FRANKFURT SUMMER SCHOOL 2019 (05.08. - 30.08.2019)

Computer Science, Physics & Artificial Intelligence Track:
“Supercomputers and Superphysics – from Artificial Intelligence to Black Holes”

General Outline:

**Module 1: Supercomputers and Superphysics – from Artificial Intelligence to Black Holes**
(weeks 1 and 2, 05.08. – 15.08.)

Rapid development of computer technologies has led to many-core computer architectures with thousands of computational elements in a single device. In addition to the quantitative growth, these devices operate simultaneously and in parallel. In addition, if operation of one computational element is similar to the rational analysis of a human brain, the parallel operation of thousand such computational elements is capable to reproduce activity of a human brain at its intuitive level.

Thus, artificial neural networks inspired by the work of the human brain have received a powerful boost for their application at the forefront of modern science, primarily in the analysis of data obtained at the Large Hadron Collider in CERN (Geneva), where experiments in high-energy and nuclear physics are aimed at studying a wide range of phenomena from the Higgs boson to the Big Bang and black holes.

**Module 2: Artificial intelligence (AI): Modern Methods**
(weeks 2 and 3, 19.08. – 30.08.)

**Goals of the course:** The students will achieve working knowledge and hands-on experience with the modern methods of the fast-growing field of artificial intelligence.

**Course topics:**
- What does the Deep-Learning-revolution mean for science and industry?
- Which methods of machine learning exist and their relative pros and cons?
- For which user cases is the application of these methods useful?
- How do I build and train a neural network for a given problem?
- Different types of neural networks (CNN, RNN, ...)
- Generative modelling (AE, VAE, GAN, ...)
- Healthy scepticism: evaluation of performance and accuracy.
- Discussion on ethics and privacy of data.
Roadmap: Statistical Analysis | Optimization | Machine learning | Neural Networks | Deep Learning | Tensorflow and Keras | Applications | Own project

Programme:
- The **seminars** are held in English (about 50 contact hours).
- **Excursions and study tours** to the German city of Heidelberg as well as a weekend visit to the French town of Strasbourg and an optional trip to Berlin are also part of the programme.
- The optional **German language courses** for beginners and advanced learners take place in small learning groups.

Requirements:
Knowledge of advanced mathematics (calculus, statistics); at least one programming language (Python, Java, C++ or similar); at least 2 years of undergraduate studies or enrolment in master studies; topics of study: computer sciences, engineering, physics, mathematics, chemistry, biology or materials.

**Programme fee:** 2,100 € (accommodation in dormitory, seminar and cultural programme, the optional German language courses, all study material, health, liability and accident insurance and the transportation fee within Frankfurt).

Find out more about Frankfurt Summer School on our website: [http://summerschool.uni-frankfurt.de/](http://summerschool.uni-frankfurt.de/)

**Deadline for applications:** 31 March 2019

**Application:** [http://summerschool.uni-frankfurt.de/application/](http://summerschool.uni-frankfurt.de/application/)
Contact:

Frankfurt Summer School
International Office, Goethe University
summerschool@em.uni-frankfurt.de,
Tel: 0049 6979817247