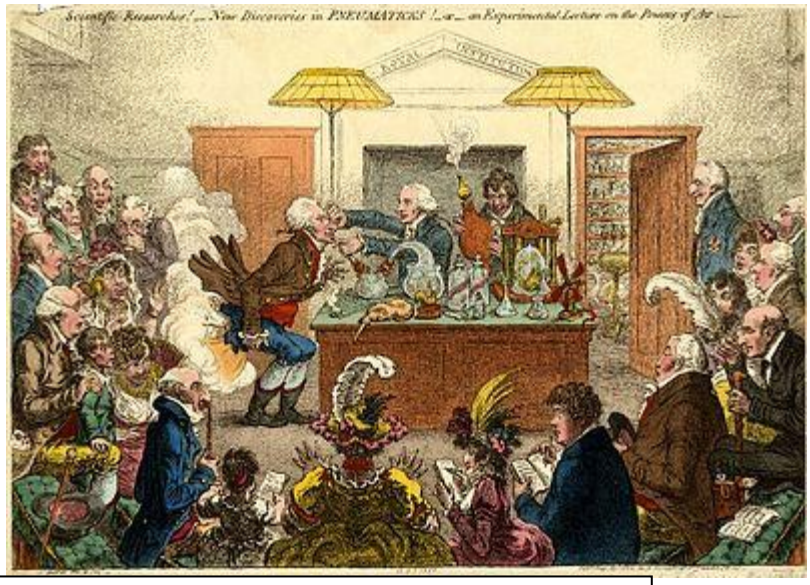
OPINIONS ABOUT THE 1ST TWINFUSYON SCHOOL

(Maria Losurdo, TWINFUSYON Partner)

The 1st School on "***Modelling and Statistic for Bioprocesses"*** organized by the TWINFUSYON project brought together students from the various disciplines of chemistry, biology, genetics, biophysics, physics and mathematics. All these disciplines are key areas for understanding sensing events and analysing sensing data.



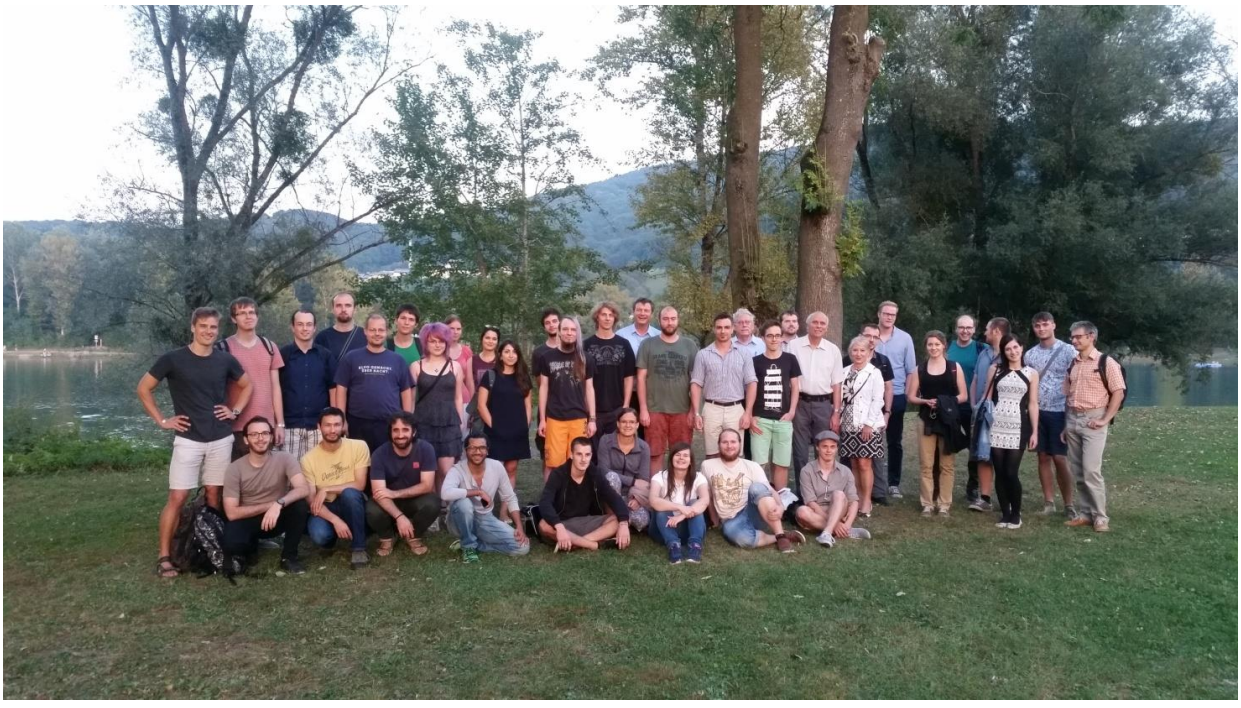
Source: https://en.wikipedia.org/wiki/Humphry_Davy

Prof. Josef Humlicek, Coordinator of TWINFUSYON, gave an original definition of the multidisciplinarity and multiscale of sensing using the

Humphrey Davy 1802 satirical cartoon:

- Physics: the gas goes from the vessel to the nose through the atmosphere
- Chemistry: attaching the molecule to the blood and sending it to the body
- Biology: interaction with blood
- Society ingredients: the behaviour of people before and during experiments

The aims of this 1st summer school was to 1) twin students from various disciplines 2) give an overview of the importance of statistic and stochastic in the analysis of biosensing processes 3) give the basic mathematical concepts to understand statistics & stochastics 4) to give hands-on experience in applications of statistics and stochastics to the analysis of physical, chemical, biological, biosensing and neuroscience phenomena.



The peculiarity of this school was the use of blackboard during the lectures, instead of slides, to keep the student tracking all the steps of the concepts demonstration. Indeed, this method resulted very effectively in keeping the students very focused and interacting with the teacher in predicting/verifying formulas

Lectures file were distributed electronically to all registered attendants.

An attendance certificate was given to the students on the last school day.

The School was opened with a tutorial and overview on thermodynamics from Prof. Kurt Hingerl of the University of Linz, who aimed to set a common language, definitions & understanding. This was followed by some experiments visualising the Brownian motion and the concept of thermal equilibrium.

Prof. Buckwar taught the fundamentals of probability, stochastics and statistics, while computer simulations on the Ising model were given by Prof. Zillich. Each lecture ended with exercises to be solved by the students in a 15 min slot assigned as a mean of verification of the acquired concepts.

Prof. Buchaw connected to the modelling of chemical kinetics, i.e., teaching how to determine the probability of a reaction to take place and how to describe the evolution of probabilities to go from state A to state B based on the current state of the system (conditions probabilities). It was shown the practical example of calculation of the probability of the reaction applied to Michaelis-ellenten-enzyme reaction.

It was a pleasure to continue with a highly interesting machine learning talk (Support vector machines, neural networks), with a lot of biology / medicine applications by Prof. Bodenhofer.

The basic concepts of equilibrium statistical thermodynamics were taught by Prof. Titulaer, who went from MICROSCOPICEQUATIONS (Hamiltonian description) to MACROSCOPIC Non-equilibrium THERMODYNAMICS, defining the intermediate state of MESOSCOPIC and Boltzam equation.

Besides the daily lectures and discussions, the school offered the opportunity to share with each other in a quite relaxing atmosphere during social activities. The students visited beautiful historic cities such as XXXX taking a boat trip. During the social dinner, the students had the opportunity to meet local traditions in a local in a small open restaurant beside the lake.

The last day, Dr. Tamburrino showed the importance of having good data and of a good model, as well as the dangerous statistical analysis.

Dr. Tamburrino introduced the “Statistical daily-life” to leave us with the idea that statistics is all around us:

“I expect to be there at....”
At the supermarket “I choose this queue which is faster...making a prediction..”
“on average I eat meat/fish/eggs..twice a week”
“I typically sleep x-hours per night”

Therefore, the school left us with a more consciousness about our *“statistical life*”....we do always have “expectation” and make “predictions” about our life: it was simply fun to learn how to calculate them!!
And to go back to science, we took home a good habit quite often forgot nowadays:

“a good model is based on a good data sampling”...

what is the reliability of scientific conclusions published in papers on the basis of few set of samples?
Something we, scientist, are left not only to think about but also to solve!
Quoting:
“If you torture your data enough, nature will always confess” Ronald Coase

The opinion of a PhD student in Biotechnology and Bioinformatics at CEITEC, Brno

During the second week of September many renowned scientists, researchers and student gathered together on the vibrant knowledge hub of JKU to attend the Advanced School on Modelling and Biostatistics organised by the TwinFusyon Project. Students of multi nationalities and different fields of Science (Biotechnology, BioChemistry, Physics, Chemistry, and Genetics) together attended the lectures on Thermodynamics, Statistics, and Physics, and Machine learning to enhance their knowledge and to understand the important of interdisciplinary and translational studies in the current and future Science.

Professors imparted their knowledge to the students and put as much effort as they could to make them understanding from the basic to higher level concepts. Although, it was an effort to gather beautiful brains together, the logical concept of combining the information diverted to the individual core sciences. Some students with a Biology and Genetics background who never encountered the huge pile of core Physics and Mathematics felt at some point a bit lost during the lectures. Despite the huge efforts of Professors, the topics were too abstract to be understood and framed in the application based point of view in the different fields.

At starting, Prof. Kurt Hingerl delivered a beautiful and energy consuming lecture on Thermodynamics. Most of the students caught everything he wanted to tell. Students also had the chance to observe the live examples of Brownian motion of small and big molecules under the microscope.

The second and third days were dedicated to Statistics and Biostatistics, which were taught by Prof. Buckwar and Prof. Bodenhofer.

Prof. Buckwar explained the core concepts of probability and set theory with an ease approach so that students from both Physics and Chemistry got most out of it. The start of the lectures was great but gradually it became more and more mathematical and deep equations concepts based, which was indigestible for students especially from Biology, Epigenetics and Bioinformatics. Yes, they had little information about statistics but Prof. Buckwar lecture turned core mathematical which was out of the knowledge range of students.

In-between the lectures tasty coffee and snacks were served which were pause time frames for discussions and interactions of great minds. The utmost care was taken by the organisers for proper food and lodging of participants.

The poster session was also very informative. 3 young researchers presented their work and it was a great moment to know about what fellow researchers and scientist are working on. During the poster session, I underwent a pleasant discussion with colleagues and students from Masaryk University, Brno and Linz University. During the discussion, we realised that the research work we are doing is related in terms of methodology and techniques used. Obviously, there are certain big differences but we exchanged quite great ideas which will definitely be a help in the progression and succession of our individual research. Especially the poster presented by Tereza Gerguri on the MD simulation was quite interesting for me. I wish her best of luck for her future. She promised me to help me in my analysis.

This is profound for generating new collaborations and incorporating new ideas in your running projects to make science even better.

The best day for not only the students but also for Professors and Organizers was the day of excursion. The destiny of the trip was a place little far from Linz, called Gmunden. The fascination of the trip was a personal report on Steamer named Gisela itself by the captain of the steamer. It was a steamer built around 1863. The functioning of the engine, with explained physical, chemical and engineering concepts, was beautifully described. It was followed by 3-4 hours of ferry ride on the lake Traunsee. That was a one in a lifetime experience for me and super amazing.

This excursion was also an important moment for the school. During the lecture session, the discussion is usually confined to the theme or idea presented in the lecture. There is less room for the discussion on the generalised and individualised mode of science and its practice. The excursion was a fantastic opportunity to dig deeper in each other research areas and also to know each other more on personal background because only good research is not the only criteria but good personality in itself is also important to establish high valued scientific and personal contacts and relations.

The following days were full of great lectures on Machine learning and its biological applications to deal real life problems. Lecture on Quantum basis of gases and matter was also informative and motivating too.

Being a Biotechnologist and Bioinformatician, during the whole school, Machine learning was the most referred and followed topic according to my skill set and knowledge base. I enjoyed the lecture most.

After this school, I am curious to learn more and deeper concepts of Machine learning, Quantum Chemistry (Quantum Mechanics). These are crucial for my research and I would like to suggest to the organisers to include more of these concepts and also the exercises in the future events (more in the closed relation to the practical Biology).

Overall, the Twinfusyon summer school was considered a success. Certificates of attendance were given to all participants with a decent dinner.

More and more these kinds of schools should be organized often to develop the scientific boom for a realistic approach.

I would suggest incorporating some practical sessions too for a day or two so that students can understand in a deep and better way in a very simplistic and coherent manner.

 Thank You and Regards

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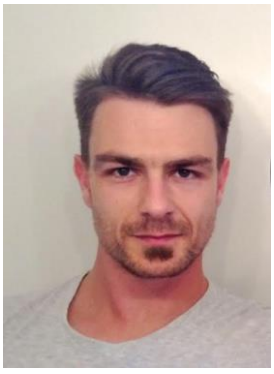
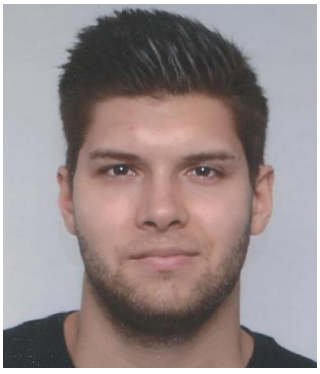
The opinion of a PhD students in Physics at JKU, Linz

Preface
This book will perhaps only be understood by those who have themselves already thought the thoughts which are expressed in it -- or similar thoughts. it is therefore not a text-book. Its object would be attained if it afforded pleasure to one who read it with understanding.

These are the first few lines of Ludwig Wittgenstein's *Tractatus logico-philosophicus*, but I deem them appropriate as a preface to the lecture notes I took during the summer school too. It all started rather harmlessly on Sunday, Prof Hingerl introduction to classical thermodynamics made us physics students all feel comfortable. How difficult can this get when it is meant for biologists, chemists and physicists alike, right? What followed was pretty sophisticated physics and "three semesters worth of stochastics condensed to two and a half days", to put it in our professor's own words. But this is not the whole story: Besides perceived countless hours sweating inside the lecture hall at best weather, trying to wrap one's mind around heavy stuff, we enjoyed captivating lectures most notably the ones about machine learning and interesting readily understood talks about statistics in neurosciences. While content-wise it felt a bit hodgepodge and unnecessarily detailed at times, the framework and organization were impeccable: From the warm and familiar atmosphere to the generous catering, the well-organized trip to Gmunden and lake Traunsee, and the engaging communal school dinner, it was all very enjoyable. We had plenty of opportunities to get in contact with one another in coffee breaks or at lunch and talk to people of various departments from a multitude of backgrounds. Though there were some rough edges that could do well with a smoothing, all in all it was a very worthwhile experience.

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