Contracts

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

Name	Domain	Range	example
;	:	→	
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Lesson 1

Reverse-Engineering: How does NinjaCat work?

Thing in the game…	What changes about it?	More specifically…
cat	Position	x, y
ruby	position	x
clouds	position	x
dog	position	x
score	value	
background	nothing	

Finding Coordinates

The coordinates for the PLAYER (NinjaCat) are: (150 , 50)

x-coordinate *y-coordinate*

The coordinates for the DANGER (Dog) are: (450 , 50)

The coordinates for the TARGET (Ruby) are: (550 , 250)

Our Videogame

Created by (write your names): Jessica and James

Background

Our game takes place in: The Zoo
(space? the desert? a mall?)

The Player

The player is a Lion.

The player moves only up and down.

The Target

Your player GAINS points when they hit the target.

The Target is a Escaped gazelle.

The Target moves only to the left and right.

The Danger

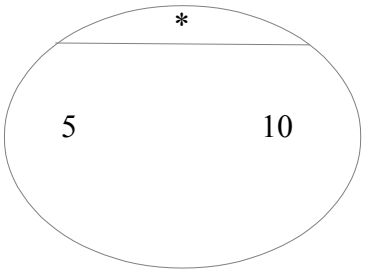
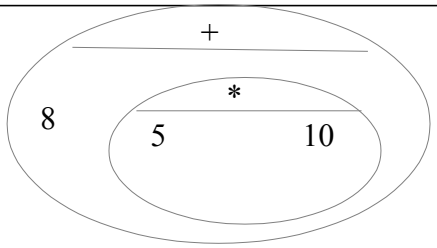
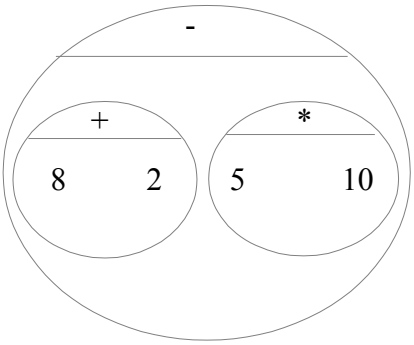
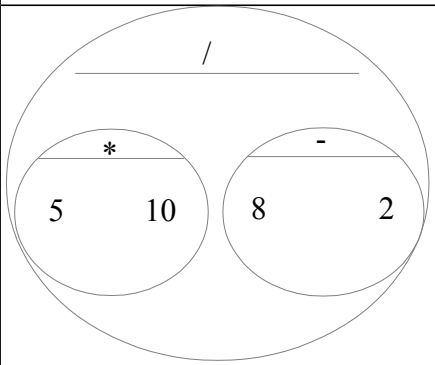
Your player LOSES points when they hit the danger.

The Danger is a Zookeeper.

The Danger moves only to the left and right.

Circle of Evaluation Practice **Time: 5 minutes**

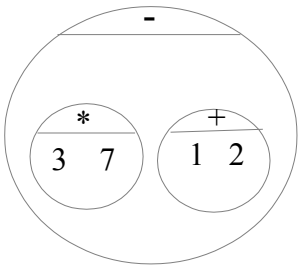
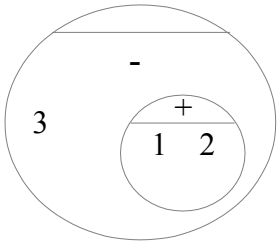
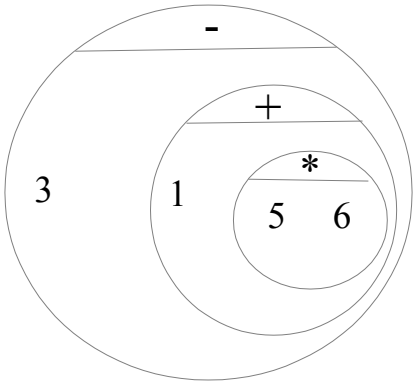
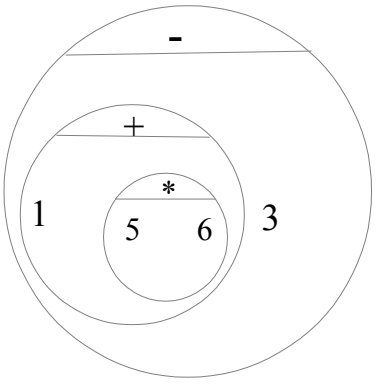
Don't forget to use the computer's symbols for things like multiply and divide!

Math	***Circle of Evaluation***	***Racket Code***
5 x 10		(* 5 10)
8 + (5 x 10)		(+ 8 (* 5 10))
(8 + 2) - (5 x 10)		(- (+ 8 2) (* 5 10))
5 x 10 / *8 - 2*		(/ (* 5 10) (- 8 2))

Lesson 2

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

Circles Competition

	Math	*Circle of Evaluation*	*Racket Code*
Round 1	*(3 * 7) – (1 + 2)*		(- (* 3 7) (+ 1 2))
Round 2	*3 - (1 + 2)*		(- 3 (+ 1 2))
Round 3	*3 - (1 + (5 * 6))*		(- 3 (+ 1 (* 5 6)))
Round 4	*(1 + (5 * 6)) - 3*		(- (+ 1 (* 5 6)) 3)

Lesson 3

Fast Functions

; gt : number -> image

name domain range

(EXAMPLE (gt 500) (triangle 500 "solid" "green"))

(EXAMPLE (gt 7) (triangle 7 "solid" "green"))

(define (gt size) (triangle size "solid" "green"))

; bc : number -> image

name domain range

(EXAMPLE (bc 19) (circle 19 "solid" "blue"))

(EXAMPLE (bc 43) (circle 43 "solid" "blue"))

(define (bc size) (circle size "solid" "blue"))

; double : number -> number

name domain range

(EXAMPLE (double 3) (* 2 3))

(EXAMPLE (double 9) (* 2 9))

(define (double num) (* 2 num))

; _____ : _____ -> _____

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:

; _rocket-height_ : __number_____ -> _number___
name Domain Range

; Takes the number of seconds passed since take-off, and produce current height
What does the function do?

II. Give Examples

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

(EXAMPLE (__rocket-height 0_____)
the user types…

___(* 7 0))_____
…..which should become

(EXAMPLE (__rocket-height 4_____)
the user types…

___(* 7 4))_____
…..which should become

III. Function

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

(define (__rocket-height __ __time__)
function name variable names
_____(* 7 time))_____

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:

; _red-square_____ : ___number___ -> _image_____

Name Domain Range

; __Draws a solid red square of the size given_____

What does the function do?

II. Give Examples

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

(EXAMPLE (__red-square 5_____)

the user says…

__(rectangle 5 5 "solid" "red"))____

…..Racket replies

(EXAMPLE (_red-square 6_____)

the user says…

__(rectangle 6 6 "solid" "red"))_____

…..Racket turns that into

III. Definition

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

(define (_red-square_____ __size_____)

function name variable names

___(rectangle size size "solid" "red"))_____

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:

; __yard-area____ : ___number number_____ -> ___number___
name Domain Range

; Takes in length and width of a yard and gives back its area
What does the function do?

II. Give Examples

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

(EXAMPLE (____yard-area 5 3_____)
Use the function here

__(* 5 3))_____
find another way to get the same result here

(EXAMPLE (_____yard-area 8 2 _____)
Use the function here…

_____(* 8 2))_____
find another way to get the same result here

III. Definition

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

(define (_yard-area_____ __length width_____)
function name variable names

___(* length width))_____

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:

; __update-danger___ : _number____ -> __number_____
name Domain Range

; ___Takes in danger's current x-coordinate and adds 50 to it____
What does the function do?

II. Give Examples

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

(EXAMPLE (___update-danger 500_____)
Use the function here

___(- 500 50))_____
find another way to get the same result here

(EXAMPLE (__update-danger 140_____)
Use the function here…

___(- 140 50))_____
find another way to get the same result here

III. Definition

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

(define (_update-danger____ _dangerX_____)
function name variable names

__(- dangerX 50))_____

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:

; __update-target_ : _number____ -> __number_____
name Domain Range

; _Takes in the target's current x-coordinate and adds 50 to it_
What does the function do?

II. Give Examples

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

(EXAMPLE (____update-target 60_____)
Use the function here

____(+ 60 50))_____
find another way to get the same result here

(EXAMPLE (_____update-target 125_____)
Use the function here…

_____(+ 125 50))_____
find another way to get the same result here

III. Definition

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

(define (_update-target_ __targetX____)
function name variable names

____(+ targetX 50))_____

Lesson 6

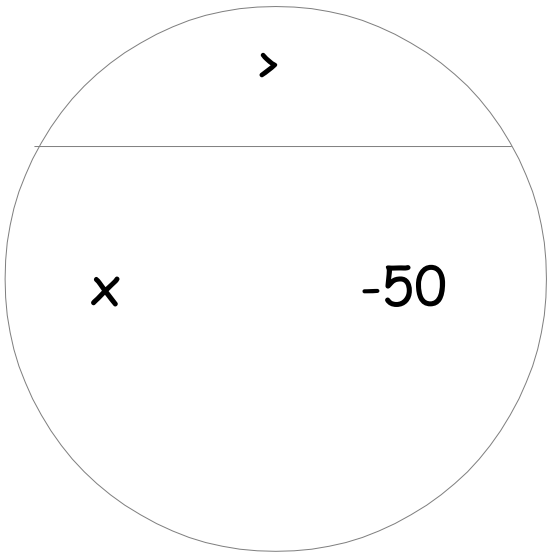
Protecting Sam

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

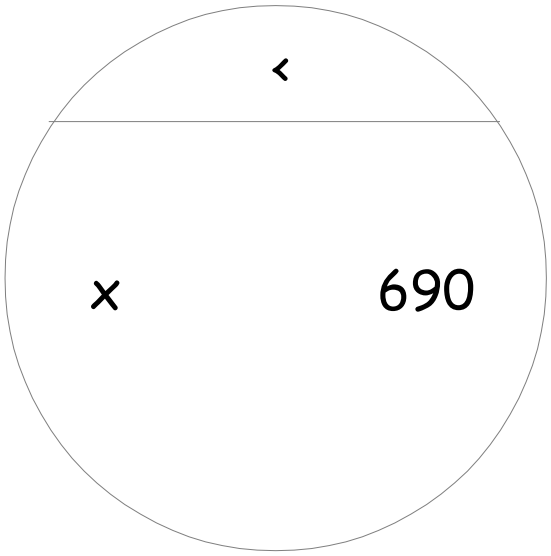
1. A piece of Sam is still visible on the left as long as... (> x -50)

2. A piece of Sam is still visible on the right as long as... (< x 690)

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



x -50



x 690

Design Recipe

Word Problem: safe-left?

Use the Design Recipe to write a function `safe-left?`, which takes an x-coordinate and checks to see if it is greater than -50.

I. Contract+Purpose Statement

Every contract has three parts:

; __safe-left?_____ : _____number_____ -> __boolean_
name Domain Range

; _Takes in the x-coordinate and checks if it's greater than -50_
What does the function do?

II. Give Examples

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

(EXAMPLE (__safe-left? 20_____)
Use the function here

_____(> 20 -50))_____
find another way to get the same result here

(EXAMPLE (___safe-left? -200_____)
Use the function here…

____(> -200 -50))_____
find another way to get the same result here

III. Definition

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

(define (_____safe-left?__ _____x_____)
function name variable names

____(> x -50))_____

Design Recipe

Word Problem: safe-right?

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

I. Contract+Purpose Statement

Every contract has three parts:

; _____safe-right?____ : _____number_____ -> ___boolean___
name Domain Range

; _____takes in the x-coordinate and checks if it is less than 690_____
What does the function do?

II. Give Examples

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

(EXAMPLE (____safe-right? 350_____)
Use the function here

____(< 350 690))_____
find another way to get the same result here

(EXAMPLE (____safe-right? 900_____)
Use the function here…

_____(< 900 690))_____
find another way to get the same result here

III. Definition

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

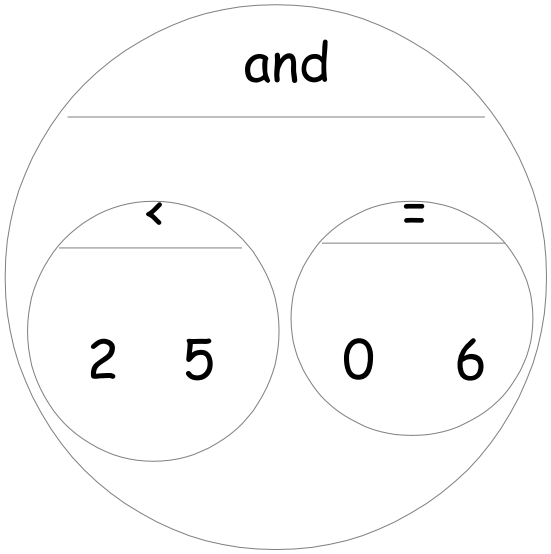
(define (____safe-right?_____ __x__)
function name variable names

___(< x 690))_____

and / or

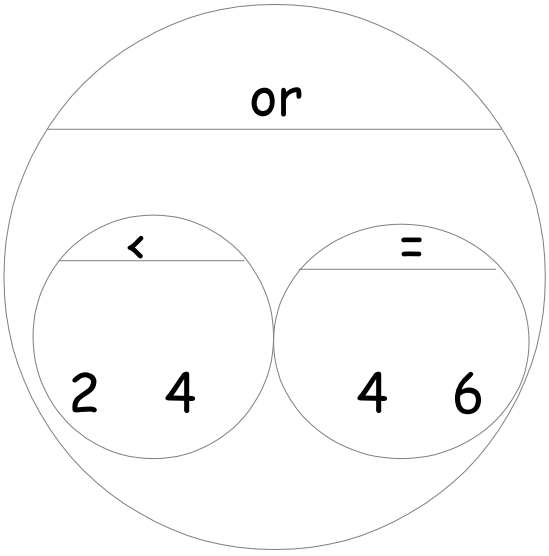
Write the Circles of Evaluation for these statements, and then convert them to Racket

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



(and (< 2 5) (= 0 6))

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



(or (< 2 4) (= 4 6))

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:

; ___onscreen?___ : __number___ -> __boolean__
name Domain Range

; _Takes in the x-coordinate and checks if target is protected on the /left and the right_
What does the function do?

II. Give Examples

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

(EXAMPLE (_____onscreen? 900_____)
Use the function here

_____(and (safe-left? 900) (safe-right? 900)))___
find another way to get the same result here

(EXAMPLE (___onscreen? 355_____)
Use the function here…

____(and (safe-left? 355) (safe-right? 355)))_____
find another way to get the same result here

III. Definition

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

(define (__onscreen?_ _x_____)
function name variable names

____(and (safe-left? x) (safe-right? x)))_____

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

Every contract has three parts:

; __cost__ : __string_____ -> ____number_____

name Domain Range

II. Give Examples

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

(EXAMPLE (___cost "pepperoni"_____) ____10.50_____)

Use the function here What should the function produce?

(EXAMPLE (__cost "cheese"_____) _____9.00_____)

Use the function here What should the function produce?

(EXAMPLE (__cost "chicken"_____) _____11.25_____)

Use the function here What should the function produce?

(EXAMPLE (___cost "broccoli"_____) _____10.25_____)

Use the function here What should the function produce?

III. Definition

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

(define (__cost___ ____topping____)

function name variable names

(cond_____

[(string=? "pepperoni" topping)	**10.50]**
[(string=? "cheese" topping)	**9.00]**
[(string=? "chicken" topping)	**11.25]**
[(string=? "broccoli" topping)	**10.25]**
[else	**100000000]))**

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

Every contract has three parts:

; ___update-player_____ : _____number string_____ -> ___number_____
name Domain Range

II. Give Examples

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

(EXAMPLE (_update-player 40 "up"__) __(+ 40 20)_____)_
Use the function here What should the function produce?

(EXAMPLE (__update-player 400 "down"_) __(- 400 20)_____)_
Use the function here What should the function produce?

III. Definition

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

(define (_update-player__ _playerY key_)
function name variable names

(cond_____

[(string=? "up" key)	**(+ playerY 20)]**
[(string=? "down" key)	**(- playerY 20)]**
[else	**playerY]))**

Lesson 8

DESIGN RECIPE

Word Problem: line-length

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:

; ____line-length_____ : ___number number_____ -> ___number_____
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 that change.

(define (_line-length___ __a b_____)
function name variable names

_(cond_____

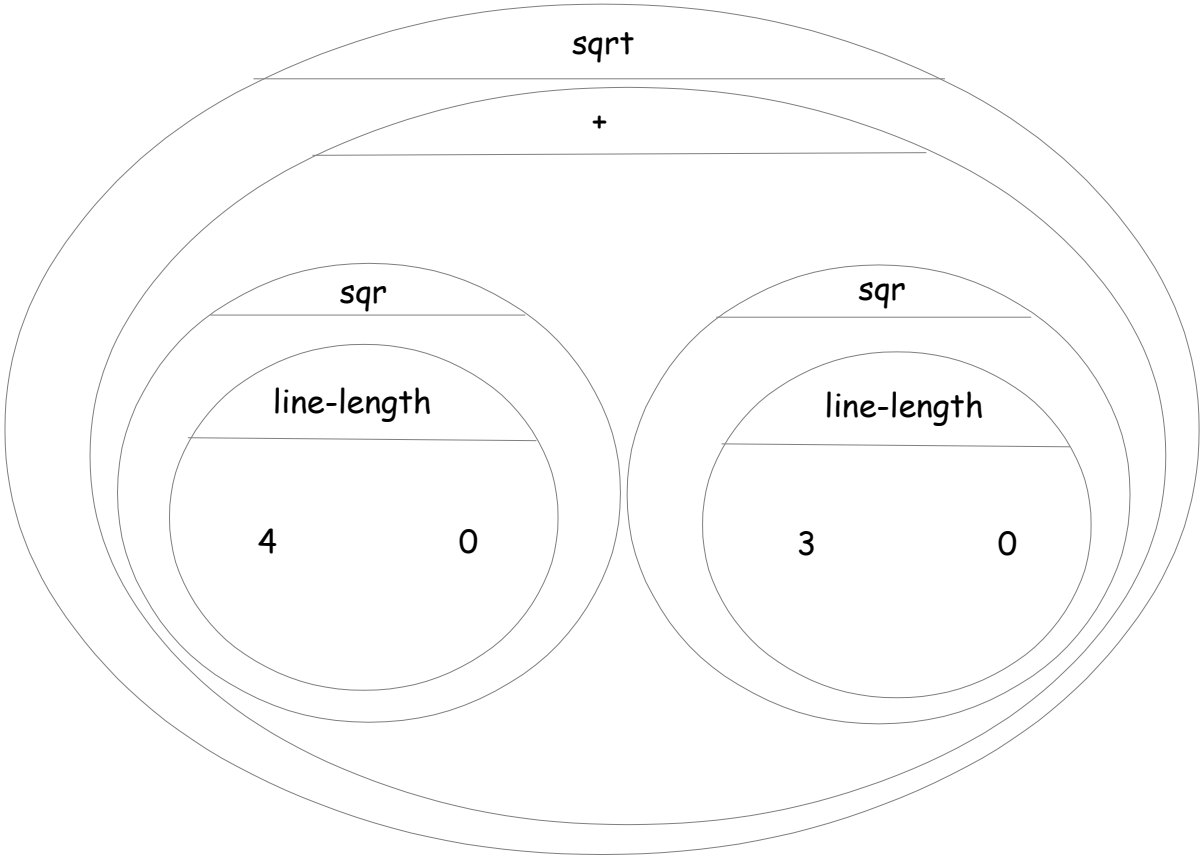
[(> a b)	**(- a b)]**
[else	**(- b a)]))**

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):

```
(sqrt (+   (sqr (line-length 4 0))
           (sqr (line-length 3 0)))))
```

DESIGN RECIPE

Word Problem: distance

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:

- Distance = $((\text{line-length px cx})^2 + (\text{line-length py cy})^2)$

I. Contract+Purpose Statement

; __distance_____ : _____number number number number __ -> __number_____
name Domain Range

;__Takes in player x and player y, character x and character y, and gives distance between them_
What does the function do?

II. Give Examples

(EXAMPLE (__distance 100 200 300 400_____)
Use the function here

(sqrt (+ (sqr (line-length 100 300)) (sqr (line-length 200 400))))__
find another way to get the same result here

(EXAMPLE (___distance 300 200 400 500 _____)
Use the function here…

(sqrt (+ (sqr (line-length 300 400)) (sqr (line-length 200 500))))_
find another way to get the same result here

III. Definition

(define (__distance_____ _px py cx cy_____)
function name variable names

__(sqrt (+ (sqr (line-length px cx)
_____(sqr (line-length py cy))))_____

Design Recipe

Word Problem: collide

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 **75 pixels** of the coordinates of the other character. Otherwise, `false`.

I. Contract+Purpose Statement

; __collide?_____ : ____number number number number_____ -> _true___
name Domain Range

; _Takes player-x, player-y, character-x, character-y and returns true if characters are colliding
What does the function do?

II. Give Examples

(EXAMPLE (__collide? 100 200 300 400_____)
Use the function here

___(< (distance 100 200 300 400) 75))_____
find another way to get the same result here

(EXAMPLE (___collide? 300 500 200 400_____)
Use the function here…

___(< (distance 300 500 200 400) 75))_____
find another way to get the same result here

III. Definition

(define (_collide?___ __px py cx cy_____)
function name variable names

___(< (distance px py cx cy) 75))_____

Lesson 9

Catchy Intro: Feel like you never get enough to eat? So does Leo. Come catch your prey, and escape the zookeeper!

Name, Age, Grade: Jessica Programmer, 12, 7th grade

Game Title: Run for your Supper

Back Story:One day, a young lion was sitting in his cage. He saw an escaped gazelle come running past. It was lunch time, and he was hungry, so he leapt out to catch food. He has to run fast to grab food and escape the evil zookeeper.

Characters: Player: Leo the lion.

Danger: Zoe Zookeeper.

Target: Gary Gazelle

Explain a piece of your code: My update-danger function takes in the current x coordinate of the gazelle, and adds 50 to it. This moves the gazelle 50 pixels to the right.

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

Every contract has three parts:

; ___red-shape___ : _____string_____ -> __image____
name Domain Range

; Given the name of a shape ("circle", "triangle", "star" or "rectangle"), produce a solid red shape
What does the function do?

\

II. Give Examples

On the computer, write an example of your function for each shape, using EXAMPLE. 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 (red-shape "triangle"___) __(triangle 50 "solid" "red"))__
Use the function here What should the function produce?

(EXAMPLE (_red-shape "star"_____) ___(star 50 "solid" "red"))____
Use the function here What should the function produce?

(EXAMPLE (_red-shape "rectangle"___) (rectangle 50 90 "solid" "red"))
Use the function here What should the function produce?

III. Definition

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

(define (_red-shape____ _shape___)
function name variable names

(cond_____

(string=? "circle" shape)	**(circle 50 "solid" "red")**
(string=? "triangle" shape)	**(triangle 50 "solid" "red")**
(string=? "star" shape)	**(star 50 "solid" "red")**
(string=? "square" shape)	**(rectangle 50 50 "solid" "red")**
else	**(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))`	**z = x + y**
`(define age 14)`	**age = 14**
`(define months (* age 12))`	**months = age * 12**
`(define days (* months 30))`	**days = months * 30**
`(define hours (* days 24))`	**hours = days * 24**
`(define minutes (* hours 60))`	**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)))`	**circle-area(radius) = pi * radius^2**

`(define (distance x1 y1 x2 y2)`
`  (sqrt (+ (sqr (- x1 x2))`
`  (sqr (- y1 y2)))))`
	distance(x1, y1, x2, y2)= $\sqrt{(x1-x2)^2+(y1-y2)^2}$

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 : Number -> Number

name Domain Range

; Given the number of seconds, produce the height of the rocket if it moves at 80mi/sec

What does the function do?

II. Give Examples

Write an example of your function for some sample inputs

D(1) = 80 * 1

Use the function here What should the function produce?

D(2) = 80 * 2

Use the function here What should the function produce?

D(3) = 80 * 3

Use the function here What should the function produce?

D(4) = 80 * 4

Use the function here What should the function produce?

III. Definition

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

D(time) = 80 * time

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:

; **time** : **Number** -> **Number**

name | Domain | Range

; Given the distance, produce the time-traveled if it moves at 80mi/sec

What does the function do?

II. Give ExamplesGive Examples

Write an example of your function for some sample inputs

time(0) = 0/80

Use the function here | What should the function produce?

time(10) = 10/80

Use the function here | What should the function produce?

time(80) = 80/80

Use the function here | What should the function produce?

time(190) = 190/80

Use the function here | What should the function produce?

III. Definition

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

time(distance) = distance/80

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:

; **collide** : **Number** -> **Number**

name Domain Range

; Given the distance between a rocket (moving at 80mi/sec) & asteroid (70mi/sec), when will they collide?

What does the function do?

II. Give ExamplesGive Examples

Write an example of your function for some sample inputs

collide(0) = 0/150

Use the function here What should the function produce?

collide(150) = 150/150

Use the function here What should the function produce?

collide(700) = 700/150

Use the function here What should the function produce?

collide(50,000,000) = 50,000,000/150

Use the function here What should the function produce?

III. Definition

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

collide(distance-between) = distance-between/150

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.

=