# Contracts

Name	Domain	Range	example
••	•	<b>^</b>	
••	•	<b>↑</b>	
••	•	<b></b>	
••	•	<b>↑</b>	
••		<b>↑</b>	
••	•	<b>↑</b>	
••	•	<b>↑</b>	
••	:	<b>↑</b>	
••		<b>^</b>	
••		<b>↑</b>	
••	•	<b></b>	
••	:	<b>↑</b>	
••		<b>^</b>	
••	•	<b>↑</b>	
••	•	<b>↑</b>	
••		<b>↑</b>	
••		<b>↑</b>	

# **Contracts**

example																	
Range	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>^</b>	<b>↑</b>	<b>1</b>	<b>↑</b>	<b>^</b>	<b>↑</b>	<b>↑</b>	<b>↑</b>	<b>^</b>	<b>↑</b>	<b>^</b>	<b>1</b>	<b>↑</b>
Domain			<u></u>	•	•	•	<u></u>	:	•	•	:	:	•	•	:	•	<u></u>
Name		••	••	••	••	••	••	••	••	••	••	•	••	••	••	:	••

#### Reverse-Engineering: How does NinjaCat work?

Thing in the game	What changes about it?	More specifically
cloud	position	x-coordinate
	,	

#### Game Parts - NinjaCat!



The coordinates for the PLAYER (NinjaCat) are	e: <b>(</b>	,	)	
		x-coordinate	y-coordinate	
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 ranger merce only to the lost and right.
The Danger Your player LOSES points when they hit the danger.
rour player LOSES points when they flit the danger.
The Danger is a
The Danger moves only to the left and right.

Time: 5 minutes

Circle of Evaluation Practice! Time:

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

Math	Circle of Evaluation	Racket Code
5 x 10		
8 + (5 x 10)		
(8 + 2) - (5 x 10)		
<u>5 x 10</u> 8 - 2		

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

	Circles Co	mpetition	Time: 5 minutes
	Math	Circle of Evaluation	Racket Code
Round 1	(3 * 7) - (1 + 2)		
Round 2	3 - (1 + 2)		
Round 3	3 - (1 + (5 * 6))		
Round 4	(1 + (5 * 6)) - 3		

		~	
<b>-14</b>		$\mathbf{A}$	1-4
	121		$\sim 1$ H

,	·	>
name	domain	range
(EXAMPLE ( (EXAMPLE (	)	)
(define (	)	)
,	<u>:</u>	>
name	domain	range
(EXAMPLE ( (EXAMPLE ( (define (	))	)
;name	: domain	->range
(EXAMPLE ( (EXAMPLE ( (define (	)	)
, ,	:domain	->
name (EXAMPLE ( (EXAMPLE ( (define (	) )	range ))

#### **Fast Functions!**

;		
name	domain	range
(EXAMPLE (	)	)
(EXAMPLE (	)	)
(define (	)	)
:	:	->
name	domain	range
(EXAMPLE (	)	)
(EXAMPLE (	)	)
(define (	)	)
,	:	->
name	domain	range
(EXAMPLE (	)	)
(EXAMPLE (	)	)
(define (	)	)
		->
name	domain	range
(EXAMPLE (	)	)
(EXAMPLE (	)	)
(define (	)	)
(EXAMPLE (	))	range )))

### Lesson 4

#### DESIGN RECIPE

#### Word Problem: rocket-height

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

Contract+Purpose State ery contract has three parts:	ement		
ery contract has three parts.			
• name	Do	 main	-> Range
			50
	What does the funct	ion do?	
Give Examples			
<b>Give Examples</b> at the computer, write an exam	ple of your function i	in action, using EXA/	MPLE.
(EXAMPLE (the	user types		)
			,
	which sh	ould become	
/EVAMDIE /			\
(EXAMPLE (the	user types		/
			)
	which sh	ould become	
. Definition		L	
Write the definition, giving	y variable names to al	i your input values.	
(define (function name			1
(define ( <sub>function name</sub>		variable names	/
and the co	omputer does this		

#### Word Problem: red-square

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

. Contract+Purpos Every contract has three			
•		->	
• Name	Domain	Range	_
		_	
	What does the function do?		-
O:			
. Give Examples on the computer, write a	n example of your function in action	. using EXAMPLE	
•		·	
EXAMPLE (	the user says	)	
	Racket replies	)	
	Nacket repties		
EXAMPLE (		<b>\</b>	
LXAMI LL (	the user says		
		,	
	Racket turns that i	<i>)</i> nto	
I. Definition			
	n, giving variable names to all your inp	out values.	
		)	
function	name variable n	ames	

#### Word Problem: yard-area

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

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

Contract+Purpose State /ery contract has three parts:	ement	
•		->
• name	 Domain	Range
	What does the function do?	
Give Examples		
<b>Give Examples</b> n the computer, write an exam	nple of your function in action, using EXAN	\PLE.
EXAMPLE (		)
Use	e the function here	
		)
	find another way to get the same result here	,
EXAMPLE (	e the function here	)
		`
	find another way to get the same result here	)
. Definition		
	g variable names to all your input values.	
define (		1
function name	variable names	<i>)</i>
and the c	computer does this	

#### Word Problem: update-danger

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

I. Contrac	ct+Purpose Statement	
Every contract	has three parts:	
•	:	->
name	Domain	Range
•		
,	What does the function do?	
II Civo Ev	ramples	
II. Give Ex On the compute	er, write an example of your function in action, using	EXAMPLE.
•		
(EXAMPLE (	Use the function here	)
	ose the function here	
_		)
	find another way to get the same result	. here
(EXAMPLE (	Line the function have	)
	Use the function here	
_		)
	find another way to get the same result	here
III. Definitio		
Write the	e definition, giving variable names to all your input valu	es.
(define (_		)
(define (_	function name variable names	/
		)
	and the computer does this	

#### Design Recipe: update-target

#### 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.

	ct+Purpose Statement			
Every contract	has three parts:			
•	•		->	
name	<b>:</b>	 Domain	/ Range	_
name		Domain	nange	
•				_
•	Wha	t does the function do?		
II. Give Ex	amples			
		our function in action, using EX	XAMPLE.	
/EVALABLE /	(		,	
(EXAMPLE (	Lise the fund	ction here	)	
	ose the fund	.cion nere		
_			)	
	find	another way to get the same result h	ere	
(EXAMPLE (	(		)	
	Use the fund	tion here	/	
_			)	
	find	another way to get the same result h	ere	
III. Definition				
Write the	e definition, giving variabl	e names to all your input values	S.	
(dofina (			1	
(define (_	function name	variable names	)	
	runction name	variable names		
				)
	and the computer	does this		

#### **Protecting Sam**

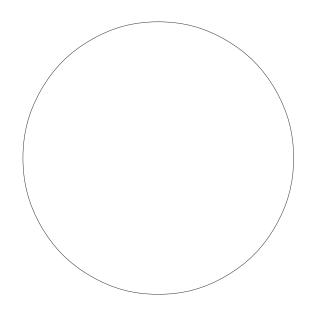
Sam is in a 640 x 480 yard. How far he can go to the left and right before he's out of sight?

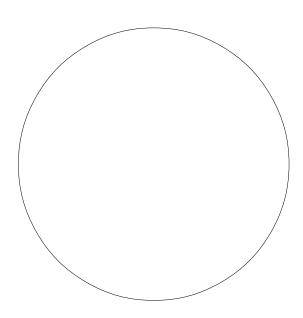
1. A piece of Sam is still visible on the left as long as...

(> 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 <code>safe-left?</code>, which takes in an 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	.7
What does the function do	
II. Give Examples	
On the computer, write an example of your function in actio	n, using EXAMPLE.
(EXAMPLE (	)
Use the function here	/
	)
find another way to get th	e same result here
(EVALIDLE (	,
(EXAMPLE (	)
ose the function here	
	)
find another way to get th	e same result here
III. Definition Write the definition, giving variable names to all you	r input values
write the definition, giving variable names to all you	i input values.
(define (	1
(define (	
ranction name varia	ote names
	,
	)

...and the computer does this

Word Problem: safe-right?

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

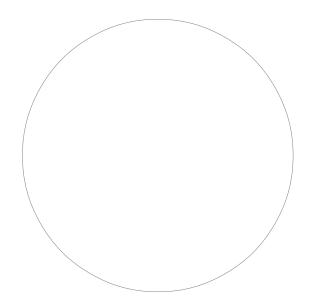
•	•		>	
name		Domain	Range	
•				
,	What de	oes the function do?		_
I. Give Example				
•		r function in action, using E		
(EXAMPLE (			)	
	Use the function	n here		
			)	
	find and	other way to get the same result	here	
(EXAMPLE (	Handle Consti	- h	)	
	Use the functio	n nere		
			)	
	find and	other way to get the same result	here	
II. Definition				
Write the defini	tion, giving variable r	names to all your input value	<b>?</b> S.	
(define (			)	
(SOINIO (	ion name	variable names	/	
tunct				

and / or

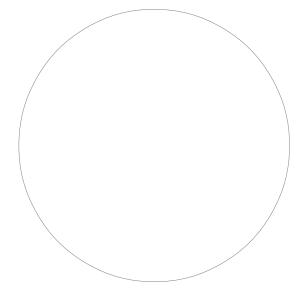
...and the computer does this

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

1. Two is less than five, <u>and</u> zero is equal to six.



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



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.

I. Contrac	t+Purpose Statement			
Every contract	has three parts:			
•	<b>:</b>		->	
name	•	Domain	Range	
•				
,		at does the function do?		
		at does the function do.		
II. Give Ex		your function in action, using EXA	MDI F	
•		-		
(EXAMPLE (		<del> </del>	)	
	Use the fun	ction here		
			)	
_	fino	d another way to get the same result here	/ e	
(EXAMPLE (		ction boro	)	
	Use the fun	ction here	,	
			,	
_	find	d another way to get the same result here	/ e	
III. Definition	an an			
		le names to all your input values.		
		,		
(define (_			)	
	function name	variable names		
				)

...and the computer does this

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	
II. Give Examples		
On the computer, write an example of yo	ur function for <u>each top</u>	<u>ping,</u> using EXAMPLE.
(EXAMPLE ( <u>cost</u> "pep)  Use the function here	peroni" )	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	
·		

#### 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.

I. Contract+Purpose Statemer	nt		
			->
name	Dom	ain	Range
II. Give Examples			
Finish the two examples we've started	d for you, and mak	e two more	
(EXAMPLE ( <u>update-player</u> Use the function h		What sho	ould the function produce?
(EXAMPLE ( <u>update-player</u> Use the function h		")What sho	ould the function produce?
(EXAMPLE(		)	
Use the function h	ere	What sho	ould the function produce?
(EXAMPLE(		)	
Use the function h	) ere	What sho	ould the function produce?
III. Definition			
(define (	variable na	ames	)
	<u> </u>		

#### Word Problem: line-length

Write a function called <u>line-length</u>, which takes in two numbers and returns the difference between them. It should always subtract the smaller number from the bigger one.

	act+Purpose State at has three parts:							
name	<b>:</b>			Domain		>	Range	
	(line-length  Use the function	10 tion here	5	)	<b>(-</b> What sh		5) nction produce?	)
	(line-length Use the func	2 tion here	8	)	<b>(-</b> What sh	8 nould the fur	2) nction produce?	)
III. Defini Write	<b>ition</b> the definition, giving	variable	names to	o all your inpu	ut values.			
(define	(					)		
	function name			variable na	mes	,		
)								

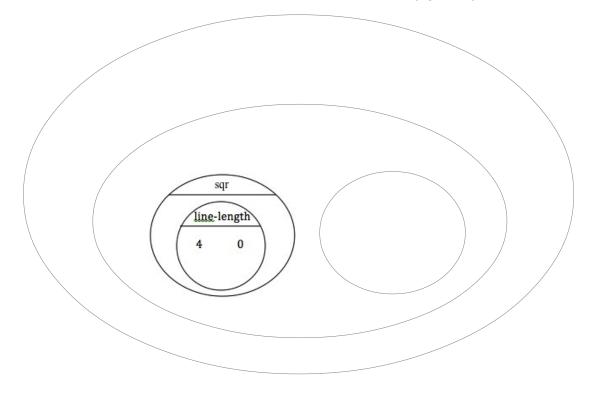
...and the computer does this

#### The Distance Formula, with Numbers

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!)



Convert the Circle of Evaluation into Racket code:

#### Word Problem: distance

Write a function distance, which takes FOUR inputs:

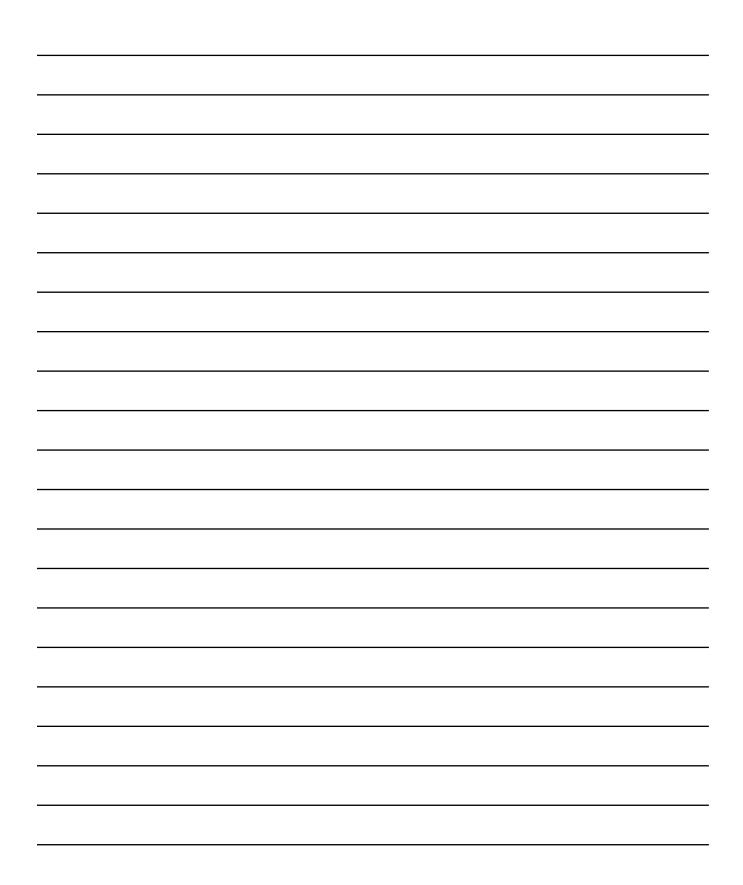
□ px: The x-coordinate of the player

. Contract+Purp	ose Statement .		
name	•Domain	> Range	_
, ,	What does the function do?		_
I. Give Examples			
(EXAMPLE (	Use the function here	)	
	find another way to get the same result he	re	)
EXAMPLE (		)	
	Use the function here		
	find another way to get the same result he	re	)
II. Definition			
(define (	n name variable names	)	

Word Problem: collide?

px: The x-cod py: The y-cod cx: The x-cod cy: The y-cod It should retu coordinates	ction collide?, which takes FOUR inputs: coordinate of the player coordinate of the player coordinate of another game character coordinate of another game character coordinate of the coordinates of the player are within 50 pixels of the other character. Coordinate of the other character.	the
l. Contract+Pu	urpose Statement	
name	Domain -> Ran	nge
;	What does the function do?	
II. Give Exampl (EXAMPLE (	Use the function here  find another way to get the same result here	)
(EXAMPLE (	Use the function here	
III. Definition	find another way to get the same result here	_)
(define (	nction name variable names	
		<i>)</i>

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.		
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

I. Contract+Purpose Statement		
;:_		->
name	Domain	Range
II. Give Examples Write some examples of red-shape below. The fi	rst one has alr	ready been done for you.
(EXAMPLE <u>(red-shape</u> "circle" Use the function here	)	(circle 50 "solid" "red") What should the function produce?
(EXAMPLE (	)	What should the function produce?
(EXAMPLE (	)	What should the function produce?
(EXAMPLE (	)	What should the function produce?
III. Definition		
(define (	م المانية	)
function name (cond	variable n	ames
	(ciro	cle 50 "solid" "red")
)		

#### Translating into Algebra

Values: Translate the Racket Code into Algebra					
Racket Code	Algebra				
(define x 10)	x = 10				
(define y (* x 2))	y = x*2				
(define z (+ x y))					
(define age 14)					
(define months (* age 12))					
(define days (* months 30))					
(define hours (* days 24))					
(define minutes (* hours 60))					

Functions: Translate the	Racket Code into Algebra
<pre>(define (double x)   (* x 2))</pre>	double(x) = x*2
<pre>(define (area length width)   (* length width))</pre>	area(length, width) = length * width
<pre>(define (circle-area radius)   (* pi (sq radius)))</pre>	
(define (distance x1 y1 x2 y2) (sqrt (+ (sq (- x1 x2))	

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.

Fivery contract has three parts:    D	I. Contract+P	urpose Statem	nent		
name  Domain  Range  I. 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?	Every contract has t	three parts:			
Domain   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(0) = $	: D	•		->	
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(0) = $	name		Domain	Range	
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(0) = $				J	
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    D(2) =	Write an example of	f your function t	for <u>some sample inputs</u>		
Use the function here    D(2) =	D( 1 )				
D(2) = Use the function here What should the function produce?  D() =	<u>D(1)</u>				
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?  D( ) =	D( 2 )				
D( ) =			What about the five time are due 2		
	Use the function here		what should the function produce?		
	D( )	_			
Use the function here vynat should the function produce?	Use the function here	<u> </u>	What should the function produce?		
That one and the famous produce.			rmat should the random 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.	Write the formula, g	iving variable n	ames to all your input values.		
D( ) =	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*.

. Contract+Purpose		
Every contract has three pa	ırts:	
		->
name	Domain	Range
I. Give Examples		
Vrite an example of your fu	nction for <u>some sample inputs</u>	
=		
Jse the function here	What should the function produce?	
=		
Jse the function here	What should the function produce?	
=		
Jse the function here	What should the function produce?	
=		
Jse the function here	What should the function produce?	
II. Definition		
Vrite the Formula, giving va	ariable names to all your input values.	
=		

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?

• _	Dame in	>
name	Domain	Range
I. Give Examples		
Write an example of your fu	inction for <u>some sample inputs</u>	
_		
	What should the function produce?	
	· · · · · · · · · · · · · · · · · · ·	
=		
Jse the function here	What should the function produce?	
=		
Jse the function here	What should the function produce?	
=	<u>-</u>	
Jse the function here	What should the function produce?	
II. Definition		
	ariable names to all your input values.	
	·	
=		

I. Contract+Purpose S	Statement	
Every contract has three par	rts:	
·		>
name	Domain	Range
II. Give Examples		
Write an example of your fu	nction 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?	
III. Definition		
	riable names to all your input values.	
=		