# 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>	
•••		↑	

# Contracts

Name	Domain	Range	example
••		<b>^</b>	
		<b>^</b>	
••		1	
••		<b>^</b>	
		<b>^</b>	
•••		<b>^</b>	
••		<b></b>	
••		<b></b>	
		<b>^</b>	
••		<b>^</b>	
••		<b>^</b>	
••		<b></b>	
		<b>^</b>	
•••		1	
••		<b>^</b>	
••		1	
••		1	

# Lesson 1

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

Thing in the game	What changes about it?	More specifically
cat	Position	х, у
ruby	position	×
clouds	position	×
dog	position	×
score	value	
background	nothing	



# Our Videogame

Created by (write your names):Jessica and James
Background
Our game takes place: <b>The Zoo</b> (In space? The desert? A mall?) The Player
The player is aLION
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 <b>Zookeeper</b> 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!

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		

# . Lesson 2

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

	<b>Circles</b> Competitie	on	Time: 5 minutes
	Math	Circle of Evaluation	Racket Code
Round 1	(1 + 2) - (3 * 7)	- + 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	(- 3 (+ 1 (* 5 6)))
Round 4	(1 + (5 * 6)) - 3	- + 1 5 6 3	(- (+ 1 (* 5 6) ) 3)

# Lesson 3


<b>Fast Functions!</b> Fill out two examples for each function, then try to write the contract, Definition and function body by yourself
• 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
(FXAMPLE (bc 25) (circle 25 "solid" "blue"))
(EXAMPLE (bc 43) (circle 43 "solid" "blue"))
(define (bc size) (circle size "solid" "blue")
;double:number>number
(EXAMPLE (double 13) (* 2 13))
(EXAMPLE (double 3) (* 2 3))
(define (double num) (* 2 num))
;>
(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 (	)	)



## 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 Statement
Every contract has three parts.
; _rocket-height_:number> _number name Domain Range
; <u>Takes the number of seconds passed since take-off</u> , and produce current height What does the function do?
Give Examples On the computer, write an example of your function in action, using EXAMPLE.
(EXAMPLE (rocket-height 0) the user types
(* 7 0) )
(EXAMPLE (rocket-height 4)
(* 7 4) )which should become
. <b>Function</b> Write the Definition, giving variable names to all your input values.
(define (rocket-heighttime) function name variable names(* 7 time))

#### Word Problem: red-square

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

. Contract+Purpose Statement
Every contract has three parts:
• mod devene
, _red-squarenumber> _Image
Name Domain Range
• Draws a solid red square of the size given
What does the function do?
On the computer write an example of your function in action using EXAMPLE
(EXAMPLE (red-square 5)
the user says
(nectanole 5 5 "colid" "ned"))
(lecturgle 5.5 solid led ))
(EXAMPLE (red-square 6)
the user says
(rectangle 6 6 "solid" "red"))
Racket turns that into
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"))

*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 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?
. 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
. <b>Definition</b> Write the Definition, giving variable names to all your input values.
(define (_yard-area length width) function name variable names
( * length width) )



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

. Contract+Purpose Statement Every contract has three parts:
;update-danger: _number>number name Domain Range
; lakes in danger's current x-coordinate and adds 50 to it What does the function do?
On the computer, write an example of your function in action, using EXAMPLE.
(EXAMPLE (update-danger 500) Use the function here
(- 500 50)) find another way to get the same result here
(EXAMPLE (update-danger 140) Use the function here
(- 140 50)) find another way to get the same result here
<b>Definition</b> Write the Definition, giving variable names to all your input values.
(define (_update-danger dangerX) <sub>function name</sub> variable names
(- dangerX 50))

# Design Recipe 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.

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?
. 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
. <b>Definition</b> Write the Definition, giving variable names to all your input values.
(define (_update-targettargetX) 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...
- 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 an x-coordinate and checks to see if it is greater than -50.

. 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?
. 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
(> -200 -50)) find another way to get the same result here
. Definition Write the Definition, giving variable names to all your input values.
(define (safe-left?x)
(> x -50))

#### Word Problem: safe-right?

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

. Contract+Purpose Statement
Every contract has three parts:
;safe-right?inumber>boolean name Domain Range
;takes in the x-coordinate and checks if it is less than 690 What does the function do?
. 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
. <b>Definition</b> Write the Definition, giving variable names to all your input values.
(define (safe-right?x) (< x 690))
and the computer does this

#### AND and OR

Write the Circles of Evaluation for these statements, and then convert them to Racket1. Two is less than five, <u>and</u> zero is equal to six.



2. Two is less than four <u>or</u> 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.

. Contract+Purpose Statement Every contract has three parts:		
;onscreen?:num!	per>boolean	Range
; _Takes in the x-coordinate and c What	hecks if target is protect at does the function do?	ed on the /left and the right_
. Give Examples On the computer, write an example of y	your function in action, using	g EXAMPLE.
(EXAMPLE (onscreen? 9) Use the fun	00) ction here	
(and (safe-legitier find	ft? 900) (safe-right? I another way to get the same resu	<b>900)))</b> It here
(EXAMPLE (onscreen? 355 Use the fun	ction here	_)
(and (safe-lef	<b>t? 355) (safe-right? 3</b> d another way to get the same resu	8 <b>55)))</b> It here
Write the Definition, giving varia	able names to all your input	values.
(define (onscreen? function name	X	)
(and (safe-left	t? x) (safe-right?	9 ×)))



#### 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.

. Co	ntract+Purpose Statement	
Every con	tract has three parts:	
;cos	st:string	>number
nar	ne Domain	Range
. Giv	ve Examples	
On the co	mputer, write an example of your function	for <u>each topping</u> , using EXAMPLE.
(EXAMP	LE (cost "pepperoni")	)10.50)
	Use the function here	What should the function produce?
(FXAMP	F ( cost "cheese" )	9,00
	Use the function here	What should the function produce?
(EXAMP	LE (cost "chicken")	11.25)
	Use the function here	What should the function produce?
(FXAMP	F ( cost "broccoli" )	10.25
(_/ 0 0 / 0 / 0 / 0 / 0 / 0 / 0 / 0 / 0 /	Use the function here	What should the function produce?
Do	finition	
. Wr	ite the Definition, giving variable names to	all your input values.
(defin	e ( cost tonni	na)
(ucini	function name	variable names
(с	ond	
•	[(string-2 "nenneroni" tonning)	10 501
	[(string=? "cheese" topping)	9.00]
	[(string=? "chicken" topping)	11.25]
	[(string=? "broccoli" topping)	10.25]
	[else	10000000]))

#### 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.

Contract+Purpose Statement	
Every contract has three parts:	
;update-player :number st	ring>number Domain Range
. Give Examples	
On the computer, write an example of your function	n for <u>each key</u> , using EXAMPLE.
(EXAMPLE (_update-player 40 "up") Use the function here	)(+ 40 20))_ What should the function produce?
(EXAMPLE (update-player 400 "down" Use the function here	"_)(- 400 20))_ What should the function produce?
. Definition Write the Definition, giving variable names to	o all your input values.
(define (_update-player	variable names
(cond	
[(string=? "up" key)	(+ playerY 20)]
[(string=? "down" key)	(- playerY 20)]
[else	playerY]))

# Lesson 8

#### 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.

. Contra Every contra	act+Purpose Stat ct has three parts:	ement						
;line-le name	ength :	number n	number D	omain	>	numbe	r Range	
. Give	Examples							
(EXAMPLE	<u>(line-length</u> Use the fur	10 Anction here	5	)	<u>(-</u> What s	10 hould the fu	5) nction produce?	)
(EXAMPLE	<u>(line-length</u> Use the fur	2 nction here	8	)	<mark>(-</mark> What s	<b>8</b> hould the fu	2) nction produce?	)
. Defin Write	ition the Definition, give	/ing variable	e names to	o all your ii	nput valı	ues that cl	nange.	
(define _(co	(_line-leng <sup>function name</sup> nd	th	a	<b>b</b> variable na	mes	)		
[(	> a b)			(- a b)	)]			
[e	lse			(- b a)	)]))			

#### 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 it into a Circle of Evaluation:



Convert it into Racket code: (sqrt (+ (sq (line-length 4 0)) (sq (line-length 3 0)))))

#### Word Problem: distance

Write a function distance, which takes FOUR inputs:

- □ px: The x-coordinate of the player
- □ py: The y-coordinate of the player
- **cx**: *The x-coordinate of* another game character
- **u** cy: The y-coordinate of another game character

It should return the distance between the two, using the Distance formula:

 $\Box$  Distance = ((line-length px cx)<sup>2</sup> + (line-length py cy)<sup>2</sup>)

#### Contract+Purpose Statement

- \_\_\_\_\_ : \_\_\_\_number number number number \_\_ -> \_\_number\_\_ distance Domain name Range
- ;\_\_\_Takes in player x and player y, character x and character y, and gives distance between them\_ What does the function do?

#### **Give Examples**

(EXAMPLE ( distance 100 200 300 400 ) Use the function here

(sgrt (+ (sg (line-length 100 300)) (sg (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

#### Definition

(define (\_\_distance\_\_\_\_\_ px py cx cy\_\_\_\_) function name

variable names

(sgrt (+ (sg (line-length px cx ) (sq (line-length py cy)))

#### DESIGN RECIPE

#### Word Problem: collide

Write a function <u>collide</u>?, 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.

#### 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?

#### **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

Definition

(define (\_collide?\_\_\_\_\_px py cx cy\_\_\_\_)

# \_\_\_(< (distance px py cx cy) 75))\_\_\_\_\_

29

# 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, 7<sup>th</sup> 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	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

. Contract+Purpose Statement	
;red-shape :string	>image Domain Range
. Give Examples On the computer, write an example of your function already been done for you.	on for <u>each shape</u> , using EXAMPLE. The first one has
(EXAMPLE <u>(red-shape</u> "circle" Use the function here	) (circle 50 "solid" "red")) What should the function produce?
(EXAMPLE ( <u>red-shape "triangle"</u> ) Use the function here	(triangle 50 "solid" "red")) What should the function produce?
(EXAMPLE (_red-shape "star") Use the function here	(star 50 "solid" "red)) What should the function produce?
(EXAMPLE (_red-shape "rectangle" Use the function here	) (rectangle 50 90 "solid" "red")) What should the function produce?
. <b>Definition</b> Write the Definition giving variable names	to all your input values
(define (_red-shapesh function name (cond	ape) variable names
(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				
(define x 10)	x = 10				
(define y (* x 2))	y = x*2				
(define z (+ x y))	z = x + y				
(define age 14)	age = 14				
(define months (* age 12))	months = age * 12				
(define days (* months 30))	days = months * 30				
(define hours (* days 24))	hours = days * 24				
(define minutes (* hours 60))	minutes = hours * 60				
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>	circle-area(radius) = pi * radius²				
(define (distance x1 y1 x2 y2) (sqrt (+ (sq (- x1 x2)) (sq (- y1 y2))))	distance(x1, y1, x2, y2) = $\sqrt{(x1-x2)^2+(y1-y2)^2}$				

#### 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

. Contract+Purpose Stateme	ent					
Every contract has three parts:						
· D · se	conds -> miles					
name	Domain Kange					
Give Examples						
Write an example of your function	for some sample inputs					
while an example of your function	tor <u>some sample inpacs</u>					
$D(1) = 80^{3}$	* 1					
Use the function here	What should the function produce?					
D(2) - <b>80</b> :	* 2					
D(Z) = OU	<b>L</b>					
Use the function here	what should the function produce?					
$D(3) = 80^{\circ}$	<u>` 3</u>					
Use the function here	What should the function produce?					
D(10) =80 *	* 10					
Use the function here	What should the function produce?					
. Definition						
Write the formula, giving variable names to all your input values.						

## D(+) = 80 + +

#### Word Problem

A rocket is traveling from Earth to Mars at 80 miles per second. Write a function that describes the <u>time</u> the rocket has been traveling, as a function of <u>distance</u>.

. Contract+Pu	irpose S	tatemen	t					
Every contract has t	hree pa	rts:						
: time		•	miles		-	> seco	onds	
name		_ •		Domain			Range	
. Give Exampl	les							
Write an example of	f your fi	inction fo	or <u>some san</u>	<u>nple inputs</u>				
<u>time(1)</u>	=	<u>1/80</u>						
Use the function here			What should t	the function produc	ce?			
<u>time(0)</u>	=	<u>0/80</u>						
Use the function here			What should t	the function produc	ce?			
<u>time(3)</u>	=	<u>3/80</u>						
Use the function here			What should t	the function produc	ce?			
<u>time(10)</u>	=	<u>   10/8(</u>	)					
Use the function here			What should t	the function produc	ce?			
. Definition			·					
write the Fo	rmula, g	giving var	iable name	es to all your inp	out value	25.		
		-						
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?

. Contract+Pu Every contract has t	i <b>rpose S</b> three pai	t <mark>atement</mark> rts:		
;collide		:distance	Domain	> _ <b>time</b> <sub>Range</sub>
. Give Example of Write an example of	les f your fu	nction for <u>some sam</u> p	ole inputs	
collide(0)	=	0/150		
Use the function here		What should the	e function produce?	
collide(300) Use the function here	=	300/150 What should the	e function produce?	
collide(5000)	=	_5000/150		
Use the function here		What should the	e function produce?	
<u>collide(100000</u>	) =	100000/150		
Use the function here		What should the	e function produce?	
. <b>Definition</b> Write the Fo	rmula, g	iving variable names	to all your input v	alues.
collide(d)		= d/150		