NPTEL MOOC

PROGRAMMING, DATA STRUCTURES AND ALGORITHMS IN PYTHON

Week 3, Lecture 6

Madhavan Mukund, Chennai Mathematical Institute
http://www.cmi.ac.in/~madhavan

Sorting

- Searching for a value
  - Unsorted array — linear scan, O(n)
  - Sorted array — binary search, O(log n)
- Other advantages of sorting
  - Finding median value: midpoint of sorted list
  - Checking for duplicates
  - Building a frequency table of values

How to sort?

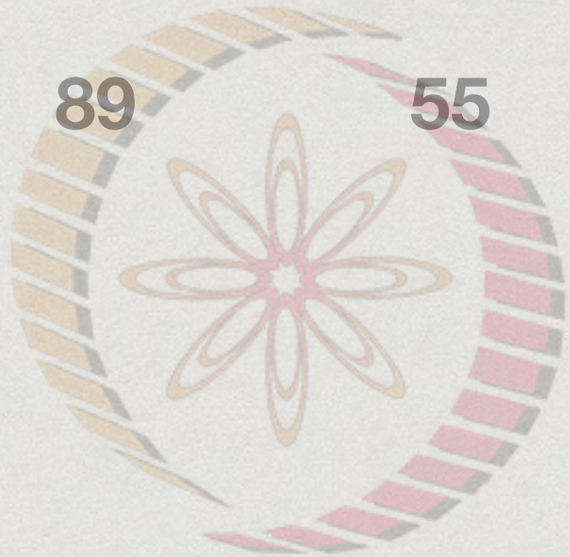
- You are a Teaching Assistant for a course
- The instructor gives you a stack of exam answer papers with marks, ordered randomly
- Your task is to arrange them in descending order

Strategy 1

- Scan the entire stack and find the paper with minimum marks
- Move this paper to a new stack
- Repeat with remaining papers
  - Each time, add next minimum mark paper on top of new stack
- Eventually, new stack is sorted in descending order

Strategy 1 …

74 32 89 55 21 64



Strategy 1 …

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Strategy 1 …

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Strategy 1 …

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Strategy 1 ...

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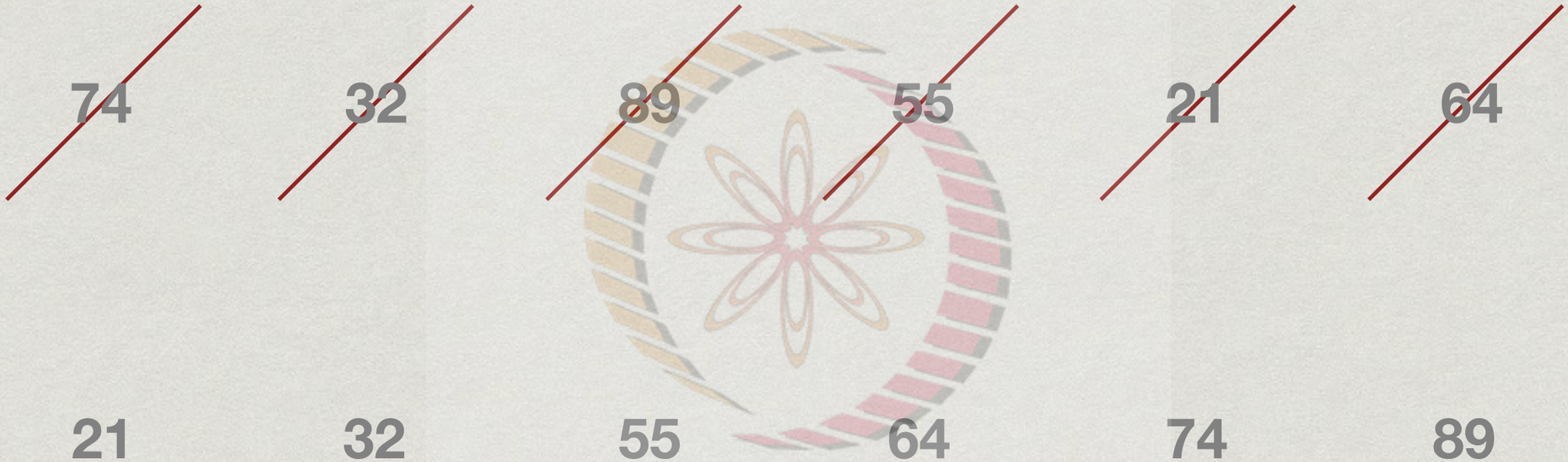
Strategy 1 ...



Strategy 1 ...

Selection Sort

- Select the next element in sorted order
- Move it into its correct place in the final sorted list

Selection Sort

- Avoid using a second list
  - Swap minimum element with value in first position
  - Swap second minimum element to second position
  - …

Selection Sort

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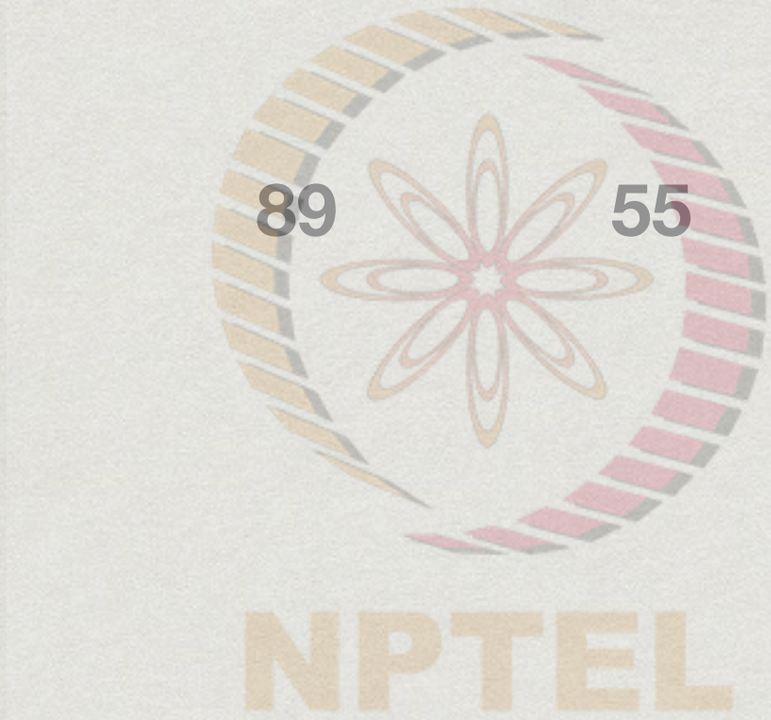

Selection Sort

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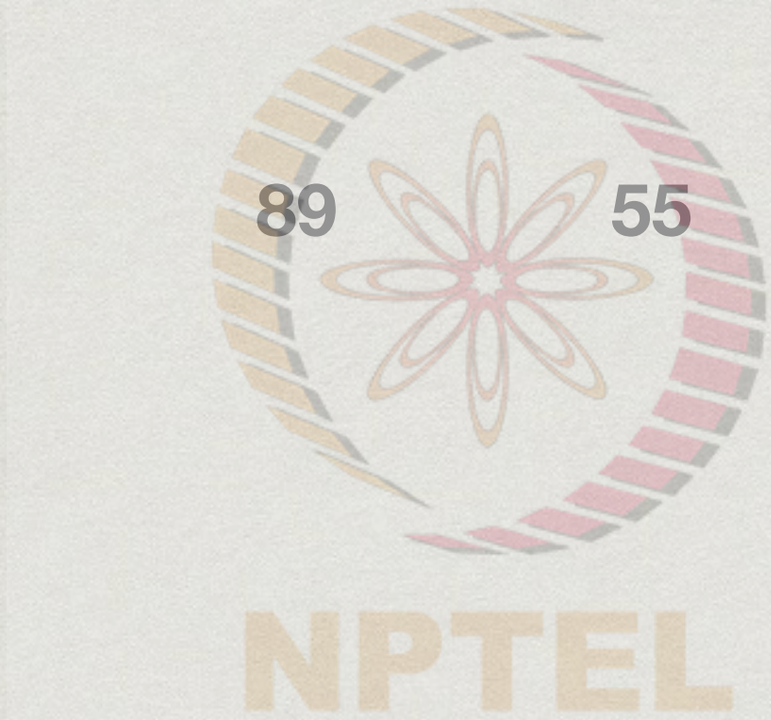

Selection Sort

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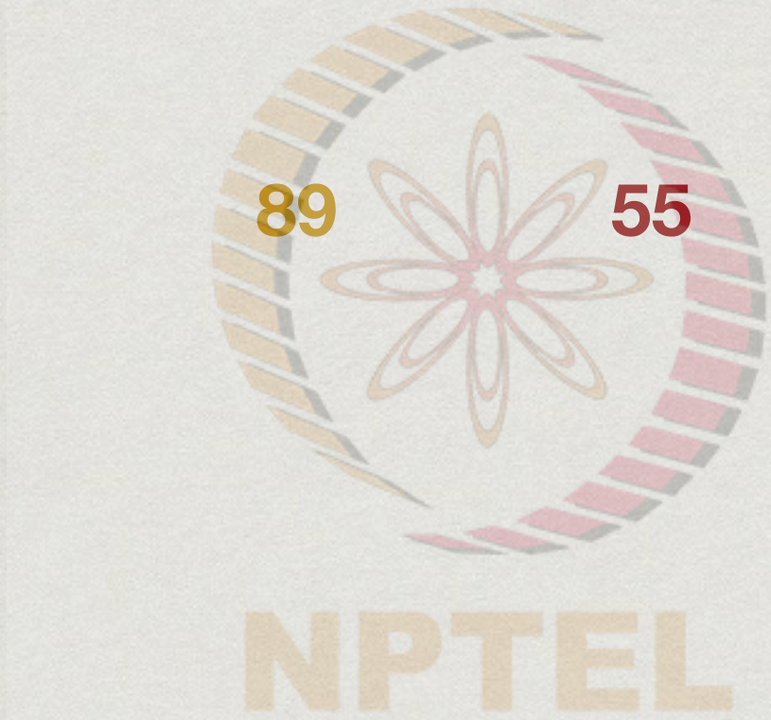

Selection Sort

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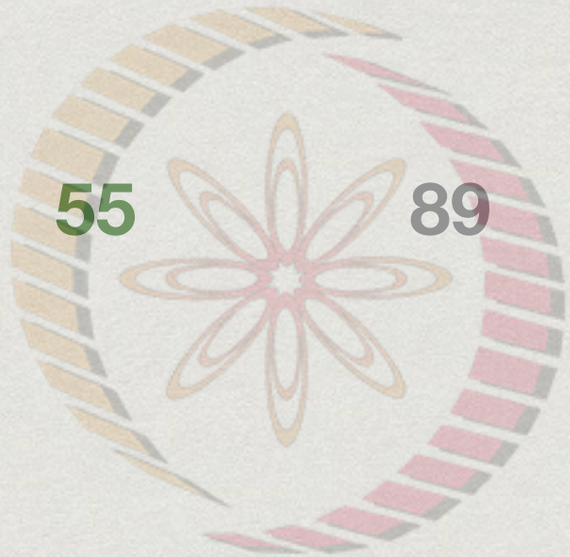

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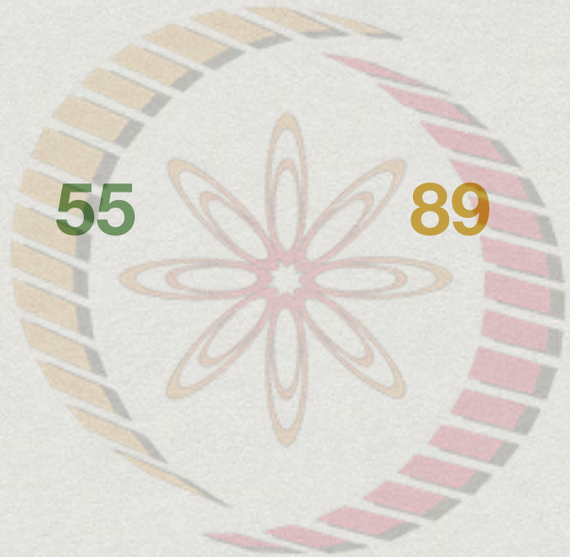

Selection Sort

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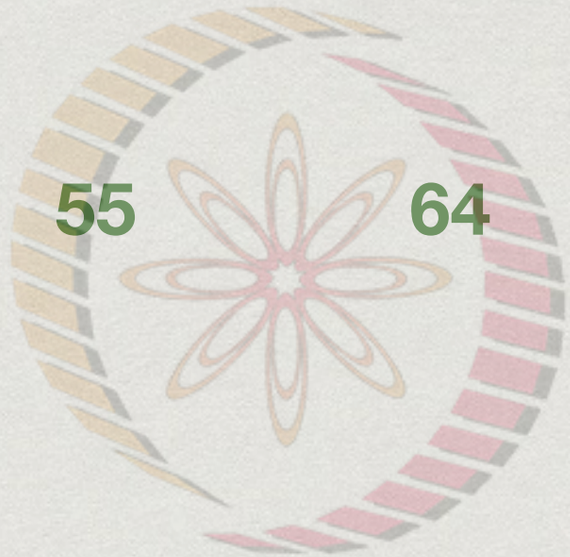

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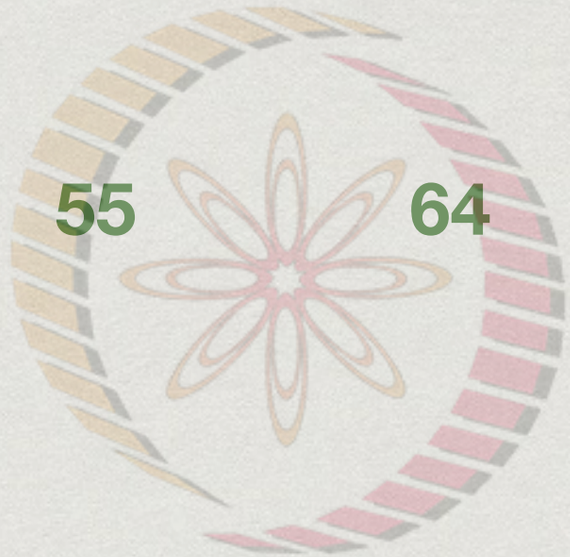

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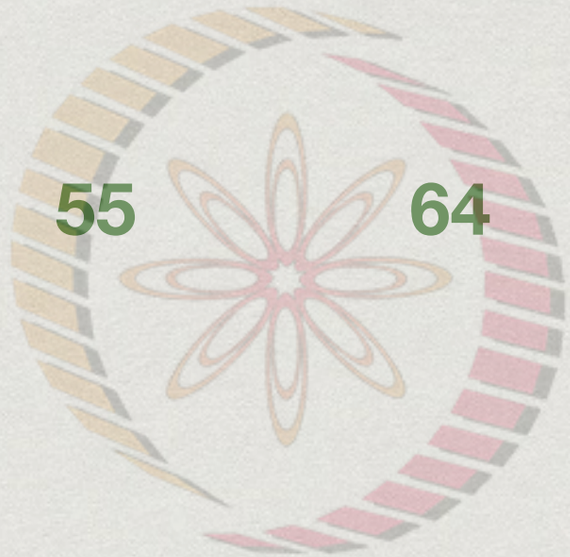

Selection Sort

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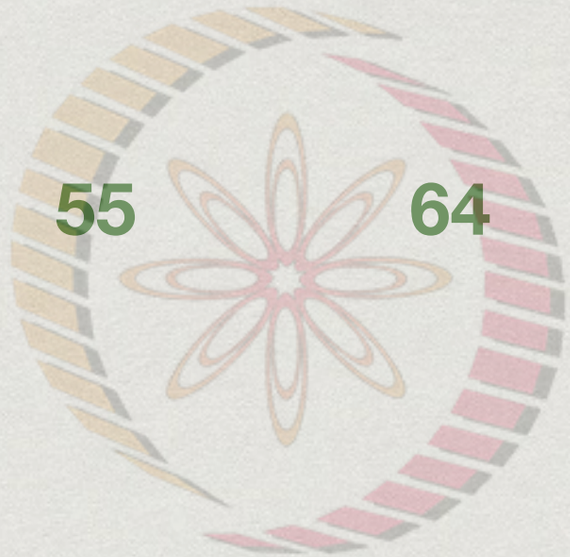

Selection Sort

```
def SelectionSort(l):

    # Scan slices l[0:len(l)], l[1:len(l)], …
    for start in range(len(l)):

        # Find minimum value in slice . . .
        minpos = start
        for i in range(start,len(l)):
            if l[i] < l[minpos]:
                minpos = i

        # . . . and move it to start of slice
        (l[start],l[minpos]) = (l[minpos],l[start])
```

Analysis of Selection Sort

- Finding minimum in unsorted segment of length k requires one scan, k steps
- In each iteration, segment to be scanned reduces by 1
- $T(n) = n + (n-1) + (n-2) + \ldots + 1 = n(n+1)/2 = O(n^2)$