This Lab Exercise is an **extension of Lab 18a**. If you have not completed Lab 18a, you should work on that first.

Due Date

You must *submit* the source code for the solution to this lab exercise to *Moodle* by

Monday, December 4, 2023

in order to receive full credit for this work. You must also *demonstrate* the solution to the instructor during class, at the earliest opportunity.

Programming Exercise

Enhance your code from Lab 18a to include recursive use of the linked list.

Interactive Commands from Lab 18a

The commands (from Lab 18a) that must still be supported are:

- **a** APPEND a new node at the end of the list
- **c** COUNT the nodes in the list (display the list length).
- **d** DELETE a node from the list
- **i** INSERT a node into the list, maintaining the sorted order.
- **m** display the MAXIMUM (largest) value in the list.
- **p** PRINT the contents of the list.
- **h** HELP text
- **q** QUIT (end the program)
- **t** display the TOTAL of all values in the list.

The APPEND, DELETE, and INSERT commands must prompt the user to enter an integer value.

New Interactive Commands for Lab 20a

The new commands that must be supported are:

- **r** RECURSIVELY print the contents of the list (in the normal "forward" direction).
- **b** Recursively print the contents of the list BACKWARDS**.** (We discussed **how** to do this during class.)
- **n** (lower-case 'N') recursively count the NUMBER of nodes in the list.
- **s** (lower-case 'S') recursively calculate the SUM of all values in list.

New EXTRA CREDIT (optional) Command

- **l** (lower-case 'L') recursively calculate the LARGEST value in the list.

(Continued on the next page.)

Sample Input / Output

A sample input / output session is shown beginning below, and continuing on the following pages. (In this example, the text that the user enters is shown in a larger, **bold** font. In actuality, all text appears in the same font.)

The initial steps in this sample input/output session utilize commands that were originally implemented in **Lab18a**. Then, after the linked list contains enough sample data, the new (recursive) commands are demonstrated.

This sample input / output session also includes the optional (extra credit) "**l**" (lower-case L) command.

Sample Input / Output

```
Command: h
Supported commands:
   a     APPEND a value to the list.
   b     BACKWARDS RECURSIVE PRINT: use recursion to print the list backwards.
   c     COUNT nodes in the list, using a loop.
   d     DELETE a value from the list.
   i     INSERT a value into the list.
   l     (lower-case 'L') recursively determine LARGEST value in list.
   m     calculate MAXIMUM value in the list.
   n     use RECURSION to count the NUMBER of nodes in the list.
   p     PRINT the list contents.
   r     RECURSIVE PRINT: use recursion to print the list contents.
   s     recursively calculate SUM of all values in list.
   t     Calculate TOTAL of all values in the list.
   h     print help text.
   q     quit (end the program).


Command: i
Enter number to insert into the list: 4

Command: i
Enter number to insert into the list: 54

Command: i
Enter number to insert into the list: 3

Command: i
Enter number to insert into the list: 99
```

Sample Input / Output

```
Command: i
Enter number to insert into the list: 55

Command: i
Enter number to insert into the list: 6

Command: p
head=0000021E51E515A0
0000021E51E515A0:  value=   3 next=0000021E51E51B40
0000021E51E51B40:  value=   4 next=0000021E51E51BE0
0000021E51E51BE0:  value=   6 next=0000021E51E51EB0
0000021E51E51EB0:  value=  54 next=0000021E51E514B0
0000021E51E514B0:  value=  55 next=0000021E51E51460
0000021E51E51460:  value=  99 next=0000000000000000

Command: c
Number of nodes in list, head=0000021E51E515A0, count=6

Command: m
MAX data value = 99

Command: t
Total of all value fields in list, head=0000021E51E515A0, total=221

Command: a
Enter number to append to the list: 2

Command: p
head=0000021E51E515A0
0000021E51E515A0:  value=   3 next=0000021E51E51B40
0000021E51E51B40:  value=   4 next=0000021E51E51BE0
0000021E51E51BE0:  value=   6 next=0000021E51E51EB0
0000021E51E51EB0:  value=  54 next=0000021E51E514B0
0000021E51E514B0:  value=  55 next=0000021E51E51460
0000021E51E51460:  value=  99 next=0000021E51E51640
0000021E51E51640:  value=   2 next=0000000000000000

Command: r
Recursive print of list, head=0000021E51E515A0
0000021E51E515A0:  value=   3 next=0000021E51E51B40
0000021E51E51B40:  value=   4 next=0000021E51E51BE0
0000021E51E51BE0:  value=   6 next=0000021E51E51EB0
0000021E51E51EB0:  value=  54 next=0000021E51E514B0
0000021E51E514B0:  value=  55 next=0000021E51E51460
0000021E51E51460:  value=  99 next=0000021E51E51640
0000021E51E51640:  value=   2 next=0000000000000000
```

Sample Input / Output

```
Command: b
BACKWARDS recursive print of list, head=0000021E51E515A0
0000021E51E51640:  value=   2 next=0000000000000000
0000021E51E51460:  value=  99 next=0000021E51E51640
0000021E51E514B0:  value=  55 next=0000021E51E51460
0000021E51E51EB0:  value=  54 next=0000021E51E514B0
0000021E51E51BE0:  value=   6 next=0000021E51E51EB0
0000021E51E51B40:  value=   4 next=0000021E51E51BE0
0000021E51E515A0:  value=   3 next=0000021E51E51B40

Command: c
Number of nodes in list, head=0000021E51E515A0, count=7

Command: n
Number of nodes in the list =7

Command: t
Total of all value fields in list, head=0000021E51E515A0, total=223

Command: s
The sum of all data values is 223.

Command: m
MAX data value = 99

Command: l
LARGEST data value = 99

Command: q
Exiting program with status = 0
```