

OPERATOR OVERLOADING

GDB

RECURSION

INTRO TO PA01

Problem Solving with Computers-II

C++

```
#include <iostream>
using namespace std;

int main(){
    cout<<"Hola Facebook!n";
    return 0;
}
```



PA01: Card matching game with linked lists

Alice:

<p>3♥</p>  <p>Genevieve Bell Australian National Univ. Director - Autonomy, Agency and Assurance Institute, ABI Woman of Vision, WITI Hall of Fame. <i>Known for:</i> combining anthropology and tech to explore social, cultural aspects of ubiquitous computing.</p> <p>http://en.wikipedia.org/wiki/Genevieve_Bell</p> <p>♠ 2</p>	<p>2♠</p>  <p>Fran Bilas ENIAC computer programmer team 1946, WITI Hall of Fame. <i>Known for:</i> being a pioneer in programming the first electronic general-purpose computer.</p> <p>http://en.wikipedia.org/wiki/Fran_Bilas</p> <p>♠ 2</p>	<p>A♣</p>  <p>Vicki Hanson CEO of ACM, Former RIT Distinguished Prof., Prof. Univ. of Dundee, Fellow Royal Society of Edinburgh, ACM Fellow, ABI Woman of Vision. <i>Known for:</i> contributions to computing technologies for people with disabilities.</p> <p>http://en.wikipedia.org/wiki/Vicki_L._Hanson</p> <p>♣ A</p>	<p>3♣</p>  <p>Sophie Wilson Designer Acorn Microcomputer, Broadcom Director IC Design, Computer History Museum Fellow, Fellow of the Royal Society. <i>Known for:</i> computer hardware design and for leadership in the transgender technical community.</p> <p>http://en.wikipedia.org/wiki/Sophie_Wilson</p> <p>♣ 3</p>	<p>9♥</p>  <p>Irene Greif ABIE Award for Technical Leadership, IBM User Experience Group, ACM Fellow, AAAS Fellow, Formed Lotus Research 1992. <i>Known for:</i> pioneering the field of Computer Supported Cooperative Work.</p> <p>http://en.wikipedia.org/wiki/Irene_Greif</p> <p>♥ 6</p>	<p>A♠</p>  <p>Radia Perlman Intel Fellow, IEEE and ACM Fellow, first ABI Woman of Vision award winner, National Inventors Hall of Fame, Internet Hall of Fame. <i>Known for:</i> contributions to network routing and security protocols.</p> <p>http://en.wikipedia.org/wiki/Radia_Perlman</p> <p>♠ A</p>
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Bob:

<p>2♣</p>  <p>Jean Bartik ENIAC computer programmer team 1946, Fellow Computer History Museum, IEEE Computer Pioneer Award. <i>Known for:</i> being a pioneer in programming the first electronic general-purpose computer.</p> <p>http://en.wikipedia.org/wiki/Jean_Bartik</p> <p>♣ 2</p>	<p>A♠</p>  <p>Radia Perlman Intel Fellow, IEEE and ACM Fellow, first ABI Woman of Vision award winner, National Inventors Hall of Fame, Internet Hall of Fame. <i>Known for:</i> contributions to network routing and security protocols.</p> <p>http://en.wikipedia.org/wiki/Radia_Perlman</p> <p>♠ A</p>	<p>J♦</p>  <p>Yueqing Gao Former IBM Distinguished Engineer, ABI Women of Vision, IEEE Fellow. <i>Known for:</i> contributions to speech recognition and speech-to-speech translation.</p> <p>https://en.wikipedia.org/wiki/Yueqing_Gao</p> <p>♦ J</p>	<p>9♥</p>  <p>Irene Greif ABIE Award for Technical Leadership, IBM User Experience Group, ACM Fellow, AAAS Fellow, Formed Lotus Research 1992. <i>Known for:</i> pioneering the field of Computer Supported Cooperative Work.</p> <p>http://en.wikipedia.org/wiki/Irene_Greif</p> <p>♥ 6</p>	<p>3♣</p>  <p>Sophie Wilson Designer Acorn Microcomputer, Broadcom Director IC Design, Computer History Museum Fellow, Fellow of the Royal Society. <i>Known for:</i> computer hardware design and for leadership in the transgender technical community.</p> <p>http://en.wikipedia.org/wiki/Sophie_Wilson</p> <p>♣ 3</p>
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Review PA01: Card matching game with linked lists

Correct output after running `make && ./game alice_cards.txt bob_cards.txt`:

```
Alice picked matching card c 3
Bob picked matching card s a
Alice picked matching card h 9
```

Alice's cards:

```
h 3
s 2
c a
```

Bob's cards:

```
c 2
d j
```

Note: 0=10, a=ace, k=king, q=queen, j=jack

Contents of `alice_cards.txt`:



Contents of `bob_cards.txt`:



GDB: GNU Debugger

- To use gdb, compile with the -g flag
 - Setting breakpoints (b)
 - Running programs that take arguments within gdb (r arguments)
 - Continue execution until breakpoint is reached (c)
 - Stepping into functions with step (s)
 - Stepping over functions with next (n)
 - Re-running a program (r)
 - Examining local variables (info locals)
 - Printing the value of variables with print (p)
 - Quitting gdb (q)
 - Debugging segfaults with backtrace (bt)
- * Refer to the gdb cheat sheet: <http://darkdust.net/files/GDB%20Cheat%20Sheet.pdf>

Overloading Binary Comparison Operators

We would like to be able to compare two objects of the class using the following operators

==

!=

and possibly others

Last class: overloaded == for LinkedList

Overloading input/output stream

Wouldn't it be convenient if we could do this:

```
LinkedList list;  
cout<<list; //prints all the elements of list
```

Overloading Binary Arithmetic Operators

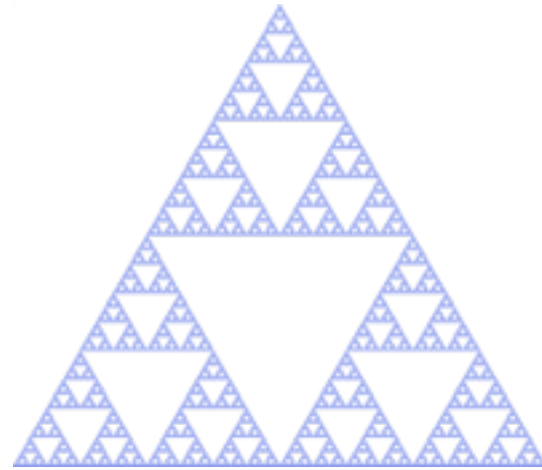
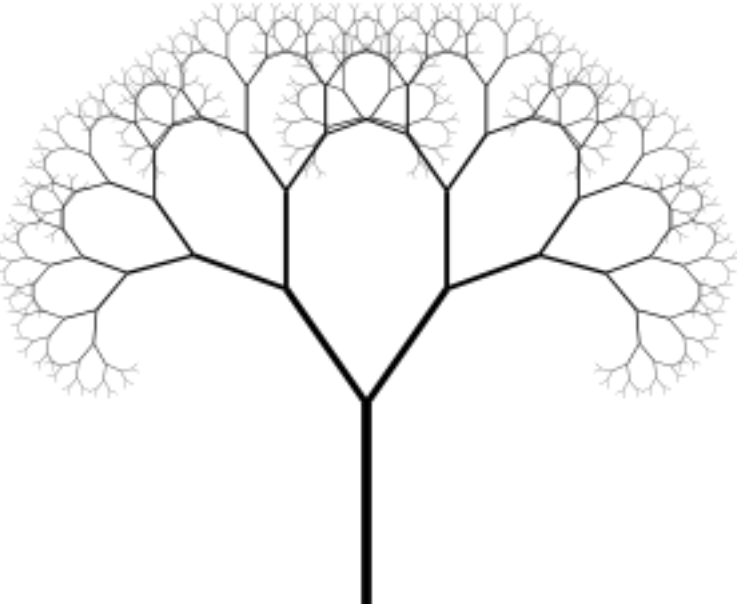
We would like to be able to add two points as follows

```
LinkedList l1, l2;
```

```
//append nodes to l1 and l2;
```

```
LinkedList l3 = l1 + l2 ;
```

Recursion



Sierpinski triangle



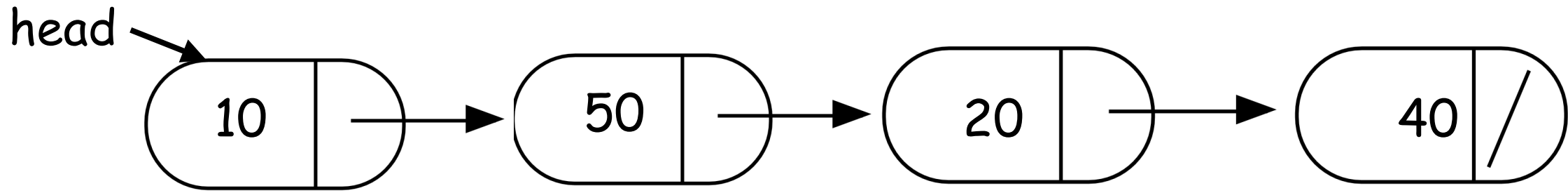
Zooming into a Koch's snowflake



Describe a linked-list recursively

Which of the following methods of LinkedList CANNOT be implemented using recursion?

- A. Find the sum of all the values
- B. Print all the values
- C. Search for a value
- D. Delete all the nodes in a linked list
- E. All the above can be implemented using recursion



```
int IntList::sum() {
```

```
    //Return the sum of all elements in a linked list
```

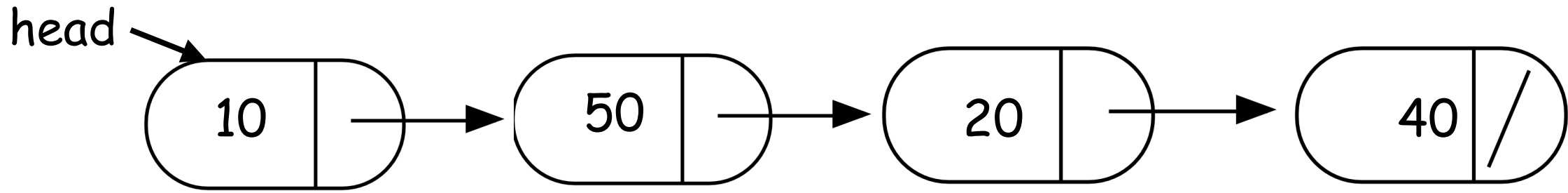
```
}
```

Helper functions

- Sometimes your functions takes an input that is not easy to recurse on
- In that case define a new function with appropriate parameters: This is your helper function
- Call the helper function to perform the recursion
- Usually the helper function is private

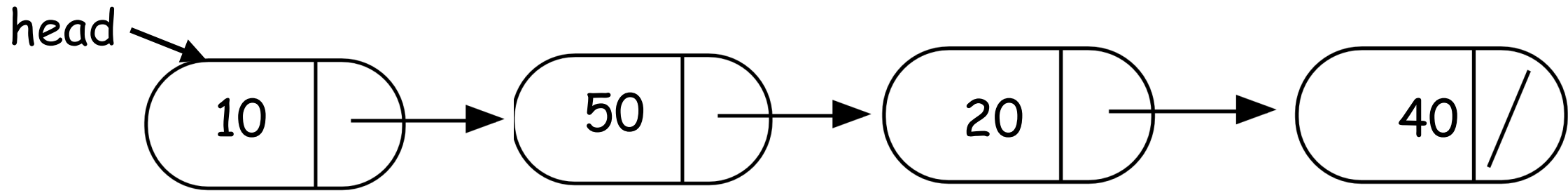
For example

```
Int IntList::sum() {  
    return sum(head);  
    //helper function that performs the recursion.  
}
```



```
int IntList::sum(Node* p) {
```

```
}
```



```
bool IntList::clear(Node* p) {
```

```
}
```

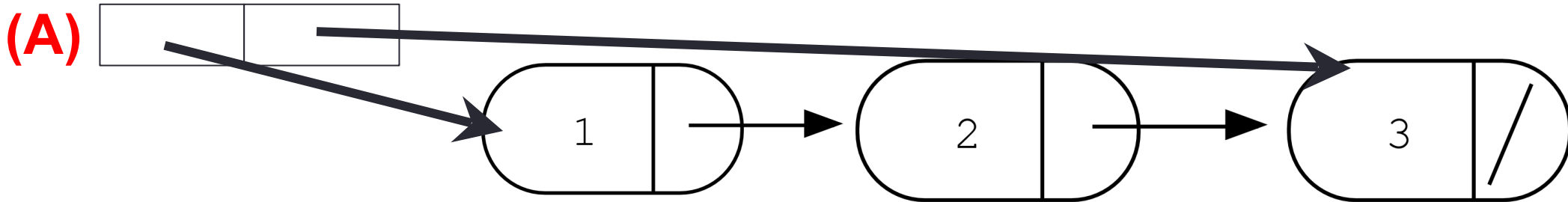
Concept Question

```
LinkedList::~~LinkedList(){  
    delete head;  
}
```

```
class Node {  
    public:  
        int info;  
        Node *next;  
};
```

Which of the following objects are deleted when the destructor of Linked-list is called?

head tail



(B): only the first node

(C): A and B

(D): All the nodes of the linked list

(E): A and D

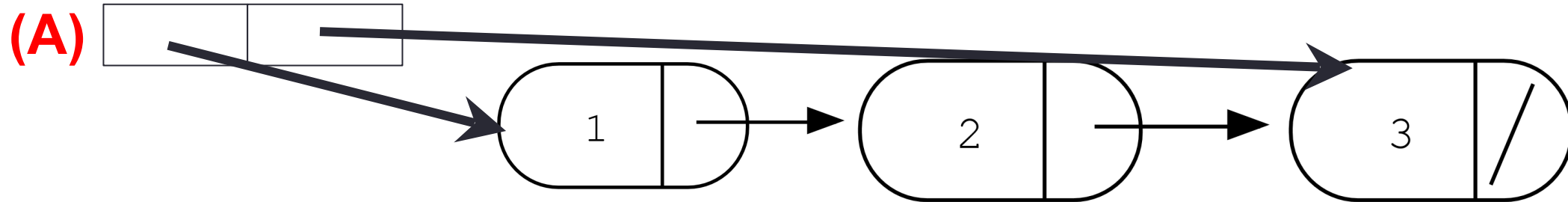
Concept question

```
LinkedList::~~LinkedList(){  
    delete head;  
}
```

```
Node::~~Node(){  
    delete next;  
}
```

Which of the following objects are deleted when the destructor of Linked-list is called?

head tail



(B): All the nodes in the linked-list

(C): A and B

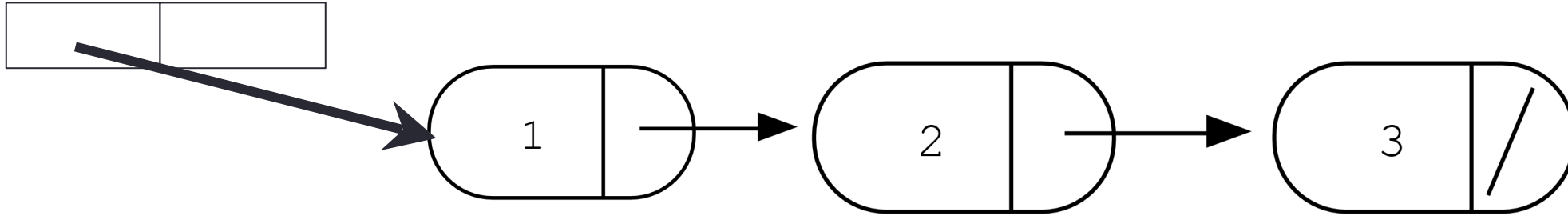
(D): Program crashes with a segmentation fault

(E): None of the above

```
LinkedList::~~LinkedList(){
    delete head;
}
```

```
Node::~~Node(){
    delete next;
}
```

head tail



Next time

- Binary Search Trees