Exercises with Linked Lists

Exercise 1: *from the book Introduction to Algorithms.* Cormen T.H. *et al.*

Implement the dictionary operations Insert, Delete, and Search using singly linked, circular lists. What are the running times of your procedures?.

Exercise 2: *from the book Introduction to Algorithms.* Cormen T.H. *et al.*

The dynamic-set operation Union takes two disjoint sets S1 and S2 as input, and it returns a set S = S1 ∪ S2 consisting of all the elements of S1 and S2 . The sets S1 and S2 are usually destroyed by the operation. Show how to support Union in $O(1)$ time using a suitable list data structure.

Exercise 3: : *from the book Introduction to Algorithms.* Cormen T.H. *et al.*

Write a linear time non-recursive procedure that reverses a singly linked list of n elements.

Exercise 4:

Suppose two linked lists that contain a sequence of integers in ascending order. Write a program that join these two list into a unique list, while preserving the relation order among the elements.

Exercise 5:

From `http://blog.ostermiller.org`:

"*When working with singly linked list, you are typically given a link to the first node. Common operations on a singly linked list are iterating through all the nodes, adding to the list, or deleting from the list. Algorithms for these operations generally require a well formed linked list. That is a linked list without loops or cycles in it.*

If a linked list has a cycle:

- *The malformed linked list has no end (no node ever has a null next_node pointer)*
- *The malformed linked list contains two links to some node*
- *Iterating through the malformed linked list will yield all nodes in the loop multiple times*

A malformed linked list with a loop causes iteration over the list to fail because the iteration will never reach the end of the list. Therefore, it is desirable to be able to detect that a linked list is malformed before trying an iteration."

Supposing that you have only a pointer to the first node of a singly linked list, write a C program that detects if the list has a loop in it.