



COSBI

Programming-based systems biology



Biology needs a theory able to highlight causality and abstract data into knowledge to elucidate the architecture of biological complexity.

Sidney Brenner

The grand challenge for all scientific and engineering disciplines in the 21st century is complexity.

Lee Hood

IMPACT CORE COMPUTER SCIENCE AND SYSTEMS BIOLOGY

Quantitative operational descriptions of the mechanistic behavior of biological systems

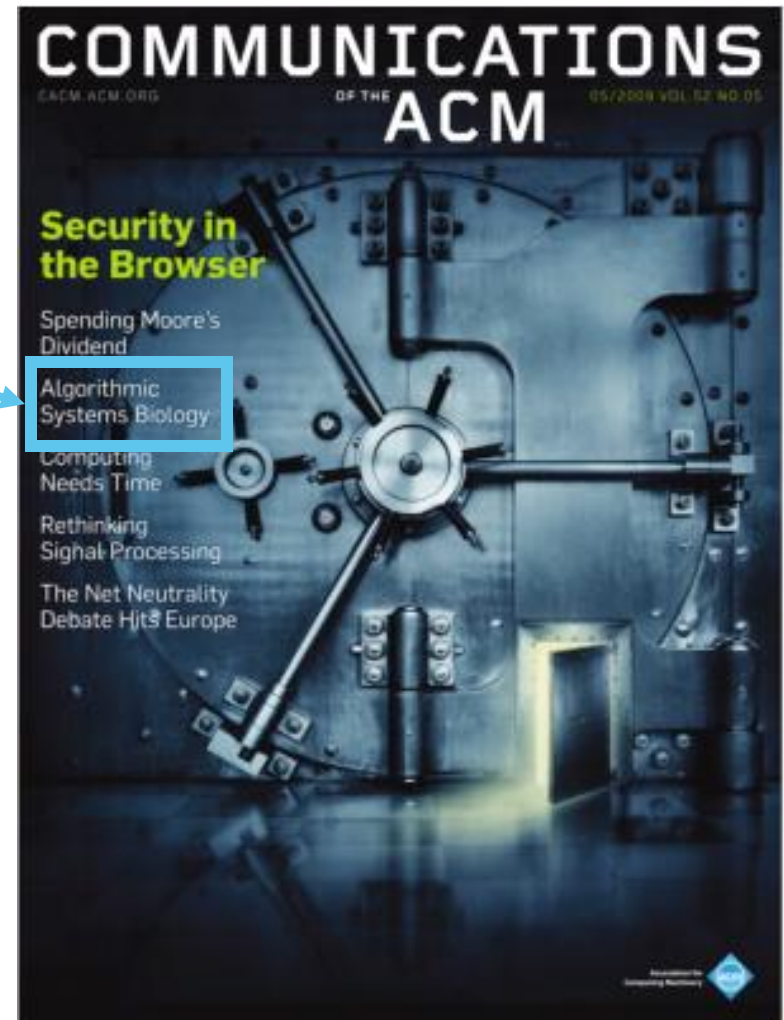
Computational thinking

Not ambiguous specifications for simulation and analysis tools

Coping with combinatorial explosion of systems description

**MOVING BEYOND MATH
MODELING:**

**ADDRESS CONCURRENCY AND
COMPLEXITY**



BIOINFORMATICS IS DIFFERENT

Comparison of strings

Storage of experiment results

Visualization of complex data

Search and analysis of data sets...

Mainly Structural/Static descriptions

MATHEMATICAL AND COMPUTATIONAL BIOLOGY ARE DIFFERENT

Static abstract relationships

Computer assisted solutions

Global pictures of dynamics

OUR DRIVING CHALLENGES

Interaction

Emergence

Partial knowledge

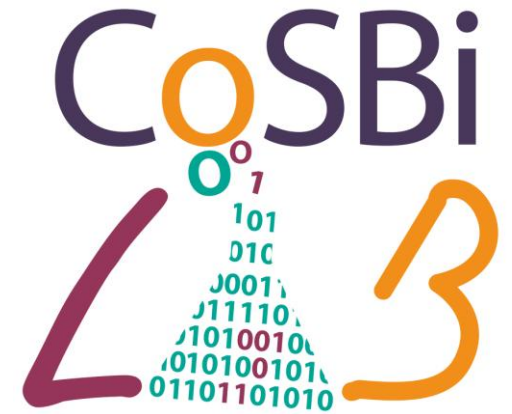
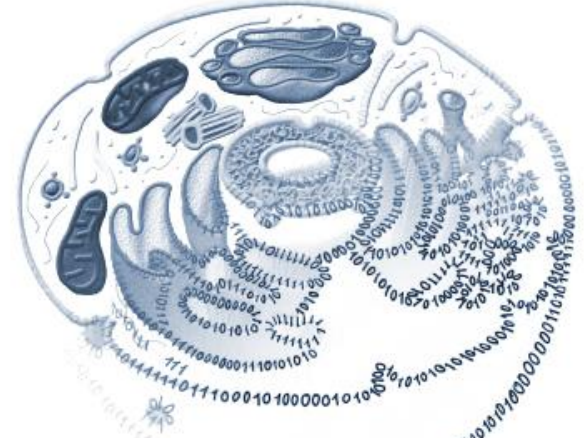
Ambiguous observations

Multi-level, multi-scale in space and time

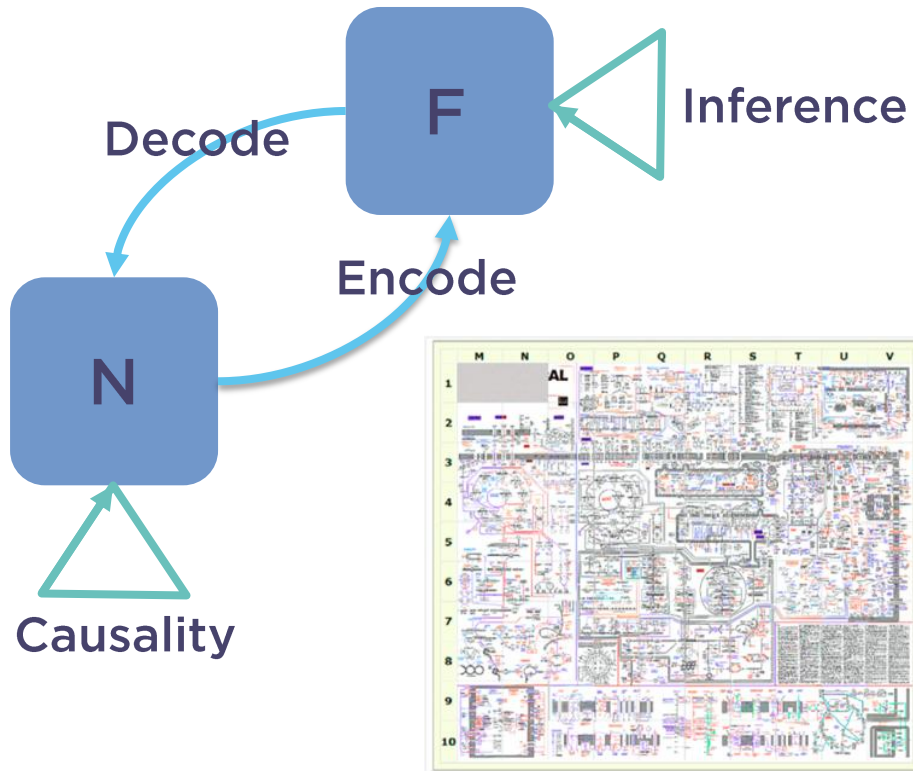
Causal relationships and context-awareness

LOW-LEVEL LOCAL MECHANISMS AFFECT HIGH-LEVEL
GLOBAL BEHAVIOR

SIMULATION-BASED, DATA-DRIVEN SCIENCE



A MODELING FORMALISM



Encode info manipulation by bio-systems

A formal framework to reason about bio-systems

Predict biological behavior and identify new hypotheses

Unambiguous description to share knowledge

the development of the appropriate languages to describe information processing in biological systems and the generation of more effective methods to translate biochemical descriptions into the functioning of the logic circuits that underpin biological phenomena

Paul Nurse