Teaching Statement

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Teaching Summary. In my role as a teaching assistant at Ecole Normale Superieure Cachan and Aix Marseille University, and later as a senior lecturer at the University of Fribourg, I have been fortunate to teach a wide range of Mathematics and Computer Science courses to undergraduate and doctoral students. I was also able to participate in several science popularization initiatives, where I taught professionals and the general public outside of academia. These experiences have equipped me with a range of teaching approaches that I continue to refine through ongoing training, such as coursework at the university didactic centers of both AMU and UniFR, and the Certificate in Graduate Teaching and Education Technology I recently passed. My teaching philosophy is articulated around two axes: A) each class is unique and requires a tailored approach, and B) I hold high expectations for both my students and myself as a professor.

Past Experience

As a teaching assistant and senior lecturer, I taught an array of Mathematics and Computer Science courses that enriched my pedagogical skills. In the field of Mathematics, I taught *Linear Algebra*, a foundational course for first-year Bachelor of Mathematics students; *Quantitative Research*, a course that introduced students from multiple bachelor's programs, including medicine and psychology, to a broad range of statistical approaches, both frequentist and Bayesian, as well as fundamental statistical methods such as the t-test, ANOVA, and mixed models; and *Markov Chains and Martingales*, a course for first-year Master of Mathematics students that explored the fundamentals of stochastic processes and advanced probability theory. In the realm of Computer Science, I taught *Formal Methods*, a course for Bachelor of Computer Science students that focused on logic, complexity, and decidability; *Social Media Analytics*, a course for Master of Computer Science students that delved into graphs, learning on graphs, and recommender systems; and *Introduction to Machine Learning*, a course for Bachelor of Computer Science students that provided a comprehensive survey of the building blocks of Learning Theory, the main principles and algorithms in Machine Learning, and data science. Additionally, I (co)-supervised four Ph.D. students, with research topics spanning time series analysis and the use of machine learning techniques to assess the health and frailty of elderly individuals, inverse reinforcement learning and graph algorithms for solving healthcare-related problems such as anesthesia, and NLP and Large Language Models. Furthermore, I mentored over twenty master theses, covering a broad range of topics in Mathematics, Machine Learning, and Computer Science. These experiences have sharpened my ability to guide and motivate students at various academic levels and nurture their critical thinking and problem-solving skills.

Teaching Philosophy

Each Class is unique I believe that each class is unique, and the best teaching approach requires a tailored selection of tools and techniques that are appropriate for the subject matter, the students' backgrounds, and the learning objectives. While my primary mode of teaching is through lectures, I also incorporate a variety of techniques to enhance students' learning, such as real-life examples, historical perspectives, and hands-on manipulation. I also really enjoy grabbing the attention of the students at the beginning of the class by using tricks or intriguing problems that are tailored to each class – an approach that I learned during the CAS is called posture of the Magician. For instance, at the beginning of the Formal Methods class that introduces the student into the theory of decidability, I like to give them a first problem that is very easy to solve, and give them one minute to solve it. Then I give them a second problem that look equally easy but is actually impossible to solve properly, and give them one minute to solve it. I then collect all their "solutions", and show what none of them work. This part is a bit frustrating for the students, as they all believe at first that they solution should work, but

really pull them in, as they are all (or at least a large part of them) very intrigued afterward and eager to know more about these impossible problems – much more than if I just said that there were impossible problems.

Gathering the students' attention is key as my overarching goal is to develop students' intuition of the problems and to provide them with the mathematical language and framework to analyze, explain, and solve these problems. In my teaching, I always aim to link theory and practice, and to emphasize the importance of a strong foundation in mathematics, especially probability and statistics, for understanding quantitative research, data mining, and machine learning. To make these theoretical concepts more accessible and relevant to students, I use real-life examples and guide them toward the questions that require mathematical theory to answer. These examples are adapted to the students; for instance, when teaching Statistics to medical students, I use data from public health institutes, and hospitals as well as genuine problems that naturally arise during my interactions with Medical Doctors. For instance, I like to use preprints of research papers that were hastily published during the covid pandemic to pinpoint the statistical problems that abound, as well as bring the discussion to the potential societal and health impact of these inaccurate results. This generally raise the interest of medical students, or at least of the subgroup that have an interest in reading and understanding research papers and medical guideline.

Similarly, History is a powerful tool, and I frequently use the historical origin of a problem, as well as the different attempts to solve it. The feedback from the student has confirmed that this helped them better understand the nature and complexity of a problem, and give powerful insight into its solution. For instance, I always introduce the student t-test with the story of the Guinness brewery, and the introduction of new tools to produce massive quantities of beers, which induced the necessity to develop a method for testing the quality of beers. Similarly, I believe that hands-on manipulation is key, particularly to the understanding of algorithms and data mining methods. I believe that while I can explain how they work, and students can understand the principles, until they have to take it apart or built it from scratch, their understanding will probably be incomplete. For instance, I found out that this approach helped students with understanding regularization and the choice of the correct metric and loss function. This is also particularly true for gradient descent algorithms, which are a key part of deep learning. Indeed this algorithm is available in many different versions, such as Adagrad, with multiple options, such as Nesterov momentum, and many parameters. Spending a few hours during a lab to explore their behavior and properties significantly helped the students, and resulted in better choices of the proper algorithm and parameters for the rest of the labs and machine learning class. To facilitate this learning process through manipulation, I organize labs and workshops regularly in my classes, and I use small project assignments as part of the evaluation whenever possible. Regardless of the teaching method, I always strive to maintain a highly organized class environment. I try to anticipate and address potential misunderstandings, and I regularly check with my students to ensure that they understand the material.

Clarity of Expectations In the classes I teach, I emphasize my high expectations for the students. My fundamental philosophy is that the level of student performance is generally dictated by the level of expectations. I encourage them to aim for mastery of the material, which requires them to not only learn the content of the class, but also how the different concepts articulate between lectures and classes, how to apply them in practice, and what are the strength and limitations of each approach. I frequently challenge them with difficult questions, to highlight the complexity of the problems and the importance of every detail. In order for them to obtain this kind of mastery, I make certain the students know that it will be necessary to ask questions and that I expect them to do so. I also expect and encourage them to take advantage of my office hours or to make appointments with me. I faithfully respond to e-mails within a day, and I also allow them to ask questions anonymously through a dedicated forum on the Moodle course's webpage. I strive to adapt my classes to the needs and backgrounds of my students, constantly updating my course materials to reflect their feedback, research advances, and new pedagogical tools. I make myself available to help those who may face personal difficulties or scheduling conflicts, by e.g. setting appointments outside of my office hours, or making the class available online. In doing these things, I make it clear that I expect them to put the same effort into being a student that I put into being an effective teacher. I am content to receive students' comments about the level of difficulty of the course, so long as I continue to receive positive feedback regarding the value of the class, and that the students recognize that my expectations are clear, exams are fair, and I am doing all I can to help them succeed.

Teaching interests

While I personally really like research, I also enjoy teaching and I think that it is one of the most important aspect of the role of a professor. Consequently I always strive to improve my knowledge and skills, and I've undertaken additional pedagogic training to obtain additional diploma in didactic, to better myself as a teacher. As a professor, I am prepared to deliver undergraduate and graduate courses in Mathematics, Computer science, and Data Science. In addition to all the classes I have previously taught, I am always eager to take on new classes, particularly in Mathematics, including multidisciplinary classes, and I am willing to develop new courses that can add value to the bachelor's and master's programs. In particular, I have worked on developing a class called *Introduction to Human Measures and their Application*, which is a bachelor course that introduces the possibilities and challenges of using human quantification in science and more specifically in data science. This class is highly linked to my research interest and covers elements of signal processing, probability theory, basic statistics, data science and research protocols. I have also started to develop a class dedicated to Bayesian statistics, to reflect their growing importance in the applied research world.