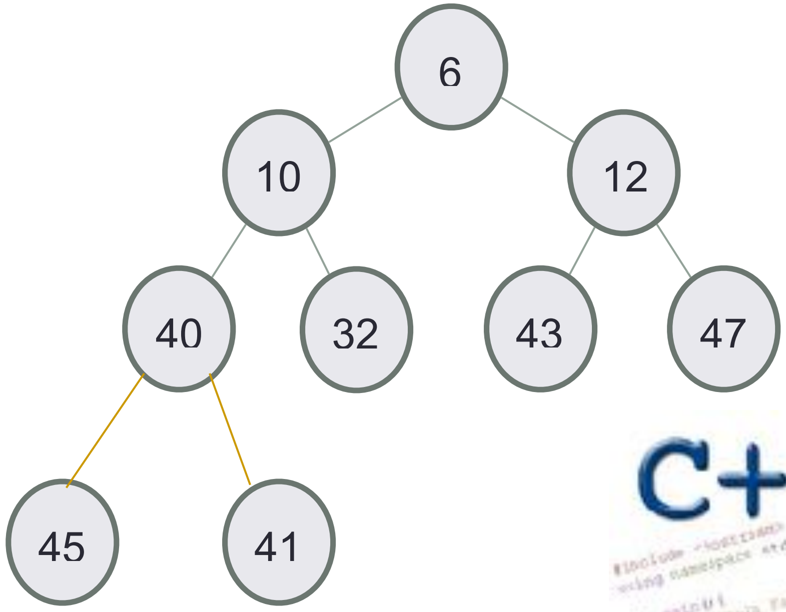
RECURSION

Problem Solving with Computers-I



Let recursion draw you in….

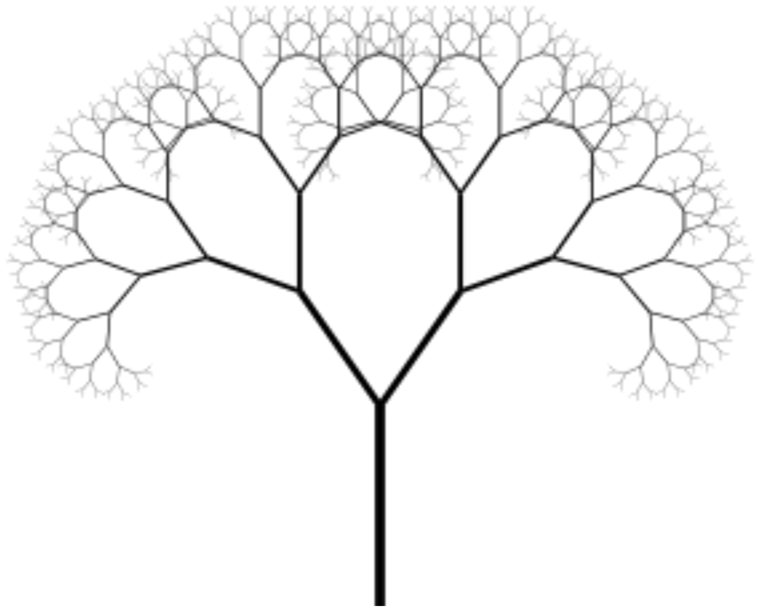
- Identify the “recursive structure” in these pictures by describing them

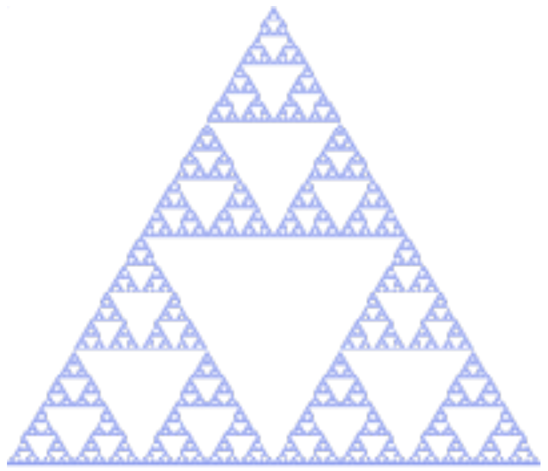
Understanding recursive structures

- Recursive names: The pioneers of open source and free software used clever recursive names

GNU IS NOT UNIX

- Recursive structures in fractals





Sierpinski triangle

Zooming into a Koch's snowflake

Why is recursion important in Computer Science

Tool for solving problems (recursive algorithms)

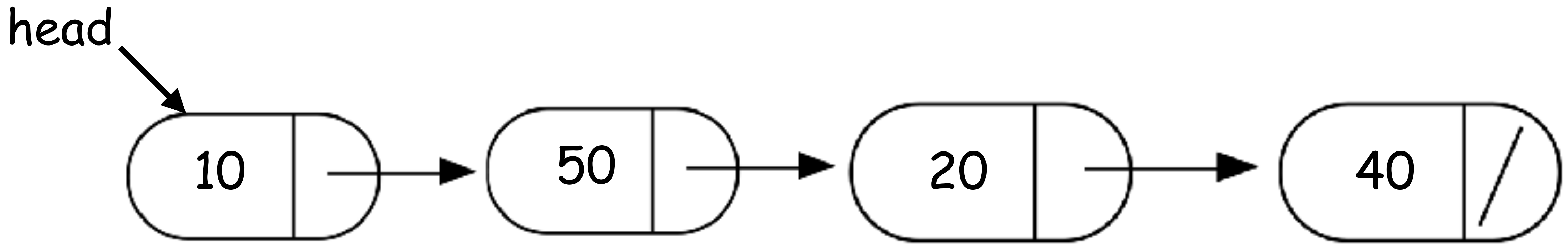
```
To wash the dishes in the sink:
    Wash the dish on top of the stack
    If there are no more dishes
            you are done!
      Else:
          Wash the *remaining* dishes in the sink
```

A new way of looking at inputs

Arrays:

- Non-recursive description: **a sequence of elements**
- Recursive description: **an element, followed by a smaller array**

Recursive description of a linked list



- Non-recursive description of the linked list: **chain of nodes**
- Recursive description of a linked-list: **a node, followed by a smaller linked list**

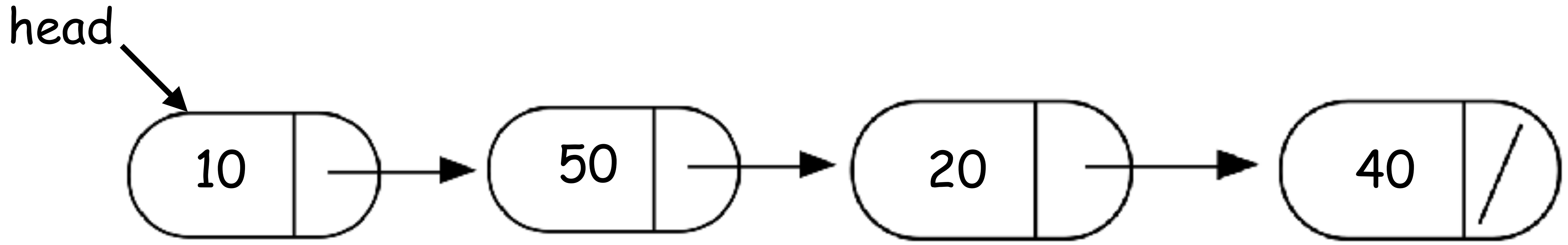
Designing recursive code: print all the elements of an array

Arrays:

- Recursive description: **an element, followed by a smaller array**

Designing recursive code: sum elements in a linked-list

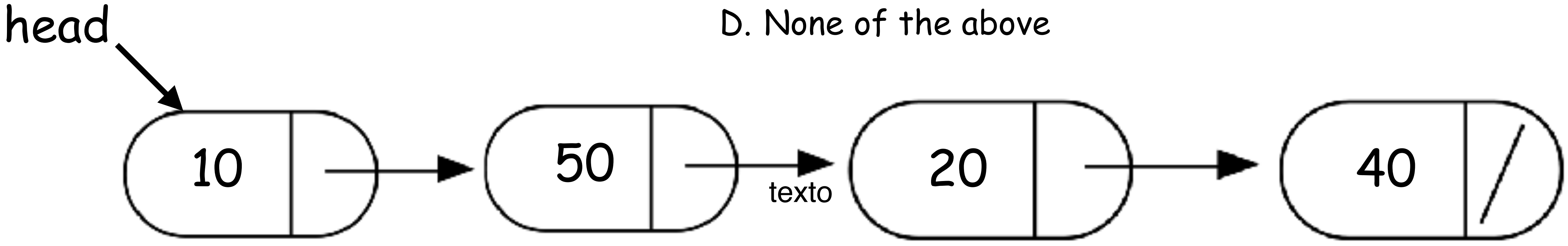
- Recursive description of a linked-list: **a node, followed by a smaller linked list**



What's in a base case?

What happens when we execute this code on the example linked list?

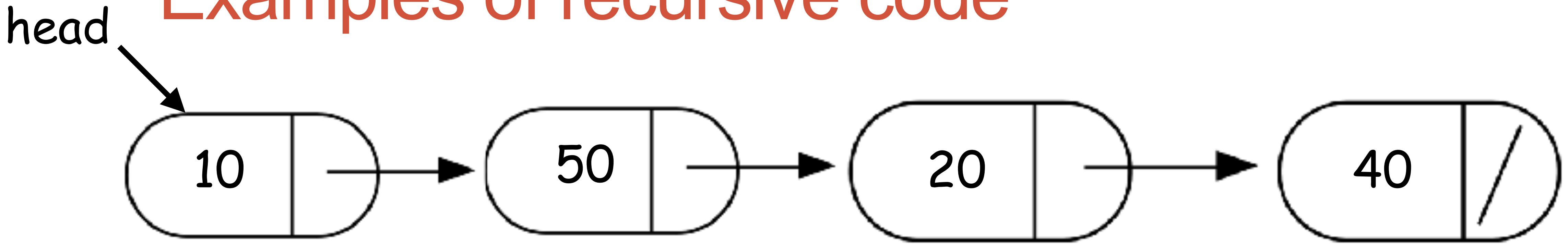
A. Returns the correct sum (120)
[✓ B.] Program crashes with a segmentation fault
C. Program runs forever
D. None of the above



```
double sumList(Node* head){

    double sum = head->value + sumList(head->next);
    return sum;
}
```

Examples of recursive code



```
double sumList(Node* head){
    if(!head) return 0;



    double sum = head->value + sumList(head->next);



    return sum;
  }
```

Find the min element in a linked list

```
double min(Node* head){
    // Assume the linked list has at least one node
    assert(head);
    // Solve the smallest version of the problem






  }
```

See code written in lecture for the complete solution

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

For example

```
double sumLinkedList(LinkedList* list){
    return sumList(list->head); //sumList is the helper
    //function that performs the recursion.

}
```