Natural Computing

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Topics of Natural Computing

(1) Nature as Inspiration

* Cellular Automata
* Neural Computation
* Evolutionary Computation
* Swarm Intelligence
* Artificial Immune Systems
* Artificial Life
* Membrane Computing
* Amorphous Computing

Topics of Natural Computing

(2) Nature as Implementation Substrate

* Molecular (DNA) computing
* Quantum computing

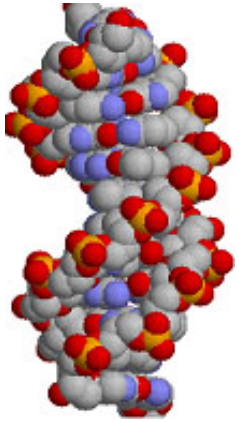
Topics of Natural Computing

(3) Nature as Computation

* Computational systems biology
  - gene regulatory networks
  - protein-protein interaction networks
  - transport networks
* Synthetic biology
* Cellular (in vivo) computing

DNA Computing Idea

- **Input / Output (DNA)**
  - -- Data encoded using the DNA alphabet = {A, C, G, T}
  - -- Synthesized as DNA strands
- **Bio-operations**
  - –Cut
  - –Paste
  - –Copy
  - –Anneal
  - –Recombination



Potential Advantages of DNA Computing

- **Information density**
  - 1 gram of DNA (1 cm^3 when dry) = 1 trillion CDs
  - 1 lb DNA – more memory then all computers together.
- **Speed**
  - Thousand to million times faster than an electronic computer due to massive parallelism
- **Energy consumption**
  - Thousand times more energy efficient

IMPACT OF NATURAL COMPUTING

- **Sheds new light into the nature of computation**
- **Opens prospects of radically different computers**
- **Could lend new insights into the information processing abilities of cells**

"Biology and Computer Science – life and computation – are related" (Adleman)

CS 9835b – Topics in Natural Computing

- **Schedule:**

  Winter 2017, Tuesday 10:30-12:30

- **Evaluation:**

  * **Class participation**
  * **Research paper**
  * **Presentation**

No pre-requisites necessary