

## **Graph Neural Networks: From fundamentals to Physics application**

*Tuesday, March 7, 2023 2:30 PM (1 hour)*

Non-Euclidean data structures are present everywhere in the physical and digital world. Over the last few years, an increasing number of scientific fields have started to leverage the information contained in such data structures with the advent of Geometric Deep Learning. This is also true for High Energy Physics, where Graph Neural Networks are nowadays developed and used for various tasks in different reconstruction steps. In this lecture we will first demonstrate the expressive power of graphs as a data structure and introduce the fundamental concepts of graph theory. Then we will discuss Graph Neural Networks and lay the mathematical foundation of the most important neural mechanisms such as Neural Message Passing or Graph Convolution. Lastly we will examine applications of Graph Neural Networks in High Energy Physics that make use of the aforementioned technologies.

This lecture aims at the particle physicist who approaches Graph Neural Networks as a practitioner. The main objectives are to illustrate the reasons that Graph Neural Networks are powerful deep learning tools and to present the minimum knowledge needed to conduct research in the computer science literature and apply established technologies to HEP.

### **Attended school**

### **Exercise hours**

### **Lecture hours**

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**Track Classification:** Data science and machine learning