

C. PROJECT SUMMARY

Computer and Network Security are very dynamic fields, with new threats and defenses appearing daily. There is a growing demand for competent workforce in these fields throughout US industries and government agencies, with main job requirements being experience and practical skills. Many universities teach security topics at the undergraduate and the graduate level. But in sharp contrast to market trends, security education in universities is often conducted in classrooms, with use of textbooks, blackboard and slides, and with focus on theory and case studies. The resulting students are not fully prepared to meet real security challenges in the real world. This approach also reduces retention in these fields and in Computer Science in general, because passive learning lessens student motivation.

Intellectual Merit: Our proposed work will generate a major leap in security education by developing a public repository of practical security exercises to accompany relevant college courses. These exercises will closely involve students in hands-on security experiments, demonstrating popular threats and defenses. The exercises will be based on the shared, public and free DETER testbed, which specializes in supporting security experiments. DETER is hosted at the lead institution – USC Information Sciences Institute.

Practical security exercises are often very complex to develop, set up and debug, which acts as deterrent for many faculty members to their adoption. We will devote special attention to developing exercises that are easily adopted by teachers who lack practical experimentation or system administration experience. The setup of each exercise will be fully automated, with key concepts described in detail. We will also provide tools for customization of exercises to allow instructors to emphasize particular issues and to prevent cheating. Since all exercises will run on the same platform – DETER – this will ensure portability.

When performing practical exercises students often need to create new or manipulate existing OS and application software. This process is sensitive to the smallest mistakes, which are often discovered by students only when the project or homework is graded. This promotes frustration, not learning. To address this each exercise will be accompanied by detailed guidelines about common pitfalls and how to handle them. Further, we will use DETER’s support for experiment health management to send students automated alerts when their experiment is misconfigured.

The five co-PIs on this proposal have unique and diverse experience in security education and research. Each PI has taught security courses for a long time, and has developed and incorporated in these courses some practical exercises related to her research. Our joint experience was that this significantly promotes student motivation and retention in Computer Science programs. We propose to extend these exercises, mold them to a common format that supports easy adoption by teachers, and customize and automate them for the DETER testbed. In the second year each PI will test the ease of adoption by including exercises developed by co-PIs in her classes. Our team includes an evaluation expert, who will continuously conduct formative and summative assessment of our progress. This feedback will be used to adjust the project direction and to evaluate the attainment of project goals. The DETER testbed, which will be our platform for exercises, has many traffic generation, visualization and experiment monitoring tools. This will enable us to create high-level exercises to attract student interest via GUI interaction, and follow them up with low-level, command-line exercises that provide more detailed knowledge of magic behind the curtains.

Broader Impact: The proposed effort will increase student interest in Network and Computer Security and significantly improve the quality of their professional training at universities. Motivated students often remain in the field and continue to graduate school, so we expect that our efforts will directly increase retention in Computer Science. Our work will further improve the quality of security research, which critically depends on using testbeds for security solution evaluation. Early exposure to the DETER testbed, and security experimentation skills gained through our exercises, will nurture the best evaluation practices in students’ later research.

Each PI teaches at least one security class per 1.5 years, with enrollment around 15+ students. We estimate that at least 50 students per year will directly benefit from our exercises. But a big part of our effort lies in developing portable, shared and publicly accessible exercises for a wider teacher and student population. The DETER testbed currently has 69 project leaders that are university professors. If each of them teaches one security course per year, with 15+ students, our exercises can annually impact more than 1,000 students. The DETER community is also growing at an increasing pace, and the process of becoming a member is fast, simple and free. Our expectation is thus to impact a much wider population in the future, as our project matures and we engage in its advertising and outreach.