

Teaching Strategy and Philosophy

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Abstract

This document provides a perspective of my teaching strategy and philosophy since 2007, as well as my teaching duties in what concerns PhD and MSc courses. The document also highlight the role that I've been having in the design of new courses and programs, as well as my involvement in University activities.

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1 General Methodology

My teaching philosophy is driven on the idea that learning should be based on critical thinking and experimentation. Following this philosophy, I organize my teaching around three principles: i) motivate students towards the fundamental concepts encompassed in the course; ii) assist students in creating a critical thinking, allowing them to understand concepts that seem complex at a first glimpse; iii) help students to design successful experimentation methodology.

The teaching approach used so far follows an interactive approach with the students, with great importance being given to the practical demonstration of the learning material. As a normal procedure, a course is divided into modules. Each module ends up with a practice class, which is based on the analysis of scientific papers by groups of students. At the beginning of each module, a small questionnaire is given about the topics discussed in the previous module. The goal is to ensure the desirable level of continuous understanding. At the end, the final evaluation of students' performance is done by means of a written exam as well as a presentation of the project developed in the practical classes.

The modular approach allows students to self-evaluate their progression. Each module is prepared taking into account that students have different styles of learning (e.g. based on textbooks, examples, practical experiments). To cope with all these differences, each module is assigned a set of textbooks, which students should use to better understand the examples used to show the applications of the learning material. Due to the novelty of most of the material that I teach, textbooks are also complemented with recent scientific articles.

In order to allow students to exercise their critical thinking, I also incorporate group activities in practical classes, allowing students to brainstorm in small groups to solve some of the problems expressed in the use-cases provided in the classes. Most of the practical work is done in an industrial context or in the context of European research projects. For this propose, at the beginning of each course students are presented with several practical cases. Students should then create small groups and select one topic to be worked out through in practical classes. Students need to create a working project, which is broken down into

milestones, which are analyzed together with the teacher. For this propose, holding weekly office hours is important to help in the development of the students' critical thinking skills.

Although my experience as teacher started in 1994 by teaching undergraduate courses of Informatics Engineering at the College of Transports and Communications in Portugal, as well as specification courses in the area of "Mobile Communication" for Telecel (now Vodafone), this document is focus on the last 7 years, over which my activity as a teacher always tries to follow my research vision. Since 2007 my teaching activity has been connected to PhD and MSc programs, which allowed me to better test my teaching philosophy: to contribute to the education of qualified people, able to pursuit important open questions in research fields, such as cooperative networking and self-organized wireless systems.

2 Teaching MSc Courses

On an MSc level, my courses are very practical, motivating students to solve real problems, most of them in an industrial context. Classes are essentially practical intertwined with theoretical classes to allow student to acquire the knowledge needed for their practical case, which is selected to encompass all the topics required in the course. My teaching methods have been recognized by the students, who not only learn about how to handle new networking and system trends, but also how to develop an efficient research method, allowing them to be in a good position in a competitive market (e.g. two of my 2012/2013 MSc students end up at Microsoft Portugal and Exago Innovation Solutions in the United States).

In the last 4 years I've been teaching two MSc courses that I created at University Lusofona to support the research work being done in the areas of cooperative sensing and data-centric networking.

The result was the education of students able to perform their MSc thesis on recent research topics, leading to the creation of software prototypes ready to be presented in international scientific conferences. I can highlight the Information and Context Oriented Networking prototype (ICON), presented at CCNxcon 2012, CCNxcon 2013, and at IEEE INFOCOM Workshop on Emerging Design Choices in Name-Oriented Networking in 2013.

I would like also to highlight the sensing middleware Maestroo, which is in the process of being integrated in a spin-off called Senception. The industrial involvement of students is very important for the success of the teaching activity, allowing an adaptation of the teaching contents and students' success in the job market.

In order to ensure the enrollment of motivated students in the MSc course, at COPELABS we have been organizing some activities open to undergraduate students aiming to ignite the development of reality aware applications based on low-cost embedded systems and user-friendly technology.

3 Teaching PhD Courses

On a PhD level, students start by working their lecture topics in the context of ongoing projects in the associated research center COPELABS (<http://copelabs.ulusofona.pt>) or paired with associated industrial partners (e.g. Cisco Systems, Alcatel-Lucent Bell Labs, Huawei). Moreover, the courses that I offer to PhD students are always related to new trends with a significant amount of open questions, and requiring a good use of relevant theories. Some of them include the participation of teaching guests from industrial partners.

I've been teaching PhD courses since 2008, encompassing two PhD programs. The MAP-Tele PhD program in Telecommunications (joint PhD program from Universities of Minho, Aveiro and Porto in Portugal) and the NEMPS PhD program on New Media and Pervasive Systems (at University Lusofona).

In the MAP-Tele program (2008 - 2010) I created and taught the courses of "Cooperative Networking" and "Advances in Forwarding and Routing" (<http://www.tele.map.edu.pt/edition-2008-2009/optional-learning-units>), which are aligned with the topics of user-centric cooperative networking in my research statement. The former covered techniques that are relevant to cooperative networks, such as wireless diversity, as well as cooperative relaying and routing. In the "Advances in Forwarding and Routing" course, I was responsible for presenting to students the recent Delay Tolerant Networking (DTN) approach, which represented a paradigm shift from the regular forwarding in packet-switched networks, given that data reception reliability can be achieved even in the presence of intermittent connectivity

In the NEMPS program (since 2012) I am responsible for the courses of "Reality Mining" and "Complex Systems" (<http://nemps.uluso>) which are aligned with the research topics in the area of human-centric pervasive systems, described in my research statement. The "Reality Mining" course provides students with knowledge and expertise concerning new paradigms of data sensing and mining as a way to explore the notion of cooperative sensing: systems and mechanisms used for collaborative and passive data collecting as a way to extract quantifiable social behaviors. The "Complex Systems" course aims to provide students with knowledge to understand the dimension of the communication structures build upon heterogeneous and dynamic systems. This way, it is fundamental to gain a good understanding about the most suitable metrics and models for the study of the evolution of communication structures, which dynamism is more and more influenced by the user-centric characteristic of the Internet.

4 Involvement in University Activities

My involvement in the University has not been only as researcher and teacher, but also as a designer of courses and programs, as well as a participant in boards and committees. The goal is to contribute to the development of the University research and teaching programs. At University Lusofona I'm a member of the Executive Council and Scientific Commission of the School of Communications, Arts, Architecture and Information Technologies (ECATI), as well as director of the NEMPS PhD program on New Media and Pervasive systems (<http://nemps.ulusofona.pt>), which I founded in 2012: was approved by the Portuguese Education Ministry in July 2012, and the first edition started in October 2012.

The PhD program on New Media and Pervasive Systems (NEMPS) created a strong link to COPELABS in several research areas, namely new digital media (e.g. smart data) and pervasive networking systems. In 2013 the NEMPS PhD program was the starting point of an international cooperation consortium with four international academic partners (University of Kent, UK; University of Urbino, Italy; Tallin University, Estonia; University Federal of Pará, Brazil) and six industrial partners (Alcatel-Lucent Bell Labs, France; Fon, UK; Critical Software, Portugal; Olisipo Consulting, Portugal; ISA - Intelligent Sensing, Portugal; ITS, Portugal). This consortium is working in a joint PhD program that will be submitted under the new Horizon2020 program.

My activities as designer of courses started still at University of Porto, where I created, in 2008, the courses of “Cooperative Networking” and “Advances in Forwarding and Routing” for the MAP-Tele PhD program (joint program from Universities of Minho, Aveiro and Porto in Portugal). These courses were correlated with research activities being conducted at the Internet Architectures and Networking group that I founded at the research laboratory INESCTEC. The goal was to establish a direct connection between the teaching of fundamental topics of cooperative networking and novel forwarding schemes and the execution of PhD thesis hosted at INESCTEC.

5 Students Advisory

Advising students to fulfill their PhD thesis and MSc dissertations does the bridge between my teaching and research activities. Some of my advising activities are done in cooperation with other universities such as the University of Aveiro in Portugal and the University Federal of Pará in Brazil. My advising activities aim to help students to excel and be recognized.

On an MSc level, students are motivated to select a research topic within an ongoing project at COPELABS in order to allow experiencing the usefulness of their work, when integrated in real systems. My approach to teaching is a combination of one-to-one and group environments: I always meet MSc students once a week to follow the progression of their work; students are motivated to work together, since their research topics are always correlated within the selected internal project. At the end of their studies, students get the opportunity to present their results in international conferences or workshops (c.f. CCNxCon 2013). Independently of the possibility to participate in international events, MSc students need to provide a working prototype of their work together with their MSc dissertation (c.f. the Maestro and ICON software packages at <http://copelabs.ulusofona.pt/index.php/technology/software>).

On a PhD level, students are highly motivated by working since day one in the context of European projects (e.g. ULOOP project – <http://uloop.eu>) or projects developed with an industrial partner (e.g. distributed mobility management with Huawei Germany; data-centric networking for Internet of things with Cisco USA). PhD students have one-to-one weekly meetings to ensure the fulfillment of the approved research plan, which needs to end up with no less than four international conference papers and one journal paper. Besides the scientific publications, PhD students are rewarded by any IPR and standardization work that they can extract from their PhD thesis, namely if such IPR is of interest to industrial partners.

The result of MSc dissertations and PhD thesis is always analyzed from an entrepreneurship perspective. For instance COPELABS signed an agreement with GeekGaps (<http://www.geekgaps.com>), is hosting an industrial project (WiRank), and I have created a spin-off in the area of pervasive sensing and perception systems (Senception Lda).

6 Future Plans

As for the future, I hope to be able to continue training qualified human resources in new technological areas. In order to support sustainable training courses, I plan to keep following the strategy used until now: motivate undergraduate students to proceed to a MSc course by involving them in technologic initiatives; to motivate MSc students to proceed to a PhD program by exposing them to scientific events, or to proceed to a successful industrial carrier. In the latter case the focus of the MSc dissertation would be on the exploration and evaluation of the impact of technological innovations into existing deployed systems.

In what concerns PhD programs, I hope to be able to teach courses that are relevant to the scientific direction given to my research, in order to better help students to excel in their scientific goals.

In addition, it is my opinion that being enrolled in courses from different scientific areas may also help to create interdisciplinary expertise, which is being requested by industry and by the Horizon2020 research program of the European Commission. An example is teaching aspects relevant to cooperative networking (e.g. social awareness) to students from social sciences.