

Programming and Data Structures Laboratory Test 2

Section 6 | April 09, 2019

For ODD-numbered PCs

Time: 3 hours

Full Marks: 60

Instructions

1. There are three questions in this test. The program for each question must be written in an individual source file. The names of the source files should be as {ROLL}_{PC}_1.c, {ROLL}_{PC}_2.c, and {ROLL}_{PC}_3.c, where {ROLL} is to be substituted by your roll number, and {PC} is to be substituted by your PC number.
 2. Each source file must have a comment at the top, containing your name, roll number and PC number.
 3. You can submit at most one source file for each question. You should compress all .c files as a single .zip or .tar.gz file before submitting via Moodle. The compressed file should be named as {ROLL}_{PC}_labtest2.zip or {ROLL}_{PC}_labtest2.tar.gz
 4. It is your responsibility to make your programs understandable, through meaningful variable names, indentation and comments. Programs that do not have at least indentation and meaningful variable names will be penalized.
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Question 1 **[20 marks]**

Define a structure to store the following information about a country: (i) country_name: string of maximum 30 characters, (ii) capital: string of maximum 30 characters, (iii) area: real number (in 1000 sq. km). Assume that each of country_name and capital will be a single word without spaces.

Assume that there is a file named 'country_data.txt' containing a database of records of several countries. Each line in the file contains the record of one country, where the three fields (country name, capital and area) are separated by whitespace. For instance, the contents of the file can be:

```
India New_Delhi 32867.263
Pakistan Islamabad 881.913
Sri Lanka Colombo 65.610
Nepal Kathmandu 147.181
Bangladesh Dhaka 147.570
Germany Berlin 349.223
```

Write a program that reads the file 'country_data.txt' and stores the information of all countries using a singly linked list. Write the following functions:

(i) **print_country_info()**: A function that prints out the information of all countries in the database. For a particular country, all three fields must be printed in the same line, separated by a pipe character '|'. Every record should be printed on a separate line.

(ii) **delete_smaller_countries()**: A function that takes a real number A as argument (area in 1000 sq. km) and deletes the records of those countries from the linked list, that have area less than A. The function must return the number of countries whose records were deleted.

(iii) **find_capital()**: A function that takes the name of a country (a string input by the user) as argument, and prints the capital of that country. The function should check whether the country entered by the user appears in the database; if not, the error message "Country not in database" should be printed.

Write a main() function that demonstrates the working of all the above functions. The program should print out the records of all countries (using print_country_info()), then ask for an area A as input, delete all countries having area lesser than A, and then print out all remaining countries again. Also demonstrate the working of the other functions.

Note: Once the linked list is created, you should close the file. The functions stated above should work on the linked list, and should not access the file.

Question 2 **[20 marks]**

Declare a 2-dimensional array *s* of characters of dimension 10 x 50. Take 10 lines as inputs through the keyboard. Assume each line to consist of a name (a sequence of English letters without any space) and a roll number (a sequence of alphanumeric characters without any space) separated by whitespace. Each line is terminated by the newline character. Following is an example of a line:

Dharamjeet 12CS1000'\n'

Assume that each line has at most 50 characters. Store the lines in the various rows of *s*. Now ask the user to enter one of the following characters: 'n', 'r'. If the user enters something else, report error. Else,

1. If the user enters 'n', display the lines sorted with respect to the names.
2. If the user enters 'r', display the lines sorted with respect to the roll numbers.

Question 3 **[20 marks]**

Write a program that takes as input a list of integers and stores the integers in an array. You can assume that there will be at most 100 integers. Write a recursive function that implements the Insertion-sort algorithm, that sorts the array in ascending order and returns the number of comparisons that were needed during the entire sorting process. *Note: you cannot use any global variables in this program.*

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Question 1 [20 marks]

Define a structure for storing the following information of a student: (i) name: A string of maximum 50 characters, (ii) roll_no: A string of maximum 12 characters, (iii) cgpa: a real number. Assume that each of name and roll_no will be a single word without spaces.

Assume that there is a file named 'student_data.txt' containing a database of records of several students. Each line in the file contains the record of one student, where the three fields (name, roll number and CGPA) are separated by whitespace. For instance, the contents of the file can be:

```
Kaushal 10CS1001 6.35
Akankha 10AG3002 8.25
Moin 12CS1005 7.45
Chaitanya 12MI3012 9.28
Maya 10CS3035 9.16
John 10MF1035 9.28
Sneha 12ME2045 7.45
```

Write a program that reads the file 'student_data.txt' and stores the information of all students using a linked list. Write the following functions:

(i) **print_all_students_info()**: A function that prints out the information of all students in the database. Every record should be printed on a separate line. For a particular student, all three fields must be printed in the same line, separated by a pipe character '|'.

(ii) **get_topper()**: A function that prints the information of the student(s) having the highest CGPA. If multiple students have the same highest CGPA, all their records should be printed. For a particular student, all three fields must be printed in the same line, separated by a pipe character '|'.

(iii) **delete_student()**: A function that takes the roll number of a student as argument, and then deletes the record of the said student from the linked list. The function must check whether the input roll number exists in the database; if not, the error message “unknown roll number” must be printed.

Write a main() function that demonstrates the working of all the above functions. The program should print out the records of all students (using print_all_students_info()), then ask for a roll number and delete the record of the said student, and then print out records of all remaining students again. Also demonstrate the working of the other functions.

Note: Once the linked list is created, you should close the file. The functions stated above should work on the linked list, and should not access the file.

Question 2 [20 marks]

Declare a 2-dimensional array *s* of characters of dimension 10 x 50. Take 10 lines as inputs through the keyboard. Assume each line to consist of a name (a sequence of English letters without any space) and a roll no (a sequence of alphanumeric characters without any space) separated by whitespace. Each line is terminated by the newline character. Following is an example of a line:

Dharamjeet 12CS1000'\n'

Assume that each line has at most 50 characters. Also assume that the names are all distinct. Store the lines in the various rows of *s*.

1. Sort the lines with respect to the roll numbers.
2. Take another line as input through the keyboard. Do a binary search on the sorted list to see if a line with same roll number as that in this input line already exists in *s* (maybe with a different name). If there is such a line, print that line. If there is no such line, print “entry missing”.

Question 3 [20 marks]

Write a program that takes as input a list of integers and stores the integers in an array. You can assume that there will be at most 100 integers. Write a recursive function that implements the Bubblesort algorithm, that sorts the array in ascending order and returns the number of comparisons that were needed during the entire sorting process. *Note: you cannot use any global variables in this program.*