Institute of Service Science
National Tsing Hua University

Service Security

Spring 2024

Time:
Friday: 9:00am – 12:00pm

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TA: TBA
(only contact on MS Teams)

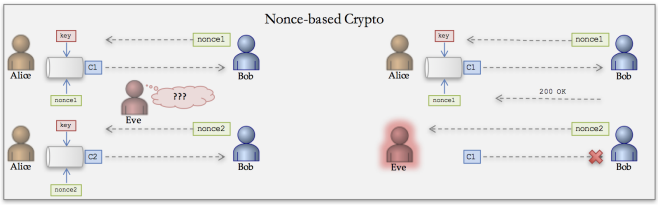
We are in the midst of a digital transformation as commercial, financial, governmental, and educational institutions rush to deliver new services over the Internet. Security is a major concern in these initiatives and bad actors are sure to take advantage of this. Secure IT services can not only *protect the privacy* of users, but even be a *competitive advantage* when offered as a core feature.

This course will show students how to *develop highly secure online services* and lead organizations to adopt a *security-conscious culture*. This class focuses on the use of *cryptographic technologies* and *software architecture* patterns to create innovative online services for e-commerce, fintech, IoT, and other hi-tech initiatives.

Prerequisites: *This course is intended for students with strong programming experience.*
You should already be comfortable with:

- Coding in an object-oriented language (Java, Javascript, C#, C++, Python, PHP, Ruby, etc.)
- Basic web page design (HTML, CSS)
- Basic database design (relational design, ERD/SQL)
- Unix based systems (Linux, MacOS, etc.)

Objectives: This course will enable students to: design better security practices; develop secure software; interact with security practitioners; engage in security research; and digest the latest technical information about security as it emerges everyday.



Ethics Statement on Generative Artificial Intelligence: *In accordance with the published Guidelines for Collaboration, Co-learning, and Cultivation of Artificial Intelligence Competencies in University Education, this course adopts the following policy:* ***unrestricted use***

Grading: Grades will be based on individual and team performance. Individual grades come from class participation, contribution to our online discussion, and from individual assignments. Students will also work on a semester project to create an innovative online security system. However, students on a team do not receive the same grade for the team project: each student is evaluated on their individual coding contribution to the project.

Individual Coding: 70% *Class and Online Participation – 10%* *Individual Homework – 20%*

Introduction to Information Theory

1. **Service Security**:
   - Services & Security
   - Meet Your Tools

   Linux Tutorial 1
   Ruby Tutorial 1
   CODE: Setup Linux & Ruby

2. **Information Theory**
   - Information Entropy
   - Binary Numbers
   - Binary Operations

   Linux Tutorial 2
   Ruby Tutorial 2
   CODE: XOR Defender

Cryptography: applying cryptographic principles

3. **Data Encoding and Error**
   - Testing
   - Information Encoding (UTF-8)
   - Error checking

   Linux Tutorial 3
   Ruby Tutorial 3
   CODE: Credit Card Example - Luhn

4. **Cryptography Beginnings**
   - Serializing versus Marshalling Data
   - Simple Symmetric-Key Crypto
   - Modern Perspectives

   Git Tutorials 1
   CODE: Credit Card Example - Crypto

5. **Symmetric Key Cryptography**
   - Stream & Block Ciphers
   - Brittleness/Complexity of SK Crypto
   - Cryptographic Hashing

   Git Tutorials 2
   CODE: Credit Card Example - Ciphers
   READING: Block-chain and Fintech

6. **Public Key Cryptography**
   - Asymmetric Cryptography
   - Complexity Theory
   - Generating Public/Private Keypairs

   PROPOSALS: Team Projects

Web Services: secure storage

7. **Web Security**
   - PK Crypto & Web-of-Trust
   - Internet Infrastructure
   - Web Services

8. **Databases and Web Testing**
   - Environments & Utilities
   - Simple Databases: Sqlite
   - Web Testing

9. **Database Hardening**
   - Threat Model and Matrix
   - Database Vulnerabilities
   - Securing Database Columns

Users: Accounts and Authentication

10. **User Accounts**
    - Protecting Passwords
    - Account Infrastructure
    - Cloud Deployment

11. **Interface and Authentication**
    - API Deployment
    - Interface Client
    - Cookies, TLS/SSL

12. **Secure Sessions**
    - Hardened Cookies and Sessions
    - Secure Messaging
    - Account Registration

Security Policy: Authorization and Validation

13. **Token-based Authorization**
    - JWT controversy
    - Discretionary Access Control
    - Authorization Tokens

14. **Policies and Validation**
    - Distributed Security Policy
    - Policy Objects
    - Form Validation

15. **Authorization Protocols**
    - OAuth Flow
    - Distributed OAuth
    - Single-Table Inheritance

16. **Client-Side Security**
    - Authenticating API Clients
    - XSS / CSRF
    - Browser Defense: Headers, CSP, Integrity

18. **Final Team Presentations**