CS141: Intermediate Data Structures and Algorithms

Ahmed Eldawy
Welcome back to UCR!
Class information

- Classes: Monday, Wednesday, and Friday 2:10 PM – 3:00 PM
- Instructor: Ahmed Eldawy
- Office hours: Monday and Wednesday 3:00 PM – 4:00PM @357 WCH. Conflicts?
- Website
Textbook

- Introduction to Algorithms. Third Edition
- Cormen, Leiserson, Rivest, and Stein
Course goals

- What are your goals?
- Analysis of algorithms
- Design of algorithms
- How to compare and choose different algorithms and data structures
- How to improve existing algorithms
Covered topics

- Analysis of algorithms
- Big-O notation
- Divide and conquer algorithms
- Greedy algorithms
- Dynamic programming
- Graph algorithms
- Computational geometry
Course work

- Five assignments (20%)
  - Prepared on Latex or any other word processor
  - Late policy: 20% per calendar day (up to four days)
- Two quizzes (15% + 25% = 40%)
- Final exam (40%)

Final Exam
Friday, March 24\textsuperscript{th}
3:00 PM – 6:00 PM
Analysis of Algorithms
Criteria of Analysis

Which criteria should be taken into account?

- Running time
- Memory footprint
- Disk IO
- Network bandwidth
- Power consumption
- Lines of codes
- …
Average Case Vs Worst Case

Running Time

- Worst case
- Average case
- Best case

Different inputs of the same size
**Case Study: Insertion Sort**

**Insertion-Sort** ($A, n$)

```plaintext
for $j = 2$ to $n$
    $key = A[j]$
    // Insert $A[j]$ into the sorted sequence $A[1 .. j - 1]$
    $i = j - 1$
    while $i > 0$ and $A[i] > key$
        $A[i + 1] = A[i]$
        $i = i - 1$
    $A[i + 1] = key$
```

<table>
<thead>
<tr>
<th>Cost</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>$c_1$</td>
<td>$n$</td>
</tr>
<tr>
<td>$c_2$</td>
<td>$n - 1$</td>
</tr>
<tr>
<td>$c_4$</td>
<td>$n - 1$</td>
</tr>
<tr>
<td>$c_5$</td>
<td>$\sum_{j=2}^{n} t_j$</td>
</tr>
<tr>
<td>$c_6$</td>
<td>$\sum_{j=2}^{n} (t_j - 1)$</td>
</tr>
<tr>
<td>$c_7$</td>
<td>$\sum_{j=2}^{n} (t_j - 1)$</td>
</tr>
<tr>
<td>$c_8$</td>
<td>$n - 1$</td>
</tr>
</tbody>
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