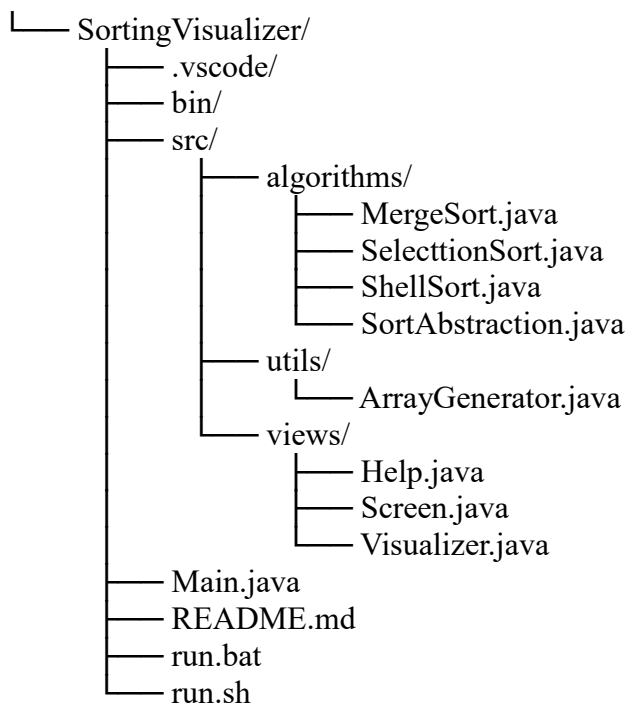


## GROUP 3: SORTING VISUALIZATION OF SELECTION SORT, MERGE SORT, SHELL SORT AND QUICK SORT ALGORITHMS.

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### 1. File system



Source code:

- **'Main'** class: entry point initializing program.
  - + extending 'javax.swing.JFrame' class: create application window.
  - + add confirmation dialog when closing window.
- **'views'** package: including components for user interface
  - + **'Help'** class: extending javax.swing.JLabel, display guideline for users in each sorting animation.
  - + **'Screen'** class: extending javax.swing.JPanel, as a wrapper including elements(controls) as JButton, JPanel, JTextField, JSlider, ...etc.
  - + **'Visualizer'** class: extending java.awt.Canvas, display sorting animation.
- **'utils'** package: including class(es) used as utilities:
  - + **'ArrayGenerator'** class: helper class which can generate random array or transform input sequence to array of numbers.
- **'algorithms'** package: includes classes performing sorting process, using methods of Visualizer class for visualizing tasks.
  - + **'SortAbstraction'** class: a abstract class, generalization for 3 sorting classes.

+ 'SelectionSort', 'MergeSort', 'ShellSort' class: extending SortAbstraction to *implement* 'SortAbstraction::sort()' method which is setting up logic for animation in 'Visualizer' class.

## 2. Algorithm

### 2.1. Selection Sort:

#### - Step-by-step:

1. **Step 1:**  $i=1$ .
2. **Step 2:** Find the minimum  $a[\text{min}]$  in array from  $a[i]$  to  $a[n]$ .
3. **Step 3:** Swap  $a[\text{min}]$  and  $a[i]$
4. **Step 4:** If  $i \leq n-1$ ,  $i=i+1$ ; repeating step 2. Or else stop ( $n-1$  element(s) sorted)

#### - Time complexity:

- ⑩ **Best Case:**  $O(n^2)$
- ⑩ **Average Case:**  $O(n^2)$
- ⑩ **Worst Case:**  $O(n^2)$

### 2.2. Merge Sort:

#### - Step-by-step:

- ⑩ **Divide** by finding the number of the position midway between and . Do this step the same way we found the midpoint in binary search: add and, divide by 2, and round down.
- ⑩ **Conquer** by recursively sorting the subarrays in each of the two subproblems created by the divide step. That is, recursively sort the subarray  $\text{array}[p..q]$  and recursively sort the subarray  $\text{array}[q+1..r]$ .
- ⑩ **Combine** by merging the two sorted subarrays back into the single sorted subarray  $\text{array}[p..r]$ .

#### - Time complexity:

- ⑩ **Best Case:**  $O(n \log n)$ , When the array is already sorted or nearly sorted.
- ⑩ **Average Case:**  $O(n \log n)$ , When the array is randomly ordered.
- ⑩ **Worst Case:**  $O(n \log n)$ , When the array is sorted in reverse order.

### 2.3. Shell Sort:

#### - Step-by-step:

1. **Step 1:** Start
2. **Step 2:** Initialize the value of gap size, say  $h$ .
3. **Step 3:** Divide the list into smaller sub-part. Each must have equal intervals to  $h$ .
4. **Step 4:** Sort these sub-lists using insertion sort.
5. **Step 5:** Repeat this step 2 until the list is sorted.
6. **Step 6:** Print a sorted list.

7. **Step 7:** Stop.

- **Time complexity:**

⑩ **Best Case:** When the given array list is already sorted the total count of comparisons of each interval is equal to the size of the given array.

So best case complexity is  $\Omega(n \log(n))$ .

⑩ **Average Case:**  $O(n \log n) \sim O(n^{1.25})$ .

⑩ **Worst Case:**  $O(n^2)$ .

## 2.4. Quick Sort:

- **Step-by-step:**

1. **Step 1:** Choose a pivot element from the array.
2. **Step 2:** Partition the other elements into two sub-arrays, according to whether they are less than or greater than the pivot.
3. **Step 3:** Recursively apply quicksort to the left and right sub-arrays.
4. **Step 4:** The recursion terminates when the sub-array has 0 or 1 elements.

- **Time complexity:**

⑩ **Best Case:**  $\Omega(N \log(N))$  when pivot is located near the middle

⑩ **Average Case:**  $\theta(N \log(N))$

⑩ **Worst Case:**  $O(n^2)$