01286222 Lab 78b Name..... id .....

Objective(s):

a. To implement a sorting algorithm as specified.
b. To measure its performance.

Task 1:

0 to blockSize -1		blockSize to 2 * blockSize - 1		2blockSize to 3 * blockSize - 1		3blockSize to 4 * blockSize - 1		4blockSize to 5 * blockSize - 1		5blockSize to arr.length - 1
10	13	9	15	18	21	13	8	5	11	3
10	13	9	15	18	21	8	13	5	11	3
9	10	13	15	8	13	18	21	3	5	11
8	9	10	13	13	15	18	21	3	5	11
3	5	8	9	10	11	13	13	15	18	21

The figure above shows the process of sorting n numbers. This algorithm process is as follows:

a. Break the data into chunks of blockSize i.e., if the blockSize is 32, blocks are as follows: 0 – 31, 32 – 63, ..., (n – 2) * blockSize – (n – 1) * blockSize – 1, lastBlock. Keep in mind that lastBlock may not be full.
b. For each block, sort it.
c. Repeat

   Keep merging 2 consecutive blocks through all blocks. After each merge, the merged block's size is double, and its data is sorted.

   Until there is only one block left.

Complete the code given.

```
private static void whatSortIsThis(int [] arr) {
  int BLOCK_SIZE = arr.length / 4 > 32 ? 32 : arr.length / 4;
  for (int start = 0; start < arr.length; start += BLOCK_SIZE) {
      int end = Math.min(start + BLOCK_SIZE - 1, arr.length - 1);
      bite_size_sort(arr, start, end);
  }

  for (int mergeSize = BLOCK_SIZE; mergeSize < arr.length; mergeSize *= 2) {
    for (int left = 0; left < arr.length; left += 2 * mergeSize) {
        int mid = left + mergeSize - 1;
        int right = Math.min(0,0 /* your code1 */);
        if (mid < right)
            merge(arr,left, mid, right);
    }
  }
  System.out.println(Arrays.toString(arr));
}
private static void bite_size_sort(int [] b, int start, int end) {
  for (int i = 0 /* your code2 */; i < end; i++) {
      int j = i;
      int tmp = b[j];
      while (j > start && b[j - 1] > tmp) {
          b[j] = b[j-1];
          j--;
      }
      b[j] = tmp;
  }
}
private static void merge(int [] twob, int low, int mid, int high) {
    int [] leftArr = new int[mid - low + 1];
    int [] rightArr = new int[high - mid];
    System.arraycopy(twob, low, leftArr, 0, leftArr.length);
    System.arraycopy(twob, mid + 1, rightArr, 0, rightArr.length);

    int leftCounter = 0;
    int rightCounter = 0;
    int twobCounter = low;
    while (leftCounter < leftArr.length && rightCounter < rightArr.length) {
        twob[twobCounter++] = leftArr[leftCounter] < rightArr[rightCounter]
                        ? /* your code3 */;
    }
    while (leftCounter < leftArr.length)
        twob[twobCounter++] = leftArr[leftCounter++];
    while (rightCounter < rightArr.length)
        twob[twobCounter++] = rightArr[rightCounter++];
}
```

You may double check that the `println(Arrays.toString(arr));` in `whatSortIsThis()` produces the same output in main (i.e. array reference in main and arr in whatSortIsThis refers to the same array.

Task 2:

Use the below code to test whatSortIsThis performance. Arrays of 2,000,000 values random by shuffle are created. After each call, its elapse time is stored in is corresponded time array.

```
private static void testRuntime() {
  int ARRAY_SIZE = 2_000_000;
  int [] arr32 = new int[1];
  int [] arr2048 = new int[1];;
  int [] arr3 = new int[1];;
  int numIter = 20;
  int [] size32Time = new int[numIter];
  int [] size2048Time = new int[numIter];
  int [] sizeSortTime = new int[numIter];
  ArrayList<Integer> list = new ArrayList<>();
  for (int i = 1; i <= ARRAY_SIZE; i++)
      list.add(i);

  for (int i = 0; i < numIter; i++) {
      Collections.shuffle(list);

      arr32 = list.stream().mapToInt(Integer::intValue).toArray();
      arr2048 = list.stream().mapToInt(Integer::intValue).toArray();
      arr3 = list.stream().mapToInt(Integer::intValue).toArray();

      long startElapse = System.currentTimeMillis();
      whatSortIsThis(arr32, 32);
      size32Time[i] = (int)(System.currentTimeMillis() - startElapse);

      startElapse = System.currentTimeMillis();
      whatSortIsThis(arr2048, 2048);
      size2048Time[i] = (int)(System.currentTimeMillis() - startElapse);

      startElapse = System.currentTimeMillis();
      Arrays.sort(arr3);
      sizeSortTime[i] = (int)(System.currentTimeMillis() - startElapse);
  }
  System.out.println("confirm isSort " + isSort(arr32)
                     + " " + isSort(arr2048) + " " + isSort(arr3));
  System.out.println("takes " + Arrays.toString(size32Time));
  System.out.println("takes " + Arrays.toString(size2048Time));
  System.out.println("takes " + Arrays.toString(sizeSortTime));
}
private static boolean isSort(int [] arr) {
  for (int i = 1; i < arr.length; i++)
      if (arr[i - 1] > arr[i])
           return false;
  return true;
}
```

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Instructions

1. capture your code

1.1 (your code 1)

1.2 (your code 2)

1.3 (your code 3)

2. Change numIter to 10. Capture your output.

3. What a brief opinion on which and why algorithm produced least elapse time outperforms the others.

Submission: This pdf

Due date: TBA