2025 Summer undergraduate research experiences at the University of Cincinnati

The International Office at the University of Cincinnati (UC International) is pleased to announce the 2025 Summer Internship opportunity at the University of Cincinnati. UC International will support undergraduate students to participate in research projects at UC during the summer (June-July) of 2025 by providing housing and a meal allowance for the duration of the project. Each project is designed to take 7-8 weeks will be performed on the campus of the University of Cincinnati. Interested students can apply to these projects by writing a short (1 page) statement of interest and including their Undergraduate résumé as one pdf file and sending this to Dr. Neil Ayres at UC International at neil.ayres@uc.edu. Students should consider any preferred skills and backgrounds suggested by the UC faculty in each project description. The University of Cincinnati Principal Investigators (PIs) will have the opportunity to review applicant files and select students. The PIs may choose to contact interested undergraduate students before accepting a student into the project. Once accepted into the project, UC International will work with the student on obtaining necessary visas. *Please note that we are unable to provide travel costs or a stipend as part of this program.* More information can be obtained by contacting the relevant contact at your institution or emailing Dr. Neil Ayres at UC International at neil.ayres@uc.edu. We would like to have students matched with projects by the end of February 2025. We realize this is an aggressive timeline, but we this will help us secure the required student Visas.

Project # 1. Algal organic matter from waters impacted by harmful algal bloom and impact on drinking water quality

PI: Xi-Zhi Niu, Department of Chemical & Environmental Engineering, College of Engineering and Applied Sciences

Project Description: With the increase of world population and the intensive utilization of resources, excess nutrient elements have entered the environment, leading to serious environmental problems. Among them, unexpected algae growth caused by excessive nitrogen and phosphorus is particularly challenging [1]. Algae blooms can produce a variety of cyanotoxins as well as taste and odor compounds that pose a nuisance to water supplies worldwide [2]. At different phases of growth, algae release algal organic matter (AOM) to water through metabolism [7]. Effectively analyzing the release and AOM properties becomes increasingly important for the control of their effects on water treatment as well as the risk of secondary pollution of their fates and treatability in water supplies. The capability to extract and analyze AOM is a primary bedrock for environmental and health research.

This project will provide the student with an opportunity to learn how to cultivate algal bloom, to extract AOM, and to collect and handle samples in the fields. The project includes possible field sampling to collect and extract harmful algal bloom water samples in Greater Cincinnati area and the Lake Erie under the guidance of the PI and a PhD student. The student will also help the team develop an optimized extraction method for AOM. The project represents not only a chance for research experience, but also exposure to knowledge on emerging contaminants, in particular harmful algal blooms that have been a pressing issue in the United States, China, Southeast Asia, and potentially the student's home as well. In addition, by working on this project, the international student has the chance to learn the rich water bodies in the Greater Cincinnati and in Ohio.

Project #2. Innocence as an International Human Right

PIs: Mark Godsey, Donald Caster, and Brian Howe, the Ohio Innocence Project at the College of Law.

Project Description: At the Ohio Innocence Project (OIP) at the University of Cincinnati College of Law, our mission is twofold—to free Ohioans who have been unjustly convicted and to reform the system that is responsible, all while teaching law students how to be effective advocates. We also advocate for lasting criminal justice reform, both in Ohio through legislation and education efforts and internationally by mentoring and supporting current and aspirational international members of the Innocence Network. One aim of this application and the addition of a student from a strategic partner to OIP's summer fellowship program is to educate a student from another country so that the student will return to their country and spread information about wrongful convictions to their home university. Another aim is to enable OIP to learn more about wrongful convictions in the recipient's country, which will advance efforts to promote an international right to innocence as well as provide Cincinnati Law students with a different perspective to the legal system they are learning to work within here in the United States. In addition, the recipient may also assist our faculty with discrete research projects related to efforts to secure an international right to innocence. Because work on securing recognition of this right by the United Nations has already begun and is currently ongoing, the exact nature of research questions is uncertain at this time. We expect the recipient will show their understanding of wrongful convictions and innocence work in the same manner as our law student fellows, primarily through interactions with supervising faculty members regarding specific cases. In addition, we anticipate that the recipient will demonstrate their understanding of the causes of wrongful convictions and the difficulties inherent in proving innocence by giving a presentation to OIP faculty and law student fellows near the end of their stay that summarizes what they have learned about the criminal legal system in the United States and then compares and contrasts the policies and procedures here with those in their home country.

The successful applicant should be enrolled in legal studies in their home institution so that they have basic familiarity with legal systems.

Project #3. Geolocating the Dark Web

PI: Jacques Bou Abdo, School of Information Technology, College of Education, Criminal Justice, Human Services, and Information Technology

Project Description:

Freedom of opinion and expression is one of the five basic human rights charted by the United Nations, and one of the pillars of successful and peaceful societies. Anonymity and anonymous communication are essential for promoting free speech and are upheld by the United States Supreme Court in McIntyre vs. Ohio Elections Commission to be a constitutional free speech right. However, identification, tracking and traffic interception are considerably easy in the cyberspace.

Anonymity networks such as the Invisible Internet Project (Garlic Router) and Tor (Onion Router), are at the forefront of fighting censorship, facilitating whistleblowing, and supporting anonymous communication. This makes anonymity networks a major target for censorship, tracking, and deanonymization. It is important to ensure the application security of each individual release of those routers (Onion and Garlic) against hacking, but this approach is neither sustainable nor future proof.

In this project, we are interested in mapping out the network structure of the Garlic Peer-to-Peer overlay network and identifying the effect of geographical location of the peers on the overall performance. The intern working on this project will learn how the anonymity networks operate and the darkweb is constructed. This skill is very important for cybersecurity professionals and very rarely acquired by cybersecurity professionals. Additionally, the intern will learn how to design experiments and build datasets.

A student with background in computer science, computer engineering, physics and information technology are preferred. However, other backgrounds can be accepted. The ideal candidate needs to be proficient in Linux and a scripting language. Exposure to Docker, Kubernetes and VMs is very helpful.

Project #4. Wetting and adhesion of stretched soft and swollen polymer networks

PI: Jonathan Pham, Chemical Engineering, Materials Science and Engineering, CEAS

Project Description:
Soft and swollen polymers are critical for many advanced applications. For example, they offer versatile control over the mechanical properties and transport of molecules through the material, enabling modulus matching of tissues for functioning synthetic biomaterials. However, not only is it important to control the mechanical properties, but it is vital to control how liquids and solids interact with their surfaces. Currently, fundamental understanding of how a liquid or solid interacts with a soft and swollen interface is lacking. These surfaces are made from lightly crosslinked polymers infused with a swelling fluid, which is situated between soft solids and traditional liquids. In this summer project, we will focus on the following question: How do liquid drops and small particles interact with soft and swollen polymer networks, which are also being stretched? Our research team has developed a deep understanding of the effects of swelling or modulus on wetting, but with very limited knowledge on the effects of stretching on drop or particle interactions. In the first stage, the intern will start by learning how to prepare soft polymeric surfaces with well-defined properties, including the modulus and the swelling ratio. They will also learn how to use standard characterization techniques to quantify the mechanical properties, including rheology and tensile testing, as well as the swelling ratio by measuring volumetric changes. They will then learn how to image surfaces utilizing microscopy methods, like confocal microscopy and digital camera imaging. After learning these methods that are commonly used in our research group, the student will then start development of a stretching device. This will likely utilize a combination of linear manual stages that enables uniaxial stretching of the polymer surface.

Students should be eager to conduct hands-on experiments in a laboratory setting and have experience with hands-on work – this can be form of labs or from hobbies. For example, skills in DIY style projects can be beneficial for developing characterization methods and building new and specialized instrumentation. Experience in LabView and/or Matlab, or similar software would be useful for controlling devices and/or image and data analysis.

Project #5. Exploring Machine Learning for Cybersecurity: Advanced Phishing Threat Detection

PI: Isaac Kofi Nti, School of Information Technology, CECH

Project Description:

The global rise of AI-driven phishing attacks presents significant cybersecurity challenges for businesses, governments, and individuals. These increasingly sophisticated campaigns often evade traditional security measures, necessitating advanced solutions. This project will attempt to address this critical issue by leveraging advanced machine learning (ML) algorithms to detect and mitigate modern phishing threats, offering real-world applications of cutting-edge cybersecurity technologies. Through this initiative, the selected international undergraduate student will gain hands-on research experience in a globally relevant field. They will learn to design and evaluate ML models, analyze complex datasets, and generate actionable insights.

The ideal candidate for this project should have a strong foundation in computer science, information technology, information security, or related fields, with an interest in machine learning and cybersecurity. Preferred skills include familiarity with Python programming, data analysis, and basic to intermediate knowledge of machine learning concepts and algorithms. While prior experience with phishing detection or cybersecurity research is a plus, it is not a requirement.

Project #6. Vying for Seats at the Head Table of the World Economy: The Commercial, Technological, and Geopolitical Significance of Multinational Corporations from the "Global South" Contesting the Long-Standing Dominance of Multinational Corporations from the "Global North"

PI: Thomas G. Moore, School of Public & International Affairs, College of A&S

Project Description: More than two decades into the 21st Century, scholars in the interdisciplinary field of international relations – economists, political scientists, and public policy experts – are reassessing the extent to which "developing" countries from the "Global South," such as China, India, and Brazil, have begun to challenge – individually or collectively – the long-standing dominance of "developed" countries from the "Global North," such as the U.S., Germany, and Japan. Students have already created original databases for me that organize the world's top 2,000 companies by industry and nationality so we can track changes over the past two decades in the relative prominence of companies from more than 60 countries in over 80 industries. Relying primarily on the Bloomberg Terminals in the Lindner College of Business, students have collected data on each company's overall sales, profits, assets, and market capitalization. In addition, they've retrieved company-specific data on how "globalized" different companies are in terms of where they generate their revenue (different countries and world regions), where they deploy their assets (again, different countries and world regions), and the nationality of their owners (shareholders). This allows us to assess whether companies from certain countries or industries are more "globalized" than others and how this has changed over time. With the quantitative data collected and the background profiles complete (there will opportunities to update and refine the work of past students), the focus in Summer 2025 will be on (1) analyzing the data, (2) visually presenting the data, and (3) preparing preliminary written assessments that evaluate the quantitative and qualitative evidence in light of the project's core questions.

Although social science majors – including but not only students in economics, business, political science, international affairs, and data analytics – might find the project's subject matter especially relevant to their studies, I'll gladly consider any motivated student who finds the topic interesting. This work would be ideal for students who either have some existing familiarity with Excel and Tableau or are interested in developing these skills. There will also be opportunities to gain hands-on experience in updating a literature review as I seek to locate my project's findings within the body of scholarly and policy-oriented work that has been published since I first formulated this project several years ago.

Project #7. The Prosecution Project Summer 2025 Intensive

PI: Michael Loadenthal, School of Public and International Affairs, College of Arts & Science

Project Description: This research supports the Prosecution Project (tPP)1, a long-term, open-source intelligence, and public policy research program focused on understanding how political violence—terrorism, extremism, hate crimes, and illegal political action—is prosecuted in US courts. Researchers work to locate cases of felony political violence occurring in the US, test that case for inclusion utilizing a decision tree, assemble requisite evidentiary documents, and code that case for 50 variables. The goals and objectives of this effort are to better understand how political violence is prosecuted in the US, and to build a deeply contextual analysis of the relationship between who a defendant is, their crime, and the sentence they receive. These data are used to test a variety of recurrent hypotheses focused on the relationship between defendant demographics and sentencing outcomes, and political ideology and lethality. The project explores defendant demographics, prosecutorial strategy and outcome, juridical rhetoric, and relevant laws dealing with hate crimes, civil rights violations, designated Foreign Terrorist Organizations, and material support, as well as assigned terrorism enhancements and the use of specialized motive-centric statutes.

Over the eight weeks, the researcher will undergo training, complete test cases, complete the work of a Pre-Coder, and in the remaining four weeks, work as a Coder. The specific knowledge and skills that will be learned include open-source intelligence gathering, locating primary source court records, interpreting legal documents, following decision trees, qualitative coding, intercoder reliability checks, data auditing, archiving, data entry, and preliminary data analysis, including descriptive statistics.

Student researchers should have strong attention to detail, be independently motivated, be self-starters, be efficient time managers, and be able to follow complex workflows. There is no field-specific or subject matter knowledge required, though a background in criminal justice, law, and/or political science can be beneficial. It is critical that students self-select based on an interest in studying political violence, and engage with an understanding that many materials reviewed will contain racist, xenophobic, misogynistic, and otherwise bigoted language. Students who are not willing and able to read past this manner of discriminatory language should pursue other opportunities. We have safeguards in place to help students deal with the content, and work with them to identify and routine health work practices based on industry standards. Throughout eight years, we have had no traumatic issues with the more than 200 team members who have come through the program.

Project #8. NeoWarm: Kangaroo Mother Care with Integrated Thermal Management and Vital Signs Monitoring

PI: Orlando S. Hoilett, Department of Biomedical Engineering, College of Engineering and Applied Science

Project Description: Neonatal hypothermia is one of the most common and dangerous complications of premature birth. In resource-rich settings, incubators are typically used to prevent hypothermia; however, incubators are scarce in low/middle-income countries (LMICs). Kangaroo Mother Care (KMC) is a technique that effectively combats the lack of incubators in LMICs. While KMC is highly effective, it requires the participation of the caregiver at all times and poses challenges for vitals monitoring used to assess the newborn's health during their early stages of life. As a response to this need, we have developed NeoWarm, a device that will augment KMC. NeoWarm is an insulated newborn carrier with integrated sensors for monitoring temperature, heart rate (HR), respiratory rate (RR), and particularly, blood-oxygen (SpO2) to detect apnea, another common complication of premature birth.
The student intern will work with Dr. Hoilett to develop a sensor chip for the NeoWarm device. The student intern will design the sensor chip in a computer-aided design software, namely Autodesk EAGLE or KiCad. The circuit outline will be provided to the student by me, and the student will complete the design by arranging how the components are organized and oriented on the physical circuit board. To assess if the design is complete, the student intern will engage in an in-depth design review with me to ensure all the necessary features, components, and functionality are included in the design. the student will develop the firmware for the sensor chip. The firmware will require coordinating sampling each of the sensors and storing the data on an SD card also designed onto the sensor chip. The student will evaluate the accuracy of the sensor chip by comparing the data extracted from the device with commercially-available FDA-cleared reference devices which we already possess in the lab. The student will use summary statistics such as average, standard deviation, correlation coefficient to compare the data from the sensor chip to the reference devices.

For this position, a background in Biomedical Engineering, Mechanical Engineering, Electrical Engineering, Computer Engineering, Computer Science, or another related field is required. Introductory experience analyzing electronic circuits, reading circuit diagrams, building circuits on a breadboard, and simulating circuits using a simulation software such as LTspice is also required. The student intern should also have previous coding experience in MATLAB, R, Python, C, C++, Java, or similar language. Previous experience with microcontrollers or single-board computers like the Arduino, STM32, Teensy, Raspberry Pi, BeagleBoard/BeagleBone, MSP430, or similar devices is preferred, but not required. Experience designing circuit boards using Autodesk EAGLE, Altium Designer, KiCad, or similar software is preferred, but not required. Experience using git, or other version-control platforms is preferred, but not required.

Project # 9: MyA: Multi-Biometric Vest for People Living with Angelman Syndrome

PI: Orlando S. Hoilett, Department of Biomedical Engineering, College of Engineering and Applied Science

Project Description: Angelman syndrome (AS) is a neurogenetic syndrome associated with severe developmental and intellectual disability. Symptoms of AS include very limited speech, difficulty sleeping, and poor motor function. At present, there is no cure for AS. Despite increased investment in clinical trials, functional outcomes that impact the lives of people living with AS and their families remain widely variable. A major barrier to clinical trials is the lack of available outcome measures suitable for AS. Wearable devices that monitor physiological and behavioral output are promising solutions because they provide objective metrics of physiological function without requiring verbal or motoric input from the patient. However, typical wearable devices in form factors such as smartwatches and headbands are often not tolerable by AS patients. Using input from AS caregivers from extensive focus groups (N = 8) conducted by our research team, we have designed MyA, a biometric vest that will measure several key signals relevant to AS (heart rate, respiration, vocalizations, temperature, and sleep), while meeting the unique sensory and tactile needs of the AS population. Our future developments will require interfacing audio and video capabilities into the vest. For the proposed project, the student intern will work closely with myself to integrate a microphone and audio codec into the vest along with a miniaturized video camera that can be discreet enclosed into the vest without causing irritation to the wearer.

The student intern will construct circuits to test the audio and video systems by using product datasheets, online resources, and discussions with me during our weekly meetings. The student will compare the performance of our systems to commercially-available audio and video recording devices. The student will compare relevant specifications like frame rate and signal-to-noise ratio, to ensure we have sufficient quality to ultimately use the device in clinical behavioral studies with people with AS.

For this position, a background in Biomedical Engineering, Mechanical Engineering, Electrical Engineering, Computer Engineering, Computer Science, or another related field is required. Introductory experience analyzing electronic circuits, reading circuit diagrams, building circuits on a breadboard, and simulating circuits using a simulation software such as LTspice is also required. The student intern should also have previous coding experience in MATLAB, R, Python, C, C++, Java, or similar language. Previous experience with microcontrollers or single-board computers like the Arduino, STM32, Teensy, Raspberry Pi, BeagleBoard/BeagleBone, MSP430, or similar devices is preferred, but not required. Experience designing circuit boards using Autodesk EAGLE, Altium Designer, KiCad, or similar software is preferred, but not required. Experience using git, or other version-control platforms is preferred, but not required.

Project #10. A Digital Archive of Cultural Productions from the Venezuelan Diaspora

PI: Patricia Valladares-Ruiz, Dept. of Romance and Arabic Languages and Literatures

Project Description: With over 9 million displaced individuals, the Venezuelan exodus is the largest refugee crisis in the history of the Americas. Venezuelans have relocated to Colombia, Peru, Chile, Argentina, the United States, Spain, and at least 90 other countries. A digital archive will allow us to explore how their cultural products address issues of displacement, identity, and resistance. We plan on developing a digital archive of cultural productions by the Venezuelan diaspora. Materials will include diverse formats such as literature, film, visual arts, popular music, performance, and digital content. This corpus will let researchers look at how displaced creators reconceptualize national identities and resistance in their work, reflecting the radical transformations in this creative landscape.
This archive aims to be a critical resource for researchers and the public to explore how displaced Venezuelan creators reimagine national identity, political resistance, and cultural memory. It will also ensure these contributions are not lost or overlooked. Our approach incorporates best practices from established digital archives, such as the Díaz-Ayala Cuban and Latin American Popular Music Collection (Florida International University) and the Digital Library of the Caribbean (University of Florida). We are also exploring a potential collaboration with the UC Libraries, which could play a key role in developing an interface that adheres to current archival protocols.

This collaboration offers the student the opportunity to build critical skills in digital humanities—such as archival protocols, metadata management, and interface design— while gaining exposure to research methodologies. This mentorship experience will provide a solid foundation for academic and professional success, equipping the mentee with practical expertise and analytical skills that are transferable across disciplines.

Project #11: Drug-coated bone grafts to prevent implant failure in pediatric cranioplasty patients

PI: John Martin, Biomedical Engineering, College of Engineering & Applied Science

Project description: Decompressive craniotomy, or removal of a portion of the skull to relieve pressure from brain swelling, is a standard procedure to prevent neurological damage in both adult and pediatric populations. Most often, the removed bone flap is frozen for cryopreservation before re-implanting back into the created skull defect once brain swelling has resolved. These procedures are reasonably successful in adult but have a nearly 50% failure rate in pediatric patients and often require extensive corrective surgeries.

Osteoclasts are the specific cells responsible for resorbing bone tissue, and pathologies with over-active osteoclasts are typically treated with systemic administration of osteoclast-inhibiting bisphosphonate drugs such as alendronate. Therefore, this project's main goal is to fabricate bisphosphonate drug coatings directly on the surface of autologous bone grafts to prevent their rapid degradation by osteoclasts. The intern will help develop these drug-coated bone grafts and evaluate their suitability for future preclinical animal model studies. The intern will be directly supervised day-to-day by Karina Bruce, a Ph.D. student in the Martin Lab. The intern will be taught the basics of polymer synthesis, drug delivery quantification and modeling, and *in vitro* cell culture by the mentoring graduate student. The student will also be instructed in experimental design and scientific communication by the PI.

Students with a background in biomedical or chemical engineering are preferred candidates for this project, but students with training in other engineering, chemistry, or biology-focused majors would also be considered. Candidates with some basic familiarity with lab work are also preferred.

Project #12: An Innovative Blood Test for Detecting Pancreatic Cancer

PI: Georg F. Weber, James L. Winkle College of Pharmacy

Project Description: Pancreatic carcinoma is usually a fatal disease. The collective median survival time of all patients is 4-6 months, and true long-term cures are rare. While the incidence of pancreas cancer continues to rise and the disease has become the fourth leading cause of death among both men and women, this cancer remains notoriously difficult to diagnose in its early stages. Due to the poor accessibility of the pancreas to non-invasive diagnostic procedures, a blood test for sensitive and specific biomarkers is currently lacking and in need. The cytokine osteopontin (OPN) is important in this process due to its ability to induce migration, invasion, and anti-anoikis. However, the full-length form, OPN-a, is present at variable levels in healthy individuals and therefore has limited value as an indicator of pancreatic cancer. We have found splice variants of OPN (OPN-b and -c) that are selectively expressed in cancer cells, but are totally absent from untransformed cells. OPN-c is more potent than the full-length form OPN-a in supporting anchorage-independence, which represents an essential component of the metastatic cascade. In this work, we will initially extend and refine our earlier RT-PCR analysis of the expression of OPN splice variants. We will extract RNA from whole blood. Following reverse transcription with oligo-dT, we will measure OPN-a, -b, and -c expression with splice variant-specific primers, using primers for β-Actin as positive control for the integrity of the templates. MDA-MB-435 cDNA will serve as a reference (these cells are reliable producers of all 3 OPN forms) and a no-template control will be included.

The student will be expected to have had some biomedical laboratory exposure. A basic understanding in the use of pipets and the concepts of the polymerase chain reaction (PCR) are desirable. The primary validator of success will be the generation of reliable scientific data, including all required controls. Consistency in this performance criterion will be an important evaluator. The main goal will be to obtain reportable outcomes, which the student can report on their resume.