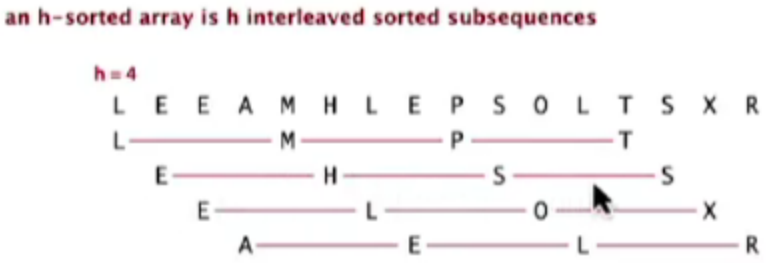
【DS】Day7

Tags	
Date	@May 29, 2022
Summary	Shell Sort, Shuffling, and Convex Hull

【Week2】Sorting

2.6 Shell Sort

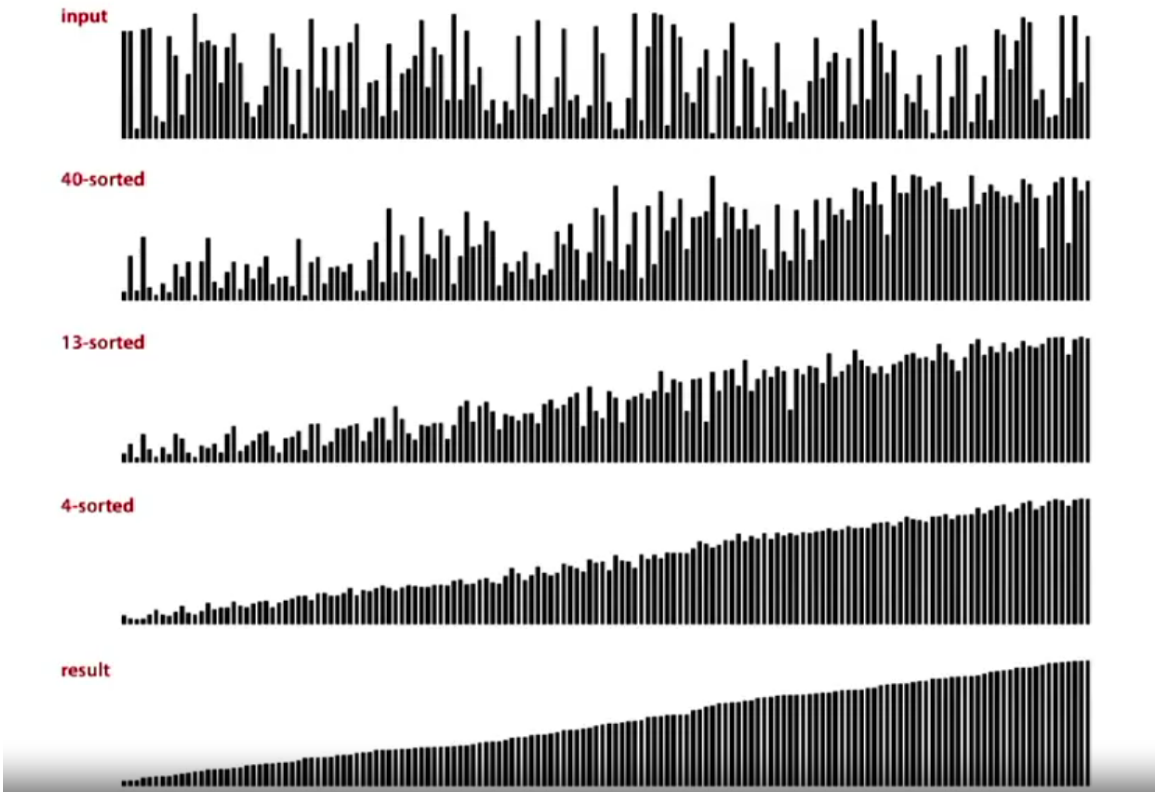
Idea: Move entries more than one position at a time by h-sorting the array.



Implementation:

```
public class Shell {
  public static void sort(Comparable[] a) {
    int N = a.length;

    int h = 1;
    // 1, 4, 13, 40, 121, ...
    while (h < N / 3)
      h = h * 3 + 1;

    while (h >= 1) {
      for (int i = h; i < N; ++i) {
        for (int j = i; j >= h && less(a[j], a[j - h]); j -= h) {
          exch(a, j, j - h);
        }
      }
      // Move to next increment
      h /= 3;
```

```
    }
  }

  private static boolean less(Comparable v, Comparable w) { ... }

  private static void exch(Comparable[] a, int i, int j) { ... }
}
```



Proposition: Tee worst-case number of compares used by shell sort with the 3x+1 increments is $O(N^{\frac{3}{2}})$

2.7 Shuffling

Generate a random real number for each array entry

Knuth Shuffle

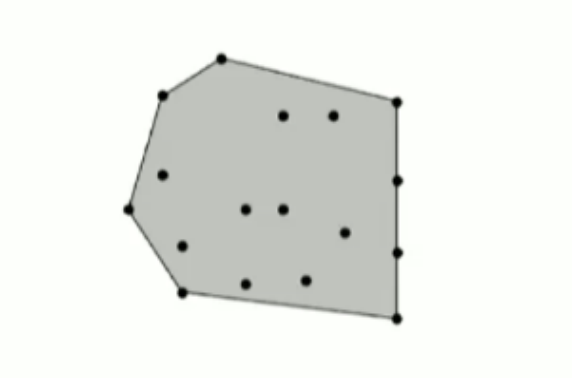
- In iteration i, pick integer r between o and i uniformly at random.

- Swap a[i] and `a[r]`.

```
public class StdRandom {
  public static void shuffule(Object[] a) {
    int N = a.length;
    for (int i = 0; i < N; ++i) {
      // Get a random number between 0 and i
      int r = StdRandom.uniform(i + 1);
      exch(a, i, r);
    }
  }
}
```

2.8 Convex Hull

The convex hull of a set of N points is the smallest perimeter fence enclosing the points.



Convex hull application: farthest pair.

Given N points in the plane, find a pair of points with the largest Euclidean distance between them.