Evolutionary Medicine

Theoretical Framework for Research

Educational Programs

Specific Research Questions
=> ASU has a large number of researchers and activities in evolutionary medicine, from Genomics to Global Health

=> CAS Emphasis is on COORDINATION AND INTEGRATION

=> Identify Targets of Opportunities and Synergies

=> Develop EDUCATIONAL PROGRAMS
Evolutionary Medicine and Informatics (EMI)

Unraveling DNA patterns and processes that produced the dazzling diversity of life and people in the world.

Harnessing the power of evolutionary knowledge for better human conditions and medicine.
Personal Genomics
Predicting Adaptive and Disease Propensities of Mutations in Individuals

Disease Origins
Tracing Pathogen Evolution to Unravel Dynamics of Infections and Drug Resistance

Functional Proteomics
Discovering functionally important elements of genomes

Discovery Bioinformatics
Modeling, Analysis, and Simulations to Discover Patterns and Test Predictions
Transforming Evolutionary Theory

- Merger of CAS and Evolutionary Theory
- Emphasis on Regulation and Developmental Processes
- Hierarchical Expansion of Processes anchored by the Genome
- Biosocial Dimension
Theoretical Framework for Research

Broad Integration of Disciplines around a Topic

Specific Research Questions
The Developmental Evolution of the Superorganism
A Hierarchical Expansion of the GRN Framework

Developmental Evolution in Social Insects: Regulatory Networks From Genes to Societies

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In silico Synthetic Experimental Evolution

Fig. 1. Diagram summarizing the flow of information and logic relations between experimental data, the GRN model deduced from it, and the Boolean computational model. Gene expression data, systemwide perturbation experiments, and cis-regulatory analyses (Top), combined with the basic facts of the embryonic process, are used to generate abstract time-space expression pattern and the interaction matrices (Middle). These results in turn underlie the design of the deduced genetic circuitry captured in the GRN model. Inputs to the Boolean computational model (Bottom) are the vector equations derived directly from each node of the GRN model; the relative geometry of the interacting embryonic spatial domains considered in the model; and the kinetics with which gene cascades operate in this embryo. The model incorporates essential aspects of the temporal and spatial biology of the embryo, and gives rise to a matrix of specific predictions of where, when, and for how long every gene is individually expressed over a 24-H period. This computed matrix of expression results can now be compared directly with the observed matrix of gene expressions, in normal or perturbed conditions.

Peter et al., 2012
We are becoming increasingly aware that the individual cannot be considered out of the context of its environment. The way in which it reacts to different environments is as much part of its characteristics as its appearance and qualities in a single environment. At the present time there is a great deal of interest in the way in which an individual can maintain stability in the face of varying environmental influences. A considerable amount of evidence has shown that this stability is under genetic control. Much of the evidence has taken the viewpoint that stability and adaptation are correlated and that lack of stability indicates lack of adaptation. But as Nilsson-Ehle implies, it seems that plasticity, or lack of stability, can be of positive adaptive value in many circumstances. This essay seeks to explore this viewpoint further.

VOGON: STATEMENTS AS NESTED QUADRUPLES

PHENOTYPIC PLASTICITY: TONY BRADSHAW
Science/Genomes as Evolving Information Systems

Clustered genomics data visualization with labels for OGS and words. The diagram illustrates clustering of texts based on content using vectorization, comparison, and decomposition techniques (LSA, PCA, etc.).
Theoretical Framework for Research

Transfer of Methods and Technologies

Challenges of Data Integration
Big Data everywhere
Open Linked Data Cloud
Data-linking

How has the distribution of commercial fish species changed in 100 years

Linked data cloud

- **TIME**: Find me data for ‘then’ and ‘now’
- **NAMES**: For this species using both old and new names
- **GEOREFERENCES**: Where did it occur then
  Where does it occur now
CAS Education

Undergraduate (Certificates, Concentrations)

Graduate (Certificates, Concentrations)

Postgraduate (Special Topics Course at the MBL)