CMPU–101–02

CS1: Problem Solving and Abstraction

Fall 2019

Midterm I

Name: _____

Instructions:

1. This is an open book, open notes exam. You may use your computer to access the online HtDP/2e textbook and course notes. You may use DrRacket, but you are on your honor not to use the Stepper, Interactions Pane, or to Run any programs.

2. BUDGET YOUR TIME. There are 75 points on this exam, so you should spend about 1 minute per point (e.g., 20 minutes on a 20 point question). Don't spend too much time on any one question.

3. Each question indicates the total number of points.

4. Please don't hesitate to ask any questions.

5. Good luck!!!

Question	Points received	Points possible
1. Basic function: follow the Design Recipe		20
2. You be the Stepper		20
3. `(define-struct...)`–related		20
4. Data with varieties		15
Total		75

Problem 1. (20 points)

In the U.S., public eduction is broken up into grade levels, from Kindergarten through 12th grade. These grades are typically grouped into elementary, middle, and high schools. The typical groupings by grade intervals are K–5, 6–8, and 9–12, respectively. For the purposes of this problem, we'll represent kindergarten as grade 0.

a) (4 points) Finish the following data definitions for the grade level intervals, and the corresponding school types.

```
; A GradeLevel (GL) falls into one of 3 intervals:
; -
; -
; -

; A SchoolType (ST) is one of:
; -
; -
; -
```

b) (3 points) Write down the signature, purpose statement, and function header for a function named `grade2school` that converts a grade level to a school type (reminder: you must use the data definitions from part a).

c) (3 points) Write down 3 `check-expect` statements, one each to test each possible school type `grade2school` might return.

d) (5 points) Using the `GradeLevel (GL)` data definition you gave in part a), write a template function here that you can use in part e) to finish the function body.

e) (5 points) Using the template function you wrote in part **d)**, and referring to your `check-expect`'s in part **c)**, finish writing function `grade2school` below.

Problem 2. (20 points)

Evaluate the following program step by step (as if *you* were the Stepper), underlining the portion of the expression in each step to be evaluated in the next step, and separating each step with an arrow ($\rightarrow$).

```
(define (my-abs x)
  (cond
    [(< x 0) (* -1 x)]
    [(>= x 0) x]))

(my-abs (+ 21 (* 7 3)))
```

Problem 3. (20 points)

Suppose we are designing a student database for Vassar. One of the capabilities we need to provide is to search the database for students meeting desired criteria, like graduation year, major, etc. Before we can do this, however, we need to define a structure to represent a student. Here are the data and structure definitions:

```
; A student is a:
;  (make-student string string num string)
(define-struct student [name id year major])
```

a) (6 points) Write the function names and signatures for the functions automatically created by the `define-struct` for `student`. (you should list six signatures)

b) (4 points) Make two examples of students: one to represent you, and one to represent a friend.

c) (10 points) Develop the template for a function that consumes a `student`. Call it `fun-for-student`. Be sure to include a signature and purpose statement for the template.

Problem 4. (15 points)

Here are data definitions for a shape, including two varieties of shapes, circle and square:

```
; a shape is either
; - circle
; - square
```

```
; a circle is a
;  (make-circle num string posn)
(define-struct circle (radius color loc))

; a square is a
;  (make-square num string posn)
(define-struct square (length color loc))
```

For parts a) through c) below, be sure to include a signature, purpose, header, and function body. No other Design Recipe elements are required.

a) (5 points) Design a function, `circle-perim` that computes the perimeter (circumference) of a given circle struct. (Recall the formula for circumference is $2\pi r$.)

b) (5 points) Design a function, `square-perim` that computes the perimeter of a given square struct.

c) (5 points) Design a function, `shape-perim` that computes the perimeter of a given shape. Your solution must use a `cond` expression and the functions you wrote in parts a) and b) above.