CS119 – Module 13: Bag ADT

Purpose: The last ADT that we will examine is the Bag (or multiset) which is a set which can contain duplications. The implementation of this using a heap is important because this structure selects minimum (or maximum) values very efficiently. This makes it a good choice for sorting values.

Knowledge: This module will help you become familiar with the following content knowledge:

- the Bag ADT
- Heaps

Activity: With your group perform the following tasks and answer the questions. You will need to use files in the `lab13` directory. You will be reporting your answers back to the class in 20 minutes.

Consider the abstract data type Bag:

Function	Explanation
`makeBag :: [a] -> Bag a`	convert a list to a bag.
`isEmpty :: Bag a -> Bool`	determines if a bag is empty
`union :: Bag a -> Bag a -> Bag a`	union of two bags
`minBag :: Bag a ->  a`	returns the minimum value in the bag
`deleteMin :: Bag a -> Bag a`	removes one occurrence of the min value in the bag

1. Suppose that we decide to implement this ADT with a heap as described in the notes. A heap is a binary tree in which the smallest value is the root and the left and right subtrees are also heaps.

   Draw two or three different heaps for the multiset (or bag) {5,10,10,22,26,26,30}.

2. Using the given implementation, what happens for each of your trees when we `deleteMin`? Draw the new trees.

3. If we have n elements in our heap, what is the order of growth of the `deletemin` operation?

Complete the following assignments to be submitted for grading. Each should be done individually but you can consult with a classmate to discuss your strategies or if you get an error message that you do not understand.

Start by creating a file and import the Bag module. Create a couple of bags containing the letters ”HELLO” and ”WORLD”. Make sure you understand why the bags are created as they are and that they maintain our heap property.

Assignment 1:
Write a function `sortBag :: (Ord a) => Bag a -> [a]` which returns a list of the items in the bag in sorted order. You should be able to do this using only the given operations on bags.

What is the efficiency of the `sortBag` function?

Criteria for Success: In a separate file that imports the Bag module create a bag from the letters ”HELLO” and verify that your function alphabetizes (sorts) the letters. Also make sure that you have clearly explained why you believe the order of growth that you provided is accurate.

Submit all your files in Canvas for grading.