Name: _____


## Student Workbook

Class: _____

BOOTSTRAP
www.bootstrapworld.org

# Bootstrap Units

01 Videogames and Coordinate Planes

02 Contracts, Strings, and Images

03 Intro to Definitions

04 Design Recipe

05 Game Animation

06 Comparing Functions

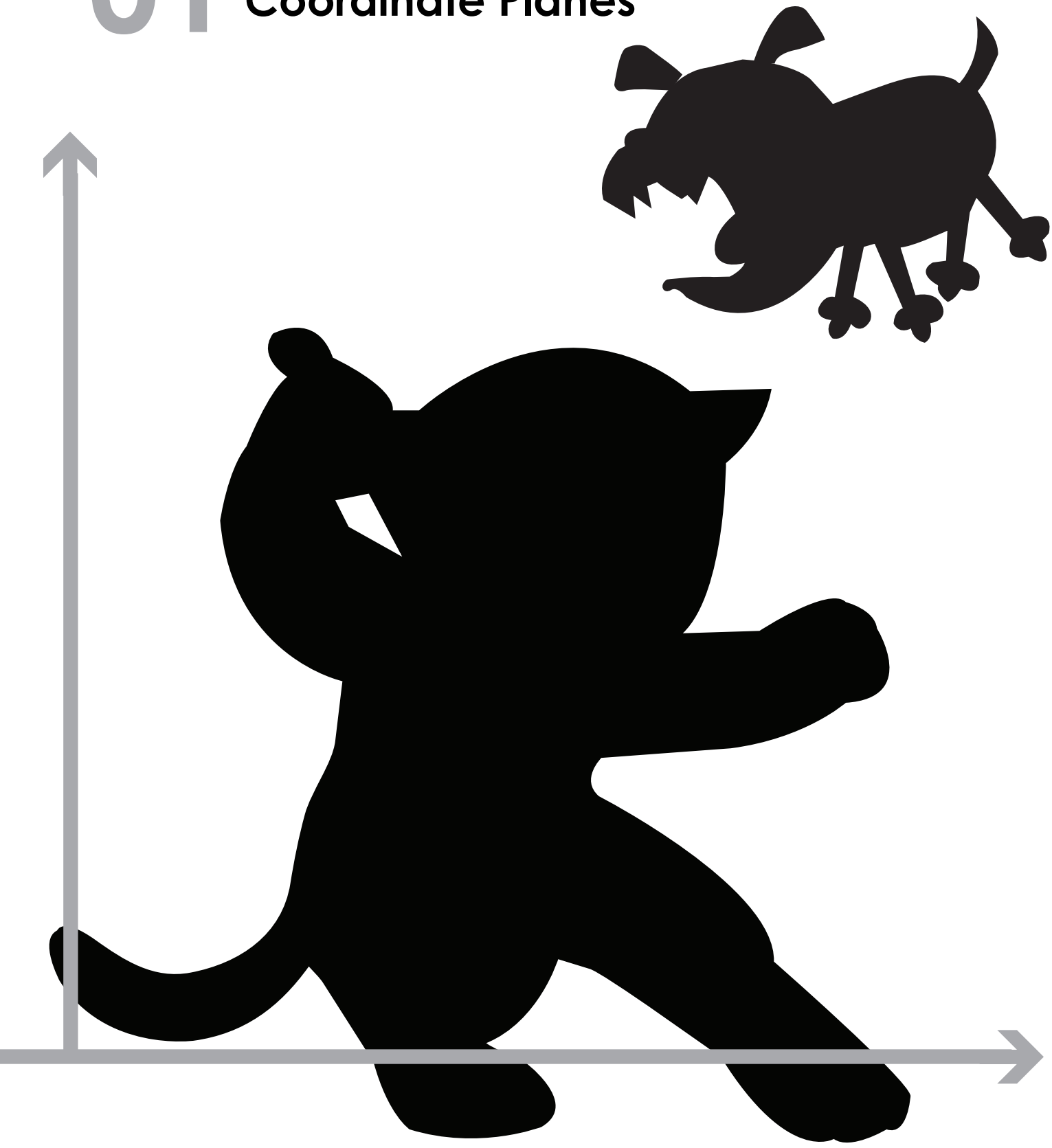
07 Conditional Branching

08 Collision Detection

09 Prepping for Launch

10 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... |
|---|---|---|
| *cloud* | *position* | *x-coordinate* |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# 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 _____.*

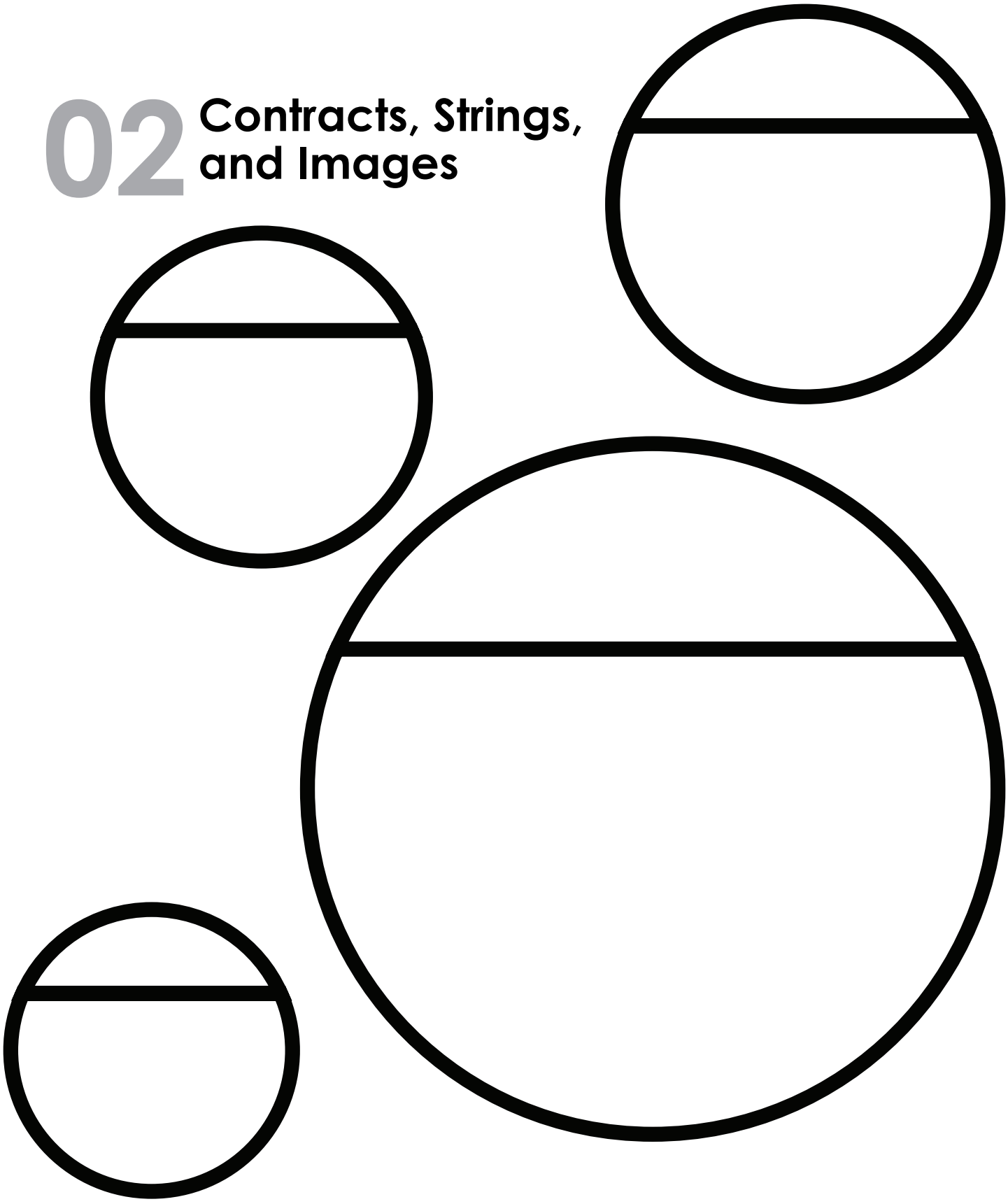
The Danger moves only to the left and right.

# Circle of Evaluation Practice Time: 5 minutes

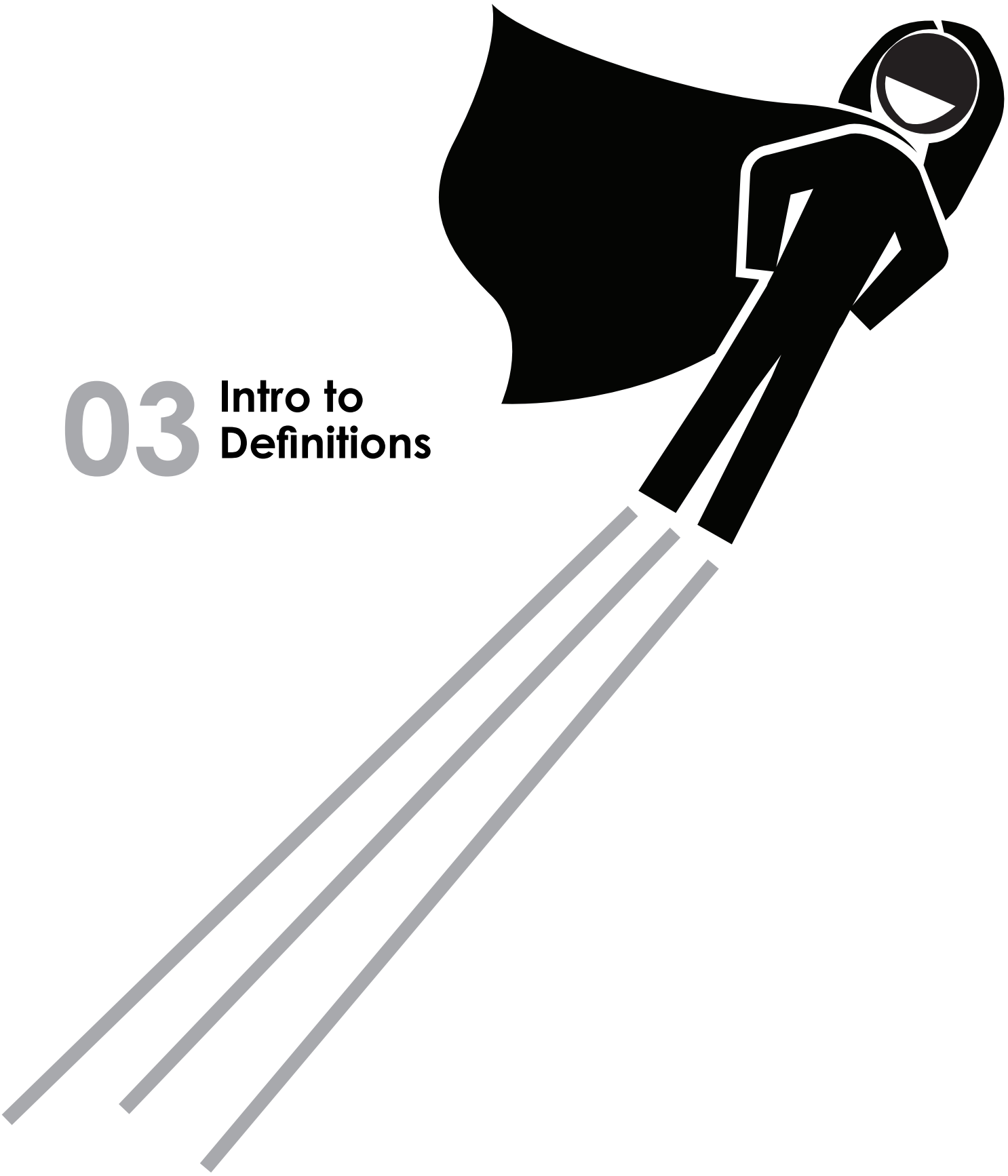
Don't forget to use the computer's symbols for things like multiply and divide!

| *Math* | *Circle of Evaluation* | *Racket Code* |
|---|---|---|
| *5 x 10* | | |
| *8 + (5 x 10)* | | |
| *(8 + 2) - (5 x 10)* | | |
| $\frac{5 \times 10}{8 - 2}$ | | |

# 02 Contracts, Strings, and Images



| Circles Competition | | | Time: 5 minutes |
|---|---|---|---|
| | ***Math*** | ***Round 1 -Circle of Evaluation*** | ***Round 2 - Racket Code*** |
| *Challenge A* | *(3 * 7) - (1 + 2)* | | |
| *Challenge B* | *3 - (1 + 2)* | | |
| *Challenge C* | *3 - (1 + (5 * 6))* | | |
| *Challenge D* | *(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 (_____ _____) _____)

# 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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ ) _____ )

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

(EXAMPLE( _____ _____ ) _____ )

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

## Definition

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

(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*

# 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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ ) _____ )

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

(EXAMPLE( _____ _____ ) _____ )

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

## Definition

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

(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*

# Word Problem: red-square

***Directions:*** *Use the Design Recipe to write a function 'red-square', which takes in a number (the length of each 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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

## Definition

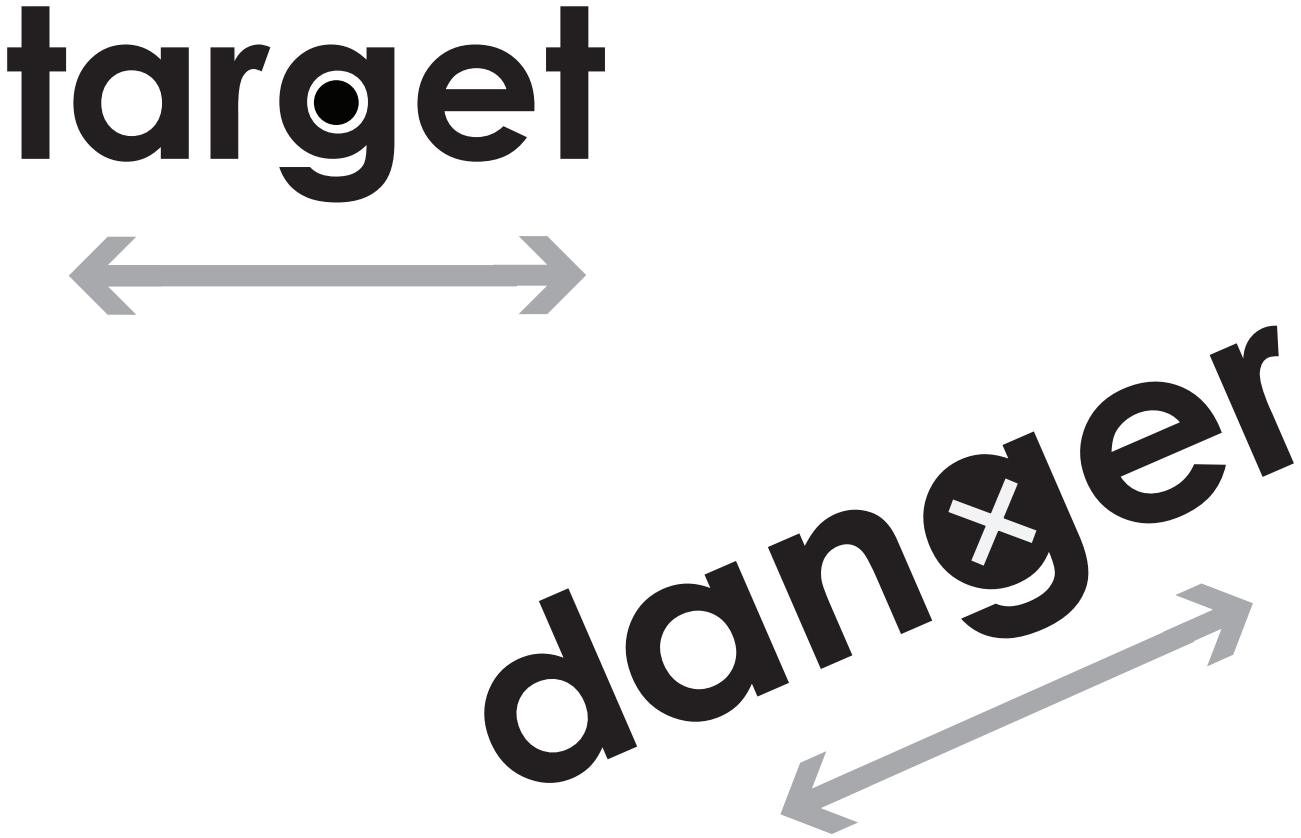
*Write the definition, given variable names to all your input values...*

(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*




# 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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ ) _____ )

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

(EXAMPLE( _____ _____ ) _____ )

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

## Definition

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

(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*

# 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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ ) _____ )

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

(EXAMPLE( _____ _____ ) _____ )

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

## Definition

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

(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*

*“safe-left?”*

# 06 Comparing Functions

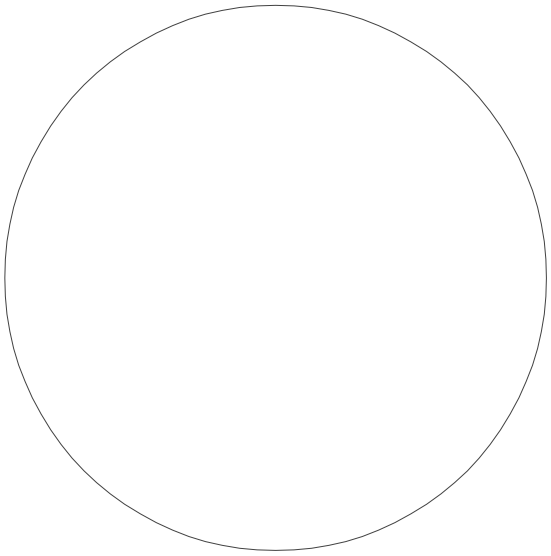
# Sam the Butterfly

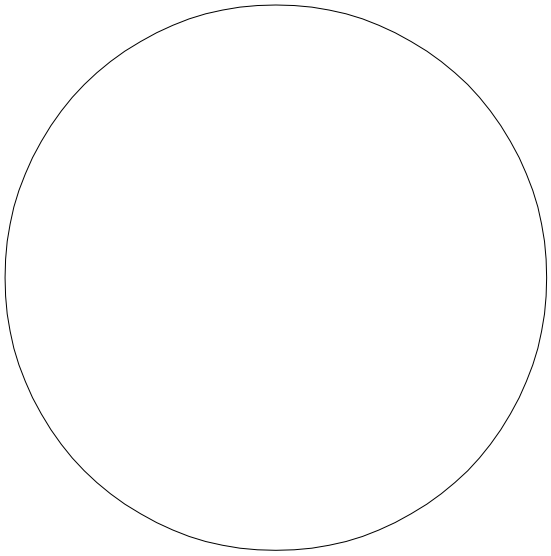
Sam is in a 640 x 480 yard. How far he can go to the left and right before he's out of sight?

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: safe-left?

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

## Contract and Purpose Statement

*Every contract has three parts...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ ) _____ )

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

(EXAMPLE( _____ _____ ) _____ )

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

## Definition

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

(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*

# Word Problem: safe-right?

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

## Contract and Purpose Statement

*Every contract has three parts...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ ) _____ )

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

(EXAMPLE( _____ _____ ) _____ )

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

## Definition

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

(define( _____ _____ )

*function name* *variables*

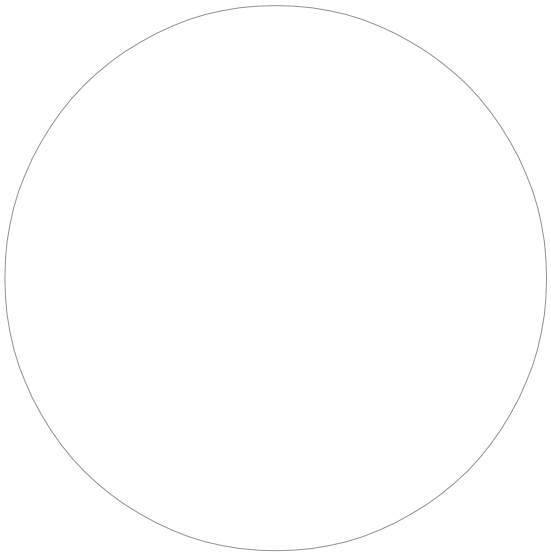
_____ )

*what the function does with those variables*

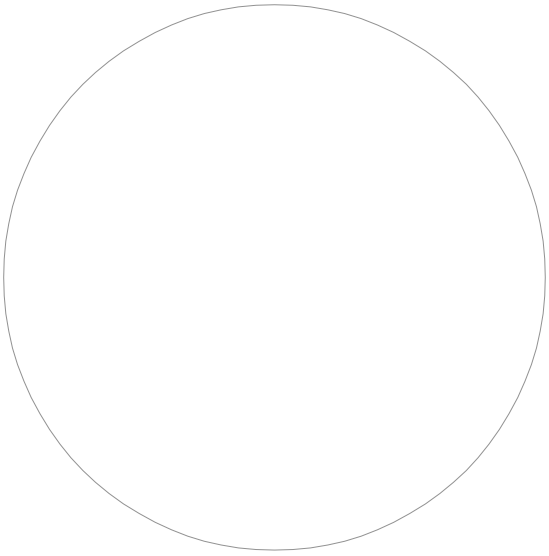
# and / or

**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 x-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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

## Definition

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

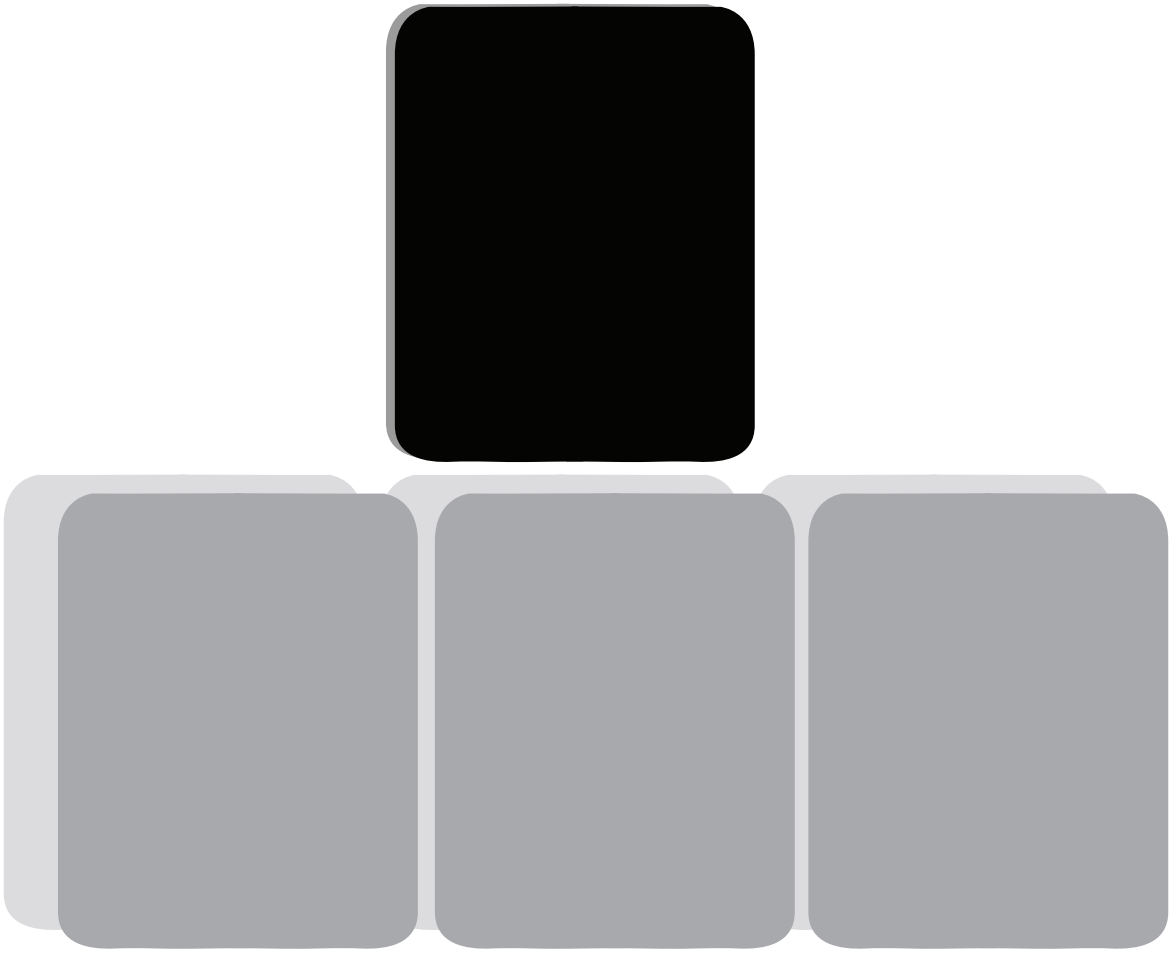
(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*

# 07 Conditional Branching



# Word Problem: cost

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

## Contract and Purpose Statement

*Every contract has three parts...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( cost "cheese" ) _____ )

*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, given variable names to all your input values...*

(define( _____ _____ )

*function name* *variables*

(cond

[ _____ ]

[ _____ ]

[ _____ ]

[ _____ ]

[ _____ ]))

# 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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( update-player 320 "up" ) _____ )

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

(EXAMPLE( update-player 100 "up" ) _____ )

*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, given 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 *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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(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, given variable names to all your input values...*

(define( _____ _____ )

*function name* *variables*

(cond

[ _____ _____ ]

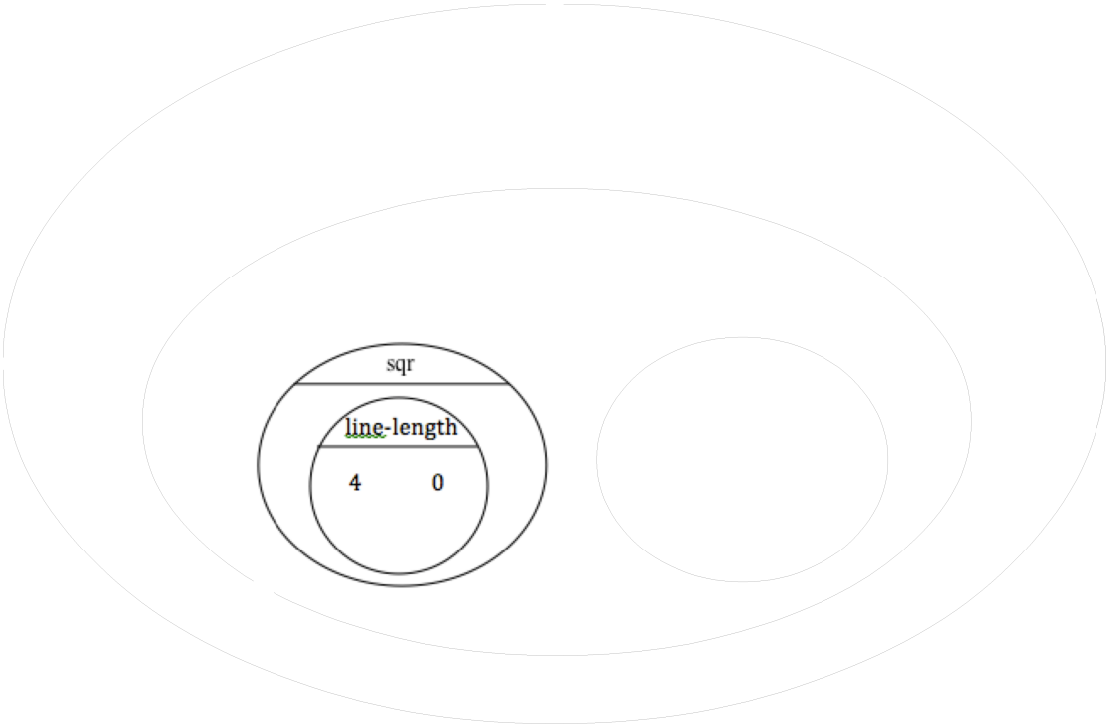
[ _____ _____ ]))

# The Distance Formula (an example)

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

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

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




Convert the Circle of Evaluation to code, then label the numbers with (x1,y1) & (y1,y2):

# 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*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

## Definition

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

(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*

# 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...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

## Definition

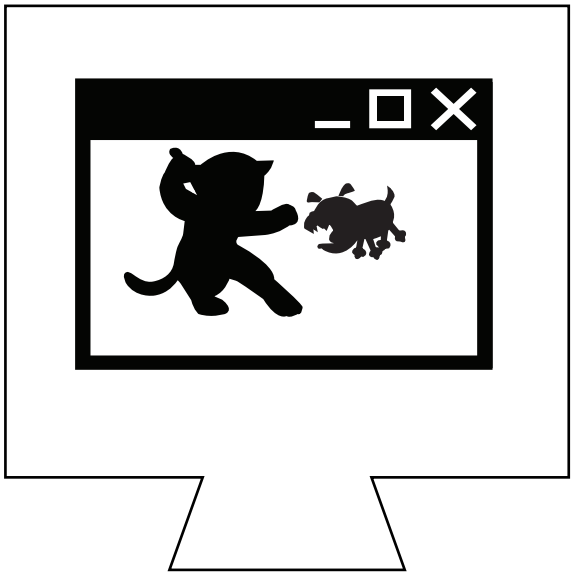
*Write the definition, given variable names to all your input values...*

(define( _____ _____ )

*function name* *variables*

_____ )

*what the function does with those variables*



# 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 else clause that produces a sensible output.*

## Contract and Purpose Statement

*Every contract has three parts...*

; _____ : _____ → _____

*function name* *domain* *range*

; _____

*what does the function do?*

## Examples

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

(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*

(EXAMPLE( _____ _____ )

*function name* *input(s)*

_____ )

*what the function produces*

## Definition

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

(define( _____ _____ )

*function name* *variables*

(cond

[ _____ (circle 50 "solid" "red") ]

[ _____

_____ ]

[ _____

_____ ]

[ _____ _____ ]

[ _____ _____ ]))

# Translating into Algebra

## Value Definitions

| 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))` | |

## Function Definitions

| Racket Code | Algebra |
|---|---|
| `(define (area length width)`<br>`  (* length width))` | area(length, width) = length * width |
| `(define (circle-area radius)`<br>`  (* pi (sqr radius)))` | |
| `(define (distance x1 y1 x2 y2)`<br>`  (sqrt (+ (sqr (- x1 x2))`<br>`  (sqr (- y1 y2)))))` | |

# 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 ) =

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( ) =

# Design Recipe

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

## I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____

name Domain Range

; _____

*What does the function do?*

## II. Give Examples

Write an example of your function for some sample inputs

= _____

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.

= _____

# 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 <u>some sample inputs</u>

| | = | |
|---|---|---|
| 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? |

| | = | |
|---|---|---|
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## III. Definition

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

=

# Design Recipe

## I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____

name Domain Range

; _____

*What does the function do?*

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# Contracts

| Name | Domain | Range | *example* |
|---|---|---|---|
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
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| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |

# Contracts

| Name | Domain | Range | *example* |
|---|---|---|---|
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
| ; | : | → | |
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