Introduction to Programming and Data Structures

Linked Lists

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October, 2023

Motivating example

Problem: Maintain a database of student information for the class teacher: roll number, name, stream, courses taken, etc.
Data structure: Linked list (AIAO)
Operations:

- `INSERT`
  - at the beginning, end, other position (by index)
  - before / after a specific element
- `DELETE`
  - at the beginning, end, other position (by index)
  - before / after a specific element
- `LENGTH`: number of elements in the list
- `GET`: return the value of an item by index
- `SEARCH`: lookup
- `ITERATE` or `FOREACH`: to do something
- `SORT`: on a specified attribute

Standard implementation – Initialization

Considering the linked list size as static:

```
LinkedListDS = []
SizeLinkedListDS = 10
```

Standard implementation – Insert operation

```
def LinkedListINSERT(QueueDS, Data, Index):
    if len(LinkedListDS) < SizeLinkedListDS:
        LinkedListDS.insert(index, Data)
    else:
        print("Linked List overflow!!!")
```

Standard implementation – Delete operation

```
def LinkedListDELETE(LinkedListDS, Index):
    if len(QueueDS) > 0:
        Data = LinkedListDS.remove(Index)
        return Data
    else:
        print("Linked List underflow!!!")
```

Note: If you do not wish to receive the deleted element, exclude the return statement.

Standard implementation – Displaying the elements

```
def LinkedListDISPLAY(LinkedListDS):
    print("The elements in the linked list are: ")
    for Element in LinkedListDS:
        print(Element)
```

Note: You can directly write `print(LinkedListDS)`.

Problems

1. Write a program in Python to find out the middle element in a linked list by having only one pass through the list. Consider that you are not aware of the length of the list and computing the length itself takes a single pass.
2. Write a program in Python to reverse a linked list.
3. Given two polynomials represented by two different linked lists, write a program in Python to add the polynomials. Note that adding the polynomials denotes adding the coefficients who have same variable powers represented within the linked lists.