Three Minute Thesis Competition
University of South Carolina
November 13, 2026

Competition Schedule: Final Round

Presenters (Presentation Order)

- Alireza Mashreghi (Civil and Environmental Engineering)
- Benedicta Nashiff (Drug Discovery and Biomedical Sciences)
- Ebenezer Seesi (Mechanical Engineering)
- Sweety Ramnani (Computer Science)
- Koryo Kwao (Chemistry)
- Chinwendu Akalonu (Journalism and Mass Communication)
- Mehak Bhatia (Chemistry)
- Sravanthi Avula (Biological Sciences)
- Mina Karami (Communication Sciences and Disorders)
- Mary Mitchell (Biological Sciences)
- Mahtab Ghasemi Dogaheh (Drug Discovery and Biomedical Sciences)
- Ademar Fernández (Geophysics)
- Diego Villafañe Ortiz (Biomedical Sciences)

Judges

- **Dr. Emily Devereux**, Associate Vice President for Research Development
- **Dr. Anthony James**, Executive Director of Inclusive Excellence Education
- **Dr. Silvia Patricia Rios Husain**, Associate Vice President for Student Success

Presenters and Abstracts (Alphabetical Order)

Chinwendu Akalonu
Title: We Need Contextual Theories: Building a Representative AI Adoption Framework for Journalism
Abstract: This study examines artificial intelligence (AI) adoption among journalists across five (5) African countries: Ghana, Kenya, Nigeria, South Africa, and Tanzania. Although research on AI and journalism is expanding, existing scholarship remains predominantly Western, limiting understanding of adoption within African organizational, economic, cultural, and professional contexts. Guided by the Unified Theory of Acceptance and Use of Technology (UTAUT), the study extends conventional adoption models by incorporating journalistic-values alignment, ethical awareness, perceived African representativeness, trust in AI output quality, organizational requirements, and cost barriers. An embedded mixed-methods design combines a cross-national survey of practicing journalists with in-depth interviews to identify predictors of AI adoption and explore the contextual reasoning shaping journalists' attitudes and practices. The analysis examines how UTAUT constructs interact with professional norms and structural conditions to influence behavioral intentions and actual use. By situating AI adoption within African news production, the study contributes to scholarship on technology acceptance and journalism while challenging universalist assumptions. Its findings offer implications for responsible, equitable, and context-sensitive AI integration in African newsrooms.

The study will evaluate whether professor characteristics, including research field, academic rank, profile-photo presentation, student-focused webpage content, visible publications and accomplishments, and student–professor demographic similarity, are associated with faculty selection. Student characteristics and prior research interests will also be considered. The second assignment will be used to determine whether students retain their original professor or research-field preference and how faculty responsiveness and availability affect final interactions.

Quantitative analyses will compare faculty selection rates, research-field preferences, student–professor similarity, and meeting outcomes. Regression-based models will be used to identify characteristics associated with professor selection. Findings may help clarify how approachability, similarity, research interest, professional accomplishment, and faculty accessibility shape early student connections with engineering faculty and research.

Sravanthi Avula
Title: The Alarm That Won't Turn Off: How a Childhood Fever Can Trigger Lifelong Dystonia, a Movement Disorder
Abstract: Dystonia is the third most common movement disorder, after essential tremor and Parkinson's disease, affecting roughly 500,000 people in North America. It twists muscles into extremely painful and debilitating postures. There is still no cure, largely because we don't understand what goes wrong inside the cells. My research follows a clue from the clinic. In two inherited forms of dystonia, clinicians have reported that several patients were healthy children until they had a fever. Weeks later, their symptoms began and never went away, and brain scans showed loss of brain cells in the regions that control movement. These two dystonias are

caused by mutations in two different genes, but both disrupt the same cellular antiviral alarm system. Every cell carries a sensor called PKR that detects viral infection and other stress. One mutation damages PKR itself; the other damages PACT, the protein that switches PKR on. Normally the sensor sounds the alarm, pauses the cell's work while the threat is cleared, and then switches off. If it stays on too long, the cell self-destructs. I asked whether these mutations leave the alarm stuck on. Using skin cells from patients and healthy donors, I mimicked a viral infection and measured the response. In healthy cells, the alarm turned on, then off, and the cells survived. In patient cells, it switched on several times more strongly, stayed on, and the cells died at far higher rates. This may help explain why dystonia can begin after a childhood fever. It also points to a possible treatment. Luteolin, a natural plant compound that our lab at USC has patented for this use, blocked this harmful response in patient cells by inhibiting PKR activation. In the first reported patient, a 3-year-old child who received luteolin as an add-on treatment, relapses after infections became fewer and milder. This is an encouraging early sign that turning the alarm down could change how inherited dystonia is treated.

Mehak Bhatia
Title: Dangling strands: A unique approach to design strong and recyclable rubber
Abstract: Millions of car tires clog landfills because traditional rubber or elastomer is held together by permanent chemical bonds, which makes recycling difficult. Removing these bonds makes the material eco-friendly but dangerously weak. This research solves this classic trade-off by breaking a long-standing textbook rule. Classical theory claims that "dangling" molecular strands attached to the rubber network at only one end are topological defects that soften rubber. Using computational molecular simulations, we proved the exact opposite: increasing the fraction and chain length of dangling strands doubled the material's stiffness. Advanced tracking showed that these free-moving dangling strands naturally thread themselves through the network in collapsed globular conformations to form entanglements. These additional entanglements act as temporary load-bearing connections, providing immense strength when pulled. Since these connections are physical rather than chemical, they can be undone during processing, allowing the material to be recycled with ease. This breakthrough offers a new blueprint to engineer next-generation materials that are exceptionally tough on the road, yet effortlessly recyclable.

Ademar Fernández
Title: Crustal Structure Underneath South Carolina Determined by Receiver Function Analysis
Abstract: South Carolina (SC) is a geologically complex region formed by the accretion of multiple terranes, resulting in a diverse array of crustal configurations across the state. In this study, we analyze the crustal structure of SC from the coast to the Appalachians, across the Eastern Piedmont Fault System, which marks a tectonic boundary between the predominantly sedimentary southeast and the cratonic northwest of the state. We computed teleseismic receiver functions (RFs) for 47 seismic stations across SC between 2012–2023. We inverted the observed RFs in a probabilistic framework to infer the crustal structure beneath each station.

To extend RF inversion across the Atlantic Coastal Plain, where thick sedimentary cover produces strong reverberations, we correct the observed RFs for sediment reverberations prior to inversion. We produce a collection of Vs profiles from the surface to the Moho beneath each station. Our findings suggest that the crust at the coast is ~30 km thick, increasing rapidly toward the northwest and reaching ~54 km beneath the edge of the Appalachians over a distance of roughly 465 km. By providing a station-scale characterization of crustal structure, our results will help improve constraints on earthquake location in SC and offer new insights into the composition and heterogeneity of its major terranes.

Mahtab Ghasemi Dogaheh
Title: The fight against cancer: Can peptides make a difference?
Abstract: Cyclin F is a unique cell cycle regulator belonging to the F-box protein family. Unlike canonical cyclins, Cyclin F does not associate with CDKs; instead, it functions as the substrate recognition component of the SCF (Skp1–Cullin1–F-box) E3 ubiquitin ligase complex, directing specific proteins for ubiquitination and subsequent proteasomal degradation. Dysregulation of the ubiquitin–proteasome system (UPS) has been implicated in the development and progression of several malignancies, including breast, hepatocellular, lung, renal, pancreatic cancers, and familial Hodgkin lymphoma. These observations suggest that Cyclin F may represent both a prognostic biomarker and a potential therapeutic target. However, strategies to directly interfere with Cyclin F–substrate interactions remain underexplored.

To interfere with Cyclin F substrate recognition, we designed a series of linear and cyclic peptides based on the structural features of the E2F1 binding motif and previous experience with peptide inhibitors of cyclin A. Cyclization was introduced to improve conformational stability and structural rigidity. In addition, molecular docking studies were performed using Glide to examine the binding interactions between the designed peptides and Cyclin F.

A series of linear and cyclic peptide analogs was successfully synthesized with high purity. Cyclization strategies were effective in generating conformationally constrained peptides with improved structural stability. Analytical HPLC and mass spectrometry confirmed the expected molecular masses and high purity of all synthesized compounds. Molecular docking studies indicated favorable interactions between the designed peptides and the Cyclin F binding site, supporting their potential as substrate recognition inhibitors. Further studies are planned to validate peptide binding using biochemical assays and to evaluate their biological activity in relevant cancer cell lines.

This work demonstrates the successful design and synthesis of peptide scaffolds targeting Cyclin F substrate recognition. Together, these findings establish a robust platform for subsequent biochemical and cellular evaluation.

Mina Karami
Title: Listening to the Heart: What Heartbeats Reveal About Attention
Abstract: Attention is fundamental to everyday cognitive functioning. Heart rate variability (HRV), particularly vagally mediated HRV, reflects autonomic regulation

and has been associated with prefrontal processes involved in executive functioning, including attention, inhibition, and working memory. The neurovisceral integration framework provides a theoretical basis for examining whether individual differences in autonomic regulation are associated with cognitive performance.

This study examined the relationship between HRV and attention-related cognitive performance in adults over 50. Participants completed attention-related cognitive tasks while their cardiac activity was recorded continuously. Behavioral task performance was examined in relation to HRV indices to determine whether individual differences in cardiac autonomic regulation were associated with attentional performance.

Preliminary findings indicated that participants with higher HRV tended to perform better on attention-related tasks. These findings suggest that HRV may represent a promising physiological correlate of attentional performance in adults over 50. By integrating behavioral and physiological measures, this study contributes to understanding the relationship between autonomic regulation and cognitive functioning across adulthood.

Koryo Kwao
Title: Molecular Principles of Protein Fold Switching
Abstract: Proteins are key molecules that control digestion, immunity, and regulation of hormones in the human body. For a long time, scientists believed that a protein's sequence, that is the arrangement of its amino acid building blocks, contained all the information necessary to determine the protein's shape. The consensus was that each protein sequence folded into one preferred three-dimensional shape or structure. We now know that some proteins can break this rule. These proteins are known as fold-switching proteins. They change their three-dimensional shape with very subtle changes in external conditions or the sequence. My research involves the design and study of synthetic fold-switching proteins, which are essentially model fold-switching proteins. Using chemistry, we hope to understand the actual principles that determine a protein's structure and function in a biological system beyond just the sequence. The findings of these studies will improve our understanding and design of fold-switching proteins with potential applications in medicine and materials science.

Alireza Mashreghi
Title: How We Built an Infinite River in a Small Room
Abstract: Rivers are dynamic systems that continuously adjust their shape in response to flowing water, sediment transport, and changing boundary conditions. These morphological changes influence flood behavior, landscape evolution, and human settlements that have historically developed along river corridors. Despite their importance, understanding how rivers evolve over time remains challenging, largely because rivers are long, open systems that are difficult to replicate under controlled laboratory conditions.

Traditional laboratory studies rely on straight flumes to simulate river flow. However, even the longest straight channels are spatially limited and cannot fully represent the

continuous nature of real rivers. This constraint restricts the ability to observe long-term channel evolution and sediment transport processes that depend on sustained flow over extended distances.

This research addresses this limitation by developing and utilizing an annular flume, a circular channel with no beginning or end—to simulate an effectively infinite river within a confined laboratory space. By transforming a linear channel into a closed-loop geometry, the annular flume allows water and sediment to circulate continuously, enabling extended observation of river-like processes such as sediment movement and channel adjustment.

A critical challenge of circular flow systems is the presence of centrifugal effects that introduce lateral forces not representative of natural rivers. To overcome this issue, a counter-rotating lid was designed and implemented above the flume. By carefully controlling the rotational speeds of the flume and the lid, these artificial forces are balanced, resulting in a stable, longitudinal flow field comparable to that of a straight river channel.

The resulting experimental framework provides a controlled and repeatable environment for studying river morphodynamics under near-natural conditions. By enabling realistic simulation of long river reaches within a laboratory, this approach enhances our ability to investigate how rivers evolve over time. The insights gained from this work contribute to a deeper understanding of river behavior and support improved approaches to river management, restoration, and hazard mitigation.

Mary Mitchell
Title: Cannabinoids and Crohn's disease: CB1 signaling promotes overgrowth of an opportunistic pathogen
Abstract: Up to one in six patients with Crohn's disease (CD) use cannabis for pain management. CD is a life-long condition that alternates between "flares" of intestinal inflammation and "remission," when inflammation is controlled. Even in remission, pain persists and affects quality of life. Unfortunately, pain remains difficult to treat, as painkillers can directly aggravate inflammation or become addictive, leading patients to self-medicate with cannabis. Active components of cannabis bind cannabinoid receptors, dampening pain signals in nerves that extend into the gut. Patients report significant relief of abdominal pain with cannabis use. However, endoscopic measures of intestinal damage remain unchanged, and one study reports that long-term use predicts a five-fold increased risk of bowel surgery.
My thesis work proposes the gut microbiota, a resident community of microbes in the gut, as an explanation. CD develops when the immune system mistakes the resident gut microbiota for a threat, resulting in significant inflammation that damages the intestines. In mice, we pharmacologically raised the body's own cannabis-like molecules, termed endocannabinoids, which act on the same cannabinoid receptors. Remarkably, activation of cannabinoid receptor 1 (CB1) led to the overgrowth of Escherichia coli, an opportunistic pathogen implicated in CD. We additionally found that this overgrowth can be blocked by using a CB1 inhibitor. Notably, the primary active component of cannabis, THC, binds CB1 with high affinity. Cannabis may therefore relieve pain but promote disease through CB1 in a subset of patients

harboring an opportunistic pathogen, which might explain why patients report symptom relief without intestinal healing.

Benedicta Nashiff
Title: Softening Tumor Walls: Making Cancer Treatments Work Better
Abstract: Cancer is not driven only by tumor cells, but also by changes in the surrounding tissue, making it stiffer and creating conditions that help cancer cells spread and resist treatment. An enzyme called lysyl oxidase, or LOX, contributes to this process by strengthening the protein fibers that form the body's structural support network. Blocking LOX may therefore help make tumors more responsive to cancer therapy.

A promising LOX inhibitor, LXG6403, has shown potential to enhance the effects of chemotherapy. However, its exact mechanism is not fully understood. In particular, it is unclear how LXG6403 binds to LOX and how it may irreversibly inhibit the enzyme. This question is challenging because an experimentally determined structure of human LOX is not yet available.

To shed light on this mechanism, computer-based molecular modeling was used to investigate the interactions of LXG6403 and closely related inactive compounds with LOX. First, a modeled human LOX structure was evaluated using a 1-microsecond all-atom molecular dynamics simulation to assess its stability. Next, Glide docking and induced-fit docking were used to predict how LXG6403 binds within the LOX active site, the region where the enzyme performs its function. Its predicted binding orientation was compared with those of known irreversible inhibitors and inactive compounds. Covalent docking was then used to model a possible irreversible LXG6403–LOX complex, followed by a 1-microsecond molecular dynamics simulation to assess the stability of the modeled adduct.

The results showed that the LOX model remained stable and that LXG6403 consistently positioned its amine group toward the enzyme's reactive cofactor, supporting a plausible mechanism for irreversible inhibition. Although the compound retained some flexibility, the overall modeled LXG6403–LOX complex remained stable in contrast to inactive compounds. These findings provide a structural hypothesis for how LXG6403 may inhibit LOX and establish a foundation for laboratory studies and development of improved cancer treatments.

Sweety Ramnani
Title: Where the Eyes Go, the Brain Responds: SyneQxis for Integrated, Automated, and Scalable Brain Research
Abstract: How can we connect what someone sees with what happens in their brain? Electroencephalography (EEG) measures the brain's electrical activity, while eye tracking records where and when someone looks. Together, they offer complementary views of attention and cognition. Yet bringing these recordings together remains a major technical challenge. Different devices produce different files and timelines, and researchers often rely on customized procedures that require weeks and hours of manual work per participant and are difficult to reproduce across studies.

I propose SyneQxis, an open-source framework that brings these separate recordings into one synchronized, standardized research workflow. It converts raw recordings into a common format, identifies and handles unwanted signal disturbances, precisely aligns brain activity with eye movements, and organizes the recordings around experimental events. Researchers can adapt the workflow to different tasks through configuration files without modifying the underlying code.

Beyond automation, SyneQxis provides a consistent foundation for comparing and reusing multimodal data. It produces integrated datasets in a community-standard format alongside interactive reports for inspecting data quality. Parallel processing supports large studies, reducing manual effort from hours to minutes per participant while computationally intensive steps run unattended. SyneQxis was validated using the Quebec 1000 Families (Q1K) cohort, including eight experimental tasks. It demonstrated consistent performance for data collected across multiple sites.
The significance extends across brain research, from development and learning to aging and recovery after injury. SyneQxis could support investigations of social attention in autism, changes in cognition and visual processing in Alzheimer's and Parkinson's diseases, attention difficulties in epilepsy, and recovery of attention after stroke. Across these areas, researchers face a shared question: how does what a person looks at relate to what their brain is doing at that moment?

By making these measurements easier to integrate consistently across participants, tasks, and hospital sites, SyneQxis provides a foundation for answering that question at scale. Researchers could use its synchronized outputs to investigate differences between individuals, track changes over time, and explore potential indicators of cognitive function or responses to interventions.

SyneQxis therefore addresses a barrier that reaches beyond any single condition or experiment. It makes integrated brain-and-behavior research more accessible and reproducible, helping research teams design experiments within a shared framework and turn combined brain and eye-tracking data into new insights about brain development.

Ebenezer Seesi
Title: Giving Waste Heat a Second Life with Tiny Metal Particles
Abstract: Every day, engines, factories, and power plants release heat that goes unused. What if we could give some of that wasted energy a second life as electricity? Thermoelectric materials can do this directly when one side is hotter than the other. My research explores how to improve a heat-resistant ceramic for this purpose. The challenge is that electrical charge does not move through it easily enough, limiting its potential to generate useful power. Our approach starts with an ingredient already inside the ceramic: nickel. We make an extremely thin layer of ceramic and heat it in hydrogen. During this treatment, some nickel atoms move to the surface and gather into tiny metal particles. Instead of adding particles from outside, we grow them from within the material itself. Our experiments show that the treated film allows electrical charge to move much more easily. This improvement addresses one important barrier to developing ceramic materials that can turn waste

heat into electricity. Better electrical flow is one part of the solution. The material must also maintain its ability to generate voltage from a temperature difference. Our findings provide a promising step toward that goal by showing how a controlled treatment can improve electrical flow while producing tiny metal particles on the ceramic's surface. Ultimately, this research could help us recover energy that would otherwise be lost and make better use of the energy we already consume.

Diego Villafane Ortiz
Title: Cancer Cachexia: A Wasting Syndrome That Demands Attention
Abstract: Cancer profoundly affects the cardiovascular system, leading to changes in cardiac muscle mass. The heart may weigh less than normal in a state of cardiac cachexia, whereas chemotherapy-induced cardiotoxicity can increase heart weight due to dilated cardiomyopathy. Additionally, left ventricular hypertrophy may rise as a compensatory response to anemia and hypoxia. To investigate these possibilities, we examined cardiac changes in adult C57BL/6J (wild-type) and ApcMin/+ (cancer) mice of both sexes. Body weight and heart mass were measured to assess the relationship between cancer progression and cardiovascular alterations. We found that colorectal cancer mice exhibited significantly increased heart mass, which correlated with decreased body weight. This heart enlargement is likely driven by pronounced anemia observed in advanced cancer cachexia. Future experiments will evaluate cardiac function in these mice, as we hypothesize that increased cardiac workload is necessary to maintain oxygen delivery. Ultimately, we aim to determine whether improving heart function or treating anemia can mitigate the severity of cancer cachexia.