HOMEWORK-6
Total Points: 75

1. [5 points] Discuss how expansion works when we implement a queue using dynamic arrays.

2. [15 points] Can we use a dynamic stack to store local variables? How will the expansion work? If you can't come up with a correct algorithm, discuss the challenges.

3. [15 points] Give an implementation of the `find_median` routine that takes the head of a linked list of integers as input and returns the median of all the values stored in the list. The prototype of `find_median` is given below. Make sure that there are no syntax errors in your implementation. Also, discuss the time complexity of your algorithm.

```
struct node {
   int val;
   struct node *next;
}
int find_median(struct node *head);
```

4. [20 Points] Propose a data structure called *MaxStack* that supports `push`, `pop`, and `find_max` operations in O(1) operations. MaxStack stores elements of type `Ty`. You are given a `cmp_val` routine that compares two values of type `Ty` and returns -1, 0, or 1 if the first value is less than, equals to, or greater than the second value, respectively. You are not allowed to store multiple copies of an existing stack element or the input value during the push operation. You can use a linked list in your implementation.
    a. What is the type of a MaxStack node?
    b. Write the pseudocode for `push`, `pop`, and `find_max` routines. You can use `list_empty`, `insert_front`, `delete_front`, and `cmp_val` directly in your pseudocode.

5. [20 Points] Write a pseudocode for the `pushb` routine that inserts an element at the bottom instead of the top of the stack `S`. The stack `S` contains integer values. You are not allowed to use additional arrays, linked lists, or any other user-defined data type (i.e., struct). You can use `stack_empty`, `push`, and `pop` routines directly in your pseudocode.

```
pushb(S, v)
// S is a stack of integers
// v is an integer value
// This procedure inserts v at the bottom of the stack S
```

Reading exercise:
Read the solutions to problems-9, 20, 23, and 27 from chapter-3 of Narasimha Karumanchi book.