CS261: HOMEWORK 4
Due 04/20/2011, at 2pm

Submit three files via the TEACH website:

https://secure.engr.oregonstate.edu:8000/teach.php?type=want_auth

General Instructions
This homework assignment consists of 2 parts, and will be graded for a total of 114 points. The points for each part are indicated at the beginning of the corresponding section in this writeup. For both part 1 and part 2, you are provided with header and implementation files. The implementation files should be completed without changing the existing content. If you have any questions regarding HW4, please email cs261-sp11@engr.orst.edu.

What to turn in
You will submit the following completed files:

- list.c
- listbag.c
- cirListDeque.c

Please use this file-naming convention. Make sure your code compiles with gcc on Unix. We have zero tolerance for compiling errors. Try to compile on flop.engr.oregonstate.edu. Design a number of test examples to thoroughly check for any errors in your code.

Part 1 – 58pts : Deque as Circularly-Doubly-Linked List
In this assignment, you will complete the implementation of a deque with Circularly-Doubly-Linked List with a sentinel. The list is circular, because the end points back to the beginning. Therefore, just one sentinel suffices. The sentinel is a special link, does not contain a value, and should not be removed. Using a sentinel makes some linked list operations easier and cleaner in implementation.

The header file and the implementation file, provided to you for this approach, are cirListDeque.h and cirListDeque.c, respectively. Some functions in the implementation (cirListDeque.c) have been completed. The comments for each function will help you understand what each function should be doing. Complete the remaining functions in cirListDeque.c. DO NOT change the provided functions and header files.

Provided Files for Part 1:

- cirListDeque.h
- cirListDeque.c
Scoring for Part 1:

1) `void initCirListDeque (struct cirListDeque *q)` = 2pts
2) `struct DLink * _createLink (TYPE val)` = 2pts
3) `void _addLinkAfter(struct cirListDeque *q, struct DLink *lnk, struct DLink *newLnk)` = 4pts
4) `void addBackCirListDeque (struct cirListDeque *q, TYPE val)` = 4pts
5) `void addFrontCirListDeque(struct cirListDeque *q, TYPE val)` = 4pts
6) `TYPE frontCirListDeque(struct cirListDeque *q)` = 2pts
7) `TYPE backCirListDeque(struct cirListDeque *q)` = 2pts
8) `void _removeLink(struct cirListDeque *q, struct DLink *lnk)` = 6pts
9) `void removeFrontCirListDeque (struct cirListDeque *q)` = 6pts
10) `void removeBackCirListDeque(struct cirListDeque *q)` = 6pts
11) `void freeCirListDeque(struct cirListDeque *q)` = 2pts
12) `int isEmptyCirListDeque(struct cirListDeque *q)` = 2pts
13) `void printCirListDeque(struct cirListDeque *q)` = 8pts
14) `void reverseCirListDeque(struct cirListDeque *q)` = 8pts

Part 2 – 56pts: List Bag with Recursions

The linked list implementation of a bag that we have discussed in class is an iterative version, in that the operations such as `contains()` and `remove()` are realized with iterative loops. An alternative is to implement these functions recursively.

Recall that recursion is used to implement the divide-and-conquer strategy, where the goal is to call the function itself, with smaller versions of the problem. For `contains()`, the recursive implementation is quite straightforward. The idea is to recursively call `contains()` each time with a smaller part of the list, where the base case is when the list contains only the sentinel. In the case of `contains()`, there is no ‘rebuilding’ upon return, it simply returns true or false.

The recursive `remove()` can also be implemented using the divide-and-conquer approach. In this case, the recursive process would operate on smaller lists, and re-build the list upon returning from the recursion. Specifically, the initial recursive call gets the entire list. If the element is not found in the front of the list, then the the list is broken into the current link being observed, and the rest of the list. The current link’s next is then set to the result of the recursive call on the rest of the list.

For this assignment, you are provided with the two header files and the two implementation files `type.h`, `listbag.h`, `list.c` and `listbag.c`, respectively. The goal is to implement all functionalities of a bag using the existing functions in `list.c` and `listbag.c`. Do not “invent the wheel”, but re-use existing functions, or functions that you have already written, as much as possible. For example, if you already have a function that initializes a general linked list, then you can immediately use a call to that function to initialize a bag. Some functions in the implementation files (`list.c` and `listbag.c`) have been completed. The comments for each function will help you understand what each function should be doing. Complete the remaining functions in both `list.c` and `listbag.c`. DO NOT change the provided functions and header files. Make sure that you implement the operations `contains()`, and `remove()` as recursive procedures using the divide-and-conquer approach. No partial credit will be given for any alternative implementation. Design a number of test examples to thoroughly check for any errors in your code.
Provided Files for Part 2:

- type.h
- listbag.h
- list.c
- listbag.c

Scoring for Part 2:

1) void initList (struct list *lst) = 2pts
2) void addLink(struct list *lst, struct DLink *lnk, TYPE v) = 2pts
3) void addFrontList(struct list *lst, TYPE e) = 2pts
4) void addBackList(struct list *lst, TYPE e) = 2pts
5) TYPE frontList (struct list *lst) = 2pts
6) TYPE backList(struct list *lst) = 2pts
7) void _removeLink(struct list *lst, struct DLink *lnk) = 6pts
8) void removeFrontList(struct list *lst) = 2pts
9) void removeBackList(struct list *lst) = 2pts
10) int isEmptyList(struct list *lst) = 2pts
11) int _contains_recursive(struct list *lst, struct DLink* current, TYPE e) = 10pts
12) struct DLink * _remove_recursive(struct list *l, struct DLink* current, TYPE e, int* sz) = 12pts
13) void listRemove (struct list *lst, TYPE e) = 2pts
14) void addToBag(struct bag* b, TYPE val) = 2pts
15) void removeFromBag(struct bag* b, TYPE val) = 2pts
16) int bagContains(struct bag* b, TYPE val) = 2pts
17) int isEmptyBag(struct bag* b) = 2pts