

## Data Science for Chemists

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| <p>17/06/2024 9h-17h (JSA)</p> <p>1. Introduction to Data Science</p>                        | <p><b>Objective:</b> This part is an introduction to different themes related to data science required for chemists</p> <p>We will take a look at different concepts related to data science</p> <ul style="list-style-type: none"><li>• History of Data Science and computing</li><li>• Computer Architecture and Systems</li><li>• Major phases of data analysis</li><li>• Algorithms for data acquisition and process control</li><li>• Applications: sustainable cities, energy transitions</li></ul> |
| <p>18/06/2024 9h-12h (OCA)</p> <p>2. Internet of things</p>                                  | <p><b>Objective:</b> This part gives an introduction to different themes related to Internet of things required for chemists</p> <p>It will cover the following topics:</p> <ul style="list-style-type: none"><li>• History of Internet of Things (IoT)</li><li>• Definition of IoT</li><li>• Applications : Industry 4.0, circular economy</li><li>• IoT architectures</li><li>• Fog/Edge/Cloud computing</li></ul>  |
| <p>20/06/2024 9h-12h (OCA)</p> <p>3. Data acquisition protocols and technologies for IoT</p> | <p><b>Objective:</b> This part presents data acquisition protocols and technologies for IoT</p> <p>We will take a look at the key concepts of IoT</p> <ul style="list-style-type: none"><li>• IoT Technologies</li><li>• Data acquisition protocols like SPI, I2C</li><li>• Sensors</li><li>• Actuators</li></ul>   |
| <p>21/06/2024 9h-12h (JSA)</p> <p>4. Fundamentals of Programming</p>                         | <p><b>Objective:</b> This part gives a general overview of programming in Python with the goal of using it for data analysis</p> <p>The student will be able to get an overview of</p> <ul style="list-style-type: none"><li>• Fundamentals of Python programming</li><li>• Manipulation of files, especially reading, writing and modifying text files and CSV/TSV and JSON files</li><li>• Interaction with the user</li></ul>  |

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|   | <ul style="list-style-type: none"> <li>• Data Analysis (basic) using built-in Python methods</li> </ul>   |
| <p>24/06/2024 14h-17h (JSA)<br/>5. Data Analysis and visualization</p>      | <p><b>Objective:</b> This part gives the fundamentals of data analysis and visualization</p> <p>It will cover the following topics</p> <ul style="list-style-type: none"> <li>• Clustering algorithms</li> <li>• Classification algorithms</li> <li>• Linear regression models</li> <li>• Recommender systems</li> <li>• Visualization techniques</li> </ul>  |
| <p>25/06/2024 9h-12h (OCA)<br/>6. Practical session on Microcontrollers</p> | <p><b>Objective:</b> This part gives a hands-on experience on the microcontrollers</p> <p>The student will be able to perform the following</p> <ul style="list-style-type: none"> <li>• Coding, compiling and flashing a firmware for microcontroller</li> <li>• Interacting with sensors and actuators using SPI and I2C protocols</li> <li>• Reading digital and analog measures</li> </ul>  |
| <p>28/06/2024 09h-12h (JSA)<br/>7. Data Mining</p>                          | <p><b>Objective:</b> This part gives an opportunity to the students to use data mining tools</p> <p>We will look at the following topics:</p> <ul style="list-style-type: none"> <li>• Introduction of Python libraries like numpy, matplotlib and pandas</li> <li>• Manipulating CSV and JSON files using the above libraries</li> <li>• Data analysis</li> <li>• Data visualization techniques for different types of data</li> <li>• Clustering, classification and linear regression using the library Scikit-learn.</li> </ul> |
| <p>02/07/2024 9h-12h (OCA)<br/>8. Network protocols for IoT</p>             | <p><b>Objective:</b> This part gives an introduction to the network protocols for data communication</p> <p>We will cover the following topics</p> <ul style="list-style-type: none"> <li>• Network protocols like LPWAN and WPAN</li> <li>• Message exchange protocols like MQTT</li> </ul>  |

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| <p>04/07/2024 9h-12h (JSA)<br/>9. Machine Learning</p>              | <p><b>Objective:</b> This part gives an introduction to machine learning techniques</p> <p>We will cover the following topics</p> <ul style="list-style-type: none"> <li>• Supervised, unsupervised and semi-supervised learning</li> <li>• Neural network models including single and multilayered perceptron</li> <li>• Analysis of sensor data</li> <li>• Image analysis</li> <li>• Prediction</li> <li>• Recognition of handwriting</li> </ul> |
| <p>04/07/2024 13h-17h (OCA)<br/>10. Scaling up IoT</p>              | <p><b>Objective:</b> This part introduces ways to scale up the IoT architectures</p> <p>The students will discover</p> <ul style="list-style-type: none"> <li>• The challenges while scaling up IoT</li> <li>• IoT Lab infrastructure</li> </ul>   |
| <p>08/07/2024 9h-12h (OCA)<br/>11. Practical session on IoT-Lab</p> | <p><b>Objective:</b> This part introduces ways to use message and network protocols for IoT lab</p> <p>The students will work on</p> <ul style="list-style-type: none"> <li>• LoRa WAN</li> <li>• MQTT</li> </ul>  |
| <p>09/07/2024 14h-17h (JSA)<br/>12. Big Data</p>                    | <p><b>Objective:</b> This part will introduce the key concepts of Big Data</p> <p>Following are the topics covered in this module:</p> <ul style="list-style-type: none"> <li>• 5V of Big Data</li> <li>• Data storage of voluminous data, especially non-relational databases</li> <li>• Artificial Intelligence</li> <li>• Open databases and extraction of information</li> </ul>   |
| <p>10/07/2024 9h-13h (OCA-JSA)<br/>13. Evaluation</p>               | <p>Final exam of two hours based on all the topics covered in this module.</p>   |

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