Universidade Federal de Santa Catarina
Centro Tecnológico
Departamento de Informática e Estatística
Programa de Pós-Graduação em Ciência da Computação

Teaching Plan

1. Identification

Course title: INE 41XXXX – Autonomous Embedded Systems I
Contact hours: 60 (30 theory, 30 practice)   **Credits**: 4
Professor: Antônio Augusto Fröhlich   **Semester:** 2021/1

2. Prerequisites

Nome

3. Syllabus

Introduction, motivation and examples of autonomous systems. Data-driven systems, autonomic computing, multi-agent systems, autonomous vehicles, Smart Grid. Autonomous systems architectures, operating systems, development platforms, simulators. Communication in autonomous systems, technologies, architectures, protocols and security. IoT and Cloud integration of data-driven systems. SmartData and the Fault-Tolerant Trustful Space-Time Protocol. Project of a real autonomous system.

4. Objectives

Enable students to execute embedded autonomous systems projects, considering both, design and implementation aspects, covering data-driven design, communication, security and cloud integration within the IoT paradigm.

4.1 Student Learning Outcomes

- Introducing concepts, technologies and tools related to the project of embedded autonomous systems;
- Instructing in the design and implement of embedded autonomous systems components;
- Instructing in the integration and validation of embedded autonomous systems components;
- Supporting in the development of an autonomous system.

5. Contents

1 - Introduction [2 hours]

2 - Autonomous Embedded Systems Design [10 hours]

2.1 - Data-driven Embedded Systems *[2 h]*

2.2 - Autonomic Computing *[2 h]*

2.3 - Multi-agent Systems *[2 h]*

2.4 - Autonomous Vehicles *[2 h]*

2.5 - Smart Grid *[2 h]*

3 - Autonomous Embedded Systems Implementation [4 hours]

3.1 - Architectures *[2 h]*

3.2 - Runtime Support Systems *[2 h]*

4 - Communication in Autonomous Embedded Systems [8 hours]

4.1 - Networks *[2 h]*

4.2 - Protocols *[2 h]*

4.3 - Security *[4 h]*

5 - IoT and Cloud [4 hours]

6 - Autonomous System Project [30 hours]

7 - Discussion and closing [2 hours]

6. Methodology

The theoretic part of the course will be covered in lectures and in discussion of read materials. Lectures will take place face to face in the classroom whenever possible. Alternatively, they will be held synchronously online over the Internet. The practical elements of the course will be carried out asynchronously by students, with access to LISHA being granted whenever necessary. All pertinent materials, activities and grading will be carried out via Moodle. Evaluation and grading will be performed based on the project that will be developed by groups of students. Experts might be invited to lecture on specific topics.

7. Grading

Grading will be focused on the project of autonomous system conducted by the students organized in groups and working asynchronously, with at least two synchronous presentation at class time. Synchronous seminars related the specific project topics will also be used for grading purposes.

S: Seminar
Pn: Project in n phases of equal weight
Grade = S * 0,3 + P * 0,7

Note: since 50% of the course is practical, there will be no replacement of partial grades as dictated by arcticle 70 of Resolution 17/CUn/97.

8. Time Plan

Seminar: between 3rd and 6th weeks
Project plan: 8th week
Project intermediate check: 12th week
Project final evaluation: 16th week

9. Textbook and Readings

- S. Poslad, *Ubiquitous Computing Smart Devices, Smart Environments and Smart Interaction*, Wiley, 2009 (ISBN 978-0-470-03560-3).
- M. Niazi and A. Hussain, *Agent-based Computing from Multi-agent Systems to Agent-Based Models: A Visual Survey*, Scientometrics. 89 (2): 479–499, 2011 (DOI: 10.1007/s11192-011-0468-9).
- J.O. Kephart and D.M. Chess, *The vision of autonomic computing*, Computer, 36: 41–52, 2003 (DOI: 10.1109/MC.2003.1160055).
- A.A. Fröhlich and D. Resner, *Data-Centric Cyber-Physical Systems Design with SmartData*, In: Proceedings of the 51st Winter Simulation Conference (WSC), pp. 1274-1285, Sweden, 2018 (DOI: 10.1109/WSC.2018.8632446).
- R. Zurawski, *Industrial Communication Technology Handbook*, CRC Press, 2017 (ISBN 9781138071810).
- S. Liu, L. Li, J. Tang, S. Wu, J. Gaudiot, *Creating Autonomous Vehicle Systems*, Morgan & Claypool, 2020 (ISBN 978-1681739359).
- Materials made available online by the Wallenberg AI, Autonomous Systems and Software

<u>Program</u>.