Java Sorting Exercises

1. Write a Java program to sort an array of given integers using Quick sort Algorithm.
Quick sort is a comparison sort, meaning that it can sort items of any type for which a "less-than" relation (formally, a total order) is defined.

2. Write a Java program to sort an array of given integers using the Bubble sorting Algorithm.
According to Wikipedia "Bubble sort, sometimes referred to as sinking sort, is a simple sorting algorithm that repeatedly steps through the list to be sorted, compares each pair of adjacent items and swaps them if they are in the wrong order. The pass through the list is repeated until no swaps are needed, which indicates that the list is sorted. The algorithm, which is a comparison sort, is named for the way smaller elements "bubble" to the top of the list. Although the algorithm is simple, it is too slow and impractical for most problems even when compared to insertion sort. It can be practical if the input is usually in sort order but may occasionally have some out-of-order elements nearly in position."

3. Write a Java program to sort an array of given integers using Radix sort Algorithm.
According to Wikipedia "In computer science, radix sort is a non-comparative integer sorting algorithm that sorts data with integer keys by grouping keys by the individual digits which share the same significant position and value".

4. Write a Java program to sort an array of given integers using Merge sort Algorithm.
According to Wikipedia "Merge sort (also commonly spelled mergesort) is an O (n log n) comparison-based sorting algorithm. Most implementations produce a stable sort, which means that the implementation preserves the input order of equal elements in the sorted output."

5. Write a Java program to sort an array of given integers using Heap sort Algorithm.

In computer science, heapsort (invented by J. W. J. Williams in 1964) is a comparison-based sorting algorithm. Heapsort can be thought of as an improved selection sort: like that algorithm, it divides its input into a sorted and an unsorted region, and it interactively shrinks the unsorted region by extracting the largest element and moving that to the sorted region. The improvement consists of the use of a heap data structure rather than a linear-time search to find the maximum. Although somewhat slower in practice on most machines than a well-implemented quicksort, it has the advantage of a more favorable worst-case O(n log n) runtime. Heapsort is an in-place algorithm, but it is not a stable sort.

6. Write a Java program to sort an array of given integers using Selection Sort Algorithm.

According to Wikipedia "In computer science, selection sort is a sorting algorithm, specifically an in-place comparison sort. It has O(n2) time complexity, making it inefficient on large lists, and generally performs worse than the similar insertion sort".

7. **Write a Java program to sort an array of given integers using Insertion sort Algorithm.**

Insertion sort is a simple sorting algorithm that builds the final sorted array (or list) one item at a time. It is much less efficient on large lists than other algorithms such as quicksort, heapsort, or merge sort.

8. Write a Java program to sort an array of positive integers using the Bead Sort Algorithm.
According to Wikipedia "Bead sort, also called gravity sort, is a natural sorting algorithm, developed by Joshua J. Arulanandham, Cristian S. Calude and Michael J. Dinneen in 2002, and published in The Bulletin of the European Association for Theoretical Computer Science. Both digital and analog hardware implementations of bead sort can achieve a sorting time of O(n); however, the implementation of this algorithm tends to be significantly slower in software and can only be used to sort lists of positive integers. Also, it would seem that even in the best case, the algorithm requires O(n2) space".

9. Write a Java program to sort an array of positive integers using the BogoSort Sort Algorithm.

In computer science, bogosort is a particularly ineffective sorting algorithm based on the generate and test paradigm. The algorithm successively generates permutations of its input until it finds one that is sorted. It is not useful for sorting but may be used for educational purposes, to contrast it with other more realistic algorithms.

10. Write a Java program to sort an array of positive integers using the Cocktail sort Algorithm.

Cocktail shaker sort (also known as bidirectional bubble sort, cocktail sort, shaker sort, ripple sort, shuffle sort, or shuttle sort) is a variation of bubble sort that is both a stable sorting algorithm and a comparison sort. The algorithm differs from a bubble sort in that it sorts in both directions on each pass through the list. This sorting algorithm is only marginally more difficult to implement than a bubble sort and solves the problem of turtles in bubble sorts. It provides only marginal performance improvements, and does not improve asymptotic performance; like the bubble sort, it is not of practical interest, though it finds some use in education.

11. Write a Java program to sort an array of given integers using the CombSort Algorithm.

The Comb Sort is a variant of the Bubble Sort. Like the Shell sort, the Comb Sort increases the gap used in comparisons and exchanges. Some implementations use the insertion sort once the gap is less than a certain amount. The basic idea is to eliminate turtles, or small values near the end of the list, since in a bubble sort these slow the sorting down tremendously. Rabbits, large values around the beginning of the list do not pose a problem in bubble sort.

12. Write a Java program to sort an array of given integers using CountingSort Algorithm.

According to Wikipedia "In computer science, counting sort is an algorithm for sorting a collection of objects according to keys that are small integers; that is, it is an integer sorting algorithm. It operates by counting the number of objects that have each distinct key value, and using arithmetic on those counts to determine the positions of each key value in the output sequence. Its running time is linear in the

number of items and the difference between the maximum and minimum key values, so it is only suitable for direct use in situations where the variation in keys is not significantly greater than the number of items. However, it is often used as a subroutine in another sorting algorithm, radix sort, that can handle larger keys more efficiently".

13. Write a Java program to sort an array of given integers using Gnome sort Algorithm.

Gnome sort is a sorting algorithm originally proposed by Dr. Hamid Sarbazi-Azad (Professor of Computer Engineering at Sharif University of Technology) in 2000 and called "stupid sort" (not to be confused with bogosort), and then later on described by Dick Grune and named "gnome sort".
The algorithm always finds the first place where two adjacent elements are in the wrong order, and swaps them. It takes advantage of the fact that performing a swap can introduce a new out-of-order adjacent pair only next to the two swapped elements.

14. Write a Java program to sort an array of given integers using Pancake sort Algorithm.

Pancake sorting is the colloquial term for the mathematical problem of sorting a disordered stack of pancakes in order of size when a spatula can be inserted at any point in the stack and used to flip all pancakes above it. A pancake number is the minimum number of flips required for a given number of pancakes. The problem was first discussed by American geometer Jacob E. Goodman. It is a variation of the sorting problem in which the only allowed operation is to reverse the elements of some prefix of the sequence.

15. Write a Java program to sort an array of given integers using Permutation sort Algorithm.

Implement a permutation sort, which proceeds by generating the possible permutations of the input array/list until discovering the sorted one.

16. Write a Java program to sort an array of given integers Shell Sort Algorithm.

According to Wikipedia "Shell sort or Shell's method, is an in-place comparison sort. It can be seen as either a generalization of sorting by exchange (bubble sort) or sorting by insertion (insertion sort). The method starts by sorting pairs of elements far apart from each other, then progressively reducing the gap between elements to be compared. Starting with far apart elements can move some out-of-place elements into position faster than a simple nearest neighbor exchange."

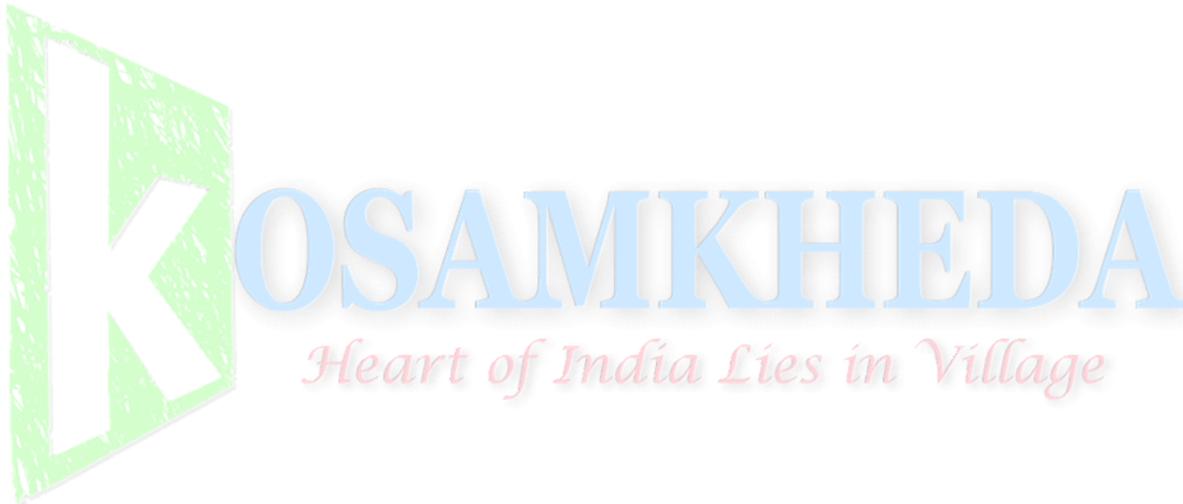## 17. Write a Java program to sort an array of given non-negative integers using Sleep Sort Algorithm.

Sleep sort works by starting a separate task for each item to be sorted, where each task sleeps for an interval corresponding to the item's sort key, then emits the item. Items are then collected sequentially in time.

18. Write a Java program to sort an array of given non-negative integers using Stooge Sort Algorithm.

Stooge sort is a recursive sorting algorithm with a time complexity of O($n$log 3 / log 1.5) = O(n2.7095...). The running time of the algorithm is thus slower compared to efficient sorting algorithms, such as Merge sort, and is even slower than Bubble sort.

19. Write a Java program to sort an array of given integers using Bucket Sort Algorithm.

Bucket sort is a sorting algorithm that works by distributing the elements of an array into a number of buckets. Each bucket is then sorted individually, either using a different sorting algorithm, or by recursively applying the bucket sorting algorithm. It is a distribution sort, a generalization of pigeonhole sort, and is a cousin of radix sort in the most-to-least significant digit flavor.

Java Search Exercises

1. Write a Java program to find a specified element in a given array of elements using Binary Search.

2. Write a Java program to find a specified element in a given array of elements using Linear Search.

3. Write a Java program to find a specified element in a given sorted array of elements using Jump Search.
From Wikipedia, in computer science, a jump search or block search refers to a search algorithm for ordered lists. It works by first checking all items L_{km}, where $\Re \in \aleph$ and m is the block size, until an item is found that is larger than the search key. To find the exact position of the search key in the list a linear search is performed on the sublist $L_{[(k-1)m,\ km]}$.

4. Write a Java program to find a specified element in a given array of elements using Interpolation Search.
From Wikipedia, Interpolation search is an algorithm for searching for a key in an array that has been ordered by numerical values assigned to the keys (key values). It was first described by W. W. Peterson in 1957. Interpolation search resembles the method by which people search a telephone directory for a name (the key value by which the book's entries are ordered): in each step the algorithm calculates where in the remaining search space the sought item might be, based on the key values at the bounds of the search space and the value of the sought key, usually via a linear interpolation. The key value actually found at this estimated position is then compared to the key value being sought. If it is not equal, then depending on the comparison, the remaining search space is reduced to the part before or after the estimated position. This method will only work if calculations on the size of differences between key values are sensible.

5. Write a Java program to find a specified element in a given sorted array of elements using Exponential search.

From Wikipedia, in computer science, an exponential search (also called doubling search or galloping search or Struzik search) is an algorithm, created by Jon Bentley and Andrew Chi-Chih Yao in 1976, for searching sorted, unbounded/infinite lists. There are numerous ways to implement this with the most common being to determine a range that the search key resides in and performing a binary search within that range. This takes O(log i) where i is the position of the search key in the list, if the search key is in the list, or the position where the search key should be, if the search key is not in the list.

6. Write a Java program to find a specified element in a given array of elements using Ternary search.

From Wikipedia, a ternary search algorithm is a technique in computer science for finding the minimum or maximum of a unimodal function. A ternary search determines either that the minimum or maximum cannot be in the first third of the domain or that it cannot be in the last third of the domain,

then repeats on the remaining two thirds. A ternary search is an example of a divide and conquer algorithm.

7. Given is a 2-dimensional integer array [0..m-1, 0..n-1], each row and column of which is in ascending order (see example)

```
b   0  1  2  3  4
  ┌───────────────┐
0 │ 2  3  5  6  6 │
1 │ 2  4  5  7  8 │
2 │ 5  5  6  8  8 │
3 │ 5  7  7  8  9 │
  └───────────────┘
```

Write a Java program to find the row, column position of a specified number (row, column position) in a given 2-dimensional array.