Summer University 2017

Ural Federal University
Russia, Ekaterinburg
12 June 2017-23 July 2017

Location	***Project name***	***Short description (2-3 sentences)***	***Prerequisites***	***Name of Professor/mentor of the Project***	***Number of students for each project***	***Possible company/Laboratory for practice***
Electrical engineering						
Yekaterinburg	Electric energy metering information verification	Mathematical processing of automated electric energy accounting systems data for "bad data" identification and accounting system online monitoring	Knowledge in "Electrical circuits theoretical basis", "Metrology"	Kochneva E.S.	up to 4	LLC «ProSoft – Systems»
	Technical state assessment and power equipment diagnostics	Power transformer technical state assessment using different technical diagnostics data.	Knowledge in "Electrical machines"	Khalyasmaa A. I., associate professor at the "Automated electrical systems" department, Ural power engineering institute, Ural Federal University	up to 4	LLC «Technical analytics»
	Intelligent automated systems of substation equipment technical state identification	Intelligent automated system development for power system equipment technical state identification. Power equipment state assessment models are to be developed for	Knowledge in "Electrical part of substations	Khalyasmaa A. I., associate professor at the "Automated	up to 4	LLC «AES TechLine»

		each specific unit under consideration, taking into account hardware configuration, physical processes and possible external influences.	and power stations"	electrical systems" department, Ural power engineering institute, Ural Federal University		
	Power system strategic development plans	Formulation of perspective power network and generation capacities development plans for regional power systems, basing on steady-state and transient operation modes calculations. Technically feasible alternatives are compared using economic efficiency analysis.	Knowledge in "Electrical part of substations and power stations", "Power networks operation modes", "Transient modes calculations"	Eroshenko S.A., leading engineer at the "Automated electrical systems" department, Ural power engineering institute, Ural Federal University	up to 4	LLC «AES TechLine»
	Designing the Distributed Generation	The project is concerned with design and development of all kinds of distributed generation, including hydrocarbon-based and renewables. Both technical and economic aspects are considered. The technical aspect includes power and energy output calculation, CHP design, relay protection and automation, grid interconnection and islanding. The economical part provides a review and calculation of the actual distributed generation economic effect.	Knowledge in "Relay Protection", "Electric energy generation and power networks"	Samoilenko V.O., engineer at the "Automated electrical systems" department, Ural power engineering institute, Ural Federal University	up to 4	Scientific and Technical Center of Unified Power System (JSC «STC UPS»)

	Short-circuit calculations approaches for bulk power systems	The project is connected with the problem of real power systems short-circuits calculations, which are used for power equipment rated parameters correspondence assessment. The issues of short-circuits forecasting are addressed. Technical part is followed by economic calculations.	Knowledge in "Relay Protection", "Electric energy generation and power networks" "Transient modes calculations"	Eroshenko S.A., leading engineer at the "Automated electrical systems" department, Ural power engineering institute, Ural Federal University	up to 4	LLC «AES TechLine»
Computer Science, IT						
Yekaterinburg	Deep Learning for image analysis	Deep Learning nowadays is the most popular machine learning algorithm. The students will use convolutional neural network to recognize objects on images such as cats, dogs, cars, and planes. Popular deep learning frameworks Keras and Theano will be used.	• Ability to write code using Python • Knowledge of Python scientific computing libraries: numpy, scipy, matplotlib, etc. • Linux. • Basic knowledge of statistics. • English language: B1+; B2.	Andrey Sozykin, PhD in Computer Science (Candidate of Science), Head of High Performance Computing Technologies Academic Department	*Up to 8*	*E.g. SKB-Kontur, Yandex.* Companies and real cases will be offered upon the group work.

	Implementing k-means clustering on parallel computing systems	K-means is one of the most popular machine learning algorithm for clustering. In Big Data era, we need a k-mean implementation for parallel computing system with several CPU cores in order to speedup the computations. The students will create the parallel version of k-means using the OpenMP programming technology for shared memory system.	• Ability to write code using C or C++. • OpenMP programming technology. • Linux. • English language: B1+; B2.	Andrey Sozykin, PhD in Computer Science (Candidate of Science), Head of High Performance Computing Technologies Academic Department		*E.g. SKB-Kontur, Yandex.* Companies and real cases will be offered upon the group work.
	Parallel image convolution	Image convolution is one of the most popular image processing operation. It allows blurring or sharpening the image, detect ages and so on. To process large images, such as satellite or aerial images, parallel computing is required. The aim of the project is to build the parallel convolutional program for modern multicore CPU using OpenMP programming technology and vectorization.	• Ability to write code using C or C++. • OpenMP programming technology. • Linux. • English language: B1+; B2.	Andrey Sozykin, PhD in Computer Science (Candidate of Science), Head of High Performance Computing Technologies Academic Department UrFU	*Up to 8*	*E.g. SKB-Kontur, Yandex.* Companies and real cases will be offered upon the group work.
	Analyzing the US patent citations	Nowadays, big graph processing is one of the popular task in the analysis of the Internet, social networks and so on. The students will create the program that will process the US patent citations SNAP dataset. MapReduce parallel computing technology will used to speed up the processing.	• Ability to write code using Java or Python • Apache Hadoop or Spark • Linux.	Andrey Sozykin, PhD in Computer Science (Candidate of Science), Head of High Performance Computing Technologies	*Up to 8*	*E.g. SKB-Kontur, Yandex.* Companies and real cases will be offered upon the group work.

			• English language: B1+; B2.	Academic Department UrFU		
	High performance computing: data access methods in DBMS	Please keep in mind, this list is small fraction of real tasks. Set of these tasks changes constantly as hackers advance the project. But be sure, there is plenty of work to do. To make a world better. To prove your skills with visible change of the world. Your project is finished with publication of a patch to PostgreSQL commitfest, and, ideally, it is committed to upstream and released with the next major version. With project for PostgreSQL you can also file application to Google Summer of Code project, but it shall be done promptly. Or next year. **Projects examples**: 1. Generalized search trees (GiST) enhancements. Implementation of new algorithms for multidimensional search in GiST extensions. 2. Index only count. Currently some queries can't benefit from index-only scans when all necessary data is inside the index. But aggregation, event count computation is done through access to heap, this shall be fixed. 3. Merge-Join operations with not only equality operators. Currently	We expect students familiar with general database concepts, some experience in writing SQL queries and programs in C. Developer tasks require skills in git source control system. Experience in Linux programming will help to ramp up learning quickly.	*Andrey Borodin, Ass. Prof. of the Department of Information Technologies and Automatization UrFU, Leading engineer at the Department of Structural Mechanics UrFU*	*Up to 3*	*E.g. SKB-Kontur, Yandex, Naumen, Host, EastWind etc.* Full list of companies and real cases will be offered upon the group work.

		Merge-Join can be executed only for '='. 4. EXPLAIN ANALYZE for running query. Functionality to output real plan of a query being executed.				
Civil engineering						
Yekaterinburg	Steel bridge	This project is about designing of single-span bridge main elements and joints. The bridge can be road bridge, railroad bridge or foot over bridge.	• Structural analysis • English language: B1+; B2 • Basic knowledge of Architecture or Civil Engineering	*Z.V. Beliaeva,* Candidate of Technical Science Degree (equiv. PhD), Lecturer, Structure Design Specialist at UrFU	*Up to 12*	*"Effect-Project", "Red-group", "ProjectStalKonstructsia"* Companies and real cases will be offered upon the group work.
	Industrial building	This project is about designing of steel frame main elements and joints. Industrial building can be one-store or multiple store.	• Structural analysis • English language: B1+; B2 • Basic knowledge of Architecture or Civil Engineering	*Z.V. Beliaeva,* Candidate of Technical Science Degree (equiv. PhD), Lecturer, Structure Design Specialist at UrFU	*Up to 12*	
	Precast concrete structures of multiple store building	This project is about designing of precast slab, beam, and column. Building is multiple store.	• Structural analysis	E.A. Redikultsev, Sen. Lecturer of the Department of Structural	*Up to 12*	

			• English language: B1+; B2 • Basic knowledge of Architecture or Civil Engineering	Engineering UrFU, Director of the Company "Effective Engineering"		
	Reinforced concrete building	This project is about designing of flat slab and column. Building can be one-store or multiple store.	• Structural analysis • English language: B1+; B2 • Basic knowledge of Architecture or Civil Engineering	E.A. Redikultsev, Sen. Lecturer of the Department of Structural Engineering UrFU, Director of the Company "Effective Engineering"	*Up to 12*	
	Other examples: Steel portal frame of single-store industrial building, Steel lattice tower		• Structural analysis • English language: B1+; B2 • Basic knowledge of Architecture or Civil Engineering			

Mechanical engineering						
Yekaterinburg	Design and Automation of Overhead Crane and its Components	This project is about designing, automating, controlling and optimizing overhead cranes, their components and operation in any automated manufacturing or warehouse facilities where various tasks of lifting and transporting heavy loads need to be managed	Engineering Mechanics, Strength of Materials, Computer-aided Design, Theory of Machines and Mechanisms, Machine Parts, Information Technologies	Ass. Prof. Olga A. Lukashuk Candidate of Engineering sciences, Chairman of the Department of Machine Building "Lifting and carrying machines and robots" Sen. Lec. Konstantin Y. Letnev Senior lecturer of the Department of Machine Building "Lifting and carrying machines and robots"	Up to 10	IT classroom, Laboratory of Lifting Machinery *Possible companies upon availability: Ural Locomotives, Uralmash, Ural Turbine works, Pervouralsk Pipe Plant, Saint-Gobain Abrasives Rus, KUKA, FANUC*
	Calculation and Design of Flexible Gripper for Industrial Robot	This project is about calculating and designing a flexible pneumatic (membrane) or mechanical gripper to be used as the end effector of an industrial robot for grasping, moving and placing machine parts of various forms and weights in any automated manufacturing	Engineering Mechanics, Strength of Materials, Computer-aided Design, Theory of Machines and Mechanisms, Machine Parts,	Sen. Lec. Valentina A. Ovchinnikova Senior lecturer of the Department of Machine Building "Metal-cutting machines and tools"	Up to 6	IT classroom, Laboratory of Robotics *Possible companies upon availability: Ural Locomotives,*

			Information Technologies			*Uralmash, Ural Turbine works, Pervouralsk Pipe Plant, Saint-Gobain Abrasives Rus, KUKA, FANUC*
	Calculation and Design of Flexible Manufacturing Systems for Production Floors	This project is about developing, refining and automating production technologies, workcells and flexible production lines designed for manufacturing products of variable range (Industry 4.0 type), while using Roboguide simulation software to design a proper adaptive system	Engineering Mechanics, Strength of Materials, Computer-aided Design, Theory of Machines and Mechanisms, Machine Parts, Information Technologies	Sen. Lec. Valentina A. Ovchinnikova Senior lecturer of the Department of Machine Building "Metal-cutting machines and tools"	Up to 6	IT classroom, Laboratory of Robotics *Possible companies upon availability: Ural Locomotives, Uralmash, Ural Turbine works, Pervouralsk Pipe Plant, Saint-Gobain Abrasives Rus, KUKA, FANUC*
	Design of Working Rolling Mill Stand Components for Longitudinal Rolling	This project is about designing components of rolling mills used for longitudinal rolling, optimized for increased load-duty and adaptable for new product types, while using computer-aided engineering (CAE) software to model, stress and analyze them	Engineering Mechanics, Strength of Materials, Computer-aided Design, Theory of Machines and Mechanisms,	Ass. Prof. Artem A. Fedulov, Candidate of Engineering sciences, Associate Professor of the Department of	Up to 2	IT classroom *Possible companies upon availability: Ural Locomotives, Uralmash,*

			Machine Parts, Information Technologies	Machine Building "Metallurgical and rotary machinery"		*Ural Turbine works, Pervouralsk Pipe Plant, Saint-Gobain Abrasives Rus, KUKA, FANUC*
	Design of Disk Brakes for Passengers Cars	This project is about developing an active torque-transfer system, calculating its basic parts and brake actuator, building 3D-models of designed mechanisms, selecting components and finding best technical solution in terms of efficiency of brakes	Engineering Mechanics, Strength of Materials, Computer-aided Design, Theory of Machines and Mechanisms, Machine Parts, Information Technologies	Sen. Lec. Anastasia A. Akulova Senior lecturer of the Department of Machine Building "Lifting and carrying machines and robots"	Up to 4	IT classroom, Laboratory of "Formula Student" Team *Possible companies upon availability: Ural Locomotives, Uralmash, Ural Turbine works, Pervouralsk Pipe Plant, Saint-Gobain Abrasives Rus, KUKA, FANUC*
	Design of Manual Gearbox for Passenger Cars	This project is about designing a reliable and efficient manual gearbox for a passenger car with specific performance characteristics by means of analyzing typical gearbox designs, estimating vehicle power requirements, determining torque-engine speed characteristics, selecting gear ratios for	Engineering Mechanics, Strength of Materials, Computer-aided Design, Theory of Machines and Mechanisms,	Sen. Lec. Anastasia A. Akulova Senior lecturer of the Department of Machine Building "Lifting and carrying	Up to 4	IT classroom, Laboratory of "Formula Student" Team *Possible companies upon availability:*

		required power conversion, plotting proper traction diagrams	Machine Parts, Information Technologies	machines and robots"		*Ural Locomotives, Uralmash, Ural Turbine works, Pervouralsk Pipe Plant, Saint-Gobain Abrasives Rus, KUKA, FANUC*
	Design of Assemblies and Components for Metal Forming Lines	This project is about designing main assemblies and subassemblies of metal forming lines which use mechanical deformation to reshape workpieces without adding or removing material, while using computer-aided engineering (CAE) software to model, stress and analyze them	Engineering Mechanics, Strength of Materials, Computer-aided Design, Theory of Machines and Mechanisms, Machine Parts, Information Technologies	Ass. Prof. Artem A. Fedulov, Candidate of Engineering sciences, Associate Professor of the Department of Machine Building "Metallurgical and rotary machinery"	Up to 6	IT classroom *Possible companies upon availability: Ural Locomotives, Uralmash, Ural Turbine works, Pervouralsk Pipe Plant, Saint-Gobain Abrasives Rus, KUKA, FANUC*
	Development and Visualization of Mathematical Model for Single-channel Control of Manipulating Industrial Robot	This project is about developing a mathematical model for smooth single-channel control of an industrial robot with two or three degrees of freedom, creating its proper kinematic diagram and synchronous control algorithm, visualizing the model for the task of transferring loads from a defined initial	Engineering Mechanics, Strength of Materials, Computer-aided Design, Theory of Machines and Mechanisms,	Ass. Prof. Svetlana A. Berestova Doctor of Physical and Mathematical sciences, Chairman of the	Up to 8	IT classroom, Laboratory of Robotics *Possible companies upon availability: Ural*

		position to a final one, while using Mathcad engineering software to build and render those	Machine Parts, Information Technologies	Department of Basic Education "Theoretical Mechanics"		*Locomotives, Uralmash, Ural Turbine works, Pervouralsk Pipe Plant, Saint-Gobain Abrasives Rus, KUKA, FANUC*