Molecular and DNA Computing

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USC

Table of Contents

- Pre-History of DNA computation
- Computing With DNA
- Remarks on Future Research

(Microsoft, Promega)

4 LOGICIANS:

Godel

Church

Kleene

Turing

2 BIOLOGISTS:

Watson

Crick

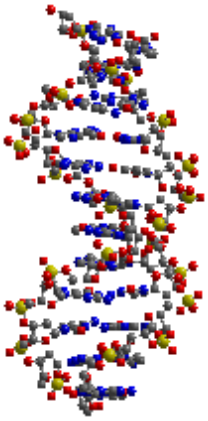
1 PHYSICIST:

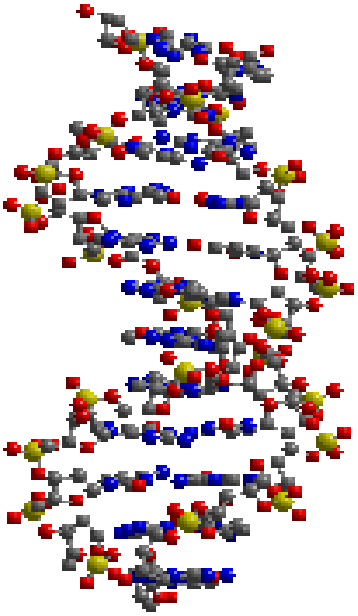
Feynman

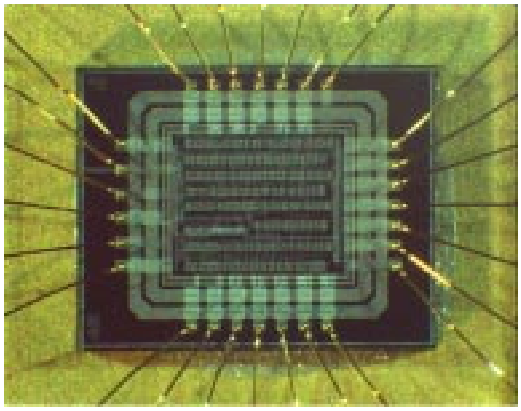
Computing is Easy

1. A METHOD FOR STORING INFORMATION

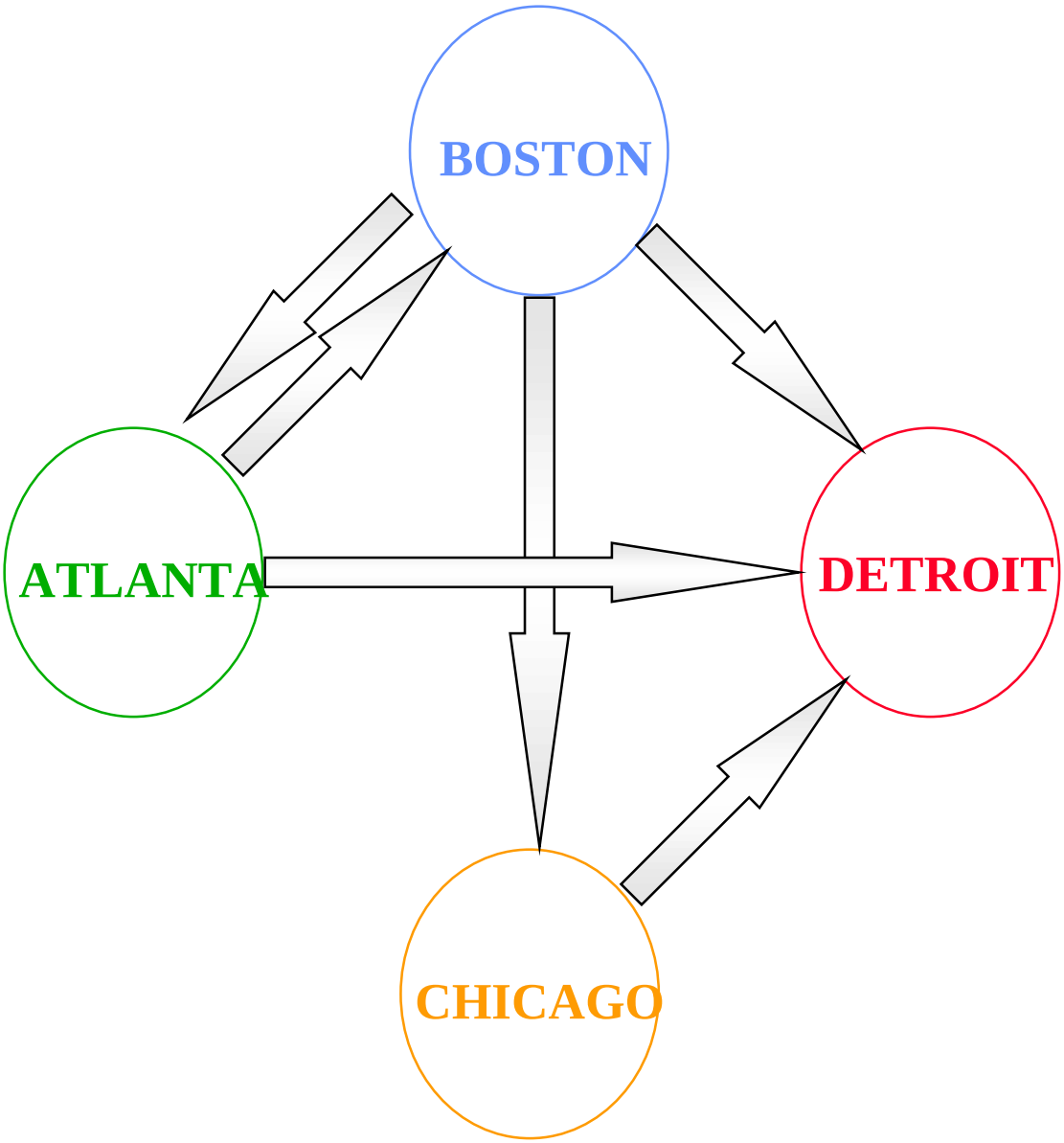
2. A FEW SIMPLE OPERATIONS FOR ACTING ON INFORMATION



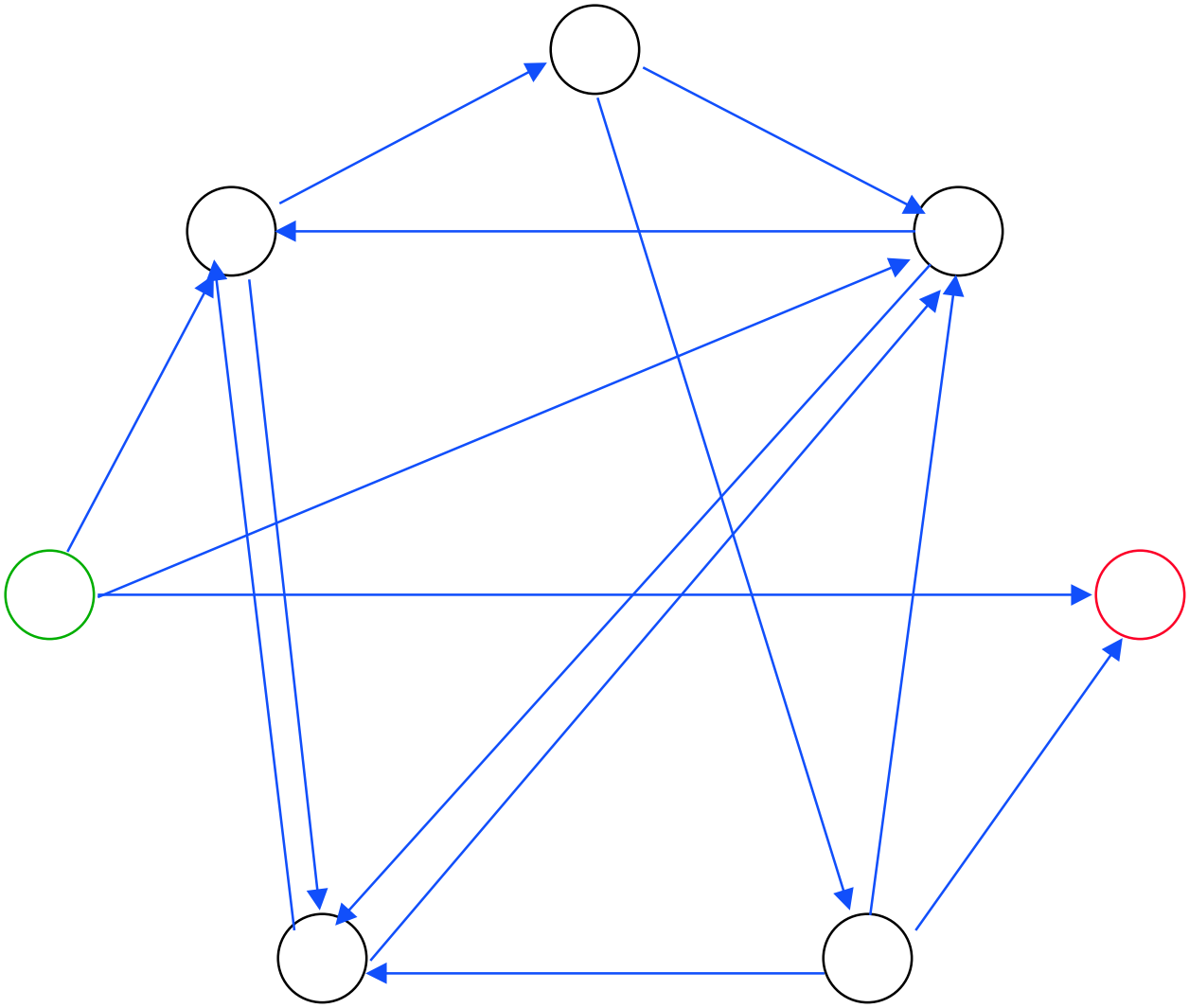


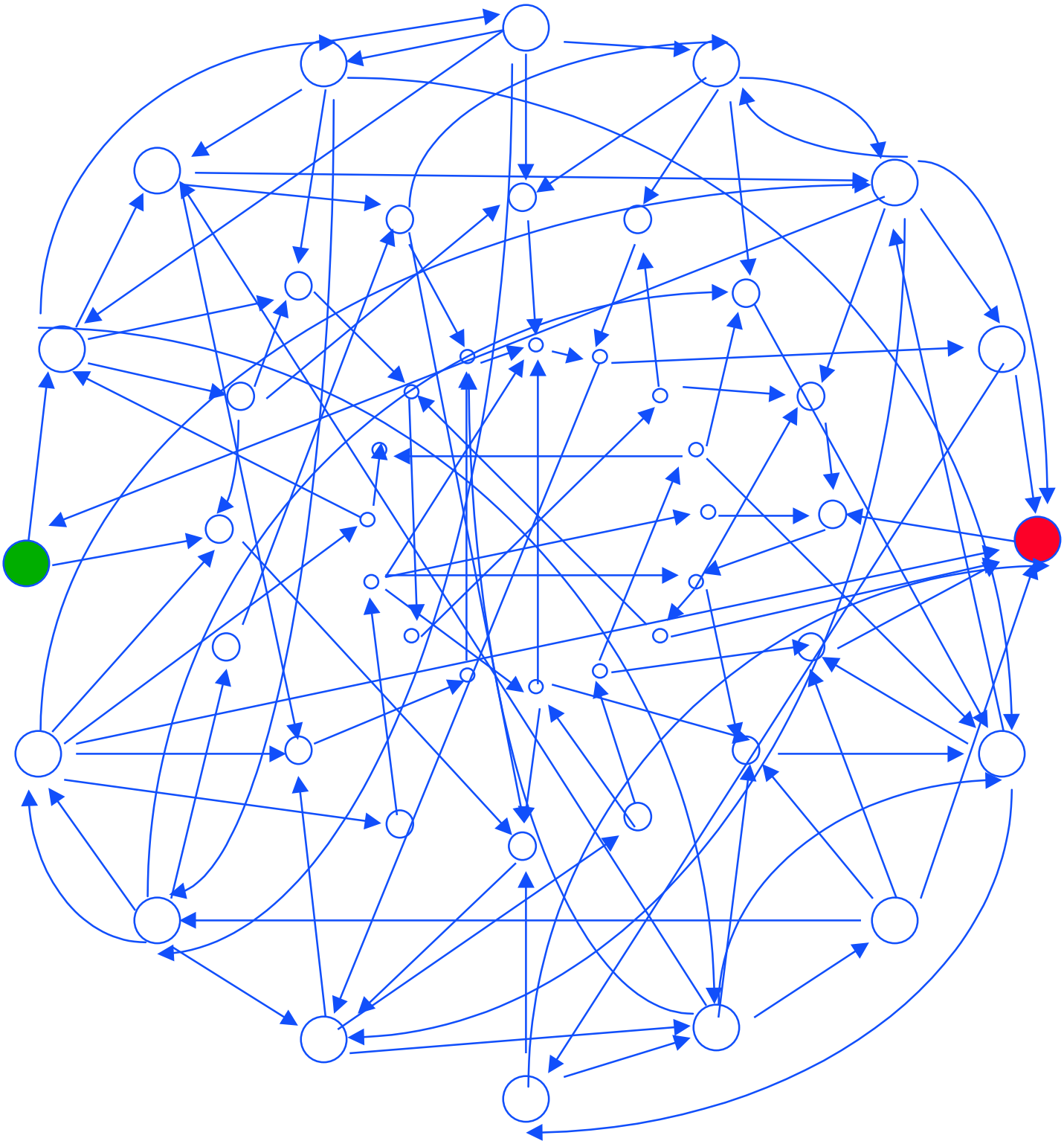


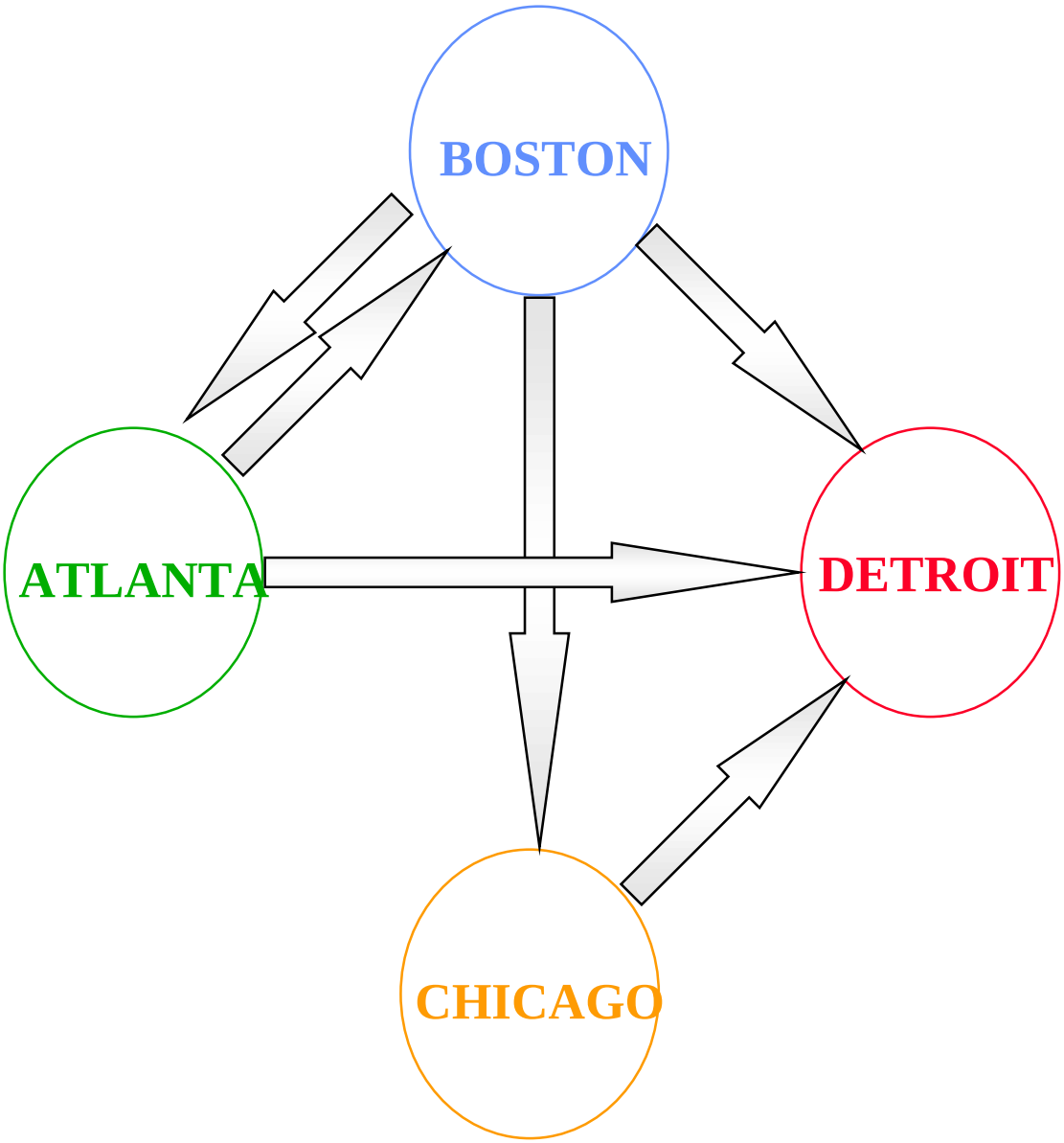
Pentium II
intel


BOSTON
ATLANTA
DETROIT
CHICAGO

The “Toy” Experiment






BOSTON
ATLANTA
DETROIT
CHICAGO

CITY	DNA NAME
Atlanta	ACTTGCAG
Boston	TCGGACTG
Chicago	GGCTATGT
Detriot	CCGAGCAA

FLIGHT	DNA FLIGHT #
Atlanta-Boston	GCAGTCGG
Atlanta-Detriot	GCAGCCGA
Boston-Chicago	ACTGGGCT
Boston-Detriot	ACTGCCGA
Boston-Atlanta	ACTGACTT
Chicago-Detriot	ATGTCCGA

CITY	COMP DNA NAME
Atlanta	TGAACGTC
Boston	AGCCTGAC
Chicago	CCGATACA
Detriot	GGCTCGTT

Atlanta-Boston

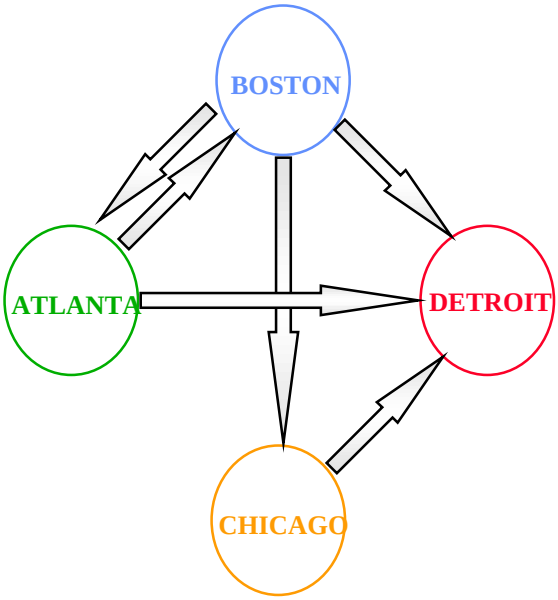
GCAGTCGG

AGCCTGAC

Boston

Boston-Chicago

ACTGGGCT



GCAGCCGA

GCAGTCGGACTGCCGA

GCAGTCGGACTGACTTGCAGCCGA

GCAGTCGGACTGGGCTATGTCCGA

GCAGTCGGACTGACTTGCAGTCGGACTGACTT

Reasons for Optimism

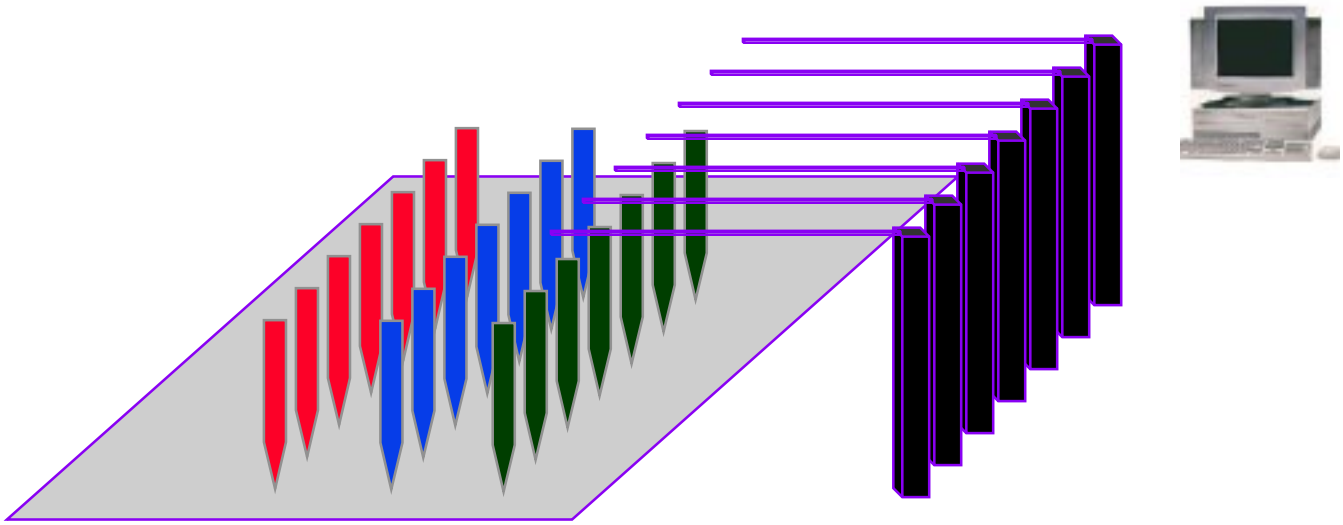
SPECS:

1. DIMENSION: 100 ul
2. SPEED: 10^{14} ops/sec
3. ENERGY: $2x10^{19}$ ops/j
4. MEMORY: 1 bit/nm^3

Reasons for Pessimism

1. **Oceans of DNA.**
2. **Phenomenal Error Rates.**
3. **Very Expensive Enzymes.**
4. **Killer Application.**

Sticker Machine



DES ON THE STICKER MACHINE

0. Desktop device:

1M x 1M x 18cm (~7in)

32 robots

1. Little DNA:

1.4g of DNA

2. Reasonable error rates:

for each operation

1 “bad” molecule for each

10,000 “good” molecules.

3. No enzymes

4. The “Killer App”?

1hr	**7mo.**
1min	**3.6days**
1sec	**1.5hrs**

Computer Science

Biology