CSE 143

Vector ADT as Linked List

[Chapter 4 p.170]

Linked List vs Vector ADT

- A linked list is a data structure
  - A programming technique for organizing data
- Earlier we defined a Vector ADT
  - Data encapsulated inside the class
  - Operations available only through the public interface
- Original implementation of Vector used arrays
  - Numerous drawbacks already pointed out
- Let's reimplement Vector using linked lists!
  - Will show a Vector of ints; Vectors of other types would be similar

Internal Data

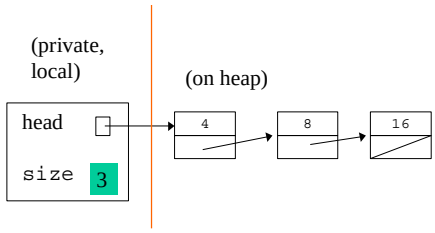
- Declare a struct to represent a node:

```
struct Node {
   int data;
   Node *next;
};

class Vector {
  public:
      ...
  private:
      int  size;,      //number of items in the Vector
      Node *head;  //pointer to linked list of items
...}
```

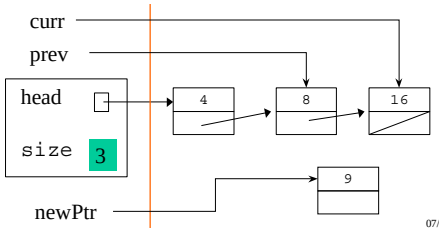

Portrait of a Vector

- Now a Vector variable might look like this:



Inserting at position X

- We have to find node X
  - Better yet, get a pointer to X (curr) and X-1(prev)
- Example: X = 2



Finding Position X

- Write a function "PtrTo" to traverse the list, return a pointer to the Xth element (code: p.175)
- Should be a member function
  - But not part of the interface, so should be private

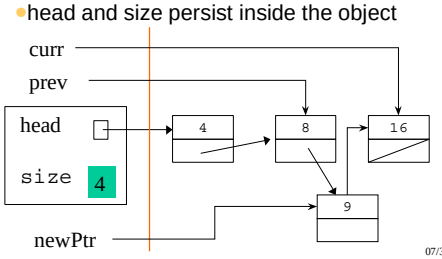
    *listNode * PtrTo (int X) const;*
- Special cases: X outside the range of the list
  - return NULL
- Given this, curr and prev are easy to get:
  - curr = PtrTo(X); prev = PtrTo (X-1)
- Better yet:
  - prev = PtrTo(X-1); curr = prev->next;

Relinking for Insert (p.176)

- Given prev and curr (via PtrTo function):
  - *newPtr->next = curr;*
  - *prev->next = newPtr;*
- Inserting at beginning is a special case (X=0)
  - *newPtr ->next = head;*
  - *head = newPtr;*
- What about inserting at end of list?
  - How to recognize?
  - Is the code special?

Final Picture

- curr, prev, and newPtr are local variables that go away
- head and size persist inside the object



ListDelete

- Similar considerations
- PtrTo is helpful again
- The deleted node should have *delete* operator applied
  - or memory leak results
- Deleting from beginning of list a special case
  - changes head value
- Full code: textbook p. 177

Variations on a theme

- Doubly linked lists
  - Point backwards as well as forwards
  - Makes finding the previous pointer a breeze
  - Takes a little more space and complexity to manage the extra pointers
- Circular lists
  - Can remove some special cases
- Head and tail pointers.
  - Good for "queues" (always add at tail, always remove at head)
- Dummy nodes at front or rear
  - Can remove some special cases