

# Security and Privacy in the Internet Era: Bringing Real World to Classroom

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**Abstract** – *Security and privacy issues have become far more critical and complex in the Internet era. Balancing security enhancement and privacy protection remains a key challenge involving both technical and non-technical issues. It is crucial to restructure computer and software engineering curricula to familiarize students with the challenges and opportunities associated with the security and privacy in the Internet era. The key is the balance between security enhancement and privacy protection. This has motivated the project led by the author to bring these real world challenges and opportunities to classroom. This project aims at familiarizing students with the security and privacy issues in this era; the ethical and legal basis for privacy protection; the major challenge of balancing security enhancement and privacy protection; security- and privacy-enhancing technologies; and psychological, social, cultural and physiological influences of security and privacy violation. This paper presents the project highlights, the latest results and lessons learned.*

**Keywords:** Security, privacy, computer and software engineering curricula.

## 1 Introduction & Motivation

The use of the Internet for everyday activities has brought new challenges and opportunities, many associated with security and privacy. Balancing security enhancement and privacy protection remains a key challenge that involves both technical and non-technical issues. However, the computer and software engineering curricula do not sufficiently address this challenge.

This necessitates restructuring computer and software engineering curriculum to familiarize students with the technical and non-technical challenges and opportunities involved in security enhancement and privacy protection in the Internet era.

To address this educational need, the author has led a project that aims at developing a new approach to restructuring curriculum to bring these real-world challenges and opportunities to classrooms.

The main objective of the project is a curriculum reform to familiarize computer and software engineering students with the following topics:

- Security and privacy issues in the Internet era
- The ethical and legal basis for privacy protection
- The major challenge of balancing security enhancement and privacy protection
- The technological advances to protect and enhance security and privacy in the Internet era
- The challenges of protection and enhancement security and privacy
- The security- and privacy-enhancing technologies
- The psychological, physiological, social, and cultural influences of violations of security and privacy on one's development across lifespan
- The interrelation of the psychological, physiological, social, and cultural factors on one's development across the lifespan
- The interrelation of the psychological, physiological, social, and cultural factors that contributes to the process of human development, and also determines the limitations, potential and options of individuals across the lifespan.

The remainder of this paper is organized as follows. Section 2 provides an overview of the approach taken in this project. Section 3 presents the highlights of our project. It provides the list of student learning objectives and a set of educational activities to meet each student

learning objective, the major topics in a required course, and different types of assignments used in this approach. Section 4 provides concluding remarks, lessons learned, and the plans for the project enhancement.

## 2 The Approach

Our approach to restructure curriculum is intended to address the key challenge of balancing security enhancement and privacy protection. This approach offers an attractive and distinguishing feature as its focus is to enable students to:

- recognize the key technical and non-technical issues associated with security and privacy in the Internet era;
- examine, analyze, discuss, and brainstorm the security and privacy issues;
- examine, discuss and brainstorm the psychological, physiological, social, and cultural influences of violations of security and privacy, and the interrelation of those factors on one's development across the lifespan;
- make trade-off decisions in dealing with these issues to address the critical need for balancing security enhancement and personal privacy protection in the Internet era, and developing security- and privacy-enhancing technologies; and
- assess and develop solutions to the real-world problems associated with security and privacy in the Internet era.

In this approach, there is also emphasis on providing students with the educational opportunities to:

- understand the learning process, as well as their responsibility and role in it;
- improve their critical thinking, reading and writing skills, information competence, and both written and oral communication skills, and discern how these skills are important to their academic and personal development; and
- use appropriate social skills to enhance learning, develop and improve positive interpersonal relationships with diverse groups and individuals, appreciate topics and issues from different perspectives, and value individual experiences and views.

## 3 The Project Highlights

In this project, we have identified student learning objectives and a set of educational activities to enable

students to meet those learning objective. We have also provided a list of the key topics to be covered in a required course and the kinds of assignments that significantly help students acquire a good understanding of the topics.

### 3.1 Student Learning Objectives and Educational Activities

This section presents the set of student learning objectives identified in this project, and the set of educational activities to achieve each learning objective.

#### Student Learning Objective #1:

To recognize the security and privacy issues faced in the Internet era, the challenges involved in protection and enhancement of security and privacy, the ethical and legal basis for privacy protection, and the technological advances to protect privacy and enhance security in the Internet era.

#### Educational Activities #1:

- Doing reading assignments on the major topics in security and privacy in the Internet era [1-32].
- Doing verbal and written assignments on those topics.
- Participating in discussion, brainstorming, and analysis of these topics in both small groups and whole class settings.

#### Student Learning Objective #2:

To recognize the psychological, physiological, social, and cultural influences of violations of security and privacy on one's personal well being in the Internet era.

#### Educational Activities #2:

- Participating in discussion, brainstorming, and analysis of the physiological, psychological, social, and cultural influences of violations of security and privacy on their own well being in the Internet era.
- Participating in discussion, brainstorming, and analysis of the physiological, psychological, social, and cultural influences of security enhancement and privacy protection in the Internet era on their own well being.
- Interviewing victims of security and privacy violation offenses in the Internet era, writing interview summaries, and participating in discussion, brainstorming, and analysis the psychological, physiological, social, and cultural influences of violations of security and privacy

on victim's personal well being in the Internet era.

#### Student Learning Objective #3:

To recognize the interrelation of the psychological, physiological, social, and cultural factors associated with violation and protection of privacy and security on one's development across his/her lifespan.

#### Educational Activities #3:

- Participating in discussion, brainstorming, and analysis of the interrelation of the physiological, psychological, social, and cultural factors associated with violation of privacy and security on one's development across lifespan.
- Interviewing victims of security and privacy violation offences, writing interview summaries, and participating in discussion, brainstorming and analysis of the interrelation of the psychological, physiological, social, and cultural factors associated with violation and protection of privacy and security on victim's development across the lifespan.

#### Student Learning Objective #4:

To recognize the interrelation of the psychological, physiological, social, and cultural factors that contributes to the process of human development, and also determines the limitations, potential and options of individuals across the lifespan.

#### Educational Activities #4:

- Examining and discussing the interdependence of psychological, physiological, social and cultural factors of violation and protection of privacy and security.
- Participating in discussion and brainstorming of how such interdependence contributes to the process of human development; the restrictions, potential and options of individuals across the lifespan.
- Participating in discussing how choices and lifestyles throughout one's lifespan have positive or negative impacts on one's personal well being.

#### Student Learning Objective #5:

To understand the learning process and their own responsibility and role in it.

#### Educational Activities #5:

- Participating in discussion of the learning process (how to study, take notes, make plans, conduct

library research, prepare for tests and work in a team on a project).

- Participating in cooperative and interactive learning activities.
- Doing in-class and out-of-class writing assignments including writing reports, reflective papers, and research papers using critical thinking and literature review.
- Writing minutes to summarize main ideas discussed in the small group or the whole class settings.

#### Student Learning Objective #6:

To enhance their skills for critical thinking, inquiry, research, and information literacy, and to explore application of those skills for academic and personal development.

#### Educational Activities #6:

- Using critical reading and thinking to do different forms of course assignments.
- Working in small teams on team-based assignments.
- Writing reports individually and with a team.
- Conducting library research and writing research papers.
- Presenting oral reports in the class.
- Participating in discussion and brainstorming of potential solutions to problems related to the major topics, and identifying shortcomings and alternative approaches to those problems.

#### Student Learning Objective #7:

To use appropriate social skills to enhance learning, develop and enhance positive interpersonal relationships with diverse groups and individuals, appreciate topics and issues from different perspectives, and value individual experiences and views.

#### Educational Activities #7:

- Developing respect for one another, and using class as a form of social support.
- Participating in class discussions, brainstorming, and other educational activities.
- Interviewing diverse individuals, writing interview summaries, and participating in class discussion of the major topics.

- Working in diverse groups on team-based assignments and projects, writing team-based reports, and giving class presentations.
- Participating in the educational activities and workshops, writing reports and reflective papers, presenting oral reports to the class, and participating in small-group and class discussions of social and cultural implications of the educational activities and workshops.

### 3.2 Course Topics

Major topics that should be covered in a required course include the following:

- Introduction to ubiquitous computing and the three waves in history of Internet
- Security and privacy issues in the Internet era
- Security violation and protection in the Internet era
  - Taxonomy of security threats
  - Confidentiality, integrity, availability
  - Authentication
  - Authorization
  - Confidentiality, Integrity, and availability of wireless traffic
  - Anonymity, traceability, and traffic analysis
  - Protecting confidentiality and the laws and regulations
  - Denial of service attacks and tracing the sources and protecting availability
- Psychological, social, cultural, and physiological influences of violations of privacy and security on one's personal well-being
- Interrelation of the physiological, psychological, social, and cultural factors on one's development across the lifespan
- Interrelation of the psychological, physiological, social, and cultural factors that contributes to the process of human development, and also determines the limitations, potential and options of individuals across the lifespan
- What is "Encryption"? What can be protected and what cannot be protected by encryption?
- Privacy, the ethical and legal basis for privacy protection
- Biometrics, Biometric recognition and related security and privacy concerns

- Security- and Privacy-Enhancing Technologies for the Internet
- Application domains that are heavily depending on privacy-protecting technologies (e.g. healthcare, financial, defense, etc.)
- Topics discussed in articles [1-32].

### 3.3 Assignments

There are individual and team-based assignments. The assignments require students to use problem solving and critical thinking techniques. In this approach, there is special emphasis on cooperative and interactive learning activities.

In this approach, there are in-class and out-of-class writing assignments as well as reading assignments, literature review, oral reports, class presentations, and effective participation in discussion, brainstorming and analysis of the course topics in small groups and in the class as a whole.

Written assignments include research papers, reflective papers, reports, interview summaries and minutes. A written assignment is assessed based on its contents, correctness of syntax and grammar, completeness, conciseness, and the appropriateness and clarity of words in a language and style appropriate to the computer and software engineering disciplines.

## 4 Concluding Remarks

Preparing computer and software engineering graduates for challenging computer and software engineering careers requires a curriculum reform to bring real-world to classroom and offer new courses and educational activities that emphasize the key challenge of balancing security enhancement and privacy protection.

In this project, we have developed a new approach for curriculum reform to address the educational needs in terms of security and privacy in the Internet era.

The new approach offers distinguishing features as its focus is to enable students to recognize, examine, analyze, and discuss not only the security and privacy issues in the Internet era, and the security- and privacy-enhancing technologies, but also the significance and necessity of balancing security enhancement and privacy protection in the Internet era; the technical and non-technical challenges in making such a balance; the ethical and legal basis for privacy protection in the Internet era; the physiological, psychological, social, and cultural influences of violations of security and privacy on one's personal well being; the interrelation of the physiological, psychological, social, and cultural factors on one's development across the

lifespan; and the interrelation of the psychological, physiological, social, and cultural factors that contributes to the process of human development, and also the limitations, potential and options of individuals across the lifespan.

Our course and curricular development is directed at addressing these educational needs. Our new approach has been evaluated favorably by students, domain experts and educators.

We are in the process of enhancing this project to include the security and privacy issues in pervasive computing environments--the emerging next generation computing world. The security and privacy issues and balancing security enhancement and privacy protection will become even more complex and critical in pervasive computing world as individual devices can collect data for various purposes at different times and different places, and combining the data collected by these devices can reveal information that could seriously violate one's personal privacy [33].

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