Technology

Statistics and data science:
Any decision you take personally or in a company is based on some causal chain assumptions. For example: "My vegan diet will impact positively the environment" or "Employees will be more productive if we stop home office". Hence, knowing how to differentiate a correlation from a causal effect might be the most important skill you will need to reduce the risk of misinformation and take educated decisions. In this class you will learn how to think about causal inference and apply related methods to real-life data. First, you will learn how to use Python to tackle issues in statistics and probability. Second, we will teach you how to analyse data, question causality and ultimately measure a causal effect using concrete applications on sustainability. Finally, this class will improve your critical thinking by helping you to question numbers and causality. Overall, this class acts as a bridge between the economics and technical classes - such as science of climate change -, while equipping you with the necessary technical skills/knowledge for the success of your master studies and career.

Data science and Machine Learning:
Machine learning deals with the creation of predictive models based on historical data. Today, because of the abundance of data, machine learning is one of the driving forces of the incredible tech-celeration that we have witnessed in the recent years. This class will give a hands-on introduction to several topics in machine learning, ranging from regression and classification to dimensionality reduction and clustering, up to neural networks and text analytics. You will learn how to analyze large datasets and implement machine learning algorithms in the Python language. You will be equipped with the tools to critically-think about the tradeoffs and pitfalls to avoid when conducting data science projects. You will apply the techniques learned in applications covering a variety of industries and topics, with an emphasis on sustainability issues and with the objective to provide decision makers with relevant insights.

Science of climate change:
How much has global climate already warmed and how will temperature evolve in the future? What impacts other than warming come with climate change? How do scientists model climate change and how do we interpret the outcome to deduce policy action from it?" These and many other questions will be addressed in this course. Climate change is a "grand challenge", meaning that it is global in scale and not easily solved by a small group of people. On the contrary, dealing with climate changes requires the imagination, energy and effort of a large number of people with a diverse set of skills. To equip students with the necessary knowledge and tools, this course will give insights into the workings of Earth's components such as the atmosphere, ocean and cryosphere, and the basic physics and chemistry of the climate system. The course reviews past climate change to put the present-day human-made climate forcing into perspective. By hands-on work with emission and observational data, and simple climate models, students will interactively understand the drivers and consequences of climate change at the global scale, and for particular hot spot areas like the polar regions. Students will discuss in-depth the current assessment report by the International Panel on Climate Change as well as policy options for mitigation, adaptation and climate engineering.

Robotics for society:
Robotics and manufacturing have a profound invisible and visible impact on our daily lives, businesses and future towards a more sustainable society. Both robotics and manufacturing are either undergoing profound evolutions or facing challenges that require disruption. These evolutions and disruptions can relate to technology, business models, sustainability or all of them. As part of an interdisciplinary master program, this course constitutes an ideal learning platform to address these topics. The theoretical basics of robotics are first introduced in the winter semester. The summer semester is then devoted to exploration projects of 5 to 6 students with interdisciplinary background to design new products and address new markets. Three specific topics will be considered: 1) open robotics 2) rehabilitation robotics and 3) transport. Each project will target the development of a solution/product. We will evaluate the technology, the choice of components and the associated business models as well as the envisioned solution, while assessing its sustainability, its disruption and the market acceptability. project examples such as a collaborative robot that assists operators to succeed in a watch' assembly task, a robotic device to enable a post-stroke rehabilitation at home, or a drone-based framework as a corporate postal solution.

Energy supply, economics and transition:
This course examines the supply of energy from various angles: available resources, how they can be combined or substituted, their private and social costs, whether they can meet the demand, and how the transition to a renewable energy system can be fostered.

Digitalization & sustainable logistics:
In this course, we address quantitatively the operational aspects linked to the management of logistics systems, focusing notably on their environmental impact. More precisely, and addressing practical situations, the aim of this course is the optimization of logistics systems, in particular when the objective is to minimize their associated environmental footprint. At the end of the course, students are expected to be able to:
- Understand and differentiate the different components that are composing the supply chain, and be aware of logistics situations arising commonly.
- Perform to the mathematical modeling of typical situations arising in logistics systems.
- Solve these models by using various tools from operations research, ranging from exact methods to heuristics.
- Analyze the results and draw managerial insights accordingly.

Information security & digital trust:
The goal of this course is to provide the students with a global knowledge on the principles of information security and privacy required to build digital trust. It includes the threats raised by information technologies and the methodology and tools to identify, analyze and address them. In addition, the students will be trained to adopt a "security mindset", thus enabling them to automatically take information security and privacy into account when analyzing systems. By the end of the semester, the students will possess some technical and methodological skills to perform an information security and privacy-oriented analysis of a system and propose solutions to address potential threats.