Data Structures
CS 246
Department of Physics and Computer Science
Medgar Evers College
Exam 3

Direction: Modify the `"exam03.cpp"` **file in your Exams directory of your GitHub repository; and then, submit your modified work in the Exams directory of your GitHub repository or Dropbox, or in your Exam03 google classroom assignment. You can only use the libraries included in the accompanying header files and the cpp file. Use of any other library will result in a 0.**

Problem	Maximum Points	Points Earned
1	5	
2	5	
3	5	
4	5	
Total	20	

Problems

1. Write the definition of the function `CommonSuffix()` whose header is

$$\text{string CommonSuffix(Vector<string>\& words)}$$

It returns the longest suffix shared by all the strings in *words* ignoring case. If *words* is empty or none of the strings have a common suffix, it returns an empty string. For instance, if *words* = `["ply","CALMLY","deeply","ally"]`, it will return `"ly"`; whereas, if *words* = `["share","bear","care","mare","car"]`, it will return `""`.

2. Given that a new phone keypad has the following digit-letters association

1	2	3	4	5	6	7	8	9
ABC	DEF	GHI	JKL	MNO	PQR	STU	VWX	YZ

Write the definition of the function `KeyPadWords()` whose header is

$$\text{void KeyPadWords(string number)}$$

Assuming that *number* only consists of digits between 1 and 9 inclusively, the function displays all the possible letter combinations generated by *number*. For instance, the function call `KeyPadWords("26")` will display `"dp"`, `"dq"`, `"dr"`, `"ep"`, `"eq"`, `"er"`, `"fp"`, `"fq"` and `"fr"`.

3. Write the definition of the function `TotalBoundedModes()` whose header is

$$\text{ulong TotalBoundedModes(Vector<ulong>\& data,ulong lo,ulong hi)}$$

Given that the values of the elements of *data* are bounded between *lo* and *hi* inclusively, the function returns the count of the mode of *data* where the mode is the value(s) that appears the most and appears at least twice. Furthermore, it must have a $O(n)$ runtime where n is the length of *data*. If *data* is empty or there is no mode, it returns 0. For instance, if *data* equals $[7, 2, 4, 3, 2, 8, 3, 9, 3, 2, 9, 4, 2, 5, 3]$ with *lo* and *hi* equals 2 and 9 respectively, it will return 2 since both 2 and 3 repeat 4 times.

4. Use the master theorem to determine the Big-O runtimes of the following recursive runtime functions. You must show work to receive full credit.

a. $T(n) = 4T(n/2) + n$

b. $T(n) = 9T(n/3) + n^2$

c. $T(n) = 6T(n/6) + 8$

d. $T(n) = T(n/5) + \log(n)$

e. $T(n) = 2T(n/4) + \lg(n)$