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# Doubly linked lists and freeList node caches

Comp Sci 1575 Data Structures



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The code that is the hardest to debug is the code you know  
can't possibly be wrong.

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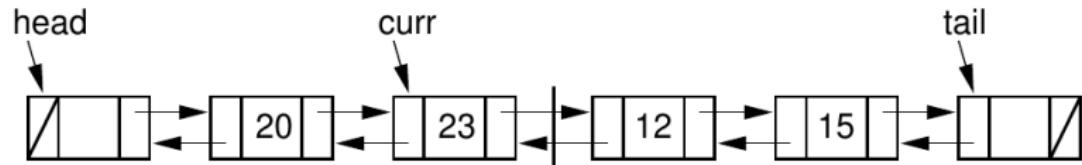
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- Doubly linked list has a set of sequentially linked nodes.
- Each node contains pointers to the previous and next node.
- Head and tail nodes are often empty/null, but not always.

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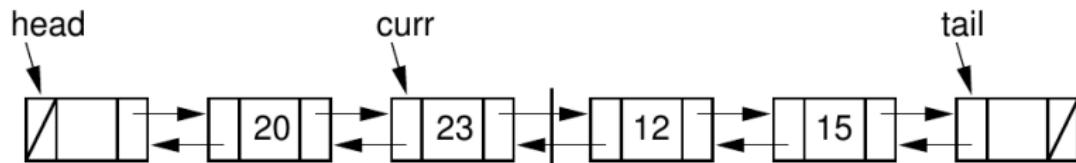
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- We no longer need to insert after current; however to keep the same functions as we have for the singly linked list, we will keep curr as pointing to the item before the operations being performed.
- Some functions, like prev(), are simpler with doubly linked lists than singly

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# Very few changes to node class from singly linked

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Comparing *node\_FL.h* to *node\_FL\_DL.h* :

- Add second pointer, pointing to previous node
- Each node now has two pointers and a data element
- Tweak constructor slightly to accommodate new pointer
- Check it out!

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# Do Q2

# Very few changes to doubly from singly linked class

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Comparing *list\_L.h* to *list\_DL.h* :

- *insert()*, *append()*, *remove()*, and *prev()* are the only functions which change appreciably.
- Check it out!

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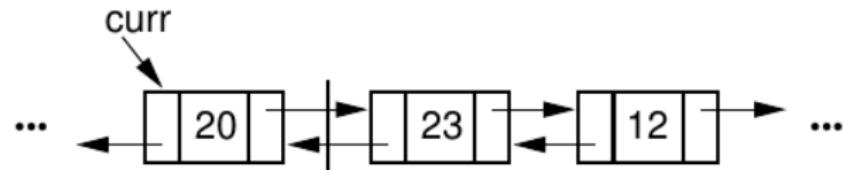
Solution

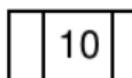
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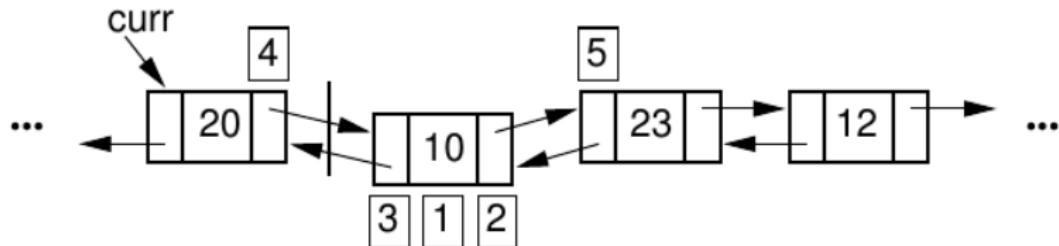
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Insert 10: 

(a)



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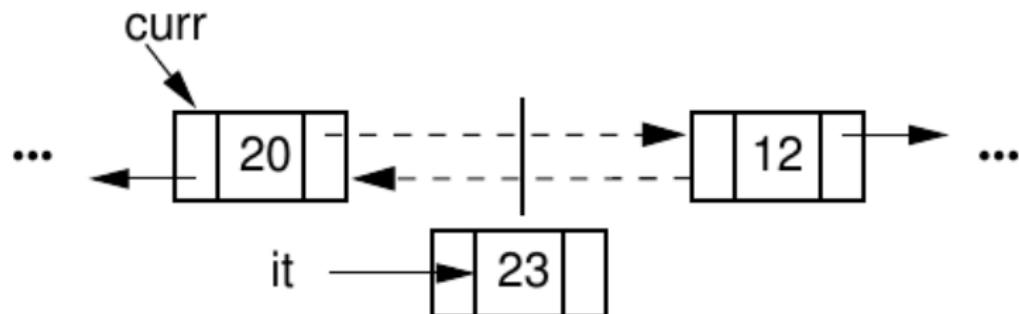
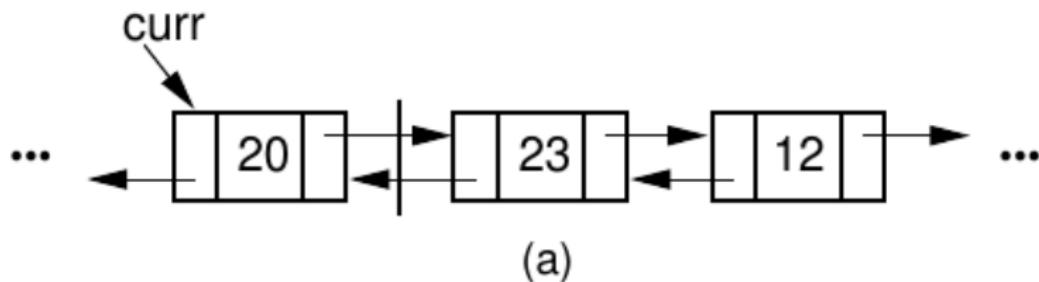
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# Operation steps related list size increase?

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	ArrayList	LinkedList	DLinkedList
Insert()	n	1	1
append()	1	1	1
remove()	n	1	1
moveToStart/End()	1	1	1
prev()	1	n	1
next()	1	1	1
length() cnt or re-calc	1	1 or n	1 or n
currPos()	1	n or 1	n or 1
moveToPos()	1	n	n
getValue() curr or spec	1	1 or n	1 or n
clear()	=	$\geq$	$\geq$

Differences between these data structures are moderate, but for other structures, choosing wrong might be the difference between tractable and not

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- Only significant disadvantage of doubly linked list compared to singly is additional space usage
- Only significant advantage over LinkedList is prev()

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- Circularly linked lists (instead of sentinel head/tail nodes)
- Data elements which are just pointers, so multiple lists can point to the same data: the larger the elements and the more they are duplicated, the more likely that pointers to shared elements is the better approach.

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- We create and delete nodes regularly with linked lists
- **new** and **delete** are relatively expensive
- With a dynamic array, we might only create a larger array every now and then.
- Is there a similar solution for our linked lists composed of node elements?

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# Cache of Node items: freelist

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- Generally, cache stores data in an easily accessible temporary location so future requests for that data can be faster (many applications and levels of caching)
- **freelist** holds some nodes not currently being used
- Rather than call standard new and delete:
  - overloaded **new** will take from the node cache and give to the list
  - overloaded **delete** will take from the list and give to the cache

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- To **delete** a node from linked list, place at head of the freelist
- To add a **new** node to a linked list, check freelist for available nodes, and if available, take node from head of freelist
- If freelist is empty, standard **new** operator called
- freelist should be a static variable. Why?

# Shared freelist between lists of the same type

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In the node class itself:

```
static Node<E> *freelist ;
```

- This creates a single variable shared among all instances of the Link nodes of a given type
- Even with one template class, the compiler automatically gives each type of the class its own class type, and thus its own freelist

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- Are freelist useful if your list only grows and never shrinks?
- Useful for linked lists that periodically grow and then shrink.
- Will never grow larger than largest size yet reached
- Operator overloading of **new** and **delete** is invisible to user, and hidden in node class

# Only change: overloaded operators in Node class

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- Linked list has two classes: *list\_L.h* and *node.h*
- *node\_FL.h* replaces *node.h*
- The list class (*list\_L.h*) doesn't have to change at all, or know that the node class has changed!
- Main just needs a new include `#include "node_FL.h"`
- Check it out.