Master of Science
Security of Complex Information Networks

Courses description

Computer and Network Security

Computer and Network Security class covers the topic of computer and network security, from advanced cryptographic techniques, innovative algorithms, security protocols and policies, trust ensuring infrastructures and specific technologies for securing networks.

At the end of this class, the students should be able to: develop a complex security policy for ensuring the safety of the provided services, identify threats and vulnerabilities at network and operating system level, identify types of attacks and mitigate them, identify the vulnerabilities of layer 2 and 3 equipments, implement a solution for ensuring a high level of security for the equipments, monitor the network, servers and workstations for identifying and stopping attacks, configuring a firewall, an IDS/IPS and an AAA system.

This class also has an important practical component, which includes: configuring routers that define the network perimeter with the use of specific instruction set for ensuring a high level of security, configuring layer 2 and 3 equipments in a safe manner, configuring a firewall for allowing basic network operations, configuring an IDS/IPS, configuring AAA both on routers and switches.

All class resources are available at http://ocw.cs.pub.ro/courses/scr.

Network Service Management

The Network Service Management class addresses topic relevant for administrating software services provided by a computer network (email, web, LDAP, file sharing, services for developers, etc). It includes aspects such as designing, securing and testing network services in order to provide high performance applications to users. We will tackle tracks such as service scalability and adapting services to the specifics of user applications.

During the lecture, we will highlight relevant concepts of each service and present advantages and disadvantages of various solutions for implementing them.

Students will be presented with the technologies in order to deploy services and network infrastructure and to be able to troubleshoot issues, both for server-side and client-side diagnostics.

The laboratory will insist on the practical side of network services. During the lab, students will engage in activities such as implementing an efficient, secure and scalable service suite for a small and medium sized organization, defining the set of necessary configuration for a Linux-based server, managing Linux-based services through active control of the file system, processes and users.

All class resources are available at http://elf.cs.pub.ro/gsr/.

Securing Networks with Dedicated Equipment

Securing Networks with Dedicated Equipment focuses on advanced security topics in networking, providing knowledge and skills required to plan, implement, and configure a secure, scalable, redundant and convergent network using dedicated firewalling systems and Unified Threat Management. Course concepts are introduced and studied in depth using equipment from multiple producers, offering a comparative analysis of performance, facility in implementation and scalability, for each technology.

With a strong practical dimension, the laboratory consists in activities that implement concepts introduced through the theoretical course, following architectures and case studies selected from the configurations of networks deployed in real, enterprise settings. During the laboratory students will configure firewalls in transparent and routed modes, advanced IP services, virtual firewalls and security contexts, IPSec tunneling and site-to-site VPNs, SSL VPNs for distance access, redundancy at firewall access, and solutions for Unified Threat Management with antivirus, antispam, antispyware and data-theft prevention services.

When finalizing the course, students will benefit from an ample perspective on security levels available in current network architectures, and they will be able to design, implement, monitor and troubleshoot a security solution at enterprise level.

Course resources are available online at http://ocw.cs.pub.ro/courses/sred.

Advanced Services for ISPs

The Advanced Services for ISPs provides students with know-how and skills regarding technologies deployed in large networks and service providers. The knowledge is complemented by the in-depth skills of designing, configuring, troubleshooting and optimizing computer systems, services and computer networks. Students will gain skills

in integrating advanced components for system and network services and ensuring their scalability and reliability.

The lectures and labs will tackle concepts in areas such as virtualization, network monitoring, storage management, traffic control and high availability.

After completing the course, students will have gained knowledge and skills useful for choosing between various solutions for providing scalable services, implementing a complete monitoring solution for a complex computer network and designing and implementing virtualization solutions that ensure scalable and highly available services.

On the practical side, during lab sessions we will tackle applications for virtualization, monitoring, traffic control and other ISP-specific components.

Considering system administration and management, the practical side will include installing, configuring and debugging modern virtualization solutions, providing high availability and scalability to computer systems and automating administrative tasks and improving activities in practical topics.

Considering communication and computer system interaction, we will provide in-depth look at topics such as securing configurations and connections at system or network level and implementing security and interoperability solutions between systems.

All class resources are available at http://elf.cs.pub.ro/saisp/.

Auditing Network Security

The course "Auditing Network Security" promotes knowledge of main concepts regarding the design of an audit for information system, starting from technical principles and current technologies, and then including considerations concerning ethical issues and legal concerns of implementation. Students will learn about the relevance of audit activities for present-day activities, current trends in this field, and specific methods for information gathering.

The course involves students in practical activities, aiming for the development of dedicated knowledge and skills for solving typical problems in network auditing, for each stage. Students will learn to identify relevant vulnerabilities and security risks, to test for their presence, to evaluate their seriousness, and to elaborate a report. Practical activities are designed to encourage students to develop their own action plan, with a high degree of autonomy, and to search for relevant, updated information.

After completing the course, students will acquire the capacity to diagnose functioning problems in complex networks, especially security problems, and to propose alternative solutions, taking into account financial, time, and human resource constraints. Students will also develop their knowledge and skills concerning the provision and evaluation of

information security, their capacity to find relevant information for current problems, to communicate directly, to elaborate technical documents and to put to practical use information from scientific research concerning complex network security.

Parallel and Distributed Systems

The course presents a new approach of parallel and distributed system, which consists of a collection of interconnected stand-alone heterogeneous systems cooperatively working together as a single, integrated computing resource. In the course are presented the type of clusters, cluster architecture, new concept in OS services for distributed processing , physical cluster interconnections and interconnect support, cluster programming environments, monitoring and performance analysis tools.

The course presents the essence of Grids how to utilize highly flexible network architectures, and how to sharing of all computing resources, not just data. Are presented the grid technologies, an extensible and open Grid architecture, general aspects of basic components that enable interoperability among different Grid resources. There are presented the principal Grid characteristics: Wide geographical distribution, Heterogeneous, Resource sharing, Multiple admin policies, Resource coordination, Transparent access, Dependable, Consistent, Pervasive. It is presented a Sample Grid Computing Environment: Resource Sharing & Aggregation and Grid Architecture for Computational Economy. The Layered Grid Architecture is presented.

In the second part of the course the students have to choose a topic of application of the Grid computing and they have to present an essay about it.

During laboratory activities students will elaborate projects concerning parallel and distributed systems, starting from current research in this domain. Students will thus learn the top-down approach in project design and implementation, and will propose technologies for testing and analyzing the performance of their designed systems.

After completing the course, students will master the main concepts, models and specific technologies for parallel and large scale distributed systems. Through their projects, students will acquire skills in effective use of design tools, in implementing and evaluating systems addressing specific needs.