Contracts

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

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	

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)

Our Videogame

Created by (write your names): ___Jessica and James_____

███

Our game takes place in: ___The Zoo_____

(space? the desert? a mall?)

███

The player is a ___Lion_____.

The player moves only up and down.

███

Your player GAINS points when they hit the target.

The Target is a ___Escaped gazelle_____.
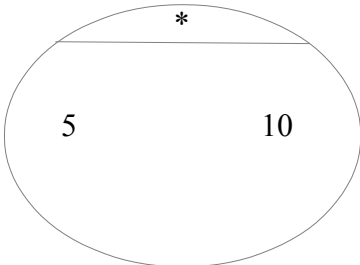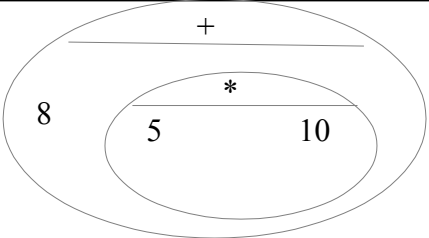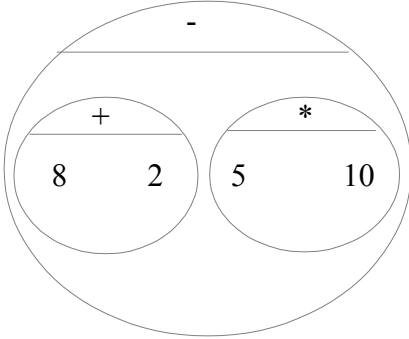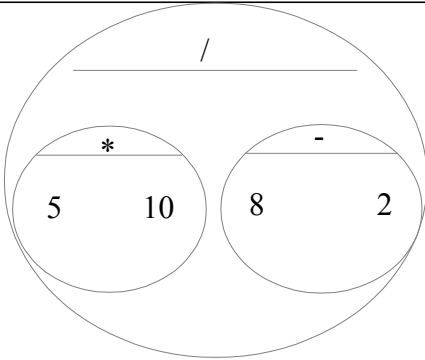
The Target moves only to the left and right.
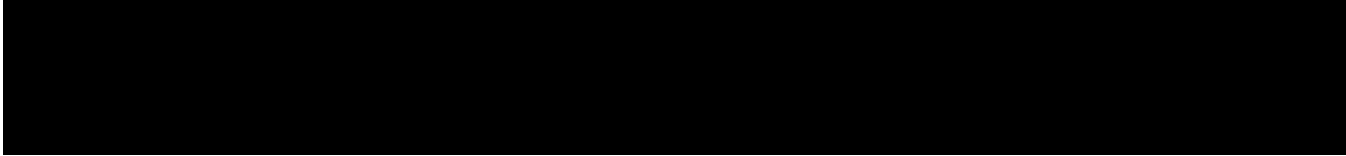
███

Your player LOSES points when they hit the danger.
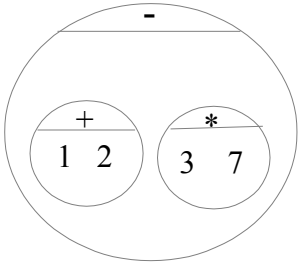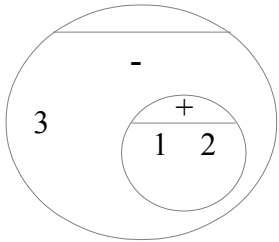
The Danger is a ___Zookeeper_____.
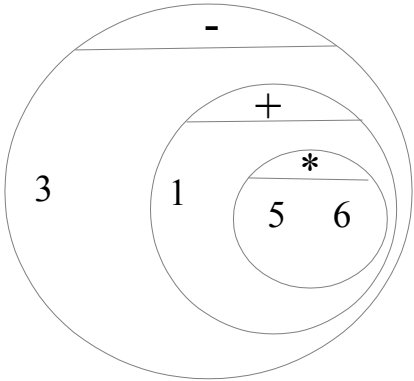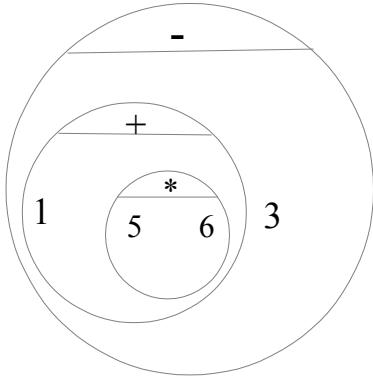
The Danger moves only to the left and right.

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

Math	Circle of Evaluation	Racket Code
5 x 10	(* over circle with 5 and 10)	(* 5 10)
8 + (5 x 10)	(+ over circle containing 8 and inner circle with * over 5 and 10)	(+ 8 (* 5 10))
(8 + 2) - (5 x 10)	(- over circle containing two circles: + over 8 and 2, and * over 5 and 10)	(- (+ 8 2) (* 5 10))
$\frac{5 \times 10}{8 - 2}$	(/ over circle containing two circles: * over 5 and 10, and - over 8 and 2)	(/ (* 5 10) (- 8 2))

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

	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)

; _____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 (_____ _____) _____)

; _____:_____ -> _____
          name   domain   range

(EXAMPLE (_____ _____)   _____)

(EXAMPLE (_____ _____)   _____)

(define   (_____ _____)   _____)

; _____:_____ -> _____
          name   domain   range

(EXAMPLE (_____ _____)   _____)

(EXAMPLE (_____ _____)   _____)

(define   (_____ _____)   _____)

; _____:_____ -> _____
          name   domain   range

(EXAMPLE (_____ _____)   _____)

(EXAMPLE (_____ _____)   _____)

(define   (_____ _____)   _____)

; _____:_____ -> _____
          name   domain   range

(EXAMPLE (_____ _____)   _____)

(EXAMPLE (_____ _____)   _____)

(define   (_____ _____)   _____)

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.

███████████████████████████

Every contract has three parts:

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

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

███████████████████████████

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

███████████████████████████

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

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

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.

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?

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

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

(define (_red-square_____   __size_____)
              function name   variable names

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

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 !)*

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?

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

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

(define (_yard-area_____   __length width_____)

        function name   variable names

___(* length width))_____

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.

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?

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

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

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

__(- dangerX 50))_____

Word Problem: update-target

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.

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?

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

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

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

      ____(+ targetX 50))_____

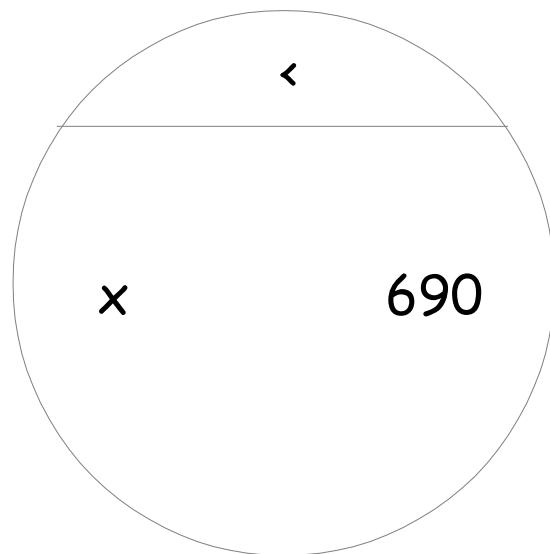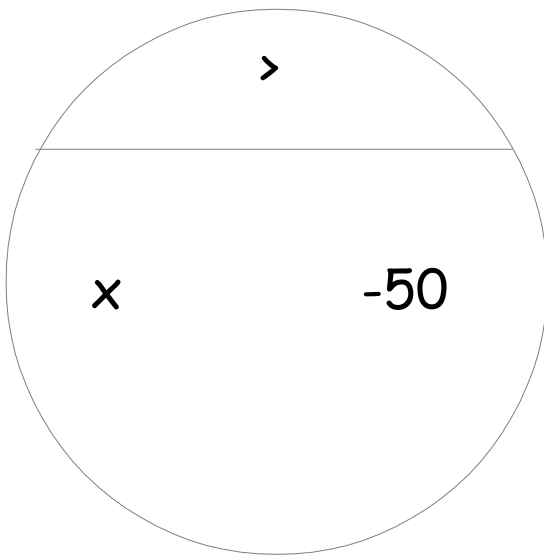Sam is in a 640 x 480 yard.   How far he can go to the left and right before he's out of sight?

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

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

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

>

x   -50

<

x   690

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.

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?

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

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

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

    ____(> x -50))_____

Word Problem: safe-right?

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

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?

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))_____
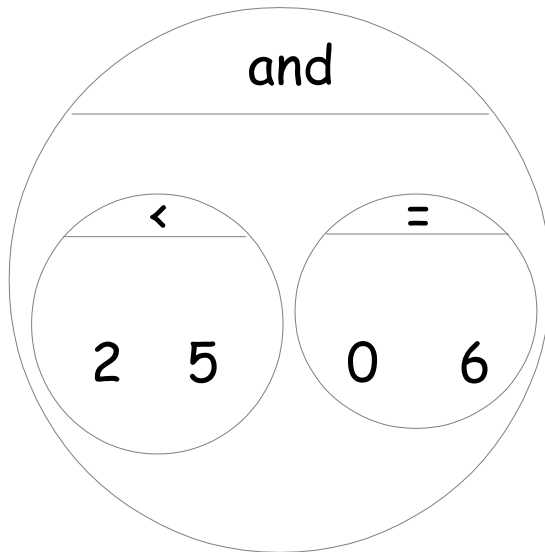   find another way to get the same result here

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

(define (____safe-right?_____   __x__)
            function name   variable names
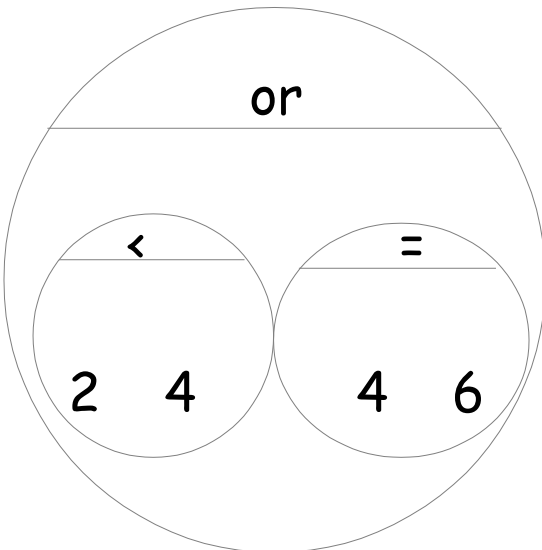   ___(< x 690))_____

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))

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.

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?

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

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)))_____

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.

Every contract has three parts:

; __cost__ :   __string_____ -> ____number_____
    name   Domain   Range

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?

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]))

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.

Every contract has three parts:

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

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?

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]))

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.

Every contract has three parts:

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

(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?

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

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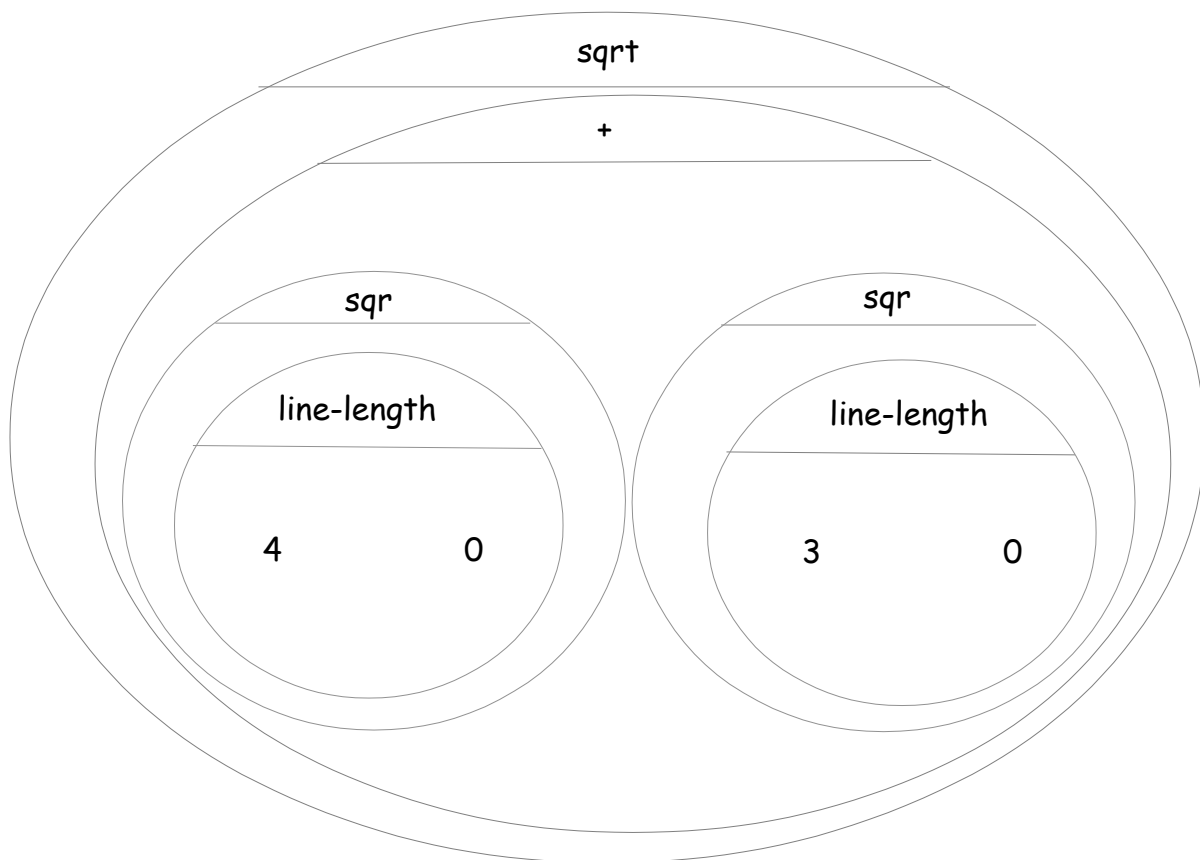   function name   variable names

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

sqrt

+

sqr

line-length

4   0

sqr

line-length

3   0

Convert the Circle of Evaluation into Racket code:

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

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

; __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?

(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...
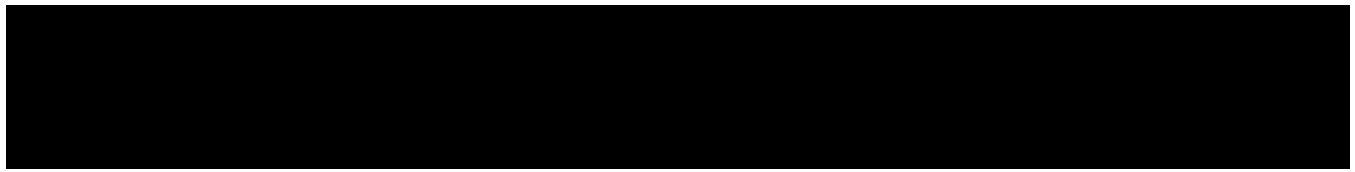
(sqrt (+ (sq (line-length 300 400)) (sq (line-length 200 500)))))_

find another way to get the same result here

(define (__distance_____   _px py cx cy_____)

function name   variable names

___(sqrt (+ (sq (line-length px cx)

(sq (line-length py cy))))_____

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.

; __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?

(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

(define (_collide?___   __px py cx cy_____)
            function name   variable names
     ___(< (distance px py cx cy) 75))_____

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.
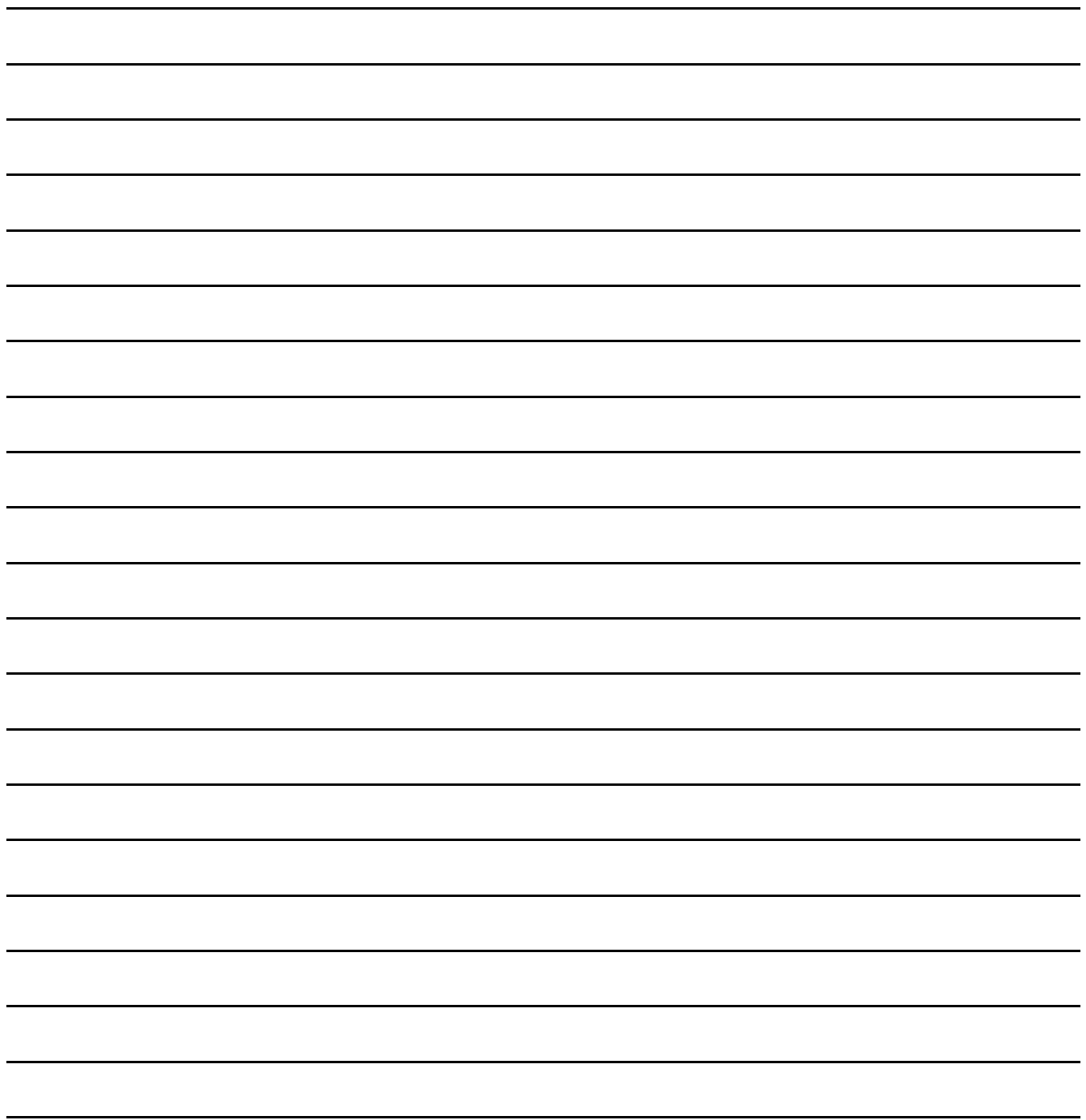
For each question, circle the answer that fits best.

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!

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

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

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?

\

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

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 Value Definitions from Code to 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

Translating Function Definitions from Code to Algebra

Racket Code	Algebra
`(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)= $\sqrt{(x1-x2)^2+(y1-y2)^2}$

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.

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?

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?

$D(4) = 80 * 4$

Use the function here   What should the function produce?

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

$D(\text{time}) = 80 * \text{time}$

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_**.

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?

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

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?

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

time(distance)　　=　　distance/80

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?

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?

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(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?

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

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

██

Every contract has three parts:

; _____ **:** _____ **->** _____
      name   Domain   Range

; _____
                             What does the function do?

██

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?

██

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

_____ **=** _____