## Contracts

<table>
<thead>
<tr>
<th>Domain</th>
<th>Name</th>
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<tr>
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<th>example</th>
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</tbody>
</table>
Lesson 1

Reverse-Engineering: How does NinjaCat work?

<table>
<thead>
<tr>
<th>Thing in the game...</th>
<th>What changes about it?</th>
<th>More specifically...</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cloud</code></td>
<td><code>position</code></td>
<td><code>x-coordinate</code></td>
</tr>
</tbody>
</table>

...
The coordinates for the PLAYER (NinjaCat) are: 
\[( , )\]

The coordinates for the DANGER (Dog) are: 
\[( , )\]

The coordinates for the TARGET (Ruby) are: 
\[( , )\]
Our Videogame

Created by (write your names): ________________________________

Background

Our game takes place: ____________________________
(In space? The desert? A mall?)

The Player

The player is a ________________________________.

The player moves only up and down.

The Target

Your player GAINS points when they hit the target.

The Target is a ________________________________.

The Target moves only to the left and right.

The Danger

Your player LOSES points when they hit the danger.

The Danger is a ________________________________.

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

<table>
<thead>
<tr>
<th>Math</th>
<th>Circle of Evaluation</th>
<th>Racket Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5 \times 10$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$8 + (5 \times 10)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$(8 + 2) - (5 \times 10)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\frac{5 \times 10}{8} - 2$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lesson 2

(draw Circles of Evaluation here if you need extra scratch paper)
<table>
<thead>
<tr>
<th>Rounds</th>
<th>Math</th>
<th>Circle of Evaluation</th>
<th>Racket Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1</td>
<td>((3 \times 7) - (1 + 2))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round 2</td>
<td>(3 - (1 + 2))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round 3</td>
<td>(3 - (1 + (5 \times 6)))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round 4</td>
<td>((1 + (5 \times 6)) - 3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fast Functions!

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

<table>
<thead>
<tr>
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Fill out two examples for each function, then try to write the contract, examples, and definition by yourself.

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Word Problem: rocket-height

A rocket blasts off, traveling at 7 meters per second. Write a function called “rocket-height” that takes in the number of seconds that have passed since the rocket took off, and which produces the height of the rocket at that time.

I. Contract+Purpose Statement
Every contract has three parts:

; _______________________________ : ___________________________ - > ___________________
    name                               Domain                        Range

; _______________________________________________________________________________________
    What does the function do?

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

(EXAMPLE  ____________________________________________)
    the user types...
    ___________________________________________________

    .....which should become ........................................

(EXAMPLE  ____________________________________________)
    the user types...
    ___________________________________________________

    .....which should become ........................................

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

(define (__________________________  ______________________)
    function name                          variable names

    ______________________________________________________)

    .....and the computer does this
Word Problem: red-square

Use the Design Recipe to write a function red-square, which takes in a number (the size of the square) and outputs a solid red rectangle whose length and width are the same size.

I. Contract+Purpose Statement

Every contract has three parts:

; __________________________________________ ; ; ___________ : ___________________________ -> _________

Name   Domain  Range

; __________________________________________

What does the function do?

II. Give Examples

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

(EXAMPLE ____________________________)

the user says...

___________________________________________)

.....Racket replies

(EXAMPLE ____________________________)

the user says...

___________________________________________)

.....Racket turns that into

III. Definition

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

(define (__________________ ____________________)

function name  variable names

___________________________________________)

.....and the computer does this
Design Recipe

Word Problem: yard-area

Use the Design Recipe to write a function `yard-area`, which takes in the width and length of a yard, and returns the area of the yard.

\[(\text{Don't forget: } \text{area} = \text{length} \times \text{width})\]

I. Contract+Purpose Statement

Every contract has three parts:

\[
\begin{align*}
; & \quad \text{name} : \quad \text{Domain} \quad \rightarrow \quad \text{Range} \\
; & \quad \text{What does the function do?}
\end{align*}
\]

II. Give Examples

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

(EXAMPLE (___________________________________________)

Use the function here

________________________________________________)

find another way to get the same result here

(EXAMPLE (___________________________________________)

Use the function here...

________________________________________________)

find another way to get the same result here

III. Definition

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

(define (__________________________)

function name \quad variable names

________________________________________________)

…..and the computer does this
Design Recipe

Word Problem: update-danger

Use the Design Recipe to write a function \texttt{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:

\begin{verbatim}
; name : Domain --> Range

; What does the function do?
\end{verbatim}

II. Give Examples

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

(EXAMPLE (___________________________________________)

Use the function here

___________________________________________

find another way to get the same result here


(EXAMPLE (___________________________________________)

Use the function here...

___________________________________________

find another way to get the same result here

III. Definition

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

(define (____________________  ______________________)

function name variable names

___________________________________________

.....and the computer does this

15
Design Recipe: update-target

Word Problem: update-target

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

I. Contract+Purpose Statement
Every contract has three parts:

; __________________________
| name                      |
|_________________________
| Domain                   |
|_________________________|
| ->                       |
|_________________________|
| Range                    |
|_________________________
; __________________________
| What does the function do? |

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

(EXAMPLE (___________________________________________)

Use the function here

_________________________________________________

find another way to get the same result here

(EXAMPLE (___________________________________________)

Use the function here...

_________________________________________________

find another way to get the same result here

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

(define (__________________________)

function name variable names

_________________________________________________

.....and the computer does this
Lesson 6

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…

3. Draw the Circle of Evaluation for these two expressions in the circles below:
Word Problem: safe-left?

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

I. Contract+Purpose Statement

Every contract has three parts:

; ___________________ : ___________________ -> ___________________

name Domain Range

; ___________________

What does the function do?

II. Give Examples

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

(EXAMPLE (___________________________________________)

Use the function here

_________________________________________________)  

find another way to get the same result here

(EXAMPLE (___________________________________________)

Use the function here...

_________________________________________________)  

find another way to get the same result here

III. Definition

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

(define (_________________ ___________________)

function name variable names

________________________________________________)  

...and the computer does this
Design Recipe

Word Problem: safe-right?

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

I. Contract+Purpose Statement
Every contract has three parts:

; name : Domain -> Range
; ____________________________

What does the function do?

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

(EXAMPLE (____________________________)

Use the function here

______________________________________________)

find another way to get the same result here

_____________________________________________________________________

(EXAMPLE (____________________________)

Use the function here...

______________________________________________)

find another way to get the same result here

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

(define (__________________________

function name variable names

______________________________________________)

...and the computer does this
Write the Circles of Evaluation for these statements, and then convert them to Racket

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

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

Word Problem: onscreen?

Use the Design Recipe to write a function onscreen?, which takes in the target's x-coordinate and checks to see if Sam is protected on the left and protected on the right.

I. Contract+Purpose Statement
Every contract has three parts:

; ___________________________ : ___________________________ --> _______
  name                   Domain                       Range

; ___________________________
What does the function do?

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

(EXAMPLE (__________________________)
  Use the function here

___________________________)
  find another way to get the same result here

(EXAMPLE (__________________________)
  Use the function here...

___________________________)
  find another way to get the same result here

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

(define (__________________________)
  function name                  variable names

________________________________________________________________________)
...and the computer does this
**Design Recipe**

*Word Problem: cost*

Luigi’s Pizza has hired you as a programmer. They offer Pepperoni ($10.50), Cheese ($9.00), Chicken ($11.25) and Broccoli ($10.25). Write a function called *cost* which takes in the name of a topping and outputs the cost of a pizza with that topping.

**I. Contract+Purpose Statement**

; ____________ : ______________________________ -> ___________

  name Domain Range

**II. Give Examples**

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

(EXAMPLE (cost "pepperoni") ________________)  
Use the function here

What should the function produce?

(EXAMPLE ________________)  ________________)
Use the function here

What should the function produce?

(EXAMPLE ________________)  ________________)
Use the function here

What should the function produce?

(EXAMPLE ________________)  ________________)
Use the function here

What should the function produce?

**III. Definition**

(define (_________ ___________ ____________)

  function name variable names)

__________________________________________

__________________________________________

__________________________________________

__________________________________________

__________________________________________

)
Design Recipe

*Word Problem: update-player*

Write a function called `update-player`, which takes in the player’s y-coordinate and the name of the key pressed, and returns the new y-coordinate.

I. **Contract+Purpose Statement**

; : ---------------  --> 
  name Domain Range

II. **Give Examples**

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

(EXAMPLE (update-player 128 “up”) ___________________________) Use the function here What should the function produce?

(EXAMPLE (update-player 451 “down”) ___________________________) Use the function here What should the function produce?

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

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

III. **Definition**

(define (__________________________)

  function name variable names

  ________________________________

  ________________________________

  ________________________________

  ________________________________

  ________________________________

)
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:

; ________________ : _____________________________ -> ________________

name: Domain -> Range

II. Give Examples

(EXAMPLE (line-length 10 5)) (- 10 5) Use the function here

What should the function produce?

(EXAMPLE (line-length 2 8)) (- 8 2) Use the function here

What should the function produce?

III. Definition

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

(define (____________     ___________________)________________________)

function name variable names

...and the computer does this
The Distance Formula, with Numbers

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

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

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

\[\text{Circle of Evaluation} \]

Convert the Circle of Evaluation into Racket code:
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. (HINT: look at what you did on page 27!)

I. Contract+Purpose Statement

; ___________________ : ___________________ -> ____________
    name                  Domain          Range

; _______________________________________________________________________
    What does the function do?

II. Give Examples

(EXAMPLE (___________________________________________)
    Use the function here

    _____________________________________________________________)
    find another way to get the same result here

(EXAMPLE (___________________________________________)
    Use the function here...

    _____________________________________________________________)
    find another way to get the same result here

III. Definition

(define (_________________ ___________________)
    function name                  variable names

                                                                                       )
**DESIGN RECIPE**

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

I. **Contract+Purpose Statement**

; : : ->

name Domain Range

; ____________________________________________

What does the function do?

II. **Give Examples**

(EXAMPLE (___________________________________________)

Use the function here

___________________________________________)

find another way to get the same result here

-On the other hand (EXAMPLE (___________________________________________)

Use the function here...

___________________________________________)

find another way to get the same result here

III. **Definition**

(define (________________________)

function name ____________________________

variable names

___________________________________________)
Lesson 9

Catchy Intro:

Name, Age, Grade:

Game Title:

Back Story:

Characters:

Explain a piece of your code:
<table>
<thead>
<tr>
<th>Question</th>
<th>No way!</th>
<th>A little.</th>
<th>Definitely!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the introduction catchy?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did they talk about their characters?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did they explain the code well?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did they speak slowly enough?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did they speak loudly enough?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were they standing confidently?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did they make eye contact?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Question</td>
<td>No way!</td>
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<td>Did they speak loudly enough?</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Were they standing confidently?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Did they make eye contact?</td>
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</tbody>
</table>
Design Recipe

Word Problem: red-shape

Write a function called red-shape, which takes in the name of a shape ("circle", "triangle", "star" or "rectangle"), and draws that shape. All shapes should be solid and red, and can be whatever size you choose.

I. Contract+Purpose Statement

; ____________ : ________________________________ -> ____________
  name                      Domain                        Range

II. Give Examples

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

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

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

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

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

III. Definition

(define (____________  ________________ )
  function name  variable names

  (cond
   ____________________________________________
   (circle 50 "solid" "red")
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
   ____________________________________________
  )
## Translating into Algebra...

### Values: Translate the Racket Code into Algebra

<table>
<thead>
<tr>
<th>Racket Code</th>
<th>Algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>(define x 10)</code></td>
<td>( x = 10 )</td>
</tr>
<tr>
<td><code>(define y (* x 2))</code></td>
<td>( y = x^2 )</td>
</tr>
<tr>
<td><code>(define z (+ x y))</code></td>
<td></td>
</tr>
<tr>
<td><code>(define age 14)</code></td>
<td></td>
</tr>
<tr>
<td><code>(define months (* age 12))</code></td>
<td></td>
</tr>
<tr>
<td><code>(define days (* months 30))</code></td>
<td></td>
</tr>
<tr>
<td><code>(define hours (* days 24))</code></td>
<td></td>
</tr>
<tr>
<td><code>(define minutes (* hours 60))</code></td>
<td></td>
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### Functions: Translate the Racket Code into Algebra

<table>
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<tr>
<td><code>(define (double x) (* x 2))</code></td>
<td>( \text{double}(x) = x^2 )</td>
</tr>
<tr>
<td><code>(define (area length width) (* length width))</code></td>
<td>( \text{area}(\text{length}, \text{width}) = \text{length} \times \text{width} )</td>
</tr>
<tr>
<td><code>(define (circle-area radius) (* pi (sq radius)))</code></td>
<td>( \text{circle-area}(\text{radius}) = \pi \times (\text{sq}(\text{radius})) )</td>
</tr>
<tr>
<td><code>(define (distance x1 y1 x2 y2) (sqrt (+ (sq (- x1 x2)) (sq (- y1 y2)))))</code></td>
<td>( \text{distance}(x_1, y_1, x_2, y_2) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} )</td>
</tr>
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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 $t$.

I. Contract+Purpose Statement

Every contract has three parts:

\[ D : \quad \text{Domain} \rightarrow \text{Range} \]

II. Give Examples

Write an example of your function for some sample inputs:

\[ D(1) = \]

Use the function here

What should the function produce?

\[ D(2) = \]

Use the function here

What should the function produce?

\[ D( ) = \]

Use the function here

What should the function produce?

\[ = \]

Use the function here

What should the function produce?

III. Definition

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

\[ D( ) = \]
# 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:

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## II. Give Examples

Write an example of your function for some sample inputs

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## III. Definition

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

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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?

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?

= _____________________________________________________________________

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.

= _____________________________________________________________________
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?

  =
  Use the function here  What should the function produce?

  =
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  =
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  =