CS344: Design And Analysis of Computer Algorithms

S. Muthu Muthukrishnan

Details

- Meeting: Tues, Fri. 11.30 – 12.50 PM. SEC 118
- Professor: Muthu Muthukrishnan, 445 2379, Core 319.
- Office hours: Tuesdays 3.30 – 4.30 PM.
- Contact:
  - muthu at cs.rutgers.edu
  - http://www.cs.rutgers.edu/~muthu
- TAs:

More Details

- Book:
  - Cormen, Leiserson, Rivest, Stein. http://theory.lcs.mit.edu/~clr/
- Grading:
  - 2 Midterms 25% each: March 4, April 8.
  - 1 Final Exam 40%: May 6.
  - Homeworks 10%.
    - Teams of X people each.
    - Assignment given on fridays, due the following friday.
- Policy: Writing "I don't know" gives you 25% of the points.
- Khachiyan is an excellent lecturer! Both sections are independent.

Syllabus

- Asymptotic analysis of algorithms
- Recursion, induction, recurrence equations.
- Sorting and Selection.
- Hashing and balanced search structures
- Graphs and Graph algorithms
- Dynamic Programming
- String matching.
- Polynomials, matrices.
- NP Completeness
- Assorted topics.

Big Picture of Computer Science

- Theory
  - What is computable? Turing machines, recursive functions.
  - What is efficiently computable? Algorithms, Complexity theory.
  - Abstract math, practical methods.
- Systems
  - Databases, OS, Networks, Programming Languages, Web,..
  - Theory, tools.
- Popular Science
  - CPU MIPS, GUIs, Blogs, SPAM,…

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- Design of efficient algorithms for problems.
- Mathematically analyze running time and space used.
- Lower bounds: What is the best possible algorithm, what is “best”?
- Are there solvable problems that have no efficient algorithms?

Example

- Problem: Maximum subarray sum
- Input: Array A[1..n] of integers.
- Output: [i,j] such that A[i]+…+A[j] is largest.

Naïve Strategy

- For all pairs 1<=i<=j<=n, compute
  - sum(i,j)= A[i]+…+A[j]
- Simple triple loop will do.
- Running time:
  - Roughly n^3.

```
For i=1 to n
   For j=i+1 to n
     Sum[i,j]=0;
     For k=i to j
          Sum[i,j]+=A[k].
```

Less Naive Strategy

- When you have sum(i,j)=A[i]+…A[j], it is easy to get sum(i,j+1)=A[i]+..A[j+1].
- Double loop will do.

```
For i=1..n
   Sum[i,i]=A[i]
   For j=i+1 .. n
      Sum[i,j]=Sum[i,j-1]+A[j]
```

- Running time: n+(n-1)+(n-2)+…1, roughly n^2.

What is the fastest running time possible?