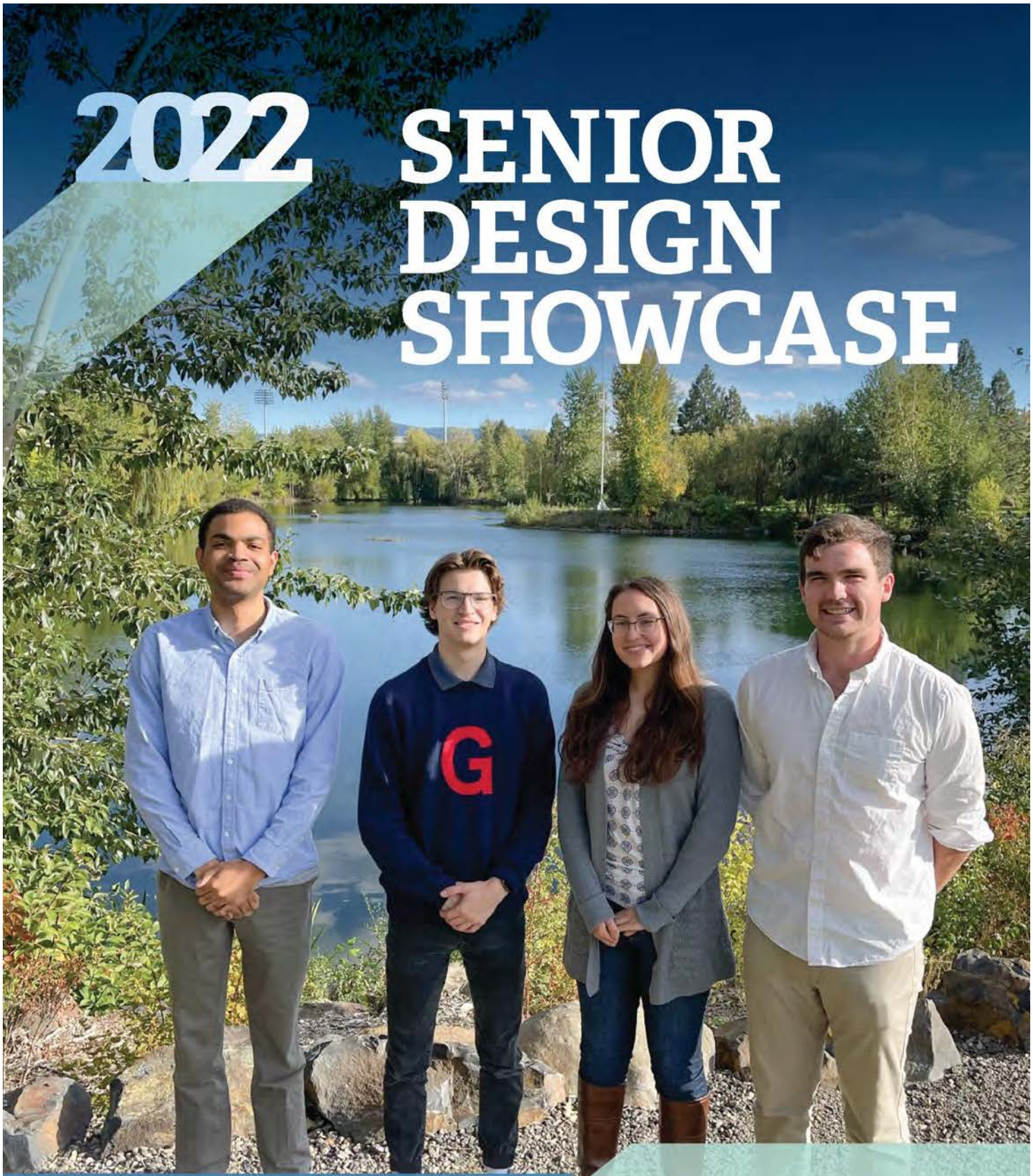
2022 SENIOR DESIGN SHOWCASE



CENTER FOR ENGINEERING
DESIGN & ENTREPRENEURSHIP

GONZAGA UNIVERSITY | School of Engineering & Applied Science

Message from the Dean, Dr. Karlene Hoo

Welcome to the Gonzaga University's School of Engineering and Applied Science 2022 Design Exposition Day. We are here to celebrate an important milestone in our engineering and computer science students' program of study – that of completing their two-semester sequence of senior design. This daunting feat required input and support from our faculty, industry sponsors, supervising faculty, and numerous community members to help transform innovative ideas into proof-of-concept and prototypes. Along the way, our students learned about project planning, teamwork and communications, report writing and technical drawings, and budgeting and resource management.

I am especially grateful to the faculty and staff of the School of Engineering and Applied Science that have assisted our students despite the numerous technical challenges, which were exacerbated by the pandemic. Academic Director, Toni Boggan, and the SEAS Capstone Committee members also deserve major praise for their tireless efforts in bringing this day to a successful fulfillment.

To our senior SEAS students, I want to congratulate you on achieving this milestone in your capstone project. Since the start of your senior year, you worked with your design team to take the project from ideation to the physical realization we see and hear about today. Thank you for your dedication and commitment to excel in this demanding but gratifying pursuit.

Finally, I wish the graduating seniors much success in all your future endeavors.

Go Zags.

Dr. Karlene Hoo, PhD
Dean, School of Engineering and Applied Science

Message from the Academic Director

Congratulations to our Senior Design graduates! We are proud of all of you and your accomplishments during your final year at Gonzaga's School of Engineering and Applied Science. You have shown determination in completing these projects and these lessons will serve you well in your careers.

Thank you to everyone who supports our Center for Engineering Design & Entrepreneurship. Special thanks to our sponsors, liaisons, and Design Advisory Board members. Your generous gifts of time and resources benefit our students in so many ways and our program would not be possible without you. Thank you to the Capstone Committee for your guidance and expertise and to the faculty who support these projects. Thank you, Megan Weed, for organizational wizardry and thank you to everyone from the Manufacturing Technology Center and to the Dean's office staff for your support.

Seniors, please keep in touch with us and send us word of your challenges and your successes. We believe in you and your future!

Toni Boggan
Academic Director
Center for Engineering Design and Entrepreneurship

Welcome to Senior Design Showcase 2022

Gonzaga University's Center for Engineering Design & Entrepreneurship was established in 1992 to enhance the design experience for senior engineering and computer science students. The Center organizes projects for the academic year and many are commissioned by sponsors in the private and public sectors. Prospective sponsors are sought throughout the year for projects involving all engineering, computer science, and computational thinking programs. Many projects are interdisciplinary.

Participating sponsors provide a definition, resources, and funding for the projects. They also commit a liaison from the sponsoring company to guide and support the students throughout the academic year. Sponsors receive several benefits from the Senior Design Program including a project completed by students and faculty members. Additionally, the sponsoring company has the opportunity to work with bright and enthusiastic individuals with innovative ideas. This team experience is an opportunity to evaluate senior students as prospective employees.

Recently, another type of project developed which is the student proposed project. During their junior year, engineering and computer science students research and refine potential projects which are then reviewed by a faculty committee. If a project is accepted, the students who proposed it work on the project. In the 2021 2022 school year, 7 of our projects were developed by student teams.

All projects are periodically reviewed by faculty and the Center's Design Advisory Board (DAB). The DAB is comprised of engineering and computer science professionals in both the private and public sectors. They are instrumental constituents for the Center and a major factor in guiding the students. The review process brings an outside perspective to the teams and is a component required to meet design guidelines established by the Accreditation Board for Engineering and Technology (ABET).

Design Advisory Board Members

Adam Hutchinson	NW Concrete Masonry
Adam Nekimken	Apple
Aimee Navickis-Brasch	—Osborn Consulting
Andrew Asper	ACI Mech. & HVAC
Andrew Matsumoto	Civil West Eng. Services
Art Miller	NIOSH
Ben Bladow	Boeing
Berry Ellison	City of Spokane
Bill Fees	WA Dept. of Ecology
Bob Reed	
Bob Turner	Spokane Schools
Brenna Doll	Boeing
Brent Barr	f5
Chris Sharman	Soft Dev Systems
Colleen Little	Spokane County
Damon Taam	Power Waste Recovery LLC
Dan Parshall	CruxSub
Dannielle Haraldson	—Boeing
Darice Brayton	Retired
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David Moss	Spokane County Utilities
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Jacob Koopmans	Boeing
Jacob Krantz	CS Alumnus
Jason Pegg	AVISTA
Jeb Kilfoyle	CS Alumnus

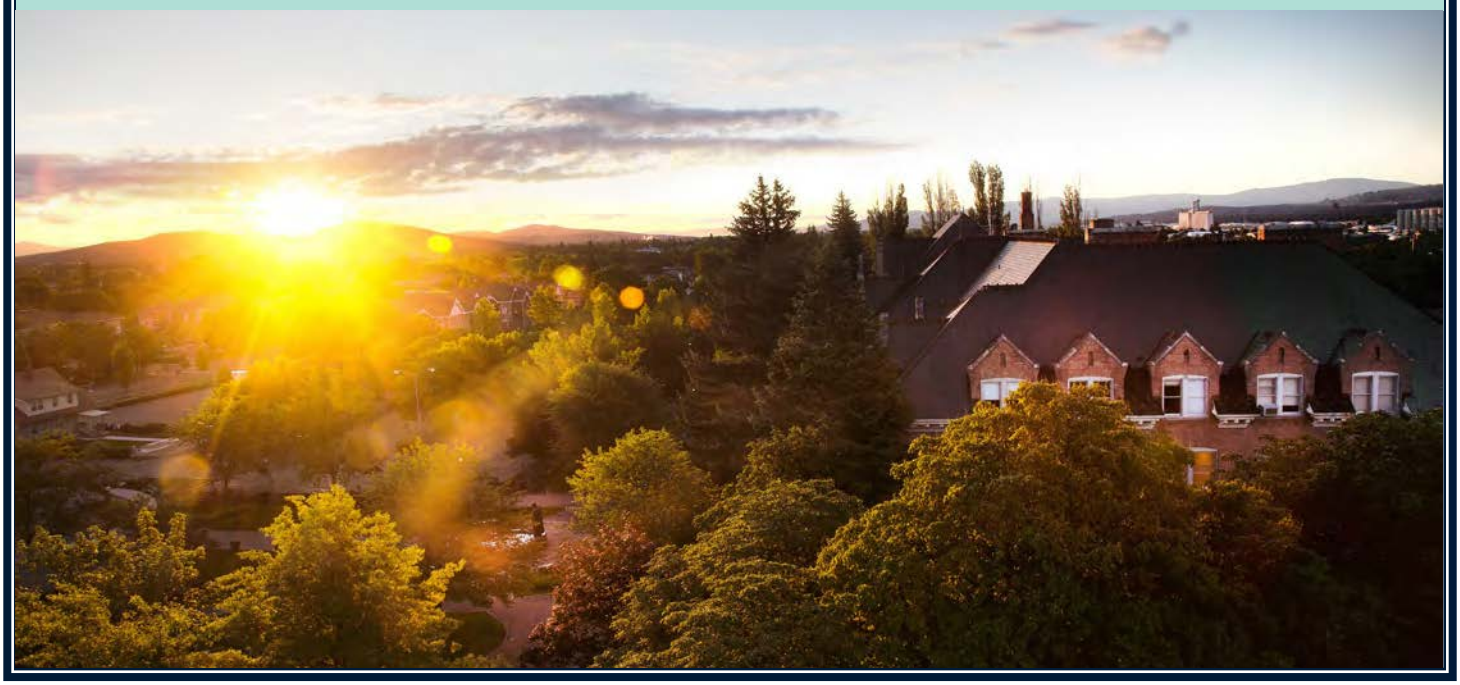
We are so grateful for the invaluable relationships forged with our students and the Design Advisory Board. If you or someone you know would be interested in serving on the Design Advisory Board, visit us on the web at www.gonzaga.edu/cede.

Pictured left: Last year's ENSC 22 on-site of the trail down to the bridge they designed for their Senior Design project sponsored by the City of Spokane.

Thank you, Design Advisory Board!!

The Center for Engineering Design & Entrepreneurship is supported by a dedicated group of volunteers from the engineering community who lend their expertise to our students and our program by reviewing our **student's presentations and reports.**

Jeff Barnhart	Boeing
Jennifer Emerson-Martin	Iteris, Inc.
Jesse Phillips	verint
Jesse Tarr	MW Engineers
Jillian Cadwell	WSU
Joe Dumoulin	CS Alumnus
Joel Lee	Metro Engineering
Jung Kim	Boeing
Kaitlyn Helsing	Itron
Katie Larimer	WA Dept. of Ecology
KJ Hanley	Parametrix
Landon Wright	Kaiser Aluminum
Les Bohush	Gibby Media
Lindsay Gilbert	Jacobs
Melissa Verwest	Oldcastle Precast
Michael Barclay	Limelyte Tech Group
Michael Herzog	Itron Corporation
Mike Mudge	Avista
Nick Questad	Boeing
Patrick Sinner	Ronix Wake/Radar Skis
Patrick Walsh	Fig1 Patents
Paul Robertson	SEL Inc.
Pete Messina	Tantus Technologies
Phillip Pintor	Coffman Engineers
Quinlan Bingham	Yelp
Richard Weeks	PNW TechPros
Russell Connole	Stantec
Ryan Floyd	Ridecell
Sean Stadelman	SEL Inc.
Stu Barton	Jacobs
Terra Donley	HDR Inc
TJ Bolser	DCI Engineers
Vince Poxleitner	
Zachary Crum	BCRA Design



Computer Science Projects

CS 01— Boeing Flight Crew Messaging App (Yodeler)

Dustin Cassell
Adriiana Kharchenko
Wesley Meuhlhausen
William Parlan

Advisor: Chris Sharman
Sponsor: The Boeing Company
Liaisons: Ethan Owyang, Sally Wei, Nick Questad

Flight attendants are currently limited to the hard-line receivers on the forward and aft sections of the aircraft for communication between crew members. Our team has developed an app that allows the entire crew to communicate via texting and calling over the cabin WiFi system. The flight attendants are able to discretely communicate with each other from any location on the aircraft without any problems with FAA safety requirements. Communication is also possible between the flight attendants and the flight crew inside of the flight deck in the event of any emergencies that might happen during the flight.

CS 02— IoT Classroom

Leo Winiecki
Sophia Braun
Haley Archuleta
Greeley Lindberg

Advisors: Dan Eshner and Dr. Steve Schennum
Sponsor: Gonzaga University Plant Services
Liaisons: Tomson Spink, Jason Schnagl, Eric Moss

Currently, Gonzaga University uses temperature sensors in each classroom with specified setpoints that keep the temperature within a specific range during regular school hours. This decreases efficiency of the classrooms and uses unnecessary power. The goal of this project is to manipulate Gonzaga's building management system (BMS) to integrate the data from the classrooms occupancy sensors into the temperature controls, so that the HVAC system is only used when the room is occupied. This was done by creating a separate server, apart from Gonzaga's BMS server, to route BACnet messages using multicast to tunnel messages from the main server. Using these messages, a Python program was created that took BACnet messages from the occupancy sensors and used that information to trigger HVAC events.

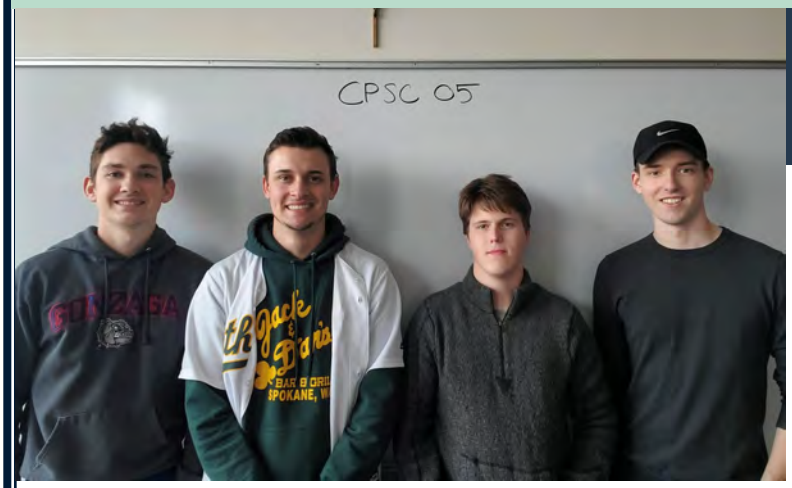
Computer Science Projects

CS 04 Aggregation of Disparate Medicare and Medicaid Reimbursement Data

Ben Howard
Troy Bechtold
Brian Steuber

Advisor: Dan Eshner
Sponsor: Amend Health
Liaison: Andrew Richards

Medical startups often struggle estimating revenue and deciding where to launch their services. Currently, Medicare and Medicaid reimbursement rates are the only publicly available metric for estimating how much insurance companies will pay medical providers for their services. This data is especially important for companies operating in rural areas whereas much as 75% of the population uses public healthcare. This reimbursement data for Medicare and Medicaid is distributed across a variety of government websites, inconsistently formatted, and difficult to decipher. Amend Health seeks to solve that problem. Our team has created software to automate collection, parsing, and presentation of this data in an easily understandable format.



CS 05— Roll Management System

Adam Lee
Joshua Seward
JC Maes
Ethan Pelton

Advisor: Dan Eshner
Sponsor: Kaiser Aluminum
Liaison: Jeff Foutch

Aluminum rolls must be ground periodically to remove chips, dents, and other inconsistencies from them and eventually these rolls must be replaced. As of now, Kaiser Aluminum has been managing their inventory of rolls manually which makes predicting when to order a replacement roll a tedious task. Our Roll Management System solves this problem by providing a centralized database that automatically calculates each roll's replacement date each time it must be ground down. Along with this database, we have provided a web application that will help employees manage each roll and visualize its lifespan.

Computer Science Projects

CS 06— BioPath

Dillon Shipley
Mateo Martinez
Clare Casey
Hannah Cole

Advisor: Bethany Alcamo
Sponsor: Dr. Jeffrey Watson

Biochemical pathways are the interconnected reactions that occur within cells, and it is critical in the fields of chemistry, biology, and medicine that these pathways are understood. Current teaching tools are complex, require straight memorization, and lack the interactivity that enhances learning. We are continuing to develop MyBioPath, a biochemical pathway creation tool for students. We have improved the website and begun development on an app that allows students to construct pathways. For each reaction within the pathway, you can choose from a list of substrates, enzymes, and products. The program will determine if the reaction is correct and in the correct order, and it will provide feedback to the learner.

CS 07—Economic Recovery Dashboard

Simon Watkins
Zac Foteff
Jessica Robertson
Lucas Abeln

Advisor: Dan Lenz
Sponsor: Greater Spokane, Inc.
Liaison: Gary Ballew

Our team was tasked with creating an economic recovery dashboard of key economic indicators for Greater Spokane Inc, a non-profit in the Spokane area. This dashboard would serve as a way for the public to get an at a glance look of the Spokane economy. Our solution is a full stack web application that utilizes APIs to take economic data from online sources and display it on a Node.js application.

Computer Science Projects

CS 08—MyRead

Angela George
Samantha Toll
Cole Thorpen
Han Tang

Advisor: Scott Broder
Sponsor: Scott Broder

Blogging is a fun way to share information with readers, but with the wealth of information already on the web, it can be tedious for the writer and repetitive for the reader. MyRead is like a curated reading list that allows you to blog as you surf the web. CS08 created a MERN web app and chrome extension to allow users to save interesting articles they find on the web under categories on their MyRead blog. MyRead users can like, share, and reblog these articles as they see fit.

CS 09—HIPPA Cyber Gamification

Rebekah Hale
Aaron Miller
Ethan Ching
Madison Call

Advisor: Mike Mudge
Sponsor: Medcurity
Liaison: Amanda Hepper

Our sponsor, Medcurity, works with companies to train employees to keep health data safe under HIPPA regulations. Our project was to build a gamified learning interface to assist Medcurity in this task. In our project, users will learn about cybersecurity, take quizzes, and then pass the training once they had taken a certain number of quizzes. We are also giving user's points for good study habits and ranking all the users in a given organization on a leaderboard where users can see how they and others are doing. The goal of this is to give users additional motivation in completing their required work.

Computer Science Projects

CS 10—ML for Real Estate and City Planning, Phase II

Michael Finch
Cole Olafson
Ben Reilly
Colton Storebo

Advisor: Michael Tobias
Sponsor: immobiliare
Liaison: Graham Morehead

The goal of our project is to disrupt the real estate market by predicting future property values, so that people can make smarter long-term investments, considering that real estate is by far the largest asset class. We are addressing this by utilizing machine learning techniques over a database formed by data we received from real estate tools as well as from Zillow by means of web scraping. We created a web application for visualizing the output of the machine learning model. Likewise, we normalized and created a data model for the application. Ultimately the efforts we made developed an MVP that will be useful for receiving funding for further research in our topic.

CS 11—Website/App RASA Chatbot for GU

Daniel Hoberman
Adrian Rabadam
Michael Valeriano
Eric Gustin

Advisor: Cynthia Freeman
Sponsor: Verint

Gonzaga University's website, gonzaga.edu, provides a large amount of useful information to the university's wider community. It is important that different users ranging from students, faculty, prospective students, and their parents learn the information they need both efficiently and accurately. This project offers a means of accomplishing this in an interactive and comprehensible way. We have created a chatbot (named "GU Chat") using a Python data analysis model and the RASA framework hosted on a custom-made website that will interact with users through text-based communication. Users can ask about all things Gonzaga with the chatbot, such as the degrees Gonzaga offers, faculty members, on-campus facilities, and up-to-date COVID guidelines.

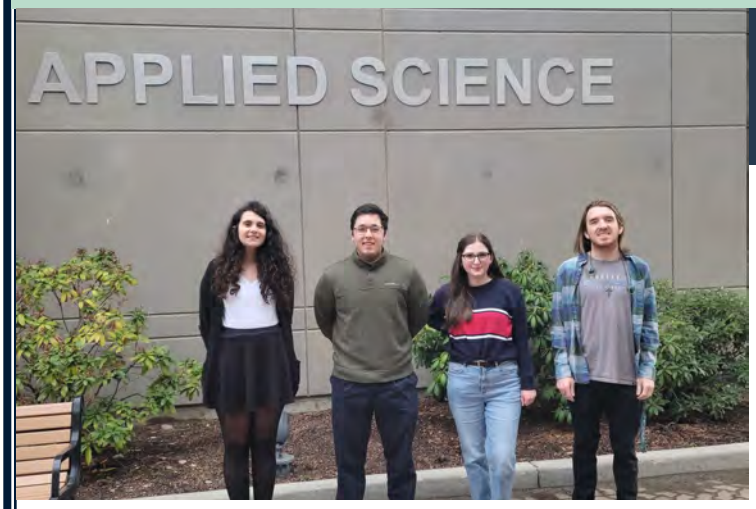
Computer Science Projects

CS 12—Machine Learning

Jacob Ottens
Evan Henderson
Maria Elena Aviles-Baquero
Alexander Hollier

Advisor: Jasmine Jans
Sponsor: Communication Seminar
Liaisons: Dr. James Hunter, Zeke Hunter

ComSem is a service to aid teachers and students in an ESL learning environment. The CS12 team is addressing this issue, by implementing a BERT Machine learning model that automatically generates hints for students. The team implemented a UI interface and established a design for machine learning models that will accomplish the project's goals.



CS 13—HMI Hygiene Compliance

Nora Howard
Weston Averill
Noemi Turner
Christopher Ferguson

Advisor: Ben Medeiros
Sponsor: Advanced Input Systems

Hygiene in hospitals is crucial for both patients and staff, but many hospitals lack a method of ensuring that devices used in patient's rooms are cleaned up to their standards. Advanced Input Systems tasked us with creating a system to aid hospital staff in better tracking their hygiene compliance. We have created a cloud-based solution to collect cleaning data from Advanced Input System's hygiene compliance monitoring keyboard to present up-to-date compliance statistics to infection control specialists within these hospitals. With this system, hospital staff can target hygiene compliance trainings where they are most needed and better allocate resources towards keeping a cleaner hospital.

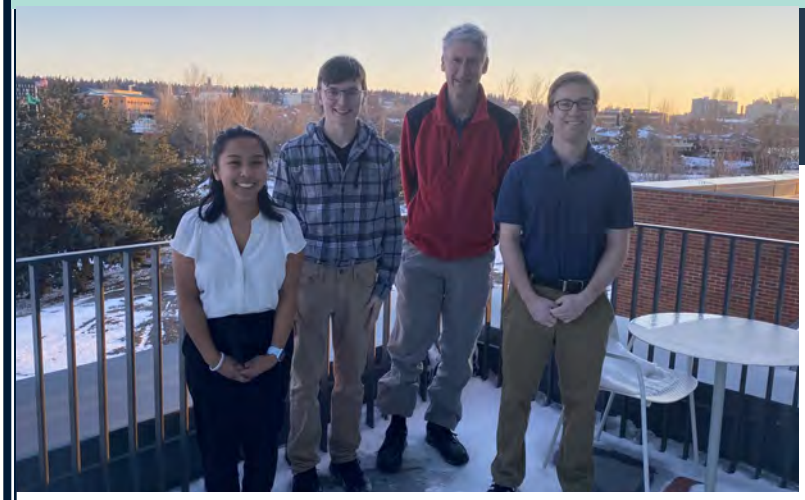
Civil Engineering Projects

ENSC 20—Sustainable Hypar Structures

The goal of our project was to analyze and model the roof of the St. Charles Church in Spokane Washington. This roof has a unique shell-like structure that is very efficient in tension and compression. By utilizing the codes from the 1950s, we were able to estimate the demand and capacity at the time of construction. To assess how the roof has deformed over the past several years, we conducted a laser scan of the roof. This scan was then analyzed in different software and compared to the original geometry to show that there have been significant amounts of deflection. In addition to the computer-generated models, we have also constructed a physical model of the roof.

Katrina Springer
Joseph Roberson,
Mark Hegbloom
Jackson Carroll

Advisor: Dr. Joshua Schultz



ENSC 21–Wastewater Lift Station Intertie

Abigail Lennah Marquez
Patrick Volsky
Nathan Hahne

Advisor: Dave Moss
Sponsor: City of Spokane
Liaison: Dan Buller

The City of Spokane owns and operates a very old and odor-producing wastewater lift (pump) station in North Spokane called the North Pointe Lift Station. The City prefers to abandon the lift station rather than rebuild it, so our goal as part of a two-year senior design effort was to design a gravity sewer intertie pipe that could transfer the flow to a nearby Spokane County interceptor sewer. Last year's team (ENSC29 2020-2021) had narrowed down to two route alternatives, so it was our task to select one and move it to Final Design. After evaluating for the best route, we prepared design drawings of the final pipe and outlined design specifications for construction. Challenges included the presence of obstacles along the selected route, constructability issues for deep excavations, designing the proposed sewer to tie to key existing City and County sewers, and incorporating a flow-measurement device.

Civil Engineering Projects

ENSC 22—Bike-Pedestrian Mobility University District

Sam Johnson
Michael Cosper
Max Nelson
Advisors: Dr. Rhonda Young, Lindsay Gilbert
Sponsor: University District Development Association
Liaisons: Juliet Sinisterra, Colin Quinn-Hurt, Mike Tresidder

Our team was tasked with identifying and producing solutions for bike and pedestrian mobility gaps within the University District boundaries. Our team identified candidate projects and created a weighted decision matrix to identify the projects with the largest impact on the area. We then took these results and created preliminary designs for the Pacific Ave. greenway which will serve as an East West connection from the University District pedestrian bridge to the downtown area for pedestrians and cyclists. The greenway will help give a dedicated route for active transportation users between these two areas as well as address safety concerns at intersections along the route.

ENSC 23–Geo-Structural Deep Foundation Design

Kenny Olsen
Jackson Zipp
Thomas Harlow
Sean Manning

Advisor: Dan Parshall
Sponsor: Crux Subsurface Inc.

Our team was tasked with designing a deep foundation for an H-Frame transmission tower in Nevada County, California. We chose to use a system of micropiles for our design because they work well in poorly accessible locations and require relatively less material for their strength. We have produced a calculations package with example calculations for all design requirements and a complete drawing package. We also provided a modeling input and output showing how the design was analyzed.

Civil Engineering Projects

ENSC 24– Spokane Waste to Ash Recycling Project

Jessica Vazquez
Nicole Stanton
Margaret Howsden

Advisors: Dr. Joshua Schultz, Dr. Kyle Shimabuku
Sponsor: City of Spokane
Liaisons: Damon Taam

The Spokane Waste-to-Energy (WTE) Plant burns 800 tons of garbage reducing the volume of waste to 300 tons of ash and generating 22 megawatts of electricity per day. Since the ash is largely landfilled, the goal of this project was to characterize the ash components and determine if there are viable ash-based products. In the first half of the project, we created and tested a concrete mix design using 10, 20, and 30% replacement of Portland cement with combined (i.e., fly and bottom) ash. The second half of the project focused on environmental testing to determine the characteristics of the ash samples. We performed toxicity characteristic leaching potential (TCLP) tests, partial digestions, and total digestions on the samples. We will report the findings for both the concrete testing, TCLP, total and partial digestion to the City of Spokane and recommend viable uses for the combined ash.

ENSC 25—Arden Bridge Replacement

Kayla Hernandez
Tanner Cline
Jared Garland
Finn Hall

Advisors: Damiano Seghetti, Nicole Norvell
Sponsor: Stevens County Public Works

HGCH Engineers was tasked with assisting Stevens County with the design for a replacement of a bridge in Arden, Washington. The existing bridge has several underlying structural concerns and has been deemed structurally deficient and in need of replacement. HGCH has performed hydraulic, structural, transportation, and environmental permitting tasks to assist in the design for the replacement bridge. HGCH delivered to the client a design package that included a hydraulics report, environmental documentation, structural plans and calculations, and transportation traffic rerouting plans. These documents will ultimately provide the county a preliminary understanding of the replacement structure for the Arden Bridge.

Civil Engineering Projects

ENSC 26—Gonzaga University Transportation Master Plan

Kyle Nolan
Carter Hill
Isabella Kolenc

Advisor: Stuart Barton
Sponsor: Gonzaga Office of Sustainability
Liaison: Jim Simon

The 2009 Gonzaga Climate Action Plan showed that 15.4% of all university emissions were due to commute trips to and from campus each day. The Commute Trip Reduction (CTR) survey is a valuable tool to measure emissions reductions year after year. Our project sought to reduce commute related emissions by beginning to lay groundwork for a university transportation master plan through information gathering and proposal of improvements that would lead to increased participation in sustainable transportation, as well as streamlining the distribution of the CTR survey. We ultimately presented the results of our information gathering and community outreach, a ranked list of improvements that could possibly be implemented on campus, and initial design for a few of these improvements.

ENSC 27—Beaver Dam Analog Design

Sarah Frisby
Matthew Roberts
Hallie Stalcup

Advisor: Dr. Sue Niezgoda
Sponsor: Lands Council
Liaisons: Kat Hall, Dawson Matthews, Colleen Little

The 2009 Gonzaga Climate Action Plan showed that 15.4% of all university emissions were due to commute trips to and from campus each day. The Commute Trip Reduction (CTR) survey is a valuable tool to measure emissions reductions year after year. Our project sought to reduce commute related emissions by beginning to lay groundwork for a university transportation master plan through information gathering and proposal of improvements that would lead to increased participation in sustainable transportation, as well as streamlining the distribution of the CTR survey. We ultimately presented the results of our information gathering and community outreach, a ranked list of improvements that could possibly be implemented on campus, and initial design for a few of these improvements.

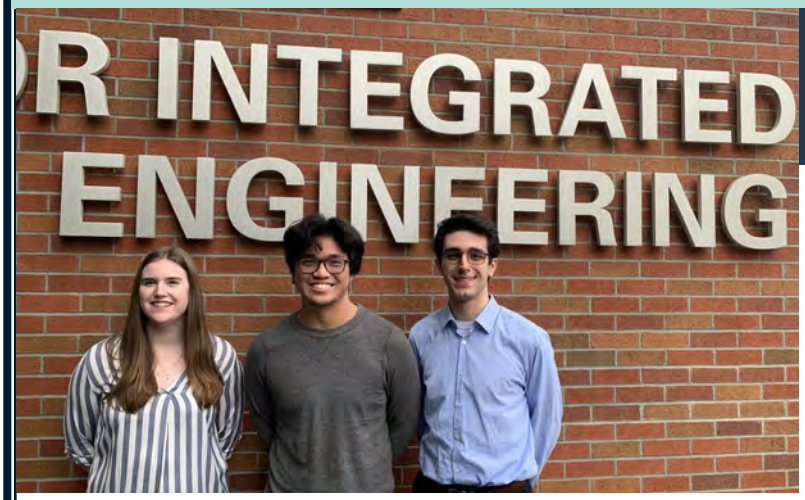
Civil Engineering Projects

ENSC 28—Stormwater Swales Study

Francisco Jimenez
Farren Linne
Elizabeth Moore
Bridget McFaul

Advisors: Kaela Mansfield, Taylor Hoffman-Ballard
Sponsor: Osborn Consulting, Inc., City of Spokane
Liaison: Trey George

The City of Spokane has installed and maintained a few hundred bioinfiltration swales that were built to provide a higher level of water quality treatment in order to protect the Spokane Valley Rathdrum Prairie Sole Source Aquifer. Recently, many of the swales in the City tend to underperform, which is commonly caused by media compaction or clogging. To address the issue, our team completed field testing including procedures such as hydraulic conductivity, particle size distribution, organic matter, and external lab testing on the media most commonly used in the City of Spokane, Spokane Regional Stormwater Manual (SRSM) media, to evaluate the swales' lifecycle. We then completed treatment performance testing on the SRSM media, the Ecology bioinfiltration media and the Ecology bioretention (BSM) media. This testing was completed by running column flow-through testing with synthetic stormwater and measuring the effluent to compare which of the three most efficiently filter out pollutants.



ENSC 29—Big Data—Traffic Count Methodology Development

Emily Feeney
Cameron McKeague
Kevin Moody

Advisor: Adam Miles
Sponsor: DOWL

Turning movement counts are an important statistic that can help jurisdictions make decisions about our transportation system. Big data can be used as a more efficient alternative to conducting manual, in-person traffic counts by allowing users to gather data from multiple intersections and days at once. The big data source we used is StreetLight. Our team developed a statistically backed methodology to guide the utilization of big data in the City of Spokane. This methodology includes a decision tree to help determine whether particular turning movement counts can be estimated with StreetLight, and if so, how to calibrate these estimates to make them as accurate as possible.

Civil & Mechanical Engineering Projects

ENSC 30—737 Wing Body Join Optimization

Brendan Stoll
Eric Candaux
Anna Miller
Danny Dougherty
Brian Kirkland

Advisor: Melissa Verwest
Sponsor: The Boeing Company
Liaisons: Nick Reasoner, Jake Koopmans, Dannielle Haraldson

The current 737 wing to body join presents a different loading condition from other areas of the production system and does not currently utilize modern computing theory to maximize aerodynamic performances. Over the course of the project, the civil team produced a free body diagram package and three concepts for revised airplane design and tooling improvement. The mechanical team created a MATLAB tool that allows Boeing mechanics to input the measured gaps during the wing to body join process and outputs the necessary final wing coordinates resulting in minimal drag penalty. The three civil concepts, the mechanical MATLAB optimization tool, and the collaborative recommendations for an overall improved 737 wing to body join process were delivered to Boeing at the end of the project.

Electrical & Computer Engineering Projects

ENSC 40—Water Pump and Energy Optimization Controller

Theophania Labay
Daniel Kar
Hayden Saalfeld
Dylan Farley

Advisor: Gerry Snow
Sponsor: AVISTA Utilities
Liaison: Landon Wright

As winter and summer temperatures become more extreme, it is important to manage energy consumption, sustain reliability of the electric grid, and reduce usage of non-renewable energy sources. Our group worked to achieve this on Avista Utilities' power distribution system by demonstrating that the operation of pumps in the city's water system can be altered to shift their electric demand to off-peak hours. We created a model of a section of the water system and designed a controller to turn the pumps on during off-peak electric demand hours while maintaining the reliability of the water distribution system. We produced a report that outlines how much load shifting we were able to achieve and extrapolated it to see how much total load shifting could be achieved if the entire water system used a similar operational strategy.

ENSC 41—Northern California Utility Scale Battery Storage

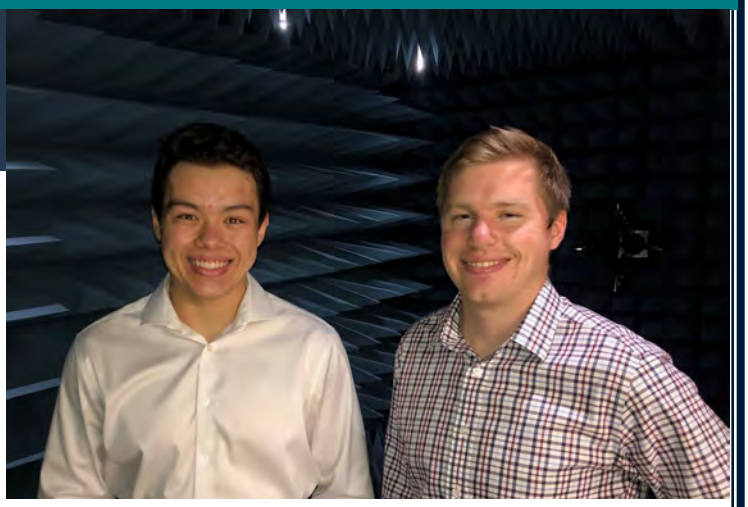
Emily Ellwein
Alex Bresnan
Aya Anderson

Advisor: Dan Harmon
Sponsor: Middle River Power

The purpose of this project was to design and specify a new battery energy storage system for use at an existing 330-megawatt combined cycle power plant in Tracy, CA. This 14-megawatt Lithium-Ion battery storage system is located behind the meter, charged during periods of low power costs, and is used to support the plant's 12-megawatt auxiliary system load. Therefore, when California system demand and power costs are high, the plant can deliver peak generated power to the grid while the battery energy storage system powers the plant's load for a period of up to four hours. The result of this project is an effective means to store and use decarbonized energy while still meeting the required energy demand. Ultimately, this will increase energy efficiency, promote renewable energy sources, and support green initiatives.

Electrical & Computer Engineering Projects

ENSC 42—Helical Antenna Array



Christopher Mau
Nick Hodge

Advisor: Bob Conley
Sponsor: Gonzaga Smart Antenna and Radio Lab
Liaison: Dr. Steve Schennum

The goal of ENSC 42 is to design and test a helical antenna array comprised of left-hand circularly polarized (LHCP) and right-hand circular polarized (RHCP) antenna elements with a printed circuit board (PCB) feed. The goal of the project was to create an easily manufacturable design for production by external sources. The antenna array was designed and validated using Ansys HFSS, a high-frequency simulation software. Then the physical model was tested in the Gonzaga University Smart Antenna and Radio Lab anechoic chamber to get real-world measurements. The current center frequency of 915MHz can be scaled to a center frequency of 2.4GHz by simply scaling the complete design. In addition, the use of an orthogonal pair of polarization (e.g., LHCP and RHCP) will enable a two-port, phase-coherent transceiver to produce any polarization.

ENSC 43—Baja SAE Off-Road Vehicle Data Acquisition & Display System

Blaine Atkins
Bradley Nickolaus
Max Nygren
Mark Pham

Advisor: Jim Weston
Sponsor: CEDE

Baja SAE vehicles do not have data collection or display systems, leaving the driver and team to guess at important driving parameters. Our team designed and implemented a modular data acquisition and display system for the Baja SAE vehicle. The data acquisition and display system will provide the driver with helpful real time data during competitions, and will allow the members from the Baja SAE club to use the data points to troubleshoot and improve the vehicle, giving a competitive advantage. The system collects vehicle speed, engine RPM, brake pressure, ambient temperature, tire pressure, CVT belt temperature, GPS position, and 3-axis acceleration. All the collected data points are displayed to the driver and sent via RF transceiver to the Baja team in real time, as well as being saved to a SD card for later analysis and development by the team.

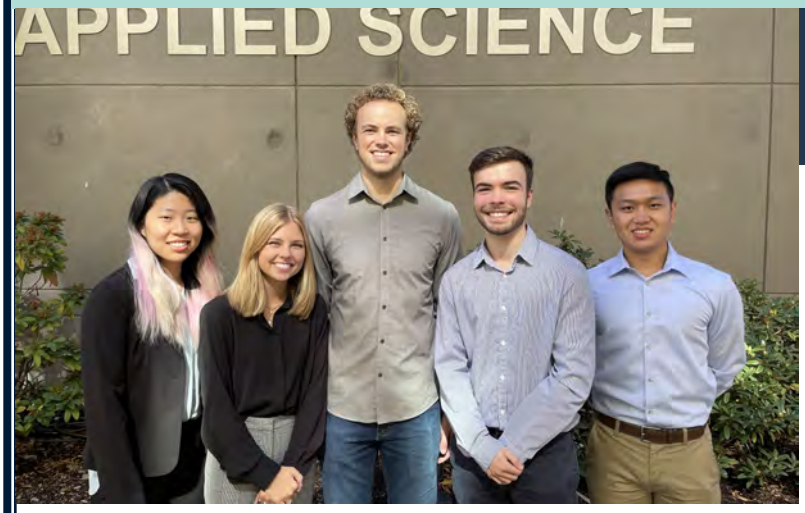
Electrical & Computer Engineering Projects

ENSC 44—Project Iris (Vehicle to Vehicle Communication)

Kevin Roundhill
Scott Tornquist
Nicholas Smith
Daniel Harrington

Advisor: Kevin Damron
Sponsor: CEDE

Over 1.3 million people die each year on the road worldwide. Our goal is to combat this issue using vehicle to vehicle communication to sense and notify drivers of hazards in milliseconds. We have a created an after-market device that can be added to a vehicle and make it into smart vehicle that can communicate with the cloud and other vehicles around it. Hazards are reported to users within fractions of a second and all without tracking user location, allowing privacy and security.



ENSC 45—Deep Vein Thrombosis Prevention—Phase II

Milee Owen
Mira Briestensky
Kelcey Kisker
Drew Caley
Patrick Munar

Advisor: Shane Pacini
Sponsor: Lung Technologies LLC
Liaison: Kerry Curran

Kerry Curran of Lung Technologies LLC has tasked this team to design two Deep Vein Thrombosis (DVT) prevention devices. These devices prevent blood stagnation in the lower leg through both passive and active motion. They manipulate blood flow passively through automated massaging and actively through user exercise. The first product is a pneumatic compression sleeve which will smoothly assist blood flow through sequentially inflating bladders along the calf. The second product is a foot elevation structure containing a resistance band system which the user will exercise their leg with. These devices can be used both concurrently and separately leading up to surgery as well as following.

Electrical & Computer Engineering Projects

ENSC 46—Therapeutic Incentive Spirometer with OPEP

Jenny Wrobel
Jedi Biswas-Diener
Byron Carabajal
Tyler Anne Trabont

Advisor: Shane Pacini
Sponsor: Lung Technologies LLC
Liaison: Kerry Curran

Due to the effects of general anesthesia and COVID-19, a Pulmonologist may require a patient to use a therapeutic incentive spirometer post-surgery to help regain lung function. Current therapeutic incentive spirometers are outdated and cannot monitor a patient's progress. As a team we have been able to re-design the incentive spirometer with the addition of an easy-to-use monitoring device to keep track of patient progress. To make the incentive spirometer a more effective product, we were able to develop and combine an OPEP (Oscillatory Positive Expiratory Pressure) device to work on a patient's exhalation function while maintaining the incentive spirometer's original function. Overall, by researching current market products, testing sensors, analyzing airflow, resistance, and vibrations, our team has created a new incentive spirometer for the next generation of patient care.

Mechanical Engineering Projects

ENSC 50—Heat Transfer System for Micro-Greenhouses

Aiden Branch
Charlotte Tavernise
Owen McKinstry
Fisher Ng
Matthew Shikada

Advisor: Jim Weston
Sponsor: CEDE

Many urban communities suffer from challenges of food insecurity and the lack of environmental sustainability, issues especially prevalent in colder climates that do not permit year-round gardening. While cold frames can retain heat and extend the growing season, to reliably grow a diverse selection of crops year-round, cold frames require additional heat, which our team supplies at a controlled rate using heat generated from a compost pile. Our team built a cold frame using wood and polycarbonate panels and attached it to a compost bin created from recycled pallets via a drainage pipe used to draw heat from the pile into the cold frame. In creating a low-cost cold frame heated by free, sustainable energy that can alter the cold frame temperature based on thermocouple input data and an Arduino controller, our team has created a tool for year-round gardening capable of supporting more diverse crops.

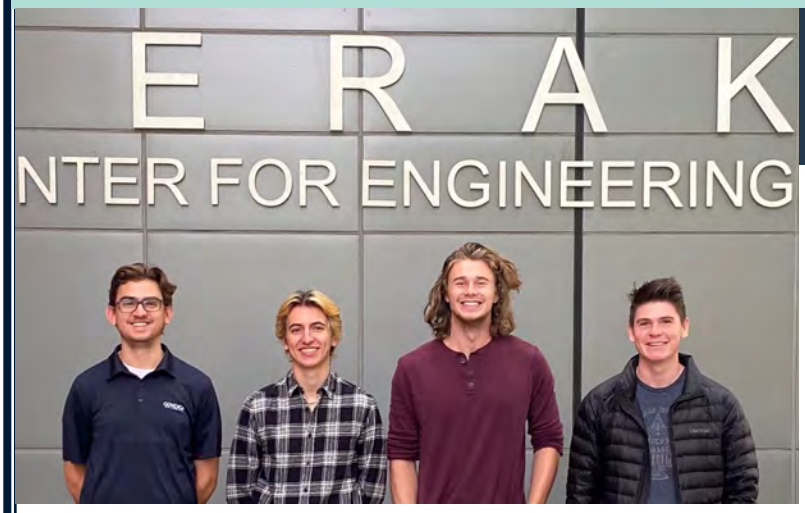
Mechanical Engineering Projects

ENSC 51—Custom Heat Transfer Testing System

Reggie Bahr
Nathan Frojelin
Evan DeSteese

Advisor: Dr. Tailian Chen
Sponsor: Mechanical Engineering Department

In order to improve capabilities of modern cooling and refrigeration systems, the ability to test heat exchangers and their capabilities is vital. This testing system acts as a tool to assist both faculty and future students to improve designs and further their own research in this field. The team's custom loop that has been constructed can be used to test a variety of different heat exchanger tubing lengths and geometries and multiple different types of refrigerants. The data gathered from this system will be used to further improve HVAC and refrigeration systems. Overall efficiencies and energy savings will increase with better heat exchangers, and this testing system will assist in creating those improvements.



ENSC 52—Inflatable Portaledge

Colin Giardino
Ethan Bailes
Max Pansegrau
TC Mixon

Advisor: Andrew Asper
Sponsor: NorthWave Sails, CEDE

Portaledges have been around for decades and allow climbers to spend the nights on large walls when they take multiple days to climb. They typically weigh between 20 and 30 pounds with a large form factor and are difficult to set up on the wall. We decided that we could improve the design by using inflatable struts instead of aluminum ones for support. The final product is less than half the weight of a traditional portaledge with a smaller form factor and shorter set up time while maintaining similar comfort standards.

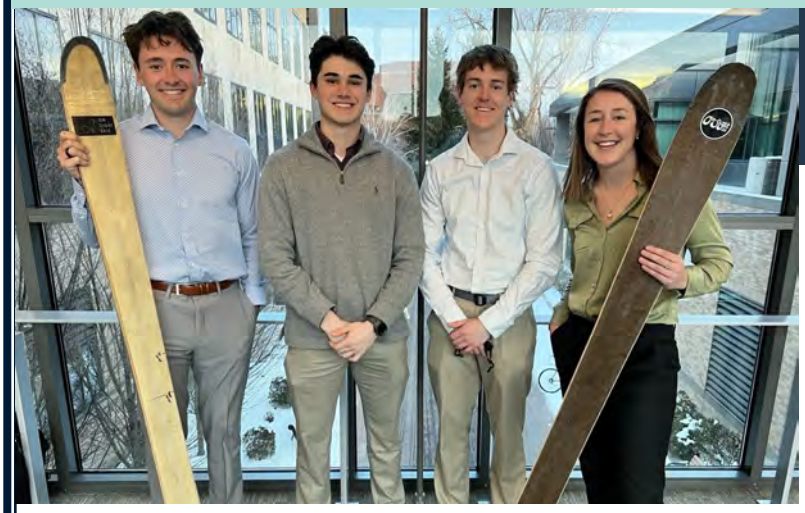
Mechanical Engineering Projects

ENSC 53—Modular Skis

David Connell
Erik Olsen
Sam Worth

Advisor: Sam Shoemaker
Sponsor: CEDE

Skiing can be a prohibitively expensive sport, especially for skiers who wish to own multiple sets of skis. The design of new skis which allow one set of bindings to be transferred between different pairs of skis would reduce the magnitude of this expense. A proof of concept was created which consists of an interlocking set of plates and a modified pair of Rossignol skis, which allow a binding to be reattached infinitely many times. With this system a user will only need to buy one set of bindings and have the capacity to use them with multiple sets of skis.



ENSC 54— On-Sight Skis

Keith Lobis
Brenden Miller
Jacob Bubb
Keely Kempt

Advisor: Sam Shoemaker
Sponsor: CEDE

Climate change is having an increasing impact on our environment, especially the health of fragile mountain environments. With the increased impact of climate change paired with the pandemic's push to find solace outdoors, recreational equipment is an area that could only benefit from being more environmentally friendly. Current innovation in the ski manufacturing industry focuses mostly on ski shape and materials rather than sustainable practices to protect our environment. By exploring alternatives to materials currently used such as carbon fiber, fiberglass, wood, and epoxy-resins, On-Sight Skis has developed a pair of sustainable skis capable of cutting carbon emissions by more than 85% while maintaining excellent performance.

Mechanical Engineering Projects

ENSC 56—Recycling Thermoplastic Composites III

Kenneth Rasmussen
Brendon Tran
Helena Laan
Joseph Gruber

Advisor: Christopher Nicol
Sponsor: The Boeing Company, ATC Manufacturing
Liaisons: Karen Hills, Jamie Langabeer, Davis Tran, David Leach, Richard Postera

The aerospace industry typically features interior components made from thermoplastic composite material which can be difficult to recycle and reintegrate into the manufacturing process. The purpose of this project was to showcase the feasibility of utilizing thermoplastic waste stream material to construct new interior aircraft components. As a continuation of two years' worth of "Recycling Thermoplastic Composites" projects, our team was able to focus solely on the implementation of this material in fabricating a Boeing-specific interior aircraft part. As such, the current model of a passenger service unit (PSU) spacer panel was used in the creation of a two-part aluminum mold that was then integrated into the stamp forming process at ATC Manufacturing. Once the component was completed, it underwent various forms of testing to evaluate the performance of an interior component made of recyclate thermoplastic material.

ENSC 57—Nuclear Decontamination Hose Leakage Remediation

James Houston
Clayton Bierman
Nathan See
Ryan Kelley

Advisor: Andy Johnston
Sponsor: Westinghouse Electric Company
Liaisons: Andrew Riegert, Christopher Morley

The process hoses being used by Westinghouse for cleaning nuclear power plants were experiencing leaks in periods of rapid cooldown. The leaks were causing project delays, safety issues, and economical concerns. The goal of our project was to research, test, and recommend a leak-free, economical, and easy to construct hose assembly to Westinghouse for future use. Over the school year, our team researched and tested numerous hose components while working towards designing a leak-free assembly. After testing was completed, our team analyzed and compiled all test data, providing our analysis to Westinghouse. Along with the compiled test data, our group delivered Westinghouse with recommendations to use for hose components that would lead to a leak-free assembly.

Mechanical Engineering Projects

ENSC 58—Optical Lever Stylus Profilometer

Jarett Wright
John Heywood
Jack Thorsland

Advisor: Dr. Harman Khare
Sponsor: Mechanical Engineering Department

The goal of our project was to design and construct a 2D optical lever stylus profilometer to determine the surface roughness of test specimens in the Gonzaga University Tribology Lab. Profilometers allow us to better capture microscale topology of surfaces and how they might interact with each other. This profilometer was designed to measure a large area while maintaining high precision at a reasonable cost. An optical-lever-based system uses a cantilever beam and a stylus to deflect from the contours of the specimen; the combination of a laser and a photodetector amplifies these deflections. This instrument is equipped with a dual-axis stage to translate the specimen in two directions. A LabVIEW user-interface controls the system and processes the roughness data.

ENSC 59—Thermal Energy Emission System

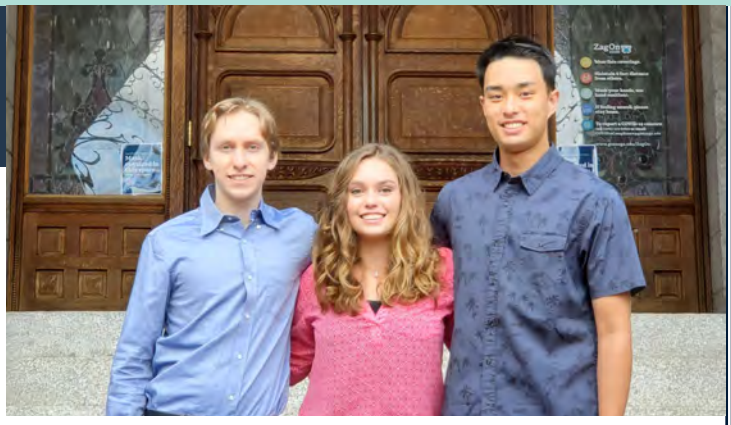
Mirza Mustafayev
Jon Udell
Ben Walker
Sara Lynn

Advisor: Alireza Toghraee
Sponsor: The Boeing Company
Liaisons: Robert Jaeger, Richard Loftis

Deicing an aircraft prior to flight take-off has proven to be an expensive, damaging, and even deadly obstacle that occurs every winter in the airline industry. The goal of our project was to design a system that would electrically heat the wing surface. More specifically, melt the layer of frozen contaminants that is in contact with the wing to provide a lubricating layer of water for the remaining snow and ice to slide off on. Results were found through the analysis of numeric energy system models in addition to multiple finite element models. The results from these models were used to determine the feasibility and viability of this technology for future use in Boeing aircraft. After developing the heating mechanism, we had to determine the best geometry for the electrical system on the wing to minimize the amount of material used and avoid significantly increasing the weight of the aircraft.

Mechanical Engineering Projects

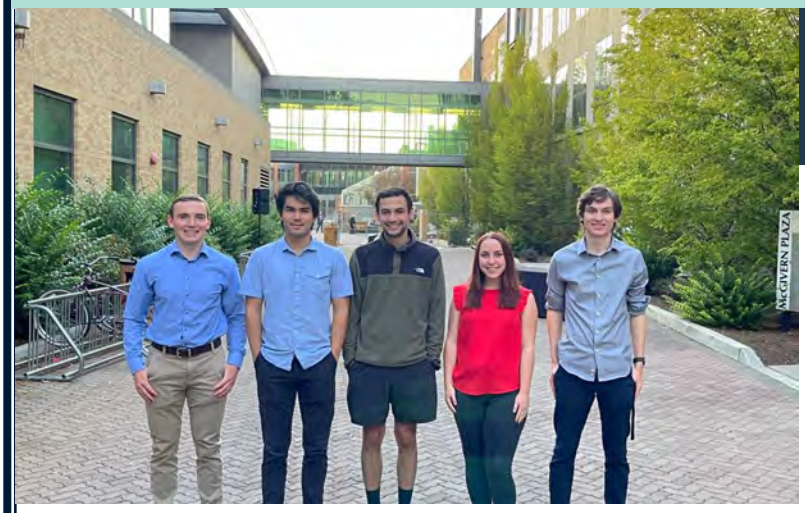
ENSC 60—No Pollution Thermal Turbine



Nathan Coats
Emily Johansen
Josh Tagawa

Advisor: Dan Harmon
Sponsor: Middle River Power

In the energy industry, there is an ever-growing need for new energy generation solutions free of carbon emissions. The primary caveat of solar production is that it cannot provide reliable energy during times of the day after the sun has set. One solution is to use excess solar energy to split water into pure hydrogen and oxygen; this reaction is reversed later in the day, through combustion, to generate energy when it is needed. The patent pending Couvillion Cycle offers a solution that eliminates carbon emissions and is a frontrunner in the effort to eliminate NO_x. Unlike previous designs, this combined Brayton-Rankine cycle is a frontrunner in the effort to eliminate NOx and theoretically allows for improved efficiency. The purpose of our project was to conduct a feasibility study to determine if this system could be profitable when implemented. This study featured a thermodynamic model, market and financial analysis, and hydrogen storage selection.



ENSC 61—Electric Ducted Fan for Hybrid Electric Aircraft Application

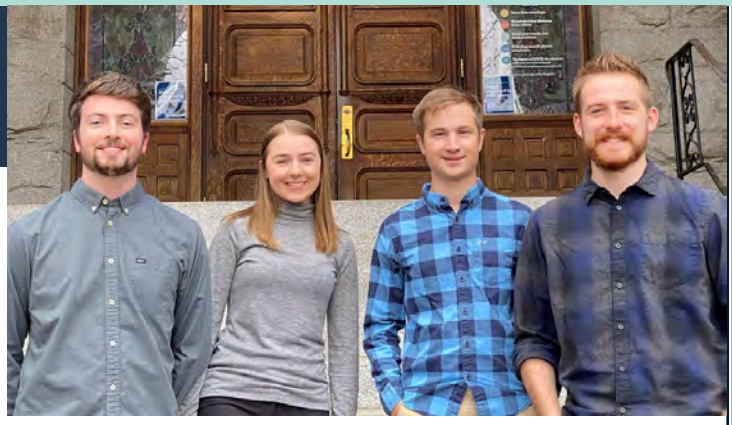
Garret Duch
Ian Linville
Mason Leach
Savannah Sweet
Jacob Farrell

Advisor: Jeff Nolting
Sponsor: The Boeing Company
Liaison: Paul Walker

Since aircraft engines traditionally rely on combustion to generate thrust, the future of electric aviation requires the development of a new type of motor. As an interdisciplinary team composed of mechanical and electrical engineering students, our objective was to design and build an electric ducted fan driven by an axial pole synchronous reluctance motor for use on a hybrid-electric airplane. A design package consisting of part models and drawings was compiled and sent to a machine shop for fabrication. Simultaneously, electrical simulations were created, electric field testing was performed on 60 steel core solenoid coils, and a control system was developed to operate the fan. After construction of the fan blades and completion of the machined parts, a prototype was assembled. Finally, testing of the completed fan was conducted to determine the efficacy of the novel electric motor.

Mechanical Engineering Projects

ENSC 62—Composite Washer Deburring Machine



Jack Griesemer
Maya Prouty
Chephren Sinko
Reese Anselmi

Advisor: Gabe Achenbach
Sponsor: WessDel
Liaison: Ryan Cook

WessDel currently fabricates around 10,000 composite washers a day, which are mostly cut out of carbon fiber sheets on a water jet. Small tabs keep the washers from falling out. After being broken out of the sheet, each retaining tab is sanded by hand. This operation is the bottleneck of the manufacturing process, so WessDel requested an automated solution for deburring. Our team produced a mechanism that combines a linear motion system and vertical clamp which automatically punches and sands the washers. The sheet moves linearly in one axis while the clamp moves perpendicularly to this motion, punching washers out of the sheet and bringing them to the sanding belt. The clamp toolhead rotates 45 degrees before depositing each washer and restarting the process. This machine eliminates the need for washers to be sanded by hand, freeing up workers and increasing consistency, without the need for complex photosensors.

ENSC 63—Boeing Seat-to-Seat Cable

Nathan Verboort
Mathew Hartlib
Justin Leach
Jayson De Jesus

Advisor: Colleen Nolting
Sponsor: The Boeing Company
Liaisons: Russell Keck, Jim Fullerton

Boeing challenged the ENSC 63 team to develop and design a new connector to provide power and data between seats in the Boeing 787, 777, and 737. Issues with the old designs included reliability, install/adjustment times, and part availability. The goal of the project was to create a prototype that solved most or all of the issues with the current design. The project was broken into three phases, those being research and idea generation, design selection, and prototype creation and testing. This project will be a success if the prototype design can provide the needed power, adjust to varying seat pitches from 28” to 32”, and reduce the number of parts required.

Mechanical Engineering Projects

ENSC 64—Reagent Tube Capping System

Angelica Floryanovich
Mikayla Lambert
Dillon Yanick

Advisor: Jacob Laete
Sponsor: Synthego
Liaison: Trevor Longbottom

The goal of our project is to screw caps onto small vials for Synthego, a genome engineering company based in California. The tubes are filled at Synthego's factory, and our task is to alleviate the strain of twisting 500 caps per day that is currently placed on employees. To do this we have worked with advisors to design and prototype a machine that will be used to screw on caps. Ultimately, we hope for this machine to be autonomous but currently we are working on a handheld design. The design of our machine also requires us to redesign the tray that the tubes are held in. For both the tray and the screw mechanism, we have modeled and 3D printed countless iterations and different designs.

ENSC 65—Tipping Floor Fire Deluge System

Isaac Lindberg
Samuel Range

Advisor: Damon Taam
Sponsor: Power Waste Recovery LLC, City of Spokane

The existing Fire Protection systems at Spokane's Waste-Energy Facility are insufficient in combatting fires that break out on the tipping floor. Our team designed a Deluge System to deliver ample water to the affected area, in order to supplement the existing systems. Our team worked to design a system compatible with the existing infrastructure, ultimately producing design drawings of the system, and cost estimates. This project allowed our team to provide the City of Spokane with recommendations for supplemental fire suppression systems should this become a future public work.

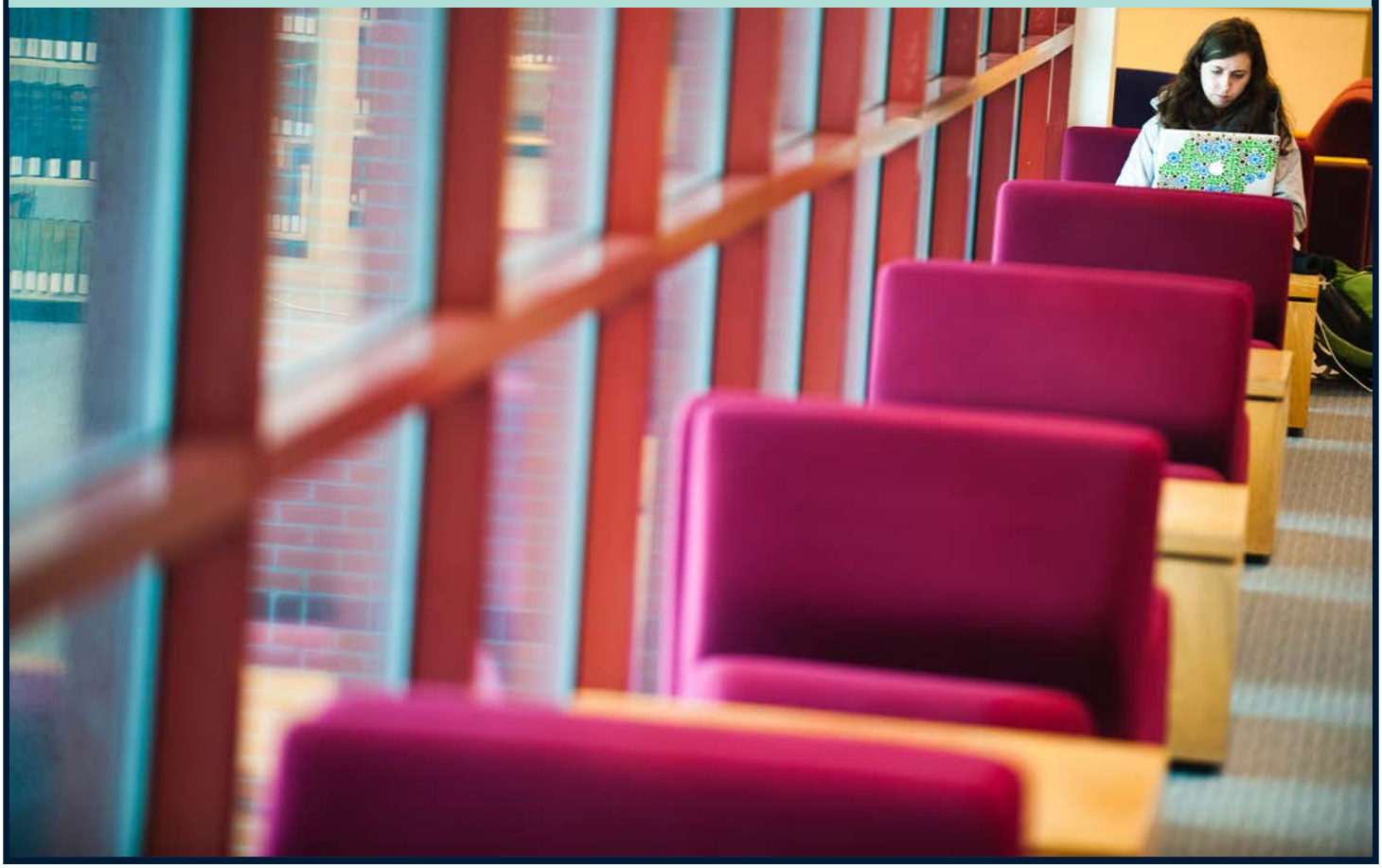
Mechanical Engineering Projects

ENSC 66—Rolling Table Lifting Device

Jake Mills
Meredith Pires

Advisor: Christopher Nicol
Sponsor: Kaiser Aluminum

At Kaiser Aluminum the gear driven tables of the rolling mills which help guide aluminum ingots in and out of the mills must be removed and reinstalled periodically for maintenance. Since this process at the 112” mill exit table was very challenging due to the location and environment, it was desired to design a lifting device to simplify this process and ensure a safer method of removing the table. A counterweight design was chosen so that the overhead crane could pick up the device directly vertical as opposed to at an angle since it was obscured from being placed directly above the table. This device eliminates problems of crane location as the crane no longer needs to be directly above the table. It also does not require craftsmen to use complex rigging operations with multiple come-alongs to successfully remove the exit table. It is a simpler process which ensures safety.



Design Exposition Day Schedule

CEDE Presentation Schedule – April 27, 2022 3:10 PM

Location & DAB Members		Project	Time	Faculty
College Hall 316 – CE - Structures (Proctor – Nicole Norvell)				
DAB:	TJ Bolser	**ENSC 20 Sustainable Hypar Structures**	**3:10p.m.**	**Joshua Schultz**
	KJ Hanley, Mel Verwest	**ENSC 23 Geo-Structural Deep Foundation Design**	**3:40p.m.**	**Dan Parshall**
	Berry Ellison	**ENSC 25 Arden Road Bridge Replacement**	**4:10p.m.**	**Norvell/Seghetti**
College Hall 325 – CE – Water/Environmental (Proctor-Sue Niezgoda)				
DAB:	Little, Matsumoto, Cadwell	**ENSC 27 Beaver Dam Analog**	**3:10p.m.**	**Sue Niezgoda**
	Duncan, Lee, Larimer, Fees, Poxleitner	**ENSC 21 Wastewater Lift Station Intertie**	**3:40p.m.**	**Dave Moss**
	Taam, Parshall	**ENSC 24 Spokane Waste to Energy Ash Recycling**	**4:10p.m.**	**Kyle Shimabuku**
	Navickis-Brasch, Connole, Moss	**ENSC 28 Spokane Stormwater Swales Study**	**4:40p.m.**	**Hoffman-Ballard/Mansfield**
College Hall 424 – CE - Transportation (Proctor – Lindsay Gilbert)				
DAB:	Lindsay Gilbert	**ENSC 22 Bike-Pedestrian Mobility U-District**	**3:10p.m.**	**Lindsay Gilbert**
	Brenna Doll	**ENSC 26 GU Master Transportation Plan**	**3:40p.m.**	**Stu Barton**
	Turner, Barton	**ENSC 29 Big Data Traffic Count**	**4:10p.m.**	**Adam Miles**
College Hall 402 – EE/CPEN (Proctor – Gerry Snow)				
DAB:	Landon Wright	**ENSC 40 Pumped Storage Hydropower**	**3:10p.m.**	**Gerry Snow**
	Kaitlyn Helsing	**ENSC 42 Helical Antenna Network**	**3:40p.m.**	**Bob Conley**
	Brent Barr	**ENSC 44 Project Iris**	**4:10p.m.**	**Kevin Damron**
Herak 244 – EE/CPEN & ME (Proctor – Gary Weber)				
DAB:	Paul Robertson, Darice Brayton	**ENSC 45 Deep Vein Thrombosis**	**3:10p.m.**	**Shane Pacini**
	Terra Donley	**ENSC 46 Therapeutic Incentive Spiro. w/OPEP**	**3:40p.m.**	**Shane Pacini**
	Pat Ferro, Fred Reinel	**ENSC 60 No Pollution Thermal Turbine**	**4:10p.m.**	**Dan Harmon**
	Terra Donley	**ENSC 41 N. Cali. Utility Scale Battery Storage**	**4:40p.m**	**Dan Harmon**
Herak 237 – ME (Proctor – Harman Khare)				
DAB:	Gary Holmesmith	**ENSC 43 Baja Data Control System**	**3:10p.m.**	**Jim Weston**
	Andrew Asper	**ENSC 50 Micro-Greenhouse**	**3:40p.m.**	**Jim Weston**
	Miller, Nekimken	**ENSC 57 Nuclear Decontamination Remediation**	**4:10p.m.**	**Andy Johnston**
	Sean Stadelman	**ENSC 58 Optical Lever Stylus Profilometer**	**4:40p.m.**	**Harman Khare**
Herak 301 – ME (Proctor – Sam Shoemaker)				
DAB:	Jesse Tarr, Patrick Sinner	**ENSC 53 Modular Skis**	**3:10p.m.**	**Sam Shoemaker**
	Dillon Turnbull, Patrick Sinner	**ENSC 54 OnSite Skis**	**3:40p.m.**	**Sam Shoemaker**
	Doug Pooler, Bob Reed	**ENSC 62 Composite Washer Deburring**	**4:10p.m.**	**Gabe Achenbach**
	David Sweet	**ENSC 52 Inflatible Portaledge**	**4:40p.m.**	**Andrew Asper**

Design Exposition Day Schedule

Paccar 001 – ME (Proctor – Jake Laete)

DAB:	Fred Reinel	**ENSC 66 Rolling Table Lifting Device**	**3:10p.m.**	**Christopher Nicol**
	Phillip Pintor	**ENSC 65 Tipping Floor Fire Deluge**	**3:40p.m.**	**Damon Taam**
	Pete Messina, Les Bohush	**ENSC 64 Capping System for Reagents**	**4:10p.m.**	**Jake Laete**
	Adam Nekimken	**ENSC 51 Custom Heat Transfer Test System**	**4:40p.m.**	**Tailian Chen**

Paccar 003 – ME & CE (Proctor – Alireza Toghraee)

DAB:	Jung Kim	**ENSC 59 Electric Wing De-Icing Weight Study**	**3:10p.m.**	**Alireza Toghraee**
	Jeff Barnhart	**ENSC 61 Electric Ducted Fan for Aircraft**	**3:40p.m.**	**Jeff Nolting**
	Eric Ryan	**ENSC 56 Recycling Themro Comp III**	**4:10 p.m.**	**Christopher Nicol**
	Nick Questad	**ENSC 63 Airplane Cable**	**4:40p.m.**	**Colleen Nolting**
	Dannielle Haraldson, Jacob Koopmans	**ENSC 30 Wing Body Join Optimization**	**5:10p.m.**	**Melissa Verwest**

CPSC 491 Presentation Schedule-April 27, 2022 4:00 PM

Location & DAB Members		Project	Time	Faculty
Bollier Center 119 – CS (Proctor – Chris Sharman)				
DAB:	Ben Bladow	**CPSC 01 Airline Crew Messaging App**	**4:00p.m.**	**Chris Sharman**
	Chris Sharman	**CPSC 09 HIPAA Cyber Gamification**	**4:25p.m.**	**Mike Mudge**
	Mike Mudge, Richard Weeks	**CPSC 12 ComSem Machine Learning**	**4:50p.m.**	**Jasmine Jans**
	Jacob Krantz	**CPSC 08 MyRead: Curated Reading List**	**5:15p.m.**	**Scott Broder**
Bollier Center 120– CS (Proctor – Dan Eshner)				
DAB:	Dwight Brayton, Quinlan Bingham	**CPSC 02 Basic Classroom IoT**	**4:00p.m.**	**Dan Eshner**
	Jeb Kilfoyle, Jason Pegg	**CPSC 04 Aggregate of Medicare and Medicaid**	**4:250p.m.**	**Dan Eshner**
	Michael Herzog, Patrick Walsh	**CPSC 05 Roll Management System**	**4:50p.m.**	**Dan Eshner**
	Jesse Phillips	**CPSC 11 Website/App RASA Chatbot for GU**	**5:15p.m.**	**Cynthia Freeman Wu**
	Bollier Center 121 – CS (Proctor – Dan Lenz)			
DAB:	Michael Barclay	**CPSC 07 Economic Recovery Dashboard**	**4:00p.m.**	**Dan Lenz**
	Dan Lenz	**CPSC 13 HMI Hygiene Compliance**	**4:25p.m.**	**Ben Medeiros**
	Joe Dumoulin	**CPSC 06 BioPath Tools for Biochemistry**	**4:50p.m.**	**Bethany Alcamo**
	Graham Morehead	**CPSC 10 ML for Real Estate & City Planning**	**5:15p.m.**	**Michael Tobias**

THANK YOU to our Sponsors!

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Gonzaga's Civil Engineering Department
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