

## Homework Assignment #3

### Problems

1. Run the Union/Find algorithm to find the least number of equivalence classes for a set of integers from 0 through 15 and a set of related pairs below.

(0, 2) (1, 2) (3, 4) (3, 1) (3, 5) (9, 11) (12, 14) (3, 9)  
 (4, 14) (6, 7) (8, 10) (8, 7) (7, 0) (10, 15) (10, 13)

It is not necessary to apply optimization techniques such as weighted union and path compression.

2. Run the Insertion sort algorithm on each of the following input sets. In each case, trace through the main loop iterations, show how many comparisons are made, and show how many times data items are moved to a different location.

(a) 26 33 35 29 19 12 22 to be sorted into increasing order.

(b) 12 19 33 26 29 35 22 to be sorted into increasing order.

3. Show running each of the following sort algorithms for an input array below.

26 5 77 1 61 11 59 15 48 19

(a) Quicksort that selects the leftmost element as a pivot.

(b) Mergesort.

(c) Heapsort (in-place).

For Quicksort and Mergesort, show how an input array is partitioned and how the algorithm is invoked recursively. For Heapsort, show how an array is utilized as a heap and for storing sorted elements.

4. Show running the Shellsort algorithm on an input array given below using either of the following sequences of increments.

9 8 7 6 5 4 3 2 1

(a) Donald Shell's increments {4, 2, 1}.

(b) Hibbard's increments {7, 3, 1}.

5. Suppose we use Quicksort to sort a reverse-sorted sequence  $A[0:N-1]$ .

(a) What is the running time if the first element is chosen as a pivot?

(b) What is the running time if the median of  $A[0]$ ,  $A[N/2]$  and  $A[N-1]$  is chosen as a pivot?

6. What is the running time of Shellsort with Donald Shell's increments for sorted input?

7. A sorting algorithm is said to be *stable* if the original ordering for duplicate keys is preserved. Are mergesort and quicksort stable?

8. Run the Radix sort algorithm on the following sequence of 5-digit numbers.

55155 35255 35216 81120 71213 71153 21851 88212 12354

Show a sequence of numbers after each iteration that orders them by a chosen digit.

9. Use the Radixsort to sort the sequence: 1405, 975, 23, 9803, 4835, 2082, 7368, 573, 746.

10. Consider a set of strings: {abab, baba, ccccc, bbaaaa, caa, bbaacc, cbcc, cbca}.

- (a) Build a standard trie for the strings.
  - (b) Build a compressed trie for the strings.
11. Build a compact suffix trie for a string `minimize`. Show how the suffix trie is used to answer a substring query `*nim*`.
  12. Find the length of a longest common subsequence for the strings `babbabab` and `bbabbbaaab`.

## Due date

There is no due date for this homework assignment because it will not be graded. The purpose of this homework assignment is to provide students with additional opportunities to review the materials covered in the class.