

MAY 3, 2024
CAL STATE LA
COLLEGE OF ENGINEERING,
COMPUTER SCIENCE,
AND TECHNOLOGY

Cal State LA College of ECST Capstone Senior Design
COMPUTER SCIENCE PROGRAM 2023-2024
PROJECT DESCRIPTIONS

A Machine Learning platform for Intelligent Water Systems Management

Client: SAYA.life
Advisor(s): Manveen Kaur

Students: Daniel Castillo, Arron Diu, Gabriel Garcia, Matthew Kim, Kobe Martinez-Barrios, Isaac Mendoza, Jimmy Nguyen, Daniel Ramirez, Jonathan Tirado, Andres Vicente

Saya Life (Saya) is a company that specializes in water management systems for commercial or personal properties. Saya gathers water analytics from third-party meters and sensors to display water consumption information to its customers via their website and mobile app.

Saya wishes to extend its service by using water data to predict and prevent significant building damage from pipe leaks. To achieve this goal, Saya Life has partnered with our senior design group at Cal State LA.

They have tasked us to write software that can produce a dynamic report on Saya's website. Registered users can generate the report to see if their building is at risk of a water leak. The report will also contain other important visuals that help explain why or where a leak is occurring. The dashboard will rely on a machine learning model (such as a neural network) that predicts if a building is at risk of a leak.

In summary, our senior design group is creating a dashboard that reports if a building is at risk of a water leak by analyzing water consumption data provided by Saya Life.

AI Research and Development

Client: Abbott & Shuger
Advisor(s): Yuqing Zhu

Students: Janis Garcia, Virginia Guadalupe Gonzalez, Ulises Gutierrez, James Hy, Charlie Martinez Dominguez, Michael Perez, Dylan Paul Tomasello, Omar Tovar, Theodore Tran, Thomas Yeung

With all that we have to worry about as students, we wanted to use what we've learned in our time at Cal State LA to make the lives of university students like ourselves easier through the use of AI. We split our team into 2 teams to tackle this from different angles: a development team as well as a research team. Our main goal was to create a virtual education assistant which could help you with your classes. The development team focuses on creating an open AI that would assist students in the subject of Automata Theory, which is considered to be a complicated subject for many students. The research team focuses on researching the limitations and capabilities of LLMs.

Autonomous Path Planning for Unmanned Aerial Vehicles

Client: MathWorks
Advisor(s): Manveen Kaur

Students: Jason Alvarez, Jonathan Dang, Lara De Jesus, Abraham Diaz, Marcos Olvera, Bryan Alfonso Segovia, Prashant Tewary, Juan Tiguila Sajche, Kevin Angel Velez, Erick Vergara

Our team will start by gaining proficiency in MATLAB®, Simulink®, UAV Toolbox, and other necessary resources and background material provided to us. Next, we will configure a simulation scenario resembling a cuboid with multiple stationary obstacles, simulating an urban setting utilizing a UAV Toolbox. We will proceed to create a 3D path-planning algorithm for drone flight that ensures collision-free navigation, taking advantage of the path-planning resources designed for a single drone. To initiate this process, we will utilize the ground truth data from simulated drones. Finally, we will evaluate the algorithm's performance in a cuboid scenario environment involving multiple drone flights.

Behavioral Cognition Project

Client: Behavioral Cognition
Advisor(s): John Tran

Students: Deep Bhakta, Yizhang Cao, Iris Ha, Erick Agustin Herrera, Shant Hovagimian, Daniel Ontiveros, Jorge Pena, Arturo Rodriguez, David Santini, Izeth Torres

Currently, there are many machine learning frameworks, applications, and libraries designed to meet the challenges of natural language processing, particularly in the large language model space. While many of these are quite good at addressing some of the most challenging ML/AI problems, they are also complex and difficult to stand up and operate, a consistently prevailing theme amongst these tools.

The Behavioral Cognition team has undertaken a strategic initiative aimed at the development of a sophisticated AI/MIL toolkit that is simple to set up, operate, and grow. This initiative has culminated in the creation of a machine learning framework that centers around the so-called "batteries include" design philosophy. One of our

overarching goals is "zero-to-hero" in a matter of minutes.

A key distinguishing feature of the framework lies in its adaptability, facilitating the integration of any language learning model with ease. This flexibility empowers users to seamlessly incorporate diverse models into the toolkit, facilitating comparative analyses to identify optimal solutions tailored to their specific needs.

Beyond the basic model integration capability, the toolkit offers users extensive customization capabilities, affording control over parameters such as temperature adjustment and role allocation, among others. This empowers users to tailor the toolkit to precise specifications, ensuring alignment with their unique requirements and objectives.

Box.com/eDefender Integration

Client: Santa Barbara Public Defender's Office
Advisor(s): Jungsoo (Soo) Lim

Students: Jose Alvarado, Coby Alvarez, Leo Gallardo, Donovan Hatfield, Florian Haule, Erwin Mcnaughton, Jacqueline Molina, Dat Tien Nguyen, Luis Perez Campos, Branden Zamora

Currently, the Public Defender’s office has a content management system called eDefender, parent company Journal Technologies. The Department has transitioned to a fully paperless case management system. As the transition from paper to paperless continues, we’ve migrated all files to the cloud with Box.com. Box.com is a cloud content management tool that allows the Public Defender to be compliant with CJIS/HIPAA requirements, have available storage to store all files digitally, have a collaborative platform, workflow automation, build API’s to eDefender, and allow governance.

Overall, we have roughly 100 terabytes of data that has been migrated to the cloud as we’ve handled the digital tsunami. The tsunami has grown as of April 2023 to approximately 5-6 terabytes of electronically stored information (ESI) a month and continues to grow. The files are made up of a variety of file formats and media players. The monthly ingestion of ESI is larger than the entire yearly consumption was three years ago.

The Public Defender is leveraging Box.com to build the necessary infrastructure and support our network needs. One of the applications within Box.com we are planning to leverage is the Box Skills framework, which allows easy integration with third-party machine-learning technologies. Using this framework, we can integrate with AWS and Microsoft Video Indexer to build an automated workflow that utilizes facial recognition and transcription (similar to the LA County Public Defender project). In the previous term, automation, and integration were created for English content that was fed into the Box.com web interface. Once files are uploaded, they are transcribed/facial recognition/keyword searched and placed back in Box Skills templates. An additional transcript document is also created and uploaded to the original file’s folder. The goal for this term is to improve the transcription accuracy, transcription marking and correction abilities, implement security for production deployment, and restructure for anticipated multi-language support and translation.

GPS Performance Analysis and Visualization

Client: Aerospace Corporation
Advisor(s): Zilong Ye

Students: John Chen, Phong Diep, Matthew Franco, Roaf Htun, Steven Lopez Carachure, Andrew Mendiola, Minh Ngo, Natalie Perales, Cindy Rodriguez, Steven Yuen

The Aerospace Corporation is an American nonprofit corporation that operates a federally funded research and development center. The corporation provides technical guidance and advice on all aspects of space missions to military, civil, and commercial customers. As the FFRDC for national-security space, Aerospace works closely with organizations such as the United States Space Force and the National Reconnaissance Office (NRO) to provide "objective technical analyses and assessments for space programs that serve the national interest." Our assignment is to develop a web application to visualize a GPS performance metric called Dilution of Precision (DOP) in a web application. DOP is a geometric measure of GPS accuracy and is commonly analyzed to gauge GPS performance. The resulting data is typically viewed on top of a world map. The ultimate goal of the web application is a world map view with a DOP overlay based on the selected date from user input.

LA City Sidewalk Assessment Project

Client: LA City Bureau of Engineering
Advisor(s): Jungsoo (Soo) Lim

Students: Gregory Celestino, Jacobo Haegendoreens, John Paolo Ignacio Hernandez, Seo Yeong Lee, Michael Maciel, Ricardo Munguia, Michael Salazar, Anthony Suchil, Ying Yu

This is the sixth term of a multi-year project. In the last term, a rover has been successfully fabricated. Now, the rover is capable of 1) moving with remote control, 2) measuring crossing slopes and running slopes, 3) collecting GPS data, and 4) taking photo images. In this term, we will develop a module to measure vertical and horizontal displacement by partnering with the Mechanical Department. In addition, we will continue developing various software by focusing on the following tasks:

Task 1 – Work with ME Department to implement a module to collect vertical and horizontal displacement. The students shall implement a module to collect horizontal/vertical displacement on the sidewalk by equipping the rover with distance-measuring components. Also, the students shall develop a program to identify the severity of vertical and horizontal displacement from the sensor data.

Task 2 – Perform field tests and verify calibration of slope measurement on the current data collection process. The students shall perform extensive field tests to assess the system for field deployment preparation. Also, the students shall work with the East Los Angeles College (ELAC) Civil Engineering Department to verify the correct procedure for collecting slope measurements in the current data collection process.

Task 3 – Integrate the front-end and back-end systems with Ubiquity Magni Rover. The students shall integrate the existing front-end system providing a graphical user interface and integration with Navigate LA, and the existing back-end system with Uniquity Magni Rover.

Leveraging Digital Phenotyping to Support Patients with Visual Field Loss

Client: NIH/CSUPERB
Advisor(s): Navid Amini, Dikshant Sagar

Students: Stellina Ao, Luis Ayala-Saldivar, Edson Castellanos, Mengying Chen, John Huang, Jooeun Jeon, Cristian Moreno, Desiree Ramirez, Thang Tran, Ashley Tran

Digital phenotyping refers to using smartphone-generated data to build a picture of an individual's lifestyle and health state. This data can help highlight potential health risks. This project is looking at how digital phenotyping can be used to alert care providers and start clinical interventions for those at risk of glaucoma, potentially preventing permanent sight loss.

Machine Learning for Network-Denied Environments

Client: NSIN/ICT
Advisor(s): Chengyu Sun

Students: Sanjog Baniya, Jonathon M Dooley, Enrico Efendi, Wilson Gan, Xavier Lara, Kevin Maravillas, Howard Nguyen, Nisapat Poolkwan, Johnson Tan, Justin To, Alvin Yu

Cloud-based AI/ML solutions are powerful and up-to-date but rely on network availability to operate. This is problematic to achieve in places where these services would be greatly beneficial, such as in conflict zones, major disaster areas, and under-developed regions. Meanwhile, client-based AI/ML solutions (e.g., MobileNet) can run without a network connection but cannot be updated very easily in such environments. Machine learning In Network-Denied Environments (MINDE) is a project that aims to showcase the feasibility of a hybrid approach combining a cloud-based server and web client with a mobile client capable of working offline. In particular, MINDE focuses on the problem of automatically classifying (i.e., labeling) the central object in pictures. The mobile client enables the collection and classification of images directly from the phone's camera or from its photo library. If the automatic classification is not correct, the user is able to relabel it, potentially with a label that has never been seen before. When a network connection is available, the mobile client will upload new images to the server along with any user-supplied labels. The server and its web client allow users to retrain/fine-tune the classification model with this new data and send the new model back to the mobile client. Alternatively, when communication with the server is not possible, the mobile client will attempt to use peer-to-peer communication with another mobile client to exchange images, labels, and updated models.

MoonTrek Augmented Reality

Client: JPL
Advisor(s): Weronika Cwir, Youssef Elzein

Students: Mike De Pacina, Isabel Gonzalez, Gavin Guo, Olga Hernandez-Garcia, Simon Johansen, Sebastian Kane, Breck Miner, Karl Sia, Jacob Valenzuela, Joan Zaldivar

The computer science senior design team from California State University, Los Angeles, is partnering with Jet Propulsion Laboratory to add further functionality to MoonTrek Augmented Reality. Previously, JPL has tasked groups of seniors to create a web application that allows users to upload their own images of the Moon and accurately annotate them with multiple overlays from JPL's MoonTrek site. Last year's group accomplished this by implementing a context-aware image registration algorithm. They did this by creating a dynamic reference image from a model of the Earth, Moon, and the Sun at the time of the user's image in three.js. They then performed image registration with the user's image cropped at dimensions provided by a circle detection algorithm, as well as a context-aware reference image created by the 3D model. The team was able to successfully test their algorithm with one overlay.

The batch of 2023-2024 primary goals are:

- Build an external website that allows users to submit images with metadata for testing purposes
- Implement AWS backend to save images and user metadata in YourMoon
- Provide 9 more choices of overlay to place on the user's image
- Improve efficiency and accuracy of the image registration
- Implement infinite zoom on user's image (allow users to zoom in to their image all the way to the surface of the Moon)
- Improve UI/UX of the website

PDGo

Client: Santa Barbara Public Defender's Office
Advisor(s): Chengyu Sun

Students: Alberto Barboza, Cassidy Barron, Mina Mekhaiel, Kevin Ornelas, Fernando Perez, Elias Schablowski, Elizabeth Silvestre, Qian Wang, Yin Thuzar Win, Tommy Youn, Andrew Zou

The Santa Barbara Public Defender's Information Technology department is expanding its technology ecosystem into the work environment to enhance workflow and efficiency. PDGo is a new application that will be developed with the goal of streamlining analog processes into digital ones for increased productivity and response rates. The application itself will be a robust administrative tool that will be responsible for a multitude of functions, including but not limited to time off requests, MCLE training, facility requests, and other administrative requests. PDGo will be developed in Microsoft's Power Apps, an app creation suite that offers a low-code environment for creating custom business applications. In addition to its administrative functions, the application will retrieve

additional data on the user and dictate the different actions and access they have to this application. At the time of writing, three tiers of users are considered: Administrator, supervisor, and staff. PDGo is planned to be used alongside the Workday application to supplement services and information for the department and the organization.

RoboSub

Client: United States Office of Naval Research
Advisor(s): Richard Cross

Students: Alexandra Barahona Amador, Joshua Chavez, Kevin Chun Celis, Jordan Doose, Edward Eckle, Jason Ha, Daniel Jimenez, Dexter Kale, Sebastian Luna, Lizbeth Vargas-Martinez

The RoboSub Software Development project aims to design, develop, and implement a comprehensive software system for an Autonomous Underwater Vehicle (AUV) participating in the RoboSub competition. The software will be responsible for controlling the AUV's locomotion, navigation, sensing, and task execution. It will also provide a user interface for monitoring and controlling the AUV during the competition.

SUAS Flight Path Visualization

Client: Army Research Lab
Advisor(s): David Krum

Students: Alex Alcazar, Franciso Brito, Helen Dam, Alex Gaeta, Alberto Gonzalez, Sergio Maradiaga Olivera, Thad Owens, Mychal Salgado, Kevin Tang, Sergio Valadez Polanco

Small, uncrewed aircraft, systems, and drones can provide small military units with valuable intelligence, surveillance, and reconnaissance information. However, the flight paths of these drones must consider several factors to successfully gather the needed information while minimizing the chances of being detected. These factors may include models of the drone’s noise and visibility signatures, models of human vision and auditory perception, environmental factors, and models of drone sensors, among others.

The objective of this project is to develop, test, and deploy a 3D visualization architecture that will enable operators in small military units to plan, visualize, and modify drone flight paths over a given terrain to meet the mission success criteria of minimizing detection while effectively using sensors over an area. With the OTA (Over-The-Air) updates provided by this web-based platform, future developers will have no trouble integrating and updating sensors, human perception, drone noise, and visibility models.

Secure Module/Key Management Application

Client: QTC
Advisor(s): Huiping Guo

Students: Jorge Espana, Gabriel Espejel, Victor Liang, Andy Munoz, Anthony Ortega, Angel Ernesto Penate Jr, Alexander Raya, Jason Schmidt, Angel Serrano, Brian Tang

The purpose of this project is to develop a Secure Module/Key Management Application. The application will send and store data, which will be encrypted using different methods depending on where it is being sent. This application is meant to transfer sensitive data, and the traffic is logged in a separate database, accessed by users who don't have authorization to see that data. This application will prevent unauthorized users from seeing data at any point during the transfer.

The ArQive

Client: The ArQive
Advisor(s): John Hurley

Students: Juan Alcobas, Hak Beak, Ryan Goshorn, Melissa Hernandez, Thien Ho, Channing Jou, Raul Martinez Sanchez, Daniel Rodas, Stephanie Tan, Antonio Vazquez Bravo

The arqive, formerly known as GlobaltraQs, is a web and mobile application that allows anyone to post fun and interesting LGBTQ+ oriented stories, events, and other information that they find meaningful. Founded in 2014 by Dr. Cynthia Wang, with Zachary Vernon subsequently joining as a cosponsor. The arqive gives users a safe platform where they can share personal, historical, and community stories, as well as have access to information about safe spaces, which all serve as valuable resources to members of the LGBTQ+ community. By providing users with the ability to place pins on the map indicating where they have been and the experiences they have lived, The arQive gives people the ability to mark their place in the world and in history.

This year's project for The arqive will focus on adding additional features to the website and mobile apps and refining the appearance and performance of The arqive.

VIPER Rocks!

Client: JPL
Advisor(s): David Krum

Kevin Andrade, Diana Arteaga-Andrade, Santiago Bautista, Michael Gibson, Cristian Gomez, Nida Sheikh, Zainab Sulaiman, Diane Tabilas, Angy Xajil Ujpan, Tammy Xaypraseuth

VIPER Rocks! will be a web-based application enabling citizen scientists to become active science participants in NASA’s Volatiles Investigating Polar Exploration Rover (VIPER) lunar mission. VIPER will be the first rover to explore lunar polar terrain. Analyzing data gathered from VIPER’s navigation and science cameras, citizen

scientists will participate in the mapping and classifying of rocks (location, size, and shape) encountered by VIPER during its traverse. These observations will greatly enhance the scientific output of the VIPER mission and provide a selenological context to VIPER's prospecting activity. Resulting rock size-frequency distributions can also inform future surface-based exploration missions, illustrating hazards at smaller scales unseen in orbital-based datasets.

This project will build and test the foundations of the citizen science application for VIPER Rocks! prior to the mission launch. Interactive rock location, size, and shape classification software tools will be developed as an undergraduate senior capstone project by Cal State LA students and integrated into NASA's established Moon Trek data visualization and analysis portal. Moon Trek is part of SSTP (https://trek.nasa.gov), a suite of online data visualization platforms developed by NASA JPL. Test images will be taken in the SSERVI Lunar Regolith Testbed at NASA Ames Research Center using spare flight VIPER rover and science cameras, ensuring the test images are captured at the same viewing geometry, illumination, and spatial resolutions of the eventual VIPER flight mission images. The Citizen Science rock classification component will be tested on diverse populations of participants leveraging SSTP's role as an infrastructure project in NASA's Science Mission Directorate's SciAct Community, as well as its existing relationships with amateur astronomy clubs in the NASA Night Sky Network, the NASA Community College Network, and numerous K-12 schools. This work will provide a foundation for a future proposal to extend this experience to data gathered during the actual VIPER mission on the Moon.

Want2Remember

Client: We2Link
Advisor(s): Huiping Guo

Nicholas Barger, Davy Chi, Kevin Fong, Hein Htet, Jennifer Lizarraga, Carlos Ramirez, Adrian Soria, Zain Syed, Ivan Wang, Joanne Wu

Within the project scope, the developers are tasked with expanding the functionality of the existing mobile application and website for Want2Remember. This includes incorporating smart reminders, advanced customization options, enhanced disability support such as speech-to-text features, calendar integration, location-based services for geo-safety, and bolstered caregiver support. A key aspect of the project involves nurturing and advancing the skills of the development team, specifically in areas such as software refactoring, quality assurance, and proficiency with application development tools like Jira and GitHub. We2Link aims to not only enhance the user experience and accessibility of their app but also foster continuous growth and expertise within the development teams.