



PROJECTS 2023 DAY

SEATTLEU
COLLEGE OF
SCIENCE AND ENGINEERING

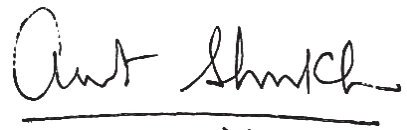


Welcome to Projects Day 2023!

This is a celebration of our students and their creativity and problem solving. We, in the College of Science and Engineering, are deeply committed to our students' success. At the beginning of the projects, each student team received a challenging, real-world assignment from an external partner. Throughout the year, students applied technical knowledge and gained professional skills in project management, teamwork, budgeting, technical writing, and oral communications. Projects Day is the culmination of their experience.

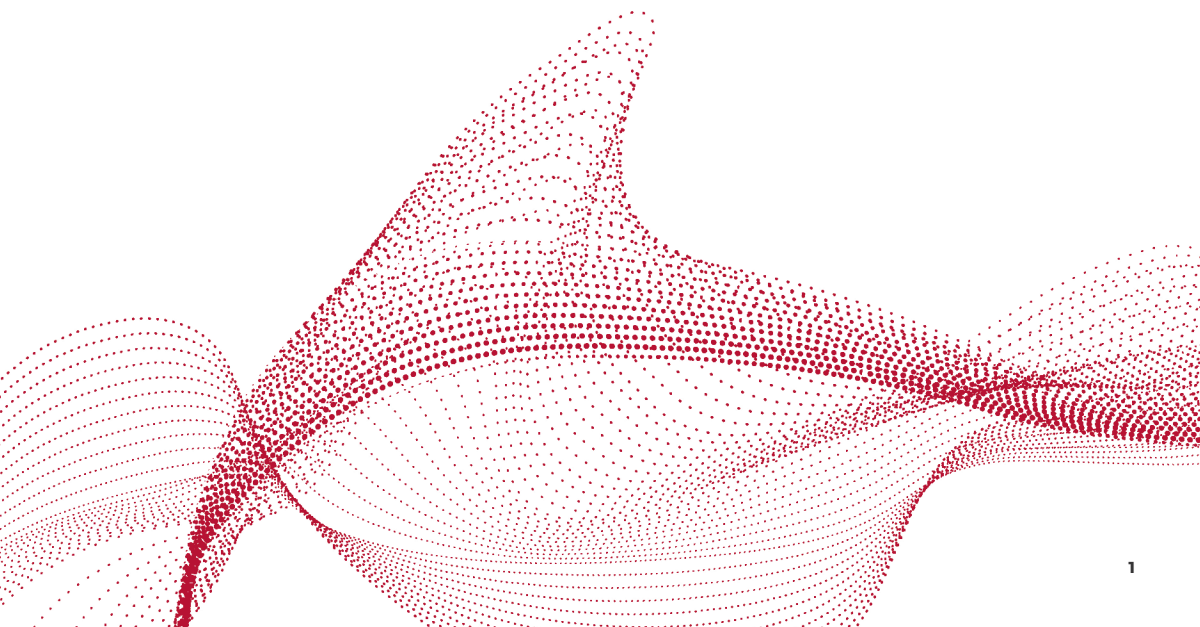
The Project Center is thankful for the support and engagement of our partners in this experience for our students. We have been successful for over 35 years, because of our partners. As we look ahead, the capabilities of the Project Center will continue to evolve. We are looking at infusing more interdisciplinary projects in the future, including partnerships with Alber's School of Business and Economics.

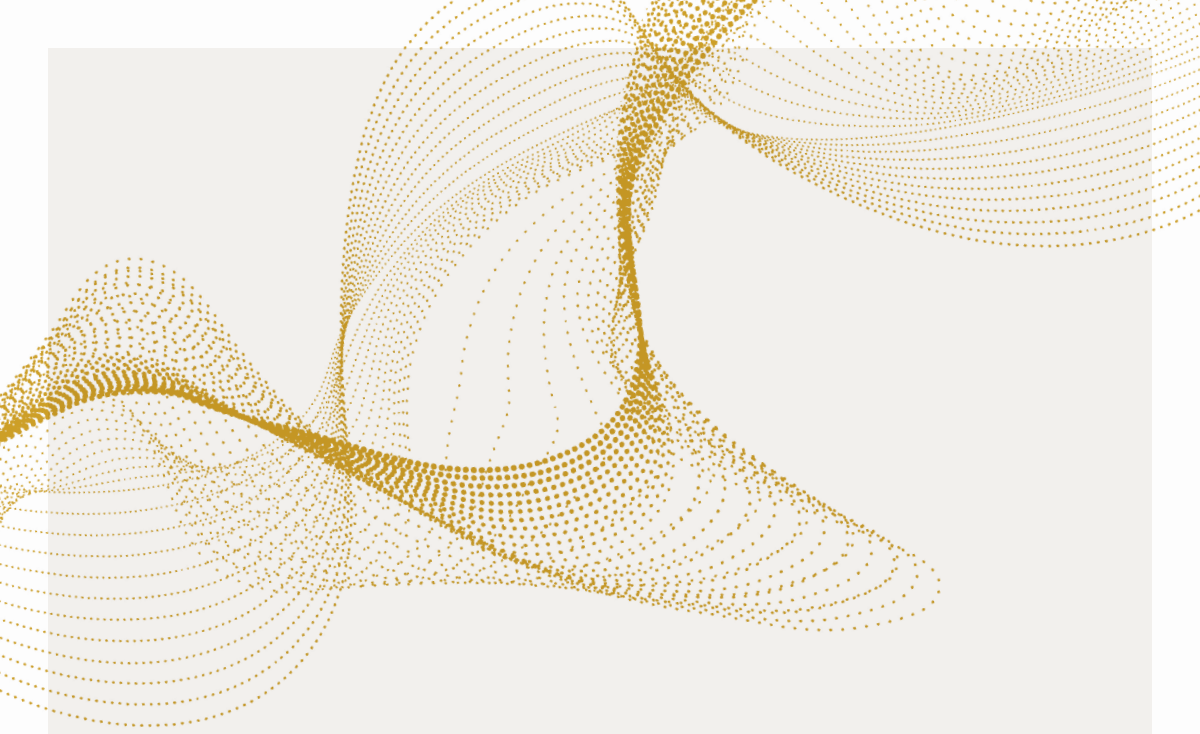
Today, we celebrate the accomplishments of our seniors and graduate students. We are grateful to the industry sponsors and to our faculty advisors who have mentored the students throughout the past year and to our staff who provided essential support to the student teams in the completion of their projects. Together, we are educating a generation of leaders in STEM who are ready to solve grand challenges with innovation and make an impact throughout the Puget Sound region and beyond.

A handwritten signature in black ink, reading "Amit Shukla". The signature is fluid and cursive, with a horizontal line underneath it.

Amit Shukla, PhD

Dean of the College of
Science and Engineering







SCHEDULE	4
CIVIL & ENVIRONMENTAL ENGINEERING	6
COMPUTER SCIENCE	9
ELECTRICAL & COMPUTER ENGINEERING	19
MECHANICAL ENGINEERING	24
MASTER OF SCIENCE IN DATA SCIENCE	28
MASTER OF SCIENCE IN COMPUTER SCIENCE SOFTWARE ENGINEERING	30
MASTER OF SCIENCE IN COMPUTER SCIENCE DATA SCIENCE	33

PROJECTS DAY

2023

JUNE 2 / SEATTLE UNIVERSITY CAMPUS

EVENT SCHEDULE

»» ENGINEERING, ENVIRONMENTAL SCIENCE, AND COMPUTER SCIENCE PRESENTATIONS

SULLIVAN HALL, LAW SCHOOL

11:45 A.M. – 12:30 P.M. CHECK-IN AND REGISTRATION

12:45 P.M. – 1:45 P.M. WELCOME AND PRESENTATION SESSION 1

Room C5

- CEE 23.4 **Skagit County Parks and Recreation, Skagit Fisheries Enhancement Group** Wiseman Creek - Cascade Trail Enhancement
- CEE 23.6 **Snoqualmie Valley Preservation** Snoqualmie River Gauge Screening Algorithm and Inundation Map Development
- CEE 23.5 **Snohomish County** 52nd Ave W and 164th St Pedestrian Improvement Plan

Room C6

- CS 23.3 **The Boeing Company** Non-Motion Detection
- ECE 23.2 **The Boeing Company** Automated Mobile Inspection Robot
- ECE 23.5 **Tacoma Power** Commercial Vehicle Charging Station Design

Room C1

- ME 23.2 **Bolden Product Development Services, LLC** VirTruVitron 7000 Exercise Machine
- ME 23.3 **Kenworth Truck Company** Point-to-Point Delivery
- CS 23.10 **Kenworth Truck Company** Predicting Sales Code Driven REIs

Room 109

- CS 23.11 **Mari's Place for the Arts** Donor Data Lake
- CS 23.17 **The Mockingbird Society** Community Resource App
- CS 23.13 **Panthera** The Effects of Image Processing Techniques for Automated Wildlife Species Detection

Room 110

- CS 23.2 **Astronics** LSAP Library
- CS 23.6 **Ecotope** Data Pipeline
- CS 23.21 **Visiting Angels** Smart Scheduler

1:45 P.M. – 2:00 P.M. BREAK

2:00 P.M. – 3:00 P.M. PRESENTATION SESSION 2

Room C5

- CEE 23.1 **Black Farmers Collective** Rainwater Collection/Irrigation System for an Urban Farm
- CEE 23.3 **Seattle City Light** Seismic Evaluation and Upgrade Design of the North Substation Control Building
- CEE 23.2 **Degenkolb Engineers** Camp Korey Fisher Lodge Renovations

Room C6

- ECE 23.4 **Sound Transit** HVAC Health and Capacity Monitoring System
- ECE 23.3 **KiloWatts for Humanity** Interactive Load Profile Archive

Room C1

- ME 23.5 **OCR Medical Device Development** One-Handed Zip Tie Applier
- ME 23.4 **Modica** Utility Bulkhead Connector

Room 109

- CS 23.16 **The Feels** After Market Mobile App
- CS 23.4 **Converge Media** Converge Remix Mobile
- CS 23.5 **Converge Media** Over-The-Top Application

Room 110

- CS 23.22 **Votegrity** Increasing Voter Access for Voteegrity Online Elections
- CS 23.7 **Ellebit** All-in-One Private Dining and Catering Booking Platform
- CS 23.18 **The Postman** The Postman App and The Neighborhood Marketplace

3:00 P.M. – 3:15 P.M. BREAK

3:15 P.M. – 4:15 P.M. PRESENTATION SESSION 3

Room C5

- MSDS 23.1 **Camp Korey** Donor Database Analysis and Recommendations
- MSDS 23.2 **Costco Wholesale** New Member Behaviors
- MSDS 23.3 **DeSimone Consulting** Predictive Model for Unconfined Concrete Strength

Room C6

- CS 23.1 **Amazon** Improving Alexa's Sensitive Content Detection Capabilities
- ECE 23.1 **Amazon Web Services** Availability Rover 2023
- ME 23.1 **Amazon Web Services** Availability Rover 2023

Room C1

- ME 23.6 **SDI Engineering** Creation and Design of Extending Crank Arm Bicycle Aid
- CS 23.15 **SDI Engineering** GearSim

Room 109

- CS 23.14 **Revere XR** Honoring our Storytellers Through Immersive Experience
- CS 23.19 **Thoughts Cost** Virtualizing Classrooms
- CS 23.20 **Thoughts Cost** Virtualizing Classrooms

Room 110

- CS 23.8 **F5** Early Warning Sentiment Analysis
- CS 23.9 **F5** RapidLab V2

4:15 P.M. – 5:00 P.M. POSTER SESSION

5:00 P.M. – 6:00 P.M. RECEPTION

RAINWATER COLLECTION/IRRIGATION SYSTEM FOR AN URBAN FARM CEE 23.1



SPONSOR: Black Farmers Collective
SPONSOR LIAISON: Ray Williams
FACULTY ADVISOR: Brianna Celaya
STUDENTS: Juliana Andrade, Aidan Bernal, Michaela Day, Isaac Tecla

Yes Farm is an urban farm located in Yesler Terrace and was founded by The Black Farmers Collective, a non-profit organization seeking to promote black leadership and support a sustainable food system. The Black Farmers Collective identified the need to improve the farm's existing rainwater collection and irrigation systems. They requested that CEE 23.1 develop a retrofit design for the farm to achieve more efficient water storage and consumption. To accomplish this, CEE 23.1 first conducted a literature review to better understand municipal design standards and irrigation needs of urban farms. The team conducted surveys of the Yes Farm site using a small unmanned aerial vehicle and a GPS surveying system to create a comprehensive site layout in AutoCAD and draft proposed improvements. Also, the existing water collection and storage capacity was evaluated to understand the farm's current and future needs. Three retrofit design alternatives were developed and evaluated using an evaluation matrix created with input from the Black Farmers Collective. The selected design was developed to 30%, including a preliminary site plan with proposed structures, plans and profiles of the design, and a cost estimate.



CAMP KOREY FISHER LODGE RENOVATIONS CEE 23.2



SPONSOR: Degenkolb Engineers
SPONSOR LIAISONS: Bianca Casem, PE, Clare Terpstra, PE
FACULTY ADVISOR: Güven Kiyamaz, PhD
STUDENTS: Aaron Aguon-Africa, Huynh Huynh, Lucas Lazaga, Danny O'Brien

Camp Korey, which includes Fisher Lodge, is a summer camp for children with life-altering medical conditions located in Mount Vernon, WA. The lodge was first built in 1968 by University of Washington architecture students and expanded in 1994. Due to an increased level of knowledge of the severity of seismic hazards since the building was designed, and Camp Korey's desire to increase the use of Fisher Lodge, team CEE 23.2 was tasked with performing a seismic evaluation and developing retrofit design concepts for the building. The team followed provisions described in ASCE 41-17: Seismic Evaluation and Retrofit of Existing Buildings to identify possible structural deficiencies and to propose design upgrades that would bring the structure into compliance with current standards. Camp Korey also requested that CEE 23.2 assist with designs to improve accessibility and functionality within the building including a wheelchair lift system and the addition of a kitchen. Upon completion of the seismic analysis, design for retrofits, and other building improvements, the team submitted a final report to Degenkolb Engineers and Camp Korey, consisting of a calculation package, drawings of the design concepts developed, and a written summary of the approach and results.

SEISMIC EVALUATION AND UPGRADE DESIGN OF THE NORTH SUBSTATION CONTROL BUILDING CEE 23.3



SPONSOR: Seattle City Light
SPONSOR LIAISON: Robert Cochran, PE, SE
FACULTY ADVISOR: Jhon Paul Smith, PE, SE, PhD
STUDENTS: Sami Almadani, Spencer Machinski, Kamie Miyaji, Madeline Phillips

Located in the Green Lake neighborhood, the North Substation Control Building is an essential facility operated by Seattle City Light (SCL) that provides electricity to the University Substation, the University of Washington, and Children's Hospital. When the building was originally constructed in 1923, little was known about earthquake-resistant design and Seattle's high seismic risk. These facts render the performance of the structure under a major earthquake uncertain, so SCL requested CEE 23.3 to complete a seismic evaluation using the design standard ASCE 41-17: *Seismic Evaluation and Retrofit of Existing Buildings*, identify structural deficiencies, and develop retrofit recommendations for non-compliant components. Deliverables from this project included a final report, calculation package, drawings of retrofitting solutions, and preliminary construction cost estimates.



WISEMAN CREEK - CASCADE TRAIL ENHANCEMENT CEE 23.4



SPONSOR: Skagit County Parks and Recreation, Skagit Fisheries Enhancement Group
SPONSOR LIAISONS: Brian Adams, Emily Derenne, Joseph A. Shea, Allison Studley
FACULTY ADVISOR: Wes Lauer, PhD, Kun Zhang
STUDENTS: Elijah Kauffman, Megan Martindale, Ryan McGeary, Alejandro Robles

The Cascade Trail is a recreational trail constructed on an old railroad grade between Sedro-Woolley and Concrete, Washington. Skagit County Parks and Recreation and the Skagit Fisheries Enhancement Group are interested in enhancing a flood-prone section of the trail near Minkler, Washington, where the trail crosses Wiseman Creek. Flooding caused by sedimentation from the creek makes the trail impassable for most of the winter. Trail use/maintenance during and after periods of inundation may negatively impact salmon and steelhead. Our team started the project with an extensive literature review and survey of the site. Five initial design alternatives were evaluated based on constructability, longevity, cost, ease of permitting, and environmental impact. The top alternative, an elevated boardwalk, was then further developed using standards from the United States Forest Service Trail Manual and guidance on fish habitat recommendations from resources provided by Skagit County. Our team created a 10% Design Solution package characterizing the boardwalk alternative. This package included a drawing set, cost estimate, fish habitat recommendations, and a final report.

52ND AVE W AND 164TH ST PEDESTRIAN IMPROVEMENT PLAN CEE 23.5



Snohomish County

SPONSOR: Snohomish County Public Works
SPONSOR LIAISON: David Lee, PE
FACULTY ADVISOR: Ahmed Dehghanpoor Sichani, PhD
STUDENTS: Glorie Chua, John Kuehlman, Janice Lee, Nazar Nazarchuk

Snohomish County Public Works requested the design of a pedestrian improvement plan in unincorporated Snohomish County along the west shoulder of 52nd Ave W between Lynnwood city limits and 164th St SW. The west shoulder of 52nd Ave W currently has no sidewalk for approximately 600 ft. Pedestrians frequently walk along the west shoulder of 52nd Ave W to access the nearby Beverly Elementary School and Sundquist Family Nature Park on the west side of 52nd Ave W. The purpose of the design is to improve pedestrian access by providing sidewalk and bicycle facilities along the west shoulder of 52nd Ave W to create a safe and convenient route for residents and visitors to commute in accordance with County (EDDS), State (WSDOT), and federal (AASHTO) design standards. Four design alternatives were drafted by our team on AutoCAD Civil 3D, and one preferred design was selected based on a decision matrix. The categories on the matrix include construction cost, environmental impact, channelization, utility conflicts, and accessibility. The team delivered a 30% design report to Snohomish County Public Works for the preferred design alternative including plans, critical areas impact, drainage design, anticipated deviations, and an engineer’s cost estimate.



SNOQUALMIE RIVER GAUGE SCREENING ALGORITHM AND INUNDATION MAP DEVELOPMENT CEE 23.6



SPONSOR: Snoqualmie Valley Preservation Alliance
SPONSOR LIAISONS: Geary Eppley, Regina Fletcher, Lauren Silver
FACULTY ADVISOR: Se Yeun Lee, PhD
STUDENTS: Jamie Elrod, Ruby Hooper, Sean Tachibana, Owen Trampe

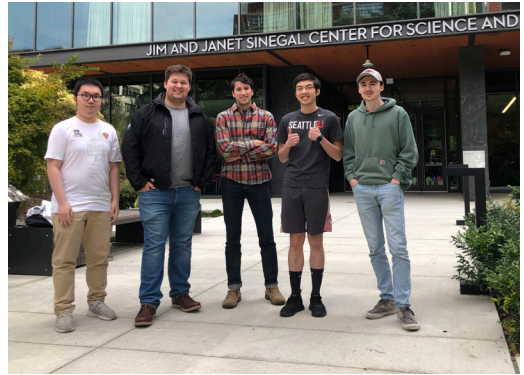
Snoqualmie Valley Preservation Alliance (SVPA) is a nonprofit organization that supports developing sustainable solutions for land use and floodplain management in the Snoqualmie Valley. SVPA provides flood information to the community through their website Floodzilla. SVPA’s Floodzilla Gauge Network provides flood forecasting and real-time water level and discharge data to the public using a network of gauges run by SVPA and the United States Geological Survey (USGS). SVPA is interested in improving the screening of data posted to the site and expanding the flood information available to users by offering real-time views of flood extents in the valley. To accomplish these goals, the Seattle U team designed an updated flagging algorithm to thoroughly screen incoming gauge data for errors. The team has also created a process for producing inundation maps using hydraulic model results and local gauge readings. When displayed on the Floodzilla site, these maps will enable users to evaluate flood extents in the valley and assess how their livelihoods could be impacted by a flooding event.

IMPROVING ALEXA'S SENSITIVE CONTENT DETECTION CAPABILITIES CS 23.01



SPONSOR: Amazon
SPONSOR LIAISON: Sundar Chandrasekaran
FACULTY ADVISOR: Sheila Oh
STUDENTS: Blaise Ntiranyibagira, Isabel Ovalles, Jacob Simons, Will Somat, Gary Tou

Alexa Sensitive Content Intelligence (ASCI) is a part of the Alexa Trust organization within Amazon. ASCI seeks to improve customer trust with Alexa devices. To provide answers for customers, Alexa uses traffic from the web which is evaluated using a combination of rule and machine-learning based algorithms to detect inappropriate or offensive content. By avoiding this type of content, customers' interactions with Alexa stay safe and appropriate. ASCI is interested in expanding system capabilities by detecting deliberate misspellings, clever word combinations, and colloquial or slang terms that are considered inappropriate or offensive. Our team developed solutions to two problems proposed by ASCI. This includes detection of profane word variations that are misspelled or spelled using Leet Speak, and detection of phonetic sounding word combinations that when read aloud sound profane but otherwise seem benign. We researched existing algorithms. such as the Levenshtein distance algorithm. and tailored them to effectively solve these two problems. Our team designed and developed an Application Programming Infrastructure (API) in the Go programming language. Text content is passed into our service as input and returns yes or no if profanity is detected. Eventually, our API will be integrated with Alexa and since we designed the API with scalability in mind, future solutions could be added as a software module to increase detection of various forms of offensive content.



LSAP LIBRARY CS 23.02



SPONSOR: Astronics Advanced Electronic Systems (AES)
SPONSOR LIAISON: Doug Brown
FACULTY ADVISOR: Zhiju Yang, PhD
STUDENTS: Collin Ennis, Jonathan Jasper, Terence Leung, Cathal Mullen, Harry Rudolph

Airplanes have countless electronic components, almost all of which have embedded software. The aerospace industry has standardized rules for the way software is prepared for loading and deploying software onto aircraft. Astronics AES does not own the current program their organization utilizes for this process. Thus, they cannot alter the software to automate workflows or to keep up with changing industry standards. Our task was to develop a C# library and API compliant with ARINC 665-5 (an industry standard for loadable software) Astronics could own, integrate into their workflow, and build upon. Our solution is an object-oriented library with classes for the different file types described in the ARINC 665-5 standard, along with an interface that populates class data, generates ARINC-compliant output files, and hashes and encrypts certain files for later integrity checks.



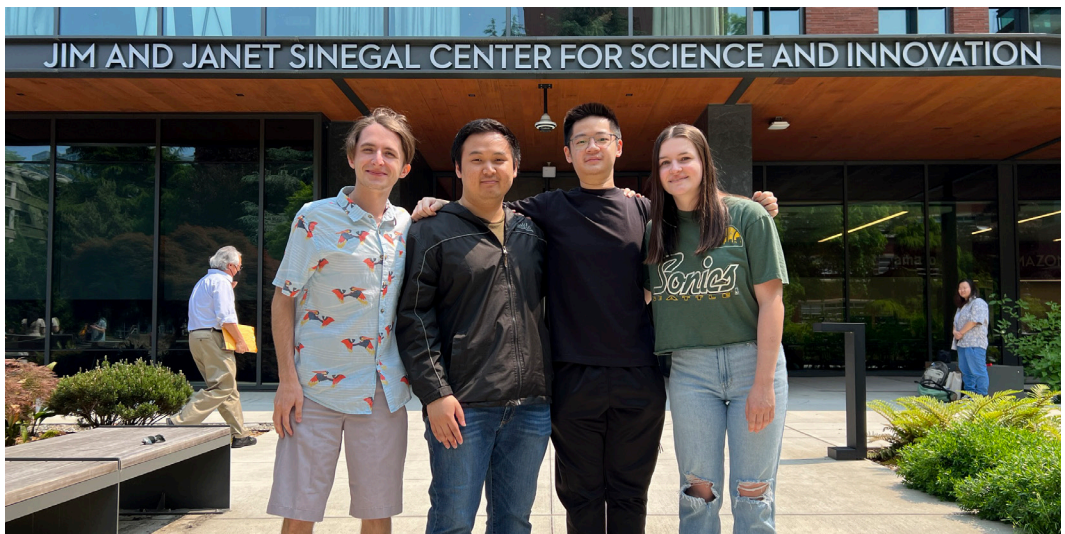
SPONSOR: The Boeing Company

SPONSOR LIAISON: Chris Esposito, Jeff Heisserman, Katherine Meza, Kevin Puterbaugh, Rohan Rana, Jim Troy

FACULTY ADVISOR: Lisa Milkowski, PhD

STUDENTS: Benediktus Albert, Hope Crosier, Hansen Rahadi, Ethan Tarlov

The Boeing Company is the world's largest aerospace company. They design, manufacture, and service aircraft, defense products, and space systems for private and commercial use. Safety for workers has always been a priority for Boeing, hence they are interested in providing innovative, accessible solutions to improve safety conditions for their employees. When working alone or in an isolated workspace, a person may injure or incapacitate themselves without others knowing. The team developed a prototype smartphone application that will continuously monitor the movement of individuals while they reside in high-risk work areas and send alerts to the appropriate response teams in the event of no motion being detected after a specified time frame. Specifically, the team developed an Android mobile application using Google's multi-platform SDK, Flutter, utilizing localization techniques to determine the user's current location and detect when they are within a specified work zone. Additionally, the students utilized the phone's internal motion sensors, specifically the accelerometer and gyroscope to monitor the user's motion, Amazon SNS, and Google Firebase Server to send alerts to the specified personnel when no motion is detected after a certain time threshold.



“We appreciate the opportunity to work with the student team. Each of the students are polite and professionally poised to begin their careers. They represent Seattle University in a positive light, and we are grateful to have a role in their professional development.”

POLLY A. BROOKS, P.E.

Public Works Supervisor

Snohomish County Public Works



SPONSOR: Converge Media
SPONSOR LIAISON: Omari Salisbury
FACULTY ADVISOR: James Obare
STUDENTS: Shawn Lee, Kalin Riley, Danh Vo

Since 2016, Converge Media has provided authentic representation for the black community in the Pacific Northwest area. Through their coverage of events such as the Black Lives Matter protest, the Capitol Hill Occupied Protest (CHOP), and the local issues that are important to the black community - Converge Media has earned an Excellence in Journalism award from the Washington State Association for Justice in 2021 and an Emmy in 2022. However, due to the nature of Converge Media's content, they have experienced censorship from 3rd party hosting websites. Converge Media faces content throttling, ad suppression, risk of content deletion and lack of audience communication channels. Converge Media has tasked team CS 23.04 with creating their own mobile platform where they can both independently host their multimedia content and connect with their user base. During our project, we focused on iOS development, while using a framework (React Native) that leaves further development open for cross platform. The mobile application uses React Native as the UI framework which communicates to a node server where we leverage APIs to retrieve desired data from MongoDB and Azure Blob Storage. After working closely with Converge Media, we delivered a functional iOS mobile app that can stream Converge Media's video and allow users to easily navigate to different videos. Additionally, the app allows users to send their email/phone number to Converge Media to stay connected.



OVER-THE-TOP APPLICATION CS 23.05



SPONSOR: Converge Media
SPONSOR LIAISON: Omari Salisbury
FACULTY ADVISOR: James Obare
STUDENTS: Nga Hoang, Annapurna Mandalika, Alison Nguyen, Tuan Phan, Sheng Xu

Converge Media is a Seattle-based media and production house with the aim of providing a platform for black and urban voices, stories, news, and entertainment to be heard across the Pacific Northwest. They have been hosting their content on third-party platforms such as Facebook and YouTube which limits their access to their audience. These platforms also have restrictions that affect the reach and availability of their content. To address these issues, Converge Media has partnered with Team CS 23.05 to create an Over-The-Top (OTT) application hosted on the Roku platform. Using Azure Blob Storage and Azure Media Services to securely store and stream their content, this Roku channel allows content to be viewed freely without any external interference or suppression. By creating an OTT application on Roku, Converge Media can reach a wider audience and maintain control over their content. It also provides more opportunities for Converge Media to expand their reach and engage with their community while pursuing a more inclusive and equitable media landscape.

DATA PIPELINE CS 23.06



SPONSOR: Ecotope

SPONSOR LIAISON: Madison Johnson,
Scott Spielman

FACULTY ADVISOR: Wan Bae, PhD

STUDENTS: Carlos Bello, Emil Fahrig, Julian Harris,
Casey Mang, Roger Tram

Ecotope is an engineering consulting firm based in Seattle, WA with a commitment to addressing the climate crisis through the development of energy efficient and renewable technologies. The company aims to revolutionize energy consumption within the built environment by providing sustainable, reliable, and cost-effective engineering solutions. Ecotope's research team collects signals from energy-monitoring sensors placed at various sites across the United States, which is then converted into digital data. The raw data is then directed through a data processing pipeline for cleaning, transformation, summarization, and database storage. The current pipelines are outdated, time-consuming to maintain, and challenging to adapt to future projects. The goal of this project is to create a new data processing system that is robust, adaptable, and easy to maintain and upgrade. We designed and developed a new Python package containing general and specialized data processing functionalities along with a general framework for maintaining and building data pipelines. This package was then utilized to rebuild the pipelines for two of Ecotope's ongoing projects: the Bayview Apartments in Seattle, WA that collects data from a heat pump water heating system and the Lawrence Berkeley National Laboratory in Berkeley, CA that collects data from numerous sites across the United States. Our solution offers Ecotope a reliable data processing system that ensures consistent and accurate data for analysis and modeling. This will have a positive impact on Ecotope's work by reducing maintenance costs and enabling the company to expand their efforts towards providing efficient energy and sustainable technology.



ELLEBIT ALL-IN-ONE PRIVATE DINING AND CATERING BOOKING PLATFORM CS 23.07



SPONSOR: Ellebit

SPONSOR LIAISON: Anna Del Toro, Kathleen Pow

FACULTY ADVISOR: Nathaniel Kremer-Herman, PhD

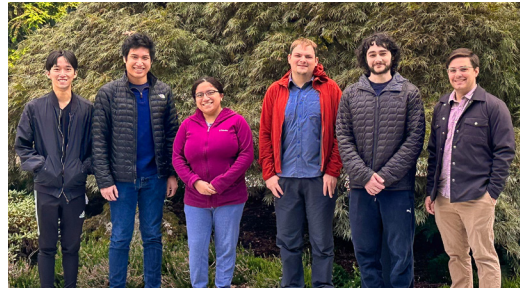
STUDENTS: Mari Kwee, Casey Nguyen,
Clayton Nguyen, Richard Ty

In 2022, Kathleen Pow and Anna Del Toro established Ellebit with the goal of simplifying the process of booking a private dining experience. Ellebit transforms the way restaurants and customers manage their private dining and catering needs by automating the time-consuming aspects of venue and menu selection for both small and large groups while maximizing efficiency of the booking process. In doing so, restaurant managers can focus on the guest experience and restaurant patrons can book their private dining experience with ease. Team CS 23.07 designed and built a web application to address this problem. The main features of the website allow restaurant managers to upload and edit their menus, receive booking information and notifications, and track past sales and bookings. Restaurant patrons can search for venues, initiate communication with the restaurants, select menu items based on their preferences, and finalize details such as the date and time of their reservation. Following the completion of these requirements, the team published the web platform on the internet and handed over the final web application's code and documentation to the sponsors.



SPONSOR: F5
SPONSOR LIAISONS: Kendall Brenneise, Nicholas Ferguson
FACULTY ADVISOR: Xin Zhao, PhD
STUDENTS: Trey Amrich, Torin Frever, Andrea Lee, Hao-Nan Wang

F5, Inc. receives hundreds of support tickets a day containing issues or questions from customers regarding their products. Maintaining a high level of customer satisfaction and alleviating customers' concerns are of great importance to the F5 service support team. To achieve this, F5 intends to be proactive with their customer support. Currently, any cases that cannot be self-solved by the customer get sent to the service support department, where an expert support engineer assists the customer. The team applied a machine learning algorithm that detects and predicts the customer's sentiment in emails and transcribed phone calls. If a negative sentiment is detected, the system will promptly alert a support engineer, who can review the case and swiftly take appropriate actions. Alternatively, positive sentiment will allow F5 to see if solutions are improving the customer's satisfaction with the product. The first component of the system is the machine learning algorithm that connects to Salesforce Chatter Feed, where the database of IT ticketing for customers is held. The second component is a front-end web user interface component that displays the sentiment of all cases, a single case, or a specific customer. These three views are shown through graphs and tables for easy access and understanding. Our project raises and maintains customer satisfaction, displays important metrics to F5 stakeholders, and provides valuable assistance to the F5 service support engineers.



RAPIDLAB V2 CS 23.09



SPONSOR: F5 Networks
SPONSOR LIAISONS: Daniel Brogan, Josh Rose
FACULTY ADVISOR: Matthew Thayer
STUDENTS: Maxime Fontana, Rucha Joshi, Samuel Monson, Brandon Wong, Colson Wong

F5 is a cloud management and security company that is headquartered in Seattle, Washington. They offer many services to their customers and protect over 4.5 billion web transactions every day. F5 is trusted by over 85 percent of the Fortune 500 including Microsoft, Alaska Airlines, Tesla, and Facebook. To bring success to its customers, F5 utilizes a team of Technical Support Engineers. Behind the scenes, F5 Technical Support Engineers utilize an in-house application called RapidLab. RapidLab replicates customer infrastructure using both physical and virtual hardware to rapidly diagnose and resolve customer issues. Recently, work has begun on a RapidLab V2 to address the shortcomings of the original design. Team CS 23.09 was tasked with adding support for a new virtual machine backend to RapidLab by modifying existing components of the RapidLab stack. The team's additions allow for full management of virtual machines from within RapidLab including their creation, power state, and deletion. These new changes will allow F5 greater control over their own technical support system. By transitioning to this new backend F5 will be able to save money and enhance Technical Support Engineers ability to diagnose F5's customer issues.

PREDICTING SALES CODE DRIVEN REIS CS 23.10



SPONSOR: Kenworth Truck Company
SPONSOR LIAISON: Nick Grant, Jerry Mischel
FACULTY ADVISOR: Susan Reeder
STUDENTS: Titus Goh, Jordan Hollier, Cameron Lee, Greta Mason-Todd, Tuan Vo

Kenworth Truck Company, a subsidiary of PACCAR, is an industry leader in the design and manufacturing of medium-duty and heavy-duty trucks. As part of Kenworth's high-end product offering, customers are able to customize their truck orders to meet specific vocational needs. During the order administration process where sales codes are converted to bills of material, orders may be disrupted due to gaps in conversion logic. These are documented as a Request for Engineering Information (REI), a work order for a design engineer to manually review and resolve the order to continue processing in the system. Currently, Kenworth addresses over 50,000 REIs per year, and has no foresight into upstream systems to predict the number of REIs in which they will encounter or predict the logic behind why the REI occurred. The CS 23.10 team continued building on deliverables provided by last year's capstone team to reduce the time engineers spend on answering REIs. Utilizing existing project data and incorporating new data, we were able to include additional factors that feed into the REI process and assess results. This allowed the team to update the existing machine learning model and test new models to drive improvements in accuracy and quality. The goal of the machine learning model is to predict REIs generated from sales codes on an order, as well as provide insight to potential causes for these REIs.



DONOR DATA LAKE CS 23.11



SPONSOR: Mari's Place for the Arts
SPONSOR LIAISON: Peter Bloch Garcia
FACULTY ADVISOR: Pejman Khadivi, PhD
STUDENTS: Jacob Charbonneau, Plamedi Diakubama, Jenna Goldberg, David Welch-Keliihoomalu

Mari's Place for the Arts is a nonprofit that provides arts and culture education programs to low-income BIPOC children and youth in Snohomish County to build their confidence, improve their education, strengthen their mental health, and close the education achievement gap. Mari's Place for the Arts is an award-winning organization that empowers approximately 1,000 children and youth by developing their creative talents and encouraging them to pursue their dreams of a positive future. Like many nonprofits, Mari's Place faces many barriers to philanthropic resources that are essential to sustaining its vital work in the region. Currently, the organization uses time-consuming processes of searching for and identifying likely funders to support the nonprofit. Mari's Place requested that team CS 23.11 create a software solution that would help it find potential funders more likely to support their work. In response, team CS 23.11 delivered a web scraper that parsed websites of funders and returned relevant pages, along with information about what makes the pages relevant, a database to store the scraped data, and a user-friendly interface to allow users to interact with the scraper and database.

**THE EFFECTS OF IMAGE PROCESSING
TECHNIQUES FOR AUTOMATED WILDLIFE
SPECIES DETECTION CS 23.13**



SPONSOR: Panthera
SPONSOR LIAISON: Thabied Majal,
Ross T. Pitman, PhD
FACULTY ADVISOR: Shadrokh Samavi, PhD
STUDENTS: Kevin Khong, Mia Rodgers,
Julian Stefanzick, Castel Villalobos

Panthera is a non-profit conservation organization dedicated to preserving the lives and ecosystems of the world's wild cat species. Panthera's software, PantheralDS, is used with images from camera traps to identify and track many different animals in their natural habitat. Panthera was interested in optimizing PantheralDS so users with low computing power could leverage their platform without sacrificing speed or accuracy. We aimed to identify how various combinations of image processing techniques and convolutional neural networks impact speed and accuracy when identifying animals in camera trap data. The models we experimented with included DenseNet, Exception, MobileNet, and ResNet. We utilized image processing libraries from OpenCV and Pillow to transform images into smaller files, focusing on cropping out unnecessary data and highlighting the animal found in the picture. Our tests were performed on a dataset of over 30,000 images. Finally, we compiled our results into a formal analysis to assist Panthera in its efforts to update PantheralDS.



**HONORING OUR STORYTELLERS THROUGH
IMMERSIVE EXPERIENCE CS 23.14**



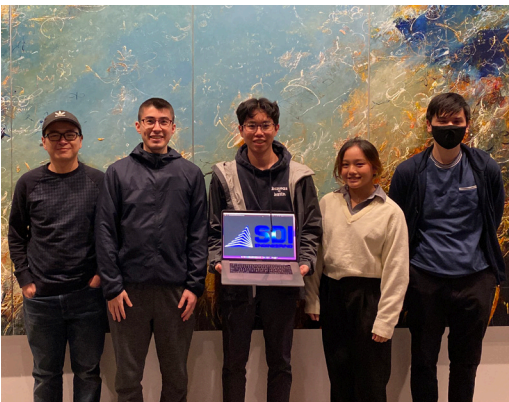
SPONSOR: RevereXR (RVR)
SPONSOR LIAISON: Yolanda Barton
FACULTY ADVISOR: Braxton Cuneo, PhD
STUDENTS: Matthew Lau, Sarah Nguyen, Supreet Sandhu, Wesley Wong

RevereXR is a company that focuses on storytelling and aims to preserve the history of the Seattle Central District through an immersive virtual reality (VR) experience. CEO Yolanda Barton tasked our team with preserving the music and cultural history of the Central District to let the voices of those who grew up in the Central District be heard. Due to the gentrification of the community and its surrounding areas, the Central District that is known to those who grew up here has changed drastically. This in turn has erased parts of their history, in addition to hiding generations of voices from those who lived there. To let these voices be heard, our team created an immersive museum built in VR to allow people to hear these stories and highlight key aspects of the community. Within this experience, there are two planned exhibits. The first exhibit will focus on audio and video of stories shared by elders within the community. The second exhibit will highlight items that represent or belong to the elders and aim to show a part of their history. By creating an immersive museum, we intend to preserve the history of the Central District and let the voices in the community be heard.



SPONSOR: SDI Engineering Inc.
SPONSOR LIAISON: Dennis Fredell,
 Phillip Richards, PhD
FACULTY ADVISOR: Yingwu Zhu, PhD
STUDENTS: Travis Ishihara, Eugene Keehan,
 Carter Martin, Richard Nguyen, Sothaninn Sieng

GearSim is a software tool that offers insights and simulations related to aircraft landing gear components. It enables aircraft manufacturers and other clients to reduce costs and time spent on physical aircraft landing tests. However, the initial version of GearSim was written in MATLAB, has an outdated design, is hard to maintain, or add new features to. SDI Engineering worked with previous Seattle University senior design teams to create a rough demo version with a new C++ and Qt Framework. Utilizing the design from the previous team we have continued the project and added more functionalities so the prototype becomes more interactive. Specifically, the team built fully functional interfaces and implementations that allow customers to input and store data for simulation and refactoring the codebase using C++. Our team focused on using object-oriented design to create reusable components, completed the architecture to store numerical details of the model with GearSim, and enabled the history log of data and simulation changes by efficiently tracking changes to the numerical model. The team delivered an updated version of GearSim to SDI Engineering that includes an interactive user interface, functionality to create, load, and save user data and project history log, testing frameworks, and refactoring and documentation of the existing codebase.



AFTER MARKET MOBILE APP CS 23.16



SPONSOR: The Feels Foundation
SPONSOR LIAISON: Tori Kiriara, Zachary Self
FACULTY ADVISOR: Tim Spinney
STUDENTS: Sirish Gurung, Imran Islam, Lolita Kim,
 Andrew Varela

The Feels Foundation is an all-volunteer non-profit that produces art showcases, teaches youth, provides select funding to emerging artists, and provides a platform for BIPOC artists to dive deeper into their respective story. The Feels Foundation currently has an e-commerce website called After Market that provides a place to sell products to a network of creatives and collectors of art. However, The Feels Foundation's goal is to create a functioning omni channel solution where artists can use the website and a mobile application interchangeably. The Feels Foundation requested that team CS 23.16 create a mobile application for Android and iOS that queries and populates The Feels Foundation's existing WordPress CMS. The team delivered a final mobile application that is compatible on iOS and Android which provides a storefront for artists to list their products as well as customers to buy products. Our app connects emerging artists who seek to shed light on their artwork and build their own community and/or platform. As a result, artists who are not familiar with technology may find it easier to showcase and present their products to the customers who are interested in art.



SPONSOR: The Mockingbird Society
SPONSOR LIAISON: Brianna Fenske
FACULTY ADVISOR: Michael McKee
STUDENTS: Samantha Marie Bruce, Bryce Chinn, Gabriele Gilioli, Thomas Sohocki

The Mockingbird Society is a non-profit youth advocacy group founded in 2000 that works to provide the youth of Washington state with opportunities and resources so that they can develop self-advocacy and activist skills to realize change in their community. Previously, The Mockingbird Society distributed information, stories, and resources tailored to their community, but they needed a more organized way to achieve this. The Mockingbird Society contacted Seattle University to develop a mobile application to aggregate these resources. After consulting members from multiple departments across the organization, our team decided to engineer a cross-platform mobile and web application by utilizing Dart and the Flutter SDK. Key features of the application include a calendar to organize events, a resource directory with detailed information on organizations in The Mockingbird Society’s network, and an archive of The Mockingbird Times newsletters.



“I want to let you know that I love the program, and I’m exceedingly grateful to work with such great youth.”

PETER BLOCH GARCIA
 Mari’s Place for the Arts



THE POSTMAN APP AND THE NEIGHBORHOOD MARKETPLACE CS 23.18



SPONSOR: The Postman
SPONSOR LIAISON: Ke’Anna Rose Pickett
FACULTY ADVISOR: Lin Li, PhD
STUDENTS: Jonathan Doan, Cong Ho, Julie Mammen, Haley Uyeunten, Danhriel Vu

When COVID-19 hit, the Postman’s business was impacted due to rising concerns regarding customer health and safety. The pandemic changed how the Postman viewed their shipping and business services. To protect their business and customers, the Postman worked to automate their services through a mobile application. This application would extend the Postman’s business to a new platform, increasing accessibility and convenience to their services. The Postman requested that CS 23.18 continue development on their mobile app, tasking the team with three main features. First, a profile manager that allows users to create, delete, and edit different profile types. Second, an e-commerce marketplace that enables users to buy, sell, rate, and review products. Finally, a messaging feature where buyers and vendors can directly chat with one another. Following the completion of these tasks, the team delivered a prototype of the Postman mobile application on both iOS and Android platforms. The Postman app enables users to manage their profiles along with the ability to purchase, rate, review, or sell products through the Neighborhood Marketplace.



VIRTUALIZING CLASSROOMS CS 23.19

VIRTUALIZING CLASSROOMS CS 23.20



SPONSOR: Thoughts Cost
SPONSOR LIAISON: Anthony Washington
FACULTY ADVISOR: Jason Wong
STUDENTS: Jaidan Dovala, Braedon Gipson, Akhil Kondepudi, Sahil Unadkat

SPONSOR: Thoughts Cost
SPONSOR LIAISON: Anthony Washington
FACULTY ADVISOR: Jason Wong
STUDENTS: Khoszaya Erdenebat, Sean Li, Connor MacKenzie, Haley Richardson, Savanna Ton

Thoughts Cost’s mission is to promote fairness and equity in education, with a focus in assisting special education teachers in individualizing their curriculum to match student’s Individualized Education Plan (IEP) goals. Our motivation behind working with Thoughts Cost is to support their mission in pushing towards a systemic approach to provide an equitable education for all students. With the reality being that not all students are able to physically attend resource rich classes, Thoughts Cost proposes to create a VR classroom experience allowing students who are unable to take classes at a normal capacity to have all the availability and access that every classroom should have. Thoughts Cost has requested both teams, CS 23.19 and CS 23.20, to cooperatively work towards bringing this idea into reality. Team CS 23.19 specialized in designing and implementing a virtual reality classroom experience tailored towards students with invisible disabilities. Specifically, the team worked on a guided science experiment where students can learn fundamental concepts of chemistry. The experiment contains features such as concept checks where students are assessed for their performance, video input, auditory stimuli, and haptic feedback. This program allows students to interact with virtual objects as they walk through the lab and retain the key information. Our goal is for students to feel safe with exploring new topics, so they focus on learning optimistically and ultimately allowing the learning outcomes to resonate in their personal lives and beyond.

Thoughts Cost’s mission is to promote fairness and equity in education, specializing in assisting special education teachers in individualizing their curriculum to match student’s IEP goals. They envision a systemic approach to providing an equitable education for all students. With the reality being that not all students are able to physically attend resource rich classes, Thoughts Cost proposes to create a VR classroom experience allowing students who are unable to take classes at a normal capacity to have all the availability and access that every classroom should have. Thoughts Costs has requested both teams, CS 23.19 and CS 23.20, to cooperatively work towards bringing this idea into reality. Following up analysis and concepts for a VR classroom experience, teams CS 23.19 and CS 23.20 produced a proof of concept with a single multiplayer online lab synced with a database to store relevant educational information on student progress. Team CS 23.20 focused on creating a synchronous database that processes data from virtual classrooms. Data collection is an important feature for teachers and schools to understand the progress of students for ensuring their IEP is fulfilled. The data also allows teachers to see the progression of the students’ understanding of a subject. This allows teachers to make decisions on how to better teach these topics to students. Along with our database, we are focused on creating an application for teachers to view our database in a convenient manner.



SPONSOR: Visiting Angels
SPONSOR LIASON: Tina Valdez
FACULTY ADVISOR: Eric Larson, PhD
STUDENTS: Daniel Eum, Sebastian Kuc, Katherine Pryal, Luke Schroeder

The Smart Scheduler Senior Capstone team worked with Visiting Angels, a senior home care company which employs caregivers who provide in-home care to their clients. Visiting Angels did not have a scheduling system where they could have a full picture of their caregivers' schedules along with the territories they serve or their open availability. Smart Scheduler is a web application that will help Visiting Angels maintain a flexible, readable, and accurate schedule. The created application works in parallel with existing data from management software called AxisCare by allowing the scheduler to upload the caregiver data and schedules into a database. This enables a feature that allows the scheduler to search and filter available caregivers so that the user can choose the best fit for their client. Smart Scheduler follows design specifications to prioritize usability while also providing a foundation for future developers to add new functionality such as a caregiver mobile app for open availability, increased security, and the migration to additional platforms.



INCREASING VOTER ACCESS FOR VOTEGRITY ONLINE ELECTIONS CS 23.22



SPONSOR: VoteGrity

SPONSOR LIAISON: Tom Thomas

FACULTY ADVISOR: Brian Daugherty

STUDENTS: William Alicar Jr., John Bjorge, Quinn Goldstein, Rafay Khan

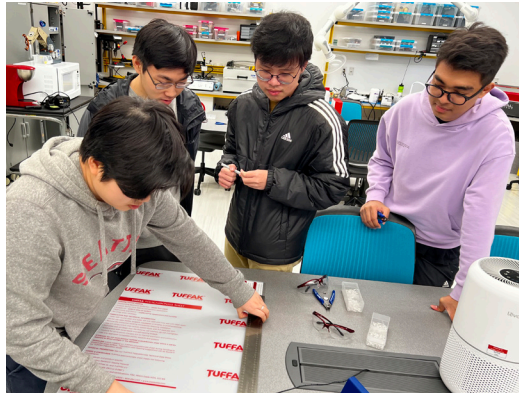
VoteGrity supports private elections for various groups like homeowners' associations, unions, and other private clubs. The company was founded with the vision of empowering voters and allowing all voices to be heard in the decision-making progress. The company brings this vision to fruition by supporting both online and paper voting for its users. To better support its user base and increase usability, VoteGrity requested that team CS 23.22 increase voters' ease of access to online ballots while maintaining security measures. Namely, the team focused on two ways of doing so: an automatic login process and text notifications for elections. The team implemented the automatic login process using a unique tokenization system that encodes user data into a personalized link that signs the user in to their ballot via user ID and password. This keeps unique user data secure to authenticate and legitimize elections. To implement text notifications, the team used the Twilio API to send texts notifying users that their ballot was ready for voting and created a verification page to get voters' phone numbers. Finally, the team combined these two processes by providing the capability for both emailing and texting voters their ballot links. The team worked to find the balance between ease of use for voters and secure elections - various checks were completed throughout the project to ensure the security of voter data and ballots.





SPONSOR: Amazon Web Services
SPONSOR LIAISONS: Derek Bennett, Mike Tran
FACULTY ADVISOR: Alvin Moser, PhD
STUDENTS: Chinh Hoang, Logan Kuniyuki, James Lynch, Supavit Rojbundit

Amazon Web Services (AWS) provides cloud computing products and services to millions of companies and organizations globally. From creating secure infrastructure for an IT department to utilizing machine learning tools for computing data, companies rely heavily on the resources AWS has to offer. These resources rely on the servers within data centers distributed around the world which operate 24/7. A failure in these data centers would gravely impact AWS customers who rely on their services. Trained human technicians laboriously inspect the infrastructure to prevent critical hardware failure and this project, the AWS Availability Rover, seeks to enhance worker abilities. Last year, a mechanical engineering team, ME 22.1, and an interdisciplinary team, INT 22.1, consisting of mechanical, electrical, and computer engineering students from Seattle University, were tasked with and completed the following: designing and constructing a prototype of a modular data-center-inspection cart that can be pushed by a data center technician and collect thermal, auditory, visual, and positional data. This year, a mechanical engineering team, ME 23.1, and an electrical and computer engineering team, ECE 23.1 were tasked to improve the design of the cart, make the cart semi-autonomous and improve the overall structure and efficiency of the cart. The result is a modular, more lightweight sensor platform with improved technical capabilities and fewer security risks. AWS plans to use the second iteration of the AWS Availability Rover prototype design as a proof-of-concept for future modular data-center-inspection cart iterations.



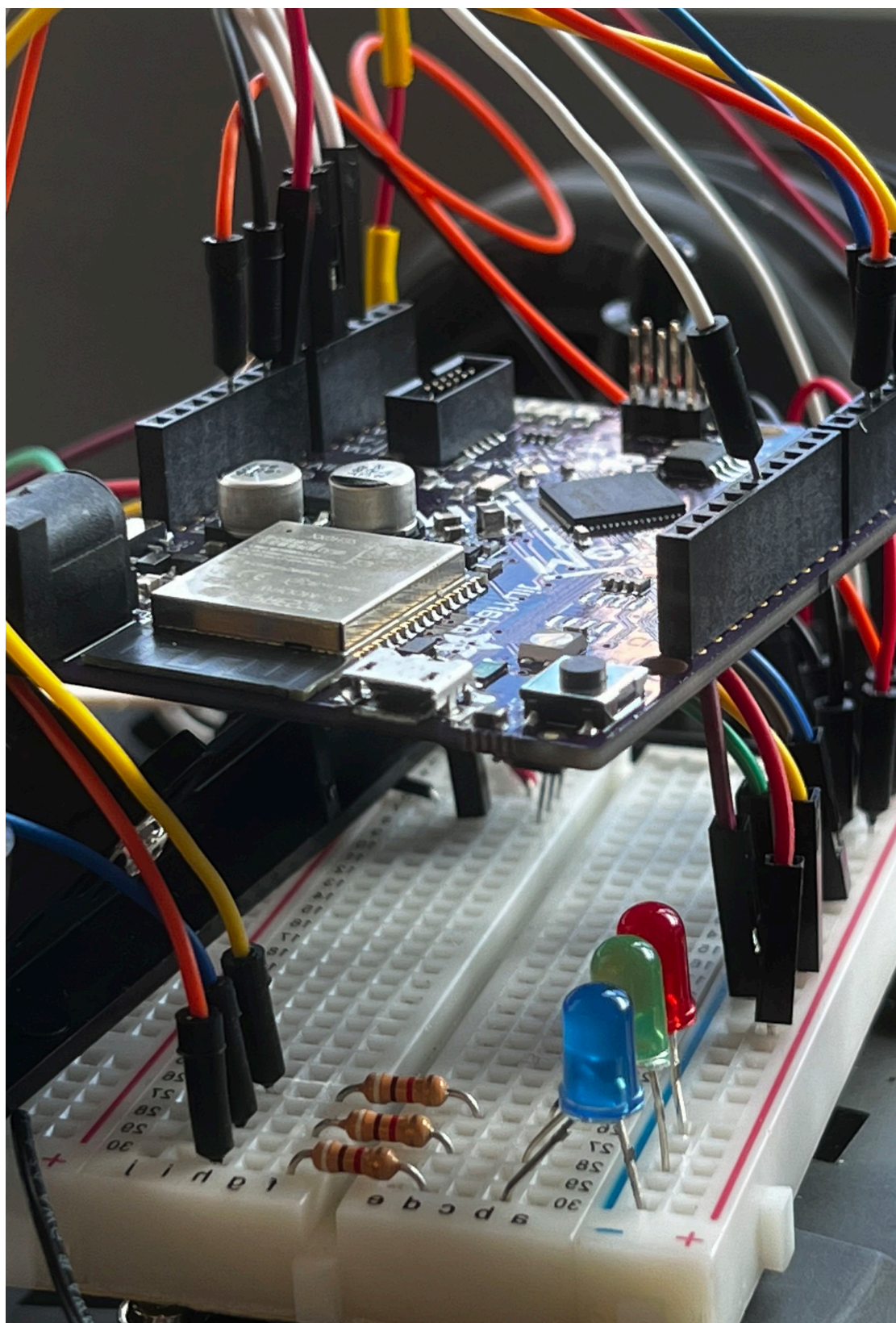
AUTOMATED MOBILE INSPECTION ROBOT
 ECE 23.2



SPONSOR: The Boeing Company
SPONSOR LIAISONS: Jeff Heisserman, PhD, Alma Limon-Vichy, Katherine Meza, PhD, Rohan Rana, Jim Troy, PhD
FACULTY ADVISOR: Alvin Moser, PhD
STUDENTS: Jessica Bowerman, Jaron Ngo, Wai Phyto, Khoi Trinh

The aircraft inspection process is a crucial aspect of aviation safety since it helps to ensure that all components of the aircraft are working properly and are in airworthy condition. Over the past decades, the number of aircraft manufactured and used has increased massively. As the number of jetliners increases, the inspection process of an aircraft before a flight has become harder to manage. Before departure, a ground crew needs to physically walk around the aircraft to perform various visual inspections and checks to make sure the aircraft is in good condition. Currently, there are several noticeable limitations that can be improved. These limitations include the lack of prior inspection data, time-consuming physical inspection, and unsafe working conditions for inspection crew during extreme weather events. Boeing requested that team ECE 23.2 design an automated platform system that can autonomously inspect the aircraft and save inspection records. This will allow for quicker turnaround time between the aircraft inspection and flights. The model built is a mecanum wheel chassis robot that allows for multi-directional movement which can access hard-to-reach areas. Mounted on the robot is a LiDAR sensor that helps determine the position relative to the aircraft. A camera is used to visually scan the underside of the plane and capture data that can be used to help detect anomalies.







**KILOWATTS
FOR HUMANITY**

SPONSOR: KiloWatts for Humanity
SPONSOR LIAISON: Daniel Nausner, PE
FACULTY ADVISOR: Agnieszka Miguel, PhD
STUDENTS: Caleb Malaer, Brian Phuong, Adrian Rivera, Loan Tran

KiloWatts for Humanity (KWH) is a non-profit organization that constructs off-grid solar-powered systems in rural communities, primarily in Sub-Saharan Africa. To ensure that these systems meet the specific energy needs of each community, KWH asked for enhancements to the Load Analyzer Graphical User Interface (LAGUI) using the Off-Grid Load Analyzing Device (O-GLAD), which were both developed by a previous Seattle University student team. The enhancements extend the functionality of the LAGUI by creating an Interactive Load Profile Archive (ILPA). The team created features on the ILPA that allow it to exhibit and merge load profiles, as well as create a file that a commercial energy optimization software can import data for future off-grid power system planning. Team ECE 23.3 performed a significant amount of both laboratory and field electrical testing on a variety of appliances and tools to ensure the accuracy and efficiency of the ILPA. The O-GLAD gathers the data that the LAGUI utilizes, and the output is comprehensible to both KWH volunteers and solar optimization software. This allowed for a more accurate and customized system that meets the specific energy needs of each community. With the completion of the ILPA, team ECE 23.3 delivered the software along with a final report to KWH that contained detailed technical information on the new features of the archive and recommendations for next steps.



HVAC HEALTH AND CAPACITY MONITORING SYSTEM ECE 23.4



SPONSOR: Sound Transit
SPONSOR LIAISONS: Craig DeLalla, PE, Benjamin McNutt, PE, Drew Peters
FACULTY ADVISOR: Shiny Abraham, PhD
STUDENTS: Lucas Efcavitch, John Nguyen, Laura Olson, Ace Taniguchi, Matthew Turner

Sound Transit is a regional transit agency that operates transit services, including Link light rail, throughout the Greater Seattle area. The Tukwila International Boulevard Station (TIBS) has a communications room which contains equipment that must be maintained within a specified temperature range. Unlike with newer stations that have heating, ventilation, and air conditioning (HVAC) controls integrated with the Building Management System (BMS), Sound Transit has no way of monitoring the HVAC systems in the TIBS communications room. Team ECE 23.4 was asked to solve this problem by creating an HVAC health and capacity monitoring system. The team created a system of hardware and software components to monitor relevant environmental and operating parameters in the communications room to determine the health of the HVAC system. The system uses custom hardware to transmit sensor data via the cellular network. This data is displayed to the user via a website and processed using a machine learning algorithm, which once fully trained on data collected from the sensors will predict when maintenance is needed.

COMMERCIAL VEHICLE CHARGING STATION DESIGN ECE 23.5



TACOMA POWER
TACOMA PUBLIC UTILITIES

SPONSOR: Tacoma Power – Tacoma Public Utilities

SPONSOR LIASONS: Riley Simpson, Jeremy Stewart

FACULTY ADVISOR: Mehmet Vurkaç, PhD

STUDENTS: Manuel Aguirre, Cameron Ching, Brittany Giangarra, Matthew Le

The Clean Energy for Americas Act that was passed on June 17, 2021, provides tax incentives for investment in electric transportation. As electric vehicle adoption increases, Tacoma Power, the electric utility serving the City of Tacoma and surrounding communities, will need to upgrade electric grid infrastructure to support public and private vehicle charging. Tacoma Power requested team ECE 23.5 to research alternative technologies to be used in a secondary system that can generate, store, and reallocate power to reduce the cost of upgrading current infrastructure or negate it. The study found that most local grid issues could be mitigated with managed charging, but extreme loads at some sites required significant onsite storage or generation to avoid grid upgrades. Following the study, a cost analysis was performed to compare each alternative technology for locations selected by Tacoma Power. Utilizing the cost analysis, Tacoma Power selected an alternative technology and the team delivered high-level drawings and justifications for four selected locations.



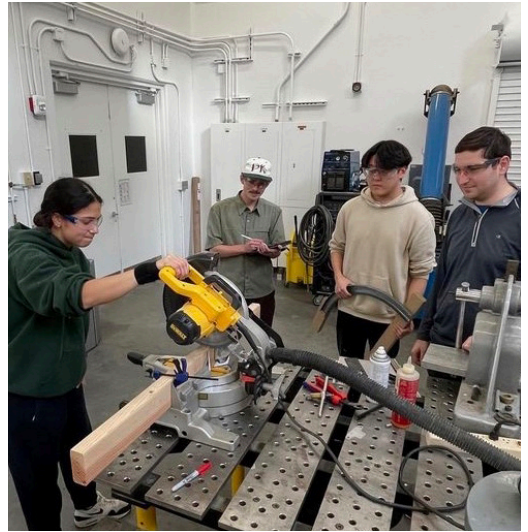


AVAILABILITY ROVER 2023 ME 23.1



SPONSOR: Amazon Web Services
SPONSOR LIAISON: Mike Tran, BSME
FACULTY ADVISOR: Mohsen Dadfarnia, PhD
STUDENTS: Kai Alberghini, Joshua Chung, Joseph Hess, Weston Lyons, Albert Sutandar

Amazon Web Services (AWS) operates data centers worldwide, storing critical data 24/7/365. As of June 2022, AWS led the \$200 billion cloud infrastructure industry with a 34% market share, so any server shutdowns could lead to data and monetary losses for numerous clients. Currently, servers are replaced or repaired when they fail, and AWS is seeking a proactive and preventative approach to avoid an unacceptable customer experience. AWS tasked team ME 23.1 to work with ECE (Electrical and Computer Engineering) 23.1 to create a second iteration of a preventative maintenance cart: Availability Rover 2023. Availability Rover 2022 was a successful initial proof of concept for collecting data from functioning server racks using thermal imaging. Availability Rover 2023 improved on the previous iteration regarding data collection, cart footprint, and sensor platform operation. ME 23.1 has created a rover with a custom-made frame constructed from T-slot aluminum extrusion to fit linear actuators, sensor arrays, and large batteries for long run times. An automated telescopic lifting system is mounted on the rover to vertically translate thermal imagers and microphones to scan the 90.4" height of a server rack from floor to top. The telescopic actuators are controlled by a centrally located laptop. All sensors are connected to the platform using modular, quick connect-disconnect systems for easy and efficient connection and adjustments. In addition to the initial fully functional prototype rover, ME 23.1 built a second fully functional rover prepared to be shipped - along with assembly instructions - to an AWS data center in Virginia. The final report includes future recommendations we have for future iterations of the AWS Availability Rover.



VIRTRUVITRON 7000 EXERCISE MACHINE ME 23.2



SPONSOR: Bolden Product Development Services, LLC
SPONSOR LIAISON: Jon Bolden
FACULTY ADVISOR: Kenya Mejia
STUDENTS: Brian Baek, Dara Keo, Theo Proctor, Emmanuel Rujoni, Madison Waguspac

The VirTruVitron 7000 is a full extension exercise machine that allows for movements to be performed in an arcing motion with vertical and horizontal gliders, engaging all muscles, tendons, and ligaments within an extended limb. The team was asked create a proof of concept of the given full-body exercise machine by evaluating how to make the machine functional and safe through engineering requirements. The team worked on the vertical gliding system to focus on structural design and prove functionality with the existing American Society for Testing and Materials (ASTM) fitness machine standards, ASTM F2276-10(2015). Through 3D modeling, FEA analysis, and physical prototyping, the team tested several different prototypes to meet the machine functionality and verified its structural stability and load bearing capabilities. The team delivered a scaled model to prove the functionality of the vertical gliding system that can endure the scaled weight stack load. In addition, the team also created a full-scale 3D model that fits both the safety factor and design specifications.



A **PACCAR** COMPANY

SPONSOR: Kenworth Truck Company
SPONSOR ADVISOR: Jeffery Spaulding
ACADEMIC ADVISOR: Sam Hoang, PhD
STUDENTS: Ethan Burigay, Peter Chronowski, Katie Mason, Stephen Thomas, Noah Turoski

Monitoring the energy use of battery electric vehicles (BEVs) is crucial for optimizing their performance and managing energy consumption. Kenworth, a leading manufacturer of heavy-duty trucks, is exploring the use of energy monitoring systems to track the energy use of its BEVs along predetermined pathways. They tasked team ME 23.3 to develop an autonomous point-to-point BEV and a corresponding energy monitoring system that leverages sensors to provide insights into the energy consumption patterns of key systems. A mathematical model was also developed to simulate energy consumption behavior. Following the design and assembly of an autonomous point-to-point delivery BEV with an energy monitoring system, the team built a digital model of energy usage data across various tested pathways. The pathways of interest are a straight, circle, and oval shaped path to draw conclusions and make future predictions on BEV performance. The final report has a verified simulation of the effects of curved pathways and changing speeds on energy consumption of a BEV along with supporting calculations, the final digital model, and a detailed explanation of the findings.



“I started working as a project engineer on the 520 bridge replacement project that is similar to Trout Creek Bridge but a bigger scope! I was literally hired on spot when I told them about the senior design project and shared with them what we did with our report and design.”
SAM MUTONI '21



UTILITY BULKHEAD CONNECTOR ME 23.4



SPONSOR: MODICA

SPONSOR LIAISON: Will Gibbs

FACULTY ADVISOR: Eric Gilbertson, PhD

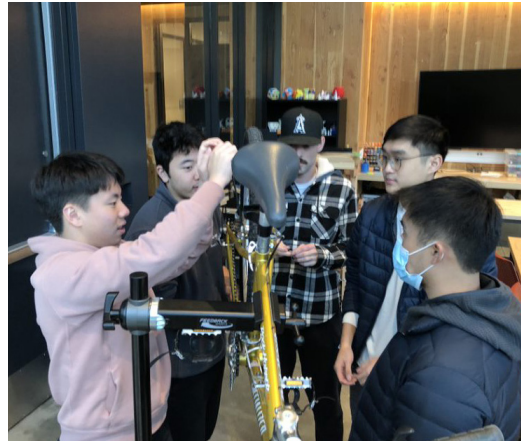
STUDENTS: Matt Baysa, Celeste Inouye, Ethan Nelson-Atkins, Colleen Webb

MODICA is developing a new manufacturing solution called MicroFabs, which consists of an array of pods each holding a 3D printer, CNC machine, or another small manufacturing device. Each device's functions are dependent on a unique combination of power, data transfer, and fluids. MODICA is designing the pods to be universally compatible with the backplane, which will supply each pod and, subsequently, machine with their required utilities. To achieve this ME 23.4 designed a universal bulkhead connector. Using a Multi-Criteria Decision-making Matrix (MCDM), the team chose four off-the-shelf connectors to transport the necessary mediums: USB C for data, three prong sockets for electricity, valves for liquids, and compressed air. With the chosen connectors, the team began to design apparatuses to address the creation of a compact, single action, and future proof of concept for the bulkhead connector. Through an iterative prototyping process, ME 23.4 developed a connector solution characterized by the transportation of the outlined utilities and the ability to connect and disconnect by pushing or pulling the connector. The connector functions with less than 30 pounds of exerted force, fits within the given size constraints, and can handle the pressures and temperatures of dynamic fluids through the system. This novel product's development will assist MODICA in advancing manufacturing automation.



SPONSOR: OCR Medical Device Development
SPONSOR LIAISON: Stephen Kerr, MD
FACULTY ADVISOR: Shen Ren, PhD
STUDENTS: Manilyn Cabrera, Kai Chen, Sophia Coseo, Samuel Lund, Georelle Marc Matias

In a laparoscopic cholecystectomy (gallbladder removal), the cystic duct, which drains the gallbladder, must be sealed and cut before the gallbladder is removed. There are current solutions on the market to seal ducts, but they can puncture the ducts and sometimes do not produce a perfect seal. ME 23.5 was tasked with designing and prototyping a medical zip-tie applier to replace the current solutions. This device will enter a patient through a surgical port (12mm), attach a zip-tie to the duct, and tighten and seal the duct. Once the duct is sealed, the device will cut the tail of the zip-tie, release the zip-tie from the device and exit the body. ME 23.5 developed a system of eight components to fulfill the requirements. The initial prototype was built to be twice the size of the final device and had six components (modified zip-tie, cartridge, hook, pin system, handle, and plunger). Two components (cutting mechanism and tail capture) were deemed unnecessary for initial tests and were left out to help isolate functional issues. The final functional prototype is also double-sized but has a refined design and uses higher-quality materials. The final prototype can seal a duct (or comparable tube), quickly reload with zip-ties, and capture zip-tie tails. This prototype is the final deliverable for OCR Consulting and will be used as a starting point for the manufacturing process.



CREATION AND DESIGN OF EXTENDING CRANK ARM BICYCLE AID ME 23.6



SPONSOR: SDI Engineering Inc.
SPONSOR LIAISONS: Dennis Fredell
FACULTY ADVISOR: Frank J. Shih, PhD
STUDENTS: Dylan Gerard, Matthew Lai, Tyler Luke, Mack Nishida, Jadrian Png

The SDI Engineering project aimed to redesign the bicycle crank arm to increase its mechanical advantage by extending the crank length while riding using a mechanical mechanism to activate the device on or off. Physical prototypes and numerical simulations were created, and design modifications were made based on the results. The redesign process resulted in a mechanical advantage increase of 15% at 3-centimeters and 11% at a 2-centimeter increase. In addition, laboratory testing was carried out to validate the performance of the new crank arm, and results showed an improvement in the mechanical advantage provided by the crank arm during high force pedaling. The findings of this project demonstrated the importance of a well-designed crank arm in achieving an improved performance bicycle and highlighted the benefits of using simulation and optimization techniques in the design process.

DONOR DATABASE ANALYSIS AND RECOMMENDATIONS MSDS 23.1



SPONSOR: Camp Korey

SPONSOR LIAISON: Kathleen Banks

FACULTY ADVISOR: Ariana Mendible, PhD

STUDENTS: Liya LaPierre, Radhika Magaji, Aishwarya Saibewar, Karthika Selvaraj

As a non-profit organization providing free activities to children with severe medical conditions, Camp Korey depends on donors and volunteers to support their summer camp events and programs. However, Camp Korey struggles with missing or incorrect contact information for their donors and a lack of data-driven insights into when donors give, how much they give, and how engaged they are with the organization. To help address these problems, we have worked with their data to identify the donors with invalid addresses and emails. We have also used Microsoft Power BI to visualize trends in the data over multiple dashboards, tracking various performance indicators over the past three years. As requested by Camp Korey, in one of these dashboards, we segmented donors based on their annual giving amount and provided an analysis of the differences between the resulting groups. Finally, we have developed a methodology for Camp Korey to score individuals' engagement using an equation that considers percentile scores for donation and volunteer activity. By improving the quality of their data and providing insights into their donor base, this work will help Camp Korey develop more informed and effective fundraising strategies.





PREDICTING NEW MEMBER BEHAVIORS
MSDS 22.2



SPONSOR: Costco Wholesale
SPONSOR LIAISON: Bryan Cikatz, Malou Leonardo, Michael Sunderland
FACULTY ADVISOR: Brian Fischer, PhD
STUDENTS: Fidan Aydamirova, Pooja Bhatia, Swathi Kolar Ravikumar, Nitharsan Sivakanthan

Costco provides one of the largest membership-based shopping experiences with warehouses across 14 countries. They pride themselves in bringing their members high quality products at the best prices. Costco’s marketing team is focused on membership renewal and acquisition. Team MSDS 23.2 focused on identifying first-year members that are not likely to renew their membership. Using data analysis and statistical methods, the team provides Costco with features that help identify whether someone will renew or not. These features are used in machine learning models to predict a member’s renewal status. This model can support Costco’s marketing team in deciding which members to send selective advertising towards to keep their business thriving. In addition, these same features may be used in a customer acquisition model. This model will help Costco grow its business by identifying individuals likely to join Costco in the future who will renew their membership.

PREDICTIVE MODEL FOR UNCONFINED CONCRETE STRENGTH MSDS 23.3

DESIMONE

SPONSOR: DeSimone Consulting Engineers
SPONSOR LIAISON: Jeff Dragovich, PhD, PE, SE, FACI
FACULTY ADVISOR: Ariana Mendible, PhD
STUDENTS: Prateek Kakkar, Xuanzhi Li, Ramgopal Reddy Putta

"Unconfined Concrete Strength" is a term used in structural engineering to describe the maximum compression stress that a structural material can withstand before breaking under axial stress. This value is crucial for ensuring building safety. As a leading firm in the field of structural engineering, DeSimone Consulting Engineers (DCE) have been testing the strength of concrete mix design specimens from various construction sites. However, the reports containing this data are stored in a nested shared drive in PDF format, making it difficult for DCE engineers to retrieve the data and challenging for data analysts to uncover insights about concrete strength. To solve this problem, MSDS 23.3 provided clean structured data files and stored them in adequate schemas after extracting them from the PDF reports. The team also identified the key factors affecting concrete strength and enabled the prediction of this variable by developing a machine learning model with the best prediction accuracy. With these solutions in place, DCE engineers can efficiently retrieve and analyze the data, uncover insights about concrete strength, make well-informed decisions regarding future design and construction, and ultimately save time and money.





BILIRUBIN ASSAY EVALUATION AND JUDGING SYSTEM MCSC 23.1



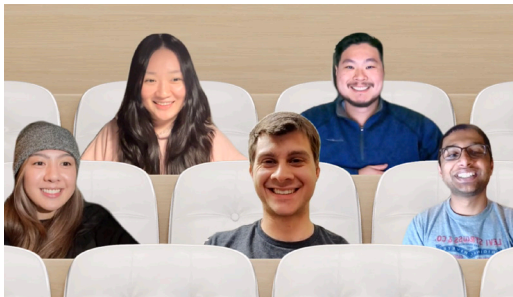
SPONSOR: Bilimetric USA, LLC
SPONSOR LIAISON: Richard Partridge-Wennberg, MD
FACULTY ADVISOR: Mike Koenig, MSE
STUDENTS: Bao Tran Do, Xinyu Qiu, Gregory Reneris, Marwa Saleh, Yiu Wing Wong

The Bilimetric program is dedicated to the fast, cheap, and accurate testing of bilirubin levels in infants to prevent kernicterus in low resource countries. When a sample is taken and placed on a premade test card, the technician can take a picture of the sample. That picture can be analyzed to determine the level of bilirubin in the blood. The Bilirubin Assay Evaluation and Judging System team focused on enhancing the implementation, improving the image analysis and the algorithms behind the evaluation of the sample. Before the project, the analysis conducted by the researchers on the data from these tests was quite time-consuming and inefficient. Additionally, the probability of human error was high and could skew the results. Bilimetric USA requested that team MCSC 23.1 enhance the site image judging system. The team reviewed the image results, streamlined human evaluation, and created additional datapoints for the machine learning pipeline. Upon completion of the project, the team delivered the final product to Bilimetric USA. The following features were developed and added to the project: development of a standardized list of image issues and image severities and analysis of the image, including the RBG and color values. RGB values were also used to classify the issue types and severity. This process is now automated and does not require much interaction from the researcher. The researchers can add or delete image issues for specific images as required, enhancing their classification abilities. Furthermore, the researchers can filter by issue type, resulting in a better experience when searching for images with specific problems.



SPONSOR: Bilimetricx USA, LLC
SPONSOR LIAISON: Richard Partridge-Wennberg, MD
FACULTY ADVISOR: Michael Koenig, MSE
STUDENTS: Yanqing Xie, Dominic Burgi, Meryll Cruz, Adit Goyal, Henry Song

Bilimetricx USA is committed to providing affordable solutions that prevent kernicterus in low-resource countries. Founded by Richard Wennberg, MD in 2012, Bilimetricx USA, LLC developed the BiliStick which is a point-of-care bilirubin assay that utilizes a plasma/blood cell separator and a reflectance reader - and the BiliPic, which estimates bilirubin levels using a smartphone camera to measure color without requiring the more expensive BiliStick reader. However, the current BiliPic app has limitations in correcting for image quality, lighting, and camera variations, leading to many test results being rejected due to poor saturation, distortion, and blue color image issues. To address this, Bilimetricx USA, LLC enlisted team MCSC 23.2 to research and apply the latest artificial intelligence (AI) and machine learning (ML) approaches to improve the image processing capabilities of the existing system. After exploring cutting-edge AI and ML techniques for correcting the most common reasons for test result rejections, the team developed a machine learning model for predicting the optimal color type for image processing and added AI-based image correction capabilities to address oversaturation, rotation, and box detection issues. The enhanced system will be incorporated into the mobile application for field-based evaluation.



**NEXTGEN RADIOLOGY REPORTING SYSTEM
 MCSC 23.3**



SPONSOR: Imorgon Medical
SPONSOR LIAISON: Andy Milkowski
FACULTY ADVISOR: Michael McKee, MSE
STUDENTS: Kai Ying Chan, Wei-Che Chung, Zi Qi Li, Anthony Pinza, Carlo Provenzani, Fangsheng Xu

Imorgon Medical focuses on improving workflow in ultrasound Radiology departments. Currently, sonographers take paper notes and collect information on paper worksheets. This workflow cannot handle the increasing ultrasounds volume and shortage of sonographers and radiologists. Our project aims to improve ultrasound information collection and eliminate paper forms and worksheets by creating electronic forms. The team built full-stack software that will help deal with several of the issues that Imorgon Medical has been facing. One of the biggest obstacles was the increasing number of forms that were created using HTML and CSS. We created a form-building tool that lets the user build the form that they desire from scratch. The current solution allows sonographers to switch to a patient's exam with the correct form attached to it. These customized electronic worksheets facilitate quick data entry through context-sensitive input tools such as drop-down, checkbox, radio button and free text entry. Our software takes a solid step in improving sonographer efficiency to quickly conduct a new ultrasound exam. Our most important specification was to create a web-based tool that enables the user to create and edit data entry forms. We achieved this by using REACT for our front end, NodeJS on our server side, and SQLite for our database. Another essential feature was to separate out administrative work and the work that sonographers do. This feature allows the administrator to do all the behind-the-scenes work and eliminate any redundant work the sonographer must do. An admin has the capability of creating a new patient, creating a new ultrasound exam template, and assigning a particular patient the exam type they will have on a given date. This function allows the sonographer to focus on the exam and not worry about administrative work.

SCHEDULING STUDENT TEACHING ASSISTANTS (TA'S), GRADERS, AND TUTORS APPLICATION MSCS 23.5



SPONSOR: Seattle University College of Science and Engineering

SPONSOR LIAISON: Steven Hanks, PhD

FACULTY ADVISOR: Eric Larson, PhD

STUDENTS: Prajakta Bimalkhedkar, Robert Brown, Avery Dinh, Jia Jin Koh, Bakyadevi Ray, Chien-Cheng Wang

The Scheduling Student Teaching Assistants (TAs), Graders, and Tutors Application is a standalone application developed for the Computer Science Department at Seattle University. The purpose of the application is to simplify and partially automate the process selection and hiring of student workers each quarter. The Department typically hires 30 or more student workers for TA and Grader positions each quarter. The current process involves manual creation of surveys to send to faculty and students to gather data, resulting in multiple spreadsheets of Qualtrics survey results. The department spends hours manually sorting information from interested students. To simplify the process, our team developed an application to partially automate this selection process and management of the surveys. Our team built a Python-based API to handle instructor and student worker survey creation and management utilizing the Qualtrics API platform, and a React web application to allow the department display and manage assignments based on the survey results stored in a MongoDB database. Our application allows the department to see a list of all available students interested in becoming student workers for each course in a single web browser window, instead of divided among 3 or more separate spreadsheets. It maintains the ability of the department to make worker assignments themselves with data from interested students, via a minimal graphical user interface, with all necessary data in one place.



CANVAS CODE GRADER MSCS 23.4



SPONSOR: Seattle University

SPONSOR LIAISON: Beatriz Diaz Acosta, MS

FACULTY ADVISOR: Steve Hanks, PhD

STUDENTS: Alicia Garcia, Sanchita Jain, Omid Shamoil, Francis Kogge, Mark Taylor, Hector Herrada

Canvas is widely used in the Seattle University CS department for course material sharing and assignment submissions. However, code assignment submission for core CS courses is currently handled through a separate, multi-step process. Students in these classes submit their code by copying their files to the department's CS1 Linux Server through an instructor-provided evaluation script. Instructors and graders must use CS1 to run and analyze student code submission while providing feedback separately through Canvas. To alleviate this laborious process for students, graders, and instructors, the MSCS 23.4 team was tasked to develop a solution to consolidate all code submissions, evaluations, and execution within Canvas. The core features of the product include enabling students to run an evaluation check of their submission, as well as providing graders and instructors with a read-only view of each code file and the ability to interact with the program during execution. The solution must comply with Seattle University security guidelines to prevent students from seeing their peers' submissions. The team created a browser extension to mediate communication between a code evaluation/execution system and the Canvas user interface where all events and messages are emitted. By incorporating this tool in the CS department resources, students can self-verify if their code is ready for submission, with clear warnings if it is not, while professors can assess student submissions entirely through Canvas.

“While the MSDS program has taught me many of the technical skills needed to become a data scientist, the capstone project helped me to refine professional skills that are so important for working in industry.”

LIYA LAPIERRE

Masters of Data Science

PARROT: AN ABSTRACTIVE MEETING SUMMARIZATION APPLICATION

SPONSOR: Sada Narayanappa, PhD

SPONSOR LIAISON: Geospaces.org

FACULTY ADVISOR: Wan Bae

STUDENTS: Vincent Marklynn, Anjali Sebastian, Yong Long Tan

Around 83% of employees spend a third of their work-week attending meetings. We aim to conduct analysis from speech to text specifically in conversations with more than two speakers in a meeting environment. Besides granting accessibility accommodations to hard-of-hearing people, we also want to provide accurate and insightful analysis to customers and researchers. With recent advances in automatic speech recognition and natural language processing (NLP) models such as OpenAI’s Whisper and Meta’s BART, we seek to simplify the process of speech recognition and abstractive summarization of long meetings. Unlike extractive summarization, abstractive summarization creates summaries by synthesizing new words and sentences that maintain the original meaning of the source. This is challenging due to the necessity of NLP models for text generation. Our solution consists of developing a pipeline that takes large audio files (approximately 1 hour) and transcribes and diarizes the conversation using OpenAI’s Whisper and Pyannote. Our summarization solution involves retraining the BART model. Our retrained model makes the base-model compatible with summarizing long meeting dialogues and improves summarization by 148%. The solution includes a front-end website built using Django that integrates our model and enables users to upload a meeting recording to get the full meeting transcript and summary.

NETWORK TRAFFIC ANOMALY DETECTION USING ENSEMBLE STACKING METHOD

FACULTY ADVISOR: Wan Bae

STUDENTS: Joshua Palicka, Alexander Sheardown, James Talbott

The world of technology has allowed us to be more connected, but it also makes us more vulnerable to cyber threats, making advanced threat detection more important than ever. We build on recent work by Carrera et al., further testing their two-phase anomaly detection process. In essence, they propose that a model that can predict quickly can be used to reduce incoming data for a second, slower, more accurate model, and thus achieving faster and more accurate predictions than either model alone. To improve the model pipeline, we introduce new data augmentations and test many combinations. We use autoencoder variants for the first phase and isolation forest variants for the second. We consider a two-phase pipeline to have outperformed its component models if the pipeline predicts faster than the phase 2 model without significant loss of score and scores higher than the phase 1 model without significant loss of prediction speed. Our results confirm that the two-phase prediction pipeline generally outperforms its components under this guideline.

AUTOMATED POTHOLE DETECTION AND REPORTING SYSTEM USING COMPUTER VISION

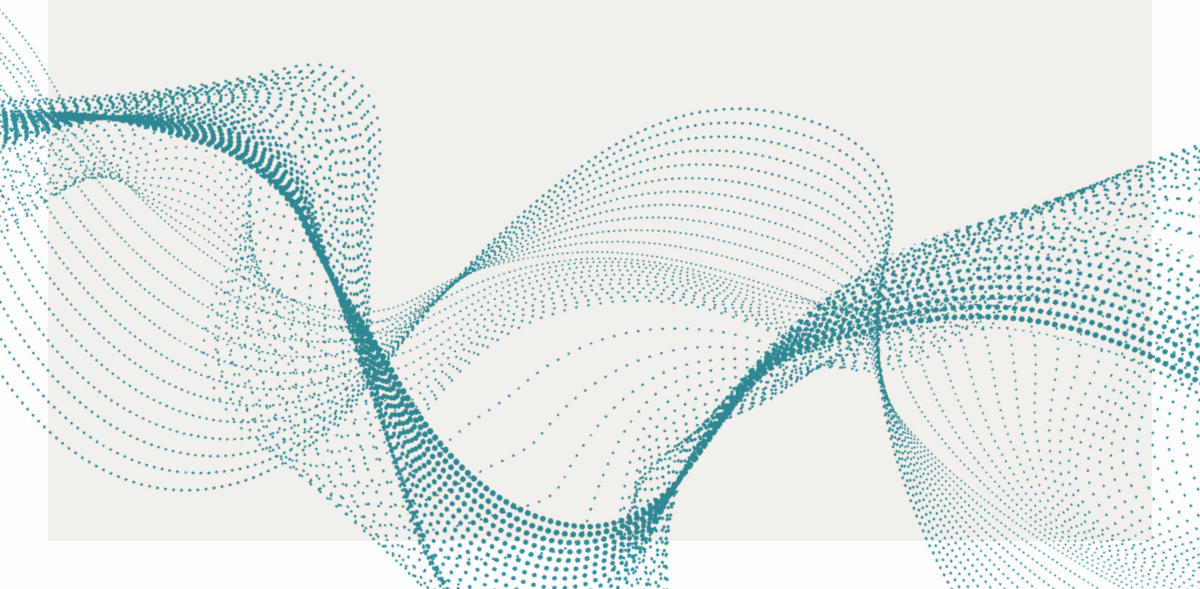
FACULTY ADVISOR: Wan Bae

STUDENTS: Zachary Jeffreys, Kshama Kumar, Zhuojing Xie

The rapid growth of remote sensing technologies, superior computing power, and machine learning techniques can help local governments to make pothole detection and reporting more efficient. We proposed an automated pothole detection and reporting system that utilizes an edge computing device installed on a garbage truck to detect and report potholes automatically. The device captures images of the road surface, and object detection techniques are used to detect potholes. If a pothole is detected, the device sends the road surface image, GPS latitude, and longitude to the server. The server counts the number of potholes and prioritizes them based on severity. The system provides a user-friendly interface for visualizing the potholes’ locations on a map. The proposed system reduces the need for manual reporting, minimizes time and resources for road maintenance, and increases road safety. The system also positively impacts the environment by utilizing an existing garbage truck for data collection and minimizing unnecessary maintenance, reducing costs and carbon footprint. Overall, the proposed system provides a safer, more efficient, and environmentally friendly method for tracking road conditions.

“The Seattle University students have demonstrated tremendous proficiency in designing a solution to the interface of the Cascade Trail and Wiseman Creek. They collaborated thoughtfully while considering a variety of potential solutions and without a doubt, this section of trail will become an attractive destination.”

BRIAN ADAMS, Director
Skagit County Parks & Recreation



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