Managing Complexity, Security, and Safety of Large Software

Introduction

Software malfunctions can have catastrophic consequences and enormous costs. The error-prone and laborious manual practices of developing and maintaining large software must change to cope with ever increasing complexity of software, and the enormous safety and security challenges it poses. Formal verification is not a practical alternative for large software; it is riddled with problems of low accuracy and high computational complexity. The need for automation in software engineering is undoubted, however, a human is indispensable to reason about complex software. With this background, we have conducted two decades of research on human-in-loop automation (HLA) as a pragmatic alternative to manage complexity, safety, and security of large software systems in the cyber-physical world.

This course will introduce the HLA technology developed through our research, with unprecedented capabilities to model, analyze, visualize, verify, and transform large software in multiple languages. The HLA technology incorporates a graph database platform with a powerful query language to extract knowledge from software and build visual models to solve complex problems through automation guided by human reasoning. The HLA technology has been validated by applying it to: automatic parallelization of climate model software, model-based software development for critical avionics and automobile control systems, safety verifications of the Linux operating system, and cybersecurity challenges posed by Defense Advanced Research Projects Agency (DARPA) research programs. More than 300 companies including all major avionics and automobile companies use the HLA tools developed by EnSoft, the company founded on our research.

This course will provide a solid foundation on fundamentals of software that are applicable across all programming languages. With examples of real-world software problems, we will elaborate how this fundamental knowledge can be applied using HLA to cope with software complexity, safety, and security. We will present HLA as a modeling and problem-solving activity. Starting with a HLA model for systematic debugging, the course will show how to gradually advance to build HLA models for verifying complex software such as the Linux kernel. As in physics and mathematics, rigorous problem solving will be taught with models as powerful abstractions. We will use the Atlas platform from EnSoft to build visual models of software. Atlas stores program semantics in a graph database, and provides interactive and programming interfaces to query, model, and visualize software.

A strong laboratory component will include demonstrations, interactive experiments, and programming exercises. The labs will include challenging problems from real-world software in C, Java, and Java byte code. The participants will get a first-hand experience of how to implement HLA techniques through Atlas and perform analysis tasks in a few minutes. These will include examples of difficult analysis tasks for which automated analysis is intractable, manual effort is prohibitively high, and thus HLA is the only practical solution.

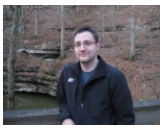
The lecture notes, exercises, and the HLA tools for conducting the labs will be available to the participants for free academic use. The course will provide transformative ideas and introduce tools to implement them. It will enable academic participants to transform their research and education to focus on real-world problems of large software. It will impel new thinking among industry and government participants to innovate application-specific HLA practices and tools that can save significant time, money and effort with unprecedented capabilities to achieve safety and security in their software systems.

For details, please refer to MNIT website (http://mnit.ac.in)

Dates	**Course Duration: September 12 – 16, 2016** **Last date of Registration: September 02, 2016**
Modules	**Modules A, B, and C with dates (September 12 – 14, 2016)** **Modules D, E, and F with dates (September 14 – 16, 2016)** **A: Importance of Managing Complexity of Large Software,** **B: Fundamentals of Program Analysis,** **C: An Overview of Software Safety and Security,** **D: Challenges of Software Analysis and Verification,** **E: One-of-a-kind Catastrophic Malware,** **F: Building Advanced Software Assurance Tools.** **Number of participants for the course will be limited to fifty. Selection of participants shall be on "First Come First Served" basis only.**
You Should Attend If you are …	▪ You are anengineer or scientist interested in state-of-the-art research on managing complexity of software and its applications to verifying software for safety and security. ▪ You are a student or faculty interested in acquiring new knowledge to enhance your research and education activities in software engineering and cybersecurity.
Registration Fees	**GIAN Portal registration fee: Rs 500 (mandatory for all participants).** 1. Create login and password at http://www.gian.iitkgp.ac.in/GREGN/index 2. Login and complete the Registration Form and select Course(s) 3. Confirm application and pay Rs. 500/- (non-refundable) through online payment gateway. 4. Download "pdf file" of the application form and email it to the Course Coordinator. 5. Once course coordinator shortlists the applicant, an email shall be sent to him/her. He/she may proceed for course registration as described in next section. **Registration Fee (excluding GIAN Portal Registration Fee)** **Participants from abroad : US $100** **Industry/ Research Organizations : Rs 5000** **Faculty from other Academic Institutions : Rs 3500** **Students from other Academic Institutions : Rs 1000** **Faculty /Students from MNIT and IIIT Kota : Rs 1000**
Course Registration	1. Fees may be paid via Demand Draft in favour of "REGISTRAR (SPONSORED RESEARCH) MNIT Jaipur" payable at Jaipur. OR Fees can be paid through National Electronic Funds Transfer (NEFT) Account No. : 676801700388 In name of "REGISTRAR (SPONSORED RESEARCH) MNIT Jaipur" Bank : ICICI Bank, Branch MNIT Jaipur IFSC Code: ICIC0006768. 2. Email filled in "Registration Form", scan copy of "Demand Draft/ NEFT Transaction Receipt" and pdf file (downloaded from GIAN Portal Registration) to vlaxmi@mnit.ac.in. Please mention "GIAN (Advanced System Security) in Subject of the email on or before June 20, 2016.

The Faculty

Prof. Suraj Kothari (Suresh) is the Richardson Professor of Electrical and Computer Engineering (ECE) at Iowa State University (ISU). He is the founder and President of EnSoft. He has pioneered research on machine-enabled reasoning to solve complex problems of software productivity, security and safety. He served as a PI for the 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. EnSoft, the company he founded in 2002, provides software productivity, safety, and security products and services worldwide to more than 300 companies including all major avionics and automobile companies. 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 100 invited talks at major conferences, government organizations, universities, and industry.



Ben Holland was a fulltime research scientist at ISU working on DARPA projects with Dr. Kothari. He has extensive experience of writing program analyzers to detect novel and sophisticated malware in Android applications. He has served on the ISU team as a key analyst for DARPA's APAC program. He has given security talks at DEFCON, Derbycon, and at DARPA's. His past work experience has been in mission assurance at MITRE, government systems at Rockwell Collins, and systems engineering at Wabtec Railway Electronics. He holds a master's degree in Computer Engineering and Information Assurance, a B.S. in Computer Engineering, and a B.S. in Computer Science. Currently he serves on the ISU team for DARPA's STAC program as a doctoral student.

Prof. M. S. Gaur is a professor at Computer Science and Engineering Department of Malaviya National Institute of Technology Jaipur. His research interests include information security and NoC (Networks on Chip). He has obtained his B.E. (JNV University , 1988), M.E. (IISc, 1992) and PhD (from University of Southampton, UK, 2004). He has guided 14 PhDs and has 150 publications in Journals and Conferences. He has coordinated national and international projects in the domains of Information Security and Networks on Chip. He is a member of IEEE, ACM, VLSI Society of India.

Dr. Vijay Laxmi is an associate professor at Computer Science and Engineering Department of Malaviya National Institute of Technology Jaipur. She has been teaching in MNIT since 1995. Her research interests include information security. She obtained PhD from University of Southampton, UK under Commonwealth Scholarship and Fellowship Plan. She has guided 12 PhDs and has 125 publications in Journals and Conferences. She has been involved in various R&D projects, some of which are International Collaboration. She is an IEEE and ACM member. She has been a member of TPC of various conferences.

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