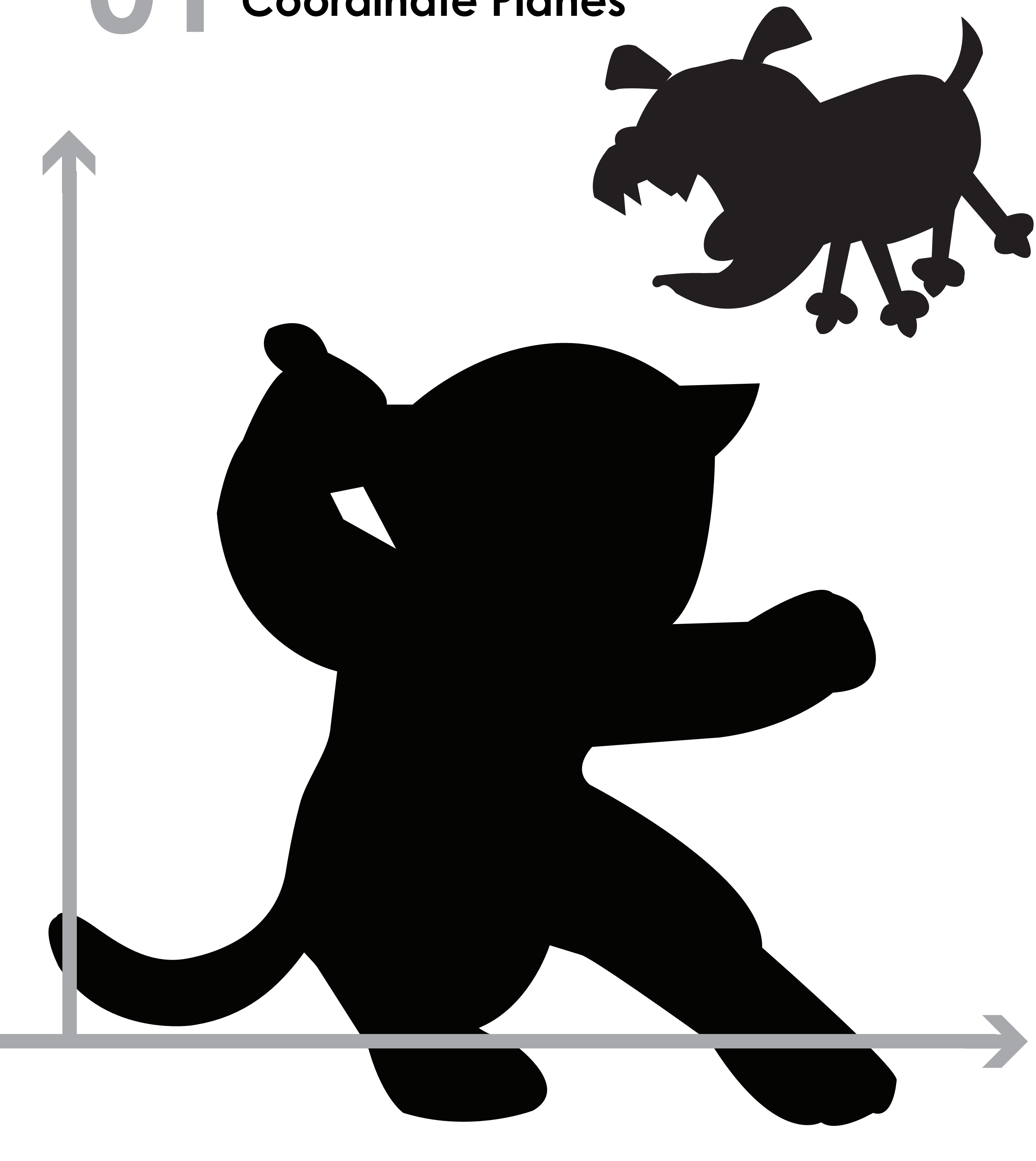
Bootstrap Units

01 Videogames and Coordinate Planes

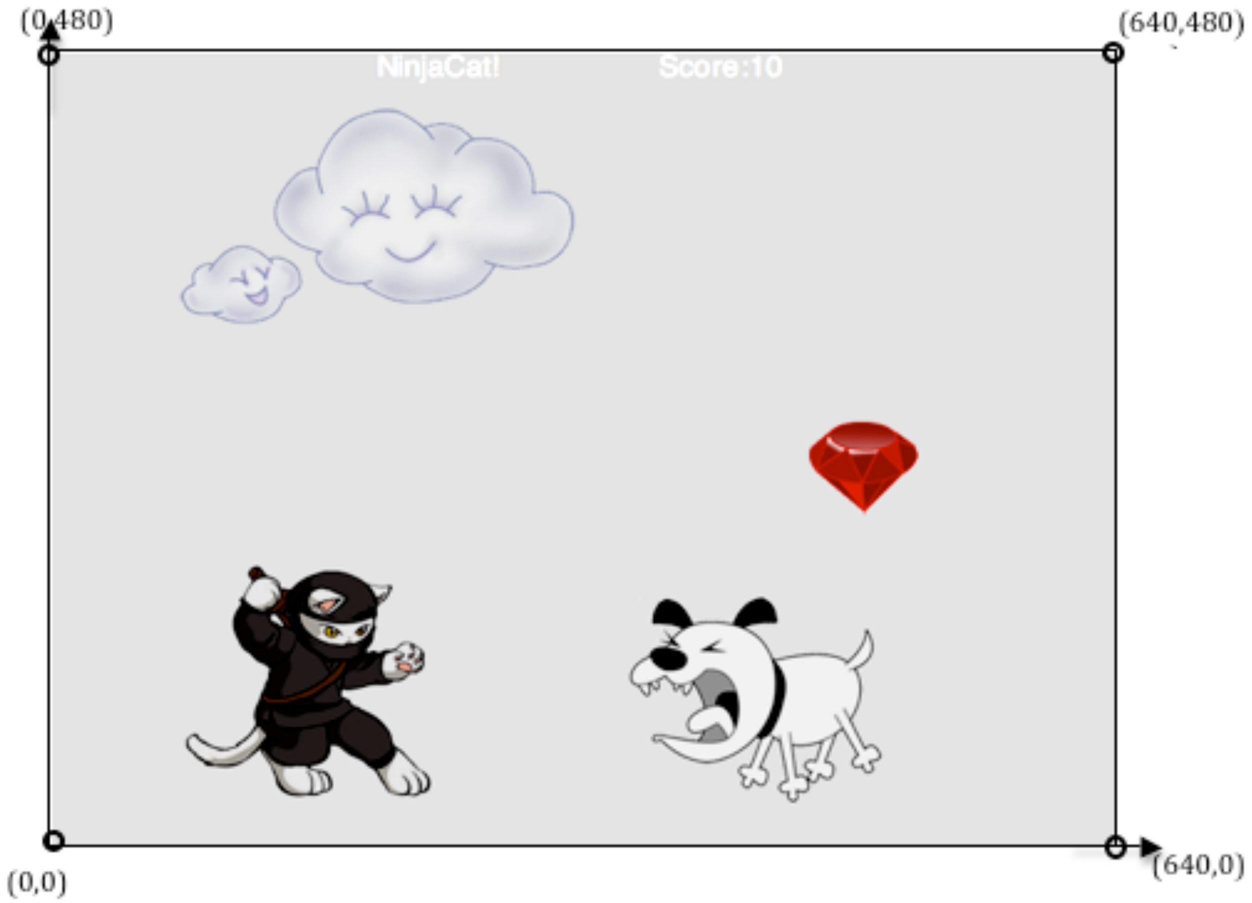


Lesson 1

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!

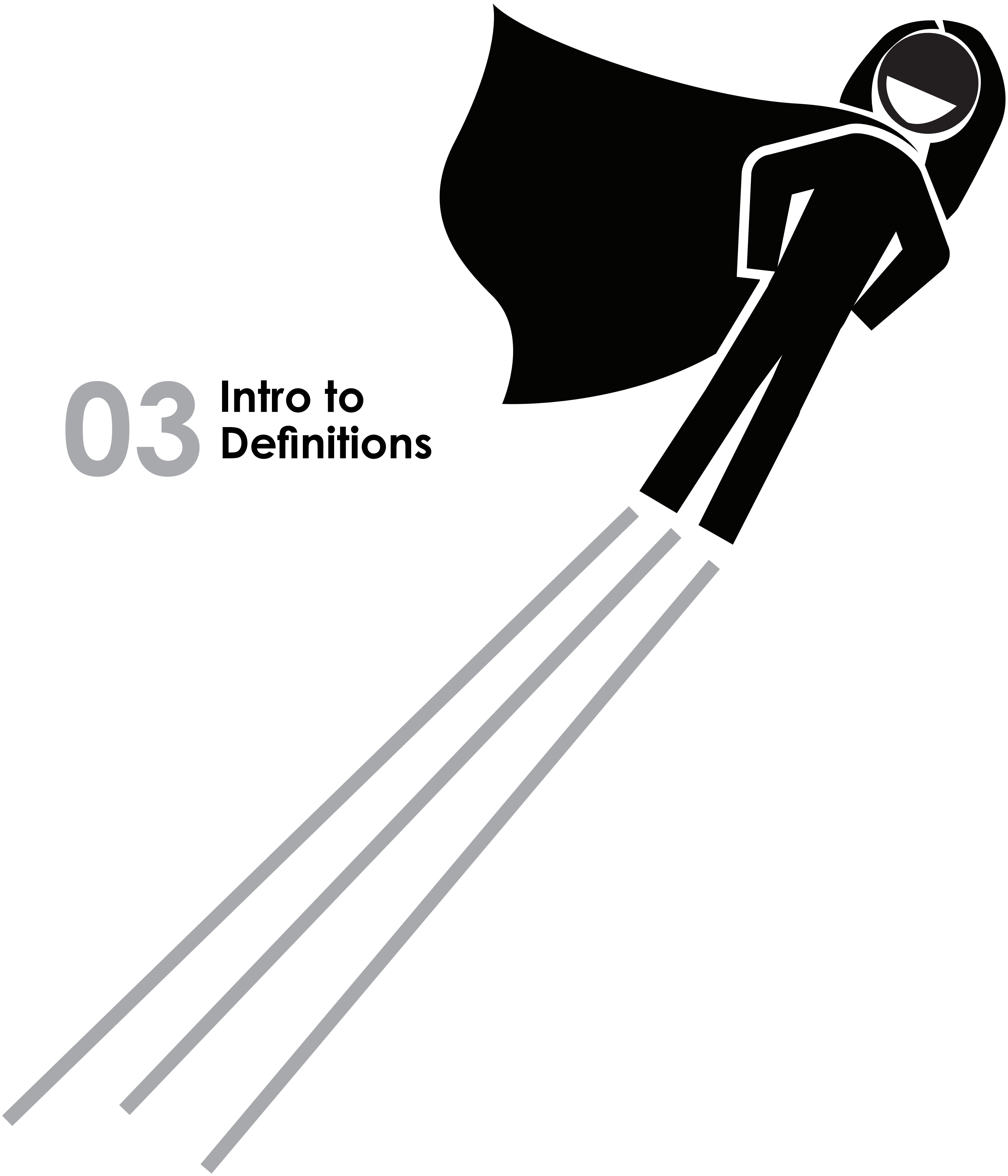
Math	***Circle of Evaluation***	***Racket Code***
5 x 10		
8 + (5 x 10)		
(8 + 2) - (5 x 10)		
$\frac{5 \text{ x } 10}{8 - 2}$		

02 Contracts, Strings, and Images

Circles Competition Time: 5 minutes

	Math	*Circle of Evaluation*	*Racket Code*
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 (______ ______)  ____________________________________)
```

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

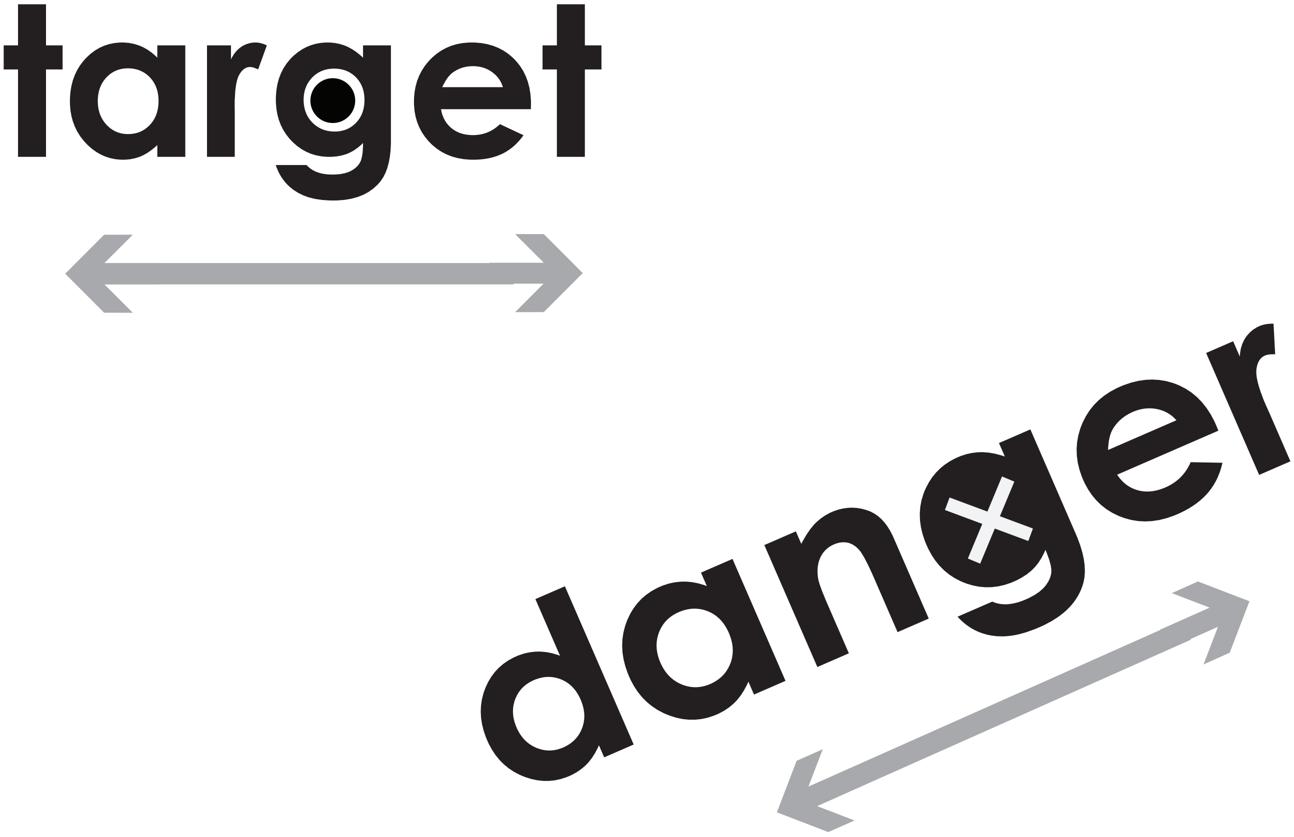
Write the definition, given variable names to all your input values...

(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

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: 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...

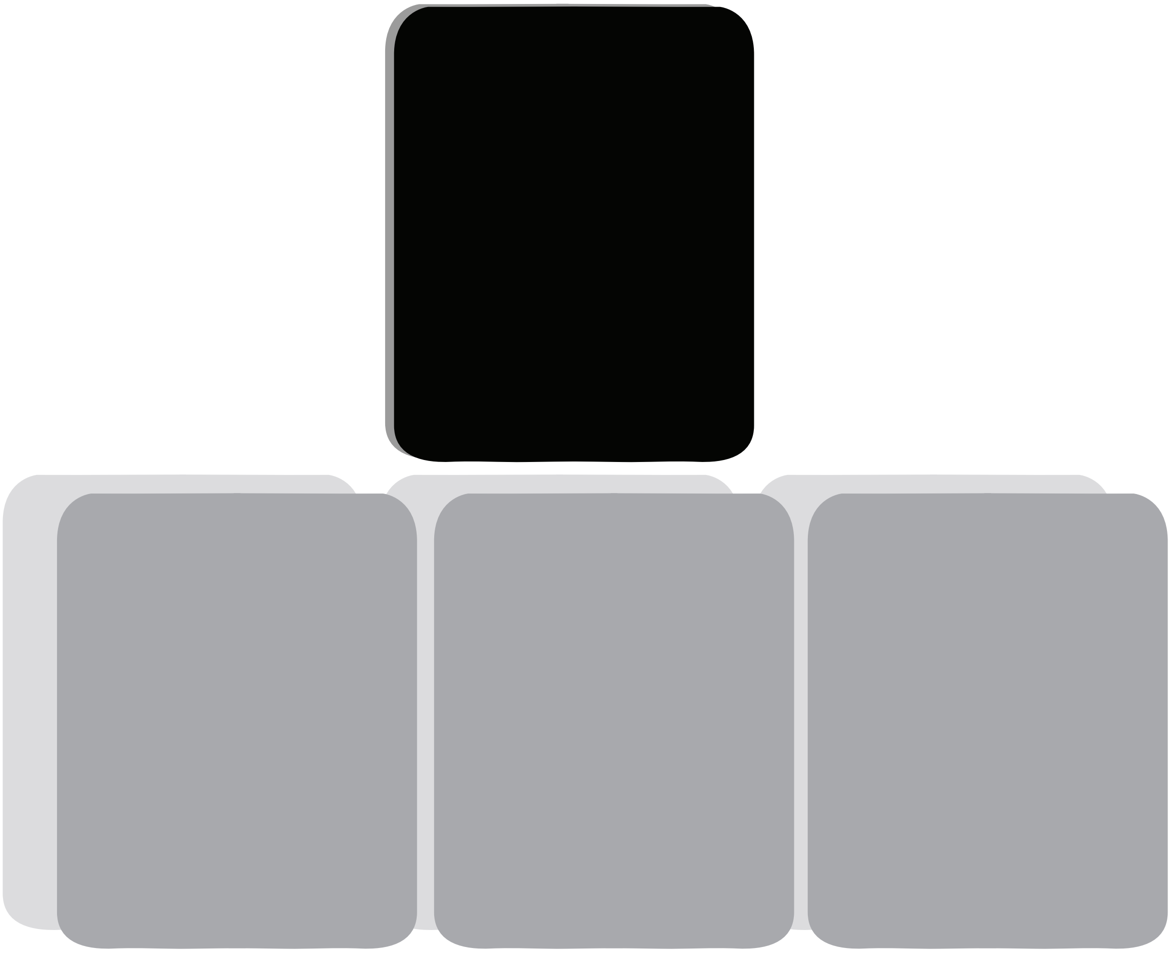
(define(_______________ _______________)

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 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...

; ____________ : ________________________ → ____________

function name *domain* *range*

; ____

what does the function do?

Examples

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

(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, 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*

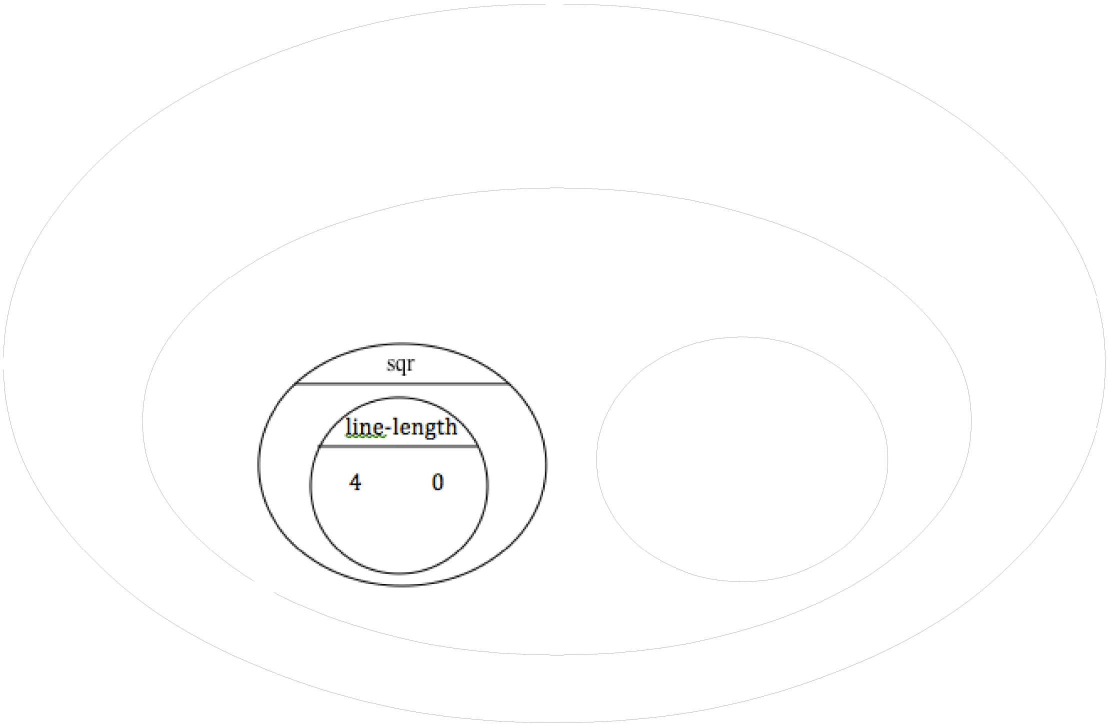
```
        (cond ____________

         [ ______________________ ______________________ ]

         [ ______________________ ______________________ ]))
```

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 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...

; ________________ : ____ → ____________________

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

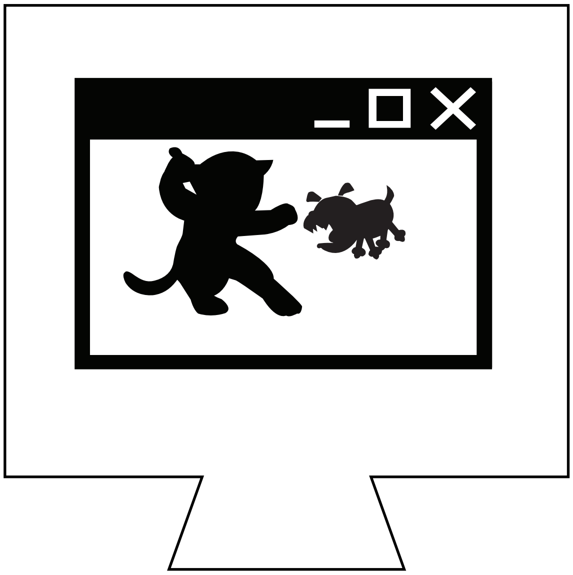
Write the definition, given variable names to all your input values...

(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) (* length width))	area(length, width) = length * width
(define (circle-area radius) (* pi (sqr radius)))	

(define (distance x1 y1 x2 y2)
   (sqrt (+ (sqr (- x1 x2))
            (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?

______________________ = ____

Use the function here What should the function produce?

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?

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?

= ____

Use the function here What should the function produce?

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?

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?

=

Use the function here What should the function produce?

III. Definition

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

=

Contracts

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

Contracts

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