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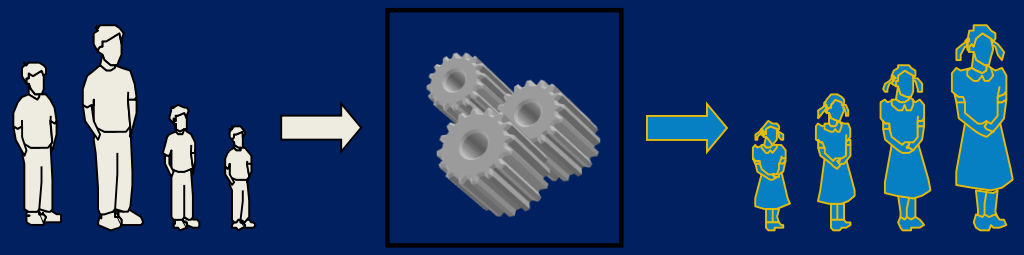
DESIGN & ANALYSIS OF ALGORITHM (BCSC0012)

Chapter 4: Sorting

Selection Sort



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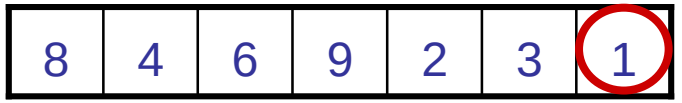
Selection Sort

- **Idea**
  - Find the smallest element in the array
  - Exchange it with the element in the first position
  - Find the second smallest element and exchange it with the element in the second position
  - Continue until the array is sorted
- **Disadvantage**
  - Running time depends only slightly on the amount of order in the file

Selection Sort: Algorithm

Alg.: SELECTION-SORT(*A*)

```
n ← length[A]
for j ← 1 to n - 1
    do smallest ← j
        for i ← j + 1 to n
            do if A[i] < A[smallest]
                then smallest ← i
        exchange A[j] ↔ A[smallest]
```



Selection Sort: Analysis

Alg.: SELECTION-SORT(*A*)

	cost	times
n ← length[*A*]	c_1	1
for j ← 1 **to** n - 1	c_2	n
do smallest ← j	c_3	n-1
for i ← j + 1 **to** n	c_4	$\sum_{j=1}^{n-1}(n-j+1)$
do if *A*[i] < *A*[smallest]	c_5	$\sum_{j=1}^{n-1}(n-j)$
then smallest ← i	c_6	$\sum_{j=1}^{n-1}(n-j)$
exchange *A*[j] ↔ *A*[smallest]	c_7	n-1

≈$n^2/2$ comparisons

≈n exchanges

$$T(n) = c_1 + c_2 n + c_3(n-1) + c_4\sum_{j=1}^{n-1}(n-j+1) + c_5\sum_{j=1}^{n-1}(n-j) + c_6\sum_{j=2}^{n-1}(n-j) + c_7(n-1) = \Theta(n^2)$$

Selection Sort: Time Complexity Analysis

- Selection sort algorithm consists of two nested loops.
- Owing to the two nested loops, it has $O(n^2)$ time complexity.

Time Complexity	
Best Case	n^2
Average Case	n^2
Worst Case	n^2

Selection Sort: Summary

- Selection sort is an **in-place** algorithm.
- It performs all computation in the original array and no other array is used. Hence, the **space complexity** works out to be **O(1)**.
- The default implementation is **not stable**.
- Selection sort is not a very efficient algorithm when data sets are large.
- This is indicated by the average and worst case complexities.
- Selection sort uses minimum number of **swap operations O(n)** among all the sorting algorithms and can be useful when memory write is a costly operation.

Any Questions ?

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