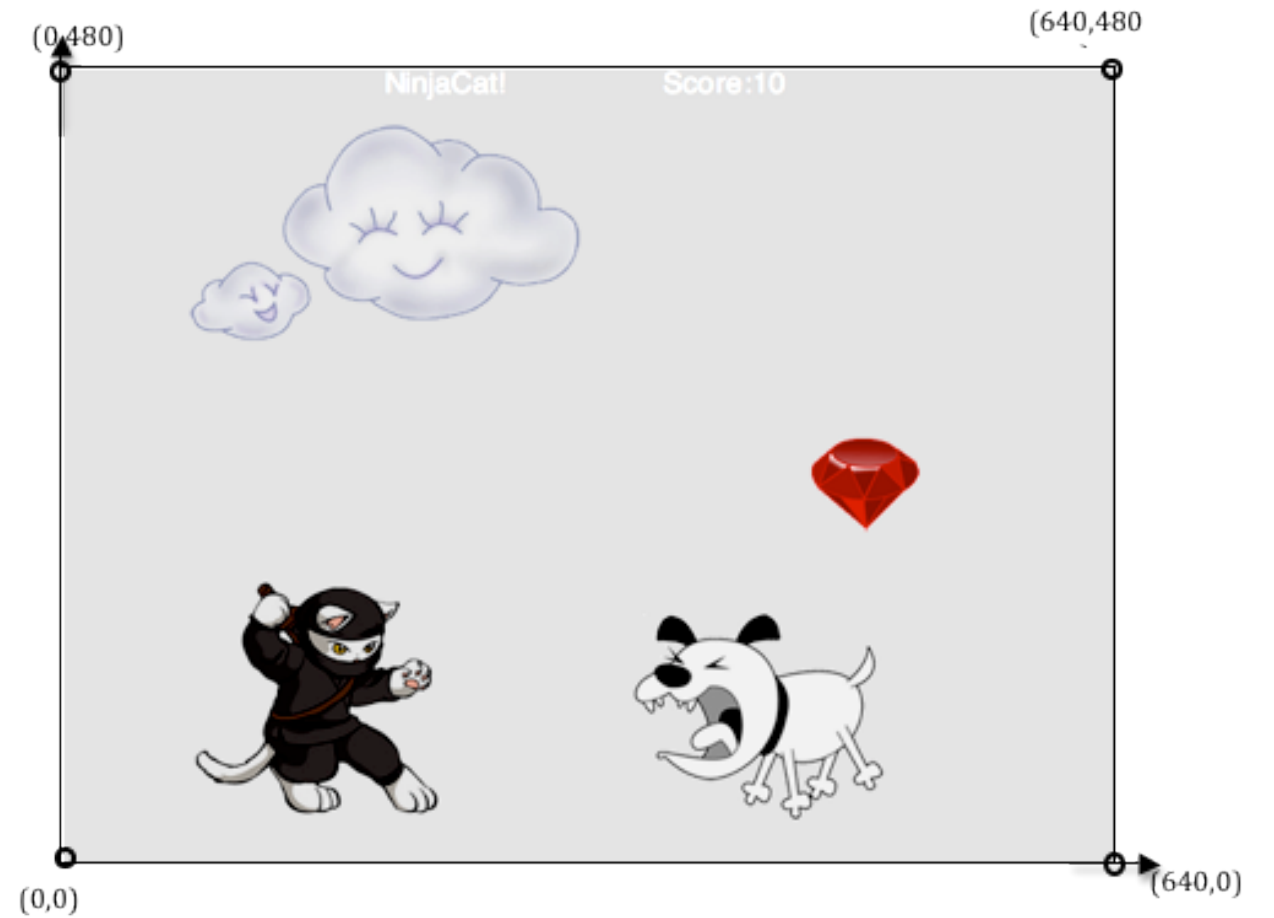
More specifically..

Time to get technical! Write the mathematical version of how the element changes.

x-coordinate

Ninja Cat Game Elements

Write your best guess for coordinates of the following players.



(x , y)

PLAYER COORDINATES

(_____ , _____)

DANGER

(_____ , _____)

TARGET

(_____ , _____)

Video Game Brainstorm!

Time to start brainstorming the elements that will go into your own video game! You need to come up with a background, a player, a target, and a danger. To get your brainstorm working, you can make up a story behind your video game.

Title of your game:

Created by:

Background

Where does your game take place? A desert? On a mountain? At the mall?

Player

Who is the player of your video game? Remember, the player can only move up and down.

Target

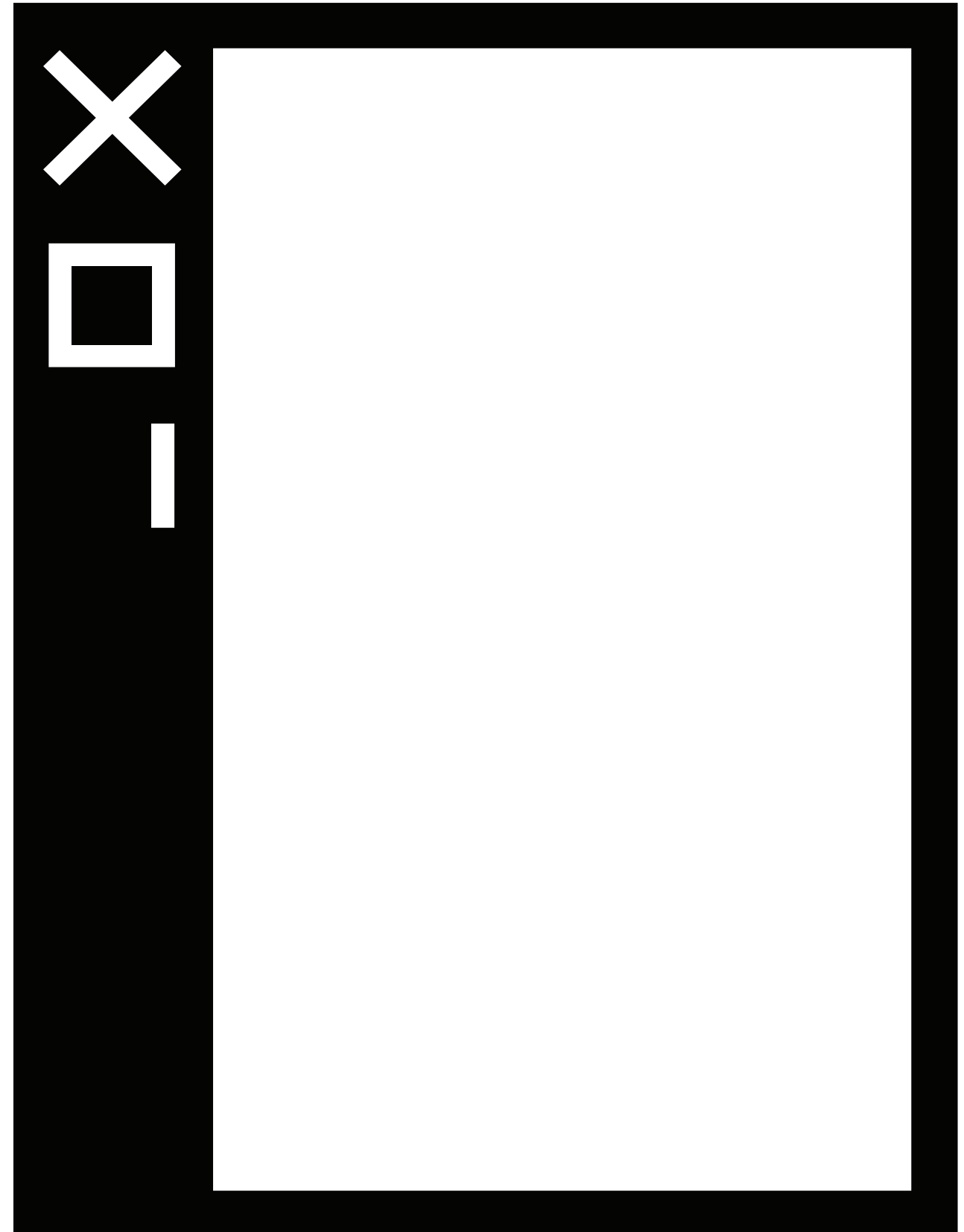
What or who is the target of your video game?

When your **PLAYER** hits the **TARGET** it gets points. The target only moves right.

Danger

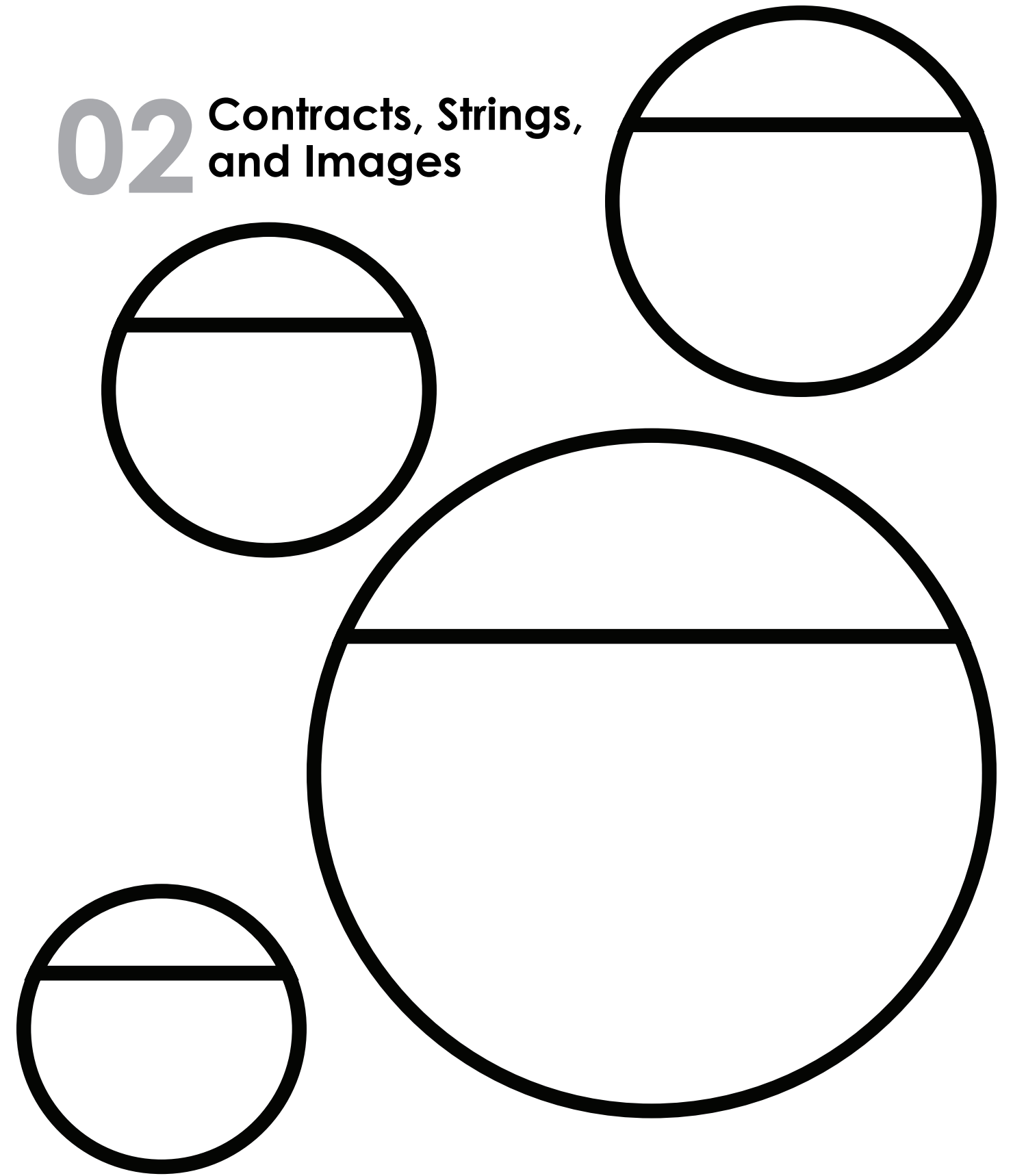
What or who is the danger of your video game?

When your **PLAYER** hits the **DANGER** it loses points. The danger only moves left.



Draw a sketch of what you'd like your video game to look like!

02 Contracts, Strings, and Images



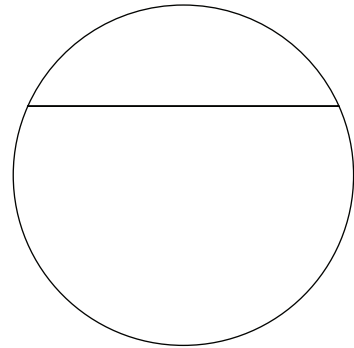
Circle of Evaluation Practice

Math

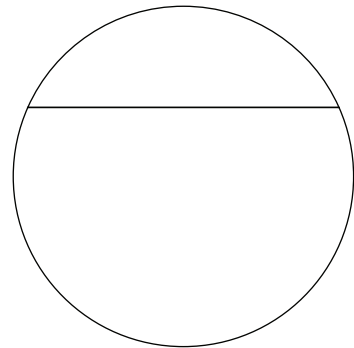
Circle of Evaluation

Racket Code

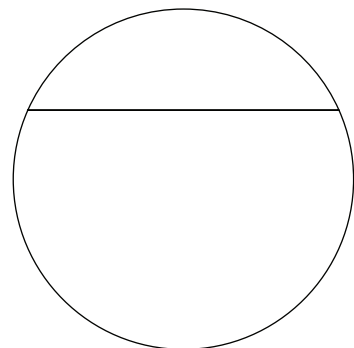
$$5 \times 10$$



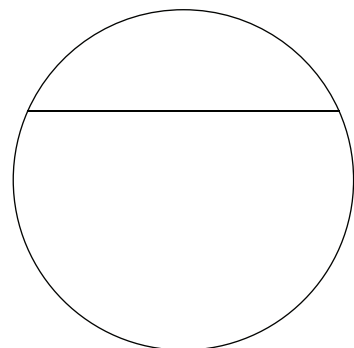
$$8 + (5 \times 10)$$



$$(8+2) - (5 \times 10)$$



$$\frac{5 \times 10}{8 - 2}$$

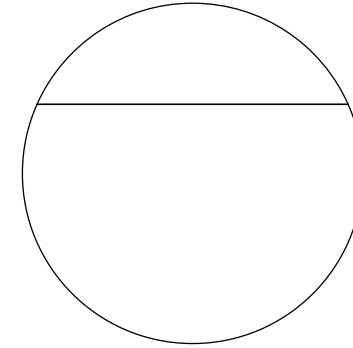


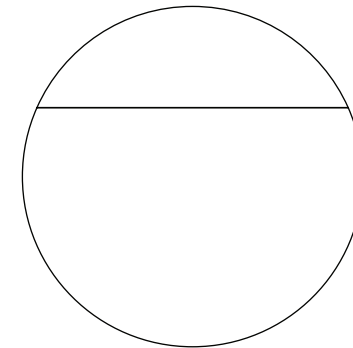
Circle of Evaluation Practice

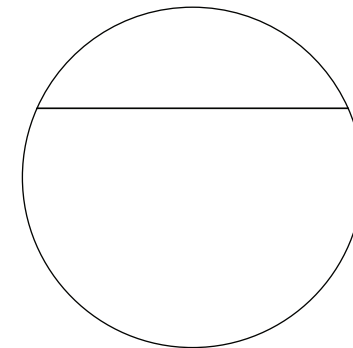
Math

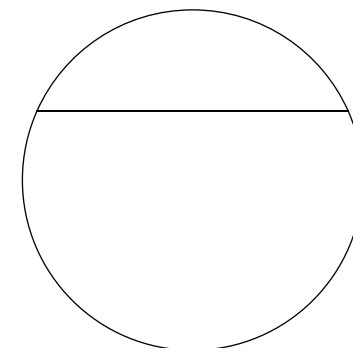
Circle of Evaluation

Racket Code

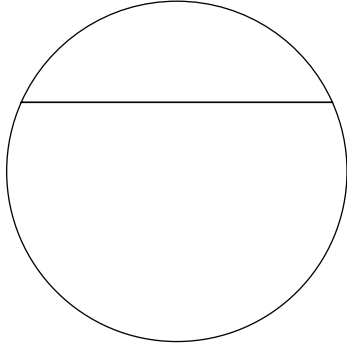
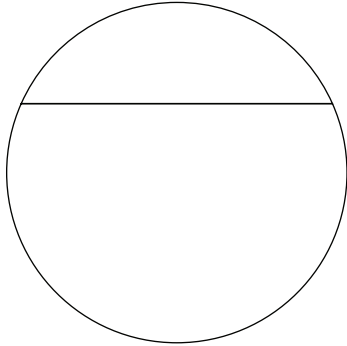
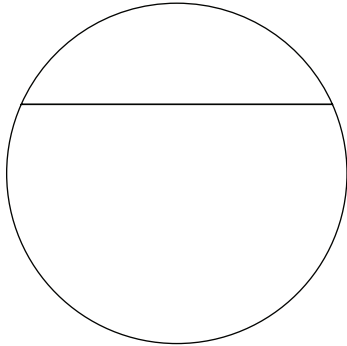
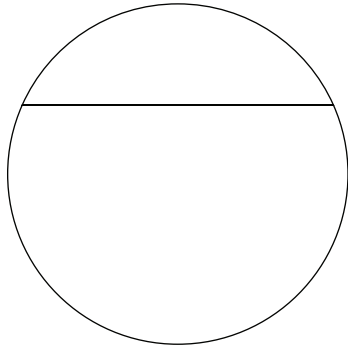




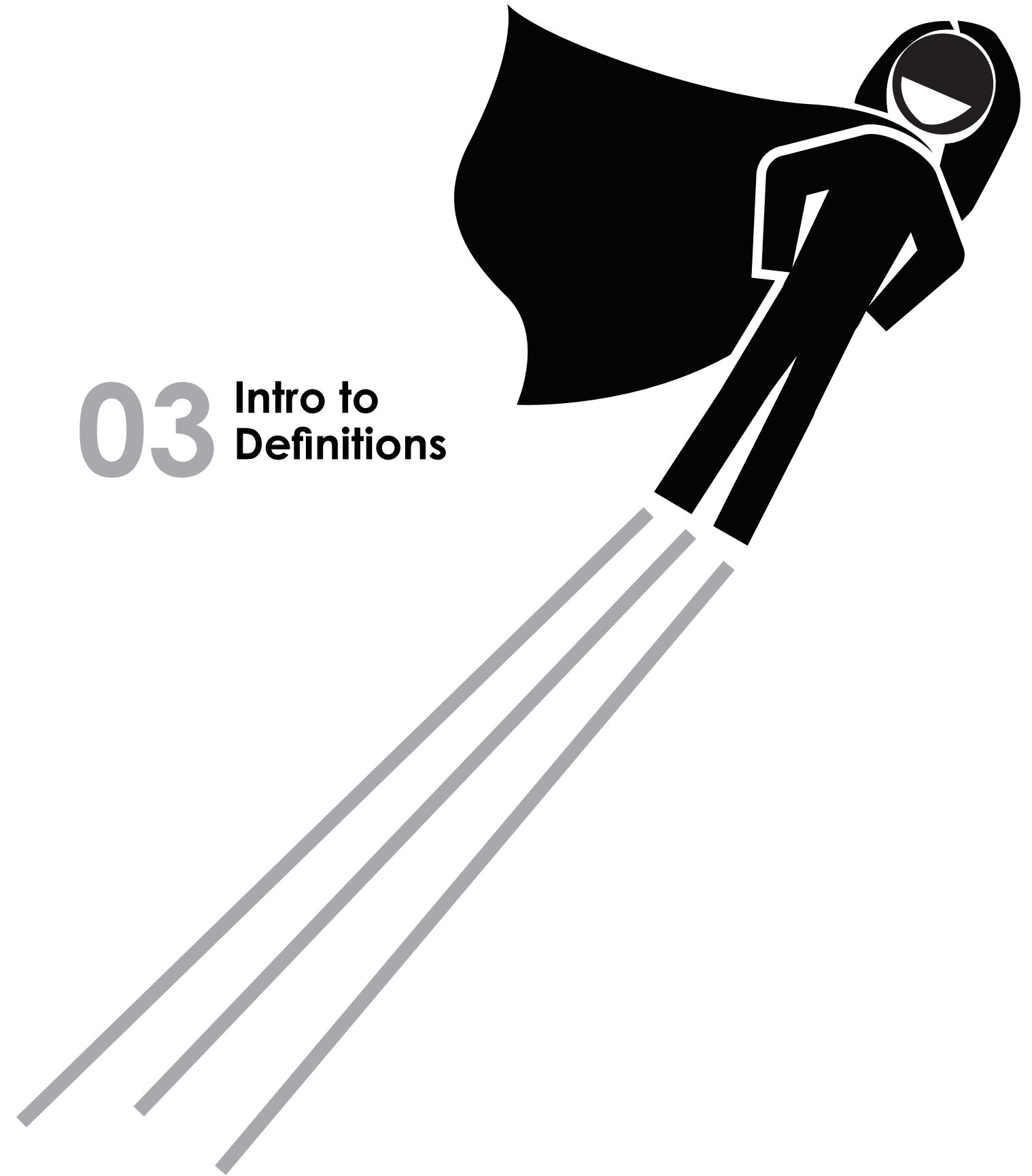




Circles Triathlon

	Math	Circle of Evaluation	Racket Code
1	$(3 \times 7) - (1 + 2)$		<hr/>
2	$3 - (1 + 2)$		<hr/>
3	$3 - (1 + (5 \times 6))$		<hr/>
4	$(1 + (5 \times 6)) - 3$		<hr/>

03 Intro to Definitions



SUPER Fast Functions



;

name domain → range

(EXAMPLE ())

(EXAMPLE ())

(define ())

;

name domain → range

(EXAMPLE ())

(EXAMPLE ())

(define ())

;

name domain → range

(EXAMPLE ())

(EXAMPLE ())

(define ())

SUPER Fast Functions



;

name domain → range

(EXAMPLE ())

(EXAMPLE ())

(define ())

;

name domain → range

(EXAMPLE ())

(EXAMPLE ())

(define ())

;

name domain → range

(EXAMPLE ())

(EXAMPLE ())

(define ())



04 Design Recipe

1 Contract

2 Example

3 Definition



Design Recipe

A rocket blasts off, traveling at 7 meters per 1 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

:	:	→
_____	_____	_____
name	domain	range
:	:	

Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types



Example

_____)

should become

(EXAMPLE (_____)

the user types

_____)

should become



Definition

(define (_____)

function name variable names

_____)

and the computer does this

Design Recipe

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

:	:	→
_____	_____	_____
name	domain	range
:	:	

Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types



Example

_____)

should become

(EXAMPLE (_____)

the user types

_____)

should become



Definition

(define (_____)

function name variable names

_____)

and the computer does this



Design Recipe

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.

*Hint: area = length * width*

Contract

;

name	:	domain	→	range
------	---	--------	---	-------

;

Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types

_____)

should become

(EXAMPLE (_____)

the user types

_____)

should become

Example

Definition

(define (_____)

function name

variable names

_____)

and the computer does this

target



danger



05 Game Animation



Design Recipe

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

;
_____ : _____ → _____
name domain range

;
Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types



Example

_____)
should become

(EXAMPLE (_____)

the user types

_____)
should become



Definition

(define (_____)
function name variable names

_____)
and the computer does this

Design Recipe

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

;
_____ : _____ → _____
name domain range

;
Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types



Example

_____)
should become

(EXAMPLE (_____)

the user types

_____)
should become



Definition

(define (_____)
function name variable names

_____)
and the computer does this





“safe-left?”

06 Comparing Functions



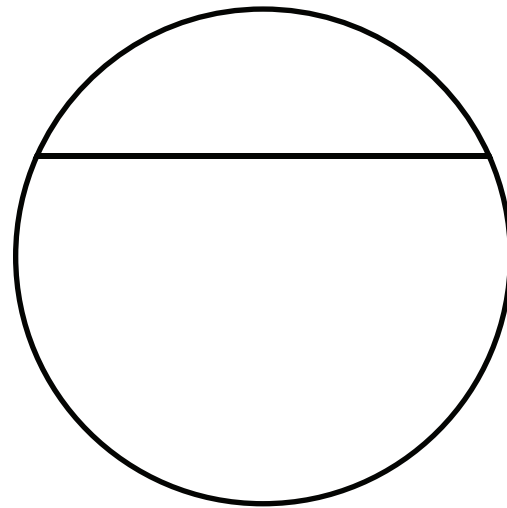
Protecting Sam

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

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

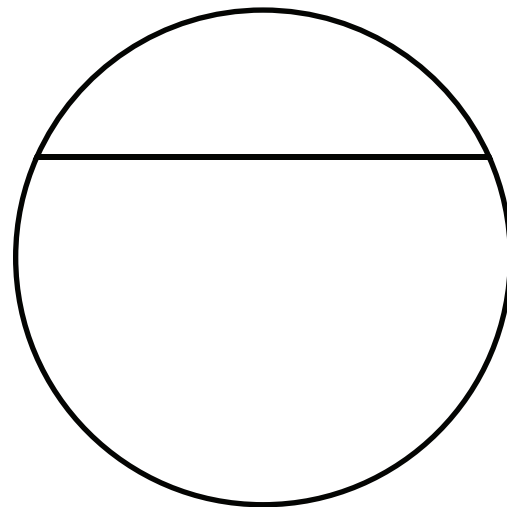
(> x -50)

Write this expression in a Circle of Evaluation.



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

Write this expression in a Circle of Evaluation.



Design Recipe

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



Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types

_____)

should become

(EXAMPLE (_____)

the user types

_____)

should become

Example

Definition

(define (_____)

function name

variable names

_____)

and the computer does this



Design Recipe

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

;

 name domain range

;

 Purpose Statement: What does the function do?

(EXAMPLE (_____)
 the user types



Example

_____)
 should become

(EXAMPLE (_____)
 the user types

_____)
 should become



Definition

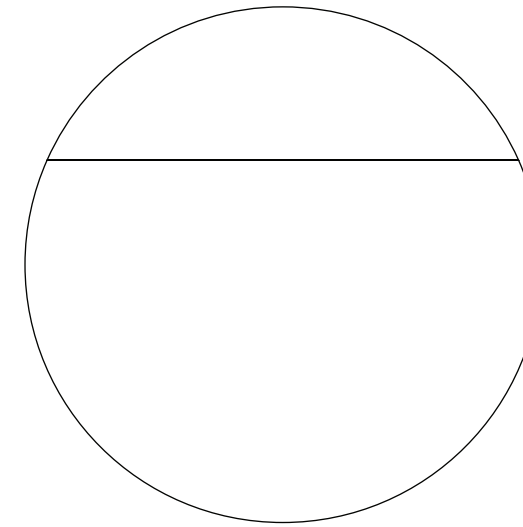
(define (_____)
 function name variable names

_____)
 and the computer does this

Circles to Racket

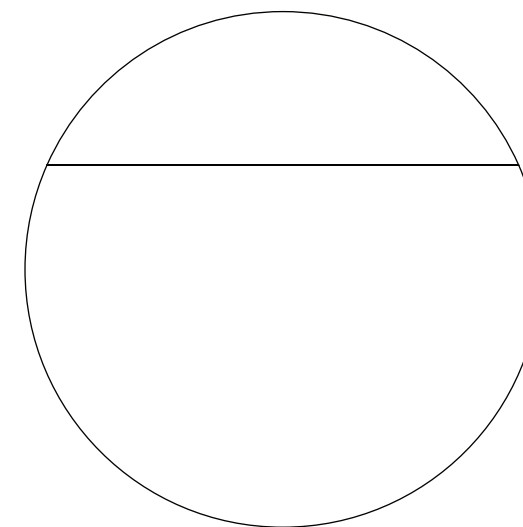
Write the Circles of Evaluation for these statements, and then convert them to Racket.

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



Racket Code:

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



Racket Code:



Design Recipe

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

;
_____ : _____ → _____
name domain range

;

Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types



Example

_____)

should become

(EXAMPLE (_____)

the user types

_____)

should become



Definition

(define (_____)

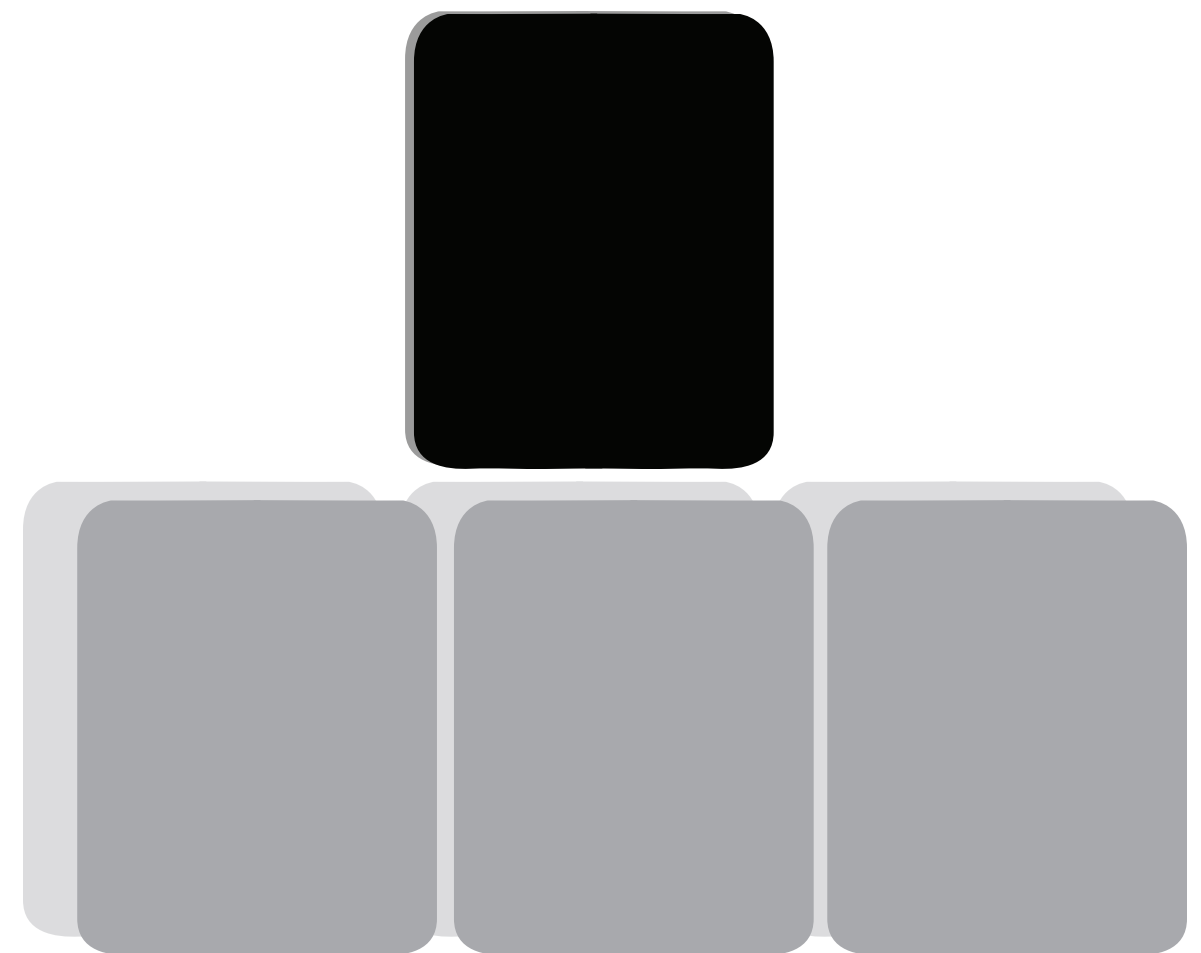
function name

variable names

_____)

and the computer does this

07 Conditional Branching



Design Recipe

Luigi's Pizza has hired you as a programmer. They offer:

"pepperoni" (\$10.50) "cheese" (\$9.00)

"chicken" (\$11.25) "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



(EXAMPLE (cost "pepperoni") _____)

Use the function here

What should the function produce?

(EXAMPLE(_____) _____)



Example

(EXAMPLE (_____) _____)

(EXAMPLE (_____) _____)

(define (_____) _____)

function name

variable names



Definition

Design Recipe

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



(EXAMPLE (update-player 128 "up") _____)

Use the function here

What should the function produce?

(EXAMPLE(update-player 451 "down") _____)



Example

(EXAMPLE (_____) _____)

(EXAMPLE (_____) _____)

(define (_____) _____)

function name

variable names



Definition



08 Collision Detection

collision



distance



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



;

;

Purpose Statement: What does the function do?

(EXAMPLE (line-length 10 5) (- 10 5))

Use the function here.

What should the function produce?



Example

(EXAMPLE (line-length 2 8) (- 8 2))

Use the function here.

What should the function produce?

(define (

function name

variable names



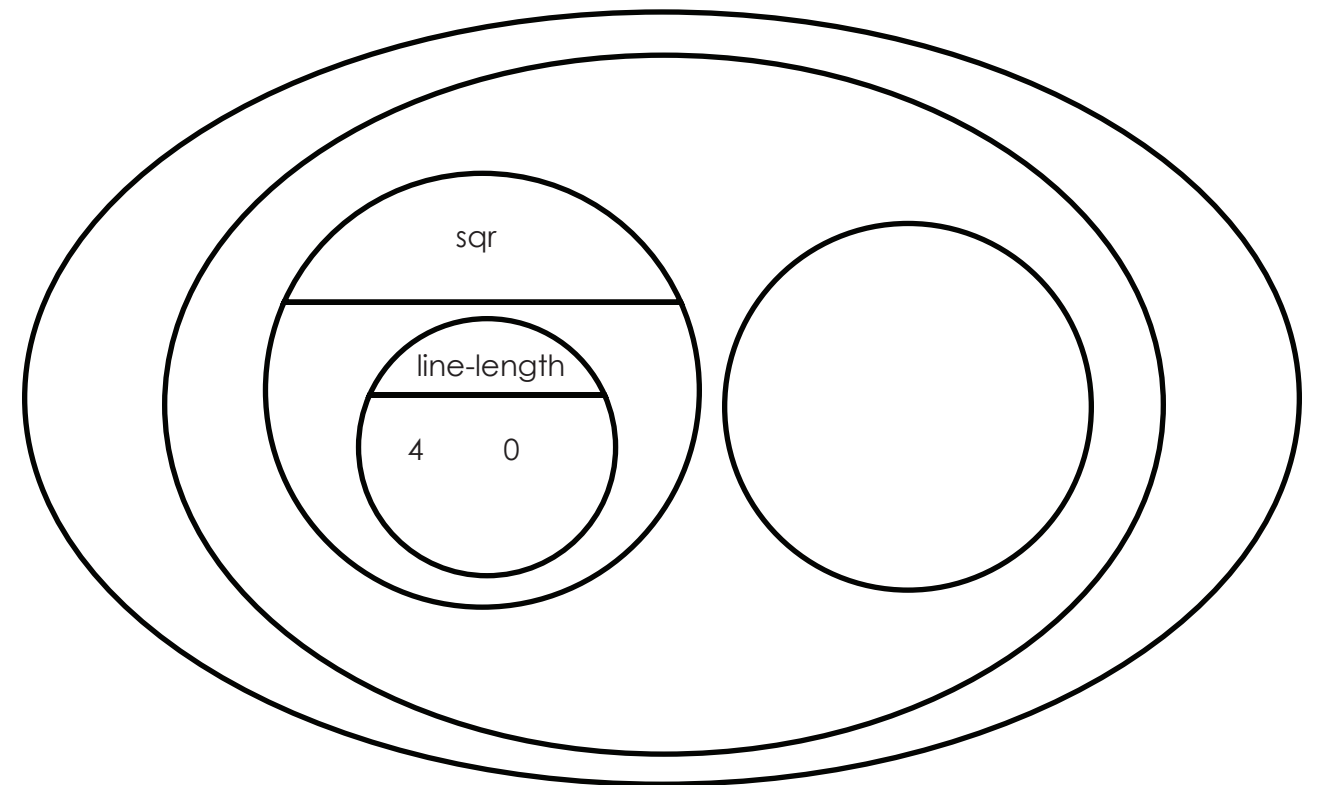
Definition

The Distance Formula with Numbers

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

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

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



Convert the Circle of Evaluation into Racket code:



Design Recipe

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 page 45**



Contract



Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types



Example

find another way to get the same result here

(EXAMPLE (_____)

the user types

find another way to get the same result here



Definition

(define (_____)

function name variable names

and the computer does this

Design Recipe

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

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



Contract



Purpose Statement: What does the function do?

(EXAMPLE (_____)

the user types



Example

find another way to get the same result here

(EXAMPLE (_____)

the user types

find another way to get the same result here

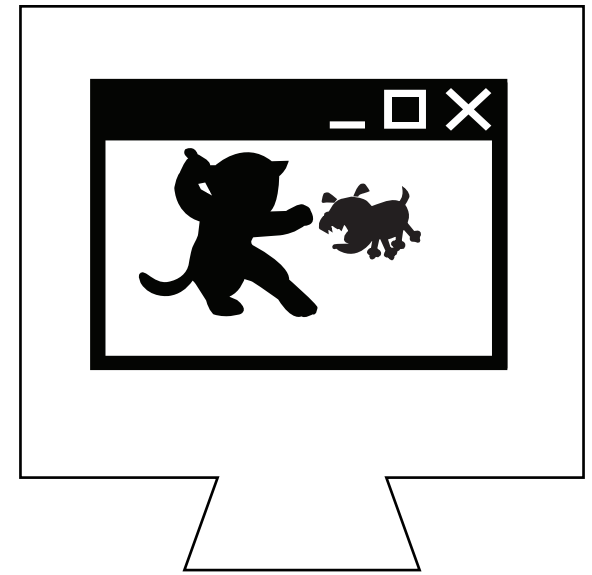


Definition

(define (_____)

function name variable names

and the computer does this



09 Presentation Preparation



Presenting Your Video Game

After all of that hard work it's time to present the video game you created. Fill out the information on the next two pages to prepare yourself for your presentation.

Created by:

Age:

Grade:

Game Title:

Catchy Introduction:

What was the story behind your video game?

Please explain some of your code:

Presentation Feedback

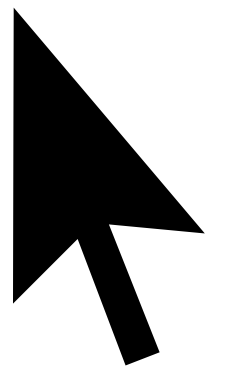
It is important to give feedback about everyone's presentation, that way they can see what they did well and what they can work on next time!

Was the introduction catchy?	Totally!	A little	No way!
Did they talk about the characters?	Totally!	A Little	No way!
Did they explain the code well?	Totally!	A little	No way!
Did they speak slowly enough?	Totally!	A little	No way!
Did they speak loudly enough?	Totally!	A little	No way!
Were they standing confidently?	Totally!	A little	No way!
Did they make eye contact?	Totally !	A little	No way!

:: Congratulations!

You've programmed your own video game!

Seriously, that is **AWESOME!!!**



Algebra Translations

Translate the Racket Code into Algebra.

Racket Code	Algebra
<code>(define x 10)</code>	$x = 10$
<code>(define y (* x 2))</code>	$y = x \cdot 2$
<code>(define z (+ x y))</code>	
<code>(define age 14)</code>	
<code>(define months (* age 12))</code>	
<code>(define days (* months 30))</code>	
<code>(define hours (* days 24))</code>	
<code>(define minutes (* hours 60))</code>	

Algebra Translations

Translate the Racket Code into Algebra.

Racket Code	Algebra
<code>(define (double x) (* x 2))</code>	$\text{double}(x) = x \cdot 2$
<code>(define (area length width) (* length width))</code>	$\text{area}(\text{length}, \text{width}) = \text{length} \cdot \text{width}$
<code>(define (circle-area radius) (* pi (sq radius)))</code>	
<code>(define (distance x1 y1 x2 y2) (sqrt (+ (sq (- x1 x2)) (sq (- y1 y2)))))</code>	

Design Recipe

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



D (1) =

Use the function here.

What should the function produce?

Example

D () =

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?

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

Definition

D () =

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.



Write an example of your function for some sample inputs

Use the function here.

What should the function produce?

Example

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?

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

Definition

=

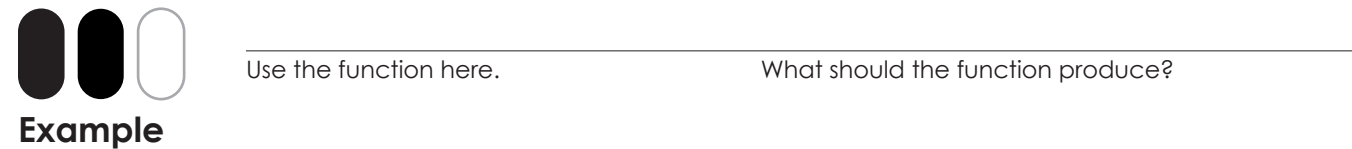
Design Recipe

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?



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?

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



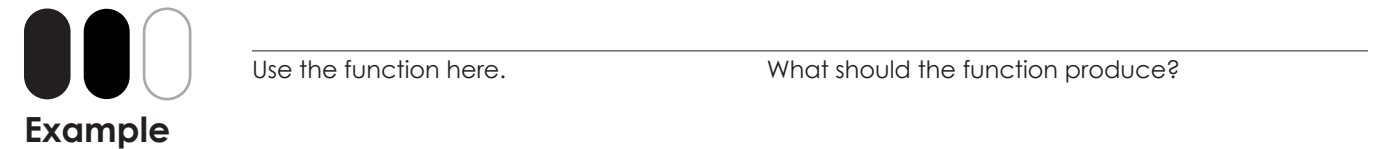
Design Recipe

Word Problem:



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?

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



