UC SANTA BARBARA
THE Current

May 6, 2013
Shelly Leachman

Mapping the Online Landscape to Predict, Prevent Digital Tipping Points

If somebody in a remote corner of the world sets fire to an American flag, but no one else is there to see it, did it really burn?

Absolutely. And thanks to social media, it will keep burning –– figuratively, anyway –– as news and images of the desecration fan the flames across the internet. Given the reach of today's ever-connected global society, the online outcry could quickly result in a real-world uprising. Writ large, think Arab Spring.

But could such an occurrence be prevented if we better understood –– and could even predict –– when, why, and how something will go viral? What if we could identify digital tipping points before they induced potentially massive chain reactions?

The answer may lie in network modeling, a way of mapping the digital landscape in order to more readily identify when a new highway is evolving –– or when something, or someone, is about to go metaphorically off-road. Call it cartography 2.0.

Such hypothetical solutions may soon become reality, courtesy of an ongoing project in which a group of UC Santa Barbara computer scientists is playing a key role.

Hoping to enable advanced intelligence for the digital age, the U.S. Army-funded initiative aims to model different types of information networks and discern the shared dynamics that could make predictions possible.

"If a flag burning happens somewhere, maybe it will lead to a riot, so you want to understand how messages about this riot are going to spread. And if you want to contain the effects of those messages, what is the right way?" said Ambuj K. Singh, a professor in UCSB's Department of Computer Science who is part of the effort. "You need to have a model for how that information propagates. Can we model these effects so that we can predict what will happen, and –– if we have to stop this from happening –– ensure that it does not happen?

Singh and fellow UCSB computer science professors Tobias Hollerer and Xifeng Yan comprise a team that has received an approximately $1-million-per-year grant to continue work on the endeavor that is four years into its 10-year timeline. The interdisciplinary undertaking has involved a number of students and postdoctoral researchers.

To explore these questions of network dynamics and behavior, the UCSB-based group is examining data from Facebook, Twitter, and Wikipedia, as well as from transportation and communications networks, looking for shared patterns across multiple networks. The intent is to predict potential end results by tracking beginnings –– whether it's the first post about a flag burning, or the first cluster of searches about an illness or pharmaceutical side-effect.

In addition to improved military intelligence and public health, the work has multiple implications with potentially widespread impact –– from the development of novel search functions, to the design of more robust networks overall.

"We are looking for tipping points, but we first need to find the outliers to understand which are the patterns that have become larger, that have shifted around the maximum amount," Singh said. "What makes it a tipping point? We first need the data to try to understand the different patterns, then we can try to find what exactly makes it go viral."

Take the example of Google's oft-cited, search-based flu map.

"By presuming that if you are searching for flu, it's more likely you have flu symptoms, they can build these maps that are better than what the CDC can find

with surveys of doctors," Singh noted. "You can map out its flow at any point in time, but you can also model how it spreads –– whether it spreads more because of the highway network or air traffic –– and what changes it most.

"If you have to halt the spread of some specific disease, or contain the effects of a flag burning, what kind of action should you be taking?" he asked. "Understanding these networks and their dynamics gives us a way of doing that."

The UCSB team is part of one of four research centers, along with assorted government researchers, and the U.S. Army Research Laboratory, engaged in the Network Science Collaborative Technology Alliance. The alliance unites research across organizations, technical disciplines, and research areas to address the critical technical challenges of the Army, including what's being called "network-centric warfare."

"The intent is to understand these dynamics of network behavior because the kind of wars the country will be fighting is going to change –– rather than big tanks, battleships, and planes, we will see small wars being fought as much in the social domain as on the battlefields," Singh said. "If I take a complex circuit and change the voltage level somewhere, it will affect how the entire network behaves. In the same way, the Army would like to understand: If I send a message to you, can I predict what's going to happen next?"

Related Links

Ambuj Singh

UCSB Giving

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.