Design Lab Projects: Fall 2025 – Spring 2026

Albany Medical Center

Startup founded by Albany Medical Center doctor Nibras Bughrara MD, and Albany Medical College's Office of Translational Research, Innovation, and Technology Transfer. The founder and CEO of 1st Playable Productions (Dr. Tobi Saulnier) is also available for support and mentorship on this project.

- **Project Title**: EASyExam: Artificial Intelligence for Ultrasonic Heart Images
- **Likely Skills / Technology Involved:** Software & interest in learning more about artificial intelligence and pattern recognition tools & software libraries
- **Description:** Each year, almost 300,000 in-hospital cardiac arrests occur in the United States, with survival rates standing at a mere 15-20%. Sepsis contributes to 40% of these cardiac arrests, with over 1 million new cases diagnosed annually in America. Ideally, a comprehensive echocardiographic assessment would guide the best treatment plan for a patient. However, most situations render this impractical, as only 2% of hospital personnel are trained in formal echocardiography, and a full assessment takes at least an hour to complete. Consequently, the current treatment protocol for sepsis requires clinicians to make critical care decisions based on limited clinical information. Regardless of the diverse underlying conditions potentially causing sepsis, each patient receives similar treatment, which can be ineffective or even exacerbate conditions in certain cases. There's a need for an AI-based software tool compatible with a handheld ultrasound machine for critical care scenarios. This tool should recognize a patient's anatomical structures and suggest management plans. Nibras Bughrara, MD, has developed a user-friendly and readily accessible exam, Echocardiographic Assessment using Subxiphoid-Only View (EASy Exam). This allows any clinician to obtain a suggested patient management plan by quickly analyzing a single view from a handheld ultrasound. Previous capstone design teams made significant progress automatically classifying ultrasound images. This year's project aims to further expanding their algorithm to read and classify subxiphoid ultrasound image on a local device that can be used in a medical setting.

New York State Department of Transportation

- **Project Title:** Electrical Testing Board for Traffic Signal Systems
- **Likely Skills / Technology Involved:** Circuit analysis & design, PCB layout, electrical safety, and documentation
- **Description:** This capstone project, sponsored by the New York State Department of Transportation, involves the design and construction of an electrical testing board that simulates a simplified traffic signal system. The board will visually demonstrate the internal electrical workings of a traffic signal, featuring test points and indicator lights on the front, while the back will display actual wiring configurations, including the ability to create opens and shorts for testing purposes. Students will be required to spec out all necessary components, perform relevant calculations, determine costs, and assemble the board. The project incorporates a range of electrical components, including 120VAC, 24VDC, TRIAC switching, LEDs, rectifiers, circuit breakers, and fuses. The final product will serve as a functional training tool to help DOT technicians troubleshoot traffic signals. This project provides engineering students with a practical application of their theoretical knowledge gained over the past three years, offering hands-on experience in both design and assembly. Additionally, students may be tasked with drafting a lab assignment for DOT technicians, which would involve detailing test procedures, expected meter readings, and troubleshooting steps. This project not only meets the needs of the DOT but also gives students a valuable opportunity to apply their skills in a real-world context. This project would be expanding upon existing design developed last academic year by a previous capstone team.

Green Mountain Semiconductor

- **Project Title**: Portable Data Logger for In Situ Radiation Testing of a Novel AI Chip
- **Likely Skills / Technology Involved:** Embedded systems programming, microcontroller development, hardware design and adaptation, and software development for data logging.
- **Description**: This project focuses on developing a microcontroller-based data logger and control board designed for portability and in situ operation during radiation testing. The system will be capable of operating on battery power, allowing it to be transported to radiation testing equipment and used during testing. The chip under test is an AI image processor test vehicle utilizing resistive memory (RRAM) circuits, developed by Green Mountain Semiconductor in collaboration with the University at Albany and NY Creates, as part of a NASA Phase II SBIR contract. Testing will take place in situ, allowing for real-time observation of temporary and permanent changes caused by radiation exposure. The project encompasses both hardware and software tasks, with the potential to adapt an existing microcontroller board for this purpose. Software will be developed to control the test chip and log relevant data, storing it in the microcontroller's Flash memory. The project may conclude with actual testing and the presentation of results. Green Mountain Semiconductor, based in Vermont, is an innovative chip design company specializing in memory products and in-memory computation for AI applications. This semester marks the launch of this project and the first time collaborating with Green Mountain Semiconductor. This team will expand upon work completed by a capstone team that started in Spring 2025.

Atmospheric Sciences Research Center

Professor Scott Miller, Dept. of Atmospheric Sciences

- **Project Title:** Unknown
- **Likely Skills / Technology Involved:** This research center typically builds instrumentation that integrates electronics, software programming, and a mechanical component. It's beneficial for this project to have a team that is willing to jump into mechanical design and implementation, such as integrating motors and moving parts into their design. I
- **Description:** This project involves working with the Atmospheric Sciences Research Center (https://www.albany.edu/asrc) at the University at Albany. This center is focused on using fundamental and applied interdisciplinary research to expand our understanding of the physical and chemical processes that govern the atmosphere-land-water system to improve the quality of life and economic well-being of New York State, the nation and the world. Previous electrical and computer engineering capstone teams designed and implemented a large system that mimics the motion of a off-shore weather buoy to support lab testing of instrumentation, specially ensuring that instrumentation readings are not significantly distorted from weather movement. For this year's project, the stakeholder is interested in exploring multiple possibilities. One possibility might be to expand and improve upon the existing design developed previously year. Another possibility (if approved by the stakeholder and your instructor) to identify another project of high importance to the lab.

CREATE Competition

We will be fielding two CREATE projects/teams this year.

New York State Industries for the Disabled (NYSID) & Center for Disability Services

- **Likely Skills Utilized:** Participate in CREATE Competition which requires attending the half day symposium held in Albany in mid-April; interest in having a positive real-world impact, willing to work and assist people with disabilities, some limited local travel (timing is very flexible) to the Center for Disability Services mailing center (about 10 minute drive from the uptown campus). The systems developed commonly have a significant mechanical component, so eagerness to jump into hands-on building involving motors and moving parts is a plus. Each team will have a $1,000 budget provided by their sponsor to build their systems. Participating students will almost certainly have the option (not required) to be interviewed on local news broadcasts which can be a great thing to include on your LinkedIn and/or resume.
- **Description:** This project involves competing in a statewide university competition focused on building assistive technology that promotes employment for disabled workers. The competition is for $30K in cash prizes ($15K 1st place, $10K 2nd place, $5K for 3rd place) and provides an opportunity to directly help people in our community. Students keep 60% of the prize money, with the reminder split between the partnering non-profit and university (which is placed in an account to support student capstone projects). A budget of $1000 from the New York Industries for the Disabled (NYSID) is provided develop these projects. Students will partner with the Center for Disability Services mail fulfillment center. This mailing center processes hundreds of thousands of pieces of mail per day supporting official New York State mailing operations and about 70% of their workforce has a disability. The goal of this project will be to work with the mailing center to identify and develop a system that will enable disabled workers to complete a job they would otherwise have difficulty completing. This goal is to increase the number of disabled workers that can be hired by the Center for Disability Services. Some previous UAlbany teams have been highly successful, specifically by providing new jobs to numerous disabled workers and our UAlbany ECE students have won $50,000 in prizes (three first place finishers, and one third place finisher). We will be supporting two UAlbany teams this year for this CREATE competition.

Naval Nuclear Laboratory

- **Project Title:** Energy Harvesting for Embedded Systems
- **Likely Skills / Technology Involved:** Interest and/or experience with embedded C programming, circuits, and power electronics. The current project design utilizes an ultra-low power microcontroller which is similar to the one used in ECE334 *Programming Hardware Systems*.
- **Description:** This project involves designing, implementing, and testing innovative methods for powering embedded systems without relying on traditional power sources. Students will explore alternative energy harvesting techniques, such as solar, vibration (haptic) energy, and heat (Peltier effect), to power an ultra-low power embedded microcontroller. The system will be required to handle a range of various scenarios and be designed with careful consideration of stakeholder design constraints. The project's success will depend on the ability to integrate these energy sources effectively, ensuring reliable operation even under variable environmental conditions. Students will also need to evaluate the long-term sustainability and efficiency of their solutions, aiming to meet or exceed the standards expected in real-world applications.

Northeast Regional Defense Technology Hub (NORDTECH)

This is a collaborative project involving the ECE department (Professor Muckell & Moulic), Department of Nanoscale Engineering (Professor Cady), NY CREATES, and resources available from the Northeast Regional Defense Technology Hub (NORDTECH)

- **Project Title:** Shared Silicon Framework for IC Projects
- **Likely Skills / Technology Involved:** Vivado, Cadence Tools, Hardware Description Languages (HDL) specifically Verilog, VLSI and ASIC Design
- **Description:** The primary goal of this project is to create a reusable hardware framework that will serve as a cost-effective fabrication option for future capstone teams. Specifically, this framework will support up to four separate independent capstone projects that can fabricate and single shared chip (IC). This modular framework must support at least four independently developed Verilog modules. At runtime, a control signal will select which module is active, allowing the modules to share I/O ports without interference. The final design must satisfy all standard fabrication and verification requirements, including DRC (Design Rule Check): ensuring compliance with process-specific layout constraints, LVS (Layout vs. Schematic): verifying that the physical layout matches the intended logic, and additional verification steps required by the foundry. By consolidating multiple projects into a single shared tape-out, this approach will reduce fabrication costs while also preparing students with workforce-ready skills in modern semiconductor design and verification. The framework will be well-documented, modular, and designed for scalability to support future teams with minimal interdependencies.

GlobalFoundries

We will be fielding two GlobalFoundries projects/teams this year.

- **Project Title:** ASML Scanner UPW Bath Level Monitoring
- **Likely Skills / Technology Involved:** Embedded systems programming, microcontroller interface design, sensor selection and integration, optical sensing for non-contact measurement, 3D modeling and printing for mechanical mounts, and data acquisition systems.
- **Description:** ASML photolithography scanners at GlobalFoundries utilize two coolant water reservoirs that supply internal cooling loops with ultra-pure water (UPW). Over time, water can evaporate or leak, requiring refills or repairs. At present, reservoir levels are manually monitored via a sight glass, meaning fills are reactive—triggered only after levels are already low—leading to tool downtime and potential collateral damage. In addition, the current process cannot track rate-of-change data, making it impossible to detect leaks before they trigger hard errors. This project will design and implement a monitoring solution that digitizes the sight glass reading and interfaces with a microcontroller. The system must operate externally to the reservoir, with no contact with the UPW, and should be capable of streaming real-time data to the factory monitoring network (IT interface to be developed by GlobalFoundries). The design will include selecting or developing a non-contact sensor system capable of accurately reading fluid levels through the existing sight glass, creating a mechanical mounting solution (via 3D printing or other methods), and integrating the sensor with a microcontroller for continuous monitoring. The final deliverable will be a functional prototype with documented calibration procedures, leak detection capabilities based on rate-of-change analysis, and a clear path for integration into factory systems.

GlobalFoundries

We will be fielding two GlobalFoundries projects/teams this year.

- **Project Title:** Portable Helium Capture and Analysis System
- **Likely Skills / Technology Involved:** Embedded systems programming, microcontroller-based sensor integration, data acquisition and logging, signal processing, electronics for precision gas sensing, and mechanical integration with sensor hardware.
- **Description:** GlobalFoundries' Fab 8 relies on extremely high-purity helium in numerous semiconductor manufacturing processes. Due to its small atomic size and low density, helium can escape through the smallest leak points and disperse quickly, making detection challenging. Helium is both expensive and finite, and current leak detection methods are slow, labor-intensive, and depend on costly specialized equipment. This project will design and prototype a portable, microcontroller-driven helium capture and analysis system. The team will integrate a sealed gas sampling chamber with electronic sensing components capable of detecting and quantifying helium concentration. Tasks will likely include selecting and interfacing appropriate gas sensors, designing signal conditioning electronics for accurate measurements, implementing microcontroller firmware for sensor control and data logging, and developing algorithms to process sensor data for leak detection. Additional work will involve designing a user interface or data output method for real-time readings, and documenting a repeatable testing and calibration procedure.

TT Electronics & UAlbany Signals & Networks (SINE) Lab

- **Project Title:** LiFi Modules for Internet Access
- **Likely Skills / Technology Involved:** Hardware description languages (VHDL), familiarly or interest in learning about FPGAs, interest in learning PCB layout. Circuits and digital logic.
- **Description:** This project focuses on developing an innovative wireless communication system using visible light communication (VLC), commonly known as LiFi. This technology serves as an alternative to traditional radio frequency (RF) communications, offering advantages such as unlicensed spectrum, enhanced security, and resistance to jamming. The project aims to create LiFi modules capable of delivering Internet access at speeds exceeding 1 Mbit/s, using commercial off-the-shelf (COTS) components. The design will leverage iCE40 FPGA technology to enable real-time processing and high-speed data acquisition, addressing the limitations of existing LiFi solutions that often lack networking capabilities. The project will include hardware design, software development, and extensive testing to ensure the modules are cost-effective, compatible with existing networks, and perform reliably under various conditions. The expected outcome is the successful demonstration of these modules, contributing to the advancement of LiFi technology for indoor wireless connectivity. This is a collaborative project involving a business leader at TT Electronics (Sergey Komarov) that is also a UAlbany physics alumni, and electrical and computer engineering professor Hany Elgala. This work expands upon a working prototype developed last academic year by a previous capstone team, but which needs additional improvements to meet or exceed the 1 Mbit/s bandwidth goal.

UAlbany Signals & Networks (SINE) Lab

- **Project Title:** Spatio-temporal Assessment for Population RF exposure
- **Likely Skills / Technology Involved:** RF Engineering, Data Analysis, AI and Machine Learning.
- **Description:** Over the years, various worldwide governing bodies have imposed emission limits on EMF radiation from wireless networks, yet concerns remain about whether these limits account for the increasing use of wireless devices, densification of deployments, in-building systems, and emerging technologies such as smart meters. While studies have shown potential harm from long-term EMF exposure, most have assessed individual exposure in controlled environments rather than the total exposure experienced by the general public in real-world indoor settings. Building on work developed by a prior capstone team, this project will expand the system to focus on large-scale data collection using low-cost EMF sensing units, the creation and curation of robust datasets, and the integration of AI/ML methods to analyze patterns, predict exposure trends, and identify potential high-risk scenarios. Students will also develop a mobile or web application to visualize results, support public participation in data gathering, and democratize access to EMF exposure information for sub-6 GHz frequencies used in 5G and WiFi.

Wolfspeed

- **Project Title:** Unknown
- **Likely Skills / Technology Involved:** Programming, data analysis, databases, visualization, testing, collaboration tools.
- **Description:** This capstone project involves collaborating with Wolfspeed, a leader in semiconductor technology, to develop software solutions aimed at optimizing their processes. Students will work closely with industry experts to design, implement, and test software tools that enhance efficiency, streamline operations, and support innovation within Wolfspeed's semiconductor manufacturing. This project provides hands-on experience in applying programming skills to real-world challenges, offering valuable insights into the role of software in driving process improvements in the semiconductor industry. At the time of this writing, numerous ideas have been proposed, but a specific project has not been identified. The plan is for the student team to work collaboratively with the stakeholder to identify a problem of interest (with stakeholder and instructor approval), and then subsequently design, implement, and test a solution.