Internet of Things security nuggets

IoTnuggets

2018-1-BG01-KA202-047919

SYLLABUS

Non-IT students at the University level

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OVERVIEW

The Internet dramatically changed the world around us. Billions of computers, devices and sensors work together in so called Internet of Things (IoT). The new sets provide different services and understanding for a single item. The network evolution becomes more complex and the cybersecurity needs increase. The understanding of cybersecurity challenges is the main goal of this course. The IoT set is secure as much as the weakest link or device in it. This course delivers the awareness of SMEs staff to new IoT realm. The course will introduce the security and vulnerabilities in IoT technologies and systems as well as cybersecurity policies, practices and principles.

Every module will include learning nuggets as readings, videos, case studies, and a quiz to help make sure you understand the material and concepts. This course offers a place to learn, reflect, and plan for a smart community approach to IoT.

The IoT ecosystems have own life, technologies and principles in cybersecurity to protect end user. The connected devices, operating systems, sensors, data storage, networking and communication protocols, and system services have to be projected together.

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IoTnuggets aims at teaching non-IT students how to apply the IoTnuggets Methodology to unearth a wide range of new options and ultimately to secure their world that is facing digitalization rapidly. To develop students' awareness of cybersecurity with respect potential problems is based on a new methodology and content, based on ICT, as it foresees full utilization of such tools and development of digital skills.

TRAINING APPROACH

The learning approach is a response to the needs of trainers for quick and adequate tailor-made course. The vision is that due to the fast-paced changes taking place in life and practice, the adaptation of the education process to this dynamic could and should happen in a (r)evolutionary way with "nuggets".

Learning nuggets is a standalone mini learning activity, usually less than 5 minutes in length, that would vary in size and scope that learners undertake in a particular context in order to attain specific learning outcomes[1]. A learning nugget task will take a prescribed length of time and may, or may not be assessed. Nuggets should be designed with a particular approach to learning and teaching in mind[2]

Learning nuggets are the essential elements of the Subscription Learning approach. In this context, the learning happens through a stream of intermittent nuggets which involves a variety of learning-related events which include "content presentation, diagnostics, scenario-based questions, job aids, reflection questions, assignments, discussions, etc.[3] The nuggets are delivered to the learner in many format like email, text message, smart-phone notifications, or any other form of prompting. They are designed to be delivered on predetermined intervals to support learning. The series of learning nuggets are called learning threads. For utmost effective learning, sending a learning nugget could be dynamically triggered by many factors like learners' leaning need, results of a learning assessment or learners' performance.

Target group:

- Non-IT students at the University level

Training activities

To facilitate and enhance the good running of the implementation of the model, learning units are designed and developed according to a number of learning cycles that, following a sequence of stages, promote the development of this independent, meaningful learning. Inspired by the model of Kolb and others (1976)[4] and St Ignatius' teachings (Gil Coria, 1999)[5], five stages are proposed for the development of a learning cycle:

[1] Polsani, P. R. (2003). "Use and Abuse of Reusable Learning Objects". Journal of Digital Information. 3 (4). Retrieved 12 June 2017.

[2] Conole, G. C.; Fill, K. (2005). A toolkit for creating effective learning activities. Montreal: Ed-Media World Conference on Educational Multimedia, Hypermedia & Telecommunication.

[3] "What is it: Subscription Learning Defined". SubscriptionLearning. Archived from the original on 1 October 2017. Retrieved 4 October 2015.

[4] Kolb, D. A. (1976). Learning style inventory technical manual. Boston, MA: McBer.

[5] Gil Coria, E. (1999). La pedagogía de los jesuitas ayer y hoy. Madrid: Universidad Pontificia Comillas.

- Experiential context:

This first stage seeks to give students an insight into the topic or issue under study. "From known to unknown": The aim is to motivate students through their own experience and context so that they can have an initial general overview on the subject and the context in which it is especially relevant, or where the contents to work on can be applied.

Learning should be related to personal experience (analysis of concerns, diverse experiences, information on the subject to contextualize it, relationship with other contexts, future expectations, issues on how we learn, participants' common and differing perceptions). This can be done collaboratively, by exchanging and contrasting individual experiences and approaches on the subject.

- Reflective observation:

The aim of this stage is to encourage students to ask questions, to question themselves, as there cannot be significant learning if one does not ask oneself or questions about it. It can be a question, a number of questions, a conflict, or a gap between what I know and what I need to know or do; all that drives students into action and hence, to the construction and reconstruction of knowledge.

- Conceptualization:

The aim of this stage is to bring students closer to the theoretical approaches that have been developed in a specific scientific or technical area: the answers given by authors and schools to key issues in each discipline. Conceptual learning is based on the acquisition of knowledge, scientific terminology, facts and data, methods and strategies, principles and theories that make up the scientific and technical knowledge of each discipline. As the aim of the course is to move knowledge into action, it should be noted that IoTnuggets is a new discipline in the academic world and the scientific approach is being done not only bay academics but by real practitioners. So, there are many real examples that can illustrate this phase.

- Active experimentation:

In this fourth learning stage, we consider how students can apply the contents they have just worked on. It refers to the theoretical/practical relationship and includes any activity (exercises, internships, projects, research work, designs or any other active proposal to be carried out by students on a specific subject, year or degree) that promotes the development of students' competences concerning the application of concepts, theories or models in order to strengthen them, use them for problem solving or to design or implement a model or strategy.

- Assessment:

We cannot complete a learning cycle without asking ourselves what we have done and what we have achieved. To do this, we can distinguish three assessment levels: Personal level: It seeks each person's self-assessment on the acquired knowledge and skills, their limitations, personal motivations, and individual attitudes, beliefs and values. It also includes a personal contribution and the value students attach to learning: What do you think you have learnt? What has this learning given you? What difficulties have you encountered?

Academic level: It is based on feedback as a key element for students' progress. Receiving feedback on how we learn, what the main difficulties and obstacles to overcome are, the main flaws to correct, is the basis for improvement and optimal performance.

Summative level: Its aim is to balance students´ work and study. It is therefore forming a judgement or assessing a student's attainment of knowledge, which is assessed with a mark and shows the level of competence achieved.

This is a final point to a learning cycle and it can be the beginning of a new one to refine all the concepts and skills that have not been sufficiently achieved in the previous one. So it helps go deeper into the subject in an iterative way.

SYLLABUS

The following syllabus is an exhaustive description of security in the field of IoT. It has been developed with great level of detail, not with the objective of transferring every one of the items described to learning objectives, but to provide a broad context according to the diversity nature and level of knowledge learners. This broad context will allow to be adapted to learning outcomes for each nugget.

Understanding the cybersecurity in each of 7 IoT layers is significant for learners. These layers are:

1	Device connection	IoT devices, IoT connectivity, Embedded Intelligence
2	Data Sensing	Capture Data, Sensors and tags, Storage
3	Communication	Focus on across, Networks, cloud, edge, Data transport
4	Data Analytics	Big data analysis, al and cognitive, analysis at the edge
5	Data Value	analysis to action, APIs and processes, Actionable intelligence
6	Human Value	Smart Applications, Stakeholder benefits, Tangible benefits
7	Data protection regulations	

Learning Objectives

- Classify the components of the IoT ecosystem, including devices, computers, networks, operating system services, and distributed systems.
- Evaluate core cybersecurity principles from an IoT perspective
- Distinguish system, service, application, and network security and privacy threats and vulnerabilities on client and server systems.
- Analyze technologies commonly used in IoT sensors, storage, communication, and system services
- Analyze IoT devices and systems from a cybersecurity perspective
- Implement and use computer-based tools to examine IoT network and security issues
- Demonstrate techniques for exploitation and vulnerability mitigation in IoT devices and systems.

Topics

Understanding IoT Architecture

- IoT devices
- IoT connectivity (Device to device, device to cloud, device to gateway, cloud to Gateway)
- Embedded intelligence

- Data sensing (capture data, sensors and tags)

Need of Internet of Things (IoT) Security

- Main Challenges and Security Issues: poor cybersecurity awareness
- The lifecycle of an attack
- Confidentiality, integrity, availability, non-repudiation
- IoT vulnerabilities (weak authentication, unprotected communications, complex system administration, open access to organizational data).
- IoT safeguards (access control, audit, authentication, biometrics, cryptography, deception, denial of service filters, ethical hacking, firewalls, intrusion detection systems, response, scanning, security policy, threat management).
- Need for a comprehensive cybersecurity IoT policy.

Intrusion Detection and Prevention

- Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection,
- Intrusion detection and prevention Techniques
- Anti-Malware software
- System Integrity Validation.

IoT Security and the Law

- Cybersecurity Regulations, Roles of International Law, the state and private sector in cyberspace, cyber security standards.

Case Studies and Discussion

The course will pass through some of the more common IoT devices in use in:

- Smart Homes
- Smart Retail Supply
- Smart Healthcare
- Smart Grid
- Smart Cities
- Smart Industry

and how they are used as well as security and privacy-related issues found with these devices.

Specific objectives for non-IT students. Their workplaces are different – office, home, street, industrial manufacturing, hotels. They have to be aware of several aspects of the IoT cybersecurity listed in the table below Table 1:

Table 1 Syllabus v Profiles

	IoT devices	x

Understanding IoT Architecture	IoT connectivity	x
	Embebdded Intelligence	x
	Data Sensing	x
Need of Internet of Things (IoT) Security	IoT Security challenges	x
	Confidentiality	x
	Integrity	x
	Availability	x
	No-Repudiation	x
	Access Control	x
	Weak Authentication	x
	Unprotected Communications	x
	Biometrics	x
	Denial Of Service Filtering	
	Ethical Hacking	
	Firewalls	
	Intrusion Detection Systems	
	Threat Management	
	Security Policy	
	Audit	

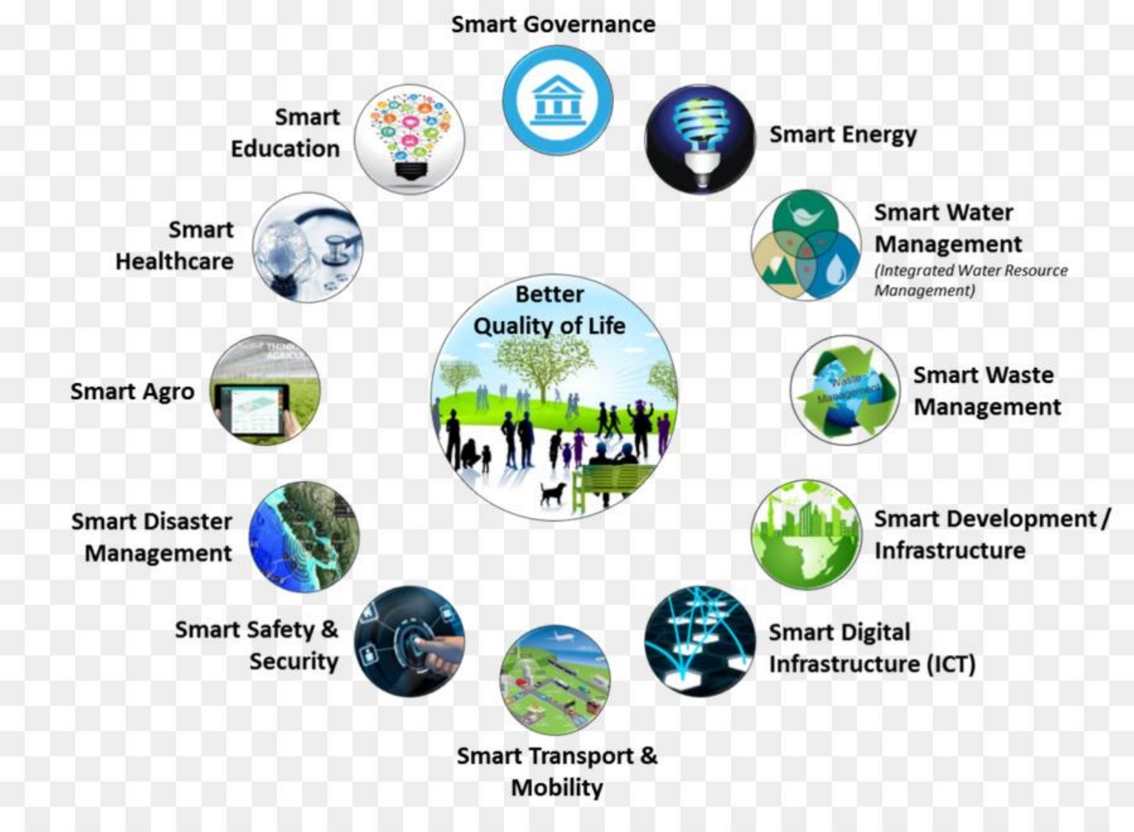
Security Classification & Access Control	Privacy Issues in IoT	x
	IoT Ecosystem Access Control	
	Authentication	
	Authorization	
	Accounting	
	Data Integrity	
Attacks & Implementation	Risk of IoT	x
	Vulnerability Exploitation	x
	Attacks of Privacy	x
	Web Based Attacks	x
Security Management	Identity and Access Management	
	Key Management	
Intrusion Detection and Prevention	Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access , Malware infection	x
IoT Security and the Law	Cybersecurity Regulations and standards.	x
Case Studies and Discussion	Smart Homes	x
	Smart Retail Supply	x
	Smart Healthcare	x
	Smart Grid	x
	Smart Cities	x
	Smart Industry	x

REFERENCES AND CONTRIBUTIONS

This syllabus is the result of research work on competence frameworks, specifically in the field of security carried on by the experts of the IoTnuggets project, and also the collaboration of a group of experts from the University of Deusto in the field of IoT and cybersecurity between Those of us who want to highlight Borja Sanz (University of Deusto), José Ignacio Vázquez (University of Deusto). There has been also vey interesting contributions from industry, and specially, Carlos Laorden (Etxe-tar) and Carlos Polo (NTS).

In addition to their contributions, a vast internet research has been carried on, focused on basic concepts, awareness about the importance of security and threats and specific risk environments and security application. A deep search on different level training courses about cybersecurity and IoT have also been carried on in Spanish Universities o different VET training courses.

Due to the methodology used in IoTnuggets videos, use cases and short material have been focused and references taken into consideration for the composition of the syllabus and elaboration of materials are indicated below organized by themes.



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