INTRO TO PA02
RULE OF THREE
RECURSION
GDB

Problem Solving with Computers-II

Announcements

- PA01 due tomorrow (1/29)- you may submit until this date for a 5% deduction.
- Lab02 due Thursday (1/31)
- Midterm next week (Monday)(02/04) - All topics covered so far.
- PA02: checkpoint due next week (02/06), final deadline (02/15)

Review PA02: Card matching game involving linked lists

Expected files: Makefile, main.cpp, cards.cpp, cards.h, testcards.cpp

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`:

```
h 3
s 2
c a
c 3
h 9
s a
```

Contents of `bob_cards.txt`:

```
c 2
s a
d j
h 9
c 3
```

Review PA02: Checkpoint: Design and test!

Expected files: Makefile, main.cpp, cards.cpp, cards.h, gameplan.cpp, testcards.cpp

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

```
Alice's cards:
h 3
s 2
c a
c 3
h 9
s a

Bob's cards:
c 2
s a
d j
h 9
c 3
```

Contents of `alice_cards.txt`:

```
h 3
s 2
c a
c 3
h 9
s a
```

Contents of `bob_cards.txt`:

```
c 2
s a
d j
h 9
c 3
```

RULE OF THREE

If a class defines one (or more) of the following it should probably explicitly define all three:

1. Destructor
2. Copy constructor
3. Copy assignment

The questions we ask are:

1. What is the behavior of these defaults (taking linked lists as our running example)?

2. Is the default behavior the outcome we desire ?

3. If not, how should we overload these operators?

Behavior of default

Assume that your implementation of LinkedList uses the default destructor, copy constructor, copy assignment

```
void test_defaults(){
    LinkedList l1;
    l1.append(1);
    l1.append(2);
    l1.append(5);
    l1.print();
}
```

What is the expected behavior of the above code?

A. Compiler error

B. Memory leak

C. Code is correct, output: 1 2 5

D. None of the above

Behavior of default copy constructor

Assume that your implementation of LinkedList uses the overloaded destructor, default: copy constructor, copy assignment

l1 : 1 -> 2- > 5 -> null

```
void test_default_copy_constructor(LinkedList& l1){
    // Use the copy constructor to create a
    // copy of l1




}
* What is the default behavior?
* Is the default behavior the outcome we desire ?
* How do we change it?
```

Behavior of default copy assignment

Assume that your implementation of LinkedList uses the overloaded destructor, copy constructor, default copy assignment

l1 : 1 -> 2- > 5 -> null

```
void test_default_1(LinkedList& l1){
   LinkedList l2;
   l2 = l1;
}
* What is the default behavior?
```

Behavior of default copy assignment

Assume that your implementation of LinkedList uses the overloaded destructor, default: copy constructor, copy assignment

l1 : 1 -> 2- > 5 -> null

```
void test_default_2(LinkedList& l1){
    // Use the copy assignment
    LinkedList l2;
    l2.append(10);
    l2.append(20);
    l2 = l1;
}
* What is the default behavior?
```

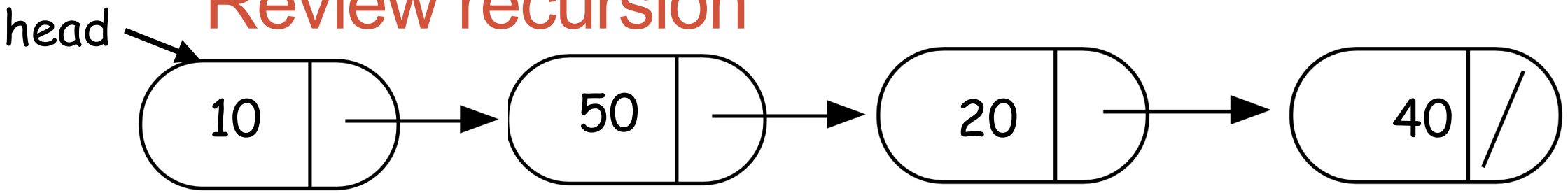
Behavior of default copy assignment

Assume that your implementation of LinkedList uses the overloaded destructor, copy constructor, default copy assignment

l1 : 1 -> 2- > 5 -> null

```
void test_default_assignment(LinkedList& l1){
    // Use the copy assignment
    LinkedList l2;
    l2.append(10);
    l2.append(20);
    l2 = l1;
    l1 = l1;
}
* What is the default behavior?
```

Review recursion




```
int IntList::search(int value){

      //Search for a value in a linked list
      //using recursion
   }
```

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

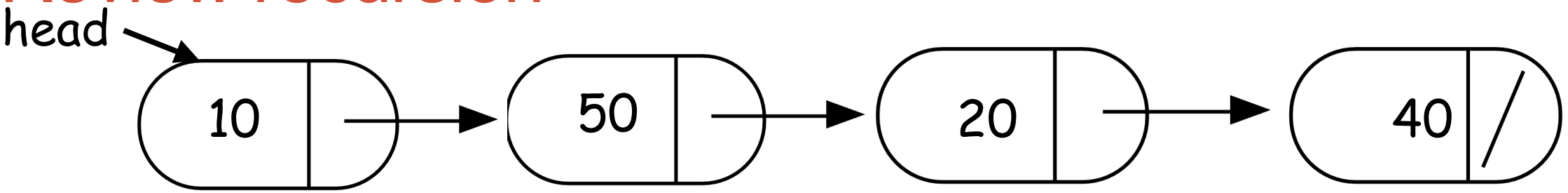
For example

```
bool IntList::search(int value){

   return searchHelper(head, value);
    //helper function that performs the recursion.

}
```

Review recursion




```
int IntList::searchHelper(int value){

   if(!head) return false;
    if (head->value == value)
        return true;

    search(head->next, value);
   }
```

What is the output of
`cout<<list.searchHelper(50);`

A. Segmentation fault

B. Program runs forever

C. Prints true or 1 to screen

D. Prints nothing to screen

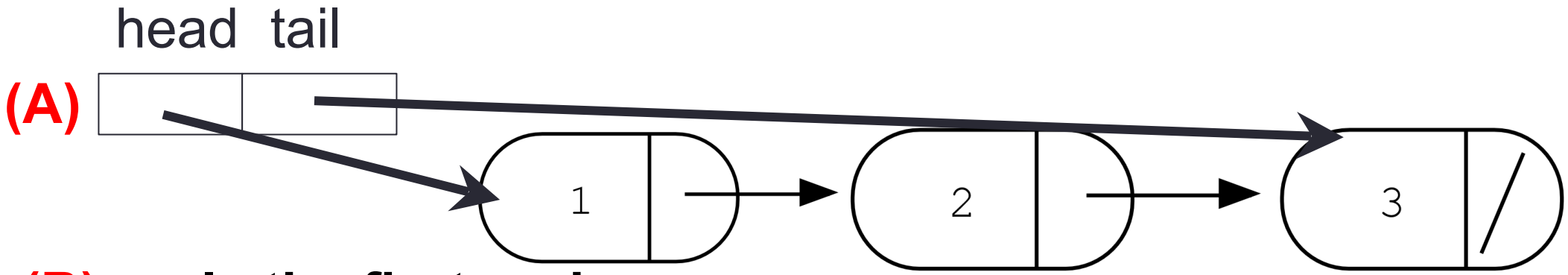
E. None of the above

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?



(B): only the first node

(C): A and B

(D): All the nodes of the linked list

(E): A and D

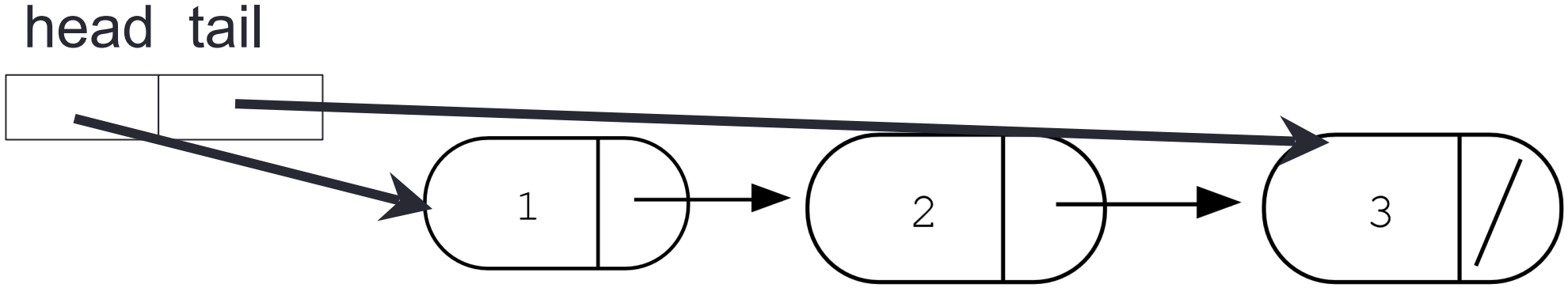
Concept question

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

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

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

(A)



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

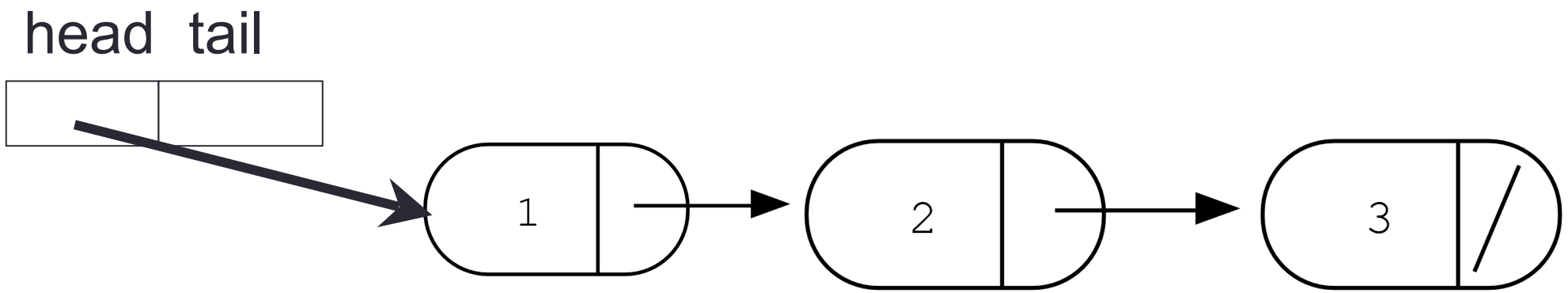
(C): A and B

(D): Program crashes with a segmentation fault

(E): None of the above

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

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



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

Next time

- Complexity and running time analysis