Análise de Algoritmos

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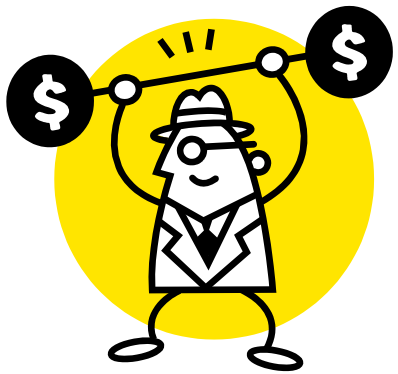
Boss assigns task:

- Given the revenue per add; users profile; inventory per advertiser

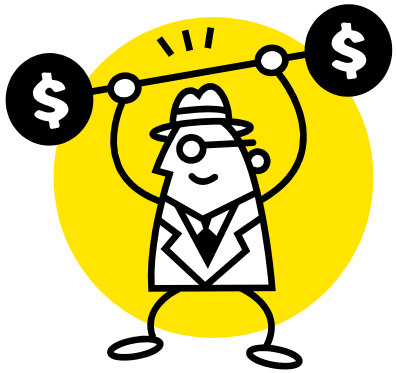
- Which ads should the search engine exhibit to maximize revenue?



Everyday industry asks these questions

Boss assigns task:

- Given bandwidth, processing capacity, number of available CPU's, memory, external storage
- Given constraints on how a crawler operates
- Make the most efficient crawler



Everyday industry asks these questions

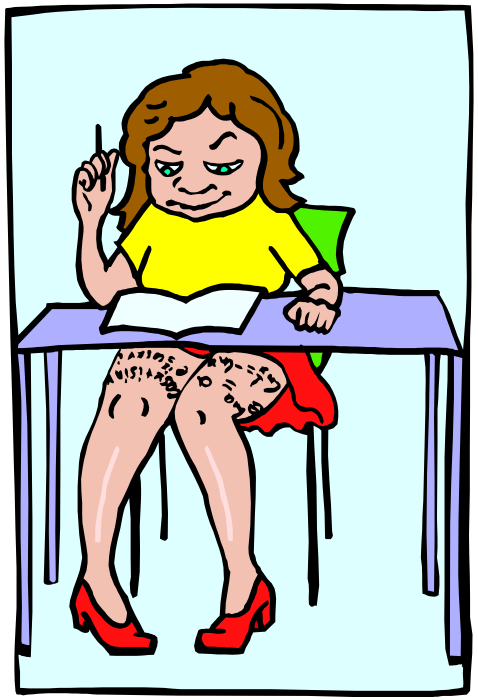
Possible answer

- Um? Tell me what to code.

Bad: Mundane programmers are not as valued as they use to be

Your answer after **AA**

- I learned this great algorithm that will work.



Outcome 1: Know many different algorithms

Your answer after **AA**

- I can develop a new algorithm for you

Distinguished professionals will always be needed

Outcome 2: Know methods for designing new algorithms

Some questions

1. Write a regular expression which matches a email address
2. If you have 1 million integers, how would you sort them efficiently?
3. Given a file of 4 billion 32-bit integers, how to find one that appears at least twice?
4. Given an array, i) find the longest continuous increasing subsequence. ii) find the longest increasing subsequence
5. You are given three sorted arrays (in ascending order), you are required to find a triplet (one element from each array) such that the distance is minimal
6. Given two linked lists, return the intersection of the two lists: i.e. return a list containing only the elements that occur in both of the input lists.
7. Describe the algorithm for a depth-first graph traversal

Microsoft/Google questions

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Given 4 billion integers, find a number that appears at least twice (if exists)

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Solution 1: Try out all pairs of numbers (**brute force**)

```
For i=1 to A.len
  For j=1 to i-1
    If A[i]==A[
      Return A
```

Takes 80 milion sec. at 100 Gflops

Q: How many pairs tested?

Given 4 billion integers, find a number that appears at least twice (if exists)

Can we do better and not compare all pairs?

Solution 2: For each number, search for its partner (bin. search)

```
sort(A)
For i=1 to A.len
   Binary search fo
   If found
      Return A[i]
```

Takes 1 sec. at 100 Gflops

Q: How many pairs tested? ≈

We need to design efficient algorithms

Brute force solution

Takes 80 milion sec. at 100 Gflops

Efficient solution

Takes 1 sec. at 100 Gflops

Tentative Topics

1. Analysis of algorithms

Basics

How to formalize efficiency of an algorithm?

Sorting

There is no other general sorting algorithm that makes fewer comparisons than Mergesort

Graphs

Because of prerequisites, can I finish all remaining courses in 4 semesters?

2. Design techniques

Greedy

With time conflicts, how should a university assign classrooms?

Divide-and-conquer

More efficient multiplication of 2 numbers

Dynamic programming

Compute similarity of 2 strands of DNA

3. Additional topics

Prediction with experts

Given "experts" predicting stock movements, how to perform like the best expert?

Complexity

What is P vs NP?

Useful Learning Techniques

Read Ahead

- You are expected to read the lecture notes **before** the lecture.
- This will facilitate more productive discussion during class.

Be Creative

- Ask questions
- Why is it done this way and not that way?

Estrutura do curso

Material: slides de aula, listas de exercicios, (livro texto)

Livro texto: *Algorithm Design,* Kleinberg-Tardos

Avaliacao: 3 provas + prova final

Informações

http://www.inf.puc-rio.br/~mmolinaro