CPSC 126 Sample Midterm

Name: _____
Student ID: _____
Section: _____ Lab Section: _____

– You have 75 minutes to write the 6 questions on this examination. A total of 60 marks are available.

– **Justify all of your answers.**

– No notes or electronic equipment are allowed, except for **one** 8.5 × 11 **sheet of paper, handwritten**.

Question	Marks
1	
2	
3	
4	
5	
6	
Total	

– Keeps your answers short. If you run out of space for a question, you have written too much.

– The number in square brackets to the left of the question number indicates the number of marks allocated for that question. Use these to help you determine how much time you should spend on each question.

– Use the back of the pages for your rough work.

– **Good luck!**

UNIVERSITY REGULATIONS:

– No candidate shall be permitted to enter the examination room after the expiration of one half hour, or to leave during the first half hour of the examination.

– CAUTION: candidates guilty of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action.

  1. Making use of any books, papers or memoranda, electronic equipment, or other memory aid devices, other than those authorised by the examiners.
  2. Speaking or communicating with other candidates.
  3. Purposely exposing written papers to the view of other candidates. The plea of accident or forgetfulness shall not be received.

– Smoking is not permitted during examinations.

[12] 1. As seen briefly in class, an assembly-language program is a list of 0 or more labels and simple instructions (a "label" is like a name we give to a memory location; we did not talk about labels in class). Here is a description of a simple assembly-language: "An instruction is one of

- A `dataword` assembler directive, which is a Scheme list containing the string "dataword", followed by a name or an integer. E.g. `(dataword -12)`.
- A `define-symbols` assembler directive, which is a Scheme list containing the string "define-symbols" followed by zero or more pairs, where each pair consists of a name followed by an integer. E.g. `(define-symbols (x . 4) (y . 7))`.
- A CPU instruction, which is a list that contains an instruction name, followed by zero, one, two or three operands (names or integers). E.g. `(halt)`, `(inchar 15)`, `(copy 3 x)` or `(load 3 x y)`.

Names and labels must start by a letter, and be followed by letters or digits. Write the EBNF for programs in this assembly-language. Some categories have been fully written out. Other categories that you may want to use have been provided. Do not worry about spaces and formatting. Remember that a | b means "a or b", that [a] means "a or nothing", and that { a } means "zero or more copies of a".

letter: "a" | "b" | $\cdots$ | "z"
digit: "0" | "1" | $\cdots$ | "9"
instructionname:"load" | "store" | $\cdots$ | "outnum" | "halt"

name:

integer:

dataword:

defsymbol:

CPUinstruction:

instruction:

program:

[10] 2. Data Representation

[3] a. Consider the following binary (base-2) number:

    1101010101111010

What is the equivalent value in hexadecimal (base-16) notation?

[2] b. What would be the decimal representation for the binary number 101110?

[5] c. Consider an 8-bit CPU that uses two's complement notation to represent integers. Perform the following addition by

- Writing the binary representation for both decimal integers.
- Computing the sum in binary, with carries clearly indicated.

Hint: $27 = 16 + 8 + 2 + 1$, and $105 = 64 + 32 + 8 + 1$.

    (27)   ————————————————

  $+(-105)$ ————————————————

    $=$ ————————————————

[9] 3. Your friend wrote a C++ function that takes as parameters a real number v representing a car's initial speed, another real number a that represents the car's acceleration, and a real number t that represents a time in seconds. It returns the distance travelled by the car in t seconds. Recall that the distance travelled d is given by the formula $d = vt + 1/2at^2$

```
float distanceTraveled(float v, float a, t)
{
    d = v*t + a*t*t;
    return d;
}
```

Assume that the program does not contain any global variables. The code your friend wrote for function `distanceTraveled` contains three **independent** mistakes. Explain what each of them is *briefly*, and state for each one whether or not it will be detected by the compiler.

[6] 4. Consider the following expression:

    `I < like || green && eggs && and > ham`

    [3] a. Knowing that the > and < operators have higher precedence than the `&&` operator, that the `&&` operator has higher precedence than the `||` operator, that `&&` associates left to right, add parentheses to obtain an equivalent expression whose value could be computed *without* knowing anything about the precedence and associativity of the operators involved.

    [3] b. Suppose that variables `I`, `like`, `green`, `eggs`, `and` and `ham` have values 152, 122, `true`, `true`, 8 and 17 respectively. What is the value of the expression you wrote in part (a)? Show all intermediate steps.

[9] 5. You have been asked by a primary school teacher to write a program called "Matching the Circles". When the program runs, it displays a bunch of circles (different colours and sizes) on the left half of the screen, and only one circle on the right half of the screen. The goal of the program is for the children to select the single circle on the left that has the same color and diameter as the circle on the right.

   You have at your disposal a class `CircleShape` whose objects have the following characteristics:

   - the x-coordinate of the center of the circle (a float value);
   - the y-coordinate of the center of the circle (a float value);
   - the diameter of circle (a float value);
   - the colour of the circle (either BLUE, RED, YELLOW, or BLACK).

   You can retrieve the value of these characteristics using the functions:

   - float getXCenter( );
   - float getYCenter( );
   - float getDiameter( );
   - Colour getColour( );

Write a function isThisTheCircle that returns `true` if the child has selected the correct circle, and `false` otherwise. We have provided the function header below:

```
bool isThisTheCircle(CircleShape circleSelected, CircleShape circleOnRight)
{



}
```

[14] 6. Design and implement a `Temperature` class with the following member functions:

- A constructor that takes as argument a temperature (a floating point number) and a scale (a character, whose value should be either 'C' for Celsius, or 'F' for Fahrenheit), and initializes the temperature accordingly.
- An accessor that returns the value of the temperature in Celsius degrees.
- An accessor that returns the value of the temperature in Fahrenheit degrees.

Recall that if C is a temperature in Celsius, then the corresponding temperature in Fahrenheit is given by the equation $F = 9C/5 + 32$.