Fine Grained Analysis of Algorithms and Data Structures

Análisis fino de algoritmos y estructuras de datos

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Abstract

The adaptive analysis of algorithms remedy to the pessimism of the standard worst-case analysis of algorithms by considering other parameters than the input size, in order to better capture the difficulty of the input instance. Developped since the 70's, such an analysis technique has become even more relevant nowadays as the size of data explodes, and with it the gap between the worst case performance and the typical one. We give an introduction of this technique by revisiting classical problems through this analysis, discuss the relations between this analysis technique with output sensitivity and parameterized complexity, and present some preliminary work on problems for which such an analysis seems promising, such as Searching in sorted arrays, Sorting, computing the Convex Hull, computing Optimal Prefix Free Codes (Huffman), etc...

Outline (1/2)

- Dia 1: Desde la Torre de Hanoi a pilas de discos
  1. Peor caso por n fijado
  2. Peor caso por n, δ fijado
  3. Peor caso por $\delta, n_1, \ldots, n_\delta$ fijado
  4. Plan of the rest of the course
  5. Assignment: Selenite Towers

- Dia 2: Operaciones sobre Conjuntos Ordenados
  1. Binary Search -> Doubling Search
  2. Binary Encoding -> Gamma Coding
  3. (2,4) Search Trees -> Finger Search Tree
  4. Splay Arboles
  5. Sorted Merge -> Adaptive Sorted Merge
  6. Sorted Intersection -> Adaptive Insertion

Outline (2/2)

- Dia 3: Ordenamiento
  1. Insertion Sort -> Local Insertion Sort
  2. Heap -> Adaptive Priority queues
  3. Heap sort -> Smooth Sort
  4. Sorted Merge -> Adaptive Sorted Merge
  5. Merge Sort -> Adaptive MergeSort
- Dia 4: Geometria Computacional Adaptativa
  1. Convex Hull -> Output Sensitive Convex Hull
  2. Dominating Set -> Instance Optimal DS
  3. MCS Trees -> MCS Splay Trees
  4. Optimal Boxes -> Adaptive Optimal Boxes
- Dia 5: Otros Problemas de interes y Wrapup
  1. Alternation of Optimal Prefix Free Codes (Huffman)
  2. Swap Insert Edit Distance
  3. Synergy Sorting

Pedagogical Objectives

After taking this course, the student should be able to

- mention some **examples of fine grained analysis** of some computational complexity;
- **identify the potential** of a fine grained analysis in a problem; and
- **perform a fine grained analysis** of the complexity of some simple problems.

Similar work by the same Author

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