

LAB ASSIGNMENTS

Problem Solving and Program Design Using C (CSE 3942)



Department of Computer Science & Information Technology
Faculty of Engineering & Technology (ITER)
Siksha 'O' Anusandhan Deemed To Be University
Bhubaneswar, Odisha - 751030

Lab Assignment-7

7. Programming project on Recursion, Structure, Union and Dynamic Data Structures

7.1 A palindrome consists of a word or debanked, unpunctuated phrase that is spelled exactly the same when the letters are reversed. Write a recursive function that returns a value of 1 if its string argument is a palindrome. Notice that in palindromes such as level, deed, sees, and Madam I'm Adam (madamimadam), the first letter matches the last, the second matches the next-to-last, and so on.

7.2 Write and test a recursive function that returns the value of the following recursive definition:

$$f(x) = 0 \quad \text{if } x \leq 0$$

$$f(x) = f(x - 1) + 2 \quad \text{otherwise}$$

What set of numbers is generated by this definition?

7.3 In question 6.5 of assignment 6, description of an iterative algorithm for searching for a target value in a sorted list is given. Here again is the introduction to that problem. The binary search algorithm that follows may be used to search an array when the elements are in order. This algorithm is analogous to the following approach to finding a name in a telephone book.

- Open the book in the middle, and look at the middle name on the page.
- If the middle name isn't the one you're looking for, decide whether it comes before or after the name you want.
- Take the appropriate half of the section of the book you were looking in and repeat these steps until you land on the name.

ALGORITHM FOR BINARY SEARCH

- Let **bottom** be the subscript of the initial array element.
- Let **top** be the subscript of the last array element.
- Let **found** be false.
- Repeat as long as **bottom** isn't greater than **top** and the target has not been found
- Let middle be the subscript of the element halfway between **bottom** and **top**.
- if the element at middle is the target
- Set **found** to true and **index** to middle.
else if the element at middle is larger than the target
- Let **top** be middle - 1.
else
- Let **bottom** be middle + 1.

Develop a recursive binary search algorithm, and write and test a function **binary_srch** that implements the algorithm for an array of integers.

7.4 Define a structure type **auto_t** to represent an automobile. Include components for the make and model (strings), the odometer reading, the manufacture and purchase dates (use another user-defined type called **date_t**), and the gas tank (use a user-defined type **tank_t** with components for tank capacity and current fuel level, giving both in gallons). Write I/O functions **scan_date**, **scan_tank**, **scan_auto**, **print_date**, **print_tank**, and **print_auto**, and also write a driver

function that repeatedly fills and displays an auto structure variable. Here is a small data set to try:

Mercury Sable 99842 1 18 2001 5 30 1991 16 12.5

Mazda Navajo 123961 2 20 1993 6 15 1993 19.3 16.7

- 7.5 Define a structure type **element_t** to represent one element from the periodic table of elements. Components should include the atomic number (an integer); the name, chemical symbol, and class (strings); a numeric field for the atomic weight; and a seven-element array of integers for the number of electrons in each shell. The following are the components of an **element_t** structure for sodium.

11 Sodium Na alkali_metal 22.9898 2 8 1 0 0 0 0

Define and test I/O functions **scan_element** and **print_element**.

- 7.6 Write a program using C for creation of singly linked list and perform the operation given below. The singly linked list as shown below:

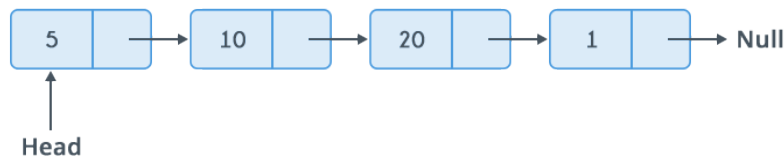


Figure 3: Singly link list

Write the **insertion** function to add a node with another data value in the above linked list. Also, create a **display** function which shows elements of linked list after insertion.