NPTEL MOOC

PROGRAMMING, DATA STRUCTURES AND ALGORITHMS IN PYTHON

Week 3, Lecture 7

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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 2

- First paper: put in a new stack
- Second paper:
  - Lower marks than first? Place below first paper
    Higher marks than first? Place above first paper
- Third paper
  - Insert into the correct position with respect to first two papers
- Do this for each subsequent paper:
  insert into correct position in new sorted stack

Strategy 2 …

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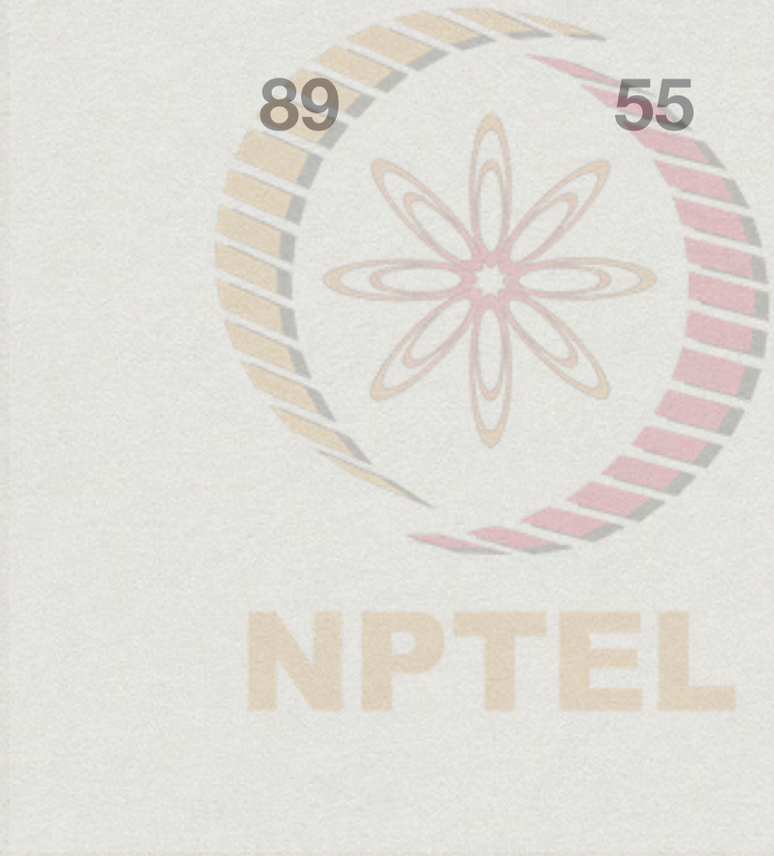

Strategy 2 …

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Strategy 2 ...

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Strategy 2 …

Insertion Sort

- Start building a sorted sequence with one element
- Pick up next unsorted element and insert it into its correct place in the already sorted sequence

Insertion Sort

```
def InsertionSort(seq):

 for sliceEnd in range(len(seq)):
   # Build longer and longer sorted slices
   # In each iteration seq[0:sliceEnd] already sorted

   # Move first element after sorted slice left
   # till it is in the correct place
   pos = sliceEnd
   while pos > 0 and seq[pos] < seq[pos-1]:
     (seq[pos],seq[pos-1]) = (seq[pos-1],seq[pos])
     pos = pos-1
```

Insertion Sort

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Insertion Sort

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Insertion Sort

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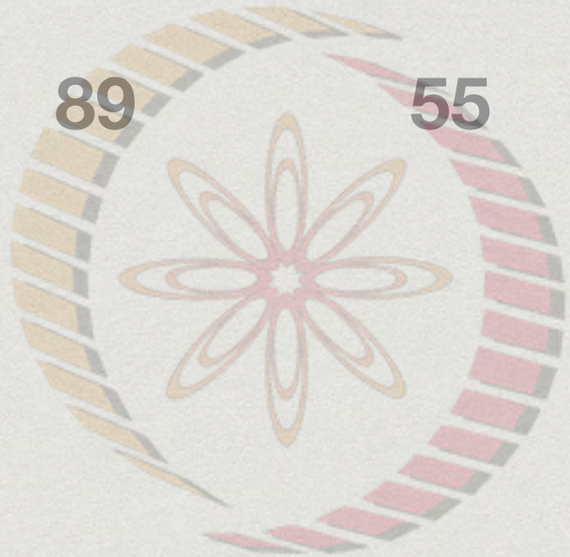

Insertion Sort

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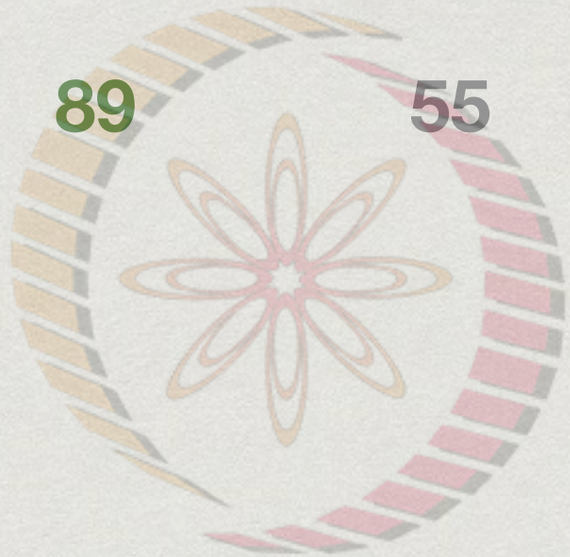

Insertion Sort

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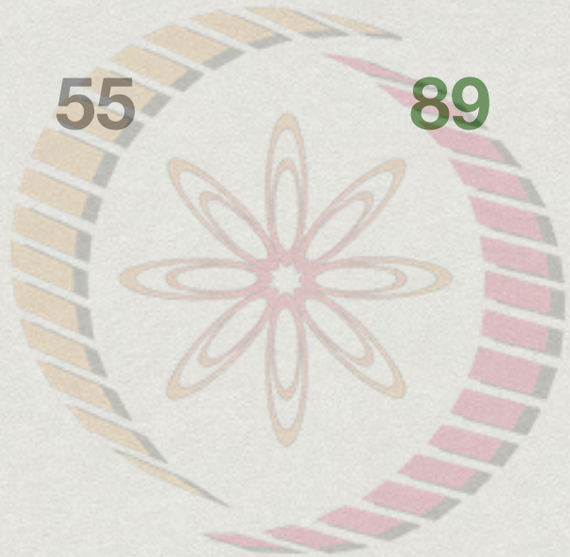

Insertion Sort

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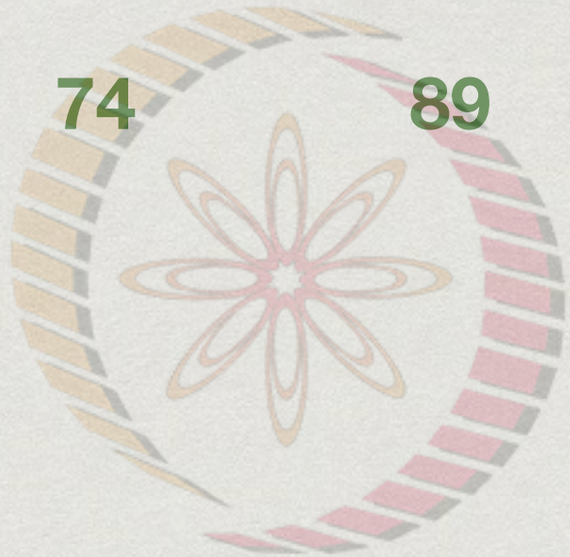

Insertion Sort

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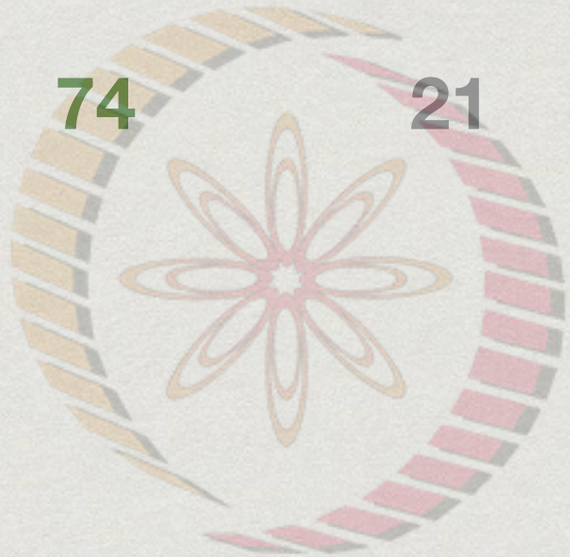

Insertion Sort

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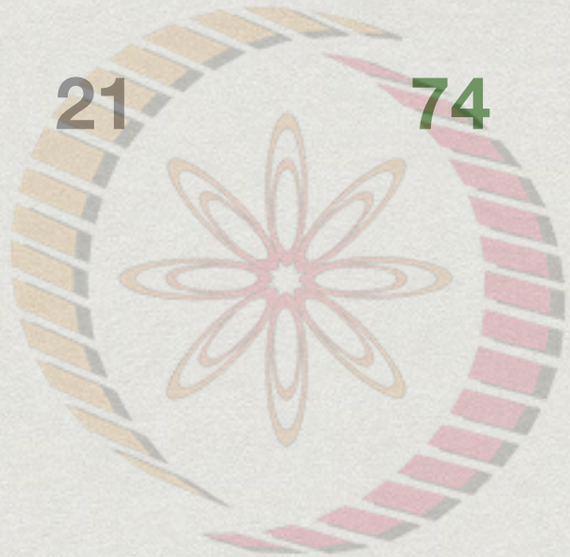

Insertion Sort

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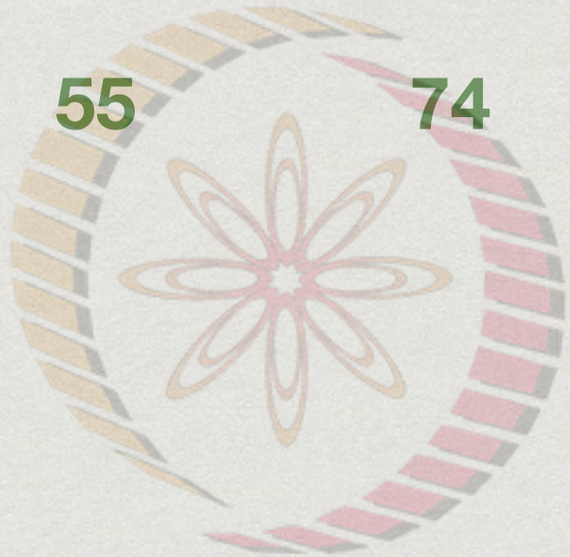

Insertion Sort

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Insertion Sort

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Insertion Sort

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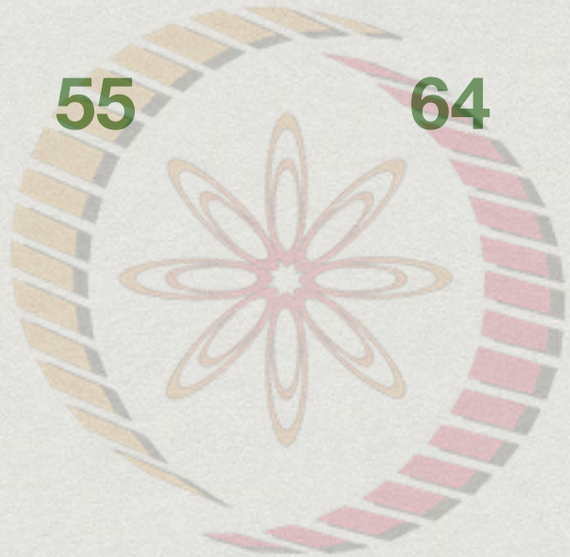

Analysis of Insertion Sort

- Inserting a new value in sorted segment of length k requires upto k steps in the worst case
- In each iteration, sorted segment in which to insert increased by 1
- $T(n) = 1 + 2 + \ldots + n-1 = n(n-1)/2 = O(n^2)$

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