Workbook v2.6

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Visual Design: Colleen Murphy

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<table>
<thead>
<tr>
<th>Bootstrap Units</th>
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<tbody>
<tr>
<td><strong>01</strong></td>
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<td><strong>05</strong></td>
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</table>
01 Videogames and Coordinate Planes
Lesson 1

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

...
Finding Coordinates

The coordinates for the PLAYER (NinjaCat) are: $(x, y)$

The coordinates for the DANGER (Dog) are: $(x, y)$

The coordinates for the TARGET (Ruby) are: $(x, y)$
Our Videogame

Created by (write your names):

Our game takes place in:

(space? the desert? a mall?)

The player is a ____________________________.

The player moves only up and down.

Your player GAINS points when they hit the target.

The Target is a ____________________________.

The Target moves only to the left and right.

Your player LOSES points when they hit the danger.

The Danger is a ____________________________.

The Danger moves only to the left and right.
## Circle of Evaluation Practice

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>
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<tr>
<td>$(8 + 2) - (5 \times 10)$</td>
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<tr>
<td>$\frac{5 \times 10}{8 - 2}$</td>
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</table>
02 Contracts, Strings, and Images
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<tr>
<th>Math</th>
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<tbody>
<tr>
<td>Round 1</td>
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<tr>
<td>$(3 \times 7) - (1 + 2)$</td>
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<tr>
<td>Round 2</td>
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<tr>
<td>$3 - (1 + 2)$</td>
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<tr>
<td>Round 3</td>
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<tr>
<td>$3 - (1 + (5 \times 6))$</td>
<td></td>
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<tr>
<td>Round 4</td>
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<tr>
<td>$(1 + (5 \times 6)) - 3$</td>
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03 Intro to Definitions
### Fast Functions

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Word Problem: rocket-height

**Directions:** 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 and Purpose Statement**

Every contract has three parts ...

```
<table>
<thead>
<tr>
<th>function name</th>
<th>domain</th>
<th>range</th>
</tr>
</thead>
</table>
```

what does the function do?

**Examples**

Write some examples, then circle and label what changes ...

```
(EXAMPLE(                  )                           )
  function name           input(s)                     what the function produces

(EXAMPLE(                  )                           )
  function name           input(s)                     what the function produces
```

**Definition**

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

```
(define(                          )
  function name variables

                           )
  what the function does with those variables
```
Directions: Use the Design Recipe to write a function 'red-square', which takes in a number (the side of the square) and outputs a solid red rectangle whose length and width are the same size.

Contract and Purpose Statement
Every contract has three parts ...

; function name : domain → range ;

what does the function do?

Examples
Write some examples, then circle and label what changes ...

(EXAMPLE( ) )

(EXAMPLE( ) )

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

(define( ) )

what the function does with those variables
**Word Problem: lawn-area**

**Directions:** Use the Design Recipe to write a function 'lawn-area', which takes in the width and length of a lawn, and returns the area of the lawn. (Don’t forget: area = length * width!)

**Contract and Purpose Statement**

Every contract has three parts ...

; ___________________________ : ___________________________ → ___________________________

  function name  domain                    range

;

what does the function do?

**Examples**

Write some examples, then circle and label what changes ...

(EXAMPLE( ___________________________ )

  function name  input(s)                  what the function produces

(EXAMPLE( ___________________________ )

  function name  input(s)                  what the function produces

**Definition**

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

(define( ___________________________ )

  function name  variables

  __________________________________________________________

  what the function does with those variables
**Word Problem: update-danger**

**Directions:** 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.

### Contract and Purpose Statement
Every contract has three parts ...

\[
\text{function name} : \text{domain} \rightarrow \text{range}
\]

### Examples
Write some examples, then circle and label what changes ...

\[
(\text{EXAMPLE} ( \quad ))
\]

\[
(\text{EXAMPLE} ( \quad ))
\]

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

\[
(\text{define} ( \quad ))
\]

\[
(\text{define} ( \quad ))
\]
Word Problem: update-target

Directions: 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.

Contract and Purpose Statement

Every contract has three parts ...

; function name : domain → range ;

; what does the function do?

Examples

Write some examples, then circle and label what changes ...

(EXAMPLE( ) )

(function name input(s) what the function produces)

(EXAMPLE( ) )

(function name input(s) what the function produces)

Definition

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

(define( ) )

(function name variables)

; what the function does with those variables


06 Comparing Functions

"safe-left?"
DESIGN RECIPE

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?**

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

**Contract and Purpose Statement**

Every contract has three parts ...

\[
\begin{array}{ccc}
\text{function name} & \text{domain} & \text{range} \\
\end{array}
\]

\[
\begin{array}{c}
\text{what does the function do?}
\end{array}
\]

**Examples**

Write some examples, then circle and label what changes ...

\[
\begin{array}{ccc}
\text{function name} & \text{input(s)} & \text{what the function produces} \\
\end{array}
\]

\[
\begin{array}{c}
\text{(EXAMPLE(} \\
\end{array}
\]

\[
\begin{array}{c}
\text{function name} & \text{input(s)} & \text{what the function produces} \\
\end{array}
\]

**Definition**

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

\[
\begin{array}{ccc}
\text{define(} \\
\end{array}
\]

\[
\begin{array}{c}
\text{function name} & \text{variables} \\
\end{array}
\]

\[
\begin{array}{c}
\text{what the function does with those variables}
\end{array}
\]
Word Problem: safe-right?

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

Contract and Purpose Statement

Every contract has three parts ...

; function name : domain → range ;

what does the function do?

Examples

Write some examples, then circle and label what changes ...

(EXAMPLE( function name ) input(s) what the function produces )

(EXAMPLE( function name ) input(s) what the function produces )

Definition

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

(define( function name variables )

what the function does with those variables)
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.

2. Two is less than four or four is equal to six.
**Directions:** Use the Design Recipe to write a function 'onscreen?', which takes in the x-coordinate and checks to see if Sam is safe on the left AND safe on the right.

**Contract and Purpose Statement**

Every contract has three parts ... 

; function name : domain → range ;

what does the function do?

**Examples**

Write some examples, then circle and label what changes ... 

(EXAMPLE( function name input(s) )

what the function produces

(EXAMPLE( function name input(s) )

what the function produces

**Definition**

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

(define( function name variables )

what the function does with those variables
Conditional Branching
Word Problem: cost

Directions: 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 and Purpose Statement

Every contract has three parts ...

; function name : domain → range

; what does the function do?

Examples

Write some examples, then circle and label what changes ...

(EXAMPLE(cost "pepperoni")

(EXAMPLE(cost )

(EXAMPLE(cost )

(EXAMPLE(cost )

(EXAMPLE(cost )

Definition

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

(define )

(cond

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]))}
Word Problem: update-player

Directions: 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.

Contract and Purpose Statement

Every contract has three parts …

; function name domain → range ;

what does the function do?

Examples

Write some examples, then circle and label what changes …

(EXAMPLE( update-player 320 "up" )

function name input(s) what the function produces

(EXAMPLE( update-player 100 "up" )

function name input(s) what the function produces

(EXAMPLE( )

function name input(s) what the function produces

(EXAMPLE( )

function name input(s) what the function produces

Definition

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

(define( )

function name variables

( )

[ ]

[ ]

[ ]

))
Collision Detection

distance e

Collision

08 Collision Detection
Word Problem: line-length

Directions: Write a function called 'line-length', which takes in two numbers and returns the *positive difference* between them. It should always subtract the smaller number from the bigger one, and if they are equal it should return zero.

Contract and Purpose Statement

Every contract has three parts ...

{function name} : {domain} → {range}

what does the function do?

Examples

Write some examples, then circle and label what changes ...

(EXAMPLE (line-length 10 5) (- 10 5))

(input(s) what the function produces)

(EXAMPLE (line-length 2 8) (- 8 2))

(input(s) what the function produces)

Definition

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

(define (line-length) )

{function name} {variables}

(cond 

[ ] )

[ ] )
The Distance Formula (an example)

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:
**Word Problem: distance**

**Directions:** 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 the previous page!)

### Contract and Purpose Statement

Every contract has three parts ...

<table>
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what does the function do?

### Examples

Write some examples, then circle and label what changes ...

(\text{EXAMPLE} ( \quad ))

what the function produces

(\text{EXAMPLE} ( \quad ))

what the function produces

### Definition

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

(\text{define}( \quad ))

what the function does with those variables
Word Problem: collide?

**Directions:** 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

Are the coordinates of the player within 50 pixels of the coordinates of the other character?

**Contract and Purpose Statement**

Every contract has three parts ...

; __________ : __________ → __________

<table>
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; __________

what does the function do?

**Examples**

Write some examples, then circle and label what changes ...

(EXAMPLE( __________ )

<table>
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<th>input(s)</th>
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(EXAMPLE( __________ )

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**Definition**

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

(define( __________ )

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| what the function does with those variables |
09 Presentation Preparation
Lesson 9

Catchy Intro:

Name, Age, Grade:

Game Title:

Back Story:

Characters:

Explain a piece of your code:
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.*

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<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>
<td></td>
</tr>
</tbody>
</table>
Word Problem: red-shape

Directions: Write a function called red-shape, which takes in the name of a shape ('circle', 'triangle', 'star', or 'rectangle'), and produces a solid, red version of that shape. Use 50 as the radius of the circle and star, and as the side-length of the triangle. Make the rectangle 99 long by 9 wide.

Contract and Purpose Statement
Every contract has three parts ...

; function name : domain → range ;

what does the function do?

Examples
Write some examples, then circle and label what changes ...

(EXAMPLE (red-shape "circle") (circle 50 "solid" "red") )

(EXAMPLE )

(EXAMPLE )

(EXAMPLE )

(EXAMPLE )

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

(define )

(cond

[(circle 50 "solid" "red") ]

[ ]

[ ]

[ ]

[ ]

[ ]

[ ]

) )
## Translating into Algebra

### Value Definitions

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

### Function Definitions

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>(define (area length width)</td>
<td>area(length, width) = length * width</td>
</tr>
<tr>
<td>(* length width))</td>
<td></td>
</tr>
<tr>
<td>(define (circle-area radius)</td>
<td></td>
</tr>
<tr>
<td>(* pi (sqr radius)))</td>
<td></td>
</tr>
<tr>
<td>(define (distance x1 y1 x2 y2)</td>
<td></td>
</tr>
<tr>
<td>(sqrt (+ (sqr (- x1 x2))</td>
<td></td>
</tr>
<tr>
<td>(sqr (- y1 y2))))))</td>
<td></td>
</tr>
</tbody>
</table>
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:

; ____________: ______________________________________ -> ____________
    name      Domain               Range
; _________________________________________________________________

What does the function do?

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?

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

D(    ) =
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:

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

What does the function do?

Write an example of your function for some sample inputs

\[
\text{Use the function here} \quad \text{What should the function produce?}
\]

\[
\text{Use the function here} \quad \text{What should the function produce?}
\]

\[
\text{Use the function here} \quad \text{What should the function produce?}
\]

\[
\text{Use the function here} \quad \text{What should the function produce?}
\]

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

\[
= \quad \text{What should the function produce?}
\]
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:**

<table>
<thead>
<tr>
<th>name</th>
<th>Domain</th>
<th>Range</th>
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*What does the function do?*

**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?

Use the function here | What should the function produce?

Write the Formula, giving variable names to all your input values.
Every contract has three parts:

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What does the function do?

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?

Write the Formula, giving variable names to all your input values.
Every contract has three parts:

; ______________: ___________________________________ -+ ______________
  name                        Domain                   Range

What does the function do?

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?

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

  =
<table>
<thead>
<tr>
<th>Name</th>
<th>Domain</th>
<th>Range</th>
<th>example</th>
</tr>
</thead>
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