An Introductory Tutorial on Applying Mathematics to Address Cybersecurity and Software Safety

This tutorial will trace the history of a branch of mathematics and how that mathematics is likely to be the key to verify software for safety and security. While mathematics is crucial, being able to apply it to real-world software with millions of lines of code poses colossal engineering challenges. The tutorial will bring out the challenges and expose an innovative approach to address those challenges. The exposition will use real world examples of detection of sophisticated malware and verification of the Linux kernel.

The overarching themes for the tutorial will be:

1. A practical mathematical approach to software verification, as exposed by De Millo, Lipton, and Perlis (the first recipient of the Turing Award, 1966) in "Social processes and proofs of theorems and programs."

2. A practical approach to build supporting tools to reason about hard problems, as expounded by Brooks (the recipient of the Turing Award, 1999) in "The computer scientist as toolsmith."

3. An experiential approach to problem solving, as explained by Epstein and Levy in "Experimentation and proof in mathematics."

Bio: Suresh Kothari is the Richardson Professor of Electrical and Computer Engineering (ECE) at Iowa State University (ISU). He has pioneered research on machine-enabled reasoning to solve complex problems of software productivity, security and safety. He served as a Principal Investigator (PI) for the US Defense Advanced Research Project Agency (DARPA) Automated Program Analysis for Cybersecurity (APAC) program, and a Co-PI for the DARPA Software Enabled Control (SEC) program. Currently he is a PI for the DARPA Space/Time Analysis for Cybersecurity (STAC) program.

He was awarded in 2012 the Iowa State Board of Regents Professor Award for excellence in research, teaching, and service. He has served as a Distinguished ACM Lecturer. He has given more than 120 invited talks at major conferences, government organizations, universities, and industry. EnSoft, the company he founded in 2002, provides software productivity, safety, and security products and services worldwide to governments and industry including all major avionics and automobile companies.