CS 201 – Data Structures II (L2), Spring 2024
Quiz # 3

Name: _____ ID: _____

Q1 –Implement a method rotate(r) that "rotates" a Doubly-Linked List so that list item *i* becomes list item *(i+r) mod n*. This method should run in *O (1 +min(r, n-r))* time and should not modify any nodes in the list.

Note: The structure of a node in the Doubly-Linked List is given below, and the DLList keeps track of both head and tail pointers.

DLList

```
struct Node {
  T x;
  Node *prev, *next;
};
```

Q2 – Given the code to add a new node to the skiplist, answer the following questions?

```
1  template<class T>
2  bool SkiplistSSet<T>::add(T x) {
3      Node *u = sentinel;
4      int r = h;
5      int comp = 0;
6      while (r >= 0) {
7          while (u->next[r] != NULL
8          && (comp = compare(u->next[r]->x, x)) < 0)
9              u = u->next[r];
10         if (u->next[r] != NULL && comp == 0)
11             return false;
12         unknown[r--] = u;
13     }
14     Node *w = newNode(x, pickHeight());
15     while (h < w->height)
16         unknown[++h] = sentinel;
17     for (int i = 0; i <= w->height; i++) {
18         w->next[i] = unknown[i]->next[i];
19         unknown[i]->next[i] = w;
20     }
21     n++;
22     return true;
23 }
```

```
struct Node {
  T x;
  int height;
  Node *next[];
};
```

a) What is the purpose of '*unknown*' list in this code? What is it doing?

b) Identify lines where the search is a) moving right and b) going down.

c) What is happening in the while loop on line 15.

Q3 – Prove that the expected number of nodes in a skiplist containing n elements, not including occurrences of the sentinel, is 2n.