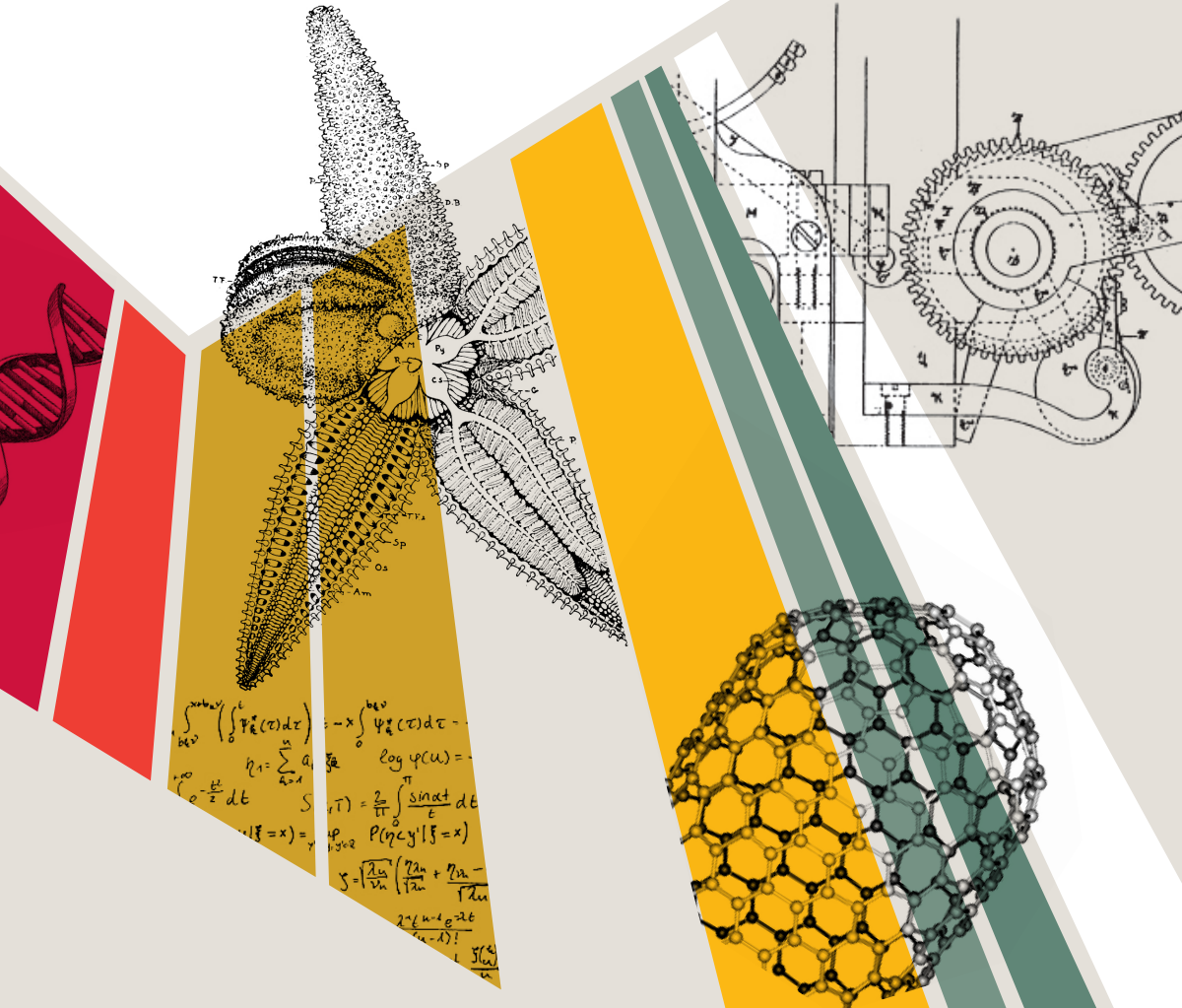
CELEBRATING 35 YEARS

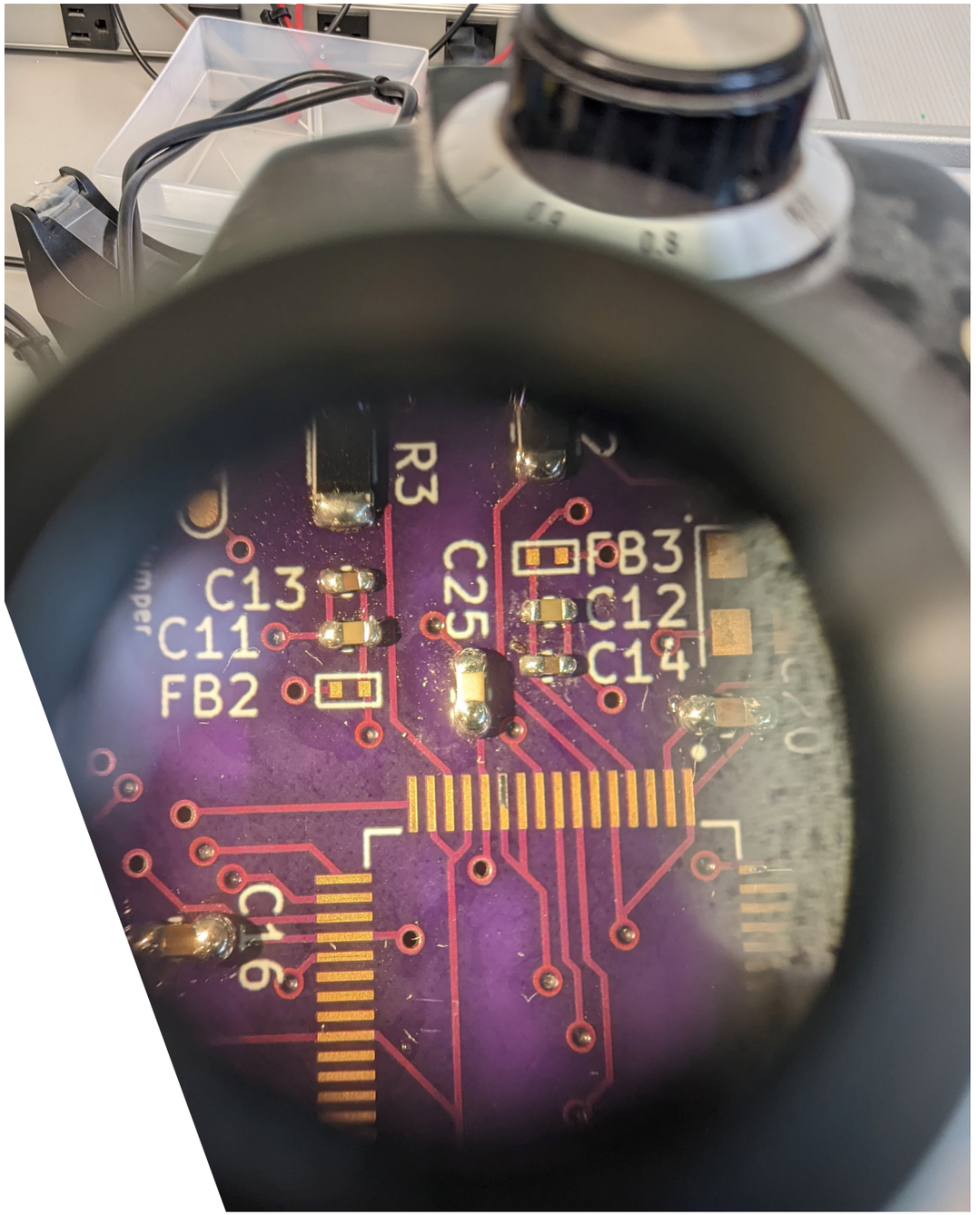
PROJECTS DAY

2022



SEATTLEU

COLLEGE OF
SCIENCE AND ENGINEERING



Welcome to Projects Day 2022!

We are pleased that you can participate in this important end-of-year celebration, either in person or online. Last September, each student team received a challenging, real-world assignment from a local external partner. As the students worked throughout the year on their projects, they applied the technical knowledge gained in their coursework and gained skills in project management, teamwork, budgeting, technical writing, and oral communications. Projects Day is the culmination of their experience. Today 196 students will report the results from their 44 projects.

This year marks the 35th anniversary of the establishment of the Project Center. We are proud that the Project Center has become one of the most visible and distinguished elements of the College of Science and Engineering, with a national reputation for excellence. Over the history of the Project Center, a total of 3738 students have completed 897 projects for 271 companies, government agencies, and non-profits.

This year also marks the completion of the Center for Science and Innovation project, which has resulted in the construction of the Jim and Janet Sinegal Center for Science and Innovation and the renovation of the Thomas Bannan Center for Science and Engineering. The new engineering and science facilities will help Seattle University connect even more closely to external partners.

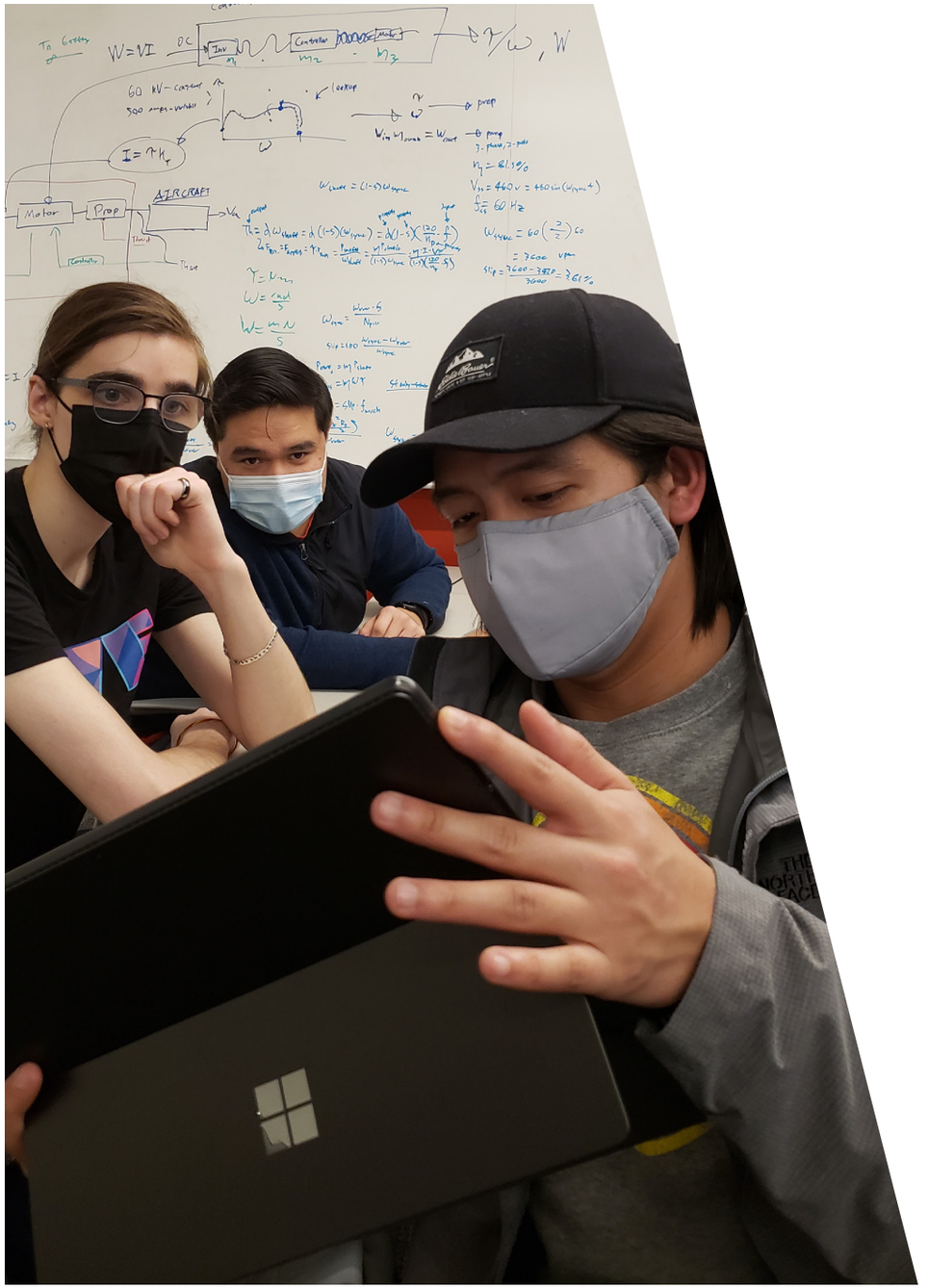
We are grateful to the companies, government agencies, and non-profits who have partnered with us to make possible this important, award-winning educational experience. We give special thanks to the sponsor liaisons, faculty advisors, and staff who provided unfailing support to the student teams in the completion of their projects.

Finally, both of us are retiring from Seattle University at the end of June. We are grateful to have held leadership positions in the College of Science and Engineering during an era of unprecedented growth for STEM education at Seattle University. We know the Project Center is on a strong trajectory that will lead to even greater successes in the future.

Best Wishes and Farewell,

Michael J. Quinn, PhD
Dean
College of Science and Engineering

Jean Jacoby, PhD
Associate Dean
College of Science and Engineering



PROJECTS DAY 2022

JUNE 3 / SEATTLE UNIVERSITY CAMPUS

EVENT SCHEDULE

ENGINEERING, ENVIRONMENTAL SCIENCE, AND COMPUTER SCIENCE PRESENTATIONS

11:45 A.M. – 12:30 P.M. CHECK-IN AND REGISTRATION
TENT IN SINE ZEN GARDEN

12:30 P.M. – 1:45 P.M. WELCOME AND PRESENTATION SESSION 1
Sullivan Law School C5
- ENSC 22.1 **Snoqualmie Valley Watershed Improvement District**
  The Effects of Pond Levelers on Flow and Overtopping Frequency in Beaver Dams
- ENSC 22.2 **USDA Forest Service**
  Evaluation of Unmanned Aircraft Systems (UAS) and Traditional Aerial Imagery for Mapping Large Wood on Forested Shorelines of an Urbanized Pacific Northwest Estuary

Sullivan Law School C6
- ECE 22.2 **KiloWatts for Humanity**
  Obtaining Energy Data for Analysis and Simulation Using an Off-Grid Load Analyzer
- ECE 22.3 **Panthera** Project Spot Check

Sullivan Law School C1
- ME 22.2 **Kenworth Truck Company** Energy Monitoring for Electric Systems
- ME 22.3 **Microsoft Global Services** Retrofitting a Hot Aisle Containment Structure into Microsoft's Data Center
- ME 22.4 **MODICA** Robotic Interposer Arm Selection

SINE 110
- CS 22.05 **Babelflex** COLDBYTE Temperature Monitor
- CS 22.06 **Envirovector** Raw Land Reports
- CS 22.17 **Satchl** Satchl Companion Loyalty Program

SINE Oberto Commons
- CS 22.19 **The Postman** The Postman Mobile Application
- CS 22.20 **Votegrity** Votegrity SaaS Solution
- CS 22.12 **Mari's Place for the Arts** Search Engine of Community Organizations

1:45 P.M. – 2:00 P.M. BREAK

2:00 P.M. – 3:00 P.M. PRESENTATION SESSION 2
Sullivan Law School C5
- CEE 22.1 **Pallet SPC** Off the Grid Community Development for Transitional Homeless Populations
- CEE 22.3 **Snohomish County Public Works Department**
  South Machias Road/Three Lakes Road Intersection Improvements

Sullivan Law School C6
- ECE 22.4 **Schweitzer Engineering Laboratories** Meter Testing Device Using a Smartphone Phase 2
- ECE 22.6 **Tacoma Public Utilities - Tacoma Power** Ketron Island Initial Microgrid Feasibility Study

Sullivan Law School C1
- INT 22.2 **St. James Cathedral** St. James Cathedral Carbon Footprint and Energy Use Assessment
- INT 22.1 **Amazon Web Services** Availability Rover
- ME 22.1 **Amazon Web Services** Availability Rover - Rover Cart Hardware

SINE 110
- CS 22.14 **Rahber Thariani, PhD** Sports Modelling and Outcome Prediction
- CS 22.15 **Rahber Thariani, PhD** Google and Reddit Trends Analysis
- CS 22.18 **SDI Engineering Inc.** GearSim UI/UX Graphics and Design

SINE Oberto Commons
- CS 22.07 **F5 Networks** Infrastructure Tooling
- CS 22.08 **F5 Networks** iHealth
- CS 22.09 **F5 Networks** Knowledge Services Data

3:00 P.M. – 3:15 P.M. BREAK

3:15 P.M. – 4:15 P.M. PRESENTATION SESSION 3
Sullivan Law School C5
- CEE 22.2 **Seattle City Light** Seismic Evaluation and Retrofit of Lucky Peak Powerhouse
- CEE 22.4 **Community Roots Housing, Swenson Say Faget** Larned Apartment Seismic Retrofit

Sullivan Law School C6
- ECE 22.5 **Sound Transit** Light Rail System Track Voltage Data Processing and Analysis
- ECE 22.1 **The Boeing Company** RoboRilla: A Human-Model Input Device

Sullivan Law School C1
- ME 22.5 **NASA-Psyche Project** Robotic Explorer for Psyche's Hypothesized Surfaces
- ME 22.6 **SDI Engineering Inc.**
  Modeling of Electric Aircraft Drivetrain in Matlab Simulink to Determine Flight Characteristics
- ME 22.7 **Sky Island Farm** Conveyor Wash Station

SINE 110 ends at 4:35 P.M.
- CS 22.01 **Amazon Web Services** Business Data Catalogue Management for Data Handling
- CS 22.02 **Amazon Web Services** Partner Central Data
- CS 22.03 **Amazon Web Services** Well-Architected Scoring System
- CS 22.04 **Amazon Web Services** Well Architected Review on Deployment

SINE Oberto Commons ends at 4:35 P.M.
- CS 22.13 **Our Fabric Stash** Growing a Sustainable Crafting Community
- CS 22.10 **Kenworth Truck Company** Request for Engineering Information (REI) Effort and Complexity
- CS 22.11 **Kenworth Truck Company** Predict Sales Code Driven Requests for Engineering Information (REIs)
- CS 22.16 **Redmond Dudes Baseball** Redmond Dudes Baseball Web App

4:15 P.M. – 5:00 P.M. POSTER SESSION

5:00 P.M. – 6:00 P.M. RECEPTION

OFF THE GRID COMMUNITY DEVELOPMENT FOR TRANSITIONAL HOMELESS POPULATIONS CEE 22.1

SPONSOR: Pallet SPC
SPONSOR LIAISONS: Jordan Barde, Zane Geel
FACULTY ADVISOR: Mike Marsolek, PhD, PE
STUDENTS: Molly Elrick, Jenelle Ho, Kyra Lemmelin, Khang Nguyen, Darwin Phu

Pallet Social Purpose Corporation (SPC) provides modular and transportable shelter units for people experiencing homelessness and other communities in transition. Pallet has self-identified the need to improve their facilities to better serve residents' personal and social health, and tasked CEE 22.1 to develop a reproduceable village configuration for a development of 177 units in Chico, California. To accomplish this, CEE 22.1 conducted a literature review and created a specifications sheet to identify best practices that promote social wellbeing. These best practices were used to design two alternative layouts in AutoCAD, which were scored against Pallet's baseline layout using a decision matrix. Team CEE 22.1 then applied the social well-being design principles developed for the Chico site to a 7–12-unit community expansion located in Burlington, Washington. This site plan included implementation of off-grid technologies, including solar panels for electricity, a cistern and pressure vessel for water supply, a firelight toilet for black water, and greywater collection system for all other wastewater. Utilization of off-grid technologies minimizes infrastructure costs, which is a common barrier when developing transitional housing facilities and provides site flexibility when traditional infrastructure is not readily available.

SEISMIC EVALUATION AND RETROFIT OF LUCKY PEAK POWERHOUSE CEE 22.2

SPONSOR: Seattle City Light
SPONSOR LIAISON: Robert Cochran, SE, PE
FACULTY ADVISOR: Jhon Smith, PhD, PE, SE
STUDENTS: Mauricio Ayala-Cruz, Roberto Cordero, Mia Pizzuto, Eugenio Sanchez, Meng Juan Timm

Lucky Peak Powerhouse, located in Boise, Idaho, is an essential facility managed by Seattle City Light that provides hydroelectric power. The powerhouse was constructed in 1989 when understanding of seismic design was limited as compared to today. Due to increasing earthquake risk in Boise since the time of construction, Seattle City Light requested that Team CEE 22.2 conduct a seismic evaluation and retrofit of the structure to bring the powerhouse building up to a higher standard. The team identified deficiencies and provided upgrade recommendations in compliance with the design ASCE 41-17: Seismic Evaluation and Retrofit of Existing Buildings. After the completion of a multi-tier analysis, the team submitted a final report to Seattle City Light, consisting of a calculation package, drawing(s) of retrofitting alternative(s), and preliminary cost estimates.

"Working with the Project Center is a collaborative way to make headway on evaluating our structures. By utilizing student teams, Seattle City Light furthers our knowledge base on the structures while the students learn seismic analysis and perform the heavy number crunching under our supervision."

ROBERT COCHRAN
PE/SE, Seattle City Light

SOUTH MACHIAS ROAD/THREE LAKES ROAD INTERSECTION IMPROVEMENTS CEE 22.3

SPONSOR: Snohomish County Public Works Department
SPONSOR LIAISONS: Oscar Fuentes, PE, Martin Jackson, EIT
FACULTY ADVISOR: Mark Siegenthaler, PE, PLS
STUDENTS: Tyler Lam, Allyssa Mae Manlapaz, Camryn Okada, Dorin Russu, Andre Shigetomi

Snohomish County Public Works requested that team CEE 22.3 design an intersection improvement plan for the unsignalized three-way intersection of South Machias Road and Three Lakes Road. The existing intersection is expected to reach a Level of Service (LOS) F by the year 2035. Improvements are required to improve traffic and Centennial Trail user operations and reduce delays. A LOS F indicates that the intersection would experience congestion and traffic delays at the intersection. The purpose of the design is to improve the LOS and safety for all users of the intersection, facilitate traffic operations, and reduce delays. The percentage of heavy traffic, projected population growth, pedestrian safety, current traffic delays, and sight distance issues are factors considered in the design process. Four design alternatives were analyzed: a three-way stop, traffic signalization, a roundabout, and a no-build option. The possible relocation of the Centennial Trail to the intersection was evaluated with each alternative. Each design alternative was analyzed based on the LOS, cost of construction, channelization, trail user safety, and critical area disturbance and mitigation using AutoCAD Civil 3D and Synchro, a software application that performs micro-simulation of vehicular- and pedestrian-related traffic. Based on the decision matrix evaluations, a preferred design alternative was selected. A 30% plan and estimates design package were created for the preferred design alternative including plans, drainage design, critical area impacts and mitigation, and engineer's estimate.

LARNED APARTMENT SEISMIC RETROFIT CEE 22.4

SPONSOR: Community Roots Housing (CRH), Swenson Say Faget (SSF)
SPONSOR LIAISONS: Greg Coons PE (SSF), Lisa Hagen (CRH)
FACULTY ADVISOR: Michael Wright, SE
STUDENTS: Rilen Loo, Jarred Mahon, Quinn Nakasato, Lan Nguyen, Lawrence Takemoto

Community Roots Housing is an affordable housing organization dedicated to providing quality homes for people of all walks of life within the Seattle area. The team was tasked with a structural evaluation and retrofit design of a three-story, unreinforced masonry (URM), multi-family residence located within the heart of downtown Seattle, the Larned Apartments. The Larned was originally built in 1909; it went through a conversion from a hotel into an apartment that also included a seismic upgrade in 1991. Due to the high seismicity of Seattle that might greatly affect URM buildings, the city proposed the Unreinforced Masonry Retrofit Standard of March 2012, also referred to as the URM Ordinance. The ordinance was created with the goal of providing a cost-effective retrofit design that would reduce the likelihood of collapse and life-threatening injuries during a seismic event. CEE 22.4 designed the mitigation concepts for the Larned Apartments in accordance with the URM Ordinance, and further referenced standards such as the 2018 Seattle Existing Building Code. The deliverables for the project included mitigation recommendations, structural drawings and details, calculation package, cost estimate, and a final report.

BUSINESS DATA CATALOGUE MANAGEMENT FOR DATA HANDLING CS 22.01

SPONSOR: Amazon Web Services
SPONSOR LIAISONS: Uchit Gandhi, Niket Soral
FACULTY ADVISOR: Matthew Thayer
STUDENTS: Denis Gojinetchi, Samuel Klosi, Loveraj Sidhu, Xi Yu

Amazon Web Services (AWS) has been leading the world into cloud computing services. The AWS Partner Network (APN) is the vital system connecting AWS with its tens of thousands of partners, to promote AWS in every industry, every size of company and every region of the world. Within AWS Partner Systems organization, AWS stores and manages customer and partner data. AWS does not have any centralized mechanism to identify how to handle these data nor the level of classification for any given data. In this project, our team is building a solution that can help business users provide classification of data (Objects and Fields) stored in the APN Salesforce. The solution will be an Amazon internal portal and will be used by product managers, stakeholders and security teams across AWS Partner Systems to determine the classification level (public, confidential, highly confidential or critical) of the data stored in APN. The scope of this project is to create a web application for internal Amazon Users on which users can see the schema of the application, search the fields and objects on APN, and find the classification level of those data sets. We will be connecting this application with APN Salesforce to fetch the new fields and objects whenever created or updated. Once the application is built, the future scope will be to extend this application to other organizations in AWS.

"Working with students is as much an education for me as it is for them."
STAN DELIZO
Kenworth Truck Company

PARTNER CENTRAL DATA CS 22.02

SPONSOR: Amazon Web Services
SPONSOR LIAISONS: Luca Certini, Nguyen Ngo
FACULTY ADVISOR: Xin Zhao, PhD
STUDENTS: Elton Huang, Mark Hymowitz, Sophia Luehmann, Vincent Marklynn

Amazon Web Services (AWS) has a network of partners in the AWS Partner Network (APN). AWS partners are companies that provide solutions that leverage the technologies that AWS has to offer. As such, AWS wants to be able to recommend partners to potential customers based on the customers' needs. Thus, the accuracy of the information provided by the partners is important. With accurate information, partners will achieve better compatibility with customer opportunities and improved marketing tools for partners with AWS' stamp of approval. Our project sponsors at AWS requested a scalable solution to verify the information that partners provided and set up an indicator called Partner Content Score (PCS) based on the accuracy and freshness of the provided information. To meet these requirements, our team built a scalable serverless architecture solution that is driven by AWS Lambda. We built a serverless web scraper that gathers and stores information in Amazon DynamoDB and S3. We then compared the scraped data with the data that are currently in AWS databases. Finally, we assigned PCS to partners using various methods including Natural Language Processing (NLP) models.

WELL-ARCHITECTED SCORING SYSTEM CS 22.03

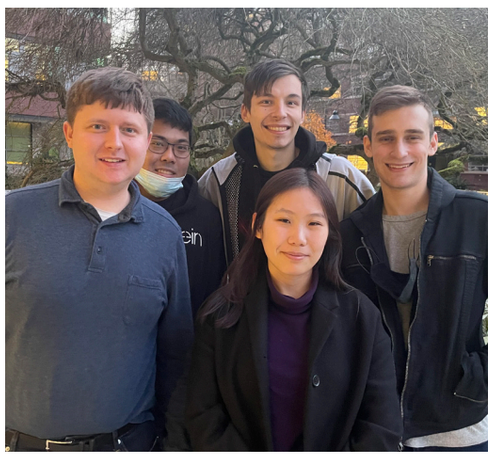
SPONSOR: Amazon Web Services
SPONSOR LIAISON: Samir Kopal
FACULTY ADVISOR: Steve Hanks, PhD
STUDENTS: Ethan Chatfield, Helen Huang, Devon McKee, Seth Valentine

The AWS Well-Architected Tool (AWS WA Tool) is designed to help review the state of a client's applications and workloads, and it provides a central place for architectural best practices and guidance. The AWS Well-Architected Tool is based on the AWS Well-Architected Framework, which was developed to help cloud architects build secure, high-performing, resilient, and efficient application infrastructures. The WA Framework provides six pillars to ensure the client's workload adheres to industry-wide best practices: operational excellence, security, reliability, performance efficiency, cost optimization, and sustainability. Today, the AWS WA Tool provides clients with the ability to know if they have a high or medium risk in their workloads. For a risk to be mitigated, clients may need to remediate multiple best practices. While risk remediation is in progress, clients are unable to see progress until all best practices have been addressed for a given risk. To better address this issue, our team has created a scoring system where clients can more easily view issues with their existing workloads. During the capstone project period, we put together a web application running on React with an AWS cloud-managed backend to deliver features such as score calculations, improvements based on individual pillars, and total calculations based on customized pillar priorities. This scoring system will allow existing clients to have better insights into the status of their risks and progress on remediation. Clients can also use this score card to compare workloads and build a standardized mechanism to measure workloads across their organization.

WELL ARCHITECTED REVIEW ON DEPLOYMENT CS 22.04

SPONSOR: Amazon Web Services
SPONSOR LIAISON: Samir Kopal
FACULTY ADVISORS: Douglas McKinley, Jason Wong
STUDENTS: Matt Ielusic, Anthony Mein, Gabriel Saurez, Kevin Wong-Hua, Yao Yao

Amazon Web Services maintains a large suite of cloud services, that enables businesses to flexibly scale their IT infrastructure capacity to match their needs. To help clients improve performance and reduce costs, Amazon has identified best practices for the use of its cloud computing products and has developed a Well-Architected Tool to allow developers to identify issues in their workflows. However, this tool can be better integrated into customer workflows. To facilitate customer process review, we have developed a proof-of-concept program that is triggered by deployment of new code, reviews the customer's description of their process, and provides feedback if there are areas that need significant improvement. We designed our proof-of-concept with a flexible rule set that facilitates transition to our tool by accommodating pre-existing workflow issues and allowing customers to tailor our product's criteria to their particular use case. Our product was implemented entirely on the Amazon Web Services platform. It is hosted as an Amazon Lambda serverless service, saves rules and historical data in Amazon DynamoDB, and is triggered by Amazon CodeDeploy deployments.



COLDBYTE TEMPERATURE MONITOR CS 22.05

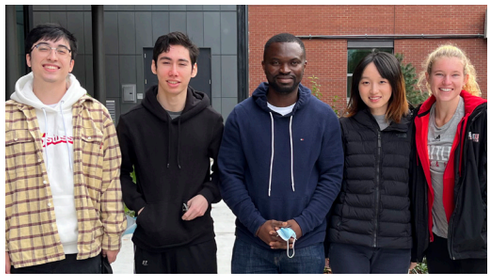
SPONSOR: Babelflex
SPONSOR LIAISONS: Ang Li, Shuai Yuan, Jialin Zuo
FACULTY ADVISOR: Lisa Milkowski, PhD
STUDENTS: Kyle Fraser, Darren Jonany, Luan (Remi) Ta, Varun Sreepathy

Babelflex aimed to expand their smart flexible sensors into the cold chain management market. Cold chain management refers to the management of cold products in all phases, from transit, to processing, storage, and distribution to consumers. Our objective was to penetrate the cold chain management at Seattle University (SU) with our product. With this objective, following customer analysis with SU Dining Services, we created a tool that would help chefs and managers maintain their produce. Using Babelflex's smart temperature sensors, we developed a one-stop web-application that allows users to monitor their produce remotely – easing the need for physical contact with the cold storages. After consultation with our university's dining service, we refined and divided our product into four distinct parts: monitor, history, toggle, and notify. Our application allows users to: 1) monitor temperatures of individual sensors in cold storage, 2) view the historical temperature data of sensors, 3) toggle sensors on and off, and 4) create a notification schedule for users. Hosted on Heroku, our frontend delivers a persistent experience using ReactJS. The backend implements an API with NodeJS, providing data ingestion and access to/from a relation database. At the heart of it all was Babelflex's temperature sensor tags, attached to cold storage products, and continuously communicating temperature data with a Radio Frequency Identification Reader. An intermediate Raspberry Pi device transmits data from the reader to our database.

RAW LAND REPORTS CS 22.06

SPONSOR: EnviroVector
SPONSOR LIAISON: Sidney Wambach
FACULTY ADVISOR: Susan Reeder
STUDENTS: Bella Aghajanyan, Adit Goyal, Nikolas Stires, Martin Wu

EnviroVector is a local organization that strives to provide a variety of professional products and services to help the local community with environmental permitting needs. Their work focuses on providing easy and simple solutions to intricate environmental issues that deal with land use. EnviroVector's clients range from landowners, small business, and developers who need permits to build on raw land. Currently, field scientists at EnviroVector are burdened with the need to access information from a myriad of different government and satellite data sources. The satellite data for waterbodies, soil, wildlife, and other information pertaining to raw land must then be synthesized and analyzed to fit the situation. Due to the overhead of managing all these systems, the scientists waste precious time that could be better used helping wildlife and ensuring their habitats are not disturbed. If these scientists can efficiently verify and update these data, then there will be more opportunities for wildlife conservation. Our solution is to bring all the data to the user in one interface that is customizable and easy to understand, while still providing the power to further analyze, document and share data. With our customizable maps the scientists at EnviroVector will be able to overlay all the data they previously viewed separately onto one map. This innovation will give scientists the ability to work much more efficiently and help humans make less of an impact on the natural world.



INFRASTRUCTURE TOOLING CS 22.07

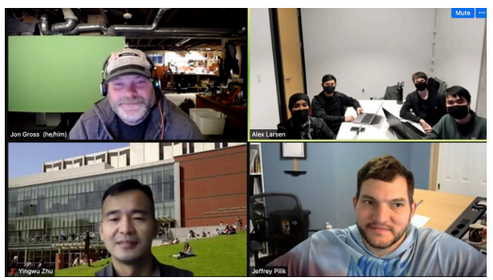
SPONSOR: F5 Networks
SPONSOR LIAISONS: Rick Mitchell, Chris Zacny, Brian Jensen
FACULTY ADVISOR: Lin Li, PhD
STUDENTS: Franck Behinan, Ryan Bush, Fiona O'Leary, Ezra Sackstein, Peyton Zhu

F5 Networks is an internet and application services company focused on security and application delivery, with hardware and software offerings that deal with performance, monitoring, and automation. The Common Engineering and Development Infrastructure (CEDI) Team at F5 manages various internal services. Development-level services need to have visibility into how those services are performing. The CEDI team is looking to aggregate metrics from various continuous delivery (CD) platforms and standalone applications to create a historical view of the performance of those services. Site reliability engineering (SRE) principles such as performance, error budget, and adoption need to be stored and quickly accessible via a timescale database and visualization. To this end, our team has developed an Application Programming Infrastructure (API) and a database to ingest and manage data from the various CD platforms and applications as well as a central dashboard to view current and historical data of desired SRE metrics. The API handles database queries and requests, sending alerts and notifications, score calculations for metrics, and is built on top of the FastAPI Python framework. It is accompanied by various scripts running in Azure Functions/Kubernetes Cron Jobs to scrape, collect, and move data into an Azure Cosmos database. The dashboard displays all monitored services and their corresponding metrics in the form of graphs and is created in Typescript/React, based off the F5 Emerald Design Systems Architecture. It also uses several proprietary F5 React data visualization and UI component libraries. The API and the React dashboard comprise a webapp that is deployed in Azure.

iHEALTH CS 22.08

SPONSOR: F5 Networks
SPONSOR LIAISONS: Rachel Feldman, Jon Gross, Andy Lin, Jeff Pilik
FACULTY ADVISOR: Yingwu Zhu, PhD
STUDENTS: Andre Dasalla, Hoang Do, Alexander Larsen, Amal Omer

F5 Networks specializes in application security, multi-cloud management, online fraud prevention, and application delivery networking. Their NetOps and DevOps management tools provide services to 48 of the top Fortune 50 companies. One of these tools is iHealth, a data display, and diagnostics engine, that allows customers and employees to monitor the health of their F5 products. The iHealth system currently retrieves data through various XML files and is outdated with a 10-year-old tech stack. F5 wants to modernize iHealth's frontend and backend systems by adopting a microservice architecture. Our team was entrusted with building an Application Programming Infrastructure (API) gateway to enable cross-API queries from multiple microservices. We utilized GraphQL, Typescript, and NodeJS to create an API gateway to query multiple data sources, aggregate the data together, and provide composite data returns. These data will be used to help customers troubleshoot their F5 installations. We also created a GraphQL client service to store and display the data on a web server. The team used Azure DevOps for code deployment and team collaboration.



KNOWLEDGE SERVICES DATA CS 22.09

SPONSOR: F5 Networks
SPONSOR LIAISONS: Laurel Poertner, Dave Thomas, Manas Tripathi
FACULTY ADVISOR: Steven Hanks, PhD
STUDENTS: Charina Abapo, Ojeet Deol, Alexander Liu, Binh Nguyen

F5 Networks gets hundreds of support tickets a day regarding issues or questions customers may have about F5's products. Measuring a customer's ability to easily find relevant content that answers some of the most asked questions or issues about F5's products is of great importance to the support team. Currently, F5's support engineers work on duplicate support tickets which takes a significant amount of effort and time. The team's goal was to build a system that provides F5 with a better perspective of the effectiveness of the AskF5 website and reduces the load on F5's support engineers. One part of the system is an ETL pipeline that categorizes visits to the F5 website as either successes, failures, or undetermined, and displays the results on a Tableau dashboard. The second part of the system identifies duplicate support tickets. We used machine learning to group similar support tickets allowing support engineers to identify duplicate tickets. These groupings and suggested actions are also displayed on a Tableau dashboard. This project improves customer satisfaction, displays important efficiency metrics to F5 stakeholders, and reduces the load on F5 support engineers.

REQUEST FOR ENGINEERING INFORMATION (REI) EFFORT AND COMPLEXITY CS 22.10

SPONSOR: Kenworth Truck Company
SPONSOR LIAISONS: Nick Grant, Jerry Mischel
FACULTY ADVISOR: Richard LeBlanc, PhD
STUDENTS: Han Duong, Nathan Nishi, Katherine Outcalt, Joshua Reingold

Kenworth Truck Company, a subsidiary of PACCAR, is an industry leader in truck production that specializes in heavy-duty and medium-duty commercial vehicles. Kenworth provides customers with the ability to customize their orders to meet specific vocational demands. Custom orders may require requests for engineering information (REI) workorders to verify the correct components will operate in service. Currently, Kenworth answers over 75,000 requests each year, and has limited visibility to the effort and complexity of incoming work orders. To help remedy this situation, Team CS 22.10 partnered with Kenworth engineering supervisors to develop a dashboard that can visualize REI workload for their respective teams. Using Human Centered Design methodologies, multiple workshops were held to understand process pain points and ideate potential solution concepts. Using Tableau, user feedback was synthesized to generate a working dashboard prototype for supervisors to visualize incoming workload. Multiple feedback sessions allowed for iterative improvements to be applied to improve user adoption. The delivered solution has helped the supervisors effectively plan their team's weekly workload and forecast future effort.

PREDICT SALES CODE DRIVEN REQUESTS FOR ENGINEERING INFORMATION (REIS) CS 22.11

SPONSOR: Kenworth Truck Company
SPONSOR LIAISONS: Nick Grant, Jerry Mischel
FACULTY ADVISOR: Richard LeBlanc, PhD
STUDENTS: Mason Adsero, Zachary Holly, Darin Hui, Joshua Palicka

Kenworth Truck Company, a subsidiary of PACCAR, is an industry leader in truck production that specializes in heavy-duty and medium-duty commercial vehicles. Kenworth provides customers with the ability to customize their orders to meet specific vocational demands. Each customer order will include a certain set of sales codes that describe all the desired options for their custom truck configuration. During the order fulfillment process when sales codes are transitioned to bills of material, there is opportunity for sets of parts to be incorrect due to the made-to-order truck model configurations. This requires engineers to review the order and amend the bill of material to meet customer specifications, which is time and labor intensive. Currently, there is no way to predict the number of requests for engineering information (REIs) or the effort needed for an REI until it has been assigned to the engineering team. To help solve this challenge, Team CS 22.11 has created an automated process to forecast these engineering requests, helping Kenworth save both money and time. Using order data from Kenworth's cloud databases, our solution was to build, train, and tune a machine learning model that reviewed orders and their sales codes to predict the number and complexity of REIs. This early detection will help REI identification for elimination, thus reducing the time engineers spend on answering repetitive REIs and improving the ability to efficiently manage REI workload.

SEARCH ENGINE OF COMMUNITY ORGANIZATIONS CS 22.12

Mari's Place for the arts
Creative Space For Children & Teens

SPONSOR: Mari's Place for the Arts
SPONSOR LIAISON: Peter Bloch Garcia
FACULTY ADVISORS: Steven Hanks, PhD, Pejman Khadivi, PhD
STUDENTS: Esther Angeles, Stephen Crocker, Michael Pablo, Afrikaan Sahra

Mari's Place for the Arts is a non-profit organization that empowers low-income BIPOC children, youth, and families to pursue their dreams. It does this through arts and culture programs that create a community of civically engaged youth and parents. Like many BIPOC nonprofit organizations, it has been continuously underfunded and is looking for alternative ways to bridge access to resources. Mari's Place for the Arts needs to increase its resources by finding new funders and applying for grants that are closely aligned to its mission. This requires a more efficient approach. Our project team seeks to connect BIPOC non-profit organizations and other underfunded communities with a broader audience of funders, and bridge access to potential funding of their needs. This project aims to create a desktop application that allows the user to search for funders whose priorities are aligned to organizations like Mari's Place for the Arts. Our application consists of three parts, a web-scraper using Beautiful Soup 4 (BS4) to gather funder data from websites, a MONGO database to hold funder information, and a python frontend that is usable and intuitive for non-technical users. With our application, Mari's Place for the Arts will be able to connect with more funders and make informed decisions when applying resources. Through these new connections, they will maintain an efficient network of like-minded organizations and increase their funding opportunities.

GROWING A SUSTAINABLE CRAFTING COMMUNITY CS 22.13

OUR FABRIC STASH™

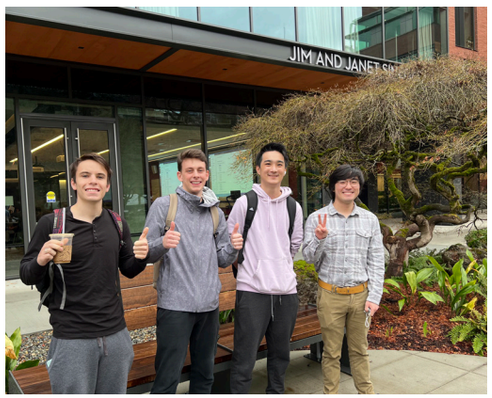
SPONSOR: Our Fabric Stash
SPONSOR LIAISON: Deborah Boone
FACULTY ADVISOR: Zhiju Yang, PhD
STUDENTS: Veronica Carpenter, Erika Skornia-Olsen, Phuong Tang

Our Fabric Stash is a local fabric and craft consignment store that is growing its online presence to reach more customers and consignors. They currently use multiple tools that aren't connected to each other to manage transactions, shipping, inventory, along with customer and consignor information, which makes tracking consignments and their associated information tedious. To reduce the number of tools the store needs, the project team CS 21.13 built a basic database and web application last year. However, this database and web application are still very simple and don't meet the inventory, administrator, consignor, and customer management needs of the sponsor. To help administrators and consignors interact more intuitively with the database, team CS 22.13 improved the UI and stored procedures for adding and viewing inventory in the web application. To reduce repetitive tasks for administrators, we automated consignor password reset emails, consignor compensation calculations, and inventory updates. The T-SQL database that contains inventory, consignor, customer, and transaction information will be hosted on Azure once it goes live. The web application that we are building upon is a Razor Pages .NET Core web application. By improving the front-end access to Our Fabric Stash's database via the web application, our solution will reduce repetitive administrator tasks while improving the consignor and customer online experience.

SPORTS MODELLING AND OUTCOME PREDICTION CS 22.14

SPONSOR: Rahber Thariani, PhD
SPONSOR LIAISON: Rahber Thariani, PhD
FACULTY ADVISOR: Shadrokh Samavi, PhD, PE
STUDENTS: Riley Cullen, Albert Hunt, Ian Murray, Evan Ruan

Current tennis outcome prediction models provide an effective way to predict the outcome of tennis matches before they begin. However, those models neglect to provide real-time updates to those predictions as the game progresses. In addition, they hide their exact methodology, which can reduce user trust in the entire process. To address these issues, our team created a tennis prediction system that uses in-play data to answer predictive questions that help tennis experts determine who will win a given match. Our solution consists of a data pipeline built using Python that takes raw in-play data and transforms it into a usable format stored remotely using Microsoft Azure. The database can then be queried using Azure SQL to answer predictive questions that correspond to the current state of a given match. For example, if the score is tied and we want to find out who is more likely to win the current point, we can write a query to find all the entries with a tied score. Then, using statistical analysis, we can determine whether the server or the receiver is more likely to win the point. Our solution focuses on answering five of these predictive questions; however, the system was built with scalability in mind to be easily extended to answer other predictive questions. With this system, our sponsor can then provide his newsletter subscribers with accurate and explainable in-play predictions.



GOOGLE AND REDDIT TRENDS ANALYSIS CS 22.15

SPONSOR: Rahber Thariani, PhD
SPONSOR LIAISON: Rahber Thariani, PhD
FACULTY ADVISOR: Jason Wong
STUDENTS: Brandon Chan, Kriston McConnell, Brad Nakamura, Baran Onalan, Stephen (Alex) Wallen

Our team, "Reddit and Google Trends Analysis," aimed to optimize the user experience for finding good deals on the Reddit platform. Our minimum viable product uses web scraping technology to extract information from Reddit submissions and persists the extracted data in a NoSQL database. Our sponsor can filter this data by search criteria and order it by relevance to create a curated newsletter for our end users. Our algorithms use the Python programming language, and our product implements a microservices architecture using Azure Functions and Cosmos DB.

"The work ethic and discipline instilled during my time at Seattle University has stayed with me throughout my career. I continue to see those same characteristics in the engineers we hire from Seattle University today. It is very satisfying to see that my contributions continue the rich tradition of developing our future leaders at Seattle University."
REID NABARRETE, '87
Kenworth Truck Company

REDMOND DUDES BASEBALL WEB APP CS 22.16

SPONSOR: Redmond Dudes Baseball
SPONSOR LIAISON: Colin McBride
FACULTY ADVISOR: James Obare
STUDENTS: Thien-An Ha, Dias Nurlanov, Yitong Wang, Zheng Zhou

For the last three years, Redmond Dudes Baseball has been a team in the Seattle Elite Baseball League, which offers a competitive summer baseball league amongst organizations and teams. Seattle Elite Baseball is responsible for planning and hosting tournaments and leagues for individuals of ages between eight to eighteen years in the Pacific Northwest. Currently, Redmond Dudes Baseball uses excel sheets in tracking and calculating data for all players and games, which is bulky, time consuming, and tedious. Our team created a website where players and teams can check information concerning teams, honors, and fixtures. This helps the staff to follow and calculate statistics for every player and game, making league planning and coordination easy. We used ReactJS for the front end, PostgreSQL database to support the back end, and GitHub for repository. The system allows players to create personal accounts and follow their statistics. The backend works with third-party vendors to offer verification for users' purchases and user Gmail accounts. The database layer is only open to the backend with critical players' personal information such as name, phone number, email address, date of birth, weight, height, and handedness. Extra information, such as players' workout schedules and statistics, is also kept. This allows Redmond Dudes to easily manage game statistics and embrace technology when solving problems.

SATCHL COMPANION LOYALTY PROGRAM CS 22.17

SPONSOR: Satchl
SPONSOR LIAISONS: Chris Lewis, Cody Myers
FACULTY ADVISOR: James Obare
STUDENTS: Fen Mayo, Anthony Ngo, Yong Long Tan, Carson Vaché

Satchl is a startup that aims to reduce the clutter of consumers' physical and digital wallets by providing an innovative way to access accounts on public devices. When a user signs into their account on the mobile app, a token is tied to their phone. Users pair accounts from vendors with their Satchl account. Then, with hardware/software enabled devices, users can scan the token ID on the Satchl app to access those accounts. The goal is to allow users to simply open and scan a single token in lieu of finding the right card (physical or digital), entering passwords, or typing in a phone number. This form of authentication provides simplicity for the users but requires participation from vendors, but it is difficult for companies to commit resources to an authentication method without an existing Satchl userbase. A companion Satchl loyalty program provides Satchl a complete package to market to small merchants and grow the vendor base. Our team has developed a method of verifying a student's status at their college using MSAL, enabling student-only rewards as the loyalty program's hook. This allows Satchl to partner with colleges across the nation. Additionally, we use a React frontend and PHP backend to enable vendors to display location, hours, loyalty status and promotions in the vendor's customized page of the Satchl app. Thus, Satchl essentially becomes the app for the merchant. Customers must then scan Satchl at checkout to earn rewards, tying Satchl's patented token technology with easy to access interfaces.

GEARSIM UI/UX GRAPHICS AND DESIGN CS 22.18

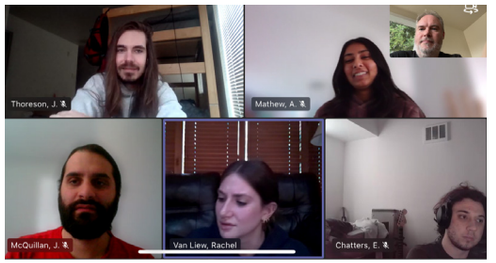
SPONSOR: SDI Engineering Inc.
SPONSOR LIAISON: Dennis Fredell
FACULTY ADVISOR: Hidy Kong, PhD
STUDENTS: Quan Pham, Kayla Shigaya, Juliette Simonds, Qiao Wang

SDI Engineering is a specialist provider of various aircraft-related services in which GearSim is one part of their software solution. GearSim is the landing gear simulation tool we have worked to redesign by making it user-friendly, linear, and modern. The key problem with their application was the inconsistent layout throughout the entire application. The UI and workflow made it especially hard for new engineers to learn due to the steep learning curve. Our solution was to reorganize GearSim's features to improve the application's user interface, linearize the workflow to improve the user experience, and redesign the appearance to make it modern and professional. Our design process began by creating different wireframe designs on Figma until we settled on our final design. Our final design was achieved by separating the application interface into three different sections: the left section which maintains the features and functionality GearSim originally had, the middle section which contains a tabbed design allowing the user to switch between data entry, project information, and the help menu. Finally, the right section which offers the user the ability to view messages, history, and recent projects. An important aspect of our design was keeping this three-section layout consistent among pages to reinforce consistency and ease of use throughout the application. The final step to our solution was rendering this design on QT i to produce a consumer-ready product for SDI Engineering.

THE POSTMAN MOBILE APPLICATION CS 22.19

SPONSOR: The Postman Seattle
SPONSOR LIAISON: D'Vonne Pickett Jr., KeAnna Rose Pickett
FACULTY ADVISOR: Wan Bae, PhD
STUDENTS: Dior Aldariz, Raymond Dela Cruz, Melliana Lays, Wyatt Merians, Carmen Romero

The Postman is a local, black-owned, small business in the Central District that provides third-party authorized mail and business services to the community and local small businesses. These services include daily shipping and package pickup through established carriers, printing, faxing, notary services, and private mailbox rentals. Recently, The Postman has been expanding their services and has begun the process of expanding The Postman's mobile application. Our team expanded the UI to include additional services such as a Marketplace feature, the ability to purchase and manage a private mailbox, and more. Additionally, we built up the basic backend for this app and connected the backend to the front-end, so that it can process and store user data. The updates made to the mobile application allow users to access most of The Postman's services without having to visit the storefront. This application accommodates the growth of The Postman and supports a foundation for future development. Beyond this, the application will help the growth and development of the local community.



VOTEGRITY SAAS SOLUTION CS 22.20

SPONSOR: Votegrity Inc.
SPONSOR LIAISON: Tom Thomas
FACULTY ADVISOR: Jason Wong
STUDENTS: Evan Chatters, Arya Mathew, Jesse McQuillan, Justin Thoreson, Rachel Van Liew

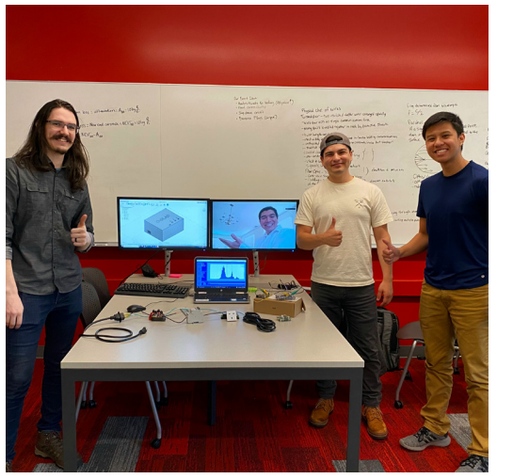
Votegrity is an online voting company catering to private market elections. Their existing product is already functional and generating revenue, however the platform has ample opportunity for expansion to further differentiate it in the marketplace. Our team has been constructing a robust administration web portal and dashboard that allows election officials to easily set up, distribute, and administer elections. Our ambition is to create an online voting service that works for everyone – one that is simple enough for a person in any demographic to feel comfortable using, while also built securely so people feel confident in the integrity of the results, as voters, administrators, and/or auditors.

> "Seattle University and the high-quality talent they provide through their capstone projects continue to far exceed Votegrity's expectations! Given the chance we will be back again and again to help build the bridge from academics to professional experience and meaningful outcomes with these bright minds from Seattle University."
> **TOM THOMAS**
> Votegrity

ROBORILLA: A HUMAN-MODEL INPUT DEVICE ECE 22.1

SPONSOR: The Boeing Company
SPONSOR LIAISONS: Christopher Esposito, PhD, Katherine Meza, PhD, Rohan Rana, Jim Troy, PhD
FACULTY ADVISOR: Paul Kostek
STUDENTS: Lucas Ehinger, Christian Lenzini, Alma Limon-Vichy, Daniel Sakai

3D Computer-Aided Design (CAD) is a vital step in Boeing's production line. During this step, digital models of the final product are created and revised, allowing for improvements without the costly manufacturing of physical prototypes. One common test during 3D modeling is analyzing if humans are physically able to use, construct, or maintain the product. For example, a mechanic must be able to fit inside the fuselage of an aircraft to perform maintenance. Manipulating the pose of a three-dimensional digital human model with a computer mouse is exceedingly difficult and time consuming. This is in part due to a mouse operating with only two degrees of freedom, while many human joints operate with three. Boeing requested that Team ECE 22.1 design a Human Model Input Device—a small anthropomorphic computer mouse—which connects via USB to a computer. The developed model named "RoboRilla", is created from 3D-printed parts and uses potentiometers to determine joint angles. RoboRilla includes 32 degrees of freedom, encapsulating most major joints to provide a high degree of anatomical accuracy.



OBTAINING ENERGY DATA FOR ANALYSIS AND SIMULATION USING AN OFF-GRID LOAD ANALYZER ECE 22.2

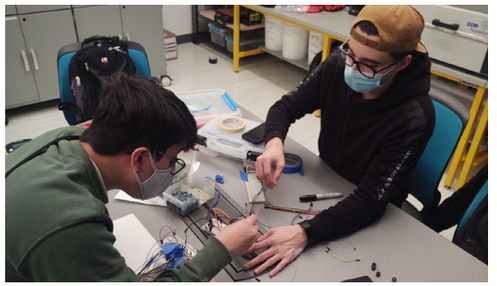
SPONSOR: KiloWatts for Humanity
SPONSOR LIAISON: Daniel Nausner, PE
FACULTY ADVISOR: Hiram Hoffman
STUDENTS: Cade Derry, Enrique Rodriguez, Julian Saturno, Frank Woodley

KiloWatts for Humanity (KWH) improves people's lives by providing electricity and enabling sustainable business models. KWH increases electricity access in rural parts of Africa through off-grid solar systems known as "energy kiosks". Communities are increasingly requesting that the energy kiosks power equipment and appliances with irregular and intermittent power and energy consumption, such as welders and machine tools. KWH requested that Team ECE 22.2 develop a custom load meter to better understand the electrical consumption characteristics for these types of loads. The load meter designed by Team ECE 22.2, known as the Off-Grid Load Analyzer Device (O-GLAD), can measure highly variable non-linear voltage and current waveforms from these loads, helping KWH engineers design the energy kiosks accordingly. The O-GLAD's measurements are viewable via the accompanying Load Analyzer Graphical User Interface (LAGUI). It is through these measurements that KWH can adapt their energy kiosks to an expanding library of appliances that they would not have been able to do otherwise.

PROJECT SPOT CHECK ECE 22.3

SPONSOR: Panthera
SPONSOR LIAISON: Rana Bayrakçısmith
FACULTY ADVISOR: Agnieszka Miguel, PhD
STUDENTS: Joseph Chean, Ben Graybael, Peter Heitkemper, Matt Manacio

Panthera is dedicated to the conservation of all forty wild cat species. A part of that effort is the monitoring of snow leopards using thousands of images obtained from camera traps set across the snow leopards' expansive two million square kilometer habitat. The process of analyzing each image is labor- and time-intensive. As such, Panthera requires an automated system to identify and match the snow leopards captured in these images. The software Recognition was created to ease the burden on Panthera biologists and data scientists, but the matching function did not produce useful matches. To produce a functional matching solution, Team ECE 22.3 employed a methodical, results-oriented approach. Through research into the field of computer vision, our team uncovered a variety of instance recognition algorithms that entail three primary steps: feature extraction, description, and matching. The team designed, implemented, and evaluated several prototypes within an isolated testing environment, producing valuable insights into the effectiveness of matching unique fur patterns. Exploration into image preprocessing presented opportunities to further refine and improve performance. The software is currently containerized and fully accessible through the command prompt, enabling it to be implemented into Panthera IDS – the sponsor's data management tool.



METER TESTING DEVICE USING A SMARTPHONE PHASE 2 ECE 22.4

SPONSOR: Schweitzer Engineering Laboratories (SEL)
SPONSOR LIAISON: Steve Szablya, PE
FACULTY ADVISOR: Maren Nelson
STUDENTS: Udi Bahatt, Josh Jurosek, Andrew Koken, Nick Matus

SEL has tasked Team ECE 22.4 to find a portable method to better demonstrate the capabilities of their SEL-735 Power Meter. To do this, the team created an intermediary hardware device that can output analog signals to the power meters, controlled via an Android app. This device can output up to eight waveforms into the meter, four voltage and four current, in the form of analog voltage signals ranging from zero to one volt. These waveforms are commonly seen in power systems and can include complex harmonics and phase shifts. The Android app can output waves generated in the app by the user, specifying wave type, harmonics, and phase shift. The app can also output waves read in from a COMTRADE file loaded onto the phone. Creating this intermediary device and smartphone app will allow SEL salespeople to easily display the range of capabilities of the meter, without relying on an adaptive multichannel source, which is not practical to move.

LIGHT RAIL SYSTEM TRACK VOLTAGE DATA PROCESSING AND ANALYSIS ECE 22.5

SPONSOR: Sound Transit
SPONSOR LIAISONS: Craig DeLalla, PE, Ringo Wong
FACULTY ADVISOR: Henry Louie, PhD
STUDENTS: Nick Nguyen, My-Lynn Pham, Zuberi Wilson, Jessie Yearwood

Sound Transit is a public transit agency serving the Seattle metropolitan area. Sound Transit's Link Light Rail, like most modern light rail systems, uses a "floating" electrical system to power the trains. In a floating system, the overhead conductor supplies DC current to the trains. The rails, which act as a return path for the DC current, are intentionally left ungrounded. This reduces corrosion of nearby utilities and structures. However, a drawback of floating systems is that a voltage touch potential can arise when the rail is unintentionally grounded (e.g., standing water or conductive debris on the rails). Touch potential can be a safety concern. Sound Transit has installed monitoring systems that automatically react to ensure safety and help detect elevated touch potential. Additionally, Sound Transit installed data acquisition systems to better understand the root causes and severity of the touch potential. However, the data collected often exceeds gigabytes in size, and is cumbersome to work with. Team ECE 22.5 has developed a python-based application to help Sound Transit visualize and analyze their data. The application shows the user the minimum/maximum of voltage/current, the threshold stages of voltage/current, the weather conditions, and an interactive graph. The team also produced a detailed research report describing the effects of stray current and its mitigation methods and a user manual for the application.

KETRON ISLAND INITIAL MICROGRID FEASIBILITY STUDY ECE 22.6

SPONSOR: Tacoma Public Utilities - Tacoma Power
SPONSOR LIAISONS: Seema Ghosh, Armand Shahbazian
FACULTY ADVISOR: Peter Dauenhauer
STUDENTS: Jinyao Hu, Taylor-Ann Miyashiro, Ryan Murai, Patrick Purviance

Ketron Island is a small island in the Puget Sound, located off the shore of Steilacoom, WA. In 1965, Tacoma Power began electrical service for the island via an underwater submarine cable, with an expected lifespan of roughly 30 years. Since the time of installation, Tacoma Power has performed several measures to extend the life of the cable. However, it is reaching the end of its useful life, and estimated replacement costs are very high. Tacoma Power has asked team ECE 22.6 to explore the feasibility of alternative power supply options for the island. Tacoma Power will use the findings to guide their decisions and plans for future work. The team investigated a variety of power generation and storage technologies based on the island's climate and electrical load profile and created multiple system designs using combinations of these technologies. The team performed simulations of the potential systems using the HOMER Pro microgrid design software to estimate each system's performance. The team submitted a final report to Tacoma Power which included each system's expected cost, environmental impact, reliability, resiliency, viability, size, and siting score. The report also entailed high-level analysis assumptions and identified the team's recommended power system to implement based on these factors. The result of the collection of this data informed the team of the feasibility of implementing the various system tested.

THE EFFECTS OF POND LEVELERS ON FLOW AND OVERTOPPING FREQUENCY IN BEAVER DAMS ENSC 22.1

SNOQUALMIE VALLEY
Watershed Improvement District

SPONSOR: Snoqualmie Valley Watershed Improvement District (SVWID)
SPONSOR LIAISONS: Erin Ericson, Lisa Kysar
FACULTY ADVISOR: Se Yeun Lee, PhD
STUDENTS: Jazmine Patten, Ruby Rañoa, Lailan Uy

Beaver dams and the subsequent increase of water upstream puts nearby roads, farmland, and private property at risk of flooding, especially during high flows when risk increases due to overtopping and dam failure. Pond levelers are flow devices installed in beaver dams to reduce the water storage in the upstream pond to manage flow and prevent flooding. In concern for fish passage, the Washington Administrative Code (WAC 220-660-230) presents challenges to install pond levelers, requiring that they must maintain enough flow over the dam in low flow periods, despite little research on how these devices impact beaver dam overtopping. The ENSC 22.1 team studied the impacts of pond levelers on beaver dam overtopping frequency by constructing water depth sensors and analyzing overtopping frequency between dams with and without the device installed in Western Washington.

"This research has been an integral part of my learning at SeattleU. It has given me valuable experience in research design, troubleshooting, field work, project management, report writing, and much more. The best part though, is spending my days out in the water!"
RUBY RANOA '22

EVALUATION OF UNMANNED AIRCRAFT SYSTEMS (UAS) AND TRADITIONAL AERIAL IMAGERY FOR MAPPING LARGE WOOD ON FORESTED SHORELINES OF AN URBANIZED PACIFIC NORTHWEST ESTUARY ENSC 22.2

FOREST SERVICE
UAS
DEPARTMENT OF AGRICULTURE

SPONSOR: USDA Forest Service
SPONSOR LIAISONS: Weston Brinkley, Matthew Goehring, Monika Derrien PhD
FACULTY ADVISOR: J. Wesley Lauer PhD, PE
STUDENTS: Bryn Allesina-McGrory, Michaela Plumage, Maxfield Powell Brown, Tessa Sharpe

Large wood is commonly used in estuary restoration projects. However, the distribution of naturally occurring large wood in estuaries is still relatively understudied. Our project aims to evaluate the performance of unmanned aerial systems (UAS) to take an inventory of large wood in estuaries. We developed and tested aerial survey approaches using variable elevations, flight patterns, and camera angles with a Mavic Air 2 UAS in two short (600- to 1,200-meter long) reaches of tidally influenced sections of the Duwamish River, an urbanized estuary near Seattle, Washington. The project focused on determining the most efficient, accurate, and low-cost way to catalog large wood under the forested canopy of the Duwamish estuary's banks. Data collected from our UAS based inventory was used to develop orthophotographs representing the banks. The photographs were then processed in a geographic information system (GIS) to delineate and determine the frequency, elevation, and size of the large wood visible in the images. We then compared the UAS findings to the frequency, elevation, and size of large wood cataloged in the field to evaluate the effectiveness of our UAS methodology.

AVAILABILITY ROVER INT 22.1

amazon

SPONSOR: Amazon Web Services (AWS)
SPONSOR LIAISONS: Derek Bennett, Brian Dressler, PE, Mike Tran
FACULTY ADVISOR: Scott Bright, MBA
STUDENTS: Alex Chee (ME), Sarah Hartley (ECE), Yusuf Hunt (ME), Melvin Lieu (ECE), Sara Marcjan (ECE), Seth Tecsi (ME)

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 servers in data centers. To prevent equipment failure, highly trained human technicians examine the equipment, which is quite time-consuming. AWS requires a system for detecting power distribution and cooling system failures that manifest heat and noise. This system must be easily and efficiently used by an operator in an Amazon data center. A mechanical engineering team, ME 22.1, and an interdisciplinary team, INT 22.1, consisting of mechanical, electrical, and computer engineers 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. Team ME 22.1 focused on designing and constructing mounts for all the sensors and Team INT 22.1 focused on creating software for data collection and storage. AWS plans to use this prototype design as a proof-of-concept for future modular data-center-inspection cart iterations.

CARBON FOOTPRINT AND ENERGY USE ASSESSMENT INT 22.2

ST. JAMES CATHEDRAL
SEATTLE

SPONSOR: St. James Cathedral
SPONSOR LIAISONS: Patrick Barredo, Mark Leahy
FACULTY ADVISOR: Shen Ren, PhD
STUDENTS: Joshua Carbajal (ME/EE), Daniel Henriksen (ME), Huy Nguyen (ME), Robert Wooldridge (ME), Brant Yamamoto (ME)

St. James Cathedral is planning to move toward carbon neutrality in the near future. Team INT 22.2 was tasked with devising a plan to update the Cathedral's current energy-consuming systems to increase sustainability while also decreasing costs. The team's primary strategy was to improve existing systems and offer carbon offset plans. This strategy was due to the construction codes of the historic building, and the desires of the St. James Cathedral and its parish. In addition to the analysis of current systems such as the steam heating network and the insulation of the building envelope, the plan also includes recommendations for the future, like implementing carbon offset technologies such as solar panels, electric car charging stations, and other carbon alternatives. The INT 22.2 team analyzed current systems that the St. James Cathedral leadership team designated as both carbon inefficient and costly, namely the building envelope, the current HVAC steam system, the Cathedral's natural gas and electricity consumption, and the parish's fleet of gas-fueled vans. Once the audit of current systems was completed, the team provided recommendations for future improvements and analyzed carbon offset programs. This report includes the projection of cost and carbon emission of current systems as well as the results of proposed recommendations. The INT 22.2 report designates both the carbon and cost vulnerability of the current system and the advantages of proposed improvements, including ROI projections and carbon credit benefits.

AVAILABILITY ROVER - ROVER CART HARDWARE
ME 22.1

SPONSOR: Amazon Web Services
SPONSOR LIAISON: Mike Tran, BSME
FACULTY ADVISOR: Greg Mason, PhD, PE
STUDENTS: Benjamin Gove, Kevin Haaland, Chiyo Miyake, Mitchell Soohoo, Alexander Weber

Amazon Web Services (AWS) hosts approximately 30% of internet websites and provides a vital service to thousands of companies. To ensure reliable service, AWS continuously monitors hundreds of data centers throughout the world and uses highly trained technicians to regularly inspect server rooms. AWS's goal is to increase the frequency and precision of these inspections to reduce human error. The proposed long-term solution is to use an autonomous rover to inspect and assess server health while moving throughout the server rooms. AWS has asked team ME 22.1 to design, build, and test a prototype modular server inspection cart (MSIC). This prototype cart can be pushed around server and auxiliary equipment rooms by an AWS datacenter technician to collect and analyze data using thermal, auditory, visual, and positional sensors. Team ME 22.1 coordinated with INT 22.1 in the design and fabrication of the MSIC. The constructed cart is complete with a sensor suite that will collect all the necessary data and store it locally. The final MSIC design uses a wide variety of components that have been tested at a local AWS data center. AWS plans to use this prototype design as a proof-of-concept for future modular server inspection cart iterations.

ENERGY MONITORING FOR ELECTRIC SYSTEMS
ME 22.2

SPONSOR: Kenworth Truck Company
SPONSOR LIAISON: Stan DeLizo
FACULTY ADVISOR: Yen-Lin Han, PhD
STUDENTS: Jackson Christian, Paula Fijolek, James Finnestad, Daniel Lee, Matthew Miramon, Kayla Smith

Kenworth is working on a multi-decade project to electrify and further optimize their workflow and products. A part of these optimizations includes an automated delivery system to transport parts within their campuses, and a system to monitor the energy consumption of the delivery apparatus along with future electric processes. To support this endeavor, Kenworth tasked the ME 22.2 team to investigate, develop, and improve electrical energy consumption monitoring systems. The team developed an electrical energy monitoring system that consists of an integrated circuit board interfaced with a microcontroller to measure the electrical power consumed by the test platform, a program to analyze the data, and a test platform featuring outdoor waypoint navigation with obstacle avoidance. The team validated their energy monitoring system with a simplified delivery rover. The team's energy monitoring system contributes to Kenworth's understanding of micro-level power management strategies and supports their long-term goals in producing more efficient electrified products.

RETROFITTING A HOT AISLE CONTAINMENT STRUCTURE INTO MICROSOFT'S DATA CENTER
ME 22.3

SPONSOR: Microsoft Global Services
SPONSOR LIAISON: Bryan Miller
FACULTY ADVISOR: Josh Hamel, PhD, PE
STUDENTS: Elias Elmorr, Nina Glasgo, Jack Maxwell, Erika Sue, Hamza Yassin

Microsoft's data centers provide cloud storage for millions across the globe. Their Tukwila data center requires about 2.9MW of electricity annually to power the servers, and energy costs soar because the space is not optimized for server cooling. Microsoft Global Services requested our team analyze the current system and retrofit a hot aisle containment structure to reduce heat loss from each server pod. Our task was to separate airflow between the hot and cold aisles to minimize the temperature difference within the hot aisle to reduce energy costs. That entailed designing a partition to direct hot air into the ceiling return vent and sliding doors at the ends of the aisles to prevent heat loss. In the end, the team delivered a Return on Investment (ROI) for our design, accompanied by a Computer Aided Design (CAD) model to show how it would fit into the data center.

ROBOTIC INTERPOSER ARM SELECTION ME 22.4

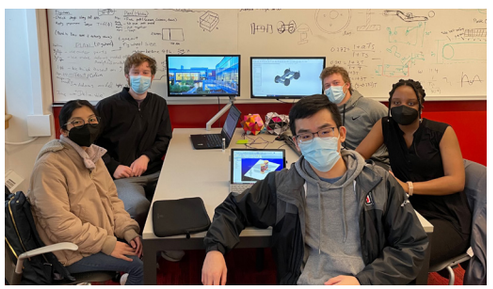
SPONSOR: MODICA
SPONSOR LIAISON: William Gibbs, Max Cerami
FACULTY ADVISOR: Eric Gilbertson, PhD
STUDENTS: Anders Bergeson, Jovial Chakkalakkal, Alec Handley, Donald Hunter, Tanner Peterson

MODICA aspires to challenge the status quo of manufacturing by offering low-cost, rapidly available manufacturing capability. MODICA is utilizing "MicroFABs," which are intermodal shipping containers filled with an array of small manufacturing equipment that is serviced by a robotic interposer arm used for the transfer of raw materials and parts. The MicroFAB contains a robotic two-axis gantry that runs down the center of the unit, which serves as the mounting point for one or more robotic arm(s) that automates the material handling in the MicroFAB. MODICA has tasked team ME 22.4 with selecting an optimal robotic arm for this purpose. The robotic interposer arm must be able to move parts and materials between any of the pods in the MicroFAB and must coordinate with the gantry to do so. Here, an optimal robotic arm is one that meets the payload and cost requirements while maximizing desirable attributes such as joint speed and positional accuracy and minimizing undesirable attributes such as weight and power consumption. Our solution utilizes an offline simulation software called RoboDK to determine how much of the pod face area a given robotic arm should be able to reach, without any collisions occurring. Our deliverable is a list of suitable robots determined by a performance function weighing accessible coverage of the pod face and other desirable attributes.

ROBOTIC EXPLORER FOR PSYCHE'S HYPOTHE-SIZED SURFACES ME 22.5

SPONSOR: NASA Psyche Mission
SPONSOR LIAISON: Cassie Bowman, PhD
FACULTY ADVISOR: Mohsen Dadfarnia, PhD
STUDENTS: Andrew Nguyen, Naomi Obaze, Kyle Sherick, Lathan Smith, Clara Tamura

16 Psyche is a metal-rich asteroid situated in the main asteroid belt. A NASA/ASU mission to explore the asteroid from orbit will launch later this year and reach Psyche by 2026. The goal of our project is to design a robotic explorer that could be used in a hypothetical second mission to explore Psyche's surface, given a successful initial mission. Psyche has challenging conditions that need to be considered such as its low gravity (1.5% of Earth's), lack of atmosphere, temperature range (-200 to -25 °C). Additionally, our team determined that the rover should be able to traverse after flipping on its back and right itself if it is stuck on its side. The rover must be able to clear 20 cm rocks while driving on either its top or bottom side. Finally, the instruments must be secure and able to operate at all times. The team was concerned with the feasibility of a wheeled rover and explored that design as well as different solutions to move the robot across Psyche's terrain. We used MSC Adams and MATLAB simulations to assess how these solutions would perform under Psyche's conditions. After this analysis, we determined that the traditional wheeled rover would work on Psyche, with some modifications. Our rover uses large wheels to generate the required clearance as well as giving the rover the ability to drive on both its top and bottom sides. The instruments sit on a rotating body to allow operation driving on either side. Finally, we designed a mechanism that will allow the rover to correct itself after being stuck on its side.



MODELING OF ELECTRIC AIRCRAFT DRIVETRAIN IN MATLAB SIMULINK TO DETERMINE FLIGHT CHARACTERISTICS ME 22.6

SPONSOR: SDI Engineering Inc.
SPONSOR LIAISONS: Phillip Richards, PhD, Dennis Fredell
FACULTY ADVISOR: Joshua M. Hamel, PhD
STUDENTS: Mauricio Ayon, Jack Jaworski, Alex Keene, Cody Winnie

SDI Engineering is looking to develop software to aid engineers in the design of electric aircraft. Our team was tasked with developing a Simulink model with interchangeable components to predict flight characteristics for a given configuration or help determine the components needed to obtain given flight characteristics. Through research into electric aircraft, their components, and how those components interact, we developed an understanding of the principles of electric aircraft drivetrain design and applied that knowledge to the development of our model. To simplify the development process, our model made important assumptions that allowed accurate predictions while limiting model complexity. The model was developed in Matlab Simulink and was designed in such a way that an external program could use a database of available components and swap them in them in and out of the model to see how flight characteristics changed. Our model accurately predicted specifications of existing electric aircraft and was designed to enable external switching of components.

CONVEYOR WASH STATION ME 22.7

SPONSOR: Sky Island Farm
SPONSOR LIAISON: Bil Thorn
FACULTY ADVISOR: Frank Shih, PhD
STUDENTS: Mohammed Bashmail, Anthony Beal, Rebecca Farmer, Coby Fraley, Cameryn Laborte

Sky Island Farm is a 15-acre organic farm providing fresh produce to the greater Grays Harbor community. The farm is increasing its production. However, their current method of handwashing produce post-harvest is both labor and time-intensive and cannot be scaled up for larger production. Sky Island Farm requested that team ME 22.7 design and build an autonomous wash station capable of washing a variety of produce quickly. Team ME 22.7 designed and constructed a prototype of the autonomous wash station that met their specifications. The station's settings can be adjusted for both leafy and root vegetables, using less than 28 gallons of water per minute and collecting used water beneath the system for reuse. The station fits within an 18x2 square foot area at waist height with open access to the produce throughout the station. The station and its instructions are delivered to Sky Island Farm for use for future harvest.

> "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

BILIMETRIX OFFLINE MOBILE APPLICATION MSCS 22.1

SPONSOR: Bilimetrix USA, LLC
SPONSOR LIAISON: Richard Wennberg, MD
FACULTY ADVISOR: Michael Koenig
STUDENTS: Sam Borhan, Jungbok Cho, Nitid Comvandee, Bruno Ruiz de Somocurcio, Nathaniel Wu

Bilimetrix USA was founded by Richard Wennberg, MD in 2012 to develop the Bilistick, a point of care bilirubin assay that employs a plasma/blood cell separator and a reflectance reader. While validating the system in Nigeria, the need for a cheaper method for measuring bilirubin that didn't required specialized equipment for caregivers to make diagnostic decisions became apparent. Infants with kernicterus were being admitted because they were sick, not at the earlier jaundice stage of disease progression, and often it was too late for treatment to prevent the worst. The availability of a quick diagnostic assay can make the difference between life and death. The solution – Bilipic – combined two technologies, a coordinating web service and a mobile application to serve as both as an infant blood sample reflectance measurement tool and a method to transmit the results to said web service. However, data transmittance and device data management required consistent internet connectivity, something that is not a guarantee in the candidate clinics and hospitals. We were challenged to develop a new feature set that could decouple the application from a constant internet connection. We accomplished this goal by implementing an SQLite local database that acts as a buffer between the phone and the web server allowing the phone to function independent of a connection to the internet for weeks at a time. This involved implementing a synchronization service to transmit data at opportune moments when internet connectivity was available or at the user's request. When we joined the project, the application was already in trial use in partner clinics working on the ground with real patient data, and our efforts resulted in much relief to these individuals. These professionals are now able to transmit results more reliably. This improved reliability has allowed Dr. Wennberg to collect valuable data that is helping to prove the efficacy of the system. We hope our work goes on to continue to help improve the system for years to come. Bilipic by Bilimetrix was built and developed using Xamarin, C#, and MVVM technologies.

EWI DATA PROCESSOR ADMIN TOOL AND FAILURE NOTIFICATION SYSTEM MSCS 22.2

KENWORTH
A PACCAR COMPANY

SPONSOR: Kenworth Truck Company
SPONSOR LIAISONS: Steve Bird, Dustin Davis, Tim McCleerey, Martin Valiquette
FACULTY ADVISOR: Mike McKee
STUDENTS: Madeline Ambrose, Doug Herstad, Diego Hoyos, Alex Peterson, Ruifeng Wang

Kenworth Truck Company is a division of PACCAR and is a manufacturer of commercial trucks. Kenworth plant workers rely on a software application built by Kenworth IT called 'Electronic Work Instructions', or EWI, which facilitates truck assembly. However, sometimes the EWI's important data input jobs fail, which can cause delays for plant workers. Additionally, there is no alert mechanism for these failures, resulting in long delays before a failed job is identified and fixed by Kenworth IT. Currently, Kenworth IT uses direct SQL database commands, which are slow, tedious, and lack flexibility. To address these issues, we developed two separate but related software applications that work together. The first was the Failure Notification System that quickly notifies Kenworth IT of failures. The second was the EWI Data Processor Admin tool that they can then use to easily fix issues and manage the EWI Data Processor. Technologies used include .NET Core, SQL Server, JavaScript/HTML/CSS, and Azure.

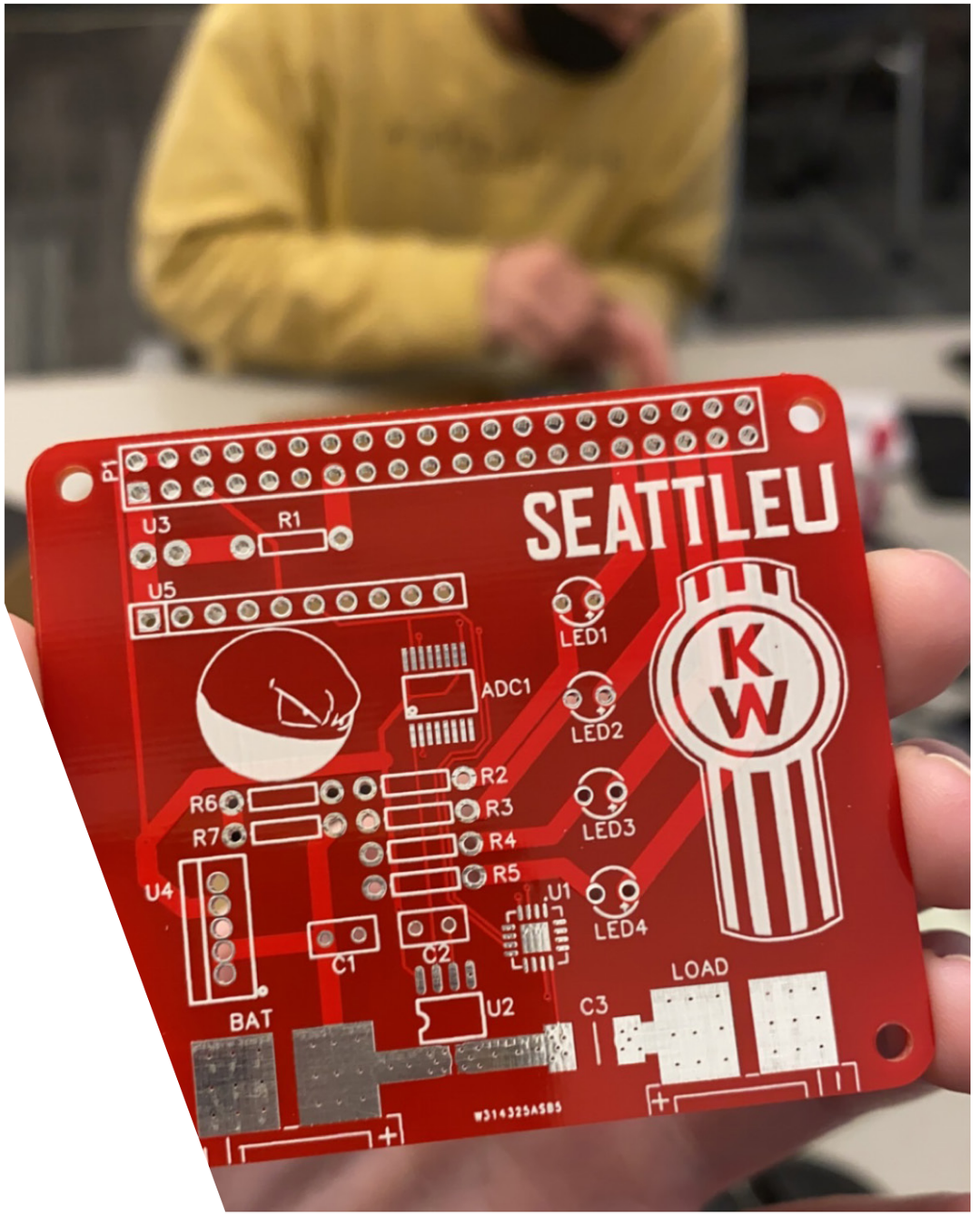
"Kenworth projects are a part of a larger concept that needs to be vetted and students are great resources for this type of work. Our goal is that the students are challenged by the experience, gained a sense of accomplishment, and increased their understanding for applied engineering."
STAN DELIZO
Kenworth Truck Company

WISE Form MSCS 22.3

SEATTLE UNIVERSITY

SPONSOR: Seattle University College of Science and Engineering
SPONSOR LIAISON: Eric Larson, PhD
FACULTY ADVISOR: Mike Koenig
STUDENTS: Ivan Anyaegbu, Ryan Barr, Ryan Barth, Sam Hesler, Leila Mirzaei Gol Mohammadi

The Seattle University College of Science and Engineering Waitlist for Science and Engineering (WISE) Form capstone team has constructed a brand-new WISE Form system that streamlined the process for both students and department administrators. The WISE Form is used to allow students to apply to be registered for courses that they cannot register for themselves due to capacity constraints or registration holds. The old WISE Form system was built on Qualtrics, which is primarily a survey tool and is not suited for student requests and provides no support for administrator request handling. Previously, students would submit requests and then wait several weeks for a response. This was because administrators were only able to access student requests via Excel dumps from Qualtrics that needed to be manually cleaned, sorted, and tracked. The new system is built on Microsoft's Power Platform and includes both student and administrator PowerApps as well as automated email notifications run via Power Automate. This system gives students the power to monitor and update their submissions through a dashboard and administrators an all-encompassing platform for managing requests in real time.



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