Sorting Algorithms

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About Sorting

- We have covered
  - Selection sort
  - Insertion sort
  - Bubble sort

  } $O(n^2)$ in worse case

  - Heap sort

  } $O(n \log n)$ in worse case
- Other efficient sorting algorithms
  - Merge sort ➔ $O(n \log n)$ in worse case
  - Quick sort ➔ $O(n \log n)$ in average case, $O(n^2)$ in worse case

Terminologies for Sorting

- In-place sorting
  - Sorting a sequence with O(1) extra space to store intermediate results

Quiz!

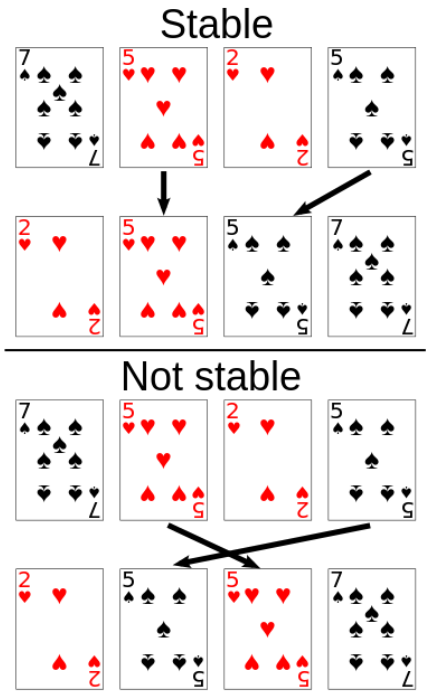
- Stable sorting
  - If the same element is presented multiple time, then they remain the original relative order of positions after sorting

Quiz!

Important for Multiple-key sorting!

- External sorting
  - Sorting records not stored in memory

Slow access!
Locality important!

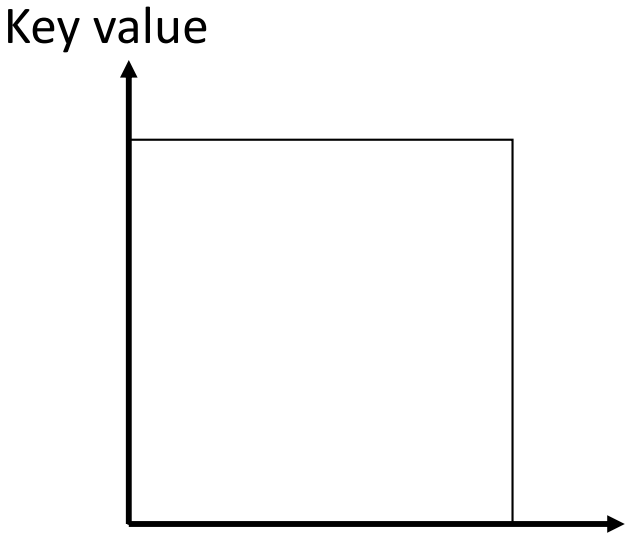


C++ STL Sorting Functions

- sort function template
  - void sort(iterator begin, iterator end)
  - void sort(iterator begin, iterator end, Comparator cmp)
  - begin and end are start and end marker of a container (or a range of it)
  - Container needs to support random access such as vector
  - sort() is not a stable sorting
    - stable_sort() is stable

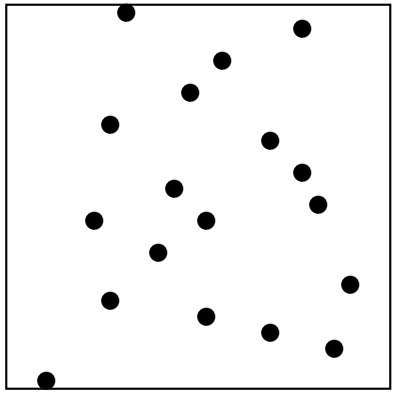
What methods are use here?
Please post to FB!

Animation for Sorting

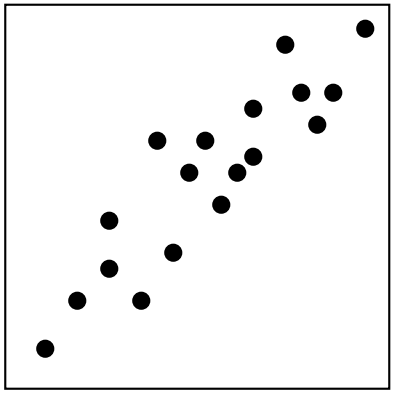


N distinct keys within [1,N]

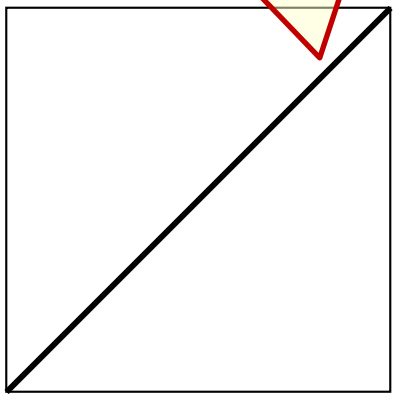
Animation of sorting algorithms



before execution



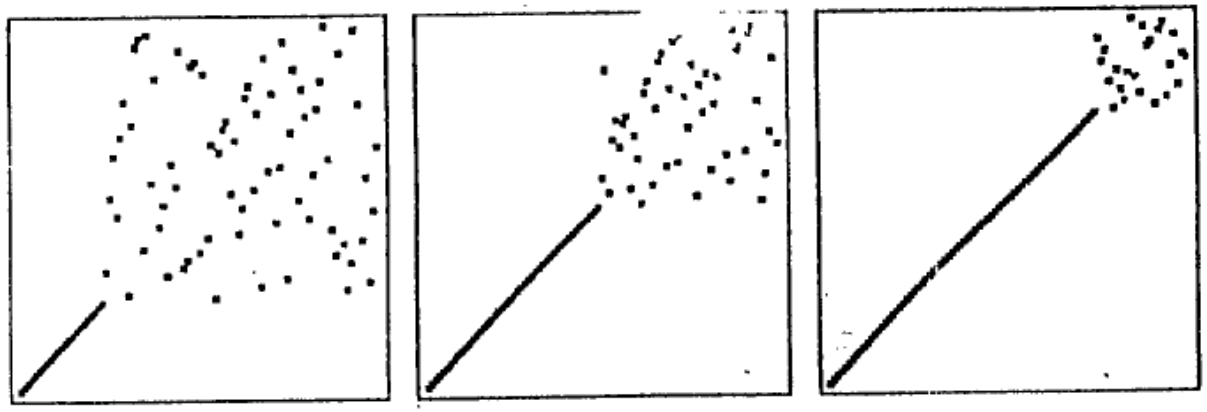
during execution

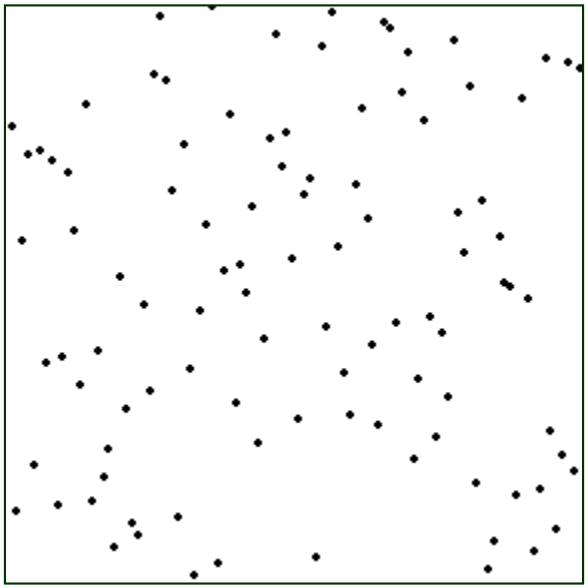


after execution

Insertion Sort

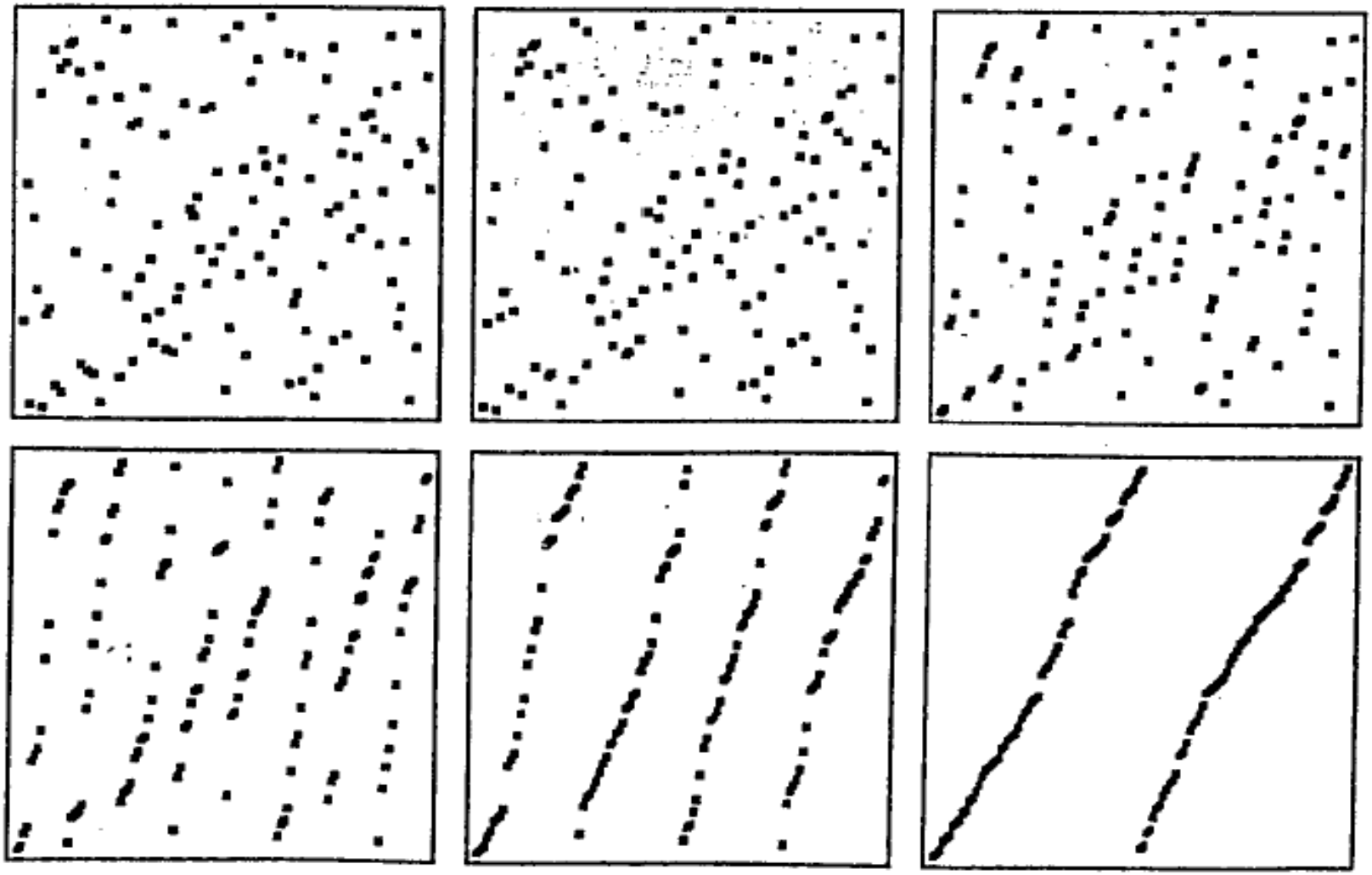
Selection Sort



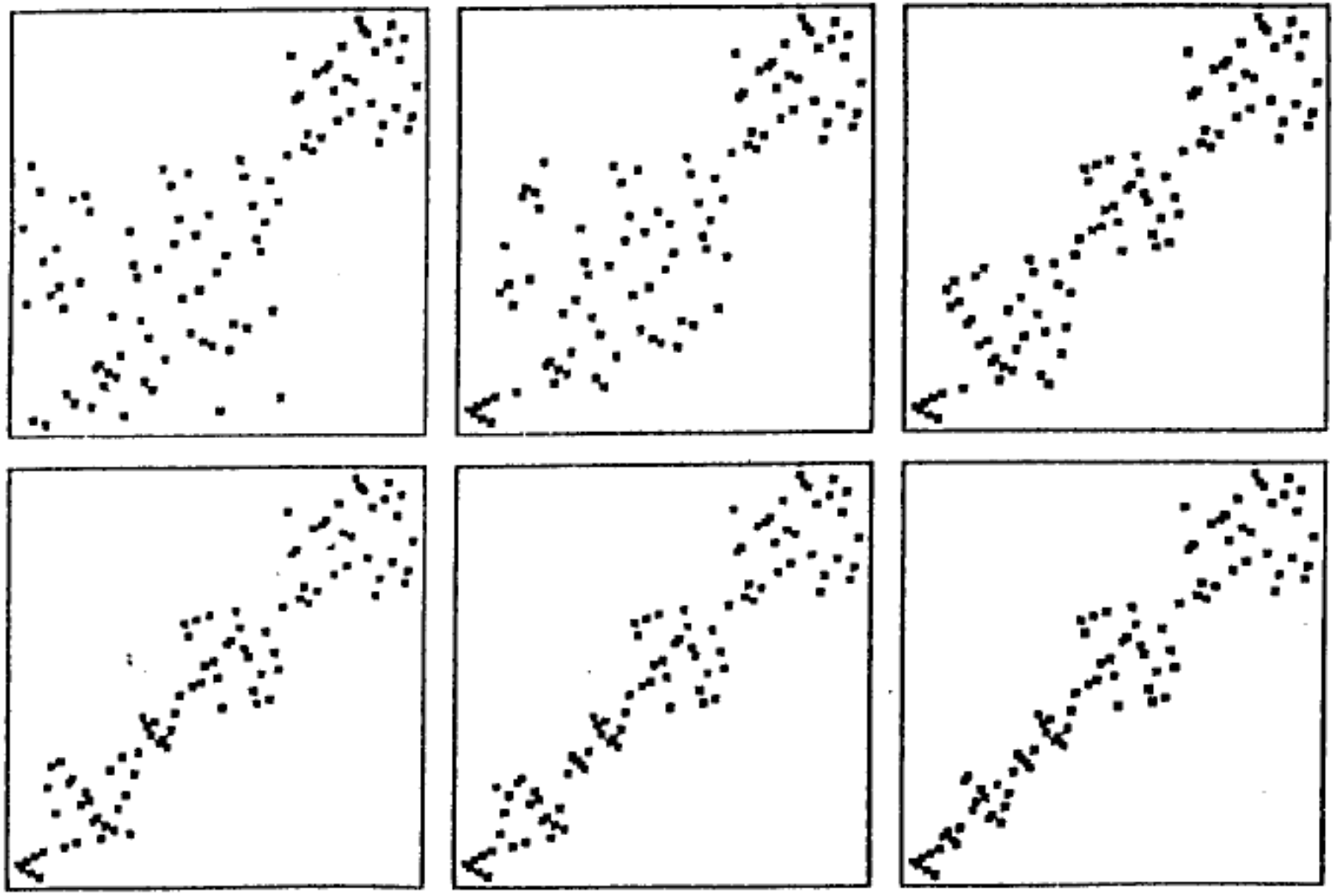


Bubble Sort

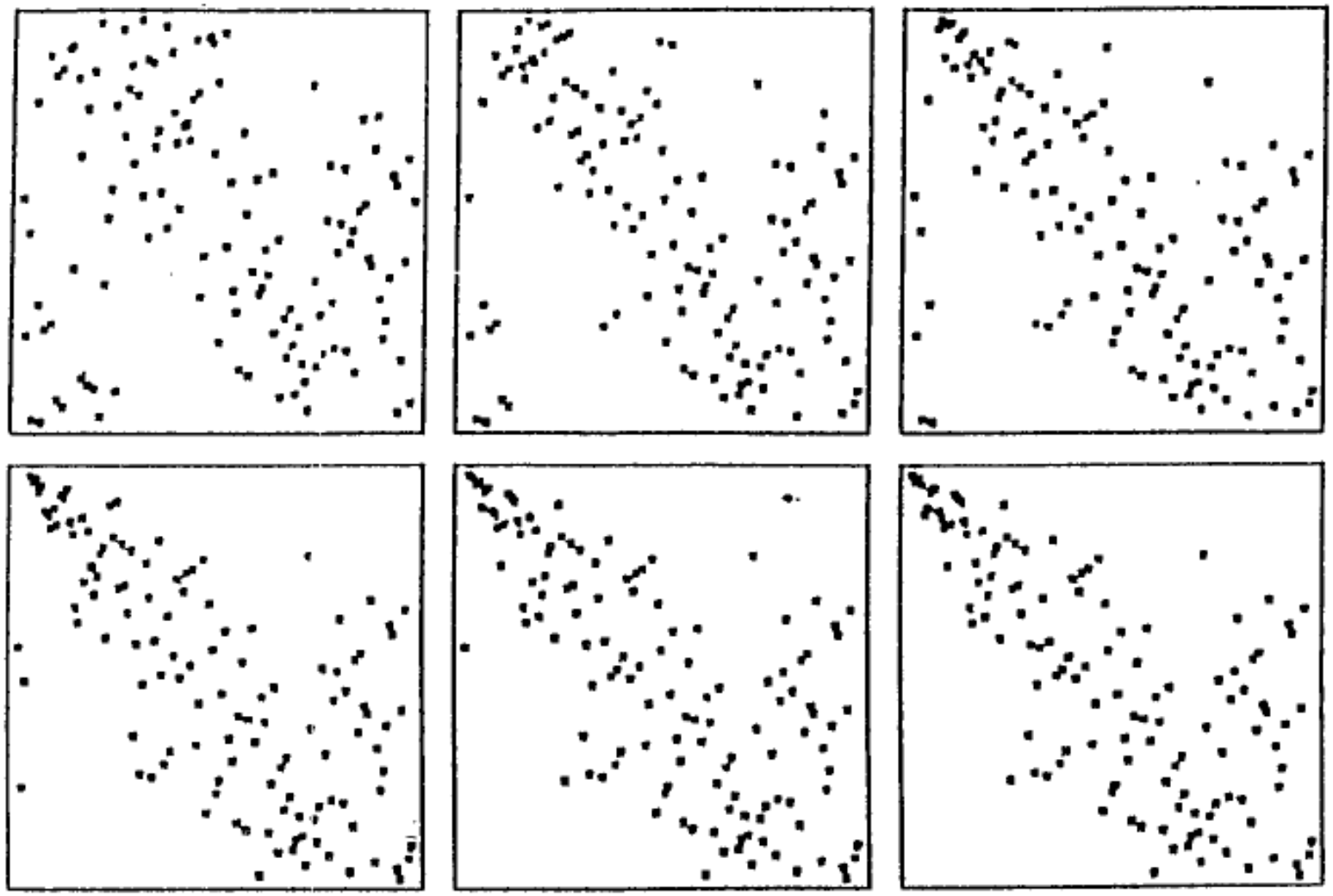
Merge Sort



Quicksort

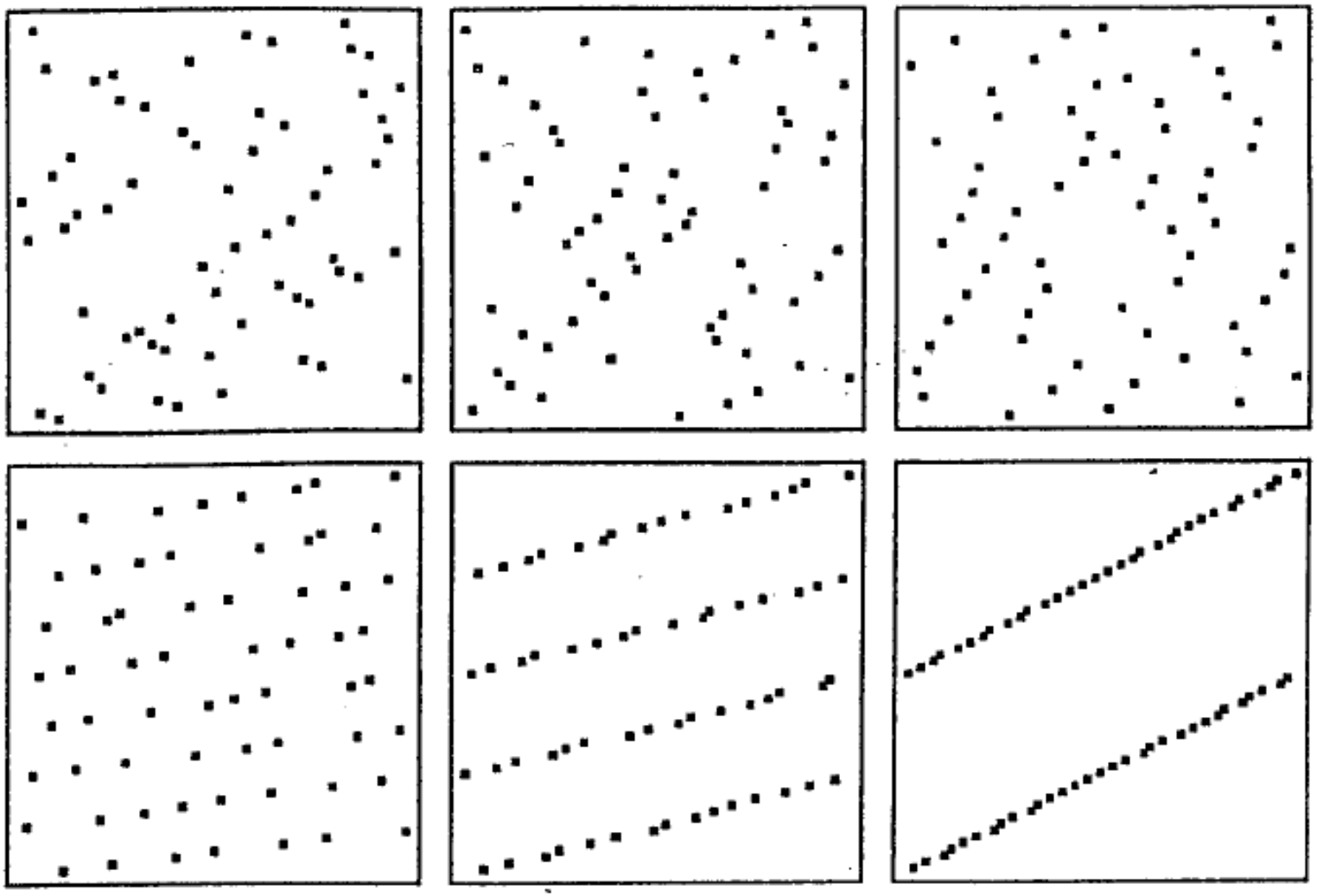


Heap Sort: Heap Construction



Heap Sort: Sorting Phase

Straight Radix Sort



Shell Sort