Universitat Autònoma de Barcelona

2021/2022

Security and Compression in IoT

Code: 44028
ECTS Credits: 6

Degree	Type	Year	Semester
4316624 Internet of Things for e-Health	OT	0	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: english (eng)

Teachers

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Prerequisites

There areno formalprerequisites.

Students may have difficulties passing this subject if they have not passed the four formation complements (Laboratorio de Programación, Sistemas Empotrados, Tecnologías de Desarrollo para Internet y Web, Sistemas Distribuidos) and have not had equivalent formation in their respective undergraduate degrees.

Objectives and Contextualisation

The goal of this course is to provide an introduction to relevant topics in security and compression in the context of Internet of Things (IoT). The two main areas of focus are:

- Innovative and recent proposals in relation with data privacy and data integrity (security).
- Innovative and recent proposals in relation with efficient data storage and distribution (compression).

Successful students will learn about the most important types of attacks to which IoT systems can be vulnerable, and best security practices in the context of IoT for e-Health. Students will also aquire in-depth knowledge about specific data compression techniques and their application in real-life scenarios. As a part of the course, students will need to provide written and oral justification of security- and compression-related design decision in IoT systems. These decisions shall rely on autonomous and rigorous literature research, and further analysis thereof to identify and analyze existing options. It will also be critical to develop oral and written skills to report, present and defend the results of that analysis.

As a result of the course, successful students will be able to make informed choices and justified designs for IoT systems for e-Health in different types of professional environments.

Competences

- Apply basic research tools in the area of IoT in health.
- Design, develop, manage and evaluation mechanisms of certification, compression and security guarantees in the processing of and access to information in a local or distributed processing system.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Use ICT applied to IoT in health.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Learning Outcomes

1. Apply basic research tools in the area of IoT in health.
2. Based on cost-performance criteria and energy efficiency, select the compression solution for IoT sensors.
3. Evaluate the suitability of network-protocol compression and security based on components used, signal characteristics and transmission channel.
4. Implement adequate compression techniques for distinct data types.
5. Implement security technologies based on devices and components used and on transmission channel.
6. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
7. Use ICT applied to IoT in health.
8. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.

Content

Information security

1. Software and Hardware vulnerabilities
2. Networks and application security
3. Security in IoT devices and in relation to e-health

Data compression

1. Wavelet compression of electrocardiograms
2. Lempel Ziv Welch (LZW) for IoT Smart E-Health
3. Compression of mixed bio-signals for portable brain-heart monitoring systems
4. Adaptive compression of sensor data in IoT systems
5. Compression without loss of low complexity for wearable ECG sensors
6. Hybrid Compression for Energy Reduction in IoT Wireless Sensors

Methodology

The methodology of this course is designed to expose the students to some of the most important concepts in the area of IoT-eH.

Different learning formats will be used in the presential lectures, including:

- Analysis of the literature
- Discussion of practical cases

- Presentation and defense of decissions and implementations related to security and compression in IoT

Autonomous student work will be required before each session, including independent literature research and preparation of written submissions and oral presentations. Active participation in class will be required for all formats to enhance learning outcomes for all course participants. Positive interactions and contributions in class will be rewarded in the final course grades

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Presential sessions	30	1.2	1, 3, 5, 4, 6, 2, 8, 7
Type: Supervised			
Presential supervised sessions	15	0.6	1, 3, 5, 4, 6, 2, 8, 7
Type: Autonomous			
Homework: resolution of exercises, reading of journal papers or technical reports, preparation of sessions	35	1.4	1, 3, 6, 2, 8, 7
Preparation of oral assignments	25	1	1, 3, 5, 4, 6, 2, 8, 7
Preparation of written assignments	25	1	1, 3, 5, 4, 6, 2, 8, 7
Study for synthesis test	15	0.6	1, 3, 5, 4, 6, 2, 8, 7

Assessment

Final course marks will be based on each student portfolio, and computed as follows:

- Active preparation and participation in sessions: 2 points.

  Students must be able to provide evidence of participation in presential lectures, e.g., by sharing aquired knowledge and participating in group discussions. Failure to provide such evidence (e.g., by not engaging in lecture activities) will result in a 0% score in this part and automatic failure of the course. A minimum of 50% in this part will be required to pass the course.

- Assignments: 6 points.

  Students will be given written and oral assignments that must be submitted/delivered before specific deadlines that will be made public in class. Scoring of this partwill be as follows:

  - Written documents: 3 points

- Oral presentations: 3 points.

  Failure to submit/deliver them will result in a 0% score in this part and automatic failure of the course. A minimum of 2 points is required for the written and for the oral parts separately. Correct usage of the English language is mandatory for both parts.

- Synthesis written test: 2 points.

  A final synthesis test will be given based on the contents discussed during the course sessions. A minimum score of 50% in this part is required to pass the course.

The minimum score for each part must be met in order to pass the course. Otherwise, a final score of 3 out of 10 will be assigned.

Notwithstanding other disciplinary measures deemed appropriate, and in accordance with the academic regulations in force, assessment activities will receive a zero whenever a student commits academic irregularities that may alter such assessment.Assessment activities graded in this way and by this procedure will not be re-assessable. If passing the assessment activity or activities in question is required to pass the subject, the awarding of a zero for disciplinary measures will also entail a direct fail for the subject, with no opportunity to re-assess this in the same academic year. Irregularities contemplated in this procedure include, among others:

- the total or partial copying of a practical exercise, report, or any other evaluation activity;
- allowing others to copy;
- presenting group work that has not been done entirely by the members of the group, if applicable
- presenting any materials prepared by a third party as one's own work, even if these materials are translations or adaptations, including work that is not original or exclusively that of the student;
- having communication devices (such as mobile phones, smart watches, etc.) accessible during theoretical-practical assessment tests (individual exams), when prohibited

An overall grade of 5 or higher is required to pass the subject. A "non-assessable" grade cannot be assigned to students who have participated in any of the individual partial tests or the final exam. No special treatment will be given to students who have completed the course in previous academic years. The grade in the Transcript of Records (ToR) will be the lowest value between 3.0 and the weighted average grade, in the event of irregularities having been committed for any assessment activity (and therefore re-assessment will not be possible).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Oral presentations	30%	1	0.04	1, 3, 5, 4, 6, 2, 8, 7
Participation in class: preparation, contributions and discussion	20%	2	0.08	1, 3, 5, 4, 6, 2, 8, 7
Synthesis test	20%	1	0.04	1, 3, 5, 4, 6, 2, 8, 7
Writen deliverables	30%	1	0.04	1, 3, 5, 4, 6, 2, 8, 7

Bibliography

Belesioti, Maria, Ioannis P. Chochliouros, Stefan Vanya, Viktor Oravec, Natalia Theologou, Maria Koutli, Athanasios Tryferidis, and Dimitrios Tzovaras. "e-Health Services in the Context of IoT: The Case of the VICINITY Project." In *IFIP International Conference on Artificial Intelligence Applications and Innovations*, pp. 62-69. Springer, Cham, 2018.

Jayabharathi, J., R. Saminathan, and G. Ramachandran. "A Comprehensive Survey on Internet of Things."

Andreu-Perez, Javier, Carmen CY Poon, Robert D. Merrifield, Stephen TC Wong, and Guang-Zhong Yang. "Big data for health." *IEEE J Biomed Health Inform* 19, no. 4 (2015): 1193-1208.

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Rahmani, Amir M., Tuan Nguyen Gia, Behailu Negash, Arman Anzanpour, Iman Azimi, Mingzhe Jiang, and Pasi Liljeberg. "Exploiting smart e-Health gateways at the edge of healthcare Internet-of-Things: A fog computing approach." *Future Generation Computer Systems* 78 (2018): 641-658.

Farahani, Bahar, Farshad Firouzi, Victor Chang, Mustafa Badaroglu, Nicholas Constant, and Kunal Mankodiya. "Towards fog-driven IoT eHealth: Promises and challenges of IoT in medicine and healthcare." *Future Generation Computer Systems* 78 (2018): 659-676.

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Yuan, Yazhou, Yu Zhang, Zhixin Liu, and Xinping Guan. "Lossless coding scheme for data acquisition under limited communication bandwidth." *Digital Signal Processing* 69 (2017): 204-211.

Sethi, Pallavi, and Smruti R. Sarangi. "Internet of things: architectures, protocols, and applications." *Journal of Electrical and Computer Engineering* 2017 (2017).

Park, KeeHyun, Joonsuu Park, and JongWhi Lee. "An IoT system for remote monitoring of patients at home." *Applied Sciences* 7, no. 3 (2017): 260.

The actual bibliography may changed due to the fast-paced nature of the subject.

Software

No specific toolbox will be used. Practices may require knowledge of different programming languages as C, Java or Python.