

24th edition

Sensing the ionosphere with AI: learning from satellite data

June, 16th - July, 6th 2024

International FBK Summer School for Data Science
and AI-based interdisciplinary research



webvalley.fbk.eu

WebValley 2024

WebValley is the International FBK Summer School for Data Science and AI-based interdisciplinary research. The school runs in a tech lab, set up at the Artigianelli high school, in downtown Trento. The WebValley Lab provides computing resources and devices to test new ways of exploring the principles of applied data science and predictive models. Students joining the school work in a lively and interactive environment together with a group of selected experts, also interacting through teleconference with other labs.

Each year, the team includes students from Trentino, nationals and internationals. More than 450 students (17-19y old) have attended the WebValley School since its first edition in 2001, as true protagonists of a challenging research project. Fellowships are sponsored by FBK and partner organizations, covering tuition and accommodation, as well as computing and scientific resources. Families can be asked for a contribution for sports and social activities organized on weekends.

The requirements to participate:

- ▶ High School student (for Italy: 4th year completed)
- ▶ Good knowledge of English
- ▶ Enthusiasm for science and new technologies
- ▶ Above-average school records
- ▶ 1 Student's Motivation letter
- ▶ 1 Teacher's Recommendation letter
- ▶ 1 recorded video interview with the candidate answering 5 written questions

Applicants need to demonstrate their inquisitiveness, their interest in STEM domains and in the topic of the year, and their programming skills (if present). In addition, aptitude for teamwork is a crucial requirement to participate. Candidates are scored both for their background knowledge and their motivation to contribute to the project.

The 2024 Challenge

In 2024, the team of about 20 students, collaborating with researchers from the Bruno Kessler Foundation (FBK), the University of Trento (UniTN) and the National Institute for Nuclear Physics (INFN), will embark on an exciting project in Artificial Intelligence. This initiative will focus on the cutting-edge field of satellite data analysis. The project will leverage the potential of the CSES-01 satellite (China Seismo Electromagnetic Satellite) payloads, particularly the High Energy Particle Detector Limadou HEPD-01.

Diverse applications will be explored, including analysis of time correlation with seismic and space weather events. In particular, the WebValley 2024 Team will face the complexity of modeling and analyzing data collected by the instruments onboard CSES-01 satellite. This advanced technology provides a unique opportunity to explore correlations and patterns in the vast dataset. It opens new possibilities in understanding space weather phenomena and their impact on various scientific domains.

The project will emphasize the development of predictive models tailored for satellite data, fostering insights into the complex interplay of factors influencing space conditions. As part of this immersive experience, students will be actively engaged in assembling a comprehensive analysis framework, improving their skills in satellite data interpretation, and gaining hands-on experience with state-of-the-art AI technology.

Throughout the project evolution the participants will develop technical skills in data science, acquiring working experience on machine learning, including reproducibility and interpretability for AI solutions, and the basics of deploying models on the cloud.

- ▶ Encourage smart students to be **entrepreneurs in science**
- ▶ **Interdisciplinarity**
- ▶ Develop **teamwork, collaboration, fast-prototyping attitudes**
- ▶ Using **high quality data** from scientific or statistical institutions-
- ▶ Gain experience about the **hardware and data** it generates
- ▶ Promote the adoption of **standard formats** and share **data policies**
- ▶ **Deduce innovative, efficient, and effective education and communication models** to be reproduced within the Italian and, potentially, the European school system



The goals of WebValley 2024

The format

In the **first week**, introductory courses in data science, visualization and AI (e.g. Python and machine learning) software are provided to the whole team, with an emphasis on the specific domain of the project (e.g. biomedicine, digital agriculture, physics, etc.). Such initial concentration efforts provide a large spectrum of tools among which the participants can choose the most proper ones for developing the research project, including programming languages and AI frameworks such as Keras/TensorFlow and PyTorch for deep learning.

The **second stage of the experience (2nd and 3rd week)** outlines a learning environment which is intentionally

shaped, where the participants have the chance to work independently on the research project, typically divided in smaller groups that are formed on the basis of the students' personal interests and the specific tasks required to tackle the challenge. The teamwork sessions will be marked by interactive experiences designed with a specific methodology that aims to develop fundamental problem solving skills while setting the goals of the challenge, and to increase the quality of the cooperation among the teams.

Lab is open all day, but group activities and leisure time are also part of the three weeks course.

Project keywords

- ★ Data Science & Tools
- ★ Unix + GitHub
- ★ Python intro
- ★ Numpy & Scipy & Pandas & Pyplot
- ★ Data Visualization
- ★ DL theory, apps & implementations
- ★ Space Weather and Satellite/Space data
- ★ Basic of space detector technologies
- ★ CSES-01 data: time series analysis and forecast
- ★ Anomaly detection methods
- ★ Unsupervised learning techniques
- ★ Project Data
- ★ Meetings and brainstorming sessions
- ★ Machine Learning

Special Event
Friday, July 5th 2024
Final presentation



Organized by



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*The 2024 WebValley summer school has the support of Limadou project onboard the CSES mission and access to their open data

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