Social Studies

Physicist Stephen Eubank:
Modeling Disease, Disaster, and Traffic

Findings

Department of Health and Human Services
National Institutes of Health
National Institute of General Medical Sciences

Stephen Eubank Studies Habits

Photo: John McCormick

Physicist Eubank builds models to predict the spread of disease.

Complex systems

- Have multiple components interacting in infinite ways
- Are affected by interactions of components
- Can be studied using mathematics

Question:

Are humans part of a complex system?

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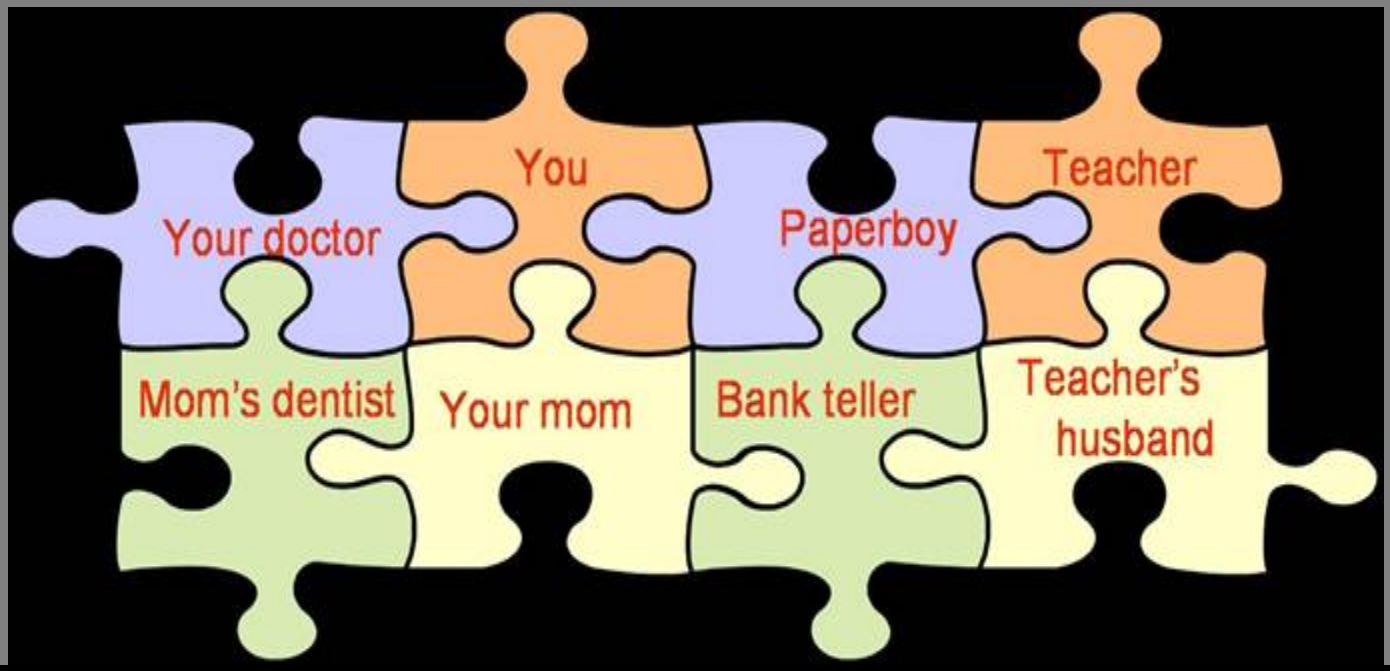
Answer: Yes

Humans are part of a complex system known as a social network.



Even if you've never met him, your friend's teacher's husband is part of your social network.

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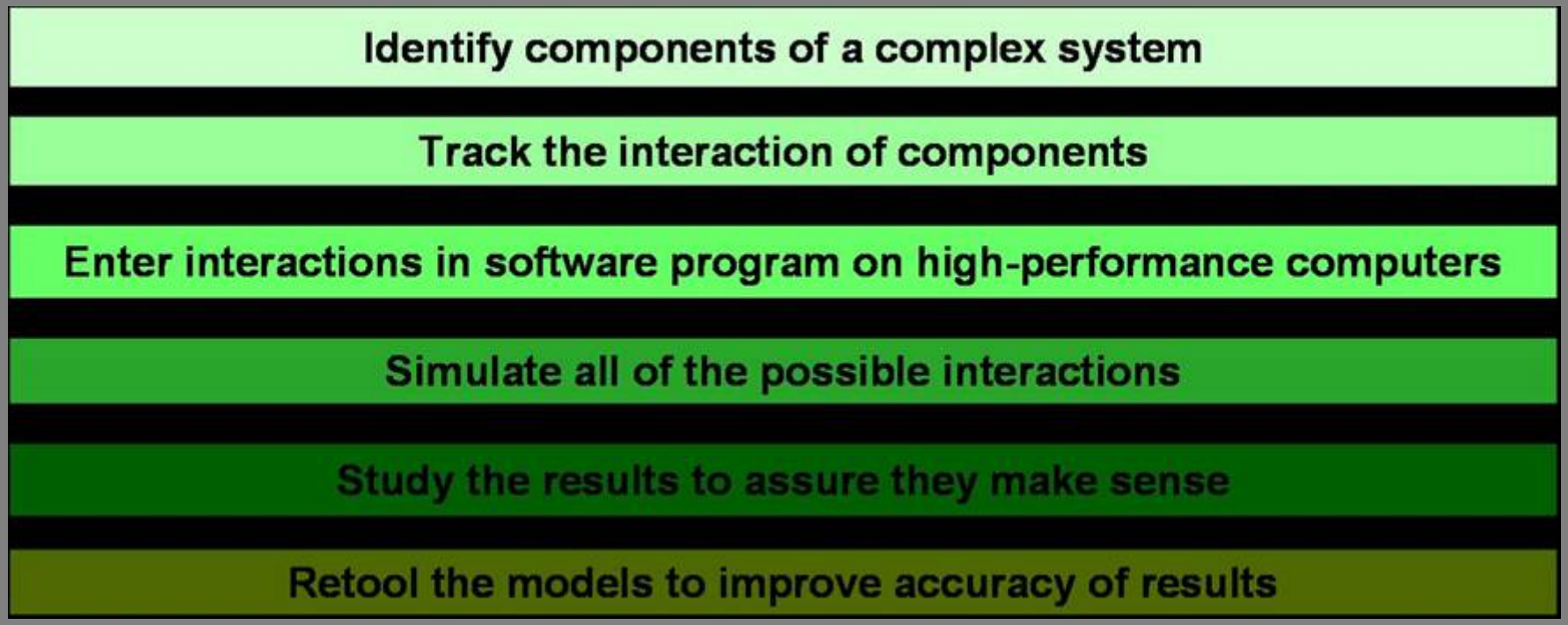
Complexity Made Easy



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Earth's Climate: a Complex System

- Static components, such as topography
- Dynamic components, such as ocean current, heat, rainfall

What are the possible results of the interactions of these components, and are the results always the same? Why or why not?

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Traffic: Another Complex System

Goal: Simulate second-by-second movements of 1.6 million people

Results: 6 or fewer degrees of separation between people

Possible uses for the TRANSIMS model: Traffic safety and energy consumption

Eubank's use for the model: Use it as a foundation for modeling how diseases might move through communities and testing which interventions might slow or stop the spread of the disease

Transportation Analysis System (TRANSIMS)

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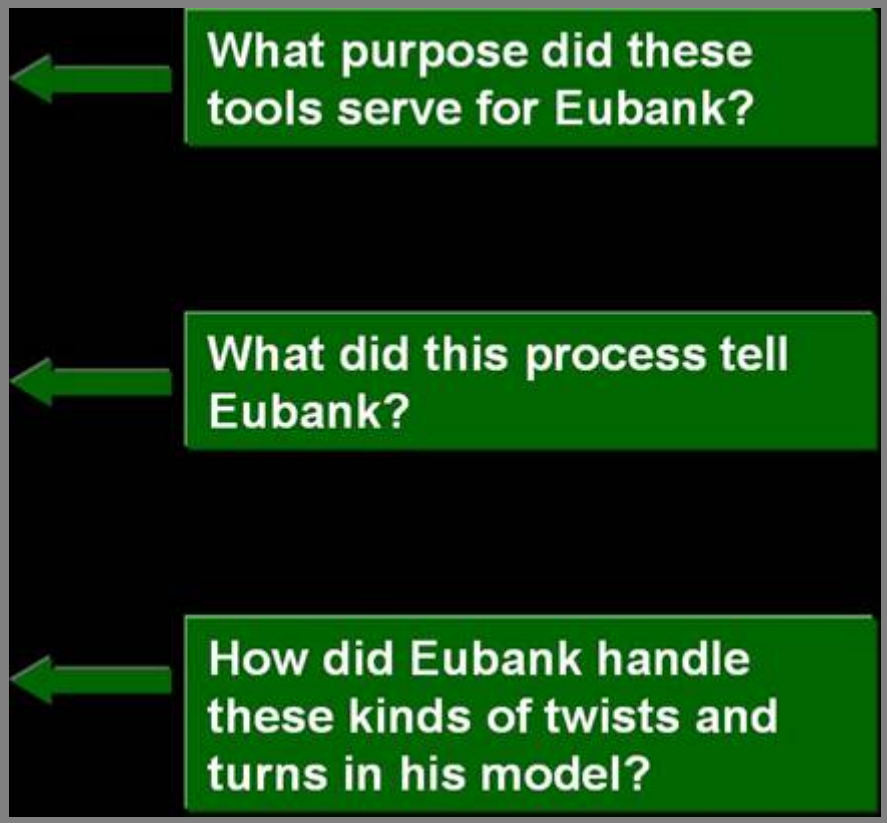
Tools and Tricks of Eubank's Trade

- Public surveys, census reports, transportation data
- Linking an individual to personal contacts, those contacts to their contacts, and so on
- Changes in plans or the weather



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The MIDAS Touch

Models of Infectious Disease Study (MIDAS)

- Made up of a network of government-funded interdisciplinary researchers
- Uses mathematical and analytical models in high-performance computer simulations
- Predicts spread of disease, such as pandemic flu
- Estimates the potential effectiveness and timing of interventions
- Provides information for other researchers and for public health officials

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MIDAS: Chicago Outbreak

- Modeled spread of pandemic flu in Chicago
- Used data about social network, historical data about spread of contagious diseases, and information about avian flu itself
- Modeled by 60 computers in 10 hours

Photo: Stephen Eubank

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Future Uses of Computer Modeling?

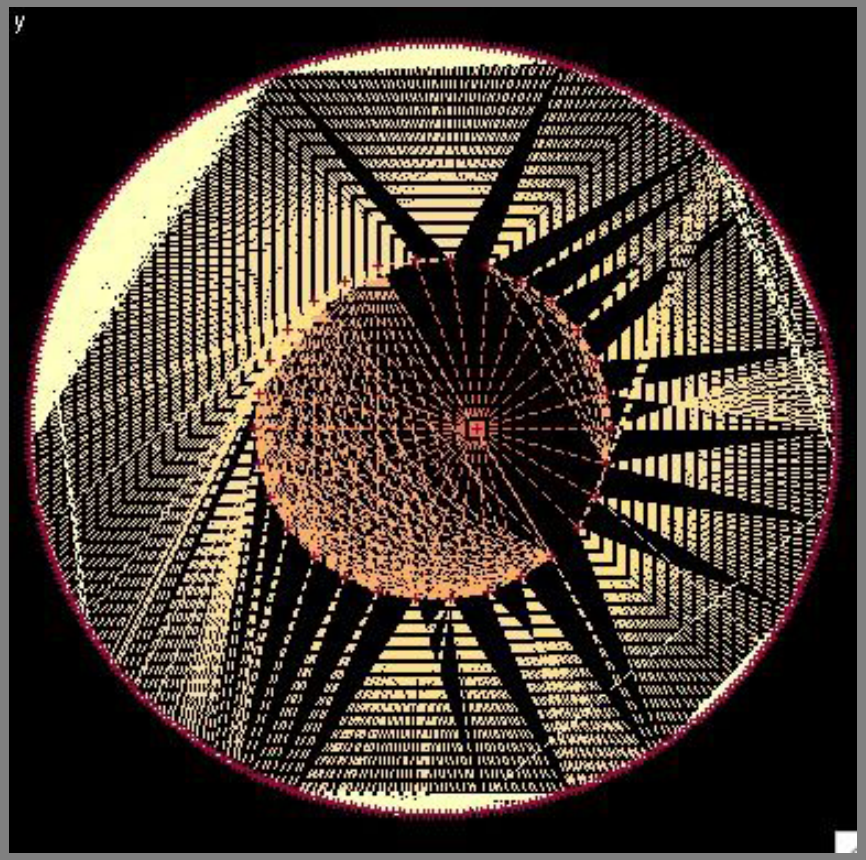

Photo: Stephen Eubank

- Predicting human behavior
- Understanding the spread of disease in insect communities
- Identifying the most effective modes of communication during emergencies

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Research Applications

How do simulation failures help researchers who study complex systems?

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