CSE 417: Algorithms and Computational Complexity

1: Organization & Overview

Winter 2005

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http://www.cs.washington.edu/417

University of Washington

Computer Science & Engineering

CSE 417, Wi '05: Algorithms & Computational Complexity

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Email
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Assignments
Lecture Notes

Time: MWF 2:30-3:20

Place: Smith 205

		Office Hours	Phone
Instructor:	Larry Ruzzo, ruzzo@cs,	Tu? ?F? 1:30-2:20, CSE 554, ?	543-6298
TA:	Yuhan Cai, yuhancai@cs,		

Catalog Description: Design and analysis of algorithms and data structures. Efficient algorithms for manipulating graphs and strings. Fast Fourier Transform. Models of computation, including Turing machines. Time and space complexity. NP-complete problems and undecidable problems.

. . .

What you'll have to do

- Programming
  - Several small projects and (maybe) a large one
- Written homework assignments
  - English exposition and pseudo-code
  - Analysis and argument as well as design
- Midterm & Final Exam

What the course is about

- Design of Algorithms
  - design methods
  - common or important types of problems
  - how to analyze algorithms
  - correctness proofs

What the course is about

- Complexity and NP-completeness
  - solving problems in principle is not enough
    - algorithms must be **efficient**
  - NP
    - class of useful problems whose solutions can be easily checked but not necessarily found efficiently
  - NP-completeness
    - understanding when problems are hard to solve

Very Rough Division of Time

- Algorithms (7 weeks)
  - Analysis of Algorithms
  - Basic Algorithmic Design Techniques
  - Graph Algorithms
- Complexity & NP-completeness (3 weeks)

Complexity Example

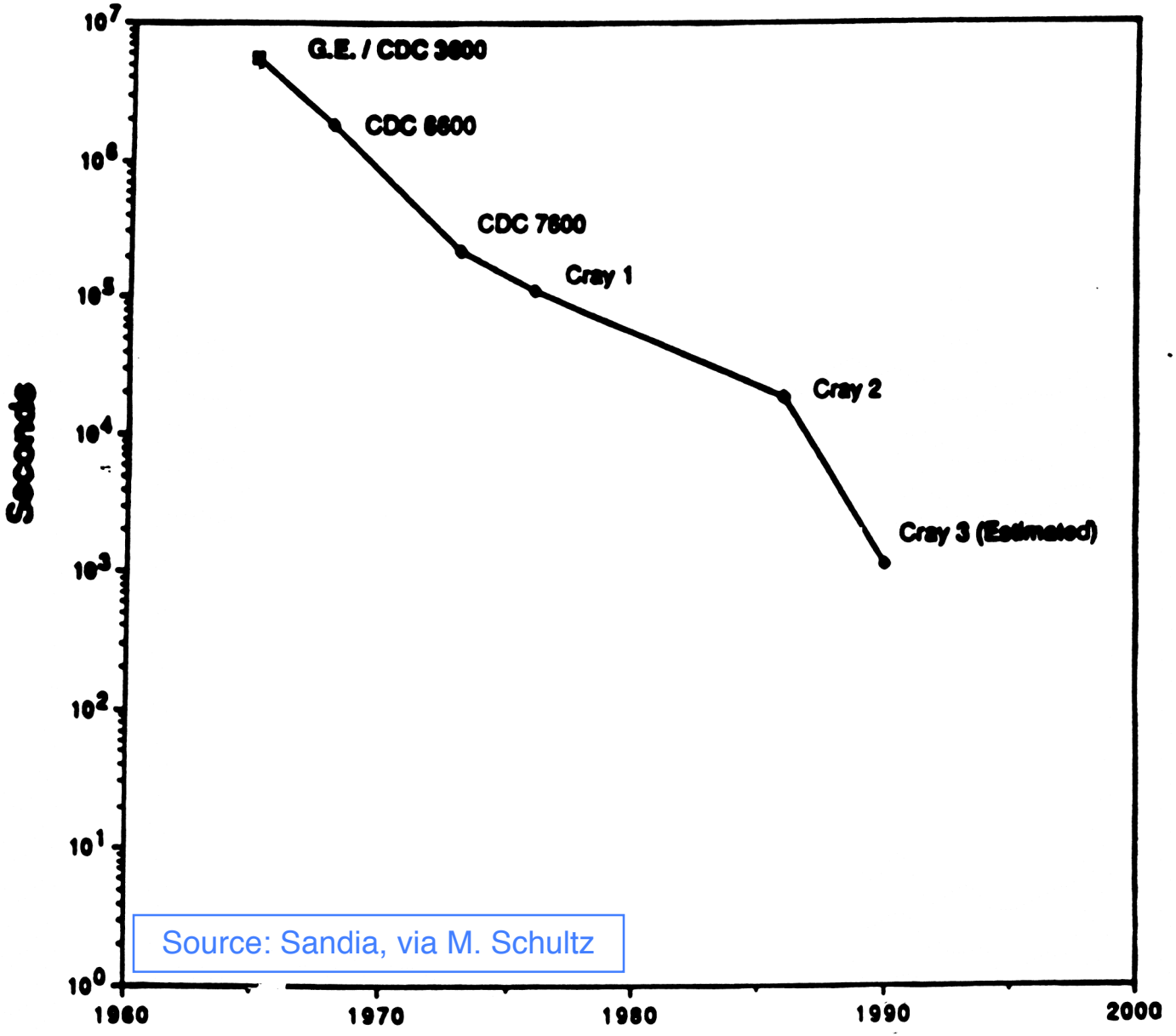
- Cryptography (e.g. RSA, SSL in browsers)
  - Secret: p,q prime, say 512 bits each
  - Public: n which equals pxq, 1024 bits
- In principle
  - there is an algorithm that given n will find p and q by trying all 2^{512} possible p's.
- In practice
  - security of RSA depends on the fact that no **efficient** algorithm is known for this

Algorithms versus Machines

- We all know about Moore's Law and the exponential improvements in hardware but...
- Ex: sparse linear equations over past few decades
- 10 orders of magnitude improvement in speed
  - 4 orders of magnitude improvement in hardware
  - 6 orders of magnitude improvement in algorithms

Algorithms or Hard-ware?

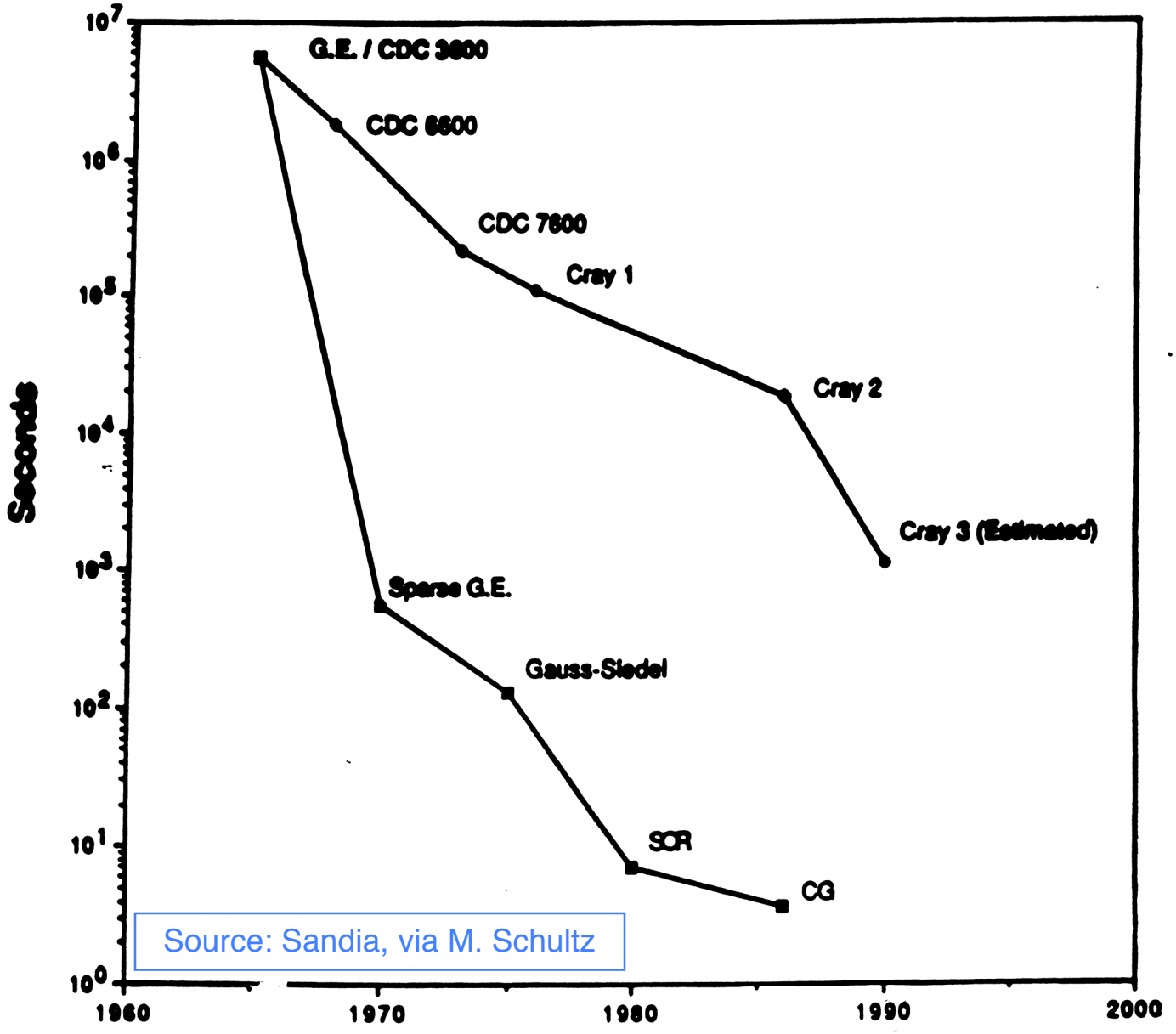
Solving sparse linear systems



Source: Sandia, via M. Schultz

Algorithms or Hard-ware?

Solving sparse linear systems



Algo-rithms or Hard-ware?

The N-Body Problem