Lecture 12

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ITERATORS CONTD, STACKS

Problem Solving with Computers-I

https://ucsb-cs24-sp17.github.io/

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How is pa04 going?

A. Done
B. I am on track to finish
C. I am passing test1()
D. Having trouble with test1()
E. Haven't started

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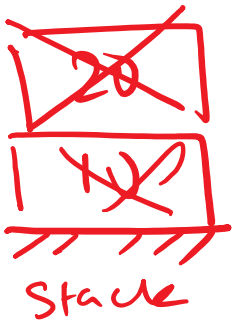
Stacks – container class available in the C++ STL

- Container class that uses the Last In First Out (LIFO) principle
- Methods
  i. push()
  ii. pop()
  iii. top()
  iv. empty()

return true if stack is empty



push(10)
push(20)
top() return 20
pop()
pop()

Demo reversing a string, and review of lab06 code

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Notations for evaluating expression

- Infix number operator number (7 + (3 * 5)) – (4 / 2)
- Prefix operators precede the operands
- Postfix operators come after the operands

Infix

7+3

7+(3*5)

Prefix

+73

+*35-7

Postfix

73+

735*+

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Lab06 – part 1: Evaluate a fully parenthesized infix expression

(4 * ((5 + 3.2) / 1.5)) // okay

(4 * ((5 + 3.2) / 1.5) // unbalanced parens - missing last ')'

(4 * (5 + 3.2) / 1.5)) // unbalanced parens - missing one '('

4 * ((5 + 3.2) / 1.5) // not fully-parenthesized at '*' operation

(4 * (5 + 3.2) / 1.5) // not fully-parenthesized at '/' operation

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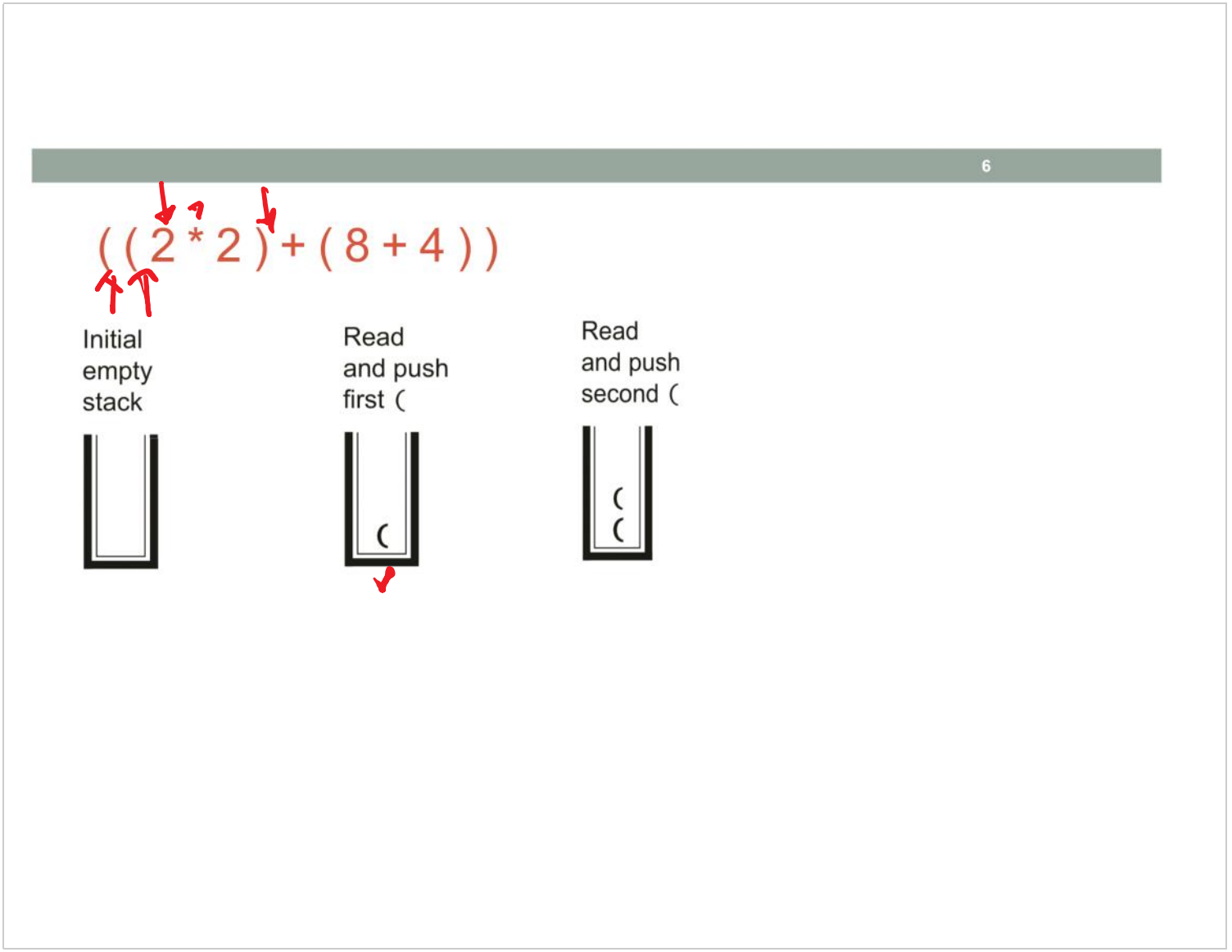

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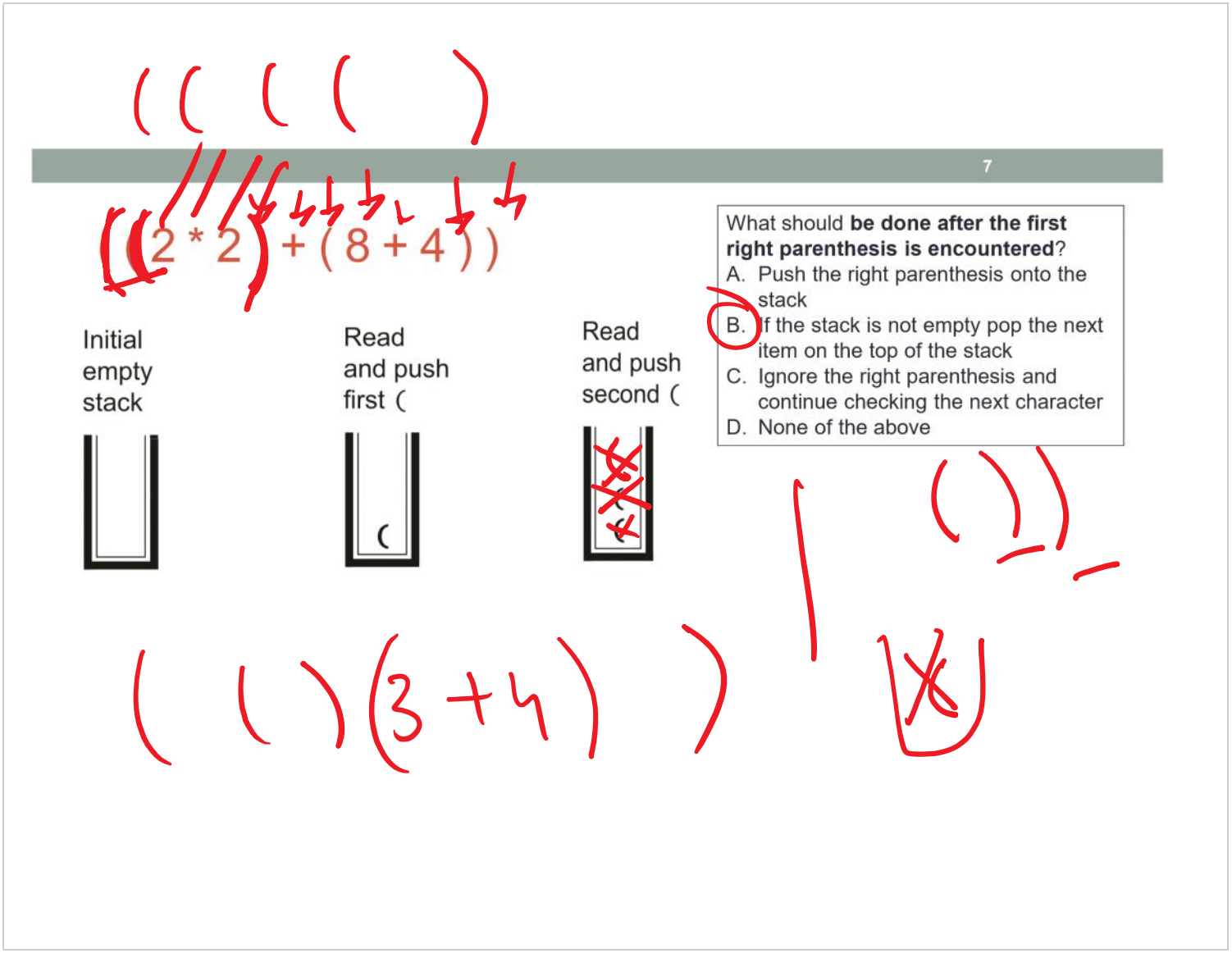

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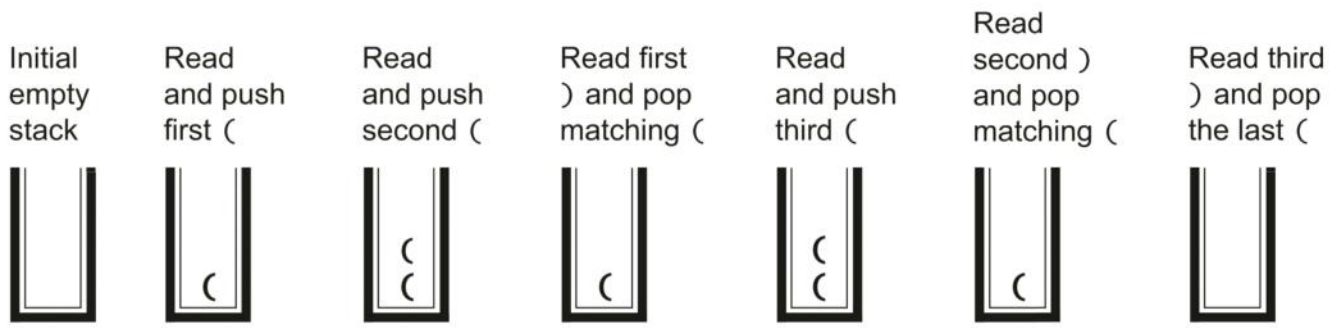
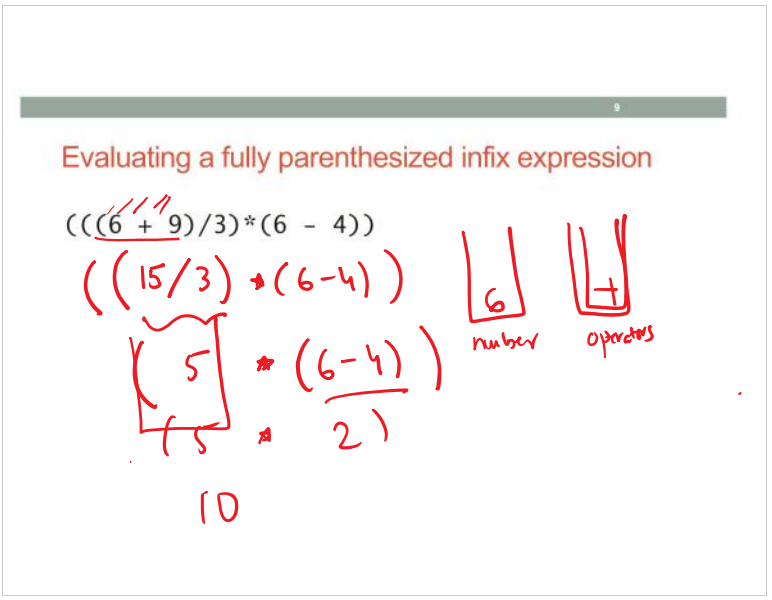
((2*2)+(8+4))

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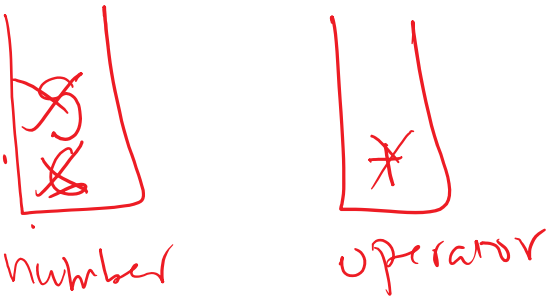
Evaluating a fully parenthesized infix expression
(((6 + 9)/3)*(6 - 4))
((15/3)*(6-4))
(5 * (6-4))
(5 * 2)
10
6
+
number
operators


number
operator


((6 + (9 / 3)) * (6 - 4))
6 + 9


2
9
num
oprv

9 / 3

6 + 3

((12 + 6) / 7)

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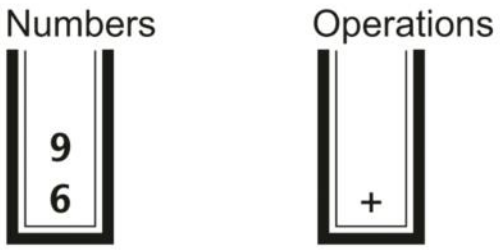
Evaluating a fully parenthesized infix expression

Characters read so far (shaded):

(((6 + 9) / 3) * (6 - 4))



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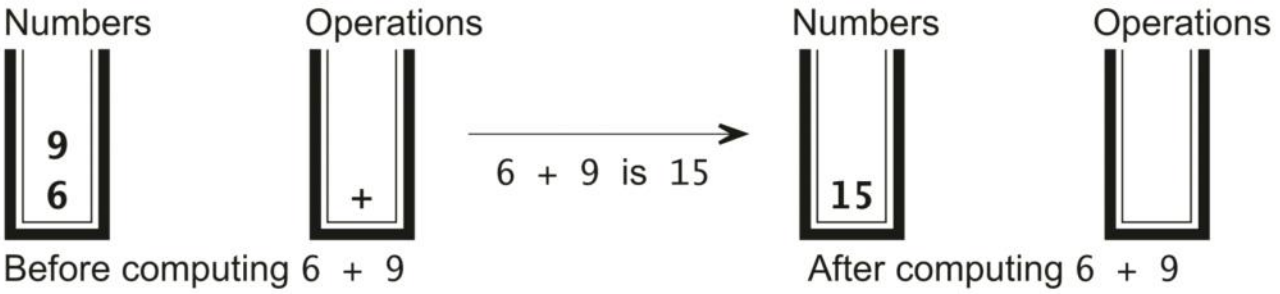
Evaluating a fully parenthesized infix expression

Characters read so far (shaded):

(((6 + 9) / 3) * (6 - 4))



Before computing 6 + 9

After computing 6 + 9

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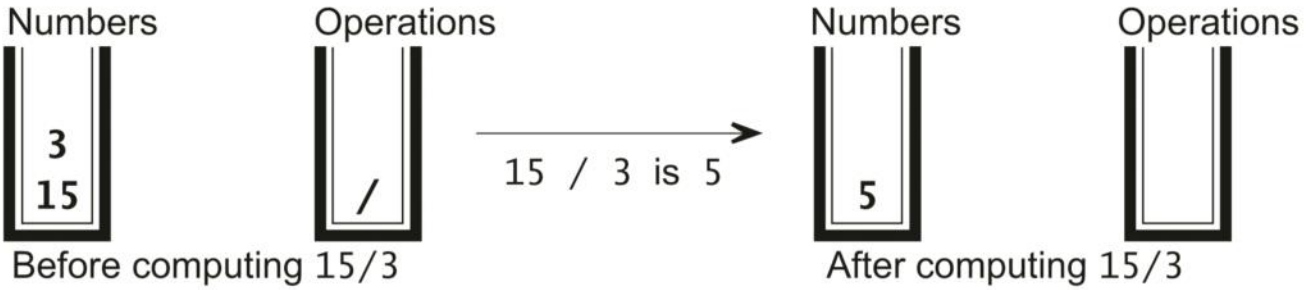
Evaluating a fully parenthesized infix expression

Characters read so far (shaded):

(((6 + 9) / 3) * (6 - 4))



Before computing 15/3 After computing 15/3

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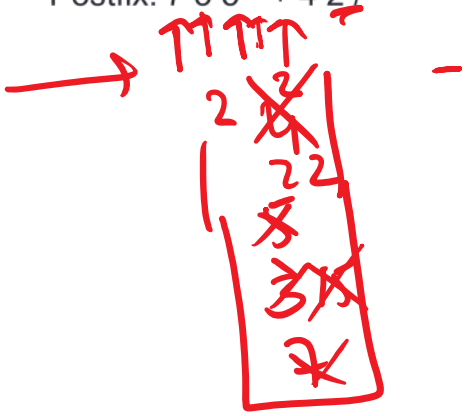
Evaluating post fix expressions using a single stack

Postfix: 7 3 5 * + 4 2 / -

Infix: (7 + (3 * 5)) – (4 / 2)



22 - 2

3 → 5

7 + 15

Pop out of the stack every time you encounter an operator

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C++ Iterators

- Iterators are generalized pointers.
- Let's consider a very simple algorithm (printing in order) applied to a very simple data structure (sorted array)

10	20	25	30	46	50	55	60

```
void print_inorder(int* p, int size) {
    for(int i=0; i<size; i++) {
        std::cout << *p << std::endl;
        ++p;
    }
}
```

- We would like our print "algorithm" to also work with other data structures
- How should we modify it to print the elements of a LinkedList?

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C++ Iterators

Consider our implementation of LinkedList

```
void print_inorder(LinkedList<int> *p, int size)  {
    for(int i=0; i<size; i++)
    {
        std::cout << *p <<std::endl;
        ++p;
    }
}
```

When will the above code work?

A. The operator "<<" is overloaded to print the data key of a LinkedList Node
B. The LinkedList class overloads the ++ operator
C. Both A and B
D. None of the above

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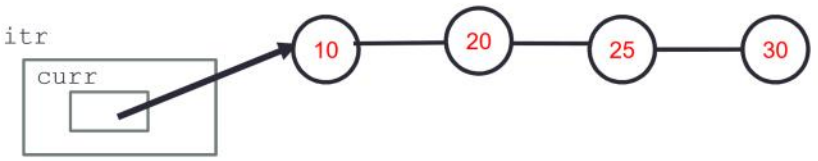
C++ Iterators

- To solve this problem the LinkedList class has to supply to the client (print_inorder) with a generic pointer (an iterator object) which can be used by the client to access data in the container sequentially, without exposing the underlying details of the class

```
void print_inorder(LinkedList<int>& ll)  {
  LinkedList<int>::iterator itr = ll.begin();
  LinkedList<int>::iterator en = ll.end();

  while(itr!=en)
    {
        std::cout << *itr <<std::endl;
        ++itr;
    }
}
```



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Demo

- Provide an iterator to the linkedList template class written in last lecture

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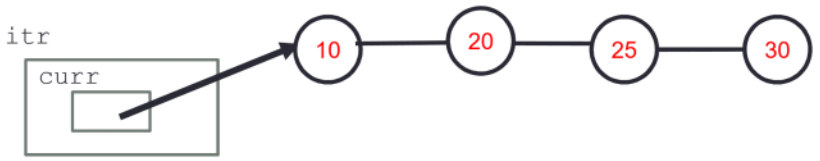
C++ Iterators

```
void print_inorder(LinkedList<int>& ll)  {
  LinkedList<int>::iterator itr = ll.begin();
  LinkedList<int>::iterator en = ll.end();

  while(itr!=en)
    {
        std::cout << *itr <<std::endl;
        ++itr;
    }
}
```

What should **begin()** return?

A. The address of the first node in the linked list container class
B. An iterator type object that contains the address of the first node
C. None of the above



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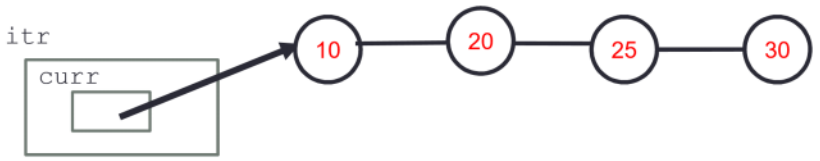
C++ Iterators

```
void print_inorder(LinkedList<int>& ll)  {
  LinkedList<int>::iterator itr = ll.begin();
  LinkedList<int>::iterator en = ll.end();

  while(itr!=en)
    {
        std::cout << *itr <<std::endl;
        ++itr;
    }
}
```

List the operators that the iterator has to implement?

A. *
B. ++
C. !=
D. All of the above
E. None of the above



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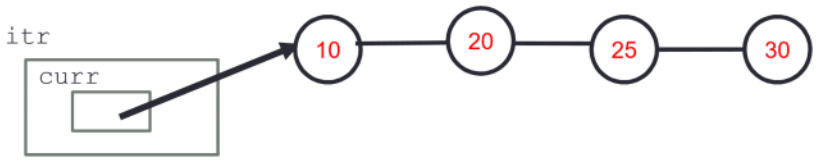
C++ Iterators

```
void print_inorder(LinkedList<int>& ll)  {
  LinkedList<int>::iterator itr = ll.begin();
  LinkedList<int>::iterator en = ll.end();

  while(itr!=en)
    {
        std::cout << *itr <<std::endl;
        ++itr;
    }
}
```

How should the diagram change as a result of the statement ++itr; ?



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C++ Iterators

```
void print_inorder(LinkedList<int>& ll)  {
  auto itr = ll.begin();
  auto en = ll.end();

  while(itr!=en)
    {
        std::cout << *itr <<std::endl;
        ++itr;
    }
}
```

How should the diagram change as a result of the statement ++itr; ?