Accomodation + 400.-/month is paid for. Thesis / Internships last 5-6 months.
The applicant must be selected by the Home University, who will nominate the candidate to HEIG-VD for acceptance.
Applications (CV + Transcript of records + Desired period to begin) coming directly from the student will not be considered !

CIVIL, ENVIRONMENTAL, BIO- ENGINEERING AND GEOMATICS		
Geoparser **Prof J. Ingensand**	In this project, we would like to associate a newspaper article with a place name. Geoparsers are used to retrieve place names in a text. The first part of the project is the review and testing of existing geoparsers. Second, the articles of an entire database are georeferenced with a place name. Finally, a web map dedicated to articles mining is implemented. Two visualisation modes are provided, points and spatial density. Moreover, a time slider allows the user to assess the activity hot spots.	**Keywords: Cartography, geographic information, augmented reality**
Maturity methods for structural concrete **Prof. M. Viviani**	A timely knowledge of concrete strength is possible through the strength-maturity curves. Preparation of these curves requires time-consuming and labor-intensive testing prior to the field operations. The production rate in field and in prefabrication plants depends on the number of molds, shores, supports and equipment available as well as the time needed to complete a production cycle. A new technique to develop strength-maturity curves has been developed at the HEIG-VD. It is based on a semi-adiabatic calorimetric method that does not need calibration of the apparatuses. In this context, the thesis proposed aims to validate the new method by isothermal calorimetry and by ASTM 1074 procedure. **Keywords: Maturity of concrete, calorimetry, strength prediction**	**Students in Civil engineering and Material sciences with strong interest for lab tests and modelling**

Evolution of reinforcement bond strength of structural concrete **Prof. M. Viviani**	Concrete hardens at a speed that depends on time and temperature. Since most of the physical properties of concrete are related to the compressive strength (also by codes), the gain of strength is of a capital importance in structural engineering. The demoulding time of a newly poured structure vary between few hours and 14 days. For normal reinforced concrete, 14 days is already considered too much time. Demoulding implies (most of the time) to take out the shores and therefore load a structure whose concrete have not reached yet maturity. In this context, the thesis proposed aims to determinate the bond strength and the flexural (traction) strength of concrete as it hardens. This will help to clarify if the concrete compressive strength evolves similarly to the tensile and the bond strength as a function of the degree of hydration. The final objective is to determine if an early demoulding of a structural element can reduce the ultimate carrying capacity. **Keywords: Recycled concrete, reinforced concrete, strength, maturity, degree of hydration**	**Students in Civil engineering and Material sciences with strong interest for lab tests and modelling**
Using public picture collections for the determination of interest in spatial features **Prof J. Ingensand**	Millions of people take pictures with GPS enabled devices such as smartphones every day. The GPS coordinates of these pictures are saved with the pictures. Behind every photo there is a reason why it has been taken. With the coordinates of a photo collection, it is possible to say that certain places are more interesting than others (e.g. because more photos have been taken at one place than at another place). There are also existing methods that are capable of detecting the angle of view of a photo using DEMs. With the coordinates and the angle of view, the contents of a photo can be analysed, e.g. using databases containing roads, buildings, mountains, etc. This method enables the establishment of zones of interest (e.g. no photos in the area or area only visible in the distance= area not very interesting). These zones of interest can be used for instance for finding spots for wind turbines (=> no photos in the area or only visible in the distance) or for determining scenic routes, etc. Technically the method could be implemented as follows: Online photo collections such as flickr or panoramio have APIs (http://www.panoramio.com/api/data/api.html) to extract photos for given coordinates (e.g. Google uses this functionality in Google Earth). These photos can be used for the detection of the angle (e.g. https://www.youtube.com/channel/UC3A4_-OEqktq4jKsMETGWbw). Another possibility for the detection of the angle are stereoscopic methods (e.g. using IGN's Micmac). Once the angle of view has been detected, several data layers could be used for the analysis of interest (POI's roads, buildings,..)	**Keywords: VGI (Volunteered Geographic Information), spatial data analysis** **Requirements: programming skills (Python or similar), GIS, spatial data**
Establishment of rules for the display of geographic information in augmented reality applications **Prof J. Ingensand**	For traditional maps well-established cartographic rules exist (e.g. point-line-symbols for common features such as railroads, waterbodies, POI or rules for the utilization of colors, shapes and labels). Augmented reality (AR) applications are a recent trend in geographic information sciences and few publications regarding rules and recommendations for the display of geographic information in these kind of applications exist. The main goals of the suggested project are to: - Identify differences between traditional cartographic rules: (including paper maps, and computer-based interactive maps) and AR applications - Identify which traditional rules can be re-applied, which rules need to be adapted; for which cases no rules exist.	**Requirements: Programming skills (e.g. HTML5/Apache Cordova/Wikitude)** **Scientific research skills (literature review)**

	Suggestion of rules Other important objectives are: - Comparison of existing encoding standards (e.g. SLD) vs the identified rules: how to adapt an existing standard in order to standardize symbology encoding in AR applications - Development of a prototype based on existing technologies in order to test rules. - Validation of suggested rules with test users **Keywords: Cartography, geographic information, augmented reality**	
Development of a method to characterize torrefied biomass by color. **Prof J-B. Michel** **Assistant M. Mc Cormick**	Torrefaction is a thermal treatment process that improves the combustion properties of woody biomass. The color of the biomass changes form light to dark brown during torrefaction. Changes in the color due to torrefaction of biomass might be correlated with process parameters such as product calorific value, dry mass loss and hemicellulose content. In this context the proposed thesis aims to identify thermal treatment process parameters that can be correlated with the color of the torrefied product.	**Student profile :** **3rd year Bachelor or Master student in chemistry or material sciences and having an interest in optical characterization techniques**
Spatial Runner **Prof J. Ingensand**	Running is an activity that many people exercise using a smartphone application. Today such applications enable users to track their paths, to play music and to suggest trainings specific for their needs. Often runners follow the rhythm of the music and use the music in order to get into a specific pace. Music thereby can potentially increase or decrease running speed. The goals of the suggested project are to : 1) investigate the influence of music on running pace 2) identify ways to select music depending on runners preferences in terms of taste and condition 3) suggest routes and corresponding music that take into account pace as well as length and slope of a road graph. The objective is to build a prototype that can be tested in the field.	**Requirements:** **Spatial databases (e.g. PostGIS), Road graphs and routing, Software to analyze music, programming skills (e.g. Python or Java)**
Camera Restricta **Prof J. Ingensand**	The project presented by Phillipp Schmit is a camera which does not allow the user to take pictures in area were many pictures are already shot. The camera is connected to Flickr and Panoramio and check the number of images shared around the camera's GPS location. Following a similar idea we would like to developp a smartphone app. The main difference would be that our database of images also store the compass direction. Hence, the app will only allow the user to shot a picture if the point of view is original.	

INFORMATION TECHNOLOGY AND COMMUNICATION (TIC)		
Game-based learning and interactive environments to learn SQL spatial queries **Prof O. Ertz**	There are some special web sites and applications focused on learning to code SQL (e.g. Schemaverse or SQL Island offer a gamified SQL learning experience). The major point is that all these initiatives do not tackle SQL spatial to manipulate geographic objects. Data analysis through SQL spatial queries requires to learn about specific data types and thematic, geometric and topological operators, etc. Therefore, this project wants to explore new ideas and interactive environments, from interactive tutorials to game principles and simulations to reach the training goal of learning SQL spatial. The main focus concerns (1) the design of "storylines" that illustrates with a game flavor the use and usefulness of geometric and topological queries (e.g. extend the storyline of SQL Island - www.sql-island.de - with a geospatial context) . The project aims also at (2) the development of at least one prototype to illustrate the result of the study. This work would require to consider existing systems that facilitate the development of serious games. **More information on the project**	**Keywords: serious games, interactive environments, SQL, spatial queries, user experience**
Development of various UI applications on Android tablet PC & Smartphones **Prof D. Rossier**	New embedded applications developed on a particular technology named SOO (Smart Object Oriented) will run into dedicated devices endowed with wireless interfaces (WiFi, BT). In order to monitor the activities of these devices and to provide applications with adequate user interfaces (GUI) based on Qt, an application interacting with the devices need to be developed (Android, tablet PC). The project is realized in collaboration with Sootech Ltd, a spin-off Company issued from the HEIG-VD (REDS Institute). Further details will be given in case of interest.	**Student from Computer Science or Embedded Systems Major** **Strong knowledge of low-level C programming, ARM assembly if possible**
Improvement of user experience in a serious game authoring system and in existing serious games **Prof D. Jaccard**	We have developed a serious game authoring system and many different serious games (www.albasim.ch). Most of them may be improved from the user experience point of view.	**End of Bachelor or Master student in Computer sciences.**
Sensor network for atmospheric and environmental data **Prof M. Rubinstein**	In this project, the student will develop a wireless sensor network based on Raspberry Pi or other platform. The sensor network will be used to collect data on atmospheric and environmental conditions in low income countries.	**Keywords: Communications. Wireless Sensor Networks. OSI model**

Study of 802.11ac and 802.11ad **Prof M. Rubinstein**	Wireless local area networks are based on the IEEE 802.11 standard and its amendments. Two recent amendments, 802.11ac and 802.11ad, increase the speeds up to the Gigabit/s range. In this project, the student will perform an experimental and biographical study of those two amendments.	**Keywords: WiFi, WLAN, 802.11, protocols, communications.**
Deep Learning for image processing **Prof A. Perez-Uribe**	Deep neural networks have shown to be very good at image classification tasks. We have been developing a system (http://www.terra-i.org) to monitor deforestation of the tropical forest in South America in collaboration with the CIAT international center for Tropical Agriculture, King's College and Global Forest Watch. Our next step is to extend such a system to cover the whole tropical zone with the aim of identifying "hot spots" of future deforestation in those regions and to develop an early-warning system. Within the framework of this project, we will use Deep networks to recognize not only forest and no-forest classes, but different land-uses and particularly the presence of cashcrops. More information	**Keywords: Deep Neural Networks, image processing, Machine Learning**
Personal mobile coach **Prof A. Perez-Uribe**	The increasing availability of wearable sensors embedded in smartphones, watches and physical activity trackers has open the door to original applications, mainly in health and wellness improvement. One typically collects data by means of sensors like GPS, accelerometers, gyroscopes, barometers, microphones, cameras, depth sensors, etc. To make sense of these data, Machine learning algorithms can be used to establish correlations among the variables under investigation, and as in every attempt to understand high-dimensional data, visualization and dimensionality reduction techniques can suggest new knowledge about the aspects of the person's life being monitored. The objective of this project is to deal with diverse application domains including self-tracking of physical activity, self-tracking and characterization of style and performance in sport (e.g., racket sports, running), daily-life logging and upcoming ideas for managing human digital memories, 24/7 monitoring of patients empowering personalized and tele- medicine. More information	**Keywords: wearable sensors, smartphones, smartwatches, time-series, machine learning, health, sports**
Diverse projects in machine learning applied to life sciences **Prof C. Peña**	Our group, Computational Intelligence for Computational Biology (CI4CB), applies machine-learning methods to solve hard data-driven problems in life sciences (e.g., diagnostic decision, biomarker discovery, personalized health). Different projects are available that address this specific kind of applications. The exact subject would be discussed and defined with the interested student prior to the beginning of the training period. **Keywords: Machine learning, Software development, Data analysis and modelling.**	**Only Master students in Computer Science, Electrical Engineering or Bioinformatics only, notions of Machine Learning and Python.**

Human-humanoid interaction **Prof A. Perez-Uribe**	The current availability of the first humanoid robots at moderate prices opens up a wide range of applications. The objective of this project is to program a humanoid robot or a human-humanoid interface using Kinect cameras. Potential applications include telepresence at the entrance of malls, hospitals or hotels. For more information: http://iict-space.heig-vd.ch/ape	**Keywords: Humanoid robots, human-humanoid interfaces, Kinect, image processing, machine learning**
Software development for the Internet of things **Prof J. Ehrensberger**	The Industrial Internet of Things is considered the 4th revolution in the field of manufacturing (Industry 4.0) with its goal to develop Smart Factories. One important element of this vision is to enable production machines to communicate with a central control system or among each other. The goal of this project is to develop a system that allows a mobile phone to communicate with a production machine in order to read data from the machine or to update the firmware on the machine. The production machine is already equipped with a WiFi interface.	**Required skills:** **• Software development, ideally on mobile phones (Android, iPhone)** **• Knowledge of wireless networking (Wifi, Bluetooth)** **• Ideally, basic knowledge of programming such microcontrollers as PIC**
Sharing cartography: from conceptual design to implementation **Prof O. Ertz**	Cartographic portrayal interoperability requires a common cartographic language that favors the sharing of cartographic visualisations between distributed systems and rendering engines. Currently, this topic is covered by one standard known as the Symbology Encoding specification at the Open Geospatial Consortium (OGC SE in below). Unfortunately, since it's first edition in 2005, it is nowadays almost obsolete. In other words, it is unable to answer all the new requirements which have appeared in ten years of evolution of cartography using web technologies. Therefore, the authors of this proposal have recently elaborated a conceptual model - http://heig.ch/rutsu - to be considered as the base of a major revision and improvement of OGC SE. Based on this conceptual design, the main focus of this project is to (1) define the default encoding rules based on XML technologies (definition of XSD schemas so as to be able to describe a cartographic visualisation using XML encoding). Also, considering a proof-of-concept that has been started with the OrbisGIS platform - http://se.orbisgis.org, the work would then also require (2) the implementation within this platform of new cartographic capabilities introduced by the conceptual design.	**Keywords: standardization, cartography, computer graphics, XML/XSD design patterns**

Diverse projects in machine learning-based data analysis and modelling **Prof C. Peña**	Our group, Computational Intelligence for Computational Biology (CI4CB), conceives, develops, and integrate a palette of machine-learning methods intended to solve engineering problems in different application domains (e.g., biomedical research, diagnostic decision, agriculture, energy management, etc.). Different projects are available that address either or both methodology and applications. The exact subject would be discussed and defined with the interested student prior to the beginning of the training period. **Keywords: Machine learning, Software development, Data analysis and modelling.**	**Only Master students in Computer Science, Electrical Engineering or Bioinformatics only, notions of Machine Learning and Python.**
Methods for modelling biological-network data **Prof C. Peña**	The goal of this project is to apply bio-inspired methods to model biologically-relevant networks (i.e., metabolic, genetic, etc.) based on existing data. The validity of the developed approach, as well as the quality of the resulting models will be tested using artificial and real data. Context: Pharma and biotech industries seek continuously for new methods to better understand disease mechanisms. One of the most recent trends in this quest is to study complex networks of interactions between the different kinds of entities present in life beings: e.g., genes, proteins, metabolites. Such an approach produces new kinds of data which demand developing new tailored data processing and modelling techniques. **Keywords: Network modeling, Machine learning, Computational biology, Bioinformatics**	**Only Master students in Computer Science, Electrical Engineering or Bioinformatics only, notions of Machine Learning and Python.**
Hunting down vulnerabilities in Internet-of-Things **Prof A. Karlov**	Internet of Things (IoT) is an emerging global technological concept where millions of objects monitoring our daily life are connected to the Internet. Unfortunately very often the manufacturers neglect the security and information technology risks during the development lifecycle. Recently it has led to several big security incidents resulting in Denial of Service (DoS) attacks or compromise of personal user's data. Some simple security bugs can be found by inspecting the configuration of the device (i.e. use of weak passwords) but finding advanced software bugs requires additional techniques. One such mean is fuzzing which is the process of providing randomised inputs to the device, its interfaces as well as APIs and observing its behaviour. If the device crashes it means the corresponding code can not correctly process the input and therefore a potential vulnerability might be present. The fuzzing process practice which starts to be quite often used to find bugs in software. However it is still quite niche for embedded devices. Several specific fuzzers, like Peach, which are targeted towards embedded computing start to appear. The main difficulty of embedded fuzzing is to get back the state of the device as well as the error trace in case the device crashes. One of the goals of the project is to design and propose a fuzzing workbench (it can be based on a specific fuzzer) and test it against a given embedded device. Another goal is to study the possibility of emulation of the embedded device firmware taking care of its IO interfaces. A successful result can lead to a publication in an international conference. **The candidate is expected to start in September 2017, but the timeline can be adapted with respect to academic**	**Interest for computer security & embedded devices Good knowledge of embedded computing (IO, buses, interfaces) Fair knowledge in reverse engineering and software exploitation Knowledge of related tools (e.g. IDA Pro, gdb, WinDbg, AFL, Radare2) Good programming**

	requirements of the partner University.	**skills (C/C++, Python, Assembly low-level programming)** **Participation in CTF security events will be considered as a huge plus**
FUZZY-DEEP-EXTRACT: Extraction of Fuzzy Rules from Deep Networks **Prof C. Peña**	The proposed project is developed in the frame of D-Rex, an exploratory research project in which we intend to develop, implement, and evaluate a novel method for extracting rules from Deep Neural Networks. The method nicknamed D-REX for Deep Rule EXtraction will be able: (1) to extract knowledge in the form of hierarchical rule representations to explain how Deep Neural Networks make their predictions while (2) preserving, as much as possible, the prediction accuracy of the neural network. The specific goal of the student's project will be to investigate, implement, and test an approach for extracting (fuzzy) rules from a specific architecture of Deep Neural Networks (e.g., convolutional or recurrent). **Keywords: Fuzzy logic, Machine learning, Deep learning.**	**Only Master students in Computer Science or Electrical Engineering only, notions of Machine Learning and Python.**
BIO-INPHINITY: Machine learning for discovering and predicting virus-bacteria interaction networks. **Prof C. Peña**	Overall goal: Using machine learning methods, to explore the methodological alternatives for modeling the interactions between bacteria and bacteria-killing viruses (bacteriophages) based on features extracted from genomic and proteomic sequences. Specific goal: A data set comprising the genomes of several, selected, bacteria and bacteriophages will be available, together with several informative measurements (features) extracted from these sequences. The project aims at (1) automatically selecting the most relevant features (variables) in order to reduce the extant redundancy and (2) to build predictive models based on this selection. The student will be guided for all the bioinformatics aspects of the project. Context: The emergence and rapid dissemination of antibiotic resistance worldwide threatens medical progress. A promising alternative to fight against multi-resistant bacteria is to use their natural predators: bacteriophages, viruses that infect and kill bacteria with the advantage of having low impact on the human bacterial flora, as they are highly strain specific. This latter fact constitutes a serious limitation for rapid therapy development as for each bacteria one must find the corresponding bacteriophage. Faced with the need to systematically examine a multitude of possible interactions, the rapid development of bacteriophages as an alternative to antibiotics can only be done with the help of a model to predict the interactions between bacteria and bacteriophages.	**Keywords: Bioinformatics, Machine learning** **Only Master students in Computer Science, Electrical Engineering or Bioinformatics only, notions of Machine Learning and Python.**

INDUSTRIAL ENGINEERING (TIN)		
Study of surface treatments for printing and coating applications - super-hydrophobic and hydrophilic surfaces **Prof. S. Schintke**	The research unit COMATEC-LANS (Lab of Applied NanoSciences) is active in research on superhydrophobic and hydrophilic surfaces. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. Depending on the study background, skills and competences, the student candidate may e.g. contribute in the modification and characterisation of materials surfaces for printing and coating technologies, perform measurements of surface free energies, atomic force microscopy studies, and perform printing and coating tests for medical, environmental and packaging applications, process optimisation and data analysis.	**Keywords: Nano & microstructures, super-hydrophobic and hydrophilic surfaces ,coating and printing technologies, surface treatment**
Printable microfluidic systems and flexible electronics **Prof. S. Schintke**	The research unit COMATEC-LANS (Lab of Applied NanoSciences) is active in research on printable microfluidic systems and flexible electronics. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. Depending on the study background, skills and competences, the student candidate may e.g. contribute in the development of materials and structures for printable microfluicid systems, flexible electronics and sensors, their characterizsation and optimisation, data analysis, as well as in the design and optimisation of experimental set-ups and analysis tools.	**Keywords: Inkjet printing, electrical caracterisation, nanoscopy & microscopy, data analysis**
Nanocomposite materials for biomedical applications **Prof. S. Schintke**	The research unit COMATEC-LANS (Lab of Applied NanoSciences) is active in research on nanocomposite materials for biomedical applications. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. Depending on the study background, skills and competences, the student candidate may e.g. contribute in the development and characterisation of nanocomposite materials, their characterizsation and optimisation, data analysis, as well as in the design and optimisation of experimental set-ups and analysis tools. **Keywords: Thin film deposition & coatings, biopolymer-composite materials, advanced microscopy, data analysis, surface and material caracterisation**	
Plasmonic nanoparticles and sensors **Prof. S. Schintke**	The research unit COMATEC-LANS (Lab of Applied NanoSciences) is active in research on plasmonic sensors and surfaces. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. Depending on the study background, skills and competences, the student candidate may e.g. contribute in the development and characterisation of materials and structures for plasmonic sensors, data analysis, as well as in the design and optimisation of experimental set-ups and analysis tools. **Keywords: Nano & microstructures, plasmonic surfaces and particles, plasmonic sensors, advanced optical caracterization, advanced microscopy, data analysis**	

MMC (Modular Multilevel Converter) with storage capability **Prof. M. Carpita**	The Power Electronics group of the IESE (Institute of Energy and Electrical Systems) is developing an MMC power converter with storage capability, to be used in a reduced scale mini-grid, simulating a MV network. This power converter will allow to test the possibility to interface a battery storage systeme directly to the MV utility grid, without a bulky 50 Hz transformer. The first prototype of MMC converter has been already developed, now the integration of the system is ongoing. The student will be inserted in a very talented working group, and will develop a specific part of the project, under the direct coaching of the project responsible and/or collaborators.	**Student profile : 3rd year Bachelor or Master student in Electrical , Electronical, Power systems engineering**
DSP controller for the resonant plasma lamp **Prof. G. Courret**	This trainee deals with the development of a control for the pulse generator of the resonant plasma lamp. Based on an electronic card digital processor (DSP), this controller will serve to put in acoustic resonance the very bright plasma, which is enclosed in the bulb. The vibration of the plasma is obtained by modulating the inductive heating of the plasma at a frequency of around 30 kHz (ultrasonic field). This vibration is measured by a photodiode, whose signal serves as controlled variable. The phase of this signal will be used as switch of the regulator. Indeed, the plasma frequency sets itself apart from the drive frequency at the onset of the resonant mode. In addition, the controller will drive the cyclic induction pulse ratio according to the phase. Moreover, a video streaming is performed using a high speed camera. Its real-time processing will be used to detect the arrival of the resonance. Indeed, the plasma forms then a ball in the center of the bulb. The work will be dedicated to the completion of the controller program. It will allow the candidate to acquire mastery of programming a DSP for 'real time' applications in the C programming with CodeComposer and knowledge of software like Matlab, Simulink or LabView	**Student profile : 3rd year Bachelor or Master student in Electrical engineering, Electronical engineering, Physics or Acoustics** **DSP Programming in C++**
SOP (Soft Open Point) converter with storage capability **Prof. M. Carpita**	The Power Electronics group of the IESE (Institute of Energy and Electrical Systems) is developing a SOP (Soft Open Point) converter with storage capability, to be used in a reduced scale mini-grid, simulating a MV network. This power converter will allow to test the manage a MV (or also a LV) grid exploiting the benefits of both radial and meshed distribution systems. The student will be inserted in a very talented working group, and will develop a specific part of the project, under the direct coaching of the project responsible and/or collaborators.	**Student profile : 3rd year Bachelor or Master student in Electrical, Electronical, Power systems engineering**