Research Statement (2016)
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The long-term goal of my research is to develop mechanisms and tools that will lead to widespread use of digital data processing in our everyday lives. A fundamental prerequisite of that is to make data processing trustworthy in distributed environments. In my current and future research, I design schemes and tools to make cloud computing, big data, and mobile computing trustworthy. I consider my main research area to be in the intersection of cloud computing, data provenance, big data, digital forensics, computer security, the Internet of Things, and mobile computing.

Research Project Themes
Cloud Computing and Forensics: While cloud computing has become popular, today's cloud architectures are not designed for security and forensics. Many factors complicate forensics in a cloud environment, such as lack of physical access, multi-tenancy, and non-accountability. As a result, clouds cannot be used to store healthcare or business data, which require audit and regulatory compliance and support for digital forensics. My research in this area focuses on creating the science behind cloud forensics, and efficient, secure, and trustworthy solutions. I have introduced provenance as a fundamental property of clouds for making them accountable. My research in this area has resulted in more than 22 conference papers in top venues such as IEEE Cloud (IEEE’s flagship Cloud conference) and IEEE SCC (top ranked Service Computing conference) and 3 journal papers. I am also a member of the NIST Cloud Forensics Working Group and have been involved in development of the first ever cloud forensics standard.

Secure Location Provenance: Many applications use the location provenance of users, i.e., the chronological history of the users' location, for purposes ranging from access control and authentication. However, location provenance is subject to tampering and collusion attacks. In this project, I examined the secure location provenance problem and introduced a witness-endorsed scheme for generating collusion-resistant location proofs. I also developed efficient and privacy-preserving schemes for protecting the integrity of the chronological order of location proofs. Results from this project have been published in 3 conference papers and 1 journal paper.

Mobile Device Security and Interaction: The proliferation of mobile computing devices has enabled immense opportunities for users, but also created new challenges. In my research, I have explored the use of mobile devices with wearables such as Google Glass to prevent shoulder surfing attacks in ATMs. Additionally, my research introduced the notion of interaction provenance to enable flexible authentication in distributed environments. Results from this research have appeared in 7 research papers.

Internet of Things and CellCloud: The Internet of Things (IoT) are low-power Internet-connected devices with sensors and computing capability. By 2020, there will be 26 Billion such devices in actual deployment in our physical environment, including buildings and smart infrastructures and vehicles. In my research, I have explored techniques for ensuring the security of such IoT devices. I have also developed practical implementations of small-scale clouds based on IoT devices, and on mobile phones under a given cellular base station (CellCloud). Results from these two projects have appeared in 5 conference papers and 1 journal paper.

Funding and Publications
Funding: My work is supported by several federally funded grants (totaling over $3M in external funds in 5 years, $1.33 as PI) including the National Science Foundation (NSF) CAREER Award (sole PI), an NSF CiCi grant (PI), a Department of Homeland Security grant (sole PI), an Office of Naval Research grant (co-PI), and an NSF MRI grant (co-PI). I have received the highly competitive 2011 Google Faculty Research Award and the Internationally recognized 2013 Google RISE Award. I am also the PI of a 2012 CAS Interdisciplinary Innovation Award. Additionally, I have received funding from the United Nations to aid in anti-terrorism research on social media.

Publications and Inventions: Since joining UAB in 2011, my new research has led to 12 peer-reviewed journal publication, 53 peer-reviewed conference papers, 2 peer-reviewed workshop papers, 3 peer-reviewed book chapters, and 1 software release. I have also filed 5 invention disclosures with the UAB Research Foundation and have been issued a provisional patent.

Future Research Goals: In my future research agenda, I want to explore practical security solutions in various application domains where large volumes of data need to be processed: cloud computing, mobile systems, big data, and the Internet of Things. I am also deeply interested in the techniques for securing the history and provenance of data, location of physical and virtual objects and users, and the use of verified provenance information in security. I will continue to seek funding from the National Science Foundation and other federal funding agencies. Additionally, I have already started collaborations with other universities (Auburn, South Carolina, North Carolina) to develop joint projects and submit large collaborative proposals.