Spring and Summer 2015: Topics for Directed Independent Study (Graduate and Undergraduate level) and MS Thesis Topics

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Please let me know if any of these topics interest you. You can find more about our work at the following sites: http://csi.fau.edu/ , http://csi.fau.edu/ , http://android.fau.edu/ , http://robotics.fau.edu/ , http://smartsystems.eng.fau.edu/ , and http://semanticweb.fau.edu/ .
If you are interested, you would register for 3 credits of DIS (directed independent study) which counts as a technical elective, or 6 credits of research for MS thesis with me, and work on the topic for one to two semesters.

Topic #1: Android App QOS Metrics

Focus: Computer Science
Level: UG (COT4900) - 3 credits/semester/student
Prerequisites: CEN 4214 (Software-Hardware Design), COT 6930 (Android Components), or background in Android programming and software engineering
Description: We have developed more than 60 Android Apps at FAU; we wish to refine them further and make them usable to all. The student will develop procedures for optimal test coverage, exception handling, refactoring, and power dissipation, and for mapping to different hardware options (screen sizes, hardware accessories and memory capacities) and operating system versions. The student will also validate the processes with two or more existing Apps. This is directly transferable as a job skill.
References: d.android.com, PowerTutor, http://junit.org/, http://android.fau.edu/
Number of DIS Students: Two. Students (may or may not work together). **Duration:** One or two semesters

Topic #2: Embedded Android

Focus: Computer Engineering
Level: UG (COT4900) / G (COT 6905) - 3 credits/semester/student
Prerequisites: Linux, C, Eclipse, microcontrollers, and background in Android programming.
Description: Android, with touch-based user interface and open source code, has created a groundswell of interest among embedded system developers. The student will use ARM's DS-10 profiler which is an Eclipse Plug-in and an ARM-based board (Panda board) to develop C-level code for Android. The book by Yaghmour shows how to create your own Android version for a particular embedded device. Android has differences with its Linux roots, though it integrates Linux components such as glibc and BusyBox. Embedded Android is in its infancy and Linaro open source project is gaining maturity. There is significant potential for creating new and exciting embedded devices as with wearable computing, medical applications, and gaming.
References: Embedded Android by K. Yaghmour, source.android.com, and www.arm.com
Number of DIS Students: Two (Students may or may not work together). **Duration:** One or two semesters

Topic #3: Biomedical Signal Processing with TI's DSP Board

Focus: Electrical Engineering
Level: UG (EEL4905) / G (EEL 6905) - 3 credits/semester/student
Prerequisites: Digital Signal Processing (DSP), C and (preferably) Eclipse
Description: TI provides a DSP board that works with an Eclipse-like new version of Code Composer Studio IDE (integrated development environment). One can plug in the board via a protocol emulator (on the board) to USB input of a PC, so the IDE can be used to develop and debug C code. The student will help develop a course around their TMS DSP board and the books for a biomedical lab. This hands-on experience will help with jobs and advances in the medical field. Three EE students (Felipe Carvalho, Khrystsina Navumenka, and Jonathan Solano) have worked on the project so far. More info is available

at: http://smartsystems.eng.fau.edu/category/biomedical-signal-processing/updates-biomedical-signal-processing/ . They are currently using the TI board in acquiring and processing the ECG signal. A second paper was submitted by Khrystsina and Jonathan to ASEE (American Society of Engineering Education) recently. You are welcome if you are interested. More information at http://smartsystems.eng.fau.edu/biomedical-signal-processing/ .

References: www.ti.com, "Real-Time Digital Signal Processing from MATLAB® to C with the TMS320C6x DSPs," Second Edition, by Welch, Wright and Morrow; and "Biomedical Digital Signal Processing" by Willis Tompkins.

Number of DIS Students: Two. Students may or may not work together. **Duration:** One or two semesters

Topic #4: Robotic Platform for Math Education and Internet of Things (multiplayer games)

Focus: Computer Engineering, Computer Science, and/or Electrical Engineering

Level: UG (COT4900, EEL 4905) / G (COT 6905, COT 6900, EEL 6905)

Prerequisites: Course on robotics/mechatronics/microcontrollers

Description: Low cost robots have been built in courses at FAU using Arduino boards and open source software. These robots are used in math education at the high school level, where students draw geometric art on a 6' x 6' canvas. The student will use modular approaches to build software using a high level (easy-to-use) language for drawing geometric primitives (arcs, lines, and angles), and use them to build more complicated shapes (circles, polygons and fractals). The UI (user interface) on the PC needs to capture raw data on speed, distance, direction, angle, and time - and use them to compute Physics and math variables of interest. Jean Lapaix, Senior in BSEE, is currently using PID algorithms to improve the robot's precision. Bianca Mesa and Johnny Yuen have also contributed. We expect the robotic programming and assembly to be fully documented by Dec '14. More students are needed for two different goals: (1) education research to incorporate Math problem solving skills; and (2) building multiplayer games with autonomous robots that will interlink Android smart phones via Raspberry Pi relay centers to robots. More information at: http://robotics.fau.edu/ and http://smartsystems.eng.fau.edu/precision-robotics/ for the first topic. For the second topic: http://smartsystems.eng.fau.edu/raspberry-pi/ . A paper has been submitted by Jean to ASEE (American Society for Engineering Education).

References: robotics.fau.edu and http://www.arduino.cc/.

Number of DIS Students: One or Two. Students may or may not work together. **Duration:** One or two semesters

Topic #5: Intelligent Web Technologies

Focus: Computer Science and Computer Engineering

Level: Graduate (COT 6905, COT 6900)

Prerequisites: Python, Java and Eclipse

Description: This is a new breed of algorithms that empowers a host of commercially successful applications with intelligence. Examples of success stories based on these techniques are Google, Amazon and Netflix. The algorithms can be categorized into those for search, recommendation, groupings, classification, and the combination of classifiers. Dr. Shankar has taught a graduate course on this in the past using the book by Marmanis and Babenko. Lucene and Nutch are tools that have been used by graduate students at FAU in their research. The student will develop tutorials for a subset of the algorithms. Kris Donate, MSCS, recently built a semantic search engine for seeking urban planning information. A paper has been submitted by Kris to ASEE (American Society of Engineering Education). More students needed, to develop similar systems for the themes of a science museum, empowerment apps for middle school students, and the large collection of smart phone Apps that we have that are yet to be catalogued.

References: Algorithms of the Intelligent Web by H. Marmanis and D. Babenko, Manning.

Number of DIS Students: One or Two. Students may or may not work together. **Duration:** One semester (Fall 2013)

Topic #6: Hydrology Modeling with EDA (engineering design automation) Tools

Focus: Computer Engineering
Level: Graduate (COT 6905)
Prerequisites: Engineering Design Automation and/or Mathematical Modeling
Description: We have used VHDL, Verilog HDL and SystemC in several EDA and chip design projects. However, our new goals are to export these concepts to other areas. For example, Frank Wissinger, one of my PhD students, has developed a hierarchical model for hydrology – current models are slow and non-real time. Frank has already shown how mixed signal modeling can be adapted here for faster response – for three of the five industry standard benchmark examples. There are many more examples and needs for increased computational speed in hydrological modeling. For example, after a hurricane hits, how one's neighborhood might be affected. Perhaps this project interests you. If so, that is one area you can contribute to. Frank has written his code in Python which is available for you to apply to other benchmark examples and improve upon.

Topic #7: Nonintrusive Monitoring of Lego EV3 Motion

Focus: All disciplines of Engineering
Level: Undergraduate (4xxx DIS course)
Prerequisites: Physics and Math
Description: Another area is the use of robotics to teach Math. We have submitted a proposal to NSF (national science foundation) on this. We have developed low cost robots to teach Math. More can be found here: http://robotics.fau.edu/ . We also want to use the commercial Lego EV3 in solving Math problems. For this, we will have to externalize distance and angle measures from the robot and find ways to control and improve the precision so Math problem solutions are more precise. This would involve nonintrusive monitoring and control perhaps with a smart phone. Here is the blog site of a visiting French graduate student, Julien Le Mellec, on this topic: http://smartsystems.eng.fau.edu/math-with-ev3/ . Study his work and improve it, for both EV3 and our own FAU's low cost robot.

Topic #8: Audio DSP Course Development with ARM and OMAP

Focus: Electrical Engineering
Level: Undergraduate (4xxx DIS course)
Prerequisites: Introduction to DSP
Description: Another area to work with the School for Multimedia Studies and Communication. The idea is to develop an introductory DSP course focused on the music/audio signal. An undergrad student (Sadrac Blanc) is exploring the use of a TI board (with ARM and OMAP) and associated software to write C-level code for biomedical signal processing. Your focus could be music/audio signal processing. This may also involve other faculty members such as Dr. Erdol, our Chair.

Topic #9: MOODLE Learning Management System for Data Analytics

Focus: Computer Science and Engineering
Level: Undergraduate (4xxx DIS course)
Prerequisites: Programming in Java/Python

Description: See https://moodle.org/ . MOODLE is an open source software developed to help the academic community with educational objectives (much like Blackboard). We want to use it for educational research purposes with K-12 and undergraduate student populations. This is a collaboration with several faculty members in the College of Education and community organizations in Broward county. The intent is to develop simple tools based on MOODLE's APIs, to monitor academic progress of students. This overlaps the research of one of my PhD students, Sifat Islam. He is developing an ontology-based approach for data analysis and applying it to study middle school students

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For PhD students, my research interests are in the general area of systems and their applications. My specific areas of interest are currently semantic web, ontology, intelligent web, STEM (science, technology, engineering, and mathematics) education - analytics and tools, Socio-Technical Systems (STS), Open source, medical informatics, EDA (engineering design automation), and embedded / mobile systems. Write to me at shankar@fau.edu.