



NEW YORK CITY COLLEGE OF TECHNOLOGY

**CITY TECH**

**Book of Abstracts**  
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## **The Solar Shed: Off the Grid, from off the Shelf**

Kevin Hernandez and Andrew Aucanzhala

Prof. Kevin Conzelmann

Today's off-grid structures are in a sense a return to pre-industrial practices i.e. living off the land, locally. Yet contemporary off-grid methods are fully informed by techniques, inventions and breakthroughs brought about by the 9000+ years of human curiosity, creativity and discovery, and their insatiable search for knowledge, advancement and improved standards of living. This research project will trace the technological timeline featuring pivotal human technological breakthroughs from the times of prehistoric cave dwellings to the beginning of agricultural settlements, to ancient civilizations, to the renaissance, the industrial revolutions and the space age. Using the Solar Shed as a real-world case study, we will explore and learn from the multitudes of natural resources (e.g. wind and sun etc) and man-made innovations (e.g. turbines and photovoltaic panels etc) to propose a solution and opportunity to consider what it can mean to be truly off-grid, living off the land, locally.

## **Optimizing Indoor Environment Quality**

Anjum Ahmmed, Nick Antoine, Jennifer Garcia, Christopher Gabriel Lopez, and Marti Tapia

Prof. Alexander Aptekar

This research investigates an integrative approach to health in building design by focusing on material selection and its impact on indoor environmental quality (IEQ). Specifically, the study examines clay plaster through sensory evaluation methods to compare its effectiveness with conventional finishes in filtering out unpleasant odors from chemicals commonly used in indoor spaces. Key parameters such as material texture, and visual satisfaction will also be assessed. Randomly selected participants from across campus will evaluate the odor of clay plaster and paint applied to the laser-cut composite boards, reporting on each finish's ability to mask the burnt smell of charred edges and the strength of the finish. We expect that clay plaster will be perceived as the most pleasant option as it doesn't contain VOCs (harmful chemicals) and will more effectively conceal burnt odors compared to the traditional finishes. The results will provide valuable insights into the performance of various clay plaster formulations relative to conventional materials, informing future choices in sustainable building design.

## **A Geospatial Analysis of the Intersection of Livability and Sustainability in NYC**

Arianna DiLillo, Sonya Weinstock

Prof. Anne Leonhardt

The study aims to bring awareness and a greater understanding of the intersections and differences between the concepts of Livability and Sustainability in New York City. Delving into this topic is crucial to assist future city planning and development to maintain the city's longevity and quality of life for its residents. Following the Economist Intelligence Unit (EIU) Index's definitions, Livability refers to the quality of life and long-term wellbeing of communities and individuals, whereas the Environmental Protection Agency (EPA) defines Sustainability as defined as the balance between equity, environment, and economy. Initially we diagrammed the different categories and aspects of Livability and Sustainability to study the overlaps, discrepancies, and connections between the various parameters. Through this visualization, we were able to pinpoint the focal ideas that apply to both Livability and Sustainability. We then began to focus on creating descriptive maps that help represent our areas of research in Staten Island and Brooklyn allowing us to have a better understanding of the comparison of Livability and Sustainability in these areas. We intend to further our research at a more micro level of the neighborhoods of Clove Lakes, Staten Island and Downtown Brooklyn. Documenting and studying the way these factors coincide within specific boroughs and neighborhoods will help with creating and maintaining a city that hosts a more sustainable and livable future for its citizens.

## **Careers in Architecture**

Ash Robertson

Prof. Charles Jenkins

Architects draw blueprints, model buildings, and keep track of construction, but they don't have to. An education in architecture can mean so much more. From the arts to the sciences, a degree in architecture might be only the beginning for a wealth of career paths. Over half of architectural graduates end up in other fields. To determine the breadth of these paths I examined data from the U.S. Bureau Of Labor Statistics website, explored anecdotal sources like Reddit and LinkedIn, and conducted interviews. Whether pursuing something else entirely or incorporating unconventional methods, there is vast potential for exploring interests and skills with the lessons afforded by a major in architecture. These findings can help current architectural major students or those considering a degree have confidence that they can continue to pursue what they find interesting while studying architecture and beyond.

## **Architectural Solutions for Marcy Houses 2050; Focus on Climate Change and Population Growth**

Bryant Ariza, Sofia Bilbao, Kaylynn Daoud, Alex Mendoza, and Elijah Walker  
Prof. Naomi Langer-Voss

From professors and students at CUNY City Tech to NYCHA Design & Implementation specialists and NYCHA residents, ARCScholars encompasses a diverse group of scholars united by the common goal of tackling urban challenges through the study and proposal of enhancements to the built environment. This session we focused on investigations and designs for Marcy Houses 2050; focusing on the effects of climate change and population growth. The team collaborated on ideas of home, and changing family structure and how to best prepare for the future. Park Avenue that bisects the development is our area of study where we have four solutions that include; medical clinics, community learning, retail spaces and additional housing.

## **Sustainable Building Envelopes**

Fareda Elsherif, Mariam Selim, Mohamed Hassan, Fatima Ikhmais, and Aia Mahmoud  
Prof. Alexander Aptekar

The foundation, walls, roof, and openings—the essential elements of a building envelope—are examined in this study with a focus on their roles in occupant comfort, energy efficiency, and environmental sustainability. The building envelope significantly impacts moisture management, acoustic insulation, and thermal performance, serving as the first line of defense against environmental influences. This research emphasizes the material composition, structural roles, and sustainability contributions of each component, with a specific focus on strawbale insulation, a heavy timber structural system, and energy-efficient apertures. We evaluate the benefits of thermal mass, particularly in enhancing temperature stability, alongside the carbon footprint and thermal performance of the materials used. Strawbale, chosen for its high insulation value and renewability, is assessed for both its advantages, such as carbon sequestration, and potential limitations, including moisture sensitivity. A green roof system further contributes to energy efficiency and stormwater management. This project also incorporates a carbon calculation for the entire building envelope to quantify its environmental impact. The goal is to provide a comprehensive guide for selecting and optimizing building envelope components, achieving a balanced design that fulfills user needs and aligns with environmental goals.

## **Air Massing**

Gladys Vigil, Emilio Tlacomulco, Michael Ray Malonjao, Levi Fraser  
Prof. Alexander Aptekar

The proposed building design prioritizes natural airflow to create an eco-friendly, energy-efficient structure. By leveraging passive systems such as cross-ventilation, the design reduces reliance on mechanical air systems, thus lowering its carbon footprint. The natural flow of air creates a negative pressure that expels warm air through high-level openings, minimizing energy use. The goal is to achieve a net-zero environmental impact, providing a "breath of fresh air" to the St. George neighborhood by replacing an empty lot with a row of townhouses that integrate seamlessly into the local architectural style. The project will focus on energy modeling using Rhino3D to demonstrate the building's potential for net-zero or even energy-positive performance. With said building design of twenty stories we intend to capture the summer wind air, this is why our vents point in a direction of the most advantageous wind flow. Once we find a more cooperative relationship with mother nature only then can we live a safer and greener life.

## **Off the Grid and Thriving: A Regenerative Architecture**

Jeremyah Herrera, Thomas Plunkett, Jocelyn Sanchez, and Brailyn Ventura  
Prof. Alexander Aptekar

Our project explores the potential of regenerative architecture by analyzing how green roofs and solar panels can work together to improve building efficiency and reduce environmental impact. Using detailed charts, we examine how green roofs help lower rooftop temperatures, boost solar panel efficiency, and support sustainable building practices. Each chart provides insights into specific aspects, including temperature reduction, energy output, and plant performance when combined with solar panels. By focusing on these areas, we aim to show how green roof systems can make a real difference in energy use and environmental health, making architecture a positive force in urban settings.



## **A Walk Through Hidden Green Scapes in NYC**

Rayen Osorio and Priya Babu

Prof. Anne Chen

New Yorkers are known for always being on the go and living a fast paced lifestyle. As a New Yorker myself I rarely have time to take a step back and escape my busy city life. Thankfully New York is home to a lot of public spaces that are very successful in providing this escape through nature. Having green areas in a busy city like New York is important because it impacts the well being of the people by encouraging community engagement, social interaction, and physical activity. We decided to research the public spaces we considered successful in this by documenting our experience there and presenting our findings through videos and storytelling with social media. Through our research we were able to find commonalities between these public spaces and what draws people to go there.

## **Anti-inflammatory Potential of Common Culinary Herbs and Spices: A Comprehensive Review of Ginger, Garlic, Turmeric, and More**

Ajla Feratovic, Jenny Haxiu, Youssef Rouzaqui

Dr. Sanjoy Chakraborty

This review explores the health benefits of widely used culinary herbs and spices, focusing primarily on their anti-inflammatory properties. The study will analyze existing research on natural compounds found in ginger, garlic, turmeric, rosemary, cinnamon, and black pepper, emphasizing their mechanisms of action in reducing inflammation. These ingredients have long been valued in traditional medicine, and recent scientific studies have shown that compounds like curcumin, found in turmeric, can inhibit proinflammatory pathways, such as NF- $\kappa$ B signaling, thereby reducing chronic inflammation. This review will examine whether turmeric or its primary active component, curcumin, has a more potent anti-inflammatory effect when used in its extracted form. The study will consolidate the current peer-reviewed articles to provide a comprehensive understanding of how these natural substances contribute to health and wellness, especially in managing inflammation-related conditions.

## **Investigating Ferric-Reductase-Like Transmembrane Protein in *Tetrahymena thermophila* Using Bioinformatics Tools**

Joshua Fernandez

Prof. Ralph Alcendor

The ferric reductase-like transmembrane protein (FRLTCFP) is a relatively understudied enzyme in *Tetrahymena thermophila*, despite its notable homology with respiratory burst oxidase homologs (Rboh) found in plants and NADPH oxidase (NOX) proteins in humans. *Tetrahymena thermophila* is a widely used model microorganism, renowned for its versatility in gene targeting, genetic crossing, micromanipulation, and biochemical research. Using bioinformatics tools and referencing homologous genes in humans, 11 ferric reductase-like (FRLTCFP) genes were identified in *T. thermophila*. Phylogenetic trees constructed in MEGA using the Neighbor-Joining method, based on protein sequences, indicate that *T. thermophila* FRLTCFP proteins are more closely related to human DUOX1 and DUOX2 proteins compared to other NOX family members. Among these, TTHERM\_00722930 appears to have the closest evolutionary relationship to human NOX and DUOX proteins. To further validate these phylogenetic findings, future studies will include protein structure alignment between human and *T. thermophila* proteins. This comparative analysis is expected to provide additional insights into their structural and functional relationships, enhancing our understanding of the biological roles of FRLTCFP in *T. thermophila*.

## **Systematic Review of the Effects of Cinnamon on Antioxidant Gene Expression**

Matthew Velez, Monique Fungkhee, Rita Zou

Prof. Ralph Alcendor

Cinnamon, a widely used spice, is recognized for its antioxidant properties, which help reduce inflammation and lower the risk of diabetes, cancer, and cardiovascular diseases. These effects are mediated through specific gene expressions regulating antioxidant enzymes and transporters. Cinnamon's activation of nuclear factor erythroid 2-related factor 2 (Nrf2) triggers antioxidant enzyme production, reducing oxidative stress and cellular damage. In some cultures, cinnamon is used in alcoholic beverages, such as rum and whisky. However, excessive alcohol consumption induces oxidative stress, leading to inflammation, organ damage, and nerve injury. Despite extensive research on cinnamon's health benefits, its impact on gene expression remains underexplored. This bibliometric analysis investigates the genes potentially affected by cinnamon and its bioactive compounds. Publications were retrieved from OpenAlex using the keywords "Cinnamon OR cinnamaldehyde OR Cinnamomum"

combined with "alcohol," "aqueous," or "gene expression." VOSviewer software was employed to analyze clusters and keywords. The search yielded 20,770 results for "Cinnamon OR cinnamaldehyde OR Cinnamomum," 7,532 when combined with "alcohol OR ethanol," and 227 with "aqueous." For "gene expression," 121 publications were identified. Bibliometric analysis revealed clusters spanning medicine, chemistry, food science, biology, and biochemistry, with key terms including "gene expression" and "antioxidant properties." This study demonstrates a strong multidisciplinary interest in cinnamon's effects on health and gene expression. Further analysis is needed to elucidate the relationships between identified clusters and the underlying mechanisms of cinnamon's impact on antioxidant pathways and oxidative stress mitigation.

### **Anti-smRNP IgM Levels as Potential Indicators of Disease Severity in *Plasmodium vivax* Malaria.**

By Sanobar Mardonova

Prof. Juan Rivera-Correa

Malaria is a major global health concern, responsible for approximately 241 million cases and 627,000 deaths annually, primarily in sub-Saharan Africa and tropical regions. Its economic and developmental impact is profound, straining healthcare systems in endemic areas. *Plasmodium vivax* is the dominant malaria species outside of Africa. While traditionally considered a mild infection, *P. vivax* malaria is increasingly associated with severe complications, including anemia and organ dysfunction, prompting investigations into its pathogenic mechanisms. Prof. Rivera-Correa's research work suggests that autoimmune responses, such as producing specific autoantibodies, may contribute to disease severity by worsening inflammation and tissue damage. Anti-smRNP antibodies, in general, have been implicated in autoimmune responses and are known to contribute to the pathogenesis of systemic autoimmune diseases such as systemic lupus erythematosus. This study explored the potential of anti-smRNP IgM autoantibodies as biomarkers for disease severity in *P. vivax* malaria in a Colombian cohort. Previously characterized plasma samples were analyzed containing the following three groups: uninfected controls (n = 8), patients with uncomplicated malaria (n = 22), and patients with complicated malaria (n = 12). Anti-smRNP IgM levels were measured using ELISA. The findings revealed that anti-smRNP IgM levels were significantly higher in malaria patients compared to controls ( $p = 0.04$ ), supporting the hypothesis that elevated anti-smRNP IgM levels are associated with malaria. These results highlight the potential of anti-smRNP IgM as a predictive biomarker for identifying patients at risk of severe disease. The findings also contribute to the growing evidence suggesting that autoimmune mechanisms may play a role in malaria pathogenesis. Further studies with larger cohorts and longitudinal designs are needed to validate these findings and assess their clinical implications.

## **Investigating the Structure and Function of Thioredoxin in *Tetrahymena thermophila* using Bioinformatics Tools**

Susanna Pahalyants

Prof. Ralph Alcendor

Thioredoxin is an antioxidant protein found in nearly all living organisms. These proteins protect cells against damage from free radicals. Thioredoxin is essential for many cellular functions including DNA synthesis, transcription, and redox reactions. Additionally, they have been shown to be involved in numerous biological processes like fighting against cancer and decreasing aging. There are two types of thioredoxin proteins found in humans: TRX1, which is more common, and TRX2 which is found mainly in the mitochondria. *Tetrahymena thermophila* is a unicellular, eukaryotic, ciliated organism that is often used in bioinformatics research due to its cell simplicity. Studies on this organism have led to the discoveries of telomeres, histone modifying enzymes, etc. While numerous studies have been conducted on thioredoxin in *Homo sapiens*, there is limited research on the effects of thioredoxin in the protist *T. thermophila*. Bioinformatics tools like PUBMED, NCBI, Blast, MAFFT, and MEGA, allowed me to find the sequences of thioredoxin proteins in both humans and *Tetrahymena*, align their bases, identify their conserved domains, and observe their relationships using phylogenetic trees.

## **What Is Dengue Fever?**

Williana Alcis

Prof. Liana Tsenova

Dengue fever, a mosquito-borne viral disease, caused by the dengue virus, has emerged as a significant public health concern globally, particularly in tropical and subtropical regions. In the Americas, dengue morbidity has escalated in recent decades, with climate change, urbanization, and increased human travel, contributing to the spread of *Aedes aegypti*, the primary mosquito vector. As of early 2024, over 13 million dengue cases and more than 8,500 related deaths worldwide have been reported, with notable increases in New York State due to travel-associated infections. The goal of this study is to bring more awareness about Dengue fever (DF) to our community by analyzing the global and regional epidemiology of the disease, highlighting contributing environmental and sociological factors. An overview on DF is provided describing the agent, transmission of the infection, signs and symptoms, and treatment of this disease. We also aim to inform preventive measures in both endemic and non-endemic areas. Findings indicate that effective management requires a multifaceted approach, including community education, mosquito population control, and personal protective measures. The results underscore the urgent need for

continued public health efforts and research to develop better treatment options and preventive strategies, particularly in regions where dengue is emerging as a critical concern.

### **Moderating Effects of Consumer Traits and Situational Factors of Collaborative Consumption PART III**

*Juan Del Pozo*

*Prof. Alyssa Dana Adomaitis*

Collaborative consumption (CC) is referred to as “sharing economy, peer economy, collaborative economy, crowdsourcing, and the maker movement.” It is built on the notion of “what mine is yours” and consumption behavior includes sharing, borrowing, lending, and exchanging skills for goods. Millennials are young enough to recall their childhood days of *negotiating toy play, borrowing games, and trading with friends*. There is a behavioral shift in millennium consumer consumption where owners of certain personal assets are sharing for profit in the digital marketplace. ‘Some see sharing, with it as a mantra where “*access trumps ownership*,” as a post-crisis antidote to materialism and overconsumption. *The purpose of this research is to examine the concept of CC as a critical concept to update theory related to fashion consumption.* Fashion marketers experimenting with retail apps that support CC may find that some consumers are not interested. Therefore, *the question of which personality characteristics determine consumer interest in CC apps are becoming increasingly relevant for fashion marketers as they consider: (1) whether to use CC retail apps; (2) how to design them to appeal to different consumers; (3) to which type of consumer to promote such service options; and (4) how to do so.* It is a content analysis of fifteen websites that are collaboratively consumed. Websites were assessed on the emphases of messages by using a survey on a Likert scale from 1-5, not present to very present. Items assessed included motivations to CC per the model we made including attitude, sustainability, economics, fun/engaging, status, and social. Analysis of the findings will compare motivations found in advertisements. The highest-rated characteristic was *Enjoyment*, scoring 17.9%, while the lowest was *Economics*, with a score of 9%.

## **How Is AI Transforming Strategic Management for Innovation and Creativity?**

Kevin Moreno

Prof. Shakira Henry

This research explores how strategic management practices have changed with the introduction of artificial intelligence in business. The focus is on understanding how these changes help companies boost innovation and encourage new ideas. The study looks at how traditional strategies have adapted to include AI, which can be used for faster decision-making and flexibility in responding to market shifts. Using case studies from companies and research, we will examine how AI supports tasks, improves collaboration, and enhances customer experiences. So far, the findings show that companies that are actively using AI work more efficiently, effectively, and also create an environment that supports the growth of innovation. This research also aims to provide a better understanding to start-up companies or companies in general who are looking to involve AI in their strategies for growing and scaling.

## **Augmented Reality for Enhanced Campus Navigation: The City Tech Fun Finder**

Amir Gamble

Professor Jenna Spevack

Augmented reality as a tool can help give better informational context to locations and landmarks in the world. City Tech Fun Finder attempts to introduce this tool to the City Tech campus. The purpose not only highlights locations of student resources but better contextualizes them and attaches familiar faces to these spaces. Augmented reality (AR) allows for the real-time integration of digital information into a user's environment. AR technology overlays content onto the real world, enriching a user's perception of reality rather than replacing it. Partnering with Membedit™, "a geolocate augmented reality (AR) storytelling platform" developed and co-founded by Jay Van Buren, this research project attempts to develop a unique user journey to better convey information to students in an engaging and innovative way. The goal is to create a new and engaging way for students to not only learn about campus resources but also to allow for information to be shared in a much easier context. This kind of integration could allow for a cheaper method of allocating campus resources to better distribute information to the student body. This implementation enhances student engagement through interactive technology, reduces printing costs compared to traditional wayfinding methods, enables real-time updates to campus information, and seamlessly integrates multimedia content with physical locations.

## **Pearl Poster Designs**

Oscar Wong

Profs. Maria Genevieve Hitchings and George Garrastegui

For this project, we worked to create an appealing method of showcasing students' final work in the Communication Design department. The hallway of the Pearl building seemed like a good place to display the capstone projects of graduating seniors. After selecting twenty projects to highlight from the previous semester, we moved to designing a layout which included consistent department branding, and citation of student author and faculty advisor. This became a template for showcasing each project as a poster. During the process, we tested various layouts to see what aspects define an aesthetically pleasing design within the set constraints. To do this, we had to manage the time constraints of combing through many student presentations, determine what represents individual projects best while curating the posters to be displayed collectively, and maintain close communications throughout the production and printing process to ensure accurate final work. We explored project and time management skills and gained a deeper understanding of the Adobe InDesign software for multipage design. We hope that the results of this research can bring ideas to other departments on how to display and showcase student final work. Our efficient process of collecting, presenting, framing and hanging student final work could be replicated by other departments throughout the college to celebrate and showcase the work of the college community.

## **Social Media Addiction**

Joel Burke and Ricky Yin

Prof. Amara-Rime Lulu

As social media platforms like Instagram and TikTok become increasingly integrated into our daily lives, social media addiction has emerged as a significant issue. These apps are designed with features such as algorithm-driven recommendations, endless scrolling, and frequent notifications, which can lead users to develop a dependency on them. This dependency is often fueled by the release of dopamine when consuming content, reinforcing the behavior. To better understand how these platforms impact mental health and promote addictive tendencies, this study investigates the roots of social media addiction and addresses an important question: what are the underlying causes of social media addiction, and how does it affect mental well-being? The research will provide valuable insights into the nature of social media addiction and explore potential solutions for fostering healthier digital habits. Initial research suggest a connection between social media use and the increased levels of anxiety, stress, depression, bullying, and loneliness, which may contribute to

rising young suicide rates. This study raises awareness by demonstrating how features such as dopamine and addictive designs contribute to social media addiction and have a negative impact on mental health. Individuals, mental health professionals, and policymakers can use these findings to develop strategies to reduce the negative effects. Encouraging healthier online habits is important to protecting one's health, especially for those most vulnerable and developing a healthier relationship with technology.

## **Garden Monitoring System Using IoT**

Afroza Aktar

Prof. Farrukh Zia

This project focuses on developing an advanced garden monitoring system designed to enhance plant care through real-time data collection and analysis. The importance of this system lies in its ability to address common issues faced by gardeners, such as overwatering, underwatering, and insufficient light exposure, thereby promoting healthier plant growth and optimizing resource usage. In real-world applications, this technology can lead to more efficient gardening practices, reducing waste of water and energy while improving the yield of plants in home gardens or agricultural settings. Several similar projects have been undertaken in recent years, showcasing various approaches to garden monitoring. One notable project involves using IoT sensors to monitor soil moisture and temperature, sending alerts to users when conditions become unfavorable for plants. To build this garden monitoring system, essential hardware components include an OLED display for visual output, sensors for measuring temperature and humidity, moisture sensors for soil analysis, and light sensors to monitor sunlight exposure. An inexpensive but advanced 32-bit microcontroller board serves as the central controller, facilitating Wi-Fi and Bluetooth connectivity for remote monitoring via a smartphone application. Software tools like the Blynk app are utilized for developing the user interface and managing data communication between devices. The system's functionality is tested by simulating various environmental conditions to ensure that sensors accurately report data, and that the overall system responds correctly to changes. The final deliverables of this project include a fully functional prototype that demonstrates the capabilities of the garden monitoring system, comprehensive technical documentation outlining the system's design and functionality, and an oral presentation to share insights. This project aims to inspire greater adoption of smart gardening technologies, promoting efficient and sustainable gardening practices for a broader audience.



## **Adaptive Multi-Agent Learning in Open Environments: Overcoming Challenges of Agent Attrition with Meta-Learning and Dynamic Reallocation**

Derrick Keith, Parviz Subkhankulov, Ostap Tymchenko  
Prof. Changkyu Kim

This research focuses on the challenge of multi-agent learning in open environments where agents work collaboratively towards a common goal yet may unexpectedly disappear. The absence of agents introduces significant non-stationarity, altering the dynamics of interaction and complicating the learning process. To address this issue, we propose a novel adaptive algorithm that enables remaining agents to effectively recalibrate their strategies in response to changes in team composition. Our approach leverages both meta-learning techniques and dynamic reallocation strategies, allowing agents to maintain alignment with the shared objective despite the challenges posed by agent attrition. Through extensive simulations in a custom-designed open environment, we demonstrate that our adaptive algorithm significantly enhances performance compared to static approaches, ensuring that teams can continue to strive towards their common goal even in the face of uncertainty. These findings underscore the importance of developing resilient multi-agent systems capable of sustaining collaborative efforts in dynamic settings, paving the way for more effective artificial intelligence applications.

## **U.S. Healthcare System**

Hailah Nagi and Halima Alazeb  
Prof. Farrukh Zia

The U.S. healthcare system is one of the most expensive in the world, taking up 17% of the nation's economy. Yet, it struggles with major issues such as high costs, uneven quality, and limited access to care. Through research we take a closer look at why the system falls short, especially for low-income families. Public programs like Medicare and Medicaid aim to help but have limits, while private insurance often costs too much for the average person. The result? Many Americans can't get the care they need, and even if they get access to healthcare service, they're likely to receive poor quality care. The research also explores how overworked doctors and nurses impact patient care, leading to mistakes and burnout. By comparing the U.S. system to countries like Italy and Singapore, it becomes clear that spending more money doesn't always mean better care. To fix this broken system, we need big changes - making healthcare affordable, improving quality, and giving everyone a fair chance to access it. This study sheds light on what needs to happen for the U.S. to create a healthcare system that truly works for everyone.

## **Empowering Accessibility Through the LipSync**

Majida Naz

Prof. Farrukh Zia

The LipSync is a mouth-controlled input device that enables individuals with limited mobility to access phones, computers, gaming consoles, and other digital devices. Developed as part of Makers Making Change's initiative to create open-source designs for assistive technologies, the LipSync is built by makers at minimal cost, ensuring it remains accessible to those in need. This research focuses on the design principles, functionality, and community impact of the LipSync, which has been successfully built and deployed over 1,400 times worldwide. Through an analysis of its open-source model and deployment success, this study highlights the LipSync's role in addressing mobility challenges and promoting digital inclusion. The findings demonstrate how open-source assistive technology can empower individuals, foster innovation, and bridge gaps in accessibility. By showcasing the effectiveness of the LipSync, this research underscores the value of community-driven solutions in transforming lives and advancing assistive technology.

## **Design and Fabrication of Custom Assistive Technology Devices**

Mareefa Khan

Prof. Farrukh Zia

The Forest Joystick Mouse Hub (Forest Hub) was created to help people who have trouble using regular computers and gaming controllers because of limited hand or finger movement. In our world today, technology is everywhere, and not being able to use it easily can make life harder for people with physical disabilities. This project explores how the Forest Hub can make it easier for people with limited dexterity to control computers, tablets, phones, and even gaming systems like the Xbox. By using a joystick and special buttons, the Forest Hub can act like a computer mouse or game controller, giving users more control and freedom. Main question in this project was: how well does the Forest Hub work to help people with limited hand movement use digital devices? To find out, we built the device using parts like a custom circuit board, a 3D-printed case, and software that lets users switch between Mouse and Gamepad modes. We tested it by connecting it to different devices to see if it could make controlling these devices easier and smoother. So far, we have found that the Forest Hub works well in translating joystick and button actions into mouse movements and game controls. This device could have a big impact on future assistive technology. It shows that affordable and customizable tools can really improve accessibility for people with physical disabilities. This project opens doors to adding more features in

the future, like wireless options and software adjustments, to make the Forest Hub even more useful.

### **3D-Printed Assistive Devices for Arthritis: Enhancing Independence with Affordable, Customizable Solutions**

Melissa Fernandes, Jasmine Tran

Prof. Farrukh Zia

In order to help people with arthritis and similar disabilities, carry out daily duties more easily and independently, this project focuses on developing inexpensive, 3D-printed assistive devices. Since arthritis frequently results in joint discomfort, stiffness, and decreased mobility, it is imperative to have accessible, adaptable instruments and devices. Conventional assistive technology is frequently expensive and might not be customized to meet the unique requirements of every patient. This project will use 3D printing technology to design and prototype ergonomic aids that address these issues, including mobility aids, adaptive handles, and specialized tools. Some devices may require the use of electrical circuits for their operation. 3D modeling and Computer Aided Design (CAD) tools will be utilized for physical and electrical design and testing. To make sure the gadgets are useful, long-lasting, and simple to use, the iterative design approach will incorporate user feedback, prototyping, testing, and troubleshooting. A functional prototype demonstration, comprehensive technical documentation on the design, 3D printing procedure, and electrical circuit implementation, as well as an oral presentation outlining the project's potential to increase accessibility for arthritis patients, will all be included in the final deliverables.

## **Task-Specific Architectures and Reinforcement Learning Algorithms**

Jason Lin, Taimoor Awan

Professor Changkyu Kim

Meta-reinforcement learning (Meta-RL) algorithms enable agents to adapt and generalize across diverse tasks by learning how to learn. In multi-agent systems, these agents can cooperate or compete to achieve shared or individual objectives. This work explores the integration of Meta-RL with GIGA-WoLF, a convergence and no-regret algorithm designed for optimizing learning in dynamic environments. GIGA-WoLF agents, with adaptive learning rates, outperform fixed strategies in zero-sum and general-sum games by achieving rapid adaptation and strategic stability. By leveraging Meta-RL techniques, we aim to enhance these agents' flexibility and efficiency in transferring learned policies to new, unknown environments. Our approach investigates the agents' ability to adapt to cooperative and competitive settings, enabling seamless interaction and collaboration with their companions. We hypothesize that this combination of Meta-RL and GIGA-WoLF will create a robust framework for optimizing multi-agent interactions in evolving and unpredictable scenarios.

## **A Model to Classify Face Emotion**

Angie Navarro

Marcos Pinto

The COVID-19 pandemic has impacted society's communications, with social distancing, video calls, and face masks limiting people's ability to express or analyze other facial expressions. Research suggests that, as of 2024, many Americans continue to struggle with recognizing facial expressions due to these prolonged effects. Effective interpretation of facial expressions is essential for communication and emotional expression. In response to this challenge, this research proposes a methodology to develop a machine-learning model to classify facial expressions by collecting data, model selections, and ethical considerations. Our proposed methodology involves a dataset of facial images, and videos, followed by selecting a model for training. However, in this research, there might be challenges such as addressing potential biases that can affect model accuracy. This study aims to provide a structured framework for future contributions to the field of machine learning. In this research, we explore possible outcomes of the proposed methodology.

## **Applying Machine Learning to Detect and Predict Fraud in Credit Card Transactions**

Bartłomiej Gralak

This research project explores the application of machine learning to detect and prevent fraudulent credit card transactions, addressing a critical issue in financial security. By leveraging advanced algorithms and feature engineering techniques, the proposed model seeks to enhance the accuracy, precision, recall, and F1-score compared to traditional fraud detection systems. The methodology includes key phases: data preparation, feature extraction, model selection, training, evaluation, and refinement. The model is trained on a large, diverse dataset of credit card transactions, incorporating both legitimate and fraudulent records to ensure robustness and reliability. Rigorous validation processes are employed to optimize performance and minimize false positives and negatives, fostering trust in financial systems. The primary goal is to create a secure environment for financial institutions and their customers, reducing economic losses due to fraudulent activities. Over the course of two semesters, the research timeline includes data analysis, feature extraction, model evaluation, deployment, and the preparation of a comprehensive research paper. This project focused on hands-on experience with machine learning tools and techniques, focusing on data analysis and algorithm selection for classification tasks. The outcomes of this research aim to contribute significantly to advancing fraud detection technologies, ensuring safer credit card usage for consumers worldwide.

## **The Technology Behind Self-Driving Cars**

Danielle White

Prof. Marcos Pinto

Autonomous vehicles (AV) propose life-changing potential to improve transportation, reducing accidents and reshaping urban landscapes. Not only that but AVs are capable of decreasing traffic jams and overcrowding the streets. In other words, it promises to enhance safety and efficiency in society. However, public acceptance remains a key barrier. Additionally, the public are mostly concerned with moral decision-making in critical situations, alongside with safety and privacy. This research will look into advances of AV technology, ethical difficulties in programming decisions, security concerns and consumer perceptions. Research indicates that society is more likely to accept AVs when safety assurances, clarity and regulatory framework are in place. It requires both policymakers and industry stakeholders to reconcile technological breakthroughs and the public restlessness to sell the benefits of AVs while addressing their ethical and operational challenges.

## **CyberSecurity Controls and Products Evaluation**

Darling Cespedes

Prof. Ossama Elhadary

In this research, I conducted a comprehensive review of the evolving field of cybersecurity systematically identifying its diverse domains. I focused on the critical area of Endpoint Security, where I conducted an in-depth analysis of leading solutions to evaluate their capabilities and offerings. My work highlights the importance of securing endpoints to safeguard organizational assets against cyber threats. Through a detailed comparative study, I examined solutions like CrowdStrike's Falcon, known for its robust threat intelligence and incident response capabilities, Cylance by Blackberry, leveraging AI for proactive malware prevention, Microsoft's Defender with its seamless integration and robust features for Windows environments, and Palo Alto's Cortex XDR, recognized for advanced threat detection and threat hunting. By analyzing these tools' unique advantages such as real-time threat detection, cross-platform support, and flexible deployment options I provided actionable insights into their strategic value for modern cybersecurity frameworks. This research offers a valuable contribution to the understanding and selection of endpoint security solutions in an increasingly digital world.

## **Improving AI Decision-Making for Self-Driving Cars and Architectures**

Fahima Zannat

Prof. Anne Chen

Self-driving cars and smart building systems have developed a great deal over the past decade, but their ability to handle complex situations effectively and safely still needs improvement. This research will cover how AI in these systems can be upgraded to make better decisions in unpredictable scenarios. For example, self-driving cars must handle unexpected road conditions like heavy traffic, accidents, or bad weather as well keeping passengers safe. They should also address threats from others, such as when a passenger is buckled in, but someone outside tries to open the door. In such cases, the car should automatically alert the driver and offer options like locking the door or calling the police. In smart building systems, the focus is on improving AI's decision making for energy efficiency, emergency responses, and user comfort. Using simulations and real-world sources, the study identifies areas where AI struggles and helps show where it can improve. This research highlights the need for AI systems that are not only smarter but also more adaptable to its environment, ensuring self-driving cars and smart buildings can safely and efficiently navigate the complexities of real-world scenarios.

## **Fraud Detection in Financial Transactions**

Faria Promi

Prof. Elizabeth Milonas

Fraud detection in financial transactions is critical to safeguarding assets, protecting consumer confidence, and preventing significant financial losses for institutions and individuals. Financial fraud encompasses a range of illegal actions, from identity theft to complex financial scams, making detection a complex challenge. This project explores various methods to detect fraud, particularly through machine learning and artificial intelligence. These approaches improve accuracy, adapt to new fraud tactics, and streamline detection. The study concludes with recommendations for improved detection methods based on findings in current literature, emphasizing real-time analytics, pattern recognition, and anomaly detection.

## **Artificial Intelligence in Education: Preparing for an AI-Enhanced**

Ibraheem Esa

Patrick Slattery

As artificial intelligence (AI) becomes increasingly integrated into daily life and the workforce, its potential to reshape education and employment has grown significantly. This paper advocates for the proactive implementation of AI in education to prepare future generations to collaborate with AI technologies rather than be replaced by them. By fostering AI literacy, ethical awareness, and technical proficiency, educational systems can equip students with the tools needed to excel in AI-driven careers. The research highlights the transformative role AI can play in personalized learning, skill development, and enhancing critical thinking. It also explores the risks of failing to adapt, including the growing threat of job displacement due to automation. By embedding AI into educational curricula, society can empower individuals to harness AI as a partner in innovation, ultimately ensuring human-AI collaboration leads to improved workplace performance and societal progress.

## **Volatility in Financial Markets: Causes and Implications**

Kevin Ramon

Prof. Ossama Elhadary

The aim of this project is to examine the behavior of stock prices and their volatility over time, exploring how fluctuations in market conditions, economic indicators, and investor sentiment contribute to stock price variability. Volatility is a key metric in finance, representing the degree of variation in stock returns and serving as an indicator of risk. By analyzing historical stock data, including price movements and trading volume, this research aims to identify patterns and potential causes of volatility in different market environments. Factors such as economic cycles, interest rates, and geopolitical events are also considered for their impact on stock volatility. The study uses statistical and econometric models to measure and forecast volatility trends, providing insights for investors and policymakers on the stability of financial markets. Using R, I was able to compute the daily Idiosyncratic Volatility (IVOL) of more than 2000 stocks and daily rank those stocks according to the computed IVOL. I am also working on modelling this volatility to gain a better understanding of its behavior.

## **Using Blockchain Technology to Safeguard Pharmaceutical Supply Chain**

Melissa Garcia

Prof. Marcos Pinto

Drug counterfeiting is a major global issue that endangers consumer health and safety. The pharmaceutical industry struggles with poor transparency, inefficient product tracking, and counterfeit or expired drugs. This research proposes a blockchain-based platform to improve transparency and traceability across the supply chain. By recording and verifying each stage of the drug delivery process, the platform allows stakeholders to confirm the authenticity and quality of pharmaceutical products in real time. The findings show that this solution can enhance trust, reduce counterfeit drugs, and protect consumers, making the pharmaceutical supply chain safer and more reliable. This study highlights the potential of blockchain technology to improve public health and trust in the industry.



## **Smart City Self-Driving Security**

Sumiya Jahan

Prof. Anne Chen

The rapid development of smart cities, as exemplified by Singapore and Shanghai, highlights the critical need to address security challenges associated with self-driving cars. This research explores the role of autonomous vehicles within smart city frameworks, focusing on security aspects like data protection, system resilience, and real-time threat mitigation. By analyzing existing smart city models and transportation infrastructures, the study examines how technologies like artificial intelligence, the Internet of Things, and big data can enhance vehicle safety while safeguarding against cybersecurity threats. Methods involved a comparative analysis of Singapore's mature smart city initiatives and Shanghai's emerging frameworks, identifying strategies for secure implementation of autonomous vehicles. Findings reveal that while self-driving cars improve mobility, reduce congestion, and support environmental goals, their reliance on interconnected systems introduces vulnerabilities that require robust cybersecurity measures. This research emphasizes the importance of real-time data encryption, secure network protocols, and comprehensive regulatory frameworks to ensure the safety and reliability of self-driving systems. These insights contribute to the development of secure, efficient, and sustainable transportation solutions, reinforcing the potential of smart cities to provide safe and innovative mobility options.

## **Innovations in Full-Stack Web Development: Front-end to Back-end**

Yassine Chahid

Dr. Patrick Slattery

This research explores emerging technologies within full-stack web development and their potential impact on current front-end and back-end solutions. Both areas employ crucial technologies that determine how end-users access information and navigate web services. Front-end solutions include HTML, JavaScript, and CSS which shape user interaction on websites. Back-end solutions use technologies such as SQL and PHP for the foundation of data processing, retrieval, and storage. The research method involves examining official documentation for these technologies to better understand their key components and to understand how their use in cyberspace has changed. The research will observe several high-traffic websites and domains to see how these technologies are applied. Networking technologies and protocols will be briefly touched upon to further understand communication. By comparing front-end and back-end development, the research will gain an understanding of their individual properties. This assessment may help identify potential areas of improvement for these

technologies as newer versions evolve. While exact timeframes for when these enhancements are integrated cannot be predicted, the research will make informed projections based on the findings and analysis.

### **How can the integration of Cisco switches and Next-Generation Firewalls (ASA) into an educational environment enhance abilities in network security?**

Yinson Tso and Jamel Williams

Prof. Xiangdong Li

Network security is very important in today's business and our life. To do the technology research requires the most recent technology from the industry. In this research program, the students will learn how to configure and implement the state-of-the-art security equipment from the industry into the educational environment, integrated with other computer technology. The advanced equipment includes the Cisco switches and Next-Generation Firewalls Adaptive Security Appliance (ASA), etc. The research includes theoretical study and lab work. The students will learn how to find the problems and then try to solve them. This project will develop the strong hands-on skills and independent learning ability for the students which are essential in the research of technology. The research will also strengthen the students background in the field of network.

### **Climate Change Impacts On Bridge Scour Risk In New York State**

Alioune Sy and Rilwan Usman

Professor Samaneh Gholitabar

Bridge scour, the leading cause of bridge failures, occurs when water flow erodes the soil around bridge foundations. Climate change exacerbates this risk through more frequent extreme weather events, rising sea levels, and changing precipitation patterns. Traditional models like HYRISK often overestimate failure probabilities and economic impacts, highlighting the need for updated frameworks. This study addresses this gap by developing a comprehensive risk analysis framework that integrates geospatial, bridge, and waterway data to more accurately assess bridge vulnerabilities to climate-induced scour.

## **Re-purposed Whole Textile Reinforced Clay to Enhance Bearing Capacity of Pavement Soils Abstract**

Angelis Almanzar, Chrisly Narcisse, Yoselin Sarita  
Prof. Ivan L. Guzman

Our research aims to monitor and verify if repurposed textile will modify the shear strength characteristics of clay soils, for the potential use in roadway pavement modified soils. During this phase of the study a procedure was established for obtaining and procuring consistent specimens. The ambient water content of the clay soil was determined. Due to the high in-place water content of naturally occurring clays, the water content of the specimens was increased by 30%. All tests conducted followed standard ASTM procedures for D2216 for moisture content determination. Once an acceptable water content was added to the specimens, they were allowed to cure under controlled laboratory conditions. Then the specimens were monitored on a daily basis to get a sense of the stability of the water content under our particular laboratory conditions. It was found that specimens remained stable for the duration of a week and a half. The Harbor Miniature Compaction method was then employed to create uniform, compacted clay specimens of similar water content. Once the specimens were prepared, they were tested following the methodology of the Unconfined Compression Test in general accordance with ASTM Standard D2166 to evaluate the mechanical strength of the samples. Results demonstrated that increased water content adversely affects undrained shear strength of the clay, verifying the inverse relationship between moisture levels and soil stability that is often found in literature. Moving forward, future research will explore following the same procedure for specimen preparation while incorporating re-purposed textile fabrics into the clay sample to enhance strength. This approach aims to improve the structural integrity of clay-based materials for construction and geotechnical applications such as pavement design and shallow foundation design.

## **Sustainability Dental Waste, Seeking Plastic Replacement Material**

Kailin Liu, Chulan Xu

Prof. Khrystyna Vyprynyuk

The dental industry is a major producer of plastic waste. Centers for Disease Control and Prevention (CDC) requires an infection-controlled environment for patients and clinicians, and plastic use is inevitable. Disposing of plastic materials is a significant and growing environmental concern, mainly due to their non-biodegradable nature. Plastic material will need many years to degrade effectively. Finding a biodegradable material with the necessary properties for dental use is essential. Our research is aimed at the concept of sustainability and how dental waste can be transformed into materials that can effectively reduce environmental impact. An extensive literature search was conducted using peer-reviewed research articles, research studies, and journal articles. Two possible biodegradable materials have been discovered: polybutylene succinate (PBS), which contains polyethylene glycol (PEG), and alginate, which is blended with starch. PBSF-PEG material has promising properties such as increased tensile strength, faster water degradation, and melting temperature. The alginate blended with starch generated plastic film, showing lower gas permeability and improved mechanical properties. Both materials show some degree of disadvantages as sustained replacements. Further research is needed to discover better sustainable replacements for plastic.

## **The Orthodontia Oral Health Connection**

Sem D. Lama, Cynthia Monroy, Alexandra Rubiano

Professor Khrystyna Vyprynyuk

Malocclusion, the misalignment of teeth, is a prevalent issue that affects both the oral cavity and periodontium. Orthodontic treatment is the most common solution to correct malocclusion, but it also presents challenges in maintaining oral hygiene. Misaligned teeth and those undergoing orthodontic treatment are more prone to plaque and tartar accumulation, which can lead to periodontal diseases such as gingivitis and periodontitis if not properly managed. A literature review was conducted to evaluate the relationship between orthodontic appliances and oral health. During this research we examined the impact of orthodontic treatment on patients with pre-existing periodontitis, effective strategies for maintaining oral hygiene during orthodontic treatment, and oral health benefits of orthodontic treatment. These findings underscore the importance of both effective orthodontic care and diligent oral hygiene in achieving optimal oral health outcomes.

## **Arduino-ESP32 based Smart Irrigation System**

Kevin Balbuena Montes, Erick Cabrera

Prof. Ahmed Hassebo

With the increasing need for efficient water management in agriculture, this research develops an Arduino-based automated irrigation system. The project integrates an Arduino microcontroller and an ESP32 module to monitor and manage irrigation through real-time data collection and control mechanisms. Soil moisture, water levels, and local weather conditions are monitored by sensors, with data displayed on an inter-inter circuit - liquid crystal display (I2C - LCD) screen to enhance accessibility for users. The ESP32 module manages alert notifications via text, enabling users to stay informed remotely. Essential components, including a water pump, valve, relay module, organic light emitting diode (OLED) screen, and LED display, are coordinated for precise control over irrigation levels, while an AC connector and speaker module support the system's operations with safety alerts. This system aims to minimize water waste, optimize irrigation cycles, and provide an accessible, data-driven solution for both agricultural and home garden applications. The report will demonstrate the system's effectiveness in improving irrigation practices, showing its potential as a sustainable model for resource management in small-scale farming and gardening contexts.

## **Constructing an Arduino-Based Electric Vehicle**

Kristian Rice and Ahmad Rafi

Prof. Ahmed Hassebo

This research aims to develop and operate an electric vehicle using an Arduino microcontroller. Key components required for the vehicle's construction include sensors, a motor, and the Arduino itself. The Arduino is programmed to control the motor's movement and activate the sensors. The sensors detect obstacles, enabling the vehicle to avoid them, while the motor drives the vehicle's motion. By integrating the sensors and motor with the Arduino, a fully functional electric vehicle is assembled.

## **Arduino-Based Color Detection Electric Vehicle**

Louis Medina, Egypt Paige

Prof. Ahmed Hassebo

The Arduino microcontroller processes sensors' data and controls the vehicle's movements through actuators, enabling it to detect colors (e.g., White and black colors) on the ground. The purpose of the Project is to create an Arduino-based electric vehicle that utilizes sensors e.g., infrared (IR) and ultrasonic to navigate a predefined environment without human interaction. This project highlights the potential applications of such systems in various fields, including robotics and autonomous technology. This project demonstrates the feasibility of utilizing Arduino-based systems for autonomous vehicles, showcasing how microcontrollers and sensors can work together for real-time decision-making and navigation.

## **Behind The Emerald Seams: The Costuming of 'Wicked'**

Amanda Padilla

"Wicked" is a widely celebrated musical that reimagines the untold story of the witches of Oz, offering a unique perspective on the iconic characters of Glinda and Elphaba. Costuming plays a crucial role in the show's storytelling, visually distinguishing the characters' arcs, social hierarchies, and transformations. This research aims to analyze the costumes of 'Wicked' to uncover how they contribute to character development, themes, and the overall narrative. It will explore the designer's artistic choices, and the symbolism within the fabrics and colors. Additionally, the study will examine how the costumes align with the emotional and psychological journeys of the characters. The findings will underscore the importance of costuming as a vital storytelling tool in musical theater.

## **Expanding Worlds: Reinventing Wayang Kulit Through AI and Collaborative Storytelling**

Samuel Cheung

Prof. David Smith

In my internship, I focused on enriching the depth and complexity of our story through immersive world-building and the collaborative integration of AI tools. To document key elements of our fictional universe, our team developed a comprehensive wiki detailing pivotal events, natural phenomena, characters, and foundational lore. This initiative allowed us to explore cultural and architectural intricacies previously underrepresented in our shadow puppet play script, broadening the narrative scope and aligning it with traditional Javanese storytelling. A major highlight of my work was the creation of Nagakara, a divine messenger inspired by the Javanese folklore of Baru

Klinting. As a guiding figure and 'destiny engine,' Nagakara bridges alternate universes within our narrative, enabling branching storylines while maintaining ties to the core plot. This character exemplifies my effort to blend cultural authenticity with modern storytelling techniques, expanding the universe of our production. By reimagining Wayang Kulit in a contemporary format, I designed a game narrative that explores alternate realities while remaining grounded in the cultural richness of the original work. Collaborating with AI tools such as ChatGPT, I created original content, refined the script, and enhanced the narrative's coherence. This process deepened my connection to the characters and enriched the story's thematic elements, fostering a collaborative and ethical approach to storytelling. As we refined the script and expanded the world, the project evolved into a multidimensional creative endeavor with the potential to extend far beyond its college roots. Through my efforts, combined with those of our research team, lead scriptwriter, and AI integration, this project demonstrates how modern technology and traditional storytelling can converge to create innovative and culturally resonant narratives.

### **Reimagining Wayang Kulit: A Modern Storytelling Approach**

Tshari Yancey

Prof. David Smith

Wayang kulit was originally used as a medium to spread Hinduism, and later Islam, in Indonesia. The performances often included stories from the Hindu epics, the Ramayana and Mahabharata, embedding religious teachings within the narrative. These tales provide moral lessons on good versus evil, justice, and devotion. This research project aims to blend the traditional art of Wayang Kulit with modern storytelling techniques. Using my screenwriting and voice acting skills, I created a modern twist on Wayang Kulit narratives, bringing new perspectives to this cultural tradition. In addition, our group will be responsible for the technical setup for video projection and editing, ensuring the performance is captured and digitally presented. A further extension of the project includes developing an illustrated book and video game by Samuel Cheung that integrates the script and visual elements from the shadow puppet performance. This semester we wanted to enhance the legendary artform with a new character background narrative and the continuation of Karna and Kunti going on this adventure to become archers. While writing the script I drew inspiration from real life events of the Javanese people through various information from Wikipedia and Britannica. I gained an in-depth understanding of Wayang Kulit as not only an art form but as a tool for cultural storytelling and religious education. Additionally, through the illustrated book extension, I've explored ways to preserve and reinterpret Wayang Kulit visually and textually, reinforcing the storytelling elements. Overall, this project has given me a multi-faceted insight into cultural preservation and adaptation, along with a hands-on role in reimagining traditional narratives.

## **Blended Shadow Puppetry**

ZiXuan Wu

Prof. David Smith

The purpose of this research is to create a virtual environment that can be the foundation of the Blended part of “Blended Shadow Puppet Project”. CST Students at City Tech provide a virtual environment and pilot project for the Blended Shadow Puppet Project using the Unity Game Engine in a 2D environment. This provides a pilot project that focuses on creating the framework for future prospects of the Project. The first phase of the project was to gain familiarity with the engine and its programming environment. The second phase of the project was to create the 2D virtual environment as a pilot test. We then create and add a couple of characters and test their ability to navigate the space, including some basic interactions. The findings of this research helps CST students be introduced to a new virtual environment in creating games and coding. This project is an important step in the development of a Blended Reality Performance System (BRPS), in that it starts to create the virtual companion for the physical set and stage of the Blended Shadow Puppet Theater in order to test the applicability of the Theoretical model Balanced Blended Space. Even though the Unity project is not currently done yet, it is intended to be the template to create a game in the future.

## **Understanding of the Impact of Climate Change on Building Energy Consumption**

Ferasuddin Siddiqui, Abdellah Gessra, Rashiek Barber, Christopher Sanchez and Takoda Nestor

Prof. Daeho Kang

Human activity and greenhouse gasses emissions have reached a record high causing global temperature to rise. Buildings are the primary contributors to climate change along with being primarily affected by climate change. To address these issues, significant efforts are needed to improve building energy efficiency, which in turn reduces climate change. This study focuses on the impact of climate change on buildings. By comparing the impact of climate change on buildings in different regions climate change can be better understood. Heat degree days and cooling degree days in different areas were measured to see how climate change impacts buildings' energy demands. The findings reveal that the rise of global warming increases the demand of the HVAC systems. The growing demand leads to a decrease in efficiency and higher operating cost, worsening climate change and its effects. This research will help with the development of different strategies to reduce energy consumption. Future research is required where a bigger database can be used to improve accuracy.



## **The Intersection Between Sustainability and Accessibility**

Aurora Hidalgo

Prof. Tracy Zimmermann

This research study explores the intersection of sustainability and accessibility regarding healthy food sourcing, with a focus on local communities in Brooklyn, New York. Urban environments often face the challenge of having limited access to affordable fresh produce. With growing concerns over food security, hydroponics is a potential solution. Hydroponics is an urban farming method that uses nutrient rich water to grow plants. By examining various scholarly articles, community reports, and utilizing City Tech's hydroponic system, this study identifies some of the key benefits and limitations of hydroponic farming. Findings suggest that while hydroponics can enhance food quality and availability, the financial investment may serve as a deterrent and calls for further research.

## **Public Spaces and Community Well-Being**

Josue Peralta

Prof. Smita Ekka Dewan

The designs and accessibility of public spaces play a vital role in positive community well-being, especially in New York City and other urban areas. Public spaces, such as parks, plazas, gardens, and local markets, like the market occasionally open on the Highline, offer some of the largest venues in the city for social interaction, physical activity, and mental relaxation. These activities contribute to the overall health and cohesion of communities. There is a clear connection between the quality and accessibility of urban public spaces and the mental, emotional, and physical well-being of urban residents. Some of the key components found in the study are the size, the seating, and the available physical activities (slides, hopscotch, monkey bars, and swings). With the current findings of this research, improving the accessibility and overall quality of a city's public spaces will positively impact the community's well-being regarding social engagement, and physical, emotional, and mental health.

## **Cultural Barriers and Communication: South Asian Experiences in Health Care Settings**

Sabahat Moughal  
Prof. Sarah Price

Communication is a complex aspect of integration into American society for immigrants, and when it involves health care, it can become particularly challenging and stressful. This is especially true for South Asian immigrants and their health care providers, who face language, cultural, and ethnic barriers. This research addresses these challenges by gathering narratives from South Asian patients and health care professionals through in-depth, open-ended interviews, conducted via Zoom or in person and voice-recorded without identifying information. The interviews aim to assess communication styles (verbal and non-verbal), methods (such as symbolic practices and culturally specific terms), and regional understandings of health care within diverse South Asian immigrant communities and among their healthcare providers. Currently pending IRB approval, this research has no findings to present yet. In addition to presenting these findings at symposiums, I intend to transform them into a podcast series that will be accessible to both patients and providers. This series will foster a broader societal impact by creating a space for healthcare professionals and patients alike to share their experiences. Ultimately, the goal is to promote greater understanding and collaboration, with the hope of bridging communication gaps through improved cultural sensitivity and competency among healthcare professionals.

## **Brewing Recommendations: A Data-Driven Approach to Coffee Recommendations Using Linear Algebra**

Angelica Tellez  
Prof. Johann Thiel

This project explores the application of linear algebra to develop a personalized coffee recommendation system based on individual preferences. By analyzing five randomly chosen user preferences across five different features that define their ideal coffee (e.g., flavor, aroma, aftertaste, acidity, and body), we created a mathematical model that uses these preferences to recommend five additional coffee beans tailored to each user. Using Python, we developed a recommendation function that enhances the coffee-drinking experience by comparing suggested options with each user's unique coffee profile. Linear algebra concepts such as the dot product, vector normalization, and vector similarity were essential to building this model. These techniques allowed us to quantify user preferences within a high-dimensional space. Through this research, we demonstrate how linear algebra can inform everyday choices, down to the specific

coffee we enjoy. In the future, we aim to gather real user data to refine the model, ideally generating accurate recommendations with even fewer inputs.

## **Real Life Applications Of Combinatorics**

Emmanuel Oitamong

Prof. Satyanand Singh

Combinatorics is a branch of mathematics that focuses on counting and arranging objects in different ways. It's a powerful tool used in various fields such as computer science, probability, and problem-solving. Two important techniques in combinatorics are binomial coefficients and the stars and bars method. These methods are used to solve counting problems where we need to figure out how many ways we can select, arrange, or distribute objects under specific Conditions. Binomial coefficients are used when we want to count how many ways we can choose a certain number of objects from a larger set, where the order doesn't matter. For example, how many ways can we select 3 students from a group of 10? The binomial coefficient helps us answer questions like this by counting all possible combinations. It's represented by the symbol  $\binom{n}{k}$ ,

where  $n$  is the total number of objects and  $k$  is how many we are choosing. The stars and bars method is used to solve problems where we need to distribute identical objects (often called "stars") into distinct groups (called "bars"). For example, if we have 5 identical candies and we want to distribute them among 3 children, the stars and bars method helps us count all possible ways to do this. The formula for the stars and bars method is:

$$\binom{n+k-1}{k-1}$$

where " $n$ " is the number of identical objects (stars) and " $k$ " is the number of distinct groups (bins or categories). This formula counts the ways to distribute the objects into the groups. These two methods are different, but both are essential tools for counting in combinatorics. Binomial coefficients are great for problems where we are selecting items, while the stars and bars method works well when we are distributing items into groups. By understanding these techniques, we can tackle a wide variety of counting problems, from organizing teams to solving puzzles and more.

## **Probabilistic Simulations**

Rona Zhang

Prof. Satyanand Singh

Proficiency in the statistical analysis of data is necessary to keep pace in a society increasingly driven by advances in machine learning, which utilizes algorithms to gain insights from large quantities of data. A fundamental concept within statistics is the probability distribution, which is used to denote the likelihood each probability will occur relative to each other for each element of the set of possible outcomes of an experiment. Fitting such distributions to data facilitates a more objective, standardized, and expeditious understanding of how the parameters of that data relate to each other; such fitting is also used extensively in machine learning as well. R-Studio is a versatile coding environment used for statistical computing and visualization that also benefits from synergy with the popular Python programming language and its multitude of data science packages. By using R-Studio to code simulations of various probability distributions, students who are new to statistics can gain an increased understanding of these distributions both conceptually and visually. This introduction can then serve as a bridge to future exploration of the multitude of ways probability distributions are encountered and applied within different fields in society, which in turn allows for improved study and focus towards career goals in these fields.

## **Space construction using Lunar soil through Geopolymerization and 3D Printing**

Maria Hashmi

Prof. AKM Rahman

To address the challenges of extraterrestrial travel and lunar habitat construction, research is underway to develop a cost-effective geopolymer utilizing lunar dust for 3D printing on the Moon. Utilizing lunar dust significantly reduces the need to transport materials from Earth, thus optimizing storage space. This study focuses on the composition of lunar maria (LMS) and lunar highlands (LHS) to determine the necessary components for a robust geopolymer capable of withstanding lunar conditions. Emphasizing aluminum-silicon ratios and Potassium Hydroxide (KOH), our objective is to create a durable, resource-efficient lunar geopolymer.

## **Use of Sensors for Mechatronic Applications**

Rachica Jean Baptiste

Prof. Andy Zhang

This project explores the use of various sensors to create applications in the mechatronic field. Main focuses are on environmental monitoring and automated hazard detection. Hall effect sensor, chemical (gas) sensor, flame sensor and vibration sensor are being used in this project. Using Arduino microcontrollers, information obtained from these sensors is being used to detect the speed of a DC motor, detect harmful gases or flames, and to detect vibrations in the mechatronic devices. Computer programs utilizing the sensor inputs were created to take actions in response to the sensed environmental changes, such as turning on fans or activating alarms based on pre-set thresholds. These experiments highlight the fundamental use of sensors, actuators, and microcontrollers in creating mechatronics applications.

## **NASA Microgreen Cultivation in Space Utilizing Minimum Water**

Thomas Alarcon Ali, Zohaib Khan, Ariel Marroquin, Samuel Martinez, Fabiha Samiha, and Emily Yong

Prof. Ozlem Yasar

During long-term space expeditions, it is crucial that astronauts receive the nutrients they need to maintain their overall health. While the current space diet of palatable foods is commendable and constantly evolving, nutritional content and food quality degrades over long durations. Microgreens are young plants that are harvested when true leaves are just emerging. They are nutrient-dense due to their high bioavailability and also small and densely grown, making them an excellent candidate for space cultivation and adding variety to the current space diet. However, antigravity, microgreen fragility, degradation speed, contamination, and limited water resources are substantial barriers to doing so. Hydroponic methods of growing microgreens in boxes and mats are currently being studied by NASA and other organizations. This study aims to address these challenges and provide an alternative solution by cultivating microgreens inside a hydrogel, a soilless medium, to minimize water usage. Samples of Polyethylene Glycol Diacrylate (PEGDA), a biocompatible polymer, were fabricated using photolithography to provide the moist environment required for microgreens. Arugula seeds were then encapsulated into these samples with inbuilt 3D printed flow channels to enable additional nutrient diffusion. 75% of the seeds germinated in the PEGDA samples within 1-3 days when left submerged in water, with true leaves emerging shortly afterwards. Although these results demonstrate great potential in microgreen cultivation in space, further research is needed to solidify the cultivation procedure, ensure continuous plant growth after plant collection, as well as observing the effects of antigravity on the cultivation itself.

## **Strong Interactions and Big Bang Nucleosynthesis**

Alexis Vidals

Prof. Boris Gelman

To understand the fundamental physics of our universe we trace all the way back to the Big Bang and the first few moments after the expansion of the universe. Big bang nucleosynthesis refers to the first few minutes of the birth of the universe where the formation of nuclei occurred. The four fundamental forces of nature, more importantly the strong nuclear force, allowed the formation of subatomic particles and the first elements of the periodic table, like hydrogen and helium, which led to the complex chemistry necessary for life. Through scientific literature we identify elementary particles and their interactions at high energies via the standard model: our best current attempt at explaining everything in the universe. We also surveyed the cosmological principles underlying the Big Bang theory and the creation of matter in the early universe. By conducting this research I gained a better understanding of quantum mechanics, the physics that studies the behavior of atomic and subatomic particles, and relate it to the theoretical infrastructure of the Big Bang Theory.

## **Parameters for Entanglement between various Qubits for Quantum Computers**

Alyssa Burtsev, Melissa Demollari, Elizabeth Frias, Houke Gao, Stefanie Rivera

Professor Oleg Berman

To make a quantum computer system, one must understand the core components of qubits, their variations, and how the entanglement of certain qubits can lead to the fast processing of complex problems. Quantum bits can occupy multiple states, 0 and 1, simultaneously. This superposition is too complicated for classic computers, which are only capable of using bits either 0 or 1, at a given time. The ability for quantum computers to do this will accelerate processing times, revolutionize technology, and bring advancements in fields such as logistics, finance and manufacturing. Since many security systems rely on factoring numbers, quantum computers could potentially breach security systems. On the contrary, it will have the ability to create their own quantum encryption becoming virtually unbreakable, using qubits, the fundamental unit of quantum information. Through researching the different types of qubits from past research, we determined what advantages and disadvantages these qubits have. Our findings were that although superconducting qubits were easy to make using already existing circuit technology, they were only able to interact with qubits around them, four maximum, and only at the very low temperature of 0.1K. Trapped atomic and ion qubits create a high quantum entanglement to work with all qubits in the system at temperatures up to 4K but very slowly. Photonic qubits work at room temperature with a high quantum entanglement, but they require matter-based

components like beam-splitters and detectors to blend light with matter, which technology is currently unable to produce. To continue our research, we can research more qubits to better understand their uses.

### **Exploring Properties Of Resolved Regions In Galaxies Through Cosmic Time**

Ena Chia

Prof. Charlotte Olsen

The properties of galaxies provide key insights into the complex physical processes governing galaxy evolution. The relationship between properties within a galaxy can reveal the internal conditions that regulate how gas is converted into stars. While observations have shown that star formation can turn on or shut off – a process known as quenching – in different parts of a galaxy, the mechanics of what causes this are not well understood. By using a hydrodynamical simulation of a Milky Way type galaxy, we investigate the variations of stellar mass and star formation rate across different regions within this galaxy. Analyzing the different properties in regions of the galaxy we can discover what areas are actively forming stars and what areas are not. Performing this same analysis on the galaxy in its past (up to 1 Gyr ago) we can see what regions were formerly active but are now quenched – or vice versa. Tracking the change in the relationship between stellar mass (amount of stars) and star formation rate over time gives us powerful insights into how galaxies evolve.

### **Heat Monitoring in the New York City Subway System**

Isatu Jalloh and Shaquan Larose

Prof. Abdou Bah

New York City (NYC) faces great challenges due to the rapidly changing climate. Many facilities including underground transportation infrastructure will be severely impacted from climate change effects, particularly from more frequent heat waves. The increased temperature in the New York City subway system during periods of heat waves could impact the health and safety not only of commuters, but also of the subway system's personnel and infrastructure. However, the severity of the temperature impacts is not well known. For this reason, this study thoroughly investigates temperature impacts and implications within the subway system. Temperature and relative humidity data were collected using sensors and thermal infrared cameras in several underground stations across NYC in the Bronx, Brooklyn, Manhattan and Queens. The findings will highlight critical areas where heat management is most needed, suggesting targeted interventions to mitigate heat buildup.

## **Fabrication and Photoluminescence of Two-Dimensional Semiconductor Materials**

Keven Cruz, Tomas Gonzalez, Stefanie Rivera

Prof. Vitaliy Dorogan

Advancements in quantum computers can rapidly change various fields due to their ability to solve complex problems that classical computers cannot. At the current state of development, quantum computers are not powerful enough if used alone. To make a network of quantum computers, a quantum transducer, a device that will turn the radio-frequency signals into optical signals, is required. Such a device can be built using two-dimensional (2D) semiconductor materials. Transition-metal dichalcogenides (TMDs) have been considered ideal for the quantum transducer. The goal of this research is to produce 2D sheets of tungsten disulfide (WS<sub>2</sub>) and molybdenum diselenide (MoSe<sub>2</sub>). By using the exfoliation method, the weak van der Waals forces that hold the layers can be torn apart and monolayers (one-molecule-thick) can be obtained. To test if the flakes are truly monolayers one can conduct photoluminescence (PL) measurements at room temperature. TMDs are known to change from an indirect band-gap to a direct band-gap semiconductor when reduced from 3D (bulk) to 2D (monolayer) material. Thick flakes (bulk) do not exhibit any PL emission while the monolayers show a strong PL signal at room temperature. We found and recorded PL spectra on some of the flakes thus proving that we produced high-quality monolayers. For future studies, we plan to produce flakes of p- and n-doped InSe overlapping each other with the goal to achieve a p-n junction. This structure will be tested for electro-luminescence signal.

## **Reconstructing Cosmic Filaments around Dwarf Galaxies with the Rubin Observatory**

Sarah Draves

Prof. Charlotte Welker

The cosmic web is the largest structure in the universe, consisting of streams of gas and dust that connect galaxies made of stars, dark matter, and more gas and dust. Denser areas of the cosmic web tend to have more massive and redder galaxies, which implies a strong connection between cosmic structure and galaxy evolution. The degree to which galaxies are influenced by the cosmic web outside of relatively dense areas, particularly in the case of small filaments near galaxies, is still an area of active study. Low mass galaxies, known as dwarf galaxies, are particularly sensitive to the environment around them and are thus an ideal way to identify smaller filaments and investigate how exactly they impact galactic evolution. We use simulated observations for the upcoming Legacy Survey of Space and Time (LSST) conducted by the Rubin Observatory, which is expected to discover 20 billion new galaxies including a wealth of



dwarfs in the nearby universe. We use these data to identify and select low mass galaxies and infer their properties, such as position, distance from our galaxy, stellar mass, and star formation rate. We use the distance and position of the galaxies to reconstruct two-dimensional filaments in a way that is consistent with what will be available from observations. We use the “truth” values from the simulation to construct three-dimensional filaments, and to determine how well the 2D projections preserve the cosmic web structure. This will allow us to study how the properties of the dwarf galaxies are correlated with their proximity to a filament and apply this process to the upcoming LSST data. This work, combined with the unprecedented amount of data from LSST, promises to unlock deep insights into the details of how the cosmic web drives galaxy evolution.

### **Exploring Stock Price Simulations and Option Pricing Strategies**

Sean Sinclair

Prof. German Kolmakov

This project explores the integration of quantum computing as a hardware accelerator for modeling complex mathematical processes, with a focus on its application in finance and physics. The primary goal is to simulate the diffusion processes of particles in one- and multi-dimensional spaces, leveraging quantum computing to enhance efficiency and accuracy. In the realm of finance, the research applies Geometric Brownian Motion (GBM) within the Black-Scholes framework to price options, a critical component of modern financial markets. Methods include utilizing IBM’s cloud-accessible superconducting quantum computers to perform simulations and calculations, integrating stochastic processes with quantum algorithms. It is believed that quantum computing can offer substantial computational benefits in simulating random walks and pricing derivatives, especially in scenarios involving high-dimensional data. Collaborating with Professor Kolmakov’s research group, I will further refine models and algorithms, expanding the scope of quantum computing applications in Quantitative research.

## **Traumatic Brain Injury Modeling by Chemical Mass Transfer**

Vanessa Robinson, Xionhui Wu, Jakiya Akter, and Kyuhyung Chae  
Prof. Mary Alice Browne, Subhendra Sarkar, and Faisal Khosa

Traumatic brain injury (TBI) is a structural and physiological disruption of brain function caused by a forceful blow or an impactful external force. TBI is sustained in two phases, with a primary injury resulting in the stretching of white and gray matter axons and a secondary injury responsible for endoplasmic reticular stress, mitochondrial dysfunction, and the buildup of reactive oxygen species. The secondary injury not only causes the neurological dysfunction of the brain but also alters the flow of cerebrospinal fluid (CSF), breakdown of the blood-brain barrier (BBB), and temporarily affects the sleep, wake, and circadian circuit of the brain. The rapid stretching of the axons causes irregularity of sodium ( $\text{Na}^+$ ) and potassium ( $\text{K}^+$ ) ion concentration outside and within the axons, which in turn causes the increased concentration of calcium ( $\text{Ca}^{2+}$ ) within the axons. The combination of the destruction of the brain tissue, the collapse of the blood-brain barrier, and the regional neuroinflammation leads to increase of iron ( $\text{Fe}^{2+}$ ) from the blood into the brain parenchyma. Iron overload and ferroptosis, which is a form of regulated cell death, is highly involved in the pathophysiological process of secondary brain injury. Both the increase of calcium and iron can lead to cell death within the brain.

## **Redistribution and Localization of Biometals in Apples Using X-Ray and MRI**

Jasper Cheung, Achlyn Genao, Somdat Kissoon, and Natalya Tomskikh  
Prof. Subhendra Sarkar, Evans Lespinasse, Zoya Vinokur, Eric Lobel, Mary Alice Browne

This project tested the bulk dynamics of endogenous biometals including potassium, calcium, and iron due to localized mechanical trauma in fruits. The hypothesis was to test the role of bulk porous structures and redistribution of such minerals to maintain homeostasis. We also used computed tomography (CT) and magnetic resonance imaging (MRI) to better visualize the interior anatomy and endogenous mineral movement prior to and after applying deep cuts from cortex to core in various apple varieties representing fresh or old carbohydrate tissue models. The soft x-ray imaging was done using a Hologic mammography system at 20-38 kVp after suitable filtration. For CT, multislice Siemens scanner and for MRI, Siemens 3T magnets were used. The apples were mechanically damaged with a shearing cut at locations identified as being iron-poor. That created a local injury to the apple causing a global response. As apples lack blood vessels, it is expected that there is a mineral flow in the form of macromolecule redistribution carrying the metals within. The mammographic images (soft x-rays) taken 3 minutes and 5 days post mechanical cuts showed biometals

immediately moving towards the site of the mechanical cuts. MR images most likely indicate, 2 kinds of iron in apples: the first one loses signal more quickly suggestive of metal particulates or deposits, while the edges near the cuts retained brighter signal presumably due to dissolved iron in the native fluid within the pores near the mechanical cuts. To avoid volume averaging but using the basic x-ray absorption, computed tomography (CT) scans of mechanical cuts in apples were done that supported acute accumulation of minerals and perhaps reorganization of pores near mechanical cuts confirming the results from MRI and Mammography.

### **Secondary X-ray Generation by Composite Filters**

Somdat Kissoon, Jasper Cheung, Daler Djuraev, Achlyn Genao

Profs. Subhendra Sarkar, Evans Lespinasse, Eric Lobel

Scatter radiation is generated when incoming photons interact with loosely bound electrons in a sample. Many of the interactions with matter produce a large number of these secondary electrons with no known utility. Scatter is generally thought to be detrimental to the generated image by creating unnecessary noise and generating unwanted additional radiation in the patient. Our experiments explore ways to benefit from these harmful Compton scattering. We generate weak photon streams from higher energy incident photons by thin cellulose or organic filters and a second composite layer of crystalline salts or salt solutions embedded in porous matrix that provide surface charges at grain boundaries and pore surfaces mainly from surface seeking electron-rich halide ions. Alkali halides in porous matrix offer many nanomaterial advantages including generation of secondary or Auger electrons and phonon assisted various photon harmonic generation within the salt lattice structures depending on composite crystallinity. These new photon streams with their weak harmonic x-rays exit the composite filters with variable flux density in select directions similar to the laser beam amplification as standing waves in laser cavities and may be useful for low-dose photon therapy of superficial tumors.

## **The Study of Endometriosis and Barriers to Healthcare**

Tais Chicaiza

Prof. Lillian Amann

Endometriosis is a chronic gynecological condition affecting an estimated 10% of women of reproductive age, characterized by the presence of endometrial-like tissue outside the uterus, causing severe pain, inflammation, and potential infertility. Despite its prevalence, endometriosis is often underdiagnosed and undertreated. The purpose of this study aims to identify, analyze the barriers to timely diagnosis and effective treatment. By Utilizing mixed methods approaches, we will identify the health outcomes based on race, ethnicity, and socioeconomic status as well as examining healthcare experiences, perceived delays, and medical gaslighting. By highlighting these barriers, this research seeks to provide actionable insights into improving diagnostic pathways, treatment options, and healthcare policy reforms that address the unique needs of women with endometriosis. Understanding these barriers is crucial not only for alleviating patient suffering but also for improving their overall quality of life and reproductive health outcomes. The findings of this study revealed that African American and Hispanic women face difficulties obtaining greater access to healthcare. Medical gaslighting and routinely prescribed drugs such as ibuprofen were ineffective at official hospitals, however, most women who visited academic medical institutes found effective answers to their condition. Overall, this research seeks to provide actionable insights into improving diagnostic pathways, treatment options, and healthcare policy reforms that address the unique needs of women with endometriosis. Understanding these barriers is crucial not only for alleviating patient suffering but also for improving their overall quality of life and reproductive health outcomes.

## **Material Sensitivity in Dentistry: Silver and Nickel Base Alloys**

Dan H. Chen and Abbi Raper

Prof. Daniel Alter

This study evaluates the strength, corrosion resistance, and oral behavior of nickel and silver-based alloys in dental prosthetics, specifically crowns and bridges. We analyze patch test (PT) data on material sensitivity to help healthcare professionals navigate the high incidence of allergic reactions. Our research includes a review of the literature on these alloys and examines effective dental care strategies while providing statistics on patient sensitivity. Nickel sensitivity is notably more common in women, occurring 4 to 10 times more frequently than in men. Children with older stainless-steel crowns (containing 72% nickel) have shown sensitivity, whereas newer crowns with only 9-12% nickel have not. Silver-based alloys also frequently induce allergic reactions due to their nickel content. The final diagnosis is confirmed through a patch test using 5% nickel

sulfate mixed with petroleum jelly. In conclusion, nickel and silver-based alloys can cause immediate contact dermatitis, such as itchiness and blisters, in hypersensitive patients. A well-documented history of patients' allergies to metals is essential for patient compliance.

### **Dual Effect of AI**

Khalid Farhad, Kevin Balbuena Montes, Daniela Sanchez  
Prof. Suela Aalsberg

Technological advances are altering previous ways of life and employment parallel to the principle of creative destruction instigated by the economist Josef A. Schumpeter. Schumpeter famously argues that capitalism is a system in which newer approaches are always replacing older ones, thus fostering economic advancement but also occasional instability. This paper is an analysis of the effects of Artificial Intelligence in three focal areas, that is employment, education, and human relationships. There exists a dispute whereby on one hand employment opportunities are under threat in the face of AI automation as it forces individuals to compete with machines in performing the most repetitive and complicated tasks, and on the other hand, the very innovation creates other avenues and makes businesses more productive. In education, while AI has the potential to improve the process of learning by making it more personalized, there are fears that students might not develop their critical thinking skills as much or they might abuse the technology and become hooked on it. From a social perspective, AI enhances social engagements while encouraging anti-social behavior, where people do not want to go out and interact with other people, which is highly detrimental to social development. As an attempt to employ Schumpeter's concept of creative destruction, this research finds out in what ways AI progress spins prevailing practices in a positive direction and causes disruption as well regarding the change made in society, joblessness and increased wealth disparities. A critical review of the available literature and analysis of case studies conducted previously have pushed on with their concentration on issues concerning artificial intelligence with the hope that the onslaught of its effects on society and the need to embrace it will be understood later.

## **How has Russian propaganda from the Soviet era been repurposed in today's conflict with Ukraine?**

Ahmed Babaev

Prof. Stephanie Boyle

In the context of the present conflict between Russia and Ukraine, we have been witnessing a resurgence of Soviet-era propaganda narratives rehashed and adopted in their new form to frame that serves to justify Russia's actions and influence of public opinion. Taking a closer look at the historical and ideological reuse of Soviet propaganda, this research draws attention to the fact that such elements of propaganda as unity, anti-Westernness, and protection of Russian identity are not only reused, but also intensively reapplied to fit the current context. At the beginning, Soviet propaganda conceived of Ukraine as an integral part of unified Russian world, and so does modern Russia, seeing Ukraine's Western ties as a betrayal. In this light, the use of 'fascist' to describe Ukrainian leaders also adapts more Soviet tactics, which delegitimized the nationalist opposition, and makes Russia look to be safeguarding against these ideological threats. Additionally, it perpetuates anti-NATO rhetoric and presents the West as an imperial aggressor stoking fears of the Cold War era. This study makes clear Russia's reappropriation of Soviet propaganda as a means to legitimize its position while obscuring uncomfortable historical facts and to solidify domestic support through analysis of Russian media, speeches, and historical documents. Awareness of this propaganda evolution provides means to comprehend the continuing impact of Soviet effects on Russian statecraft and propaganda strategies at present.

## **Authority and Legitimacy in the Albanian Case: the Kanun**

Enis Ukaj

Prof. Xavier Moysen Alvarez

The purpose of this paper is to perform a historical-comparative study of the Albanian nation's customary law: the Kanun. It will also apply Weber's theories of legitimation and domination as well as Schmitt's theory of the distinction between legality and legitimacy to this case. The Kanun is an ancient custom which continues to affect the lives of Albanians, to this day, sometimes negatively. Although falling out of fashion, it is still very prominent in Albanian society, and it is readily capable of returning in times of conflict. The supplemental material (Ehrlich's living law and Bourdieu's habitus) attempts to provide a more complete look at the Albanian customary law, and to answer how the Kanun survives and why it returns as the legitimate law in times of conflict, beyond just an analysis of where legitimacy lies. As is well known in both sociology and medicine, a good diagnosis is required to ever begin tackling a problem. This application case study begins by laying down a theoretical framework, followed by conducting a literature review of the leading sources on the Kanun, giving a good understanding of the general concepts of legitimacy and authority, particularly drawing from Weber and Schmitt, and of the Kanun itself as a body of laws and a current social as well as a historical force. The study will also emphasize the reconcilability and conflicts between the Kanun and modern liberal law. Trying to get a complete view beyond historically specific conditions, this project examines the practice of the Kanun at different moments in Albanian history. The findings will support Weber and Schmitt's theories in the Albanian case and add to their universal applicability. This topic requires more in-depth research, as the ideas can be expanded or supported by additional sources. Nonetheless, this case study may serve as a starting point for students of sociology and those interested in Albanology to perform new research.