Interns-to-Scholars Internships – Fall 2019

SBS Postings

F19.003: Subtext in Documentary Films
Faculty mentor: Kurt Lancaster

Overview
This project will examine subtext in documentary films. Subtext contain emotions beneath the surface dialogue of films expressed through a performer's body language. Hitchcock trained his actors to perform for cameras, especially during a close-up: "how to use their face to convey thought … in an unstated subtle way" (in Gottlieb, 2013: 11). If the eyes and face hold one of the most important elements in shaping the subtext of a character, then the close-up must be a key tool in shaping subtext. The body language becomes the visual language found in fiction films. Can an examination be made for discovering the body language of the subjects in documentaries as a way to help visualize the stories of documentaries? If documentary filmmakers prioritize glances, gestures, and other elements of body language like a Hitchcock film, then they, too, engage in the creation of "pure cinema," the idea that images—the composition—in cinema convey much more of the story than dialogue or interviews in documentary work. Instead of crafting the actors' bodies through blocking, as found in fiction films, the documentary filmmaker must take note of real life as it happens. This study will examine a variety of documentary films in order to discover subtext and the type of composition used as a tool for visual filmmaking in documentary filmmaking.

What the student will DO and LEARN:
The student will research readings, screen documentaries, and choose potential scenes for analysis. The work my include writing and possible co-authorship credit on a journal article.

Additional benefits:
The student will gain an understanding of research methods and close readings of documentaries, as well as applying writing as an expression of research and critical thinking.

Additional qualifications:
Writing and research skills. Clear thinking, punctuality, and a hunger for scholarship. The student must express a passion for documentaries.

Time commitment
4 hours/week for 30 weeks

F19.009: Preserving the Historic Southside Mural at the Murdoch Center
Faculty mentor: Ricardo Guthrie

Overview:
Join Ethnic Studies faculty researchers in preserving the Mural at the Murdoch Center (near Butler and S. San Francisco. Students will help research oral histories, develop walking tours and information lessons for historical figures who helped build Flagstaff and the Southside community: the most racially and ethnically diverse neighborhoods in the City! Duties include working with Murdoch Center staff, preparing art gallery displays of the mural project for "First Friday" events, designing the historic plaque and GEOCODEs for the Murdoch Center, helping paint and preserve the Mural, and researching additional mural images and histories to include on the mural wall. Student credit for Community Development, Grant Support, Art installation, as well as Social Media development will be possible outcomes.

What the student will DO and LEARN:
For this internship, the student will gather historical information from archives and collect information on art installations and mural preservation in preparation for art gallery displays at the Murdoch Center and painting projects in connection with the existing mural. Student will update website and social media portals for the Murdoch Center, and create Geocodes and historical plaques for sites throughout the Southside neighborhoods. Assembling and distributing online lesson plans for 6-12 school visits may also be possible.

Additional benefits:
The student intern will learn about the Southside and develop knowledge and skills in art installations and preservation, community building, research methods in archival research, historical analysis, content analysis, and use of demographics that reflect how to use art to reflect racial and ethnic knowledge practices at the community level. The student will contribute to art installations that can tell a story how diverse racial communities strengthen urban environments and contribute to racial understanding. This project can help students interested in community service and future careers in art/culture for social transformation. It can be utilized by students of all majors and backgrounds.

Additional qualifications:
All students are welcome to apply; seeking self-motivated and organized, energetic students who love to work in the community, outdoors as well as indoors for art celebrations and public gatherings.

Time commitment
6 hours/week for 30 weeks

F19.010: Anti-Black Gentrification and Settler Logics
Faculty mentor: Jessi Quizar

Overview
This project examines the progression of gentrification in Black urban communities. I am examining three cities--Detroit, Chicago, and Oakland--to ask how does (and does not) anti-Black gentrification echo and rely on ideologies of settler colonialism.

This is a large project, and the intern will engage with a small part of it. Specifically, they will research the particular Indigenous histories of each of these cities, as well as the particular processes of colonization that built each. They also will investigate the current context of Indigenous people in each city, including any connections and solidarities they may have with local Black communities.

What the student will DO and LEARN:
The intern will:

- Read history and other scholarship, watch videos, look at organization webpages, read news articles.
- Organize what they find into small reports.

The intern will learn:

- A great deal about the history and current context of the city that they choose, about settler colonialism in general, and about contemporary urban indigenous life.
- To synthesize information into usable reports.
- A bit about the overall process of engaging in and developing historically grounded theory.

Additional benefits:
Students will be a part of a comparative ethnic studies project that centers on both the Black and Indigenous urban experience.

Additional qualifications:
A preference for an intern that has taken an Ethnic Studies, WGS, or AIS class.

Time commitment
5 hours/week for 30 weeks

F19.013: First-Gen Journeys: Confronting, Challenging, and Crossing Academic Borderlands
Faculty mentor: T. Mark Montoya

Overview:
The research project (book manuscript) will draw attention to the academic border-crossing experiences of first-gen students and the many intersections that inform numerous first-gen journeys. While the focus is on the challenges and opportunities that first-gen students face navigating academia through classroom experiences, the project will also explicitly highlight borderlands theories/pedagogies and Ethnic Studies as we discuss what college teachers can do to guide those journeys. First-gen students are essentially starting their journey on an unequal and increasingly crowded field where the lack of social and cultural capital adds extra barriers. Attach to this race, racism, and further intersections of class, gender, sexualities, and abilities; and a college degree may seem an unreachable destination. How first-gen students succeed once they get to the university is of utmost importance. This is especially true from a moral standpoint—if institutions raise students' hopes by admitting them, then they should also provide accessible tools to support students' success on campus. As we know, first-gen students are far less likely to graduate than their continuing-gen peers are. Thus, low retention rates mean lost revenues; not financially, but instead, morally.

What the student will DO and LEARN:
The intern will not only compile and coordinate research via literature reviews and annotated bibliographies, but they will also learn how to conduct empirical and theoretical research within the groundbreaking realms of culture and learning, pedagogy, borderland studies, Ethnic Studies, and the emerging field of first-gen student experiences.
The intern will,

- Understand approaches to implement and/or continue first-gen advocacy and engagement on college campuses.
- Examine first-gen advocacy and engagement amid hierarchies of power in academia
- Investigate the social and political realities of first-gen experiences through a borderlands perspective.

Additional benefits:
I want the intern to be provided the research opportunities and mentorship that I did not have during my undergraduate and even my graduate years.

Additional qualifications:
Social Science, Education, or Liberal Arts background with first-hand knowledge of first-gen student experiences, Ethnic Studies, borderlands studies, critical pedagogy, social justice, and/or civic engagement.

Time commitment
4 hours/week for 30 weeks

F19.015: Civil Society and Politics in Russia and Ukraine
Faculty mentor: Gretchen Knudson Gee

Overview
This project will focus upon gathering data and scholarly literature on civil society and politics in the countries of Russia and Ukraine.

The intern will gather information on civil society scores, as well as data on key players in civil society (journalists, religious groups, political groups, environmental groups, volunteer groups etc) in the countries of Russia and Ukraine. They will also gather data about both countries' democracy scores and political development.

In addition, the intern will do a literature review of the scholarly literature on civil society and political change, both in general and also focused on post-Soviet countries. This literature review will be used to create an annotated bibliography.

What the student will DO and LEARN
The intern will gather, organize and present data from trustworthy sources; search through the scholarly literature to find appropriate scholarly sources; write an annotated bibliography; organize the bibliography in an appropriate fashion; present their findings to the professor weekly. They will learn skills of research, organization, writing, and oral presentation.

Additional benefits
The students will benefit from learning about civil society, political development, Russia, and Ukraine from a factual as well as scholarly perspective. They will enjoy the opportunity to engage in scholarly research, and they will contribute to the creation of scholarly work.

Additional qualifications
- Work independently
- Good time management
- Ability to research
- Strong writer
- Initiative
- Take direction

Time commitment
6 hours/week for 15 weeks

S18.019: Hypnosis, Hypnotic Susceptibility, and Peripheral Vasomotor Control
Faculty mentor: Larry Stevens

Overview
This project is the continuation of a multi-year investigation of the effects of hypnotic suggestions and suggestibility on peripheral blood vessel control, with direct implications for the management of hypertension (high blood pressure) in humans. The study will select participants on the basis of meticulously screened susceptibility to hypnosis in Phase I and will expose selected participants in Phase II to directed hypnotic suggestions to increase or to decrease blood vessel dilation. It is hypothesized that highly susceptible participants particularly will show statistically-significant changes in vasomotor control specific to the directed suggestions. The I2S scholar will be involved in all phases of the study, including implementation of tests of hypnotic susceptibility (live inductions of hypnosis in controlled settings), collection of neurological (EEG) and physiological (blood vessel dilation and constriction) data, processing and analysis of the huge psychophysiological dataset collected, preparation of a poster for the Undergraduate Symposium as well as for regional/national conventions, and assistance in the preparation of scholarly manuscripts. This study has been underway for over a year and it is anticipated that all data will be collected by the end of the spring semester, allowing the I2S scholar to truly be involved in all phases of data collection, analysis, and presentation. This is a wonderful, pioneering, and complex psychophysiological investigation that has never been conducted before, that will doubtlessly have profound implications for the treatment of hypertension, and will result in numerous presentations and scholarly publications.

What the student will DO and LEARN
The project is described in some detail above regarding what the I2S scholar will do. They will learn very many psychophysiological and neuroscience research skills, including the controlled administration of hypnotic inductions and testing of hypnotic susceptibility, the administration of electroencephalographic (EEG) studies, including placement of scalp electrodes, configuration of computer-based equipment, and live collection of EEG data, the application of peripheral blood flow measures (temperature and plethysmography sensors), the computer collection of all data, the subsequent cleaning and processing of all data, statistical analyses, and preparation of scholarly and artistic posters, as well as assistance in preparation of scholarly manuscripts.

Additional benefits
Working on our Research Team, including participating in weekly team meetings, is a genuine thrill and most collegial.

Additional qualifications
Comfort with or interest in learning neuroscience and psychophysiological data collection skills on human participants

Time commitment
6 hours/week for 30 weeks

F19.002: Patient-specific computer modeling of cardiovascular disease
Faculty mentor: Amirhossein Arzani

Overview
Cardiovascular disease is the leading cause of death in the US. In this research, the student will create patient-specific computer models of diseased vasculature using state-of-the-art open-source patient-specific computer modeling tools. Using MRI or CT scan data, 3D patient-specific computer models will be created using image segmentation techniques. Subsequently, blood flow simulations will be done using high-performance computing (HPC) simulations and computational fluid dynamics (CFD). The results from these patient-specific simulations will be used to identify novel predictive biomarkers of cardiovascular disease progression. The ultimate goal of this project is to blend computer modeling, medical imaging, fluid mechanics, and data processing to better understand cardiovascular disease.

What the student will DO and LEARN
The student will use state-of-the-art open-source (free) software to create patient-specific computer models. The student will learn how to navigate medical images and interpret medical image data. The student will learn how to create 3D personalized computer models of the diseased and healthy vasculature. The students will run computer simulations using computational mechanics tools and learn how the data is analyzed. The students are expected to attend our regular weekly lab meetings and present their results, and therefore improve their presentation skills.

Additional benefits
The students will interact with the mentor, PhD students, and MS students at PI's lab and therefore learn about other active research topics broadly related to their own project. Additionally, the student will master state-of-the art open-source software and tools that are currently being used and developed by researchers at top notch schools.

Time commitment
6 hours/week for 30 weeks

F19.004: Impacts of Viral Infection in a threatened frog species, Rana chiricahuensis
Faculty mentor: Joseph Mihaljevic

Overview
The federally threatened Chiricahua leopard frog (Rana chiricahuensis) has been extirpated from much of its historical range and is now only found in Arizona, New Mexico, and northern Mexico. One of the major drivers of this decline has been infectious disease. Over the last decade, several adult frogs that were collected from the wild for a captive breeding program tested positive for a viral infection, and our lab determined that this virus belongs to the viral genus, Ranavirus. Ranaviruses are globally distributed viruses of ectothermic vertebrates (amphibians, fish, and reptiles), and this virus is commonly found in Arizona's amphibians. Viral infection can cause severe symptoms in larval amphibians, often leading to mortality. Because the virus is highly transmissible and often virulent, large die-off events can occur in which nearly 100% of larval amphibians at a wetland die of viral infection. The goal of this project is to understand how ranaviruses might be affecting the population dynamics and recovery efforts of the Chiricahua leopard frog in Arizona. We will synthesize current and historical data to understand how the virus affects larval and adult frog survival, how the virus is distributed across current frog populations in Arizona, and how future outbreaks of the virus might impact the recovery of the species.

What the student will DO and LEARN
A major advantage of this project is that a large amount of data has already been collected. Therefore, the focus of this internship will be for the student to synthesize our knowledge by conducting statistical analyses on the available data and preparing a written report, which has the potential for publication. The intern will also help us to generate ideas for extending this project in new directions. As such, the intern will learn about literature review, statistical analysis of multiple types of data, scientific writing, scientific presentations (poster and oral formats), and the generation of novel scientific questions. The intern will also be actively involved in laboratory meetings with other staff and undergraduate students, and will participate in generating and critiquing ideas for related projects.

Additional benefits
Our lab studies a variety of topics related to wildlife disease ecology, epidemiology, mathematical modeling, and computation, and we collect data from the field and in the laboratory. We integrate these data with quantitative and computational strategies to understand how disease spreads through wildlife populations and how this affects conservation plans. Our lab is therefore highly dynamic and interdisciplinary, such that the intern will have the opportunity to explore ideas in a variety of disciplines related to epidemiology, mathematics, computer science, and wildlife conservation.

Additional qualifications
I will assume that the student requires training in all aspects of this project. However, background knowledge of basic computer programming and/or introductory statistics would be highly valuable. In general, the student should have a strong interest in wildlife biology and quantitative approaches for understanding our natural world.

Time commitment
4 hours/week for 30 weeks

F19.008: Addressing Social Issues through Quantitative Analysis of Online Social Media
Faculty mentor: Ann Collier

Overview : Social movements and activism are increasingly moving to online social networking (OSN) platforms like Twitter, Instagram, Facebook, and YouTube. By using network analysis and data mining techniques, scientists can help illuminate the discourse around some of the most important social issues of our day, including political polarization, diversification of political candidate pools, immigration, intersectionality, sexual harassment and gender-based violence, and digital divides. This research answers questions like:

- How do marginalized groups leverage OSNs to politically organize and connect?
- How do people living in news deserts use OSNs to maintain local news coverage?
- How do group sentiments change over the course of largescale social events?
- How do marginalized groups appropriate hashtags and memes to more effectively disseminate salient content?

Student researchers will be working with data mining tools from Python and R to provide complex quantitative analysis of data collected from platforms, including Twitter and Instagram. They will gain experience with techniques from network analysis, data mining, natural language processing, sentiment analysis, and descriptive statistical analysis.

What the student will DO and LEARN:
The student will:

- Use Python and R libraries to perform overview, descriptive statistical analysis of usage traces collected from Instagram and Twitter
- Use NetworkX and Gephi to create network visualizations
- Use R to generate graphs to be used in publications

The student will learn:

- How to write data analysis scripts using Python pandas, scipy, numpy, networkx
- How to use RStudio to perform a wide array of statistical tests on data and create visualizations of data distributions
- How to collect data using the Twitter API
- How to work as part of an interdisciplinary team that involves social scientists and psychologists
- How to create high-quality scientific visualizations
- How to use Monsoon to run programs on a cluster

Additional benefits: Students interested in the possibility of graduate school will receive significant mentorship and will be connected to a lab that prioritizes hiring NAU graduates to work as graduate research assistants. Dr. Vigil-Hayes currently has a graduate researcher working on this project, which will also provide students with near-peer mentorship opportunities.

Additional qualifications: Experience programming in Python
Strongly self-motivated to learn and teach themselves new skills
Excellent communication skills

Time commitment
6 hours/week for 30 weeks

F19.007: ARORA: Using Augmented Reality to Gamify a Universal Social and Emotional Learning Intervention in Low-Infrastructure Environments

Faculty mentor: Giovanni Castillo

Overview :

Recent studies have revealed promising findings of the long-term positive impact of universal social and emotional learning interventions. In addition, studies of telehealth technologies have shown that they can be an effective means for delivering behavioral health care resources to rural and remote communities. As a means of bringing these two innovations into an integrated tool, we propose the ARORA CARE app, a universal social and emotional learning intervention delivered as a mobile application. Given the success of previous studies of social and emotional learning interventions in youth and adolescents and the high rates of suicide in Indian Country associated with this age group, we propose designing the intervention as a geosocial game that leverages augmented reality technology to encourage participation in activities that develop mindfulness and empathy. We will work with students in grades 9-12 at the Flagstaff Bordertown Dormitories in Flagstaff, AZ, to pilot the ARORA CARE app. Data collected from application usage as well as data collected as part of a pre- and post-intervention survey evaluation will provide new insight into the efficacy of this type of positive psychology-focused universal intervention for Native American adolescents and will point to ways that telehealth interventions might be made to be more relevant to adolescents in Indian Country.

What the student will DO and LEARN:

Student interns will:

- Help implement new features on the ARORA CARE app
- Help test ARORA CARE software
- Help implement new API endpoints on the ARORA CARE backend server

Students will learn:

- How to develop software in Android Studio and the Unity Platform
- How to write API endpoints using the Django REST framework
- How to work as part of an interdisciplinary team that includes computer scientists, psychologists, and graphic designers

Additional benefits:

Students will have the opportunity to work in a lab that has multiple graduate and undergraduate students. Students interested in graduate school will be strongly mentored and will be connected to a lab that prioritizes hiring NAU graduates as graduate research assistants.

Additional qualifications:

- Student must be at least a sophomore
- Student has experience programming in C++, Java, and Python
- Student is strongly self-motivated to teach themselves new skills
- Student has excellent communication skills

Time commitment

6 hours/week for 30 weeks

F19.006: WOLFF: A Wireless Network Architecture for Rural Regions
Faculty mentor: Morgan Vigil-Hayes

Overview :
Rural areas, particularly in tribal communities, experience pernicious digital inequities with respect to Internet connectivity. As part of a larger project that partners with Pueblos in northern New Mexico to facilitate better Internet connectivity and content relevance in tribal communities, WOLFF is a new architecture that seeks to extend and optimize Internet connectivity in rural spaces where Internet access is not ubiquitous and not uniformly high quality. To do this, we rely on heterogeneous networking that uses LoRaWAN (a low powered radio technology designed for Internet of things communications) as a ubiquitous control channel that helps optimize user connections to higher data rate mobile Internet providers. The goal of WOLFF is to allow users to interact with Web-based content even when they do not have broadband connectivity.

What the student will DO and LEARN:
The student will:

- Test prototype network architectures and protocols and collect experimental data
- Create data visualizations for publications using RStudio

The student will learn:

- How to use basic network evaluation tools, such as tcpdump and iperf
- How to design and run wireless system performance experiments
- About the properties of wireless networks, including cellular and LoRaWAN networks

Additional benefits:
Students will have the opportunity to work in a lab that has multiple graduate and undergraduate students. Students interested in graduate school will be strongly mentored and will be connected to a lab that prioritizes hiring NAU graduates as graduate research assistants. Students will also have the ability to make a significant social impact by being part of the development of technologies that will enhance Internet connectivity in rural spaces.

Additional qualifications:

- Experience programming in C, C++, Python, and Java
- Strongly motivated to teach themselves new skills
- Excellent communicator

Time commitment
6 hours/week for 30 weeks

F19.011: Building Experimental Platforms for Research in Robotics and Intelligent Autonomous Systems
Faculty mentor: Truong Xuan Nghiem

Overview :
Autonomous systems, including robots, unmanned aerial vehicles (UAV or drones), and self-driving cars, are expected to become ubiquitous in the near future. They will see numerous applications in all aspects of our society and will have tremendous impacts on our lives. These systems are enabled by advances in science and technology, from electronics to computing and artificial intelligence (AI). However, many challenges remain to be addressed before these intelligent autonomous systems become a reality.

The Intelligent Control Systems (ICONS) Laboratory at NAU, directed by Dr. Nghiem, develops foundational theory, methods, algorithms, and applications of intelligent autonomous systems. At ICONS Lab, we are building experimental platforms for research in robotics and intelligent autonomous systems. We have set up a multi-drone platform in the lab (for a short demonstration, see: https://youtu.be/r1H-Pqc4dPY). We plan to continue to develop this platform and at least another platform. The other platform will consist of a number of autonomous small-scale racing cars, capable of advanced computing and control on themselves. The combination of the two platforms will enable exciting research in robotics and autonomous systems. In addition, the experimental platforms will be used for an outreach educational event in STEM, planned to take place in Spring 2020.

What the student will DO and LEARN:
The student intern will support the development of the experimental platforms as well as educational / training materials for these platforms. In particular, the student will

- Research different options for these experimental platforms, particularly the autonomous cars;
- Help assemble and develop the experimental platforms;
- Help set up or write software for the platforms (usually in Python, C++, and probably Matlab);
- Help PhD students write code to control these autonomous systems;
- Help conduct research experiments on these platforms, gather and analyze data;
- Create educational / training materials for the platforms (manuals, slides, and videos);
- (Optional) Help write scholarly articles of research on these platforms;
- (Optional) Help run the planned outreach event, such as demonstrations and teaching assistance.

Additional benefits:
This internship will help the student build a relationship with the faculty member and his lab and graduate students; improve soft skills such as time management, scholarly reading, general understandings of research, responsibility, accountability, taking initiative, etc. It will also help develop the student's interest and experience in research and STEM education and career.

Additional qualifications:
We are particularly interested in students who have strong interest and motivation in STEM, particularly the Electrical Engineering, Computer Science, and Mechanical Engineering disciplines. Desirable qualifications also include experience and skills in electronics, programming, or robotics (for example, if the student has created DYI robots, has programmed in Raspberry Pi or Arduino, has participated in robot competitions, etc.).

Time commitment
6 hours/week for 30 weeks

CEFNS Postings

S19.004: Native pollinators and habitat restoration in the southwest under climate change
Faculty mentor: Karen Haubensak

Overview
My collaborators and I have begun an ambitious project that attempts to understand the factors that affect native pollinators in the southwest, particularly those pollinators that depend on plants with high restoration potential. We are particularly interested in identifying those plant species that will be both robust in a restoration project as well as support a high diversity of pollinators. We will test those plant-pollinator relationships in the field under a climate change scenario. Our initial work phase will be in the greenhouse, growing thousands of forb species. The next phase will be in the field and will involve planting and measuring all these species, in addition to doing pollinator observations, over multiple years.

What the student will DO and LEARN
The student(s) will assist the PIs (Haubensak, Biology; Grady, Forestry; Aslan, SESES) as well as graduate students in greenhouse propagation tasks. The students will be encouraged to come to the field when their coursework schedule allows; the field site is approximately 3.5 hours drive from Flagstaff. The fieldwork will involve planting forb species into plots in various combinations, as well as taking initial measurements of those plants. For students who are interested, there will be the opportunity to make observations of pollinators (native bees).

Additional benefits
The students will get to join a vibrant, fun group of biologists who are passionate about using science to solve real-world problems. In this case, it's understanding how to implement the most successful habitat restoration projects that consider multiple elements of the community.

Additional qualifications
Ability to follow through; be trustworthy; show up when you say you will; have a good sense of humor!

Time commitment
5 hours/week for 30 weeks

F19.001: Determinants of the muscle force-length relationship
Faculty mentor: Natalie Holt

Overview
Skeletal muscle is the biological motor. It converts chemical energy from food into physical interactions with the environment. Despite the biological importance of force generation by muscle, its determinants remain unclear. My work uses isolated muscle tissue and imaging techniques such as electron microscopy to explore these determinants. We aim to replicated the conditions seen in an organism; such as cyclical length changes during locomotion, changing activation, and the presence to compliant tendons, to enable us to better understand and predict muscle performance during movements.

What the student will DO and LEARN
Students will start the semester by following a 2-3 week reading program to get them to the point of understanding the question we are addressing and why its important in relation to the field. During this time they will complete the mandated animal training requirements that will allow them to become experimentally involved. This process provides essential knowledge and gives them insight into the process of research. After this time the students will do some combination of the following depending on project stage and their interests 1) become involved animal care, 2) learn dissection techniques to extract living muscle tissues - they will ultimately be able to do this independently, 3) assist in muscle physiology experiments, 4) learn to fix and embed tissue for TEM imaging, 5) develop and use data, image and video analysis routines to process collected data. If students complete 2 semesters, they will be supported in developing a presentation to submit to the NAU undergraduate symposium.

Additional benefits
Students will develop general and specialized technical skills in the field such as TEM, dissection and familiarity with common software. This helps with CV building. They will work of different aspects of the project, but weekly lab meetings ensure that they have an understanding of the complete projects, and so gain an appreciation for the process of research.

Additional qualifications
Students should have taken some physiology classes, have an interest in the topic, and be comfortable working with both live animals and animal tissue.

Time commitment
6 hours/week for 30 weeks

F19.005: Creating a Trait Database of Northern Arizona Plants
Faculty mentor: Rachel Mitchell

Overview
The Functional Ecology Lab at NAU studies plant community ecology of grasslands and forests. We are currently establishing a Nutrient Network site (http://www.nutnet.umn.edu/) near Wupatki National Monument; studying seed ecology in Northern Arizona grasslands; and examining flammability traits of understory species in ponderosa pine forests using a functional trait approach. Over the next year, we will be collecting data on plant traits at each of these field sites in order to better understand why species occur where they do, how plants live and compete with one another, and how they might deal with a changing climate. In order to complete this work, we need to measure and record the functional traits of species occurring across Northern Arizona.

What the student will DO and LEARN:
Students will DO the following activities:

- Collect plant samples in the field with their faculty/grad student mentor
- Process plant samples (drying, weighing, measuring plant traits, etc.)
- Collect supporting field data (soil, plant cover data, etc)
- Contribute to the Nutrient Network experiment
- Assemble a database of functional traits for common species in Northern Arizona

Students will LEARN the following:

- The importance of a trait-based approach
- How to read scientific literature
- Standard field methods (plant identification, cover estimation)
- Trait collection and measurement techniques (e.g., specific leaf area measurements)
- Data management
- Ecology of Northern Arizona

Additional benefits to the student:

- Students will be able to visit and work in several ecologically important field sites in or near Northern Arizona.
- Mentoring by faculty and graduate students
- Opportunity to participate in lab meetings
- Networking with graduate students and faculty members in the ecological field in order to improve professional development.
- Increase familiarity with natural systems of Northern Arizona
- The student will learn how to perform common procedures for collecting ecological field and lab data.
- Additional skill building with microsoft office products, and the opportunity to use the R statistical programming language, if the student is interested.

Additional qualifications:

- Attention to detail
- Willingness to perform routine field tasks
- Familiarity with Microsoft excel
- Ability to work independently and in a team
- Willingness to work outside

Time commitment
5 hours/week for 30 weeks

F19.012: Mapping the Mycorrhizal Associations of Alaska and Hawaii
Faculty mentor: Catherine Gehring

Overview: Mycorrhizas are associations between fungi and plant roots from which both partners benefit. The fungi help plants access soil resources and receive sugars from the plant in return. Most plants have these associations but we know little about how they have changed across the US over time as land uses and climate have changed. In collaboration with The Nature Conservancy and the I2S program, we created and published maps of mycorrhizas across the conterminous United States prior to European settlement. However, we did not create maps for Alaska and Hawaii. We propose to work with a student to create pre-settlement maps of the mycorrhizal associations of Alaska and Hawaii and also to explore how those mycorrhizal associations have changed over time. The student would gain experience in developing a data base, linking plant and fungal databases, creating maps and working with a collaborative team on a scientific paper.

What the student will DO and LEARN:
The student will be provided with a database of plant species found in Alaska and Hawaii prior to European settlement and will work with Gehring to search the literature for the types of mycorrhizal associations found on those plant species or their near relatives. The two types of data will be combined and used to generate a map of the mycorrhizal associations of Alaska and Hawaii. The same things will be done for current vegetation data so that we can learn how mycorrhizal associations have changed across the United States over time. Alaska and Hawaii will make an interesting comparison given that one is largely tropical and the other temperate to boreal. To accomplish the tasks, the student will learn how to work with Microsoft excel in a large data context and also how to use ARC GIS to generate maps.

Additional benefits:
Given that we have made similar maps in the past, we can accomplish this portion of the project fairly quickly, allowing time for the student to work with the collaborative team on a manuscript describing the work. We will also show the student examples of the mycorrhizal associations that they will be learning about in the laboratory.

Additional qualifications:
Interest in the natural world and willingness to learn.

Time commitment
5 hours/week for 30 weeks

F19.014: Are mycorrhizal fungi sensitive to CO_2 enrichment in the Mojave Desert?

Faculty Name: Robert Sanford

Overview

Mycorrhizal fungi are an important component of plant productivity in all terrestrial ecosystems, providing limiting soil nutrients and water in exchange for fixed carbon from plant photosynthesis. This is especially true in desert ecosystems, where water and soil nutrients are most limiting. However, we do not know how elevated atmospheric CO_2 might change this. If plants are less limited by carbon vis higher CO2 levels, they are likely to be more limited by water in desert environments. We have samples from the Nevada Free Air CO_2 enrichment experiment, near Reno, NV, which we can use to test this hypothesis. A student intern would help to process the soil samples to extract the mycorrhizal hyphae, and then analyze the samples at the microscope. The intern would be involved in data analysis and have opportunities to present the results and co-author a paper.

What the student will DO and LEARN

The intern will learn the biology and ecology of mycorrhizal fungi and techniques to quantify them. The student will learn wet lab techniques as well as becoming proficient at microcopy. We will mentor the student through these methods, as well as data collection, management and analysis.

Additional benefits

Our intern will be integrated into an active and collegial research laboratory, with undergraduate and graduate researchers. The intern will have the opportunity to be involved in data collection, analysis, interpretation and presentation. These opportunities and experiences will build the student's resume, and expose them to a suite of research and researchers within our group. The student will get opportunities to work on presentations and to co-author a paper.

Additional qualifications

Candidates should have a GPA of 3.0 or greater, ideally with some background in biology, forestry, and/or environmental sciences. We prefer candidates with specific interests plant/soil interactions and climate change.

Time commitment

6 hours/week for 30 weeks

F19.017: Sylver Coinage via Numerical Semigroups
Faculty mentor: Jeffrey Rushall

Overview

Sylver Coinage is a 2-player game played on the positive integers. First introduced in 1976, it is simple to describe but difficult to analyze. Player 1 chooses any positive integer; their choice removes all multiples of that integer. Player 2 chooses any remaining integer; their choice removes all multiples of that integer and any combinations of both choices. The game continues until one of the players chooses the integer 1, and that player loses. The essence of Sylver Coinage is captured in this famous fact: if Player 1 chooses any prime number larger than 3 (5, 7, 11, 13, 17, ...), then Player 1 is in a winning position, but it is not known what subsequent choices allow Player 1 to stay in their winning position.

Once the integers left to play in any game is finite, the set of integers that have been removed is called a numerical semigroup. Although closely related to Sylver Coinage, numerical semigroups have never been used to analyze the game. This project will involve the student creating computer programs to generate large numbers of Sylver Coinage game states, and will introduce the student to numerical semigroups. It is hoped that the data generated will allow one to create playing strategies that can be proven to be successful.

What the student will DO and LEARN

The student will initially focus time and effort towards using software to simulate game situations and collect the huge amount of date in coherent and analyzable form. In particular, we will focus on what happens when Player 1 chooses 4 with their first move. We hope to use some software (perhaps Python) to generate large amounts of game plays based on this initial choice. Once strategy patterns emerge, we will analyze, interpret, conjecture and hopefully prove that various strategies are successful in the context of numerical semigroups. This will require the student to learn basic facts, terminology and notations associated with numerical semigroups. The goal is to formulate specific playing strategies and prove that they lead to winning game plays.

Additional benefits

I anticipate that the student will become very proficient in programming in this game context, and also in basic data analysis. In addition, the student will learn how to find winning patterns in a myriad of data, and learn how to prove that these patterns are winning positions. All of my past I2S participants have pursued graduate work in mathematics, and I seek to continue that trend.

Additional qualifications

I would prefer a math major with some computer programming experience, but neither is required.

Time commitment

5 hours/week for 30 weeks

F17.002: Optimization of Molecular Markers for Feral Horse Genetics
Faculty Mentor: Russell Benford

Overview

The intern will contribute to an ongoing project designed to inform feral horse management in Central Arizona. Techniques the intern will use involve DNA extraction, quantification, and amplification; genetic fingerprinting; and population genetic structure analysis.

What the student will DO and LEARN:

The intern will learn common laboratory techniques including pipetting, reagent handling, stoichiometric calculations; use of common laboratory equipment (centrifuges, thermocyclers, spectrophotometer, genetic analyzer); perform tissue digestion, DNA extraction and quantification, gel electrophoresis, DNA amplification using PCR, and microsatellite analysis in the Environmental Genetics & Genomics Lab. At the end of the internship the intern will have the opportunity to expand his/her synthesis and public presentation skills. The intern will be encouraged to summarize his/her findings in a poster to be presented at NAU's Undergraduate Research and Design Symposium. The skills that will be learned are industry standards and useful in a variety of life science fields, including conservation biology, health sciences, and biomedical research and engineering.

Other benefits to the student:

The intern will gain hands-on work experience in a molecular biology lab, acquire advanced skills in genetic analysis, participate in cutting-edge population genetics analysis, and contribute to the management of feral horses. This activity will provide a professional development experience that can clarify and solidify the intern's understanding and expectations of research and scholarly activities.

Additional qualifications: The intern should have a GPA no less than 3.0, have excelled (with a grade of A or B) coursework in basic biology, chemistry, genetics and/or molecular biology. In addition, personal skills such as patience, attention to detail, and perseverance would increase the intern's likelihood of success.

Time commitment: 6 hours a week/ for 30 weeks

F18.013: Acoustic communication in bark beetles
Faculty mentor: Richard Hofstetter

Overview
Acoustic communication is widespread in bark and ambrosia beetles and used in different contexts from tree colonization, to competition and species recognition. However there are many bark beetle and ambrosia beetle species in Arizona for which acoustic communication is unknown. Objectives of this research are (1) to determine the presence and role of acoustic communication in bark beetles and ambrosia beetles found in Ponderosa pine, (2) to compare and contrast the acoustic structures and sound profiles of these beetles, and (3) to describe the variety of acoustic sounds in response to experimental challenges and playback experiments. The results could yield important insights into the importance of acoustics in wood-living insects and the regulation of this unique group of beetles. Insights into their biology can also provide new avenues for successful bio-control strategies against invasive beetles and acoustic technologies may be used to detect and repel these beetles from trees.

What the student will DO and LEARN
The student will do the following:

1. Become familiar with the steps involved in developing a research project, from initial motivating ideas to design of the project, draft hypotheses, execution of the experiment, data collection, etc. (the scientific method).
2. Learn basic biology of bark and ambrosia beetles found in Arizona.
3. Learn methods used to study insects and acoustics recordings.
4. Learn various data summarization and statistical analysis tools of scientific research.
5. Gain experience in carrying out research projects, analyzing data, and writing up and presenting results in meetings (including experience in using specialized tools at each stage of this process).

In terms of research, the student will collect bark beetle and ambrosia beetles from ponderosa pine trees and grow them in the lab. The student will use experimental tools to observe beetle behavior under the microscope attached to a computer and video camera. The student will learn to use acoustic computer programming to analyze sounds and also image acoustic sound structures. The student may also have the possibility of using the Electron Microscope to take microscopic images of sound structures on the beetles.

Additional qualifications

- Interest in natural sciences (biology, forestry, conservation)

Time commitment
4 hours/week for 30 weeks

CAL Postings

SP18.016: Adapting Euler Graphs and Venn Diagrams for the Study Scientific Reasoning
Faculty mentor: Jeffrey Downard

Overview
In the 18th century, Johannes Euler developed a system of graphical logic for the purpose of clarifying the role of deductive reasoning in mathematics. In the 19th century, John Venn amended Euler's graphical system and then C.S. Peirce dramatically expanded upon these simple systems in the development of a more robust system called the Existential Graphs. In comparison to the symbolic systems of algebraic logic that are widely studied and taught today, the graphical systems make it easier to visualize the logical relations represented in the diagrams. The first step in this research project is to trace the development of the concept of composition in these systems of graphical logic. My reason for focusing on the concept of composition is that I want to explore Peirce's pregnant suggestion—which runs counter to widely held philosophical views today--that the combination of concepts to form propositions involves the same basic relations of composition that are involved in the combination of propositions to form arguments. In doing so, my goal is to buttress the argument for this claim about the centrality of relations of composition using insights drawn from the historical development of these graphical systems of logic. The student will support my work on these three systems of diagrammatic reasoning by focusing on the relative simple systems of Euler Graphs and Venn diagrams. Most students are already familiar with these kinds of diagrams based on their studies in high school and early courses at the university. The aim of the student's research will be to see how these systems can be modified to examine the abductive patterns of reasoning by which hypotheses are formulated and the inductive patterns by which they are tested.

What the student will DO and LEARN
The student intern will learn to use Euler graphs and Venn diagrams for the study of deductive reasoning. Based on this study, the intern will engage in collaborative research under my direction on the use of diagrams generally in the philosophical study of scientific reasoning and help modify the diagrams for the purpose of analyzing inductive and abductive patterns of inference. With this background, the student will analyze paradigmatic examples of scientific reasoning drawn from the history and philosophy of science and use the diagrams to explain what makes some examples good patterns of reasoning and what makes others less fruitful.

Additional benefits
The study of diagrammatic systems of logic is proving to be a fertile area of research for a wide range of areas including computer science, artificial and computer assisted intelligence graphical and video design, as well as a wide range of disciplines in the natural and social sciences. As such, I will be able to draw from student applicants from a wide range of disciplines and the experience will be a benefit for students with a wide range of interests.

Additional qualifications
- interest in interdisciplinary research involving the philosophical examination of methods of inquiry

Time commitment
6 hours/week for 12 weeks

FCB Postings

F19.017: The demographics of Poverty in Arizona
Faculty mentor: Rick Szal

OVERVIEW

Based on data from the Intercensal County Data for Arizona for 2015, it is proposed to conduct an analysis of the relationships between poverty rates and various demographic characteristics, e.g., racial affiliation, rural-urban residence, access to public transportation, number of children and the child poverty rates employment and unemployment, sector of employment, etc. for all the counties of Arizona. This is in anticipation of the 2020 Census that will allow a comparison to determine what progress has been made in alleviating the situation of families and particularly children in the State.

What will DO and LEARN

Under the supervision of the faculty member, the intern will perform statistical analyses and analyze the results to come to conclusions about the factors associated with poverty and child poverty in the various counties of Arizona. The results will be put into a presentation and a poster for the Undergraduate Symposium of 2020. This should be a good lead-in into the census to be conducted in 2020.

Additional Benefits

The student will gain greater familiarity with statistical and research activities as well as the preparation of professional presentations.

Additional Qualifications

A junior student with a cumulative GPA of at least 3.0 who has successfully completed my Business Statistics course (ECO201).

Time Commitment

6 hours/week for 30 weeks