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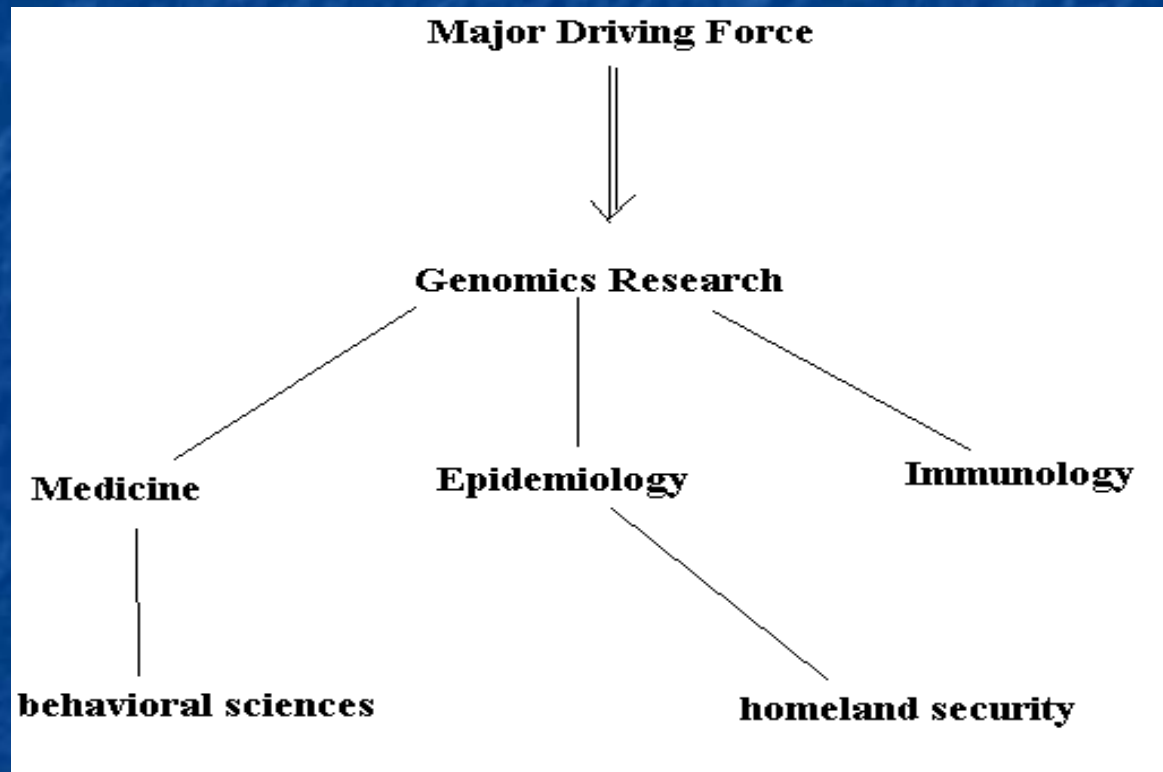
Current trends in the integration of  
biology, computer science,  
mathematics and statistics

# Current Landscape

- Growth & Expansion of Technological Innovations
- Globalization ← Phenomena that affects at multi scales and levels of aggregation

Social/Political/Economic Responses to these factors have generated Irreversible perturbations at local & global levels (communities, cities, countries,...)

# Major Driving Force (Genomics Research)



Sequencing → Huge Data Bases

Reformulation of Scientific Problems Expansion & Opening of new possibilities

Ethics--its role is way behind of where it should be.

# Three Directions



Computational  
Biology

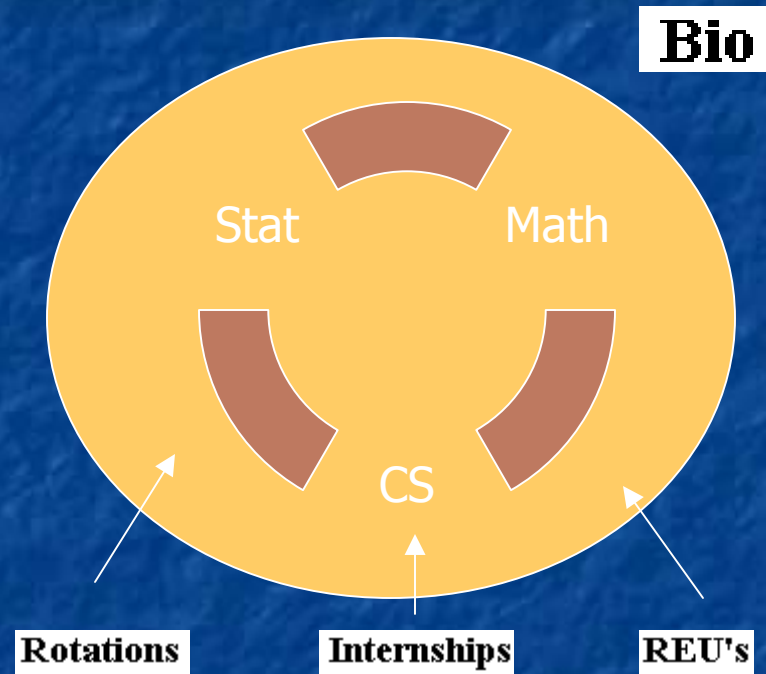
Bioinformatics

Genomics

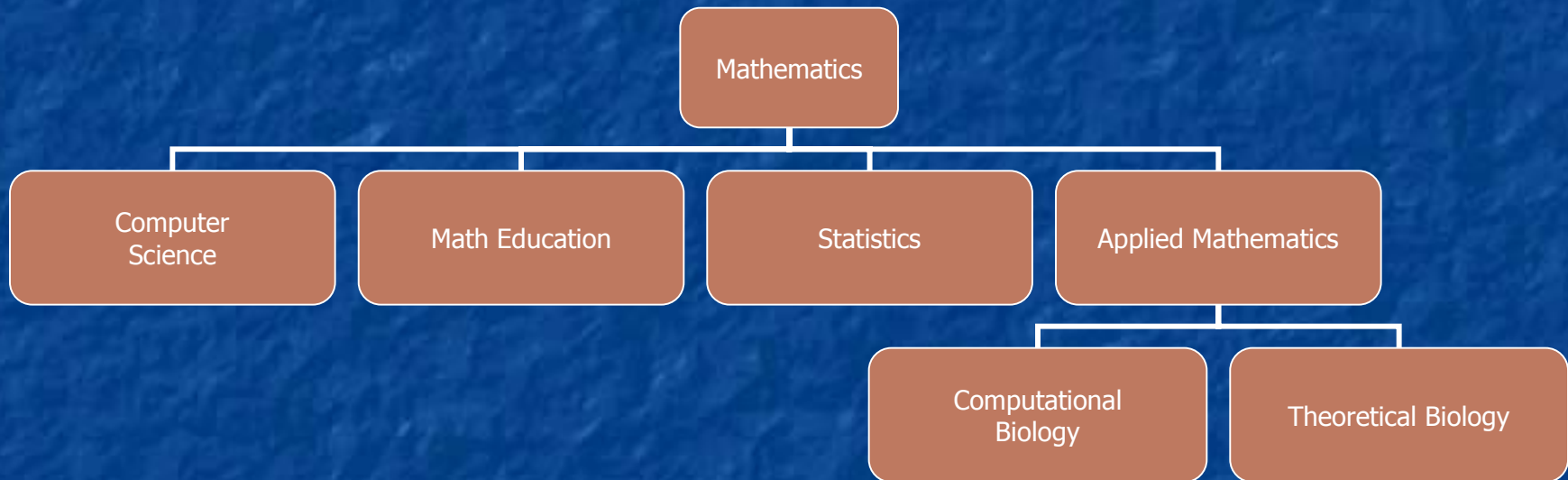
# Questions

- What are the definitions & boundaries of these fields?
- What is the appropriate curricula and for whom?
- Who should be trained in these fields?
- Where should these programs be housed?
- How will their growth affect “traditional” fields?

- Use of national & global resources (efforts) → web
  - Majors that can accommodate undergrads of various fields
- Ph.D. level work (too)



One potential organizational scheme  
(there are certainly many other perspectives)  
Different schemes for different institutions  
(based on strengths and collegiality)



# Non-unique Responses

- Huge impact by local conditions/interests
- Integrated cs/stat/math/bio programs tailored to the needs of several types of students
- Faculty retooling opportunities; curricula materials; continuous “retooling” as part of “new” positions (**Bio Quest**)

- Mathematical approaches & techniques (like in molecular bio) must become pervasive in most (if not all) biology programs
- Hiring of truly interdisciplinary faculty is important!

# Issues/Challenges

- Target same population (math/comp/stat types)--we need to expand.
- Need to bring individuals who know & love biology
- Faculty trained in non-traditional fields & “living” in traditional departments
- Lack of real incentives (tenure issues and reward system).
- Pressure to respond to trends with inappropriate resources.
- Fear of negative impact on traditional fields (turf issues)

# National Interest

- No choice but to move aggressively and intelligently in these directions

# MATHEMATICAL & THEORETICAL BIOLOGY INSTITUTE OF CORNELL UNIVERSITY (MTBI)

- ❑ Possibly the largest REU
- ❑ Cooperative learning
- ❑ Students learn the basics of dynamical systems, modeling and simulation
- ❑ Students form their own research groups
- ❑ Students work on projects of their own choosing

# MTBI STUDENTS

The focus is on a sequential research experience (selected students are invited to participate in a second summer) at the interface of mathematics, statistics and the social and natural sciences. The majority of the students come from non-selective universities. Seventy-nine out of 150 participants over the first six summers (we have had seven summer research experiences and 170 distinct participants) have enrolled in graduate programs in quantitative fields (mostly mathematics and statistics). Most of them have received a multi-year fellowship. Ten of them are at Cornell University. We also have students at Princeton (2), Stanford (2), University of Iowa (12), Rice University (1), University of Texas at Austin (3), University of Maryland (1), University of Arizona (2), Oxford (1), Harvard University (1), etc. We also have a Rhodes scholar among our alumni

# What should be the goals of REU's?

- Promote diversity
- Polish talent
- Help students make decisions about their future
- Cutting edge of technology and research
- Promote individual ability and achievement
- ....

# MTBI

<http://www.bscb.cornell.edu/MTBI/>

## New Challenges

[www.bsccb.cornell.edu/Hompeages/Carlos Castillo Chavez/index.html](http://www.bsccb.cornell.edu/Hompeages/Carlos_Castillo_Chavez/index.html)

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Carlos Castillo-Chavez &  
Fred Roberts

DIMACS Report on the Deliberate  
Release of Biological Agents