Unit 5 Circularly Linked Lists & Doubly Linked List

College of Computer Science, CQU

Circularly Linked Lists

- **Singly Linked Lists**

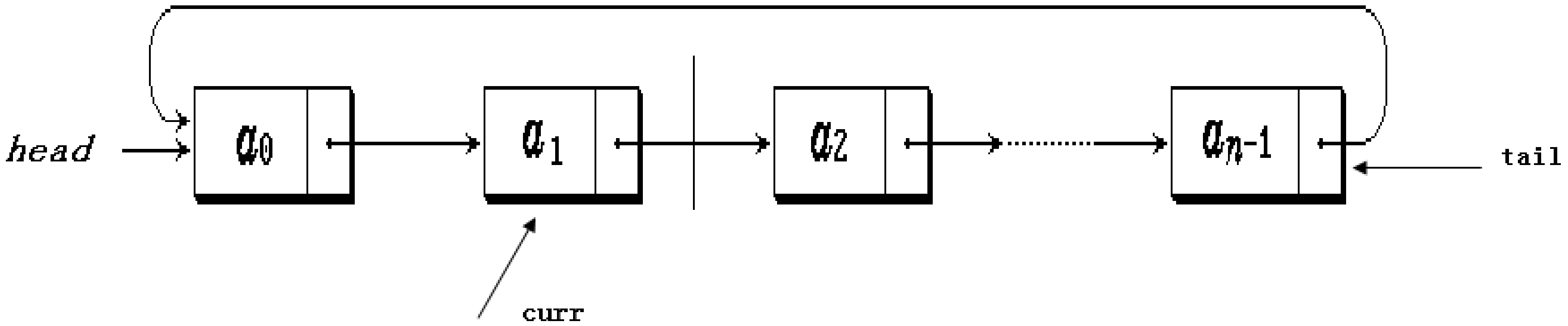
  the last node contain a NULL pointer

- **Circularly Linked Lists**
  - **the last node contains a** pointer to the first node

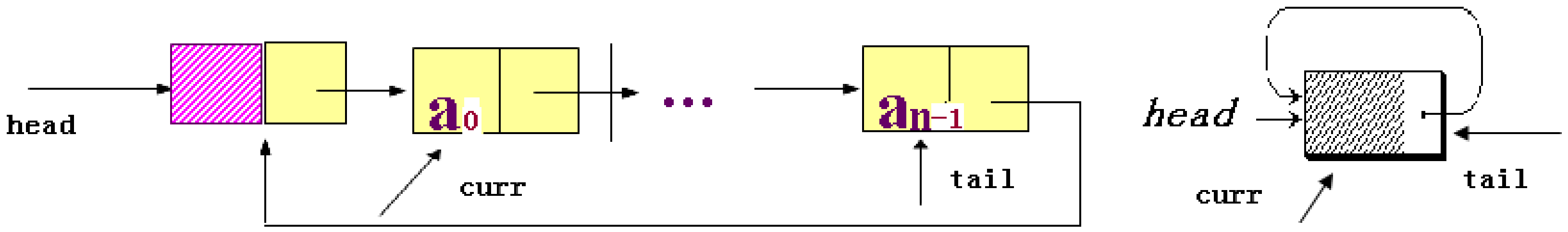
- **Advantage**

  start from any node, can access the others.

Example of circular linked list



Nonempty list & Empty list



Example:Josehus problem

- A description of the problem are: number 1,2, ..., n of n individuals sitting around a circle clockwise, each holding a password (positive integer). Choose a positive integer beginning as a limit on the number of reported m, starting from the first person to start a clockwise direction from a report number, report the number of reported m stop. Who reported m out of line, his password as the new m value, in a clockwise direction from the next person he began to re-reported from a number, it goes on until all the people all of the columns so far. Design a program, according to the column order prints each number.

Example:Josehus problem

- Use circular link list to acomplish.
- Josehusproblem.cpp

Example:Josehus problem

- Main function
- bool LList<Elem>::remove(Elem& it)
- void LList<Elem>::getOut(int &it,int& sum)
- bool LList<Elem>::append(const people& T)

Doubly Linked Lists

- **Singly Linked Lists**

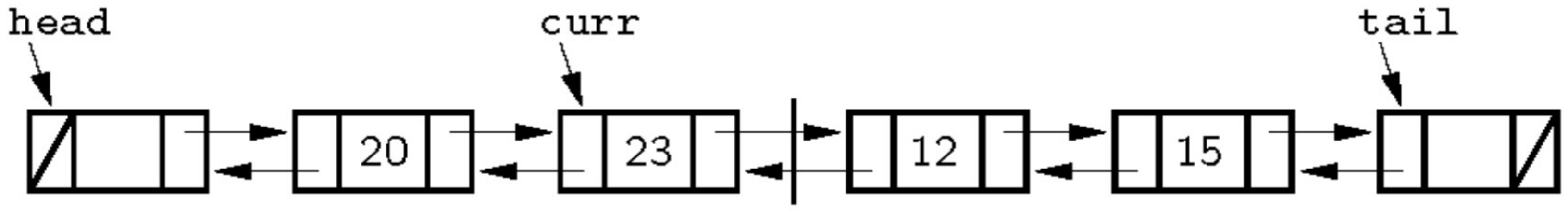
  The singly linked list allows for direct access from a list node only to the next node in the list.

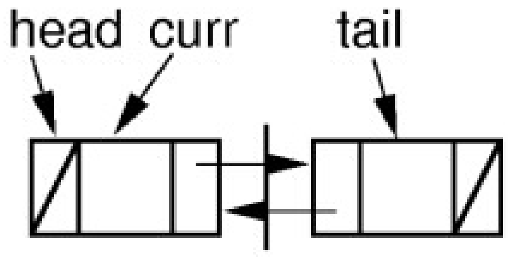
- **Doubly Linked Lists**
  - **A doubly linked list allows convenient access from a list node to the next node and also to the preceding node on the list.**

- **How to accomplish?**

The doubly linked list node accomplishes this in the obvious way by storing two pointers: one to the node following it (as in the singly linked list), and a second pointer to the node preceding it.

Doubly Linked Lists





Doubly Linked Lists

- // Doubly linked list link node with freelist support
- template <typename E> class Link {
- private:
-   static Link<E>* freelist; // Reference to freelist head
- public:
-   E element;   // Value for this node
-   Link* next;   // Pointer to next node in list
-   Link* prev;   // Pointer to previous node

Doubly Linked Lists

```
// Constructors
Link(const E& it, Link* prevp, Link* nextp) {
  element = it;
  prev = prevp;
  next = nextp;
}
Link(Link* prevp =NULL, Link* nextp =NULL) {
  prev = prevp;
  next = nextp;
}
```

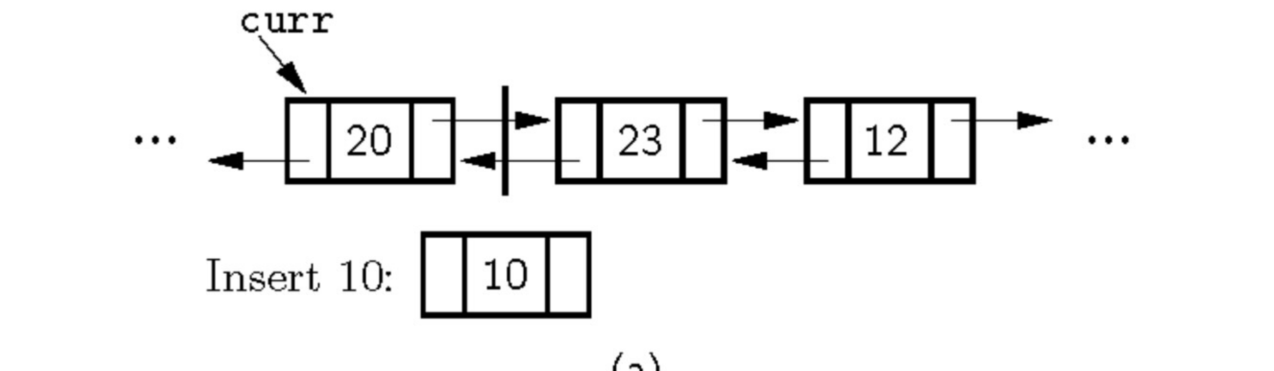
Doubly Linked Lists

```
void* operator new(size_t) {  // Overloaded new operator
  if (freelist == NULL) return ::new Link; // Create space
  Link<E>* temp = freelist; // Can take from freelist
  freelist = freelist->next;
  return temp;                 // Return the link
}
```

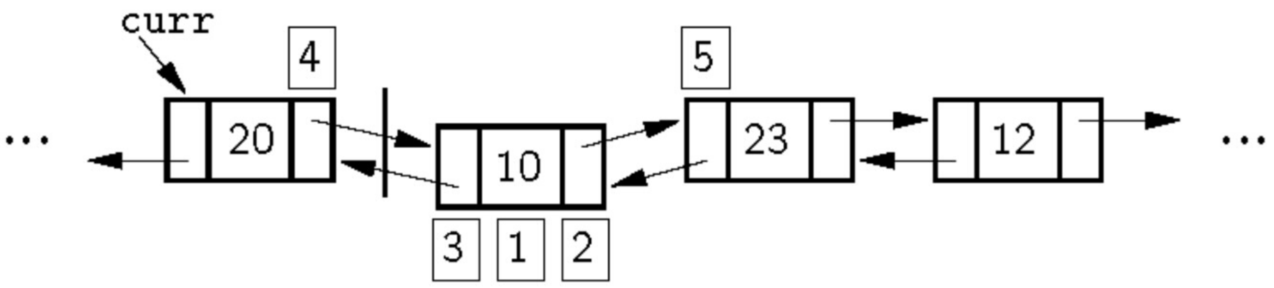
Doubly Linked Lists

- // Overloaded delete operator
- void operator delete(void* ptr) {
-     ((Link<E>*)ptr)->next = freelist; // Put on freelist
-     freelist = (Link<E>*)ptr;
- }
- };
- // The freelist head pointer is actually created here
- template <typename E>
- Link<E>* Link<E>::freelist = NULL;

Doubly Linked Insert



(a)

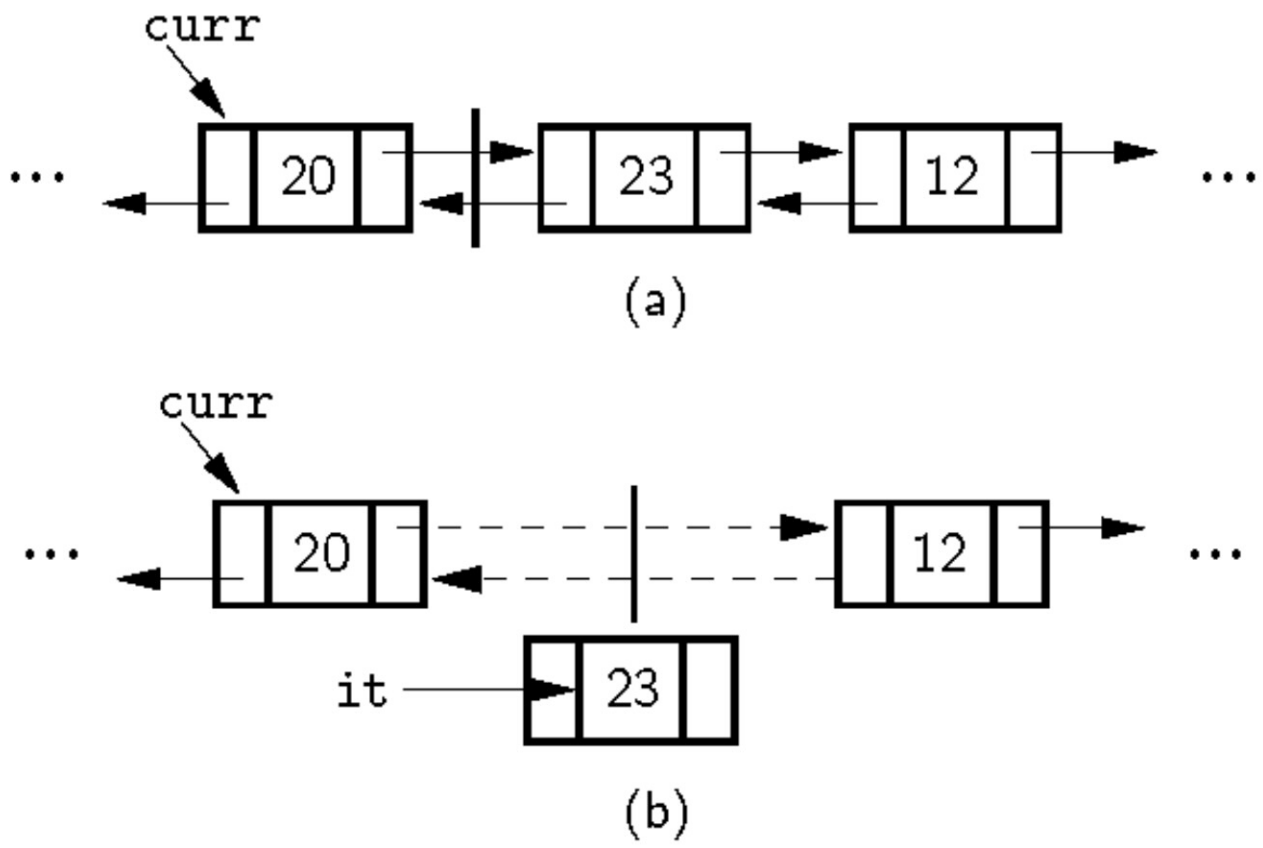


(b)

Doubly Linked Insert

```
// Insert "it" at current position
void insert(const E& it) {
  curr->next = curr->next->prev =
    new Link<E>(it, curr, curr->next);
  cnt++;
}
```

Doubly Linked Remove



Doubly Linked Remove

```
// Remove and return current element
E remove() {
  if (curr->next == tail)       // Nothing to remove
    return NULL;
  E it = curr->next->element;    // Remember value
  Link<E>* ltemp = curr->next;   // Remember link node
  curr->next->next->prev = curr;
  curr->next = curr->next->next; // Remove from list
  delete ltemp;                   // Reclaim space
  cnt--;                          // Decrement cnt
  return it;
}
```

Doubly Linked Append

```
// Append "it" to the end of the list.
void append(const E& it) {
  tail->prev = tail->prev->next =
    new Link<E>(it, tail->prev, tail);
  cnt++;
}
```

Doubly Linked Prev

```
// Move fence one step left; no change if left is empty
void prev() {
  if (curr != head)  // Can't back up from list head
    curr = curr->prev;
}
```

Doubly Linked List disadvantage

- **The only disadvantage of the doubly linked list as compared to the singly linked list is the additional space used.**

Reference

- P115----P120

-End-