MA 251 Data Structures

Laboratory Assignment 7

16-10-2019

Note: Upload your programs to the server (deadline: 4:30 pm)

1. **Quicksort with arrays**: The performance of quicksort is sensitive to the choice of the pivot. Experiment with the following ways of choosing the pivot for partitioning

   - FIRST: Choose the first element A[0] as the pivot.
   - RANDOM: Choose A[r] as the pivot for a random $r \in \{0,1,2, \ldots ,n-1\}$.
   - MEDIAN OF THREE: Choose $r, s, t \in \{0,1,2, \ldots ,n-1\}$, and take the median of A[r], A[s], A[t] as the pivot. Use both the following choices for r, s, t.
     - $r = 0$, $s = n/2$, and $t = n-1$.
     - $r = n/4$, $s = n/2$, and $t = 3n/4$.

   Write a function *quicksort(A, n, pivot type)* to sort an array A with n (non-negative) integers. The third argument pivot type indicates how you choose the pivot for partitioning: 0 means FIRST, 1 means RANDOM, 2 means MEDIAN OF THREE (1), and 3 means MEDIAN OF THREE (2).

   In the main function,
   - populate an array A with n random integers in the range [0, 103-1]. Take n=10k, where k = 1, 2 and 3.
   - Call quick sort for the three different values of k, the three different ways of choosing pivot and compute the time taken by each call. [Use the technqiue that we followed for Merge sort in Lab 6, to compute the time.]

   Sample Output

   Present your output in the following format:

n	Pivot type	Time
10	FIRST	0.001
10	RANDOM	0.001
10	MEDIAN OF THREE(1)	0.001
10	MEDIAN OF THREE(2)	0.001
100	…..	
1000	….	

2. **Min-priority queue using heaps**: A priority queue is a data structure for maintaining a set **S** of elements, each with an associated value called a key. A min-priority queue supports the following operations:
   - *insert(S; x):* inserts the element x into the set S
   - *min(S):* returns the element of S with the smallest key.
   - *extract-min(S*): removes and returns the element of S with the smallest key.

Use the min-priority queue to store name and date of birth students.
In your code x should be a paired value, i.e., name and date of birth. Here, date of birth is the key.

Sample Output

```
Enter your choice
1: Insert
2: Return min
3: Extract and return min
4: Exit


> 1
> Type the name and DoB (dd-mm-yyyy) to insert:

Alice 10-Jan-1989
> Enter 1 to continue 0 to exit:
1
> Type the name and DoB (dd-mm-yyyy) to insert:

Bob 11-March-1991
> Enter 1 to continue 0 to exit:
1
> Type the name and DoB (dd-mm-yyyy) to insert:

Jane 12-April-1993
> Enter 1 to continue 0 to exit:
0

Enter your choice
1: Insert
2: Return min
3: Extract and return min
4: Exit
>2

Jane 12-Apr-1993

Enter your choice
1: Insert
2: Return min
3: Extract and return min
4: Exit

> 4
```

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