Data Structures

Assignment 1

(1) (15 pts) Write a C++ program where you have the user enter a gas mileage and price of gas and output how much it will cost to drive from Hillsdale to Ypsilanti (57 miles away.) Then prompt the user to enter gas mileage, price of a gallon of gas, and a budget amount. Output what percentage of the distance from Hillsdale to Ypsilanti they can complete (it's OK for this to be over 100%.)

(2) (20 pts) Write a number guessing game program in C++ where you prompt the user to enter a number in a range and output whether the guess is too high or too low until the user guesses correctly. Keep track of the number of guesses the user input and ask if they want to play the game again. At the end of the program, after the user has indicated there are no more games to be played, output the scores from the play session and tell the user what their best score was.

(3) (40 pts) Represent a zip code as 27 bits. The first and last bit are always 1. The remaining 25 bits are divided into 5-bit fields. In each field exactly two bits are 1. They are converted to decimal numbers using the following weightings: 7 4 2 1 0. For example, the 5-bit field 10100 yields 7 + 2 = 9 and the 5-bit field 00110 yields 2 + 1 = 3. The digit 0 is represented by the weightings that sum to 11; that is, 11000 = 7 + 4 = 11 is the representation for 0.

Write a C++ program that reads in a zip code as a string of 27 bits, converts it to an array of ints, determines whether the zip code is valid, translates to the actual zip code, and outputs the result as a string.

The following may be useful. The string method std::stoi() converts a string to an integer. The function to_string() will convert an integer to a string. The string function substr(pos, length) returns the substring starting at index pos of a given length (note this is different than the parameters used when slicing strings in Python). The .length() method returns the number of characters in a string.

(4) (9 pts) If i is an int variable and p and q are pointers to int, which of the following assignments are legal?

(a) p = i;	**(d)** p = &q;	**(g)** p = *q;
(b) *p = &i;	**(e)** p = *&q;	**(h)** *p = q;
(c) &p = q;	**(f)** p = q;	**(i)** *p = *q;

(5) (5 pts) Suppose a dynamic variable were created as follows:

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char* p;
p = new char;
```

Assuming that the value of the pointer variable p has not changed, how can you destroy this new dynamic variable and return the momory it uses so that the memory can be reused to create other new dynamic variables?

(6) (5 pts) Describe the action of the `new` operator. What does it return? What are the indications of errrors?

(7) (6 pts) If we have the declaration `int data[100];` then explain what the expression `data + 4` represents? What is its value?