Part II

Foundations

3 Goals

- ▶ Gain knowledge about efficient algorithms for important problems, i.e., learn how to solve certain types of problems efficiently.
- ▶ Learn how to analyze and judge the efficiency of algorithms.
- ▶ Learn how to design efficient algorithms.

4 Modelling Issues

What do you measure?

- ▶ Memory requirement
- ▶ Running time
- ▶ Number of comparisons
- ▶ Number of multiplications
- ▶ Number of hard-disc accesses
- ▶ Program size
- ▶ Power consumption
- ▶ . . .

4 Modelling Issues

How do you measure?

- ▶ Implementing and testing on representative inputs
  - ▶ How do you choose your inputs?
  - ▶ May be very time-consuming.
  - ▶ Very reliable results if done correctly.
  - ▶ Results only hold for a specific machine and for a specific set of inputs.

- ▶ Theoretical analysis in a specific model of computation.
  - ▶ Gives asymptotic bounds like "this algorithm always runs in time $O(n^2)$".
  - ▶ Typically focuses on the worst case.
  - ▶ Can give lower bounds like "any comparison-based sorting algorithm needs at least $\Omega(n \log n)$ comparisons in the worst case".