CS151 Summer 2019 HW 3

## CMSC 15100 Introduction to Computer Science I Homework 3

Important: Please add to (require "../include/cs151-core.rkt") at top of your file. Your answers should be saved in a single .rkt file and submitted via Canvas before the start of the next lecture. At the top of the file for this assignment and all future assignments include a comment,

```
;; Homework 3
;;
;; your name
;; your CNET id
```

If your code doesn't compile, it may not be graded. Please double check to make sure your code runs before submitting!

## **Problems**

1. (15 points) For this problem, you should copy the definition of the Point struct from class into your .rkt file.

When you include the hospital, the Logan Center, the Law School, and Stagg Field, UChicago has a pretty big campus. We can make the campus into a coordinate grid by putting the origin at the center of the quad, and by agreeing that the positive x direction is east, and that the positive y direction is north. At the top of the next page is a map of the campus overlaid with a coordinate grid (a larger copy of this grid can be found on Canvas).

In this grid, the origin is at the center of the main quad, and each square has side length one unit. So, for example, on this map, Ryerson Hall is approximately at coordinates (0.25, 0.4). Now that we have a coordinate grid set up, we can represent places around UChicago in Racket by Points.

You don't have to write any tests for this entire problem. You should test your code in the interaction window and check that the output makes sense.

(a) Define at least 4 variables with type Point for different places around campus, including a variable ryerson with the location of Ryerson Hall. You don't have to squint too hard at the locations, just pick some reasonable coordinates.

When you want to check that your functions work in the other parts, use these points in the interaction window and check that the output you get is reasonable. For example,

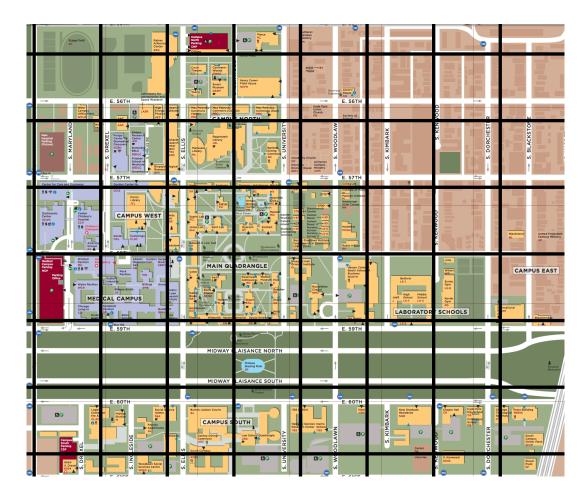
(dist ryerson ratner)

should give you something close to 3.

- (b) On this map, the quad is approximately the rectangular region between the four corners (0.75, -1), (-0.75, -1), (0.75, 1) and (-0.75, 1).
  - Write a function in-quad? that checks if a Point is in the quad.
- (c) Write a function dist that computes the straight-line distance between two Points. For points  $(x_1, y_1)$  and  $(x_2, y_2)$  this distance is given by

$$\sqrt{(x_1-x_2)^2+(y_1-y_2)^2}$$

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(d) Typically, walking around campus involves going from one place to another. We represent a route around campus by a (Listof Point) which lists the locations that are visited along the way. Write a recursive function route-dist that tells you the total distance you have to traverse along a given route. The type of route-dist should be (Listof Point) -> Real.

Hint: there are two base cases for the lists with zero or one Points, and you might need another base case for the list with two Points depending on how you write your code.

Hint: just like the function first, there is a function second, which takes a list and gives you the second element of the list.

2. (9 points) Although the department store Macy's probably doesn't use Racket, they probably do use a piece of software to keep track of the inventory in their stores (and they probably do hire computer programmers to work on that software). In this problem, we define a few types to simulate items in a Macy's store. Copy these definitions into your Racket file:

```
(define-type Color (U 'gray 'red 'white 'blue))
(define-type Size (U 'small 'medium 'large))
(define-struct Shirt
  ([short-sleeves? : Boolean]
```

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```
[color : Color]
  [size : Size]))
(define-struct Pants
  ([shorts? : Boolean]
  [color : Color]
  [size : Size]))
(define-type Clothing (U Shirt Pants))
```

(a) Make a function clothing-color that takes a piece of clothing and outputs the color. The type should be Clothing -> Color.

- (b) Make a function same-size? that takes two clothing items, and determines if they have the same size. The type is Clothing Clothing -> Boolean.
- (c) When it gets to be really hot outside, a short-sleeve shirt can help keep cool, and so can shorts. Implement a function cool? that takes an input of type Clothing and returns a Boolean if it's a short-sleeve shirt, or if it's shorts.
- (d) (1 point extra credit) Make a function draw-clothing that uses the image library from Lab 1 to create a reasonable picture of the clothing item. Make sure that the picture accurately reflects the traits of the item!