

Contracts

[illegible]

Contracts

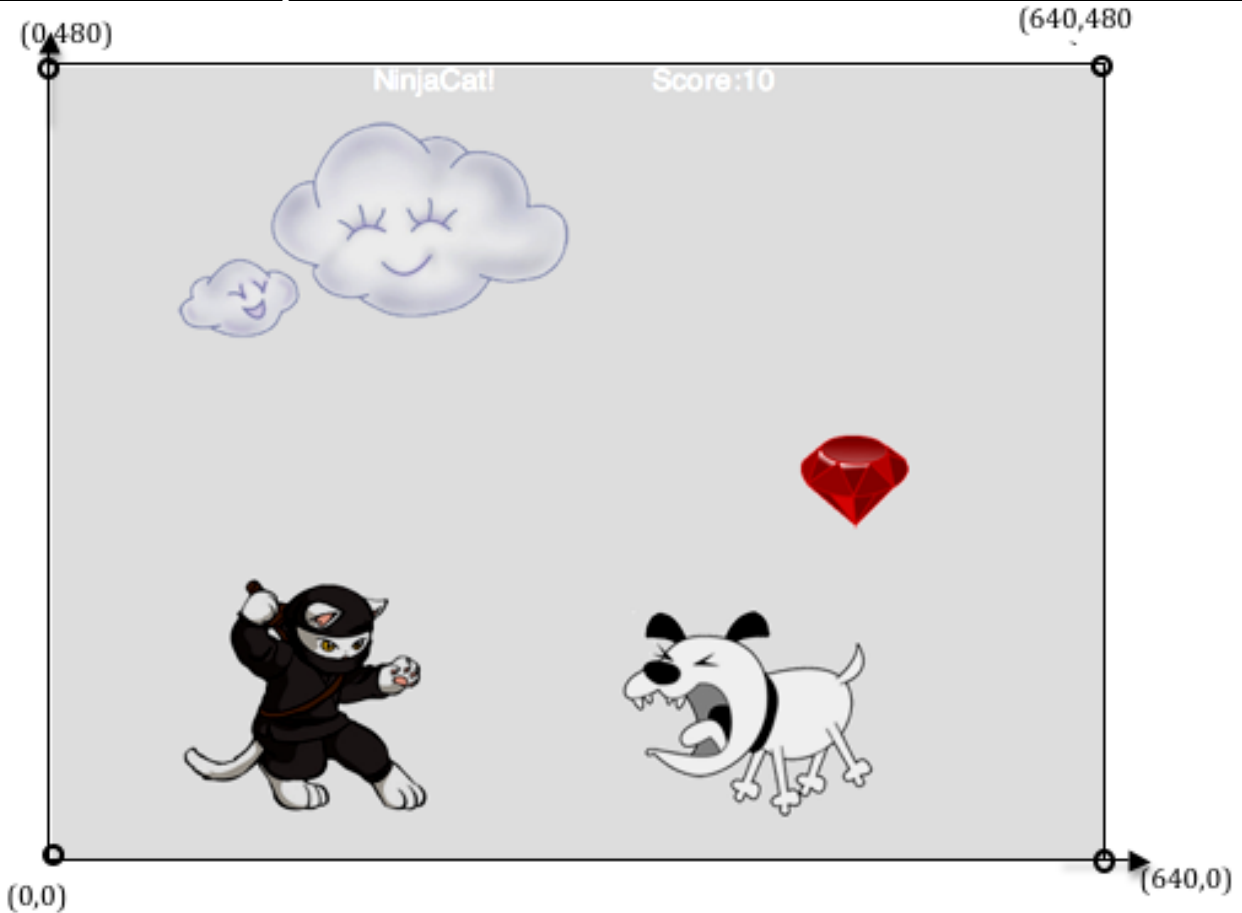
[illegible]

Lesson 1

Reverse-Engineering: How does NinjaCat work?

[illegible]

Game Parts - NinjaCat!



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** ____

Background

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.

Circle of Evaluation Practice!

Time: 5 minutes

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

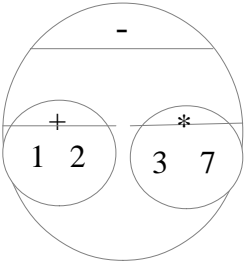
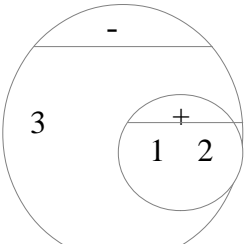
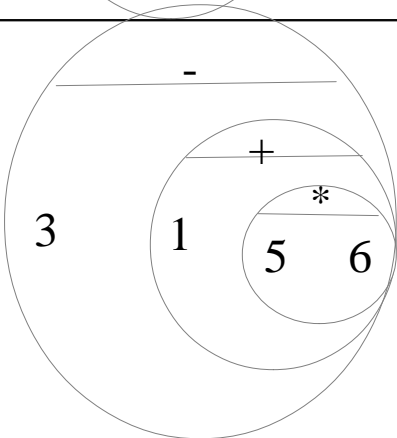
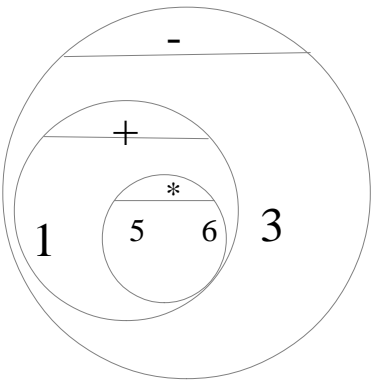
| <i>Math</i> | <i>Circle of Evaluation</i> | <i>Racket Code</i> |
|-----------------------------|-----------------------------|--------------------|
| 5×10 | | |
| $8 + (5 \times 10)$ | | |
| $(8 + 2) - (5 \times 10)$ | | |
| $\frac{5 \times 10}{8 - 2}$ | | |

I. 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

[illegible]



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 25) (circle 25 "solid" "blue"))

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

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

; double : number -> number

name

domain

range

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

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

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

; _____ : _____ -> _____

name

domain

range

(EXAMPLE (_____) _____)

(EXAMPLE (_____) _____)

(define (_____) _____)

Fast Functions!



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 (_____ _____) _____)

; _____ : _____ -> _____

(EXAMPLE (_____ _____) _____)

(EXAMPLE (_____ _____) _____)

(define (_____ _____) _____)

; _____ : _____ -> _____

(EXAMPLE (_____ _____) _____)

(EXAMPLE (_____ _____) _____)

(define (_____ _____) _____)

Lesson 4

[illegible]

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.

II. 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?

III. 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

IV. Function

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

```
(define (rocket-height __time__)  
  _____(* 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: $\text{area} = \text{length} * \text{width} !$)

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

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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

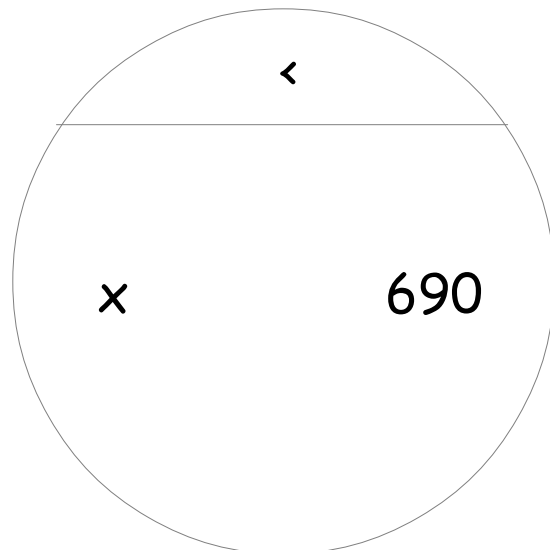
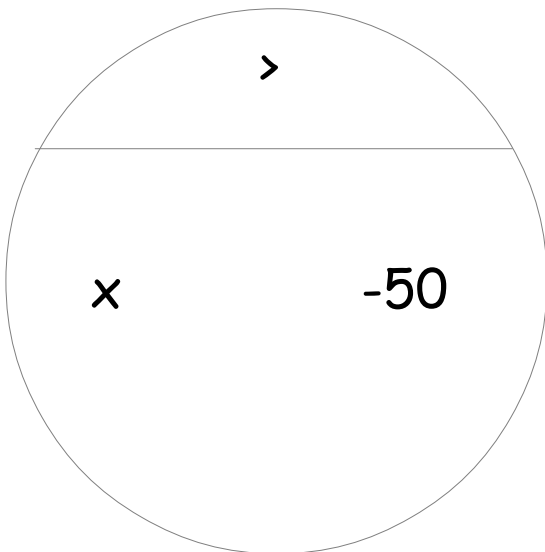
Protecting Sam

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:



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...

____($\geq -200 - 50$))_____

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)

_____ ($\times -50$))_____

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

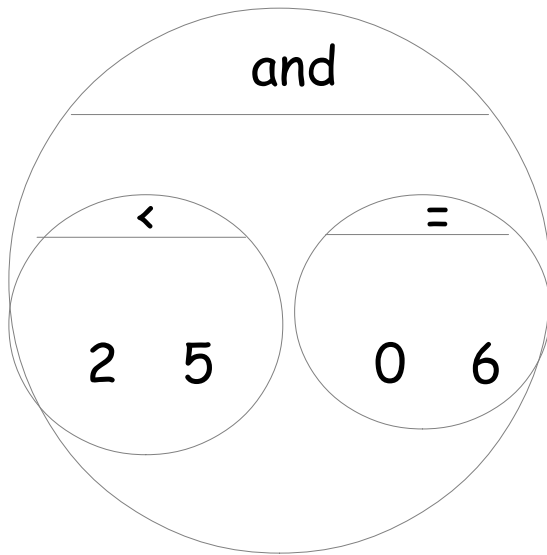
(< x 690))

.....and the computer does this

and / or

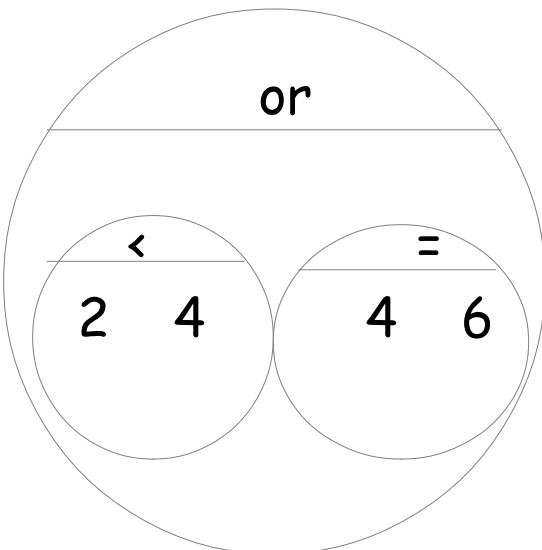
Write the Circles of Evaluation for these statements, and then convert them to Racket

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



(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

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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:

| | | |
|------------------------|------------------|---------------|
| ; <u>cost</u> : | <u>string</u> -> | <u>number</u> |
| 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_____

| | |
|--|-----------------------------|
| <code>[(string=? "pepperoni" topping)</code> | <code>10.50]</code> |
| <code>[(string=? "cheese" topping)</code> | <code>9.00]</code> |
| <code>[(string=? "chicken" topping)</code> | <code>11.25]</code> |
| <code>[(string=? "broccoli" topping)</code> | <code>10.25]</code> |
| <code>[else</code> | <code>1000000000])))</code> |

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

[illegible]

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

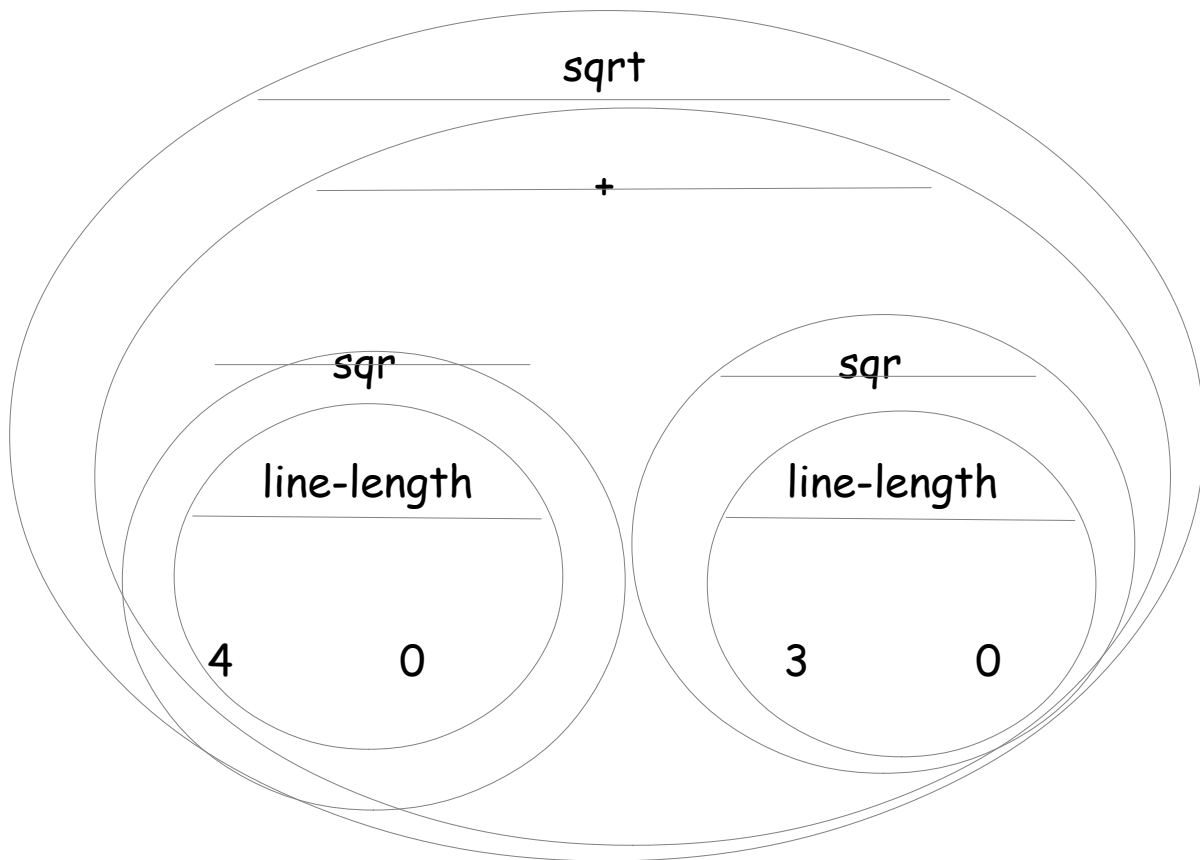
(- b a)))]

The Distance Formula, with Numbers

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

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

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



Convert the Circle of Evaluation into Racket code:

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

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

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 (+ (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

III. 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 `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

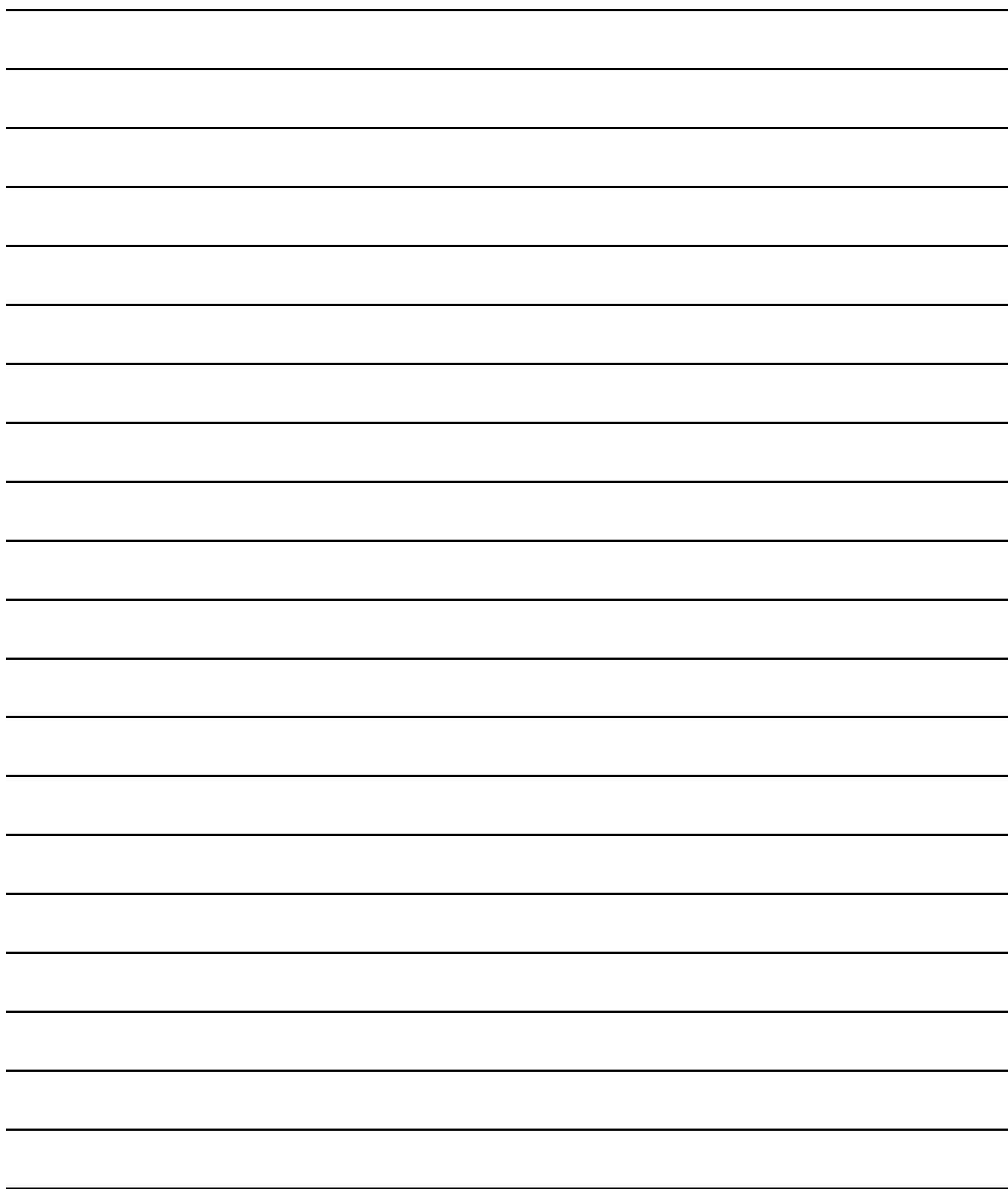
Back Story: One day, a young lion was sitting in his cage. He saw an escaped gazelle come
running past. It was lunch time, and he was hungry, so he leapt out to catch food. He has
to run fast to grab food and escape the evil zookeeper.

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

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

| Values: Translate the Racket Code into Algebra | |
|--|---|
| Racket Code | Algebra |
| <code>(define x 10)</code> | $x = 10$ |
| <code>(define y (* x 2))</code> | $y = x * 2$ |
| <code>(define z (+ x y))</code> | $z = x + y$ |
| <code>(define age 14)</code> | $age = 14$ |
| <code>(define months (* age 12))</code> | $months = age * 12$ |
| <code>(define days (* months 30))</code> | $days = months * 30$ |
| <code>(define hours (* days 24))</code> | $hours = days * 24$ |
| <code>(define minutes (* hours 60))</code> | $minutes = hours * 60$ |
| Functions: Translate the Racket Code into Algebra | |
| <code>(define (double x) (* x 2))</code> | $double(x) = x * 2$ |
| <code>(define (area length width) (* length width))</code> | $area(length, width) = length * width$ |
| <code>(define (circle-area radius) (* pi (sq radius)))</code> | $circle-area(radius) = pi * radius^2$ |
| <code>(define (distance x1 y1 x2 y2) (sqrt (+ (sq (- x1 x2)) (sq (- y1 y2)))))</code> | $distance(x1, y1, x2, y2) = \sqrt{(x1 - x2)^2 + (y1 - y2)^2}$ |

Word Problem

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 : seconds -> miles
name Domain Range

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

III. Definition

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

D(t) = 80 * t

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.

I. Contract+Purpose Statement

Every contract has three parts:

; time : miles -> seconds
name Domain Range

II. 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?

III. Definition

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

time(d) = d/80

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?

I. Contract+Purpose Statement

Every contract has three parts:

; collide : distance -> time
name Domain Range

II. Give 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(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?

III. Definition

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

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

Word Problem

I. Contract+Purpose Statement

Every contract has three parts:

; _____ : _____ -> _____
name Domain Range

II. Give Examples

Write an example of your function for some sample inputs

Use the function here What should the function produce?

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