Exercise Sheet 8

Handout: Nov 5th — Deadline: Nov 12th 4pm

Question 8.1 (0.25 marks)

Draw the following data structures after each of the following operations. Assume that the data structures are initially empty. You don't need to draw pointers for stacks and queues.

1. Consider a stack S and the operations PUSH$(S, 7)$, PUSH$(S, 4)$, PUSH$(S, 5)$, POP(S), PUSH$(S, 8)$, POP(S), POP(S).
2. Consider a queue Q and the operations ENQUEUE$(Q, 7)$, ENQUEUE$(Q, 4)$, ENQUEUE$(Q, 5)$, DEQUEUE(Q), ENQUEUE$(Q, 8)$, DEQUEUE(Q), DEQUEUE(Q).
3. Consider a singly-linked list L and the operations LIST-PREPEND$(L, 7)$, LIST-PREPEND$(L, 4)$, LIST-PREPEND$(L, 5)$, LIST-DELETE$(L, 4)$, LIST-PREPEND$(L, 8)$, LIST-DELETE$(L, 7)$, LIST-DELETE$(L, 8)$.

Question 8.2 (0.5 marks) Explain how to implement two stacks S_1 and S_2 in one array $A[1 : n]$ in such a way that neither stack overflows unless all the n elements of A are full. Present the pseudocodes for operations PUSH$S_1(A, x)$,PUSH$S_2(A, x)$,POP$S_1(A)$, and POP$S_2(A)$.

Question 8.3 (0.25 marks) Rewrite ENQUEUE and DEQUEUE to detect underflow and overflow of a queue.

Question 8.4 (0.5 marks) Show how to implement a Queue using 2 stacks S_1 and S_2. Provide the pseudo-code of the operations ENQUEUE and DEQUEUE. You don't need to check for underflow and overflow. Analyse the runtime of the two operations.

Question 8.5 (0.5 marks) Implement an algorithm that takes in input a mathematical formula with the following brackets (), [], {}, and uses a stack to check whether the brackets are appropriately balanced or not.

Question 8.6 (0.5 marks) Implement an Integer Calculator that takes a postfix expression in input using integers as operands and $\{+, -, *\}$ as operators. The algorithm should use a stack.

Question 8.7 (0.5 marks) Implement a scheduler for a shared printer that accepts requests for files to be printed and uses a queue to process the jobs in the order they have been requested as soon as the previous job is completed. The queue is implemented with an array $A[1, 10]$ and the input contains either the job number 1, 2... or a signal 0 indicating that the previous print operation has completed.

Example input: 1 2 3 0 4 5 0 0 6 7 8 0 0 0 9 10 11 12 0 0 0 0 0 0 0 0