Teaching Portfolio

presented by

Bilal AL TAKI

e-mail: bilal.altaki.math@gmail.com

webpage: https://altaki.github.io/HP/

Contents

1 Teaching Philosophy

Teaching is not just transmitting information to the students. It is not just teaching materials and skills to be able to earn a high grade. Good teachers are those who share their passion for learning with their students, who teach the students how to think and how to search for ways to solve complex problems.

For me, I believe that the following are essential things in efficient teaching:

- Passion for teaching is one of the most important things for good teaching. Being passionate about teaching means a desire to watch the students learn. This leads to very good preparation of the course material. Also, the feedback from the students is very important for improving the way of teaching and improving the course contents.
- It is essential to help students transition from memorizing formulas to thinking critically about ideas and connecting concepts with real-life examples. They should learn to think independently, to participate in discussion, and to interact with the lecturer. One of the methods to enhance their learning is the “flipped-classroom” blended learning technique.
- The course materials should be presented in an interesting and interactive environment, with very good preparation and organization.
- The students become interested in the topic being taught only if they know why they are learning this specific topic and what and how will they use it in their professional life afterward.
- Instructors must work thoroughly to improve their knowledge and teaching methods.
- Each student has his or her own way in learning and each one has his or her strengths and needs. Thus, it is essential to have office hours dedicated to help the students and serve as a mentor outside the classroom, both for highly motivated students and for those with difficulties.

I believe that effective teaching is comprised of two necessary and related elements: knowledge of the content and the ability to communicate it. Knowing the material is not enough to be effective in teaching it; likewise, communication skills won’t work alone. I want students to actively participate, rather than passively learn.

The feedback about the teaching materials, the teaching style, and assignments is essential for improving my teaching skills and methods. I am open and honest with my students to promote trust and effective communication, so the students are willing to provide me with critical feedback to improve my teaching. During the course, I always demand feedback and suggestions from the students. Also, I put a great emphasis on being available for out-of-class discussions. I encourage the students to come to see me to answer their questions, explain things, and have further discussions. Depending on the situation and the question, I, sometimes, provide "helpful hints",

rather than direct answers, to the questions. I point them in the right direction rather than giving them the final answer. This builds up the confidence to search for and discover the solution.

So, what are some of the Teaching Methods I use?

2 Teaching Methodology

I have followed a training course proposed by the French Ministry of Higher Education concerning novel teaching methods and the use of "numerical tools" to enhance teaching. Some of the teaching methods:

- Flipped classroom: students watch online lectures, collaborate in online discussions, or carry out research at home while engaging in concepts in the classroom with the guidance of a mentor. This is done using "Moodle platform".
- Online platforms such as Moodle: I use Moodle to create online classrooms where course contents are uploaded, and course-specific material questionnaires are developed, in addition to feedback questionnaires, quizzes, blogs, discussion groups, and other material
- Real-life case studies and projects: this involves engaging the students in real projects. This prepares students for the real world and arouses their curiosity, analytical skills, and creativity.
- Group work: the students in the class are given a more direct role in planning what they're going to do and how they're going to do it. An effective strategy for this is group work, where students work together to complete a project. Each student has a different responsibility and he/she should interact with the other members of the group
- Home assignments: students work individually on some specific topics (a kind of mini projects). Since autonomy is very essential in professional life, the aim of these assignments is to develop/enhance their autonomy and their ability to search for solutions and information by themselves.

3 Teaching Experience

I have had a variety of teaching experiences. I have taught undergraduates and graduate students. Below is a summary of my teaching experience

3.1. Digital Campus-Paris

- Course: Statistical Studies for Marketing (Master 2)

  Academic year: 2024/2025 Credits: 28h

  Attending students: 19 Course: B. Al Taki

  The course "Études statistiques pour le marketing" aims to equip students with the analytical skills needed to make data-driven marketing decisions. It covers essential statistical techniques, such as hypothesis testing, regression analysis, ANOVA, and data visualization, with a focus on real-world marketing applications. By the end of the course, students will be able to design, execute, and interpret statistical studies to assess marketing strategies, optimize campaigns, and provide actionable business insights.

3.2. EMLV- Leonardo da Vinci School of Management

- Course: Financial Econometrics (Master 1)

  Academic year: 2024/2025 Credits: 15h

  Attending students: 32 Course: B. Al Taki

  The course "Financial Econometrics" introduces master's students to essential econometric tools for analyzing financial data. It covers topics such as asset returns, risk assessment, and statistical modeling, with a strong focus on linear and multiple regression techniques. Through a blend of theoretical foundations and practical applications, the course prepares students to interpret financial markets, apply quantitative methods, and develop the analytical skills required for careers in finance and risk management.

3.3. Leonard de Vinci Engineering School

- Course: Partial Differential Equations PDEs (Third Academic Year)

  Academic year: 2024/2025 Credits: 15h

  Attending students: 30 Course: D. Yacoubi and B. Al Taki

The course "Partial Differential Equations (PDEs)" introduces students to fundamental PDEs and their applications, focusing on three main types: the heat equation, the wave equation, and the transport equation. Each chapter covers theoretical foundations, solution techniques, and practical implementation through Python-based exercises. With 4.5 hours of tutorials and hands-on Python practice per chapter, the course equips students with the analytical and computational skills necessary to model and solve real-world problems in physics, engineering, and applied mathematics.

- Course: Linear Algebra (Second Academic Year)

  Academic year: 2024/2025 Credits: 15h

  Attending students: 30 Course: D. Jarossay and B. Al Taki

  The course "Linear Algebra" provides a comprehensive study of orthogonality, projections, and transformations in vector spaces. Students explore key topics such as scalar products, orthonormal bases, norms, and symmetric matrices, with a focus on understanding and applying orthogonal projections, symmetries, and distances. The course also delves into advanced concepts like bilinear forms, quadratic forms, isometries, and rotations in 3D. By combining theoretical foundations with practical problem-solving, students develop the mathematical tools essential for applications in geometry, physics, and engineering.

- Course: Numerical Methods (Third Academic Year)

  Academic year: 2024/2025 Credits: 28h

  Attending students: 32 Course: S. Cohen and B. Al Taki

  The course "Numerical Methods" introduces students to essential numerical techniques for solving first-order ordinary differential equations. It covers a range of numerical schemes, including Euler, Taylor, Runge-Kutta, and Adams-Bashforth methods, with a strong emphasis on their implementation and application. Through hands-on practice in Python and theoretical insights, the course equips students with the skills to solve complex mathematical problems, preparing them for advanced studies and applications in science, engineering, and computational fields.

- Course: Introduction to statistics with R (Higher School Preparatory Classes)

  Academic year: 2022/2023 Credits: 20h

  Attending students: 32 Course: L. Imbert and B. Al Taki

  This is an introductory course to statistics: descriptive statistics, maximum likelihood estimation, confidence intervals, and tests, etc. We introduce students to R. Ah the end of this course, students are asked to do a statistics project using the program R.

- Course: Probability (Higher School Preparatory Classes)

  Academic year: 2022/2023 Credits: 24h

  Attending students: 32 Course: A. Jaghdam and B. Al Taki

  This is an introductory course to probability. We approach the following notions: probability space, combinatorial analysis, usual laws of probability, Central Limit Theorem, conditional probability, and independence, etc.

3.4. Sorbonne Université

- Course: Analysis and Algebra for the science (first academic year)

  Academic year: 2019/2020 Credits: 36h

  Attending students: 38 Course: L. Koelben and B. Al Taki

  We approach in this course the various following notions: $\mathbb{R}$: Order and intervals, Limits, Continuity, Derivations, Usual and reciprocal functions, Mean Value theorem, Taylor expansion, First order linear differential equations, The field $\mathbb{C}$ and the complex exponential, Polynomials, Roots, Rational fractions, Euclidean division, $\mathbb{R}^2, \mathbb{R}^3$, Scalar and vector product.

- Course: Vectorial analysis and multiple integrals (second academic year).

  Academic year: 2019/2020 Credits: 32h

  Attending students: 33 Course: F. Paugam and B. Al Taki

  In this course we deal with the following notions: Limits and continuity, Differential, Primitive and integral calculus, Parametric curves, Vector calculus, Partial and differential derivatives, Contour line, Curvilinear integral, Parametric surface, Implicit function theorem, Multiple integrals, Differential forms.

- Course: Introduction to differential equations (second academic year)

  Academic year: 2019/2020 Credits: 24h

  Attending students: 38 Course: C. Boutillier and B. Al Taki

  In this course we discuss the following concepts: Definitions and generalities, Cauchy-Lipschitz statement for first order equations $y' = f(t,y)$, with f globally Lipschitz in the second variable, Scalar first order linear differential equations $x' = px + q$, Matrix exponential, Linear differential equations with constant coefficients (Adaptation of the method of variation of the constant), Phase spaces, Models of population evolution.

- Course: Pre-Calculus (Post PACES of Polytech Sorbonne).

  Academic year: 2017/2018 Credits: 20h

  Attending students: 35 Course: B. Al Taki

  The Peib Post-PACES training of the Polytech network is a training that allows students who have done a first year in medicine without passing the exam afterward, to join the Polytech network in their second year. The reinforcement course that I gave consists of recalling the basic notions of analysis; stating the main theorems of analysis of the first year, and doing some exercises as applications.

- Course: Calculus I (first academic year)

  Academic year: 2021/2022 Credits: 54h

  Attending students: 32 Course: M. Postel and B. Al Taki

  We approach in this course the various following notions: $\mathbb{R}$: Order and intervals, Limits, Continuity, Derivations, Usual and reciprocal functions, Mean Value theorem, Taylor expansion, First order linear differential equations, The field $\mathbb{C}$ and the complex exponential, Polynomials, Roots, Rational fractions, Euclidean division, $\mathbb{R}^2, \mathbb{R}^3$, Scalar and vector product.

- Course: Calculus II (first academic year academic)

  Academic year: 2021/2022 Credits: 112h

  Attending students: 30 Course: Vincent Minerbe and B. Al Taki

3.5. Lebanese University

- Course: model and numerical method in geosciences (Master 2-PDEs).

  Academic year: 2018/2019 Credits: 18

  Attending students: 15 Course: J. Sainte-Marie and B. Al Taki

  The purpose of the part I taught is to present recent mathematical results on the viscous Shallow-Water equations.

$$\begin{cases} \partial_t h + \operatorname{div}(hu) = 0 \\ \partial_t (hu) + \operatorname{div}(hu \otimes u) - \operatorname{div}(2h\mathrm{D}(u)) + gh\nabla h = f \end{cases}$$

  First, a few words on how to obtain these equations from the incompressible Navier-Stokes equations. Then, we discussed the elliptic problem associated with these equations. More precisely, I identified the difficulty introduced by the fact that the water height h can be degenerate at the boundary by studying the following system:

$$\begin{cases} \operatorname{div}(h\mathrm{D}(u)) & = f \\ u|_{\partial\Omega} & = 0, \end{cases}$$

with u is the unknown of the system, and f a given function in a L^p space. Indeed, the fact that h can degenerate prevents us to apply the well-known Lax-Milgram theorem's in a classical Sobolev space frame. The existence of a solution, in this case, could be shown in weighted Sobolev spaces. Therefore, for the complete system, I started by talking about different methods used in the proof of solution existence, notably Galerkin's method and Schauder's fixed point. Then I talked about the difficulties: degeneration of h, non-linear terms. In addition, I made the calculation of different types of energies associated with this system (energy estimation and BD-entropy). The stability of an approximate solution was studied afterward. I recalled the different notions of compactness which allows us to pass to the limits in nonlinear terms. Finally, I gave some points on the question of the construction of an approximate solution.

3.6. Université de Savoie Mont Blanc

- Course: Real Analysis (first academic year)

  Academic year: 2016/2017 Credits: 32h

  Attending students: 32 Course: C. Bourdarias and B. Al Taki

  In this course, we discuss the following concepts: Real and complex numbers, Logic and sets (logical operators, Quantifiers, Demonstration techniques), Real and complex sequences, Functions of a real variable, Finite expansions, Bijective functions, Logarithm and exponential, Trigonometric functions.

- Course: Functional analysis (first academic year)

  Academic year: 2016/2017 Credits: 32h

  Attending students: 32 Course: P. Barras and B. Al Taki

  In this course we discuss the following concepts: Intervals of $\mathbb{R}$, Upper and lower bounds, Numerical sequences (arithmetic and geometric), Theorems of convergence of sequences (monotonic, adjacent, recurring, and extracted sequences), Real functions (minor, major and bounded functions), Parity and periodicity of a function, Limits and continuity, Reciprocal functions, Derivatives of usual functions, Local Extremum, Mean value theorem.

- Course: Statistics (second academic year)

  Academic year: 2016/2017 Credits: 32h

  Attending students: 32 Course: L. Vuillon and B. Al Taki

  In this course we deal with the following notions: Introduction, Addition and multiplication law of probability, Conditional probability, Random variables (Discrete and Continuous Random variable), Probability mass function and Probability density function, Expectation and variance, Discrete and Continuous Probability distribution: Binomial, Poisson and Normal distributions.

- Course: Probability and statistics (third academic year)

  Academic year: 2016/2017 Credits: 24h

  Attending students: 36 Course: S. Gerbi and B. Al Taki

  In this course we discuss the following concepts: Introduction, Discrete probabilities on subsets of $\mathbb{R}$ (Bernouilli, geometric, etc), Density probabilities on subsets of $\mathbb{R}$ (uniform, beta, exponential, etc), Random variable, Independent variables, Normal Distribution, Chi-2 Distribution, Student Distribution, Fisher-Snedecor Distribution, Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, Empirical mean, Central Limit Theorem, Confidence intervals, Hypothesis tests on means, Homogeneity test: independent samples, Homogeneity test: paired samples.

- Course: Linear Algebra (first academic year)

  Academic year: 2016/2017 Credits: 28h

  Attending students: 34 Course: M. Raibaut and B. Al Taki

  In this course, we discuss the following concepts: Reminders on set operations, relations on a set, N, Z, Q, Euclidean division, polynomials and rational fractions, vector spaces, sub-vector spaces, operations, cases of $\mathbb{R}^2$ and $\mathbb{R}^3$, free families, generators, bases, coordinates, dimension, and so on.

4 Teaching Perspectives

One of my main goals in teaching has always been pushing e-learning techniques. Even before the pandemic, I have been convinced that we need to take advantage of e-learning techniques in addition to presence learning techniques. I am convinced that a good e-learning offer will never substitute teaching staff but it will definitely improve the students' learning experience.

4.1. Courses that I would be happy to teach in the future

With an early career in science that was more oriented towards analysis, I have, however, acquired skills in teaching other subjects such as algebra, statistics and probability. Recently, I have become interested in the field of data science and artificial intelligence, which has allowed me to develop knowledge in these areas. Although I have not yet taught in all areas of data science and artificial intelligence, I am quite willing and motivated to prepare for teaching in these areas.

- Database Management System
- Python for Machine Learning and Data Science
- Mathematics for machine learning: Linear Algebra and multivariate calculus
- Mathematics for machine learning: Principal Component Analysis

Of course, this list is not exhaustive and my experience in these fields gives me the flexibility to go deeper and teach other subjects.

4.2. Towards improving my teaching methodology in the future

I'm aware of the need for documenting my teaching activities. In the coming years, I intend to

- develop a database with significant samples of the students' work,
- develop a database with assessments of my classes that specifically addresses my different teaching goals, and
- learn how to better organize group work activities in-class and outside class.