VIETNAM NATIONAL UNIVERSITY - HO CHI MINH CITY
HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
FACULTY OF COMPUTER SCIENCE AND ENGINEERING

Assignment 1

FRAGMENT LINKED LIST

HO CHI MINH CITY, 09/2020

ASSIGNMENT 1 SPECIFICATION

Version 2.0

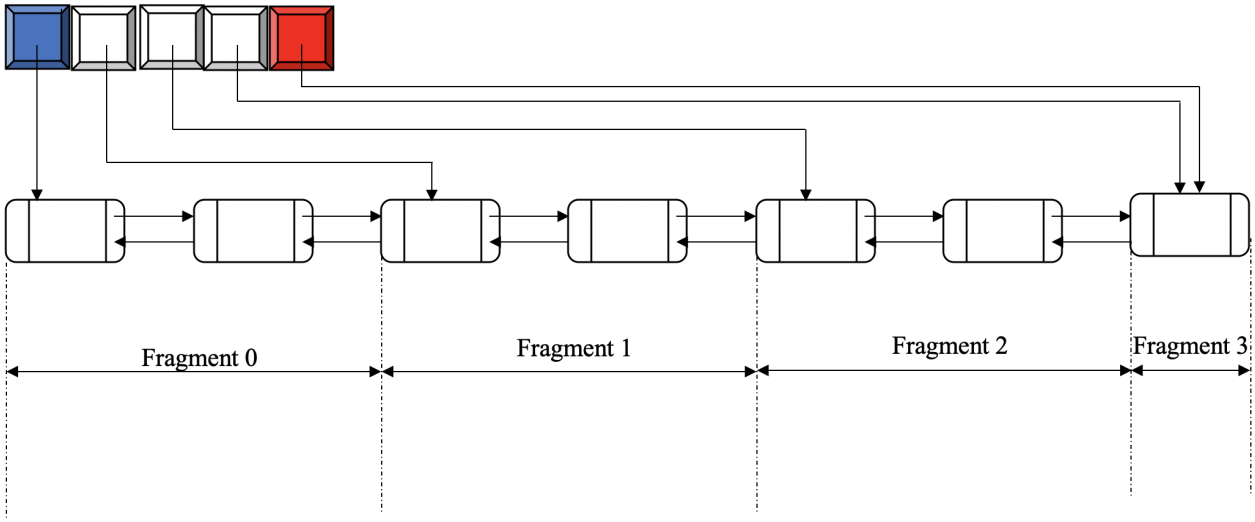
1 Outcome

After successfully completing this assignment, students will be able to:

- Implement a derivative of doubly linked list, especially fragment linked list.
- Know how to use a list data structure.

2 Tasks

Students are required to build a C++ program to implement the idea of fragment linked list, which is illustrated in Picture 1 and Picture 2.

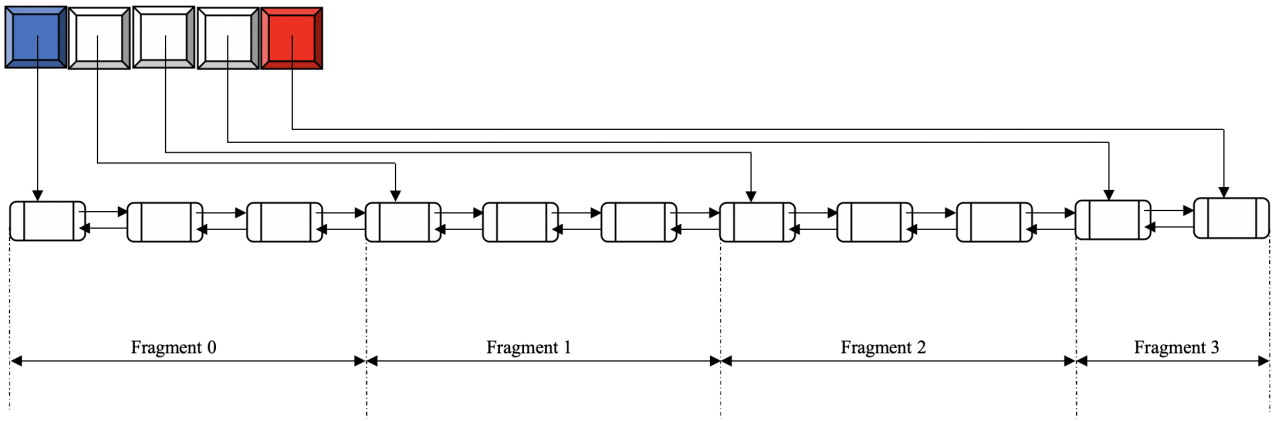


Hình 1: FLL with 7 elements, each fragment has the maximum size of 2 elements

A fragment linked list is implemented based on the doubly linked list, in which the list is divided into $fragment$ with maximum size $fragment\_max\_size$.

In order to store these fragments, list of pointers containing the address of nodes at the beginning of each fragment, where:

first pointer (in blue) in this list points to the first node of the list, also the first node in the first fragment.The last pointer (in red) in this list points to the last node of the list.



Hình 2: FLL with 11 elements, each fragment has the maximum size of 3 elements

The other pointers (in white) in this list points to the first node of each fragment in the order of fragments.

Students are required to implement the way to store data, together with methods of the above mentioned doubly linked list.

3 Instruction

Students have access to two files: 201.dsa-a1p1-des.pdf for assignment description and FragmentLinkedList.cpp for initial code:

- Class `IList` (with template `T`) demonstrates interface (as a blueprint) of general list data structure, containing following methods:
  - `void add(T e)`: add a new element into the end of the list.
  - `void add(int index, T e)`: add a new element into index `index` position.
  - `T removeAt(int index)`: delete the element at `index` position and return that element.
  - `bool removeItem(T item)`: delete the element has value `item` and return whether that element can be found.
  - `bool empty()`: checking whether the list is empty.
  - `int size()`: return the size (the number of elements) of the current list.
  - `void clear()`: delete all current elements in the list.
  - `T get(int index)`: find and return the element at `index` position.
  - `void set(int index, const T& element)`: set new value for element `index`.

  - `int indexOf(T item)`: find and return the position of the element which has value `item` in the list.
  - `bool contains(T item)`: check whether the list contains element that has value `item`.
  - `string toString()`: return the list in the form of string.

- Class `FragmentLinkedList` (with template `T`) is the fragment list data structure needs implementation (students are not allowed to modify the name of either the name of this class or the above mentioned methods):
  - Nested class `Node` and `Iterator` respectively illustrate the nodes in the list and the object used for iterating actions in the list. Students may use implemented definitions or modify if necessary.
  - The methods are overridden based on the interface `IList`.
  - Two methods for class Iterator: `Iterator`:
    * `Iterator begin(int fragmentIndex = 0)`: return the first `Iterator` corresponding to `fragmentIndex`.
      E.g: with `fragmentIndex = 1`, return Iterator corresponding to the first element in fragment 1.
    * `Iterator end(int fragmentIndex = -1)`: return the next of the last `Iterator` corresponding to `fragmentIndex`. With `fragmentIndex = -1`, return Iterator corresponding to the next of last element in the list (NULL element).
      E.g: with `fragmentIndex = 1`, return Iterator corresponding to the next of last element in fragment 1.
  - Methods in class `Iterator`:
    * `Iterator(FragmentLinkedList<T>*, bool)`: set `pNode` to the first node (`index = 0`) in the list pointed by `pList` when `begin = true`, otherwise points to `NULL` (`index = pList->size()`).
    * `Iterator(int, FragmentLinkedList<T>*, bool)`: `pNode` points to the first node in fragment in list pointed by `pList` when `begin = true`, otherwise points the next node of the fragment's last node.
    * `Iterator &operator=(const Iterator &iterator)`: assignment operator in Iterator to do assign the corresponding attributes with input iterator, and returns this `Iterator`.
    * `T &operator*()`: return `data` in pointed node. In case of `NULL`, throw an exception `std::out_of_range("Segmentation␣fault!")`
    * `bool operator!=(const Iterator &iterator)`: inequality operator in `Iterator`,

returns `true` if there is different in pointed memory or index.

* `void remove()`: remove node which iterator points. After removal, node points to the previous node. In case of head, `pNode` is assigned to `NULL` with `index = -1`.
* `void set(const T& element)`: set the new value for `pNode`.
* `Iterator &operator++()`: prefix operator++ which sets pNode to the next element and increase index by 1.
* `Iterator operator++(int)`: postfix operator++ which sets pNode to the next element and increase index by 1.

4 Regulation and Submission

Students write the implementation codes in `STUDENT_ANSWER` and submit this part to BK E-learning course site. The submission instruction and deadline will be announced on the course site specifically later.

All of the students' questions about this assignment will be answered on the course site forum. DO NOT SEND ANY EMAIL FOR QUESTIONING to the teachers or teaching assistants under any circumstances.

——————————THE END——————————