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Exploring the intrinsic nature of networking

'Informatician' studies networks as living entities

Jeff Alstott | | Date: 10/5/2004

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Last month the School of Informatics broadened its scope of information development with the addition of new faculty member Alessandro Vespignani. The new area of study developing with Vespignani's arrival is the concept of the network, as he and his colleagues reach across all areas of knowledge to create unified concepts of organization, no matter the subject.

Vespignani's work spans computer, social, biological and physical sciences as he theorizes about the nature of complex networks. In Vespignani's world, different nodes interact to transfer "anything and everything." The revolutionary part of his work is that what exactly the nodes and the things being transferred are is inconsequential, since he sees all networks as similar. Vespignani likes to use the comparison of viral epidemics online and biological epidemics as an example of how all networks are intrinsically alike.

"There is a sort of common trait that is the network," Vespignani said. "One would say 'No, that's impossible, one is the biological world, one is the product of millions of years of evolution; the internet is just 30 years old, just made by computers.' What you realize is that many of the properties are similar. It's like that the network somehow prefers to be in a certain form, a certain shape."

It's not a great leap then to see how diseases



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spread similarly in biological and digital systems, or how a physicist would study them. The infection affects one node, which then spreads the malady to all the other nodes it has interaction with, and the disease begins to reach epidemic size. Biophysics and computer science have many statistical similarities in this department, which Vespignani "data mines" to build a model of how the networks move.

This type of "mining" involves interpreting large quantities of data and formulating a model from it. The stretch is to see how this relates to social interactions.

"There are aspects which are common to this research," Vespignani said. "These complex features are also in (human networks). There is some kind of general organizing principles for networks."

The School of Informatics has teamed with the School of Library and Information Sciences to study how grants and aid are distributed among research institutions. Vespignani and Professor Katy Börner of SLIS are beginning to see, for example, that the difference between how money and the flu diffuse is slight. Both systems use specific human beings with many connections to spread. Whereas a receptionist would spread a disease more easily because of the great number of people she interacts with in a day, an eminent professor could draw in funding to a research group by his great number of ground-breaking publications, which people read.

These money magnets have great "centrality," to use Vespignani's diction, but what makes the grant-grabbers' situation more difficult to quantify is that prominence can come through various means, and that a group can have centrality, not just a single researcher.

"Usually you do not author a paper just by yourself, there is always collaboration," Vespignani said. "You cannot define the impact in terms of a single author, but in terms of the collaboration. It is the collaboration between the two that is making the difference."

Vespignani is also beginning work in two other subjects. First, Vespignani and the Biocomplexity Institute at IU are examining the interactions of proteins in the human cell from an informatics point of view. Using the same principles of networking, he hopes to create a model of how different proteins relate to each other and work together to perform tasks. Secondly, he and Professor Alessandro Flammini are

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going back to the ideas in spreading diseases to develop correlations between traffic across airways and outbreaks of SARS across the world.

The vast differences in subject do not daunt Vespignani, as he finds it to be part of the character of the new "informatician" being developed at IU.

"To do (this research), we have a physicist, a computer scientist, a biologist, whatever ... None of us is doing the actual physics, the biology in the research, but we were educated as physicists, or a biologist," Vespignani said. "What we would like to be able to do is to form a student to really be something different than us ... someone who has broad experience in different fields and can be interdisciplinary in a different way."

While network research is just one way the Informatics faculty is creating a new field of science, informatics is not just a rehash of statistics, but instead a fully functioning medley of knowledge in general.

"The fun part and the very exciting part is that (the School of Informatics) is not just made of physicists or mathematicians. There is really a little bit of everything," Vespignani said. "This is really an interdisciplinary environment in which you can hope to develop new insights, new projects, and new activities."

-- Contact staff writer Jeff Alstott at jalstott@indiana.edu.

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