CS180 - Linked lists & iterators

Note Title 10/1/2010

Announcements

- Program checkpoint due Friday
- Program due Monday

Recap of Vectors:

Idea: extend arrays, so that they grow when needed

But keep things efficient

Running times

myvector [5]

Constructor: O(1)

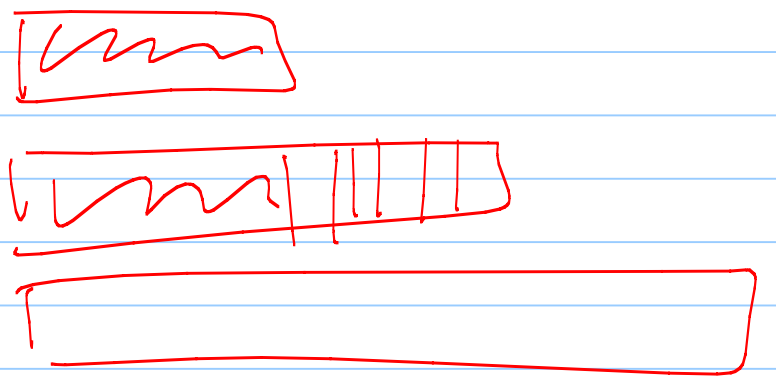
Operator []: O(1)

Destructor: O(1)

Insert: O(n) ←

Remove: O(n)

Push_back: O(n) (but not very often)



$N \cdot N = N^2$

Proposition: The running time of making N push_back operations in an ~~array~~ vector initially empty is $O(N)$.

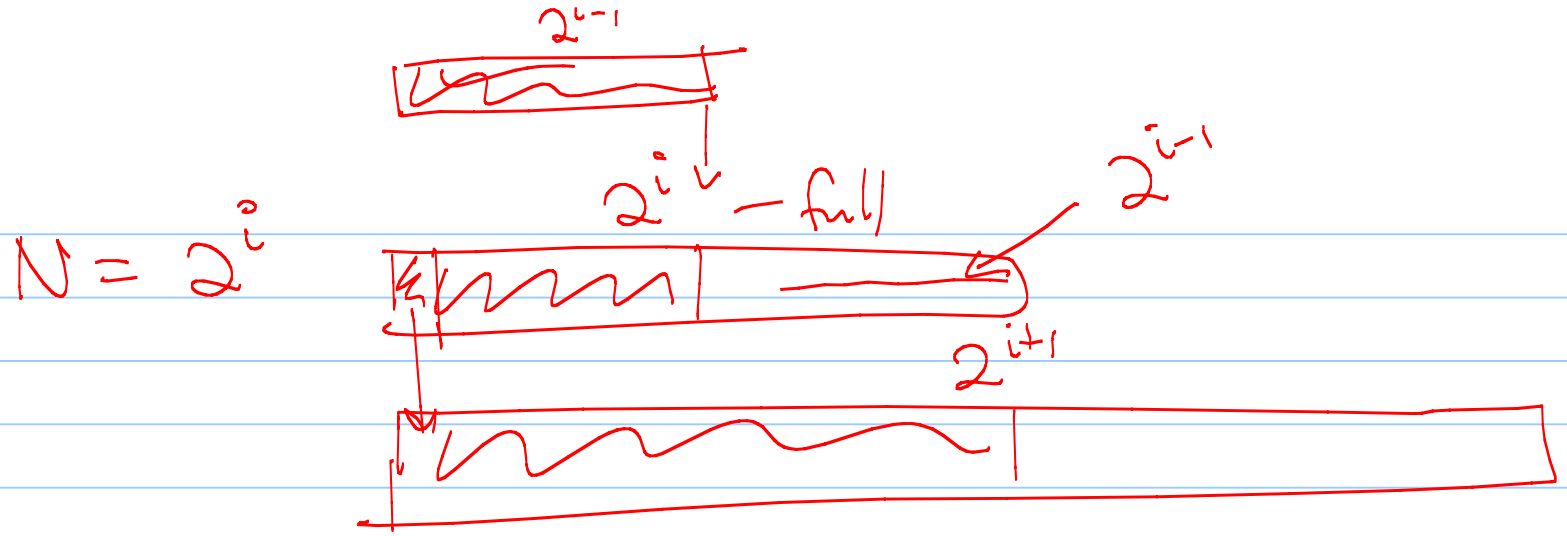
Proof: (called Amortized analysis)

consider virtual dollars — make each operation "pay" for its running time.

$1 — easy

$N — push_back when capacity = size

Instead, make each pay $3 to a bank, & withdraw only what they need for operation



$3(2^{i-1}) - 1 \cdot 2^{i-1} = 2 \cdot 2^{i-1}$ in bank

$= 2^i$

How long does it take to double + copy everything down?

Total work: (# calls)(dollars charged)

$= N \cdot 3 = O(N)$

Summarize:

Each push_back takes

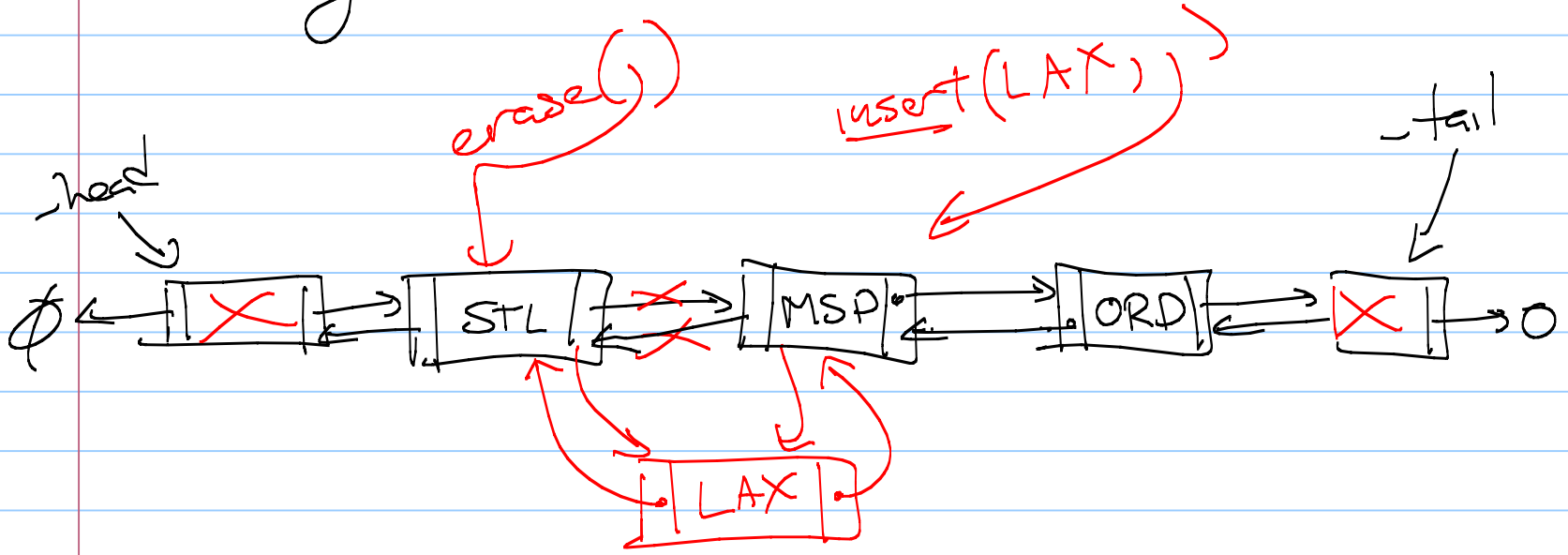
Amortized time $\frac{N}{N} = O(1)$

Linked lists

Motivation: The running time of insert in a vector is awful!

Idea: If we know where an element should go, inserting should be faster.

Doubly Linked List: Insert



(saw this code in add function)

O(1)

Problem: What do we need the user to have in order to implement insert?

pointer!

Node is private which means pointers are to.

Solution: "Wrap" pointers iterators

write functionality in our iterator class.

An iterator will give the user a "pointer", but with a heavily controlled structure (so they can't manipulate the nodes directly).

(no delete)

Compromise between hiding the underlying data & allowing the user to specify a location directly.

Check out STL functions:

insert
erase

begin
end

operator ++

push_back
:
(lots)

Usage example (STL)

```
List<int>  mylist;
List<int>::iterator  it;

mylist.push_back(5);
mylist.push_back(7);
mylist.push_back(9);

it = mylist.begin();

it++;
mylist.insert(it, 6);
```

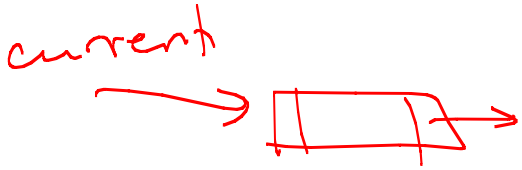
scoping

++it

```
template <typename Object>
class List {

    protected:

        struct Node {
            Object _data;

            Node* _prev;
            Node* _next;

            Node (const Object & data, Node* next,
                  Node* prev):
                _data(data), _next(next), _prev(prev) {}
        };
```

Iterator class : What should we code?

```
public: //in list class
    class iterator {
        private:
            Node * _current;

        public:
            iterator () : _current (NULL) {}
            iterator ( Node * ptr) : _current(ptr) {}
            iterator (const iterator & other) :
                _current ( other._current) {}
```




```
//prefix
void operator ++ () {
    _current = _current -> _next;
}

//postfix
void operator++ (int dummy){
    //same
}

Object& operator *() {
    return (_current -> _data);
}

Object& operator ->() {
    return (_current -> _data);
}
```