

Department of Information Systems and Technologies

CTIS 152 – Data Structures and Algorithms

Spring 2024 - 2025

Lab Guide #12 – Week 7-1

**OBJECTIVE :** Recursive Functions

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**Q1. a)** Write a **recursive** function;

- **printDigits:** prints the digits of a number in reverse order.

Write a C program that gets a number input from the user and calls the **printDigits** function.

**Project Name:** LG12\_Q1a

**File Name:** Q1a.cpp

**Example Run:**

```
Enter a number: 12587
Digits of the number 12587 are:
    7    8    5    2    1
```

**b)** Modify your solution from **Q1a.cpp** so that the recursive function prints the digits in the correct order.

**Project Name:** LG12\_Q1b

**File Name:** Q1b.cpp

**Example Run:**

```
Enter a number: 12587
Digits of the number 12587 are:
    1    2    5    8    7
```

**Q2. a)** Write a C program that **recursively** counts the number of occurrences of the given character regardless of lowercase or uppercase in a sentence.

**Project Name:** LG12\_Q2a

**File Name:** Q2a.cpp

**Example Run:**

```
Enter a string: Coffee is my morning fuel. Without it, I'm basically a zombie.
Enter a character: c

Coffee is my morning fuel. Without it, I'm basically a zombie.
The number of 'c' is 2
```

**b)** Write a C program that **recursively** counts the number of occurrences of the given string in a sentence.

**Project Name:** LG12\_Q2b

**File Name:** Q2b.cpp

**Example Run:**

```
Enter a sentence: I love books, each book is a new world to discover
Enter a word to search in the sentence: book

The word -book- occurred 2 times in the sentence
```

**Q3. a)** Write a C program that reads the number of lines from the user and displays the following pattern using the **recursive** functions.

Write the following **recursive** functions;

- **printNumbers**: takes **n** as a parameter, and prints numbers from **1 to n** on a line.
- **printLines**: takes the number of lines as a parameter, and prints the pattern using the function above.

**Project Name:** LG12\_Q3a

**File Name:** Q3a.cpp

**Example Run:**

```
Enter the number of lines: 5
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
```

**b)** Modify the function **printLines** in the program **Q3a.cpp**, so that the program displays the same pattern in a different format as in the example run.

**Project Name:** LG12\_Q3b

**File Name:** Q3b.cpp

**Example Run:**

```
Enter the number of lines: 6
1 2 3 4 5 6
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

**Q4.** Some algorithms require nested recursion where the result of one function call is a parameter to another function call. For Example, Ackermann's function is defined as:

$$A(m, n) = \begin{cases} n + 1 & \text{if } m = 0 \\ A(m - 1, 1) & \text{if } m > 0 \text{ and } n = 0 \\ A(m - 1, A(m, n - 1)) & \text{if } m > 0 \text{ and } n > 0. \end{cases}$$

Write a **recursive** function;

- **isAckermann**: takes two integer numbers as parameters, finds and returns the result according to the above rules.

Write a C program that gets two integer numbers from the user and computes the result of **isAckermann(m, n)**. The values of **m** and **n** both have got to be non-negative values {m, n} >= 0 with m being less than 4 (m < 4).

**Project\_name:** LG12\_Q4

**File\_name:** Q4.cpp

**Example Run #1:**

```
Enter the value of m: 3
Enter the value of n: 5

The result is 253
```

**Example Run #2:**

```
Enter the value of m: 4
Enter the value of n: -7

The value of both m & n had to be positive values. Exiting.
```

## ADDITIONAL QUESTION

Write a C Program that reads the users' account information (username, name, surname, and phone number) from the file "userinfo.txt" into a structure array with the maximum **SIZE 50** and does the following operations;

- displays the number of users,
- sorts the array using a recursive Bubble Sort algorithm according to the username in ASCENDING order,
- displays the sorted list on the screen,
- searches for a specified username with the help of a recursive Binary Search algorithm.

Write the following functions;

- **readFromFile, display, recBubbleSort, recBinarySearch**

**Project\_name:** LG12\_AQ

**File\_name:** AQ.cpp

**userinfo.txt**

```
gamer23 Ethan Rogers 555-123-4567
sunnydays8 Emily Chen 555-234-5678
sportsgirl11 Olivia Brown 555-345-6789
musicman99 Daniel Kim 555-456-7890
bookworm88 Alexander Garcia 555-678-9012
gamerchick42 Lily Anderson 555-789-0123
techguru76 William Hernandez 555-890-1234
travelbug29 Victoria Thompson 555-901-2345
naturelover17 Benjamin Martinez 555-012-3456
fashionista3 Elizabeth Lee 555-123-4567
foodiegirl22 Charlotte Davis 555-234-5678
fitnessguy44 Andrew Rodriguez 555-345-6789
artlover55 Isabella Wilson 555-456-7890
moviefanatic1 Michael Jackson 555-567-8901
petlover27 Noah Anderson 555-789-0123
musiclover13 Aiden Hernandez 555-890-1234
dancequeen99 Sophia Martinez 555-012-3456
techwhiz33 Kiara Davis 555-123-4567
```

### Example run:

There are 18 users in the list

Username	Name	Surname	Phone
*****	*****	*****	*****
artlover55	Isabella	Wilson	555-456-7890
bookworm88	Alexander	Garcia	555-678-9012
dancequeen99	Sophia	Martinez	555-012-3456
fashionista3	Elizabeth	Lee	555-123-4567
fitnessguy44	Andrew	Rodriguez	555-345-6789
foodiegirl22	Charlotte	Davis	555-234-5678
gamer23	Ethan	Rogers	555-123-4567
gamerchick42	Lily	Anderson	555-789-0123
moviefanatic1	Michael	Jackson	555-567-8901
musiclover13	Aiden	Hernandez	555-890-1234
musicman99	Daniel	Kim	555-456-7890
naturelover17	Benjamin	Martinez	555-012-3456
petlover27	Noah	Anderson	555-789-0123
sportsgirl11	Olivia	Brown	555-345-6789
sunnydays8	Emily	Chen	555-234-5678
techguru76	William	Hernandez	555-890-1234
techwhiz33	Kiara	Davis	555-123-4567
travelbug29	Victoria	Thompson	555-901-2345

Enter the username (END for exit): yilmazh  
NOT FOUND

Enter the username (END for exit): gamer23  
gamer23                      Ethan                      Rogers                      555-123-4567

Enter the username (END for exit): techguru76  
techguru76                      William                      Hernandez                      555-890-1234

Enter the username (END for exit): artlover55  
artlover55                      Isabella                      Wilson                      555-456-7890

Enter the username (END for exit): END