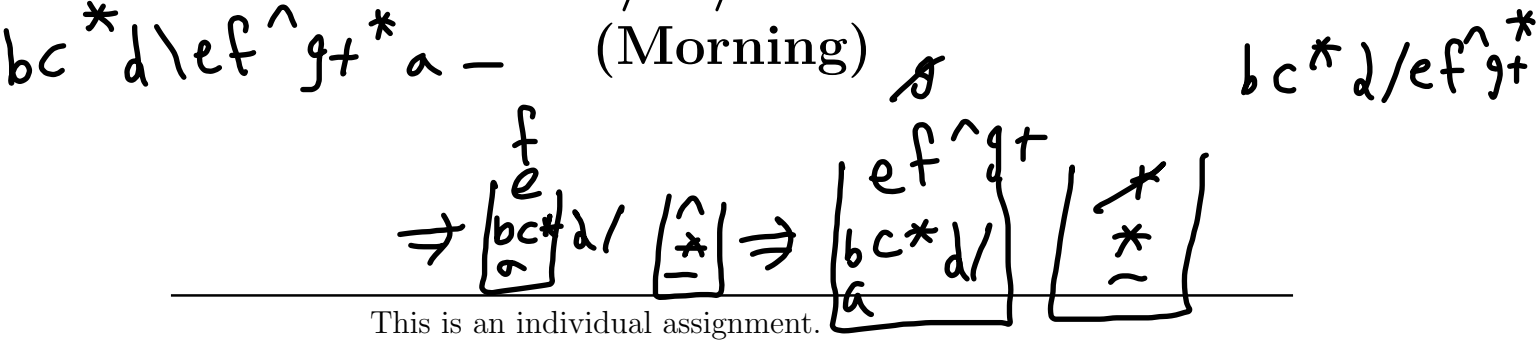
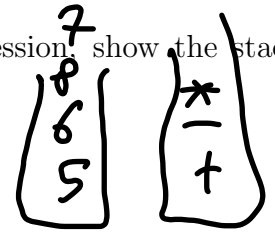
CSC 212 Homework # 3
Stacks & Recursion
Due date: 03/12/2016 at 5:00 AM (Morning)



Guidelines:	This is an individual assignment. The homework must be **submitted electronically through LMS**. **Hard copy submissions are not accepted**.

Problem 1

1. Convert the following expression to postfix notation, show the stacks after each push: `a - b * c / d * e ^ f + g`.
2. Trace the evaluation of the following expression, show the stack after each push: `6 5 2 ^ 2 3 + 8 * - 3 - *`.
3. Convert the following expression to infix notation, show the stack after each push: `6 5 2 ^ 2 3 + 8 * - 3 - *`.
4. Trace the evaluation of the following expression, show the stacks after each push: `5 + 6 ^ 2 / 2 / 3 - 2 * 4 * 7`.

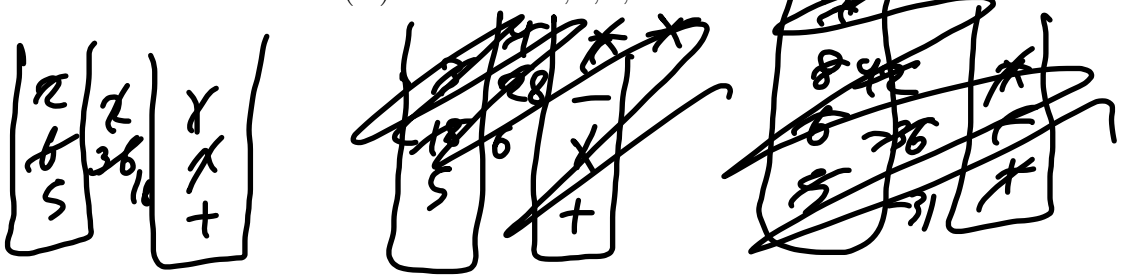


Problem 2

1. Write the static method *removeBottom* (user of Stack ADT) that takes a stack st as input, and removes the bottom element of st.

   Signature: `public static<T> void removeLast(Stack<T> st)`.

   Example 2.1. *Assuming st (top-to-bottom):* $5, 7, 5, 3, 2$. *After calling* removeBottom(st) *st will be:* $5, 7, 5, 3$.



2. Write the method *topEqualsBottom* that checks if the top element of the stack is equal to bottom element. Return true is that is the case. Method signature is `public static <T> boolean topEqualsBottom(Stack<T> st)`. The stack st should not change after the method has been called.

Problem 3

1. Given an array of integers, write the **recursive** method *containsMult3* that checks whether the array contains a multiple of 3. You have to choose the appropriate signature for *containsMult3*.

   Example 3.1. *For the array* `[1, 3, 2]`*, the method returns true, for* `[1, 4, 8]`*, it returns false, and for* `[9]`*, it return true.*

2. Given an array of integers, write the **recursive** method *sameSign* that checks whether all the elements of the array have the same sign (all strictly positive or all strictly negative).

   Example 3.2. *For the array* `[-1, -3, -2]`*, the method returns true, for* `[4, 0]`*, it returns false, for* `[2, -3, 9, 1]`*, it return false, and for* `[2, 3, 9, 2]`*, it return true.*

Problem 4

1. Write the recursive method *public boolean recSearch(T k)* member of the class *LinkedList* that searches the list for element k. It should return "true" if if found false otherwise. Do not use other data structures. You can add a private member method as needed.

   Remark. *Recursive member functions are private in general, since their parameters may depend on the internal representation of the data structure. Consequently, when one talks about a recursive public method, it is understood that the method itself is* ***not recursive****, but calls a private recursive method that does the job.*

2. Write the **recursive** method *public void reverse()*, member of the class *ArrayStack* that reverses the content of the stack.

Problem 5

1. Write **recursive** method *insertAtBottom* (user of the Stack ADT), that takes a stack st and an element e, and insert element e at the bottom of the stack. The method signature is `public <T> void InsertAtBottom(Stack<T> st,T e)`.

2. Write **recursive** method *reverse* (user of the Queue ADT), that takes a Queue q and reverses the order of the elements in the queue Q. The method signature is `public <T> void reverse(Queue<T> q)`.

3. Write a **recursive** method $merge(q_1, q_2)$ that merges the queues q_1 and q_2 into a new queue. After the call, q_1 and q_2 become empty (**Do not use any loops**). Signature: `public <T> Queue<T> merge(Queue<T> q1, Queue<T> q2)`.

   Example 5.1. *If the queue* q_1 *contains:* A, B, C*, and* q_2 *contains:* D, E, F, G, H*, then the result of* merge(q_2, q_2) *is:* A, D, B, E, C, F, G, H*.*

4. Rewrite the method *merge* so that the two queues q_1 and q_2 do not change after the call (**Do not use any loops**).