

Name of the supervisor	Title of the thesis	Short description of the work	To which students does the supervisor recommend the topic?	E-mail
Csaba Gáspár	The Method of Fundamental Solutions for solving Laplace equation.	The method is a special meshless method which requires neither domain nor boundary mesh structure. In the thesis, the mathematical steps of the method should be outlined through the example of the 2D Laplace equation. The method should be illustrated through several test examples, reflecting to the exactness as well as the main numerical properties of the method.	The topic is recommended to students who are interested in mathematical modelling of physical processes as well as in numerical solution of partial differential equations.	gasparcs@math.sze.hu
Csaba Gáspár	The Method of Fundamental Solutions for solving nonhomogeneous problems.	This method provides the solution of the original nonhomogeneous partial differential equation (e.g. the simplest Poisson problem) as a sum of homogeneous solution and a particular solution. The homogeneous solution can be calculated by the classical Method of Fundamental Solutions, while a particular solution can be constructed by some scattered data interpolation technique. In the thesis, the mathematical background should be outlined in details. The method should be illustrated through several test examples, which demonstrate the numerical abilities and the computational properties of the method.	The topic is recommended to students who are interested in mathematical modelling of physical processes as well as in numerical solution of partial differential equations.	gasparcs@math.sze.hu
Tamás Hajba	Comparing solution methods of the clustered traveling salesman problem	The clustered traveling salesman problem is a generalization of the traveling salesman problem where the nodes are divided into clusters and the cities of each cluster must be visited contiguously. In the thesis different mixed integer programming models of the problem should be introduced and furthermore a heuristic chosen from the literature should be implemented. The efficiency of the mathematical models and the heuristic should be compared through text examples.	The topic is recommended to students who completed Linear Optimization.	hajbat@sze.hu
László Környei	GPU programming with OpenMP	OpenMP 4.5 introduced support for GPUs. However, question remains how efficient it is to use this API, and what kind of performances can be achieved. The work consist of taking some basic or optimized CPU implementations of a predefined problem, parallelizing it with OpenMP and CUDA, measuring speedup and implementation time.	The topic is recommended to students who completed HPC technologies and are interested in GPU programming	laszlo.kornyeyi@math.sze.hu
Lotfi Abdelhakim	Development and application of reduced-order modeling for thermal simulation	Many physical phenomena such as heat transfer, fluid flow and mechanical deformation are modeled by partial differential equations (PDE). Traditional discretization techniques for PDEs, such as Finite Elements (FE), Finite Volumes (FV), finite difference (FD) methods, lead to very high-dimensional systems. Numerical algorithms used to compute the approximated solutions may lead to very high computational costs and storage requirements. Reduced-order modeling techniques (ROM) aim to replace the high-dimensional problems with low-dimensional models, which can significantly decrease computational demands. This work focuses on constructing reduced order model using proper orthogonal decomposition (POD), the application of developed method to thermal problems and the study of the performance of the proposed approach in terms of accuracy and speed-up with respect to full order model. All simulations in this work must be developed through the Python interface of the finite element platform FEniCS.	This work is recommended to students who have passed the following courses: Numerical methods for differential equations and Model order reduction.	lotfi@math.sze.hu
Zoltán Horváth	Development of a simulation digital twin for compressible fluids	The student shall develop a code for the simulation of compressible fluids (e.g. compressible Euler equations). The simulation is requested to be parallelly efficient. A model reduction method shall be applied (e.g. POD-DEIM), sensor inputs can be either one of the real sensors of the university or sensor data shall be simulated. Investigation of different machine learning based methods for the classical interpolatory tasks is an optional task of the thesis work. The developed code shall be applied to a problem of interest in industrial environmental or other application.	This topic is recommended to students familiar with the digital twin approach, numerical linear algebra (SVD algorithms and codes), numerical methods for differential equations at advanced level. Several students may work in collaboration for one actual digital twin implementation with clearly separated tasks.	horvathz@math.sze.hu
Pusztai Pál	Development of an educational software for Christofides algorithm	Design and develop a software for educational purpose that is able to show and teach for the students the Christofides algorithm. It is an approximation algorithm that is used to solve a special case of the Traveling Salesman Problem.		pusztai@sze.hu
Pusztai Pál	Development of an educational software for the k-patching methods	Design and develop a software for educational purpose that is able to show and teach for the students the k-patching methods. These heuristics are used to solve the Traveling Salesman Problem.		pusztai@sze.hu