Contracts

Name	Domain	Range	example
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	
..	..	→	

Contracts

Name	Domain	Range	example
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	
:	..	↑	

Lesson 1

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	

(0,480)   (640,480

NinjaCat!   Score:10

(0,0)   (640,0)

The background is a picture of: sunset

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)

2

Our Videogame

Created by (write your names): ____Jessica and James_____

Our game takes place: _____The Zoo_____

(In 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_____.
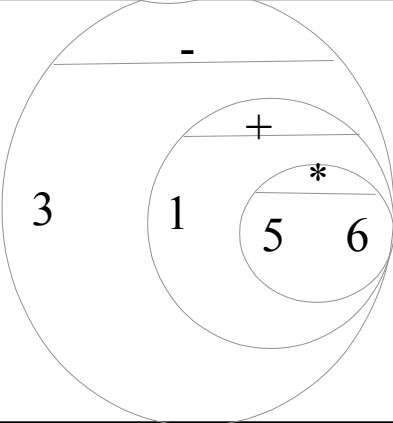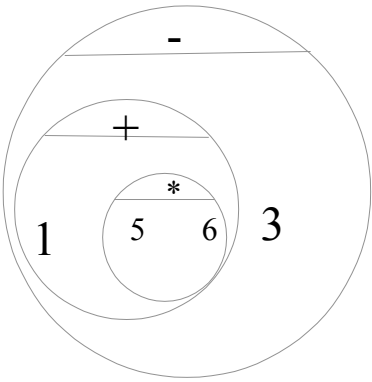
The Danger moves only to the left and right.
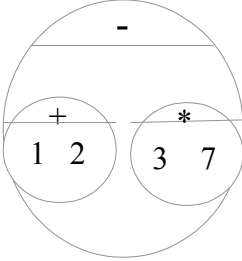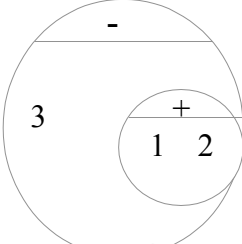
Don't forget to use the computer's symbols for things like multiply and divide!

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

. 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	(1 + 2) - (3 * 7)		(- (+ 1 2) (* 3 7))
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

Fill out two examples for each function, then try to write the contract, Definition and function body by yourself.

; _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 25)   (circle 25 "solid" "blue"))

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

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

; __double__:__number_____-> ___number____

(EXAMPLE (double 13)   (* 2 13))

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

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

; _____:_____ -> _____

(EXAMPLE (_____ _____)   _____)

(EXAMPLE (_____ _____)   _____)

(define (_____ _____)   _____)

Fill out two examples for each function, then try to write the contract, Definition and function body by yourself.

; _____:_____ -> _____

    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.

. 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?

. 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

. 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 <u>red-square,</u> which takes in a number (the size of the square) and outputs a solid red rectangle whose length and width are the same size.

. Contract+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?

. 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

. 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 <u>yard-area</u>, which takes in the width and length of a yard, and returns the area of the yard.

*(Don't forget: area = length * width !)*

.   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?

.   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

.   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 <u>update-danger</u>, which takes in the danger's x-coordinate and produces the next x-coordinate, which is 50 pixels to the left.

. 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?

. 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

. Definition

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

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

　　__(- dangerX 50))_____

Design Recipe

Write a function <u>update-target</u>, which takes in the target's x-coordinate and produces the next x-coordinate, which is 50 pixels to the right.

. 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?

. 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

. Definition

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

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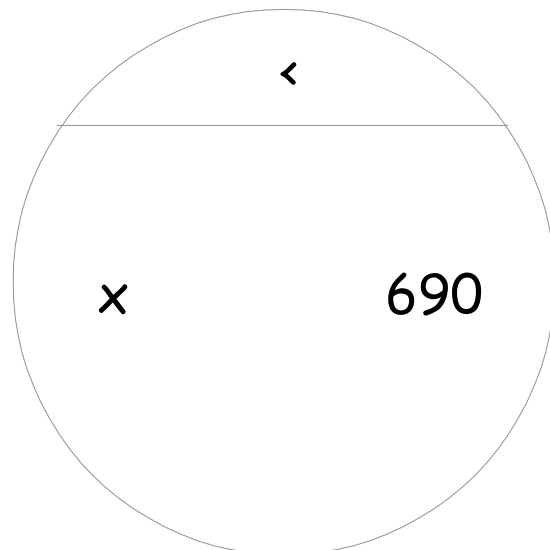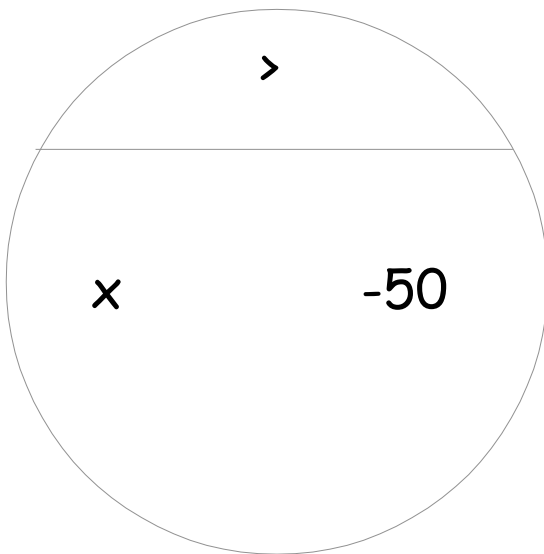   function name   variable names

    ____(+ 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... $(> \text{ x } -50)$

2. A piece of Sam is still visible on the right as long as... $\_(< \text{ x } 690)\_$

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

>

x   -50

<

x   690

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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.

. 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?

. 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

. 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.

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?

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

Definition

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

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

   ___(< x 690))_____
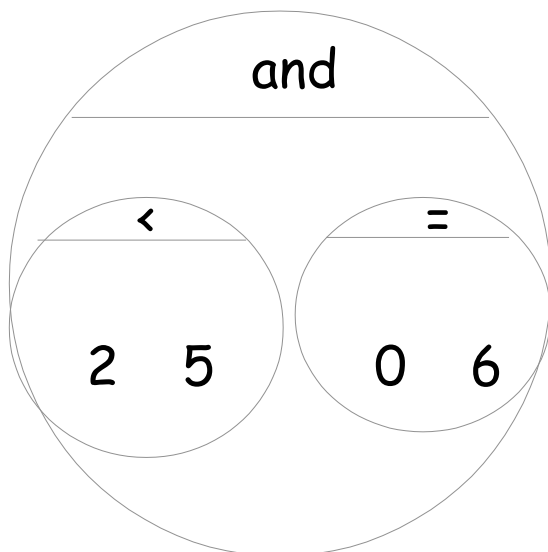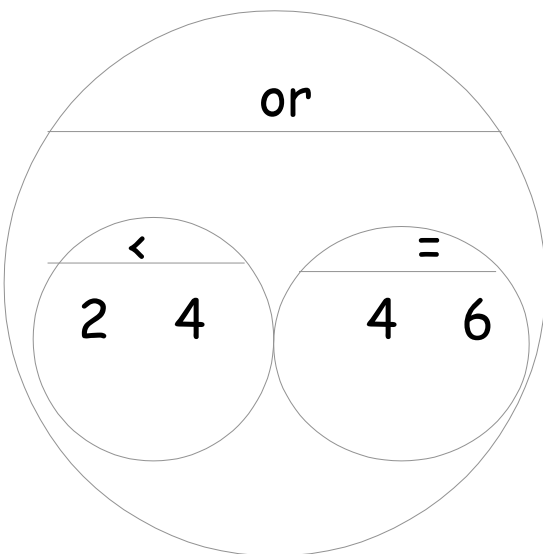   **…..and the computer does this**

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 <u>onscreen?</u>, which takes in an x-coordinate and checks to see if Sam is safe on the left <u>and</u> safe on the right.

. 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?

. 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

. 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.

. Contract+Purpose Statement

Every contract has three parts:

; __cost__ :   __string_____ -> ____number_____
    name   Domain   Range

. Give Examples

On the computer, write an example of your function for <u>each topping</u>, 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?

. 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]))

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Design Recipe

Word Problem: update-player

Write a function called <u>update-player</u>, which takes in the player's y-coordinate and the name of the key pressed, and returns the new y-coordinate.

.   Contract+Purpose Statement

Every contract has three parts:

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

.   Give Examples

On the computer, write an example of your function for <u>each key</u>, 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?

.   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]))

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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.

.   Contract+Purpose Statement

Every contract has three parts:

; ____line-length_____ : ___number number_____ -> ___number_____
       name   Domain   Range

.   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?

.   Definition

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

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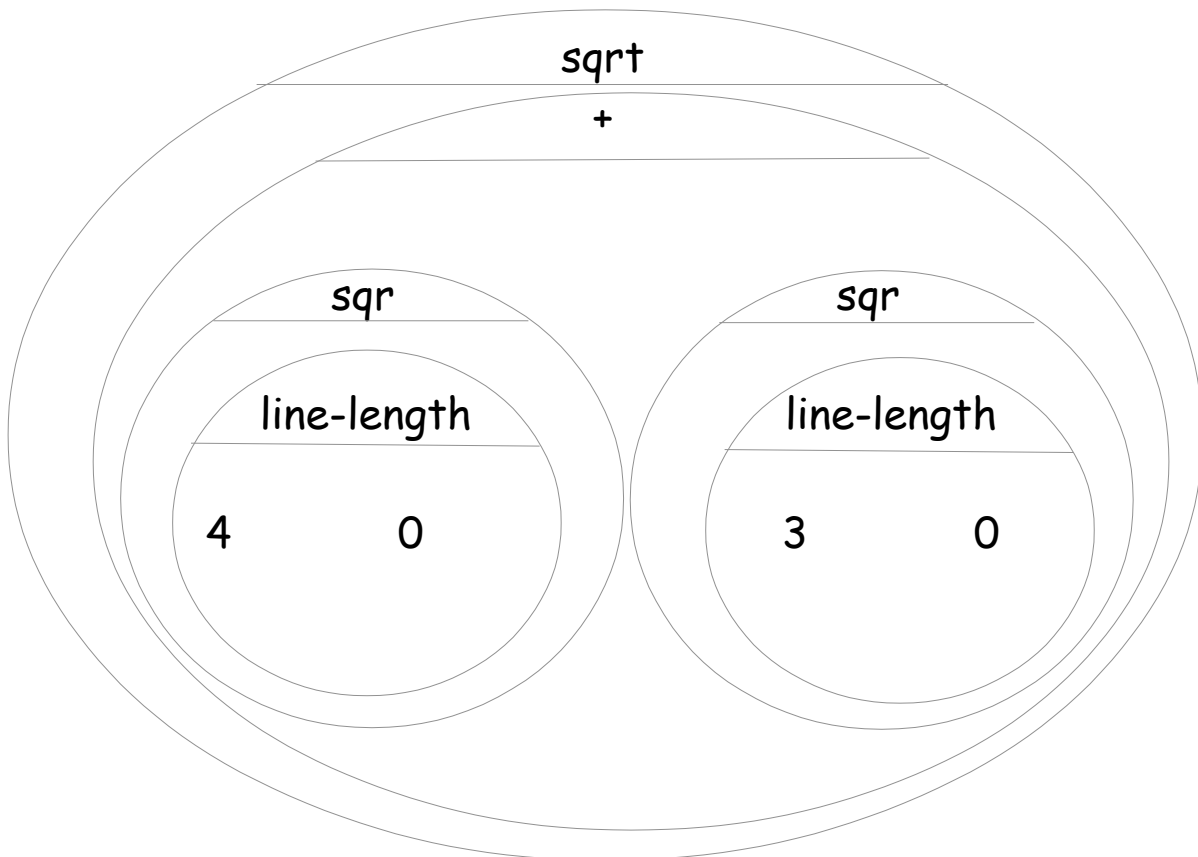
    _(cond_____

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

       [else   (- b a)]))

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

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

Convert it into a Circle of Evaluation:

Convert it into Racket code:

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

Design Recipe

Word Problem: distance

Write a function <u>distance</u>*, 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 = $((\text{line-length px cx})^2 + (\text{line-length py cy})^2)$

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?

Give Examples

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

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

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

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

Definition

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

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

DESIGN RECIPE

Word Problem: collide

Write a function <u>collide?</u>,*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.

. 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?

. 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

. 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.

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 <u>red-shape</u>, 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

. Contract+Purpose Statement

Every contract has three parts:

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

. Give Examples

On the computer, write an example of your function for <u>each shape</u>, using EXAMPLE. The first one has already been done for you.

(EXAMPLE <u>(red-shape   "circle"   )</u> <u>(circle 50 "solid" "red"))</u>
   Use the function here   What should the function produce?

(EXAMPLE <u>(red-shape "triangle"___)</u> __<u>(triangle 50 "solid" "red"))</u>__
   Use the function here   What should the function produce?

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

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

. 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...

Values: Translate the Racket Code into Algebra	
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
Functions: Translate the Racket Code into Algebra	
`(define (double x)` `   (* x 2))`	double(x) = x*2
`(define (area length width)` `   (* length width))`	area(length, width) = length * width
`(define (circle-area radius)` `   (* pi (sq radius)))`	circle-area(radius) = pi * radius^2

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

Design Recipe

Word Problem

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

. Contract+Purpose Statement

Every contract has three parts:

; _____D_____ : ___seconds_____ -> __miles_____
    name   Domain   Range

. Give Examples

Write an example of your function for <u>some sample inputs</u>

_____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(10)_____ = ___**80 * 10**_____
Use the function here   What should the function produce?

. Definition

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

D(t) = 80 * t
_____

Design Recipe

Word Problem

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**_.

. Contract+Purpose Statement

Every contract has three parts:

; __time_____ : _____miles_____ -> __seconds_____
         name   Domain   Range

. Give Examples

Write an example of your function for some sample inputs

time(1)   =   **1/80**
Use the function here   What should the function produce?

time(0)   =   **0/80**
Use the function here   What should the function produce?

time(3)   =   **3/80**
Use the function here   What should the function produce?

time(10)   =   **10/80**
Use the function here   What should the function produce?

. Definition

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

time(d)   **= d / 80**

Design Recipe

Word Problem

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?

. Contract+Purpose Statement

Every contract has three parts:

; __collide_____ : ___distance_____ -> _time_____

     name   Domain   Range

. Give Examples

Write an example of your function for <u>some sample inputs</u>

collide(0)   =   **0/150**

Use the function here   What should the function produce?

collide(300)   =   **300/150**

Use the function here   What should the function produce?

collide(5000)   =   **5000/150**

Use the function here   What should the function produce?

collide(100000) =   **100000/150**

Use the function here   What should the function produce?

. Definition

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

collide(d)   **= d/150**