Data Structures (CS201)

Lab Assignment 3 (Graded)

August 28, 2021

Instructor: Anil Shukla
Due: August 29, 10 am (Morning) Total Marks: 20

Note: Graded means the marks will be counted for the final grading. Place proper comments in your source code. Write in C only. C++ is not allowed.
Note: Plagiarism is strictly prohibited. An appropriate disciplinary action will be taken if you are found to be involved in plagiarism.
Note: The instructions for submitting the assignment is mentioned in the google classroom. Carefully read the same and follow the instructions.
Note: At the end, find some test cases for each problem.

(1) The problem is based on detecting cycles in a given linked lists. Read carefully and write a C-program for the following:

(1a) Write a C-program to construct a singly linked list with cycles/without cycles as specified by the user. In case, the user requests for a singly linked lists with a cycle, he/she will also specify the length (number of edges) of the cycle and the distance of the start node of the cycle from the head node of the linked lists. Refer test cases. (10 marks)

(1b) In your above C-program, write a function **DetectCycle** which takes a pointer to a single linked lists and detects in linear time whether it has a cycle or not. You are not allowed to store any extra information in the node of the linked-lists. Also, present briefly how your function is solving the problem and why it is correct, as a comment at the end of your source code. (5 marks)

(1c) In your above C-program, write a function **DetectFindStart** which takes a pointer to a single linked lists and detects whether it has a cycle or not, just as in the function DetectCycle above. However, in addition, if a cycle is present, it also detects the starting node of the cycle and its distance (number of edges) from the head node. Also, describe your function along with its correctness, as a comment at the end of your source code. (5 marks)

In the main function, your program should ask user to enter N for constructing linked list without cycles and Y for constructing linked list with a cycle. If the user enters N, your program should first ask for the size (number of edges) of the linked list without cycles. Then, your program should construct such a linked list. Finally, it calls the **DetectCycle** function on the same.

On the other hand, if the user enters Y, your program should ask for the length of the cycle and the distance of the start node of the cycle from the head node of the linked lists. Then your program should construct such a linked list. Finally, call the function **DetectFindStart** on the same. See test cases.
Note: Programs with hard-wired solutions will not be evaluated.

Test Cases

Test cases for the problem 1

Input 1:
Press Y for linked list with a cycle and N for without cycles: N
Enter the size (number of edges) of linked list without cycle: 3
(The algorithm should construct the linked list as shown in Figure 1)
The linked list contains no cycle (this is the output of the DetectCycle function for the linked list.
Input 2:
Press Y for linked list with a cycle and N for without cycles: Y
Enter the length of cycle in the linked list: 4
Enter the distance (number of edges) of the start node of the cycle from the head of the linked list: 3
(The algorithm should construct the linked list as shown in Figure 2)
The linked list has a cycle of length 4 and the distance of the start node of the cycle from the head of the linked list is 3. (This is the output of DetectFindStart function).

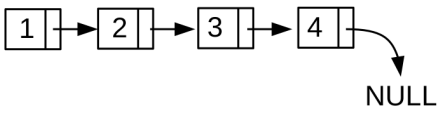

Figure 1: Linked list without cycle of size 3

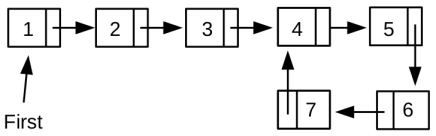

Figure 2: Linked list with a cycle of length 4 and the distance of the start node of the cycle from the head is 3

Note: We may test your functions presented in 1b and 1c for various linked lists as well.