

Homework #5: Binary search trees, augmenting data structures  
Due Date: Tuesday, 22 February 2000

*Reading:* Chapters 13, 14, 15.

Recall that *exercises* are for you to work out on your own; *problems* are to be handed in.

**Exercise 5-1.** Do Exercise 13.2–6 on page 250 of CLR.

**Exercise 5-2.** Do Exercises 13.3–6 on page 254 of CLR.

**Exercise 5-3.** Do Exercise 14.1–5 on page 265 of CLR.

**Exercise 5-4.** Do Exercise 14.3–5 on page 272 of CLR.

**Exercise 5-5.** Do Exercise 15.1–5 on page 286 of CLR.

**Problem 5-1.** Do Problem 13–2 on page 260 of CLR [40 points].

**Problem 5-2.** Do Problem 14–2 on page 278 of CLR [30 points].

**Problem 5-3. Maintaining account balances** [30 points]

The Computer Division of SiliconBank<sup>TM</sup> wants you to design a data structure that handles the database of a single account in the bank. This data structure should support insertion of past and future transactions, as well as deletion of existing transactions.

For this exercise, you may assume that no two transactions occur at the same date. You should be able to support the following operations:

**Initialize:** Initialize the account. The initial balance in the account is \$0. This operation should take  $O(1)$  time.

**InsTrans(sum, date):** Insert a given transaction at a given date. The sum can be either positive or negative, and should be added to the balance in the account starting from the following day. Notice that the date can be arbitrary (not necessarily today's date). This operation should take  $O(\log n)$  time, where  $n$  is the number of transactions in the database.

**DelTrans(date):** Delete the transaction that occurs at the given date, if there is any. When a transaction is deleted, the corresponding sum should be subtracted from the balance in the account starting from the following day. This operation should take  $O(\log n)$  steps.

**Balance(date):** Returns the balance in the account at the beginning of the given date.  
 $O(\log n)$  time.

Give a clear and concise description of each operation. **Do not write code.**