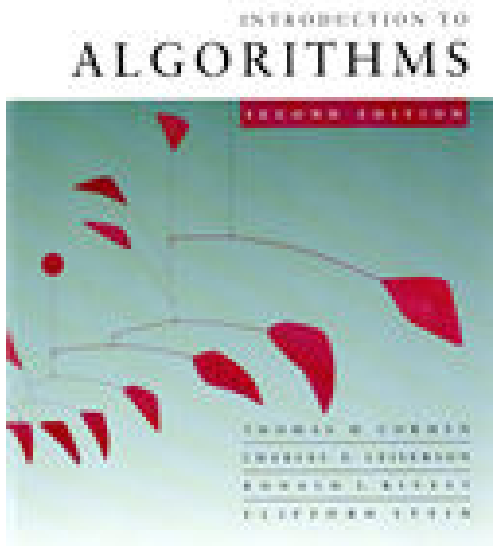
Design and Analysis of Algorithms

Introduction



Introduction to Algorithms (2nd)

by Cormen, Leiserson, Riverst and Stein

(CLRS) MIT Press

- Textbook:
  - ***Introduction to Algorithms*, 2nd edition, by T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein. The MIT Press, 2001.**（**2002年5月高等教育出版社出版影印版**）

- Grading Policy:
  - **Homework + Projects : 40%**
  - **Final Exam: 60%**

Analysis of algorithms

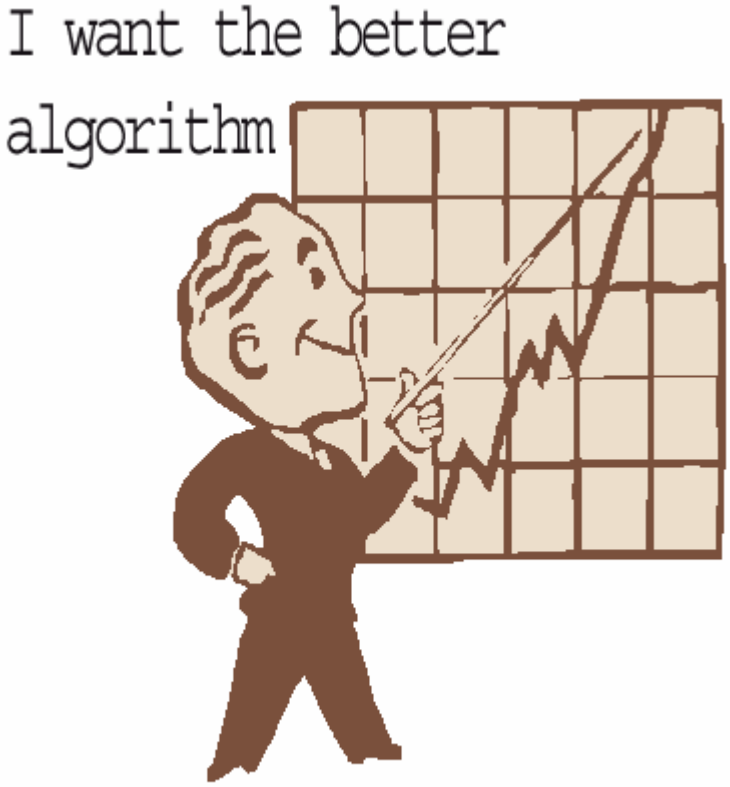
- The theoretical study of computer-program performance and resource usage.
- What's more important than performance?
  - modularity
  - correctness
  - maintainability
  - functionality
  - robustness
  - user-friendliness
  - programmer time
  - simplicity
  - extensibility
  - reliability

Why study algorithms and performance?

- Algorithms help us to understand **scalability**.
- Performance often draws the line between what is feasible and what is impossible.
- Algorithmic mathematics provides a **language** for talking about program behavior.
- Performance is the **currency** of computing.
- The lessons of program performance generalize to other computing resources.
- Speed is fun!

Two Distinct Choices

rich man



smart mathematician

Algorithm matters

- Sort 10 million integers on
  - 1 GHZ computer (1000 million instruction per second) using $2n^2$ algorithm
  - 100 MHz computer (100 million instruction per second) using $50n\log n$ algorithm
- Supercomputer

$$\frac{2\cdot(10^7)^2 \text{ instructions}}{10^9 \text{ instructions/second}} = 200000 \text{ seconds} \approx 55 \text{ hours},$$

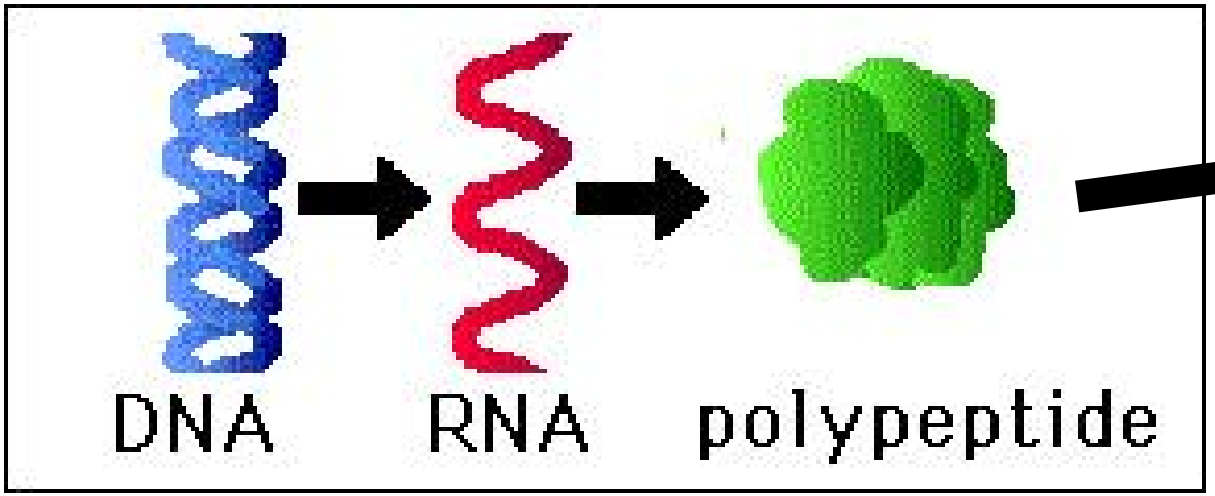
- Personal computer

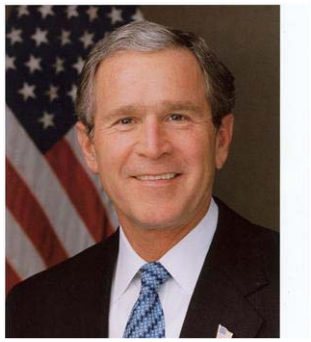
$$\frac{50\cdot 10^7 \lg 10^7 \text{ instructions}}{10^8 \text{ instructions/second}} \approx 105 \text{ seconds}.$$

Some Applications

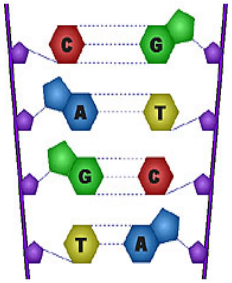
- Practical App. of Algorithms are ubiquitous and Including
  - data retrieval
  - network routing
  - games
  - human genome project
  - Internet algorithms
  - electronic commerce
  - manufacturing and other commercial settings
  - many concrete problems…

Biology in One Slide – Twentieth Century

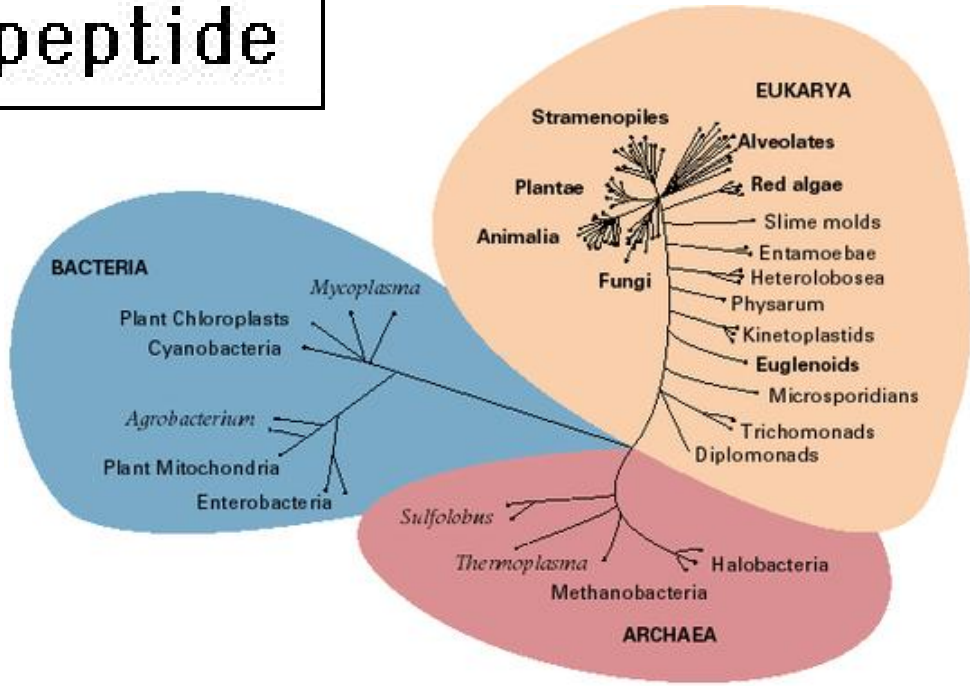




…and today



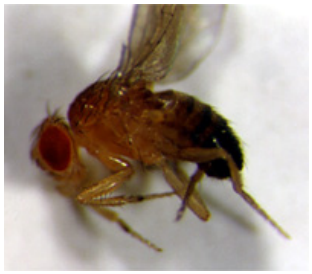
…ACGTGACTGAGGACCGTG
CGACTGAGACTGACTGGGT
CTAGCTAGACTACGTTTTA
TATATATATACGTCGTCGT
ACTGATGACTAGATTACAG
ACTGATTTAGATACCTGAC
TGATTTTAAAAAAATATT…



Complete DNA Sequences

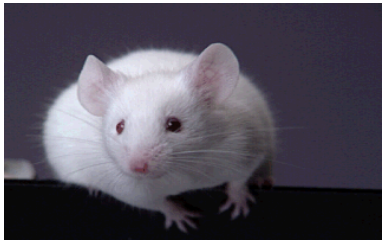






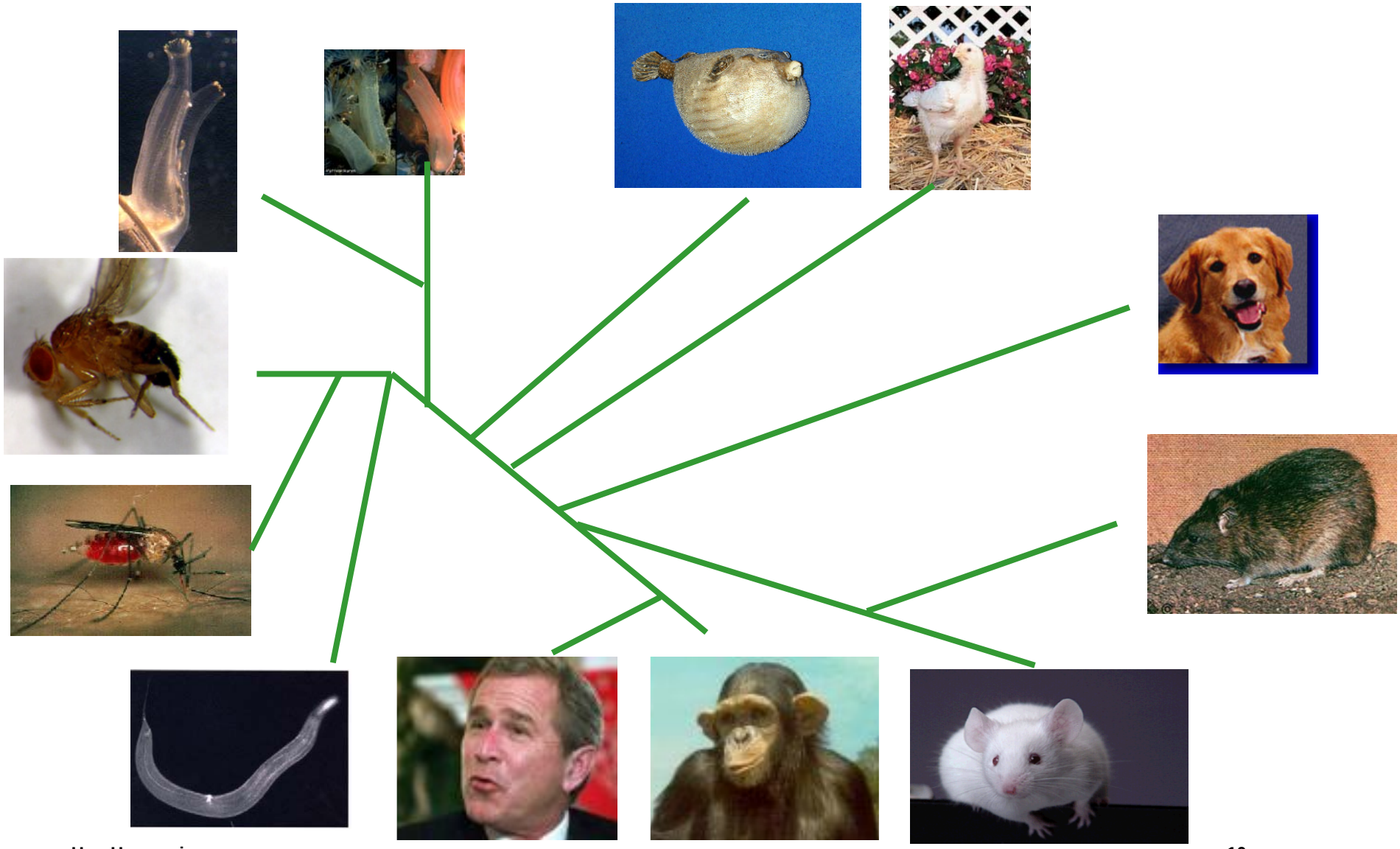


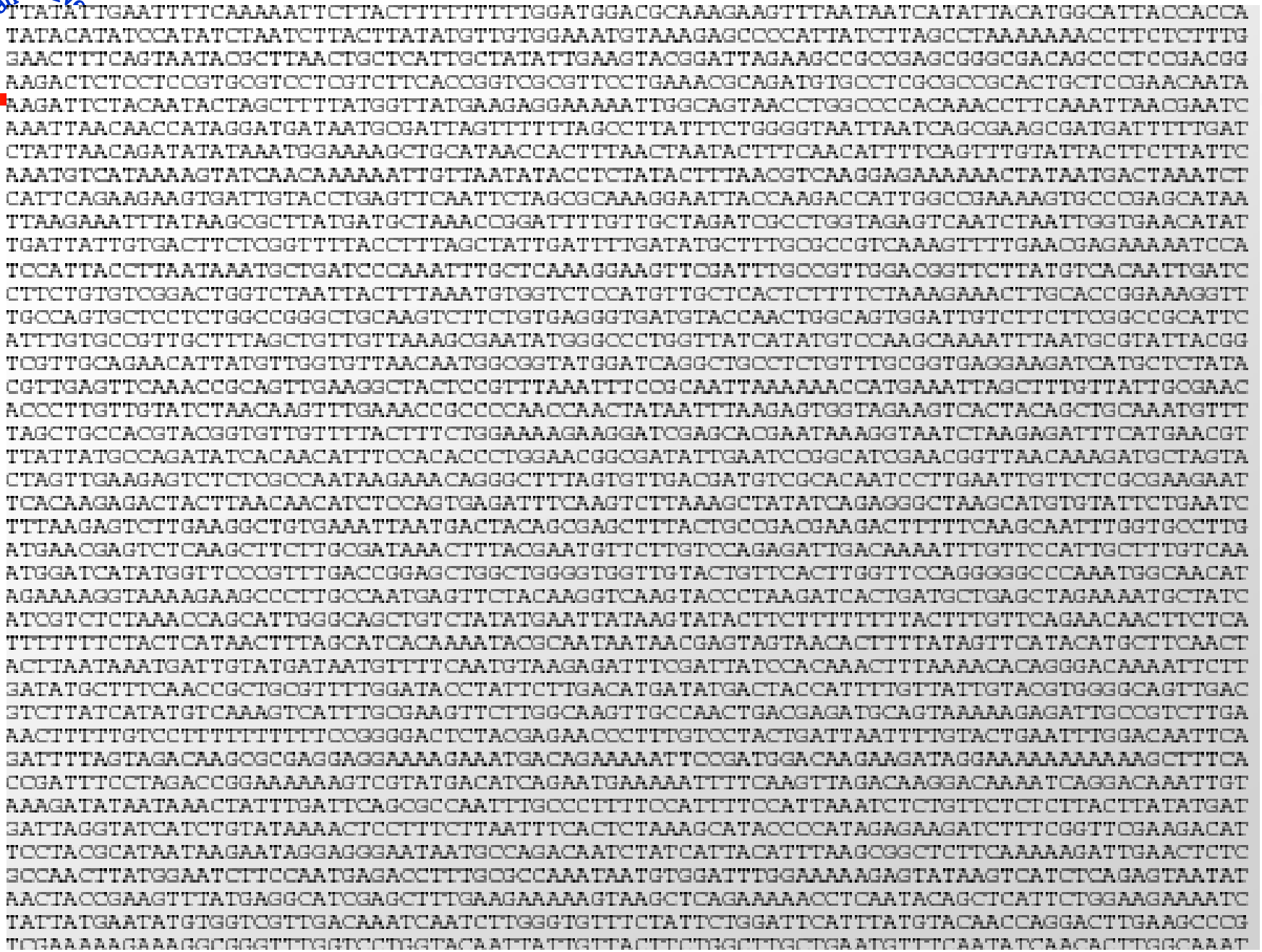


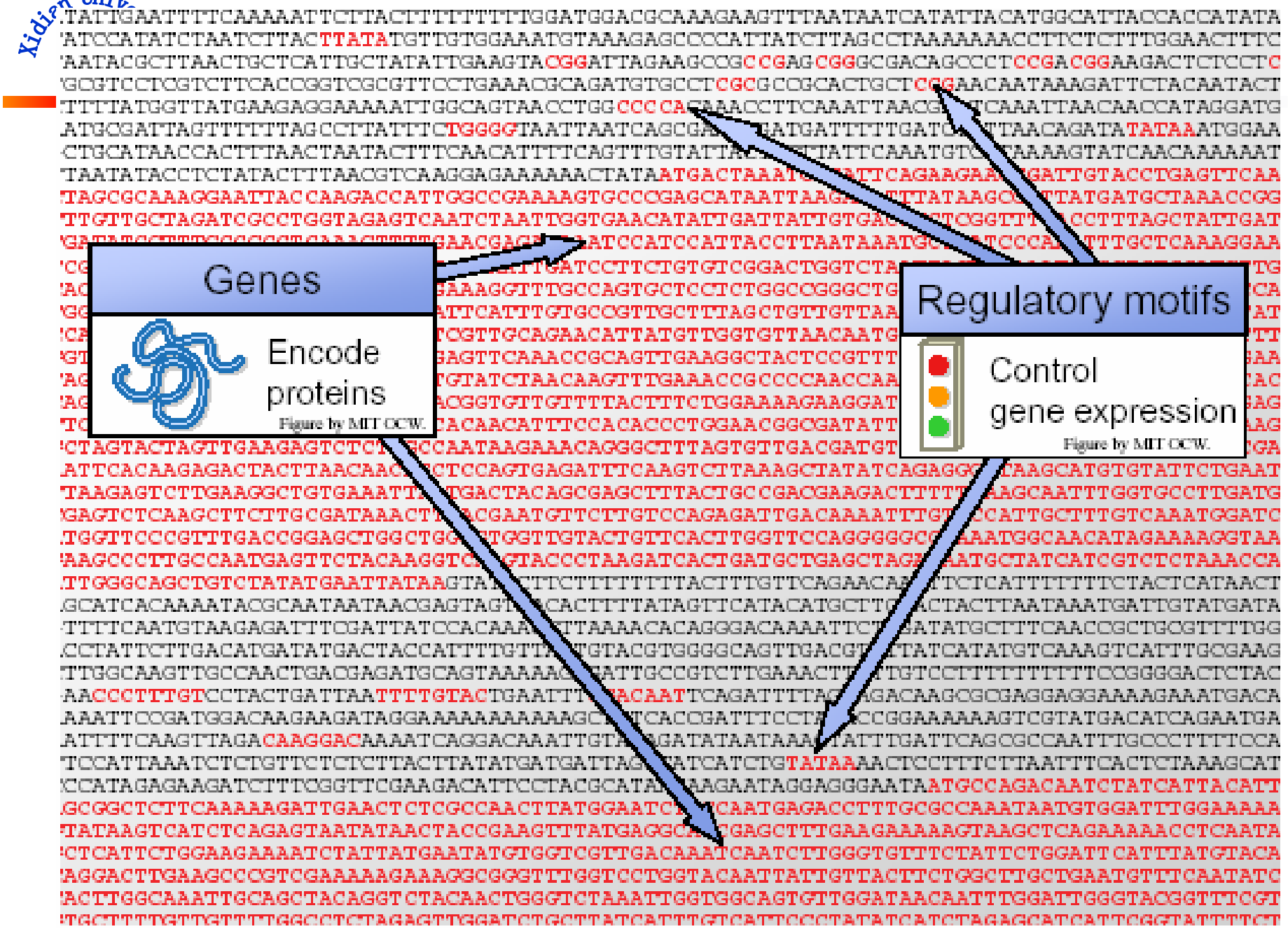



nearly 200 complete genomes have been sequenced

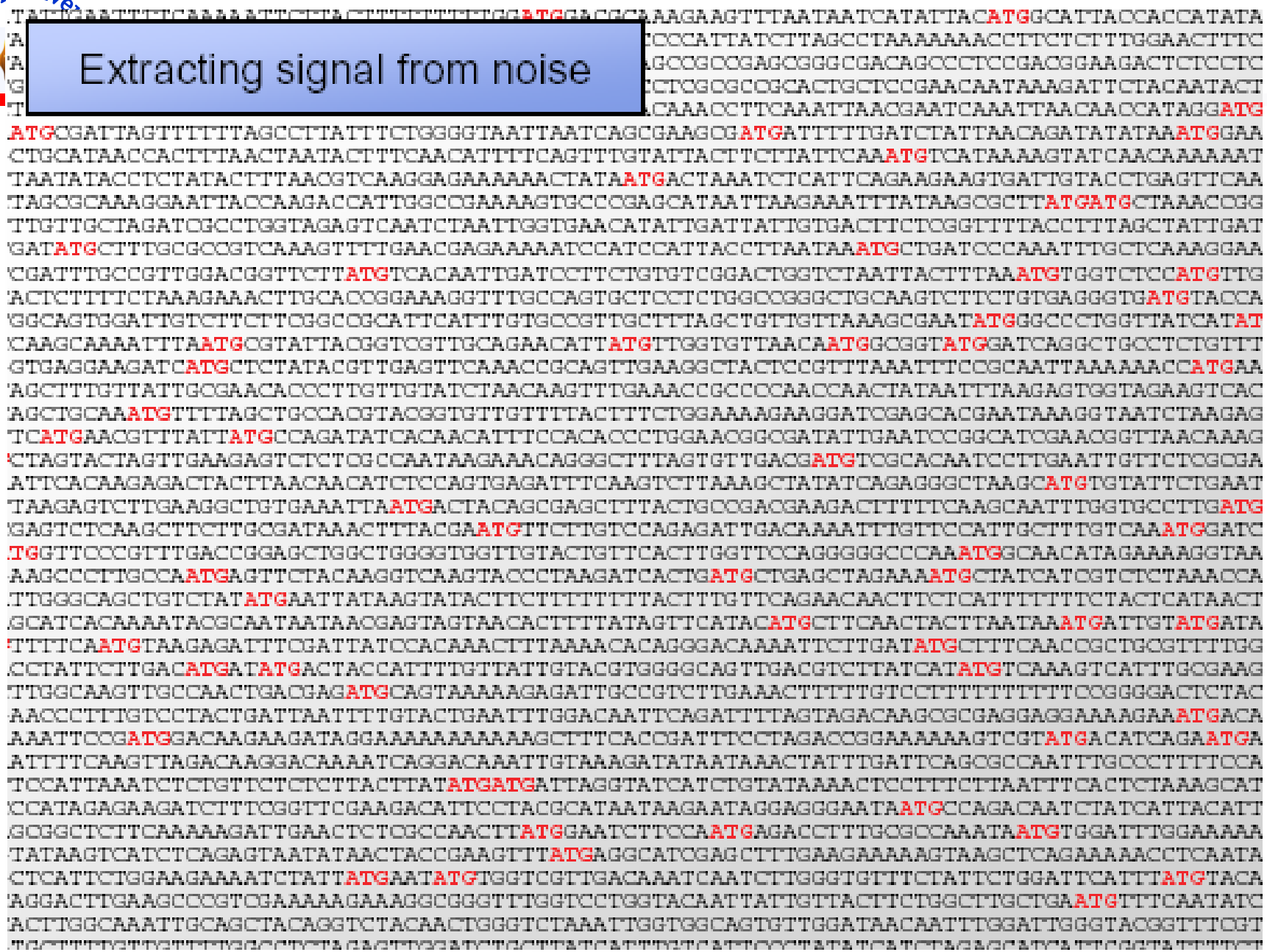
Evolution






Genes
Encode proteins
Figure by MIT OCW.
Regulatory motifs
Control gene expression
Figure by MIT OCW.

Extracting signal from noise



Challenges in Computational Biology