Contracts

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

Contracts

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

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

Lesson 2

(draw Circles of Evaluation here if you need extra scratch paper)

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*		

Lesson 3

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

Design Recipe

Word Problem: rocket-height

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.

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____
name Domain Range

; _____
What does the function do?

II. Give Examples

On the computer, write an example of your function in action, using EXAMPLE.

(EXAMPLE (_____))
the user types…

_____)
…..which should become

(EXAMPLE (_____))
the user types…

_____)
…..which should become

III. Definition

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

(define (_____ _____))
function name variable names

_____)
…..and the computer does this

Design Recipe

Word Problem: red-square

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.*

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____

Name Domain Range

; _____

What does the function do?

II. Give Examples

On the computer, write an example of your function in action, using EXAMPLE

(EXAMPLE (_____)

the user says…

_____)

…..Racket replies

(EXAMPLE (_____)

the user says…

_____)

…..Racket turns that into

III. Definition

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

(define (_____ _____)

function name variable names

_____)

…..and the computer does this

DESIGN RECIPE

Word Problem: yard-area

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 !)*

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____
name Domain Range

; _____
What does the function do?

II. Give Examples

On the computer, write an example of your function in action, using EXAMPLE.

(EXAMPLE (_____)
Use the function here

_____)
find another way to get the same result here

(EXAMPLE (_____)
Use the function here…

_____)
find another way to get the same result here

III. Definition

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

(define (_____ _____)
function name variable names

_____)
…..and the computer does this

Lesson 5

Design Recipe

Word Problem: update-danger

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.*

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____
name Domain Range

; _____
What does the function do?

II. Give Examples

On the computer, write an example of your function in action, using EXAMPLE.

(EXAMPLE (_____)
Use the function here

_____)
find another way to get the same result here

(EXAMPLE (_____)
Use the function here…

_____)
find another way to get the same result here

III. Definition

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

(define (_____ _____)
function name variable names

_____)
…..and the computer does this

Design Recipe

Word Problem: update-target

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.*

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____
name Domain Range

; _____
What does the function do?

II. Give Examples

On the computer, write an example of your function in action, using EXAMPLE.

(EXAMPLE (_____)
Use the function here

_____)
find another way to get the same result here

(EXAMPLE (_____)
Use the function here…

_____)
find another way to get the same result here

III. Definition

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

(define (_____ _____)
function name variable names

_____)
…..and the computer does this

Lesson 6

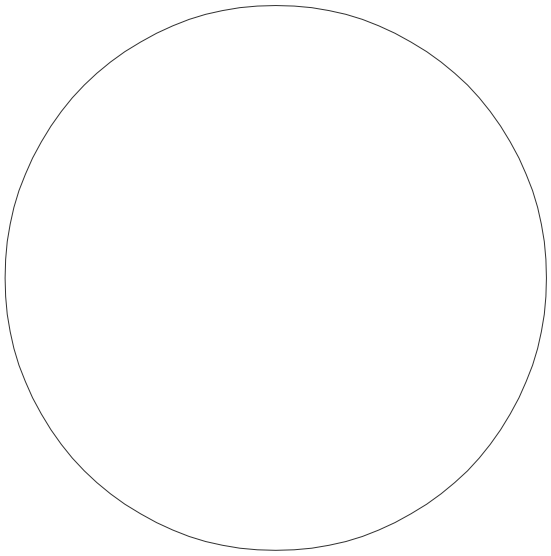
Design Recipe

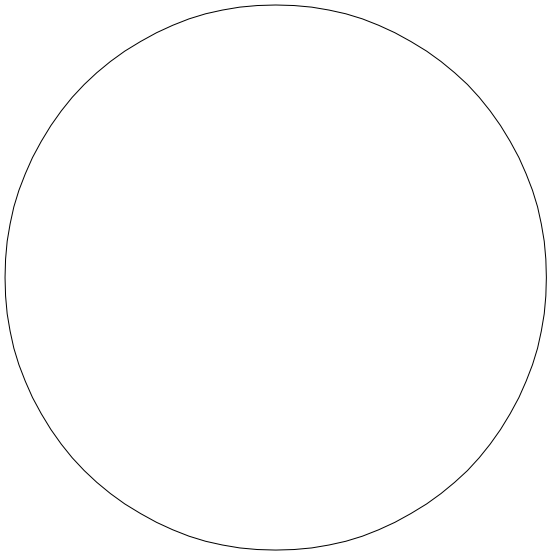
Sam is in a 640 x 480 yard. How far he can go to the left and right before he's out of sight?

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:





Design Recipe

Word Problem: safe-left?

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.*

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____
name Domain Range

; _____
What does the function do?

II. Give Examples

On the computer, write an example of your function in action, using EXAMPLE.

(EXAMPLE (_____)
Use the function here

_____)
find another way to get the same result here

(EXAMPLE (_____)
Use the function here…

_____)
find another way to get the same result here

III. Definition

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

(define (_____ _____)
function name variable names

_____)

…and the computer does this

Design Recipe

Word Problem: safe-right?

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.*

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____
name Domain Range

; _____
What does the function do?

II. Give Examples

On the computer, write an example of your function in action, using EXAMPLE.

(EXAMPLE (_____)
Use the function here

_____)
find another way to get the same result here

(EXAMPLE (_____)
Use the function here…

_____)
find another way to get the same result here

III. Definition

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

(define (_____ _____)
function name variable names

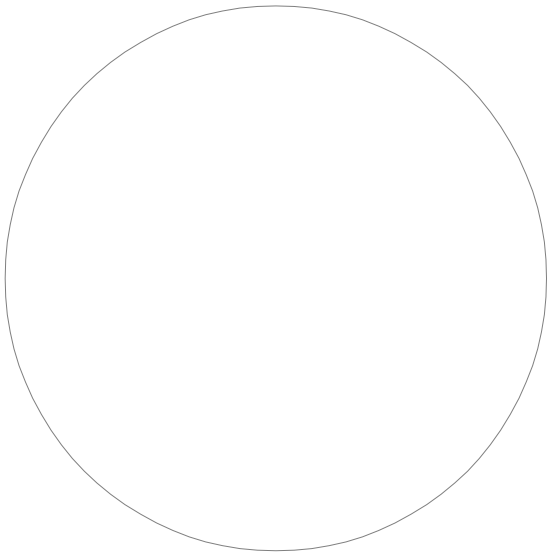
_____)

…and the computer does this

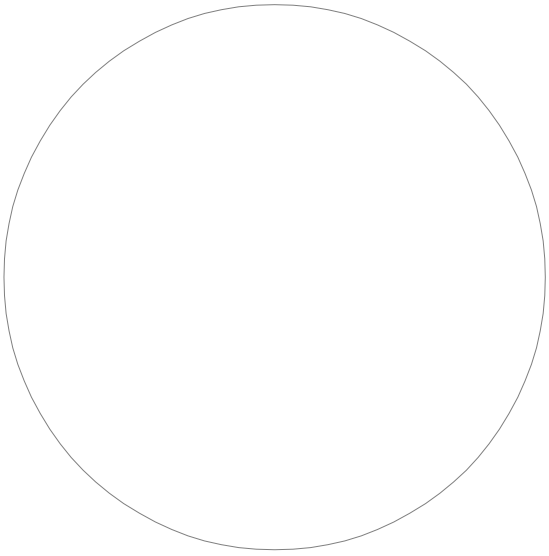
and / or

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.



Design Recipe

Word Problem: onscreen?

Use the Design Recipe to write a function ***`onscreen?`****, which takes in an x-coordinate and checks to see if Sam is safe on the left* and *safe on the right.*

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____
name Domain Range

; _____
What does the function do?

II. Give Examples

On the computer, write an example of your function in action, using EXAMPLE.

(EXAMPLE (_____)
Use the function here

_____)
find another way to get the same result here

(EXAMPLE (_____)
Use the function here…

_____)
find another way to get the same result here

III. Definition

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

(define (_____ _____)
function name variable names

_____)

…and the computer does this

Lesson 7

Design Recipe

Word Problem: cost

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.

I. Contract+Purpose Statement

; _____ : _____ -> _____

name Domain Range

II. Give Examples

On the computer, write an example of your function for each topping, using EXAMPLE.

(EXAMPLE (cost "pepperoni") _____)

Use the function here What should the function produce?

(EXAMPLE (_____) _____)

Use the function here What should the function produce?

(EXAMPLE (_____) _____)

Use the function here What should the function produce?

(EXAMPLE (_____) _____)

Use the function here What should the function produce?

III. Definition

(define (_____ _____)

function name variable names

_____

)

Design Recipe

Word Problem: update-player

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.

I. Contract+Purpose Statement

; _____ : _____ -> _____
name Domain Range

II. Give Examples

Finish the two examples we've started for you, and make two more

(EXAMPLE (update-player 128 "up") _____)
Use the function here What should the function produce?

(EXAMPLE (update-player 451 "down") _____)
Use the function here What should the function produce?

(EXAMPLE (_____) _____)
Use the function here What should the function produce?

(EXAMPLE (_____) _____)
Use the function here What should the function produce?

III. Definition

(define (_____ _____)
function name variable names

_____

)

Lesson 8

Design Recipe

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.

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____

name Domain Range

II. Give Examples

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

Use the function here What should the function produce?

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

Use the function here What should the function produce?

III. Definition

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

(define (_____ _____)

function name variable names

_____

)

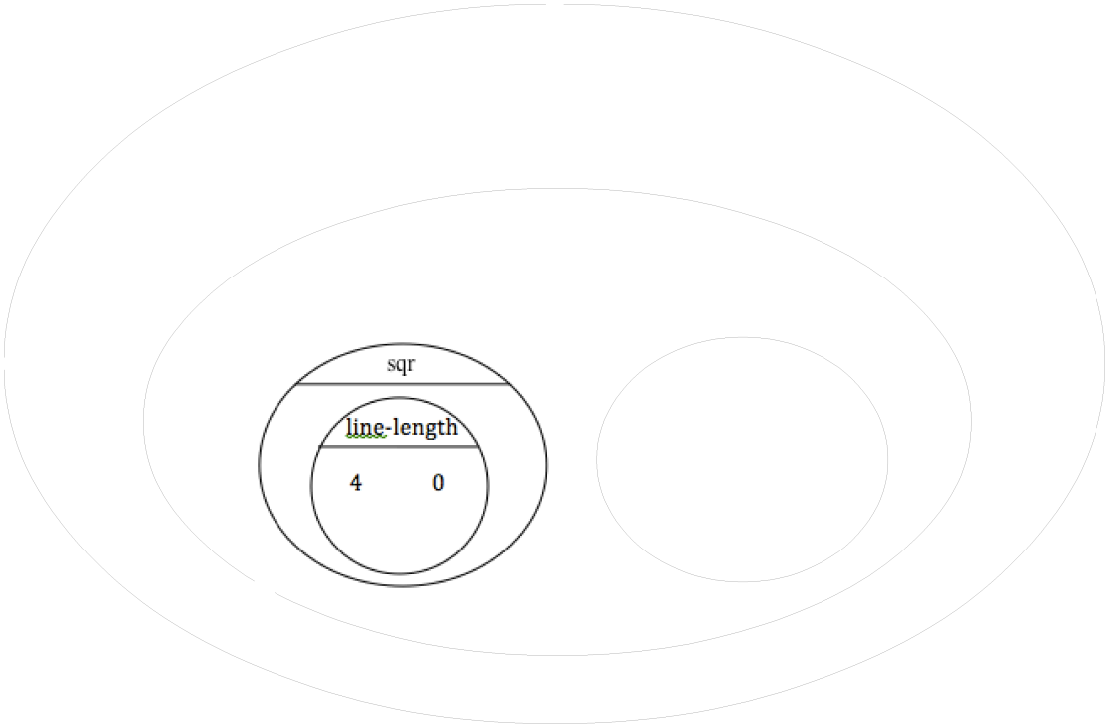
…and the computer does this

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:

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 27!)

I. Contract+Purpose Statement

; _____ : _____ -> _____
name Domain Range

; _____
What does the function do?

II. Give Examples

(EXAMPLE (_____)
Use the function here

_____)
find another way to get the same result here

(EXAMPLE (_____)
Use the function here…

_____)
find another way to get the same result here

III. Definition

(define (_____ _____)
function name variable names

_____)

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 the coordinates of the other character. Otherwise, `false`.

I. Contract+Purpose Statement

; _____ : _____ -> _____

name Domain Range

; _____

What does the function do?

II. Give Examples

(EXAMPLE (_____)

Use the function here

_____)

find another way to get the same result here

(EXAMPLE (_____)

Use the function here…

_____)

find another way to get the same result here

III. Definition

(define (_____ _____)

function name variable names

_____)

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!

Design Recipe

Word Problem: red-shape

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

I. Contract+Purpose Statement

; _____ : _____ -> _____

name Domain Range

; _____

What does the function do?

II. Give Examples

Write some examples of red-shape below. The first one has already been done for you.

(EXAMPLE (red-shape "circle") (circle 50 "solid" "red"))

Use the function here — What should the function produce?

(EXAMPLE (_____) _____)

Use the function here — What should the function produce?

(EXAMPLE (_____) _____)

Use the function here — What should the function produce?

(EXAMPLE (_____) _____)

Use the function here — What should the function produce?

III. Definition

(define (_____ _____)

function name — variable names

(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 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.

=