Supervisor	Project discription	Duration	Credit	Eligibility	Application Documents
Martin HOLLER, Institute of Mathematics and Scientific Computing	**Mathematics** The interdisciplinary research project "A machine learning approach towards data-driven cardiopulmonary resuscitation" at the University of Graz aims at developing novel machine learning techniques for understanding and improving the main factors of cardiopulmonary resuscitation that determine the outcome of out-of-hospital cardiac arrest cases. To this aim, the project can build on a rich data set of real-world vital data, such as electrocardiography (ECG) and accelerometer data, that was collected during the out-of-hospital treatment of cardiac arrest cases in Germany in the years 2013 - 2021. Based on this data, it was already shown in a first work [1] that machine learning algorithms are able to reliably predict the medical condition of patients from accelerometer and ECG data, even in situations where this is difficult for emergency physicians in the field. The offered summer research project will contribute to the above-described research project. It will focus on understanding, training and evaluating different machine learning algorithms for making prediction on the basis of the available data. In this context, topics that will be addressed are the mathematical background of machine learning algorithms, techniques for understanding the main factors causing a particular prediction (explainable AI), suitable techniques for choosing hyperparameters, and a systematic evaluation of machine learning algorithms based on test data. [1] https://arxiv.org/abs/2205.06540	12 weeks, May-July	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT and solid programming skills, ideally in Python	Resume Motivation letter Academic transcript
Quoc Bao TANG, Institute of Mathematics and Scientific Computing	**Mathematics** The research stay aims to get the bachelor student to get used to doing research by working on a concrete scientific problem.Topics of the research problem can be chosen from the followings: (1) Numerical simulations for stabilisation by boundary noise of partial differential equations: The interesting question of stabilisation by boundary noise has been investigated only recently. It is conjectured that with nonlinear boundary noise, it can either stabilise or destabilise a system. The project aims to numerically confirm that through simulations. (2) Global existence of reaction-diffusion systems with first order terms: The recent advances of global existence for mass conserved systems open a gateway to explore more general systems with similar structures. In this project, we investigate how the techniques can be extended with systems containing first order terms. (3) Pattern formation in evolving domains in two dimensions: It's a classical yet challenging topic to understand how patterns in nature arise. This project aims to see, through numerical simulations, how the evolution of the domain (e.g. body size) influences the emergence of patterns.	12 weeks (June - August 2023)	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT. The required qualifications depend on the topic that a student chooses. For topics (1) or (3), students are assumed to have some knowledge about numerical simulations for partial differential equations (using e.g. Matlab, Python, etc). Concerning topic (2), knowledge about partial differential equations is desired.	Resume Motivation letter Academic transcript
Christina KRAUSE, Institute of Mathematics and Scientific Computing	**Mathematics - Didactics** Students can propose their own research topics in the Didactics of Mathematics or choose from the reseach themes at the Dpt. of Mathematics. Research in qualitative educational research may involve: literature review, finding a research focus (small project), potentially data collection, data analysis, writing memos and potentially contribution in writing a research paper. Potentially contributing in designing / programming learning environments or learning material. Main areas of research are, among others, focusing on processes of teaching and learning mathematics, in particular concerning gestures and the role of the body in mathematical thinking and learning. One specific project concerns gestures of bilingual learners of mathematics or gestures of learners with different linguistic and cultural background. Another project concerns understanding better the cognitive processes of university students working our mathematics with worked examples. A third - international (across all continents) - project aims at developing teachers to design mathematical instruction that fosters a mindset for sustainability. Prof. Krause moreoever works with deaf students and how the use of sign languages influences their learning of mathematics and has generally a high interest in diversity (cultural, linguistic, sensory, motoric, neurological diversity) and inclusive mathematics education (more information on Prof. Krause's website: https://sites.google.com/view/christinakrause/home). A project led by my postdoc deals with bringing higher mathematics into schools.	8 weeks, May - July	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT A short description of potential interests in research in mathematics education, specifically with respect to those intersecting with the interests of the group at Uni Graz.	Resume Motivation letter Academic transcript
Cinzia SORESINA, Institute of Mathematics and Scientific Computing	**Mathematics** Nonlinear dispersal in population dynamics on networks: the goal is to explore the effect/consequences/advantages of nonlinear dispersal on the population size and spatial distribution. We are going to consider different type of graphs and population interactions.	8 or 12 weeks (May - July 2023)	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT Basic programming skills with Matlab or Python	Resume Motivation letter Academic transcript
Cinzia SORESINA, Institute of Mathematics and Scientific Computing	**Mathematics** Scale-invariance in pattern formation: we will look at how the bifurcation structure of reaction-diffusion systems modifies changing the size of the domain. We want to understand the influence of the size domain on the type of pattern and its biological interpretation in relation to the domain size. One benchmark problem is the cross-diffusion SKT model for competing species.	8 or 12 weeks (May - July 2023)	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT Bifurcations and bifurcations diagrams	Resume Motivation letter Academic transcript

Federica CAFORIO and Elias KARABELAS, Institute of Mathematics and Scientific Computing	**Mathematics** Personalisation of cardiovascular models: the cardiovascular function can be modelled by mathematical models integrating physical laws and known physiology. This enables to have access to important clinical biomarkers (e.g. pressure values) that are often unaccessible or impractical to measure non-invasively and better study the physiology and development of pathologies. However, in the perspective of personalised medicine, it is important to calibrate these models using patients' data, in order to optimise diagnosis and potential treatments. We will look at different approaches to perform model personalisation, combining biophysical models and machine-learning methods.	8 or 12 weeks, May - August	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT Basic programming skills with Python; basic knowledge of machine learning methods	Resume Motivation letter Academic transcript
Andreas HOHENAU, Institute of Physics	**Phyics** Collective lattice resonances (CLR) for refractive index sensing: CLR of metal nanoparticle arrays lead outstanding narrow extinction peaks. In this project, gold nanoparticle arrays will be fabricated by electron beam lithography and characterized for their performance as refractive index sensors by optical microspectroscopy. Tasks: Reading of introducing literature, fabrication and characterization of samples, preparation of a report on the results.	8 weeks, May - June	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study in Physics	Resume Motivation letter Academic transcript
Andreas HOHENAU, Institute of Physics	**Phyics** Light focussing with planar surface plasmon polariton (SPP) structures: Light can be coupled to surface plasmon polaritons on noble metal surfaces e.g. by gratings engraved to their surface. In this project, coupling structures that aredesigned to focus the excited SPP into a small spot shall be fabricted by electron beam lithography and tested for their performance by optical microscopy and atomic force microscopy. Tasks: Reading of introducing literature, fabrication and characterization of samples, preparation of a report on the results.	8 weeks , May - June	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study in Physics	Resume Motivation letter Academic transcript
Joerg FELDMANN, Institute of Chemistry	**Chemistry** Research Projekts in environmental or food chemistry or environmental analytical chemistry can be offered for the summer 2023. Students will be working in an international research group and will work with modern analytical equipment such as mass spectrometry to do trace analysis in biological and environmental samples such as waste water, wildlife or Alpine soil and snow. The students should commit themselves to 12 weeks and should have two years of university education in environmental science or chemistry. English is the spoken language in the working group.	12 weeks	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study in Environmental Science or Chemistry.	Resume Motivation letter Academic transcript
Melanie HALL, Institute of Chemistry	**Chemistry** The focus of the project lies in the field of biocatalysis, a discipline at the crossroad between organic chemistry, biotechnology and molecular biology. In our lab, we thrive to develop sustainable methods to make the synthesis of important molecules greener. The project may involve the use of enzymes for biotransformations, the production of engineered enzymes to improve the efficiency of the biocatalyst, or the synthesis of reference compounds needed to analyze the target biotransformation.	12 weeks	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT For students in the area of chemistry: completed laboratory course in organic chemistry with focus on the synthesis of organic molecules under state-of-the-art and safe working conditions OR for students in the area of molecular biology/biochemistry: completed laboratory course involving molecular cloning or biochemical assays	Resume Motivation letter Academic transcript
Margit HOEFLER, Institute of Psychology	**Psychology** Visual search describes the search for a target object (e.g., a pen) in a set of other objects (e.g., some pens in a box) and is one of the key paradigms to investigate attentional processes. In our research, we use eye tracking to investigate how, for instance, memory or inhibition of return are involved in visual search and how the search process is affected by interruptions. During the research stay, the student will be involved in all stages of the research process (planning & conducting eye-tracking experiments, data (pre-)analysis, literature search & documentation).	8 or 12 weeks	self-designed credit, no enrollment at Uni Graz	2.5 GPA min. 3 years of study at UofT.	Resume Motivation letter Academic transcript
Adam CLARK, Institute of Biology	**Biology** How have local grassland plant communities changed over the last century in response to urbanisation and global change? We will re-survey sites around Graz that were last surveyed in 1920, and test for differences in diversity and species composition. Sites range form urban to alpine, but are generally accessible by public transit. Students are also welcome to design and implement their own mini-projects during the summer to test their own research questions.	8 weeks, May - June	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT. Some experience with plant taxonomy or botany would be helpful, but is not required.	Resume Motivation letter Academic transcript

Monika OBERER, Institute of Molecular Biosciences – Structural Biology	**Molecular Biosciences - Structural Biology** Monika Oberer has long-standing expertise in combining structural biology with biochemistry, biophysics and molecular biology. The international, English-speaking group aims to establish mechanistic insights of proteins important in lipid metabolism. In light of the ongoing obesity panedemic our research is of critical importance from a medicinal point of view as well as considering the immense socio-economic burdens assosciated with metabolic diseases. The group studies proteins primarily from eukaryotes, but also from (pathogenic) bacteria. The laboratory has contributed important insights into the structure-function relationship and domain architecture of adipose triglyceride lipase, its co-activator CGI-58, and its inhibitory proteins G0S2 and HILPDA. The group also successfully determined the structures of lipid hydrolyzing carboxylesterases (Ces2 family) and monoacylglycerol lipases in their native form and in complex with substrates and inhibitors. The incoming research will participate in ongoing research tasks. The specific aspects will include cloning, protein expression from bacterial and mammalian cells, protein purification, activity assays, protein crystallization and bioinformatic analysis. Our publications can be viewed online in PubMed (search term ' Oberer M').	12 weeks, May-July	Nominated students must enroll in a UofT research course	2.5 GPA min. 3 years of study at UofT.	Resume Motivation letter Academic transcript