Experiences in research Summer 2022 Internship Projects

Introduction:

This booklet provides a list of all project options for Experiences in Research 2022. Applicants should read through the project descriptions to find 3 projects that seem like a good fit for their skills and interests, then specify those projects on their application. Use the table of contents below or the outline to the left of the document to jump between sections and projects.

Please do not reach out to project mentors directly, all contact will be mediated through the K-12 Program and application process.

Applicants will receive an update on the status of their application by April 25.

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Administration and Communications Projects

AD01

Communications, Experimental Research/Data Collection

Project Title: Metrics for a Successful Scientific Career

Mentors	Meg Rodriguez - Lab Directorate Justin Placencia - Lab Directorate Cami Sowers - Lab Directorate
Background	The Career Pathways Office has launched a project to track scientists and engineers' hire and promotion metrics. We would like to provide additional context on how these metrics vary by discipline and career stage.
Project Description	Interns will research common scientific metrics that are used to measure job performance. Research will include independent research through online resources, followed by interviews with Senior Scientists of different disciplines. They will put together a summary presentation to share their findings.
Prerequisite Skills	• Communication skills • Ability to use Google platform (Sheets/Slides/Docs)
Planned Weekly Meetings	• Monday: 10am - 11am • Wednesday: 9am - 9:30am: CPO Working Meeting • Thursday: 2pm - 2:30pm

AD02

Administration

Project Title: Uninspected Electrical Equipment Survey

Mentors	Ron Scholtz - Energy Technologies Area
Background	The Energy Technology Area (ETA) uses vast quantities of electrical equipment in its research and operations. Effective tracking and monitoring of this equipment is essential for the safe continuation of our work. ETA is seeking an intern to help with organizing and conducting this effort.
Project Description	Review the large list of uninspected electrical equipment assigned to Energy Technology Area (ETA) divisions and determine if the equipment is still in use or has been salvaged. The equipment list from the Electrical Equipment Inspection Program will be updated accordingly. Arrangements will be made for inspection of equipment that is still in use and not inspected or listed by a Nationally Recognized Testing Lab (NRTL). Tasks include: ● Develop a spreadsheet listing uninspected equipment. ● Contact equipment owners to determine the status of equipment. This will be through an online survey or directly by email/phone call. ● Update equipment status on spreadsheet. ● Create a list of equipment still in use that requires inspection.
Prerequisite Skills	● Experience with Excel spreadsheets ● Experience with Google forms for development of online survey
Planned Weekly Meetings	● Monday: 9am - 10am ● Thursday: 9am - 10am

AD03

Communications

Project Title: Emery Station East (ESE) Science Communications Internship - Social Media and Outreach Projects

Mentors	Sara Harmon, ESE Manager of Communications and Outreach (Biosciences) - Lead Mentor Emily Scott - ESE Public Affairs (Biosciences) - Project Lead
Background	The Communications team at ESE (one of LBNL's satellite locations in Emeryville) has a variety of social media outreach campaigns and projects in the works on which we would like to collaborate with a student intern.
Project Description	The intern will collaborate on social media campaigns throughout the internship as well as help prepare several social media assets to keep on hand in our inventory for later usage. The work could include basic video editing of videos for YouTube, graphic design of social media campaign assets, curating relevant videos and social media content for posting, teamwork, and reviewing outreach and communications documents and plans. The intern will be a valuable member of our team and will be encouraged to provide feedback and brainstorm ideas with us. The student intern can expect to receive mentorship by the senior members of the team on science communications and outreach principles as well as general professional development guidance.
Prerequisite Skills	We are seeking an individual who is interested in learning communications and public affairs skills, is passionate about environmental topics, and wants to help the general public understand scientific concepts. We prefer an intern who happens to be familiar with video editing, social media channels and tools, and/or graphic design software such as Canva. However, we are happy to teach these skills to a student who is interested in learning them.

Planned Weekly Meetings	• Monday: Weekly 15 minute check-in (can schedule based on availability)
	  ○ *Optional: Emery Station East operations meeting 10-10:30am*
	  ○ *Optional: Biosciences Communications Team Meetings 11am -11:50am (1-2 times monthly)*
	• Wednesday: ESE Communications Team Meeting - 30-60 minutes. Currently scheduled at 4pm weekly but can be rescheduled based on team member schedules

AD04

Communications

Project Title: Transforming News Releases into Social Media Friendly Content

Mentors	Laurie Chong - Energy Sciences
Background	The aim of this project is to take news releases from the Molecular Foundry (a “user facility” where researchers from other institutions can come use advanced equipment free of charge) and turn them into engaging and informative ‘short stories’ for social media. The goal is to encourage people to click to hear the full story and visit the Foundry website, where they can learn more about our science, what we offer, and learn that they can become a Foundry user.
Project Description	The intern will select a recent news release and will work on distilling it down to its key points. Next we’ll develop a visual story to accompany those points in a slideshow/carousel format. The visuals will be animated either with Visme (a web application) or Powerpoint. Finally, we’ll write captions that will accompany the posts on social media.
Prerequisite Skills	Previous work with any sort of graphics programs would be helpful but is not required.
Planned Weekly Meetings	• Monday: Check-in #1 (1 hr, scheduled when interns are available) • Thursday: Check-in #2 (1 hr, scheduled when interns are available)

AD05

Administrative

Project Title: Analysis of Molecular Foundry Impacts, 2019-2022

Mentors	Shannon Ciston - Energy Sciences
Background	The Molecular Foundry is a user facility encompassing the work of around 50 scientific and technical staff and 500-1000 visiting researchers each year. Analysis of the impacts of the nanoscale science research work is complex, and aids in demonstrating the reach of this free access model in the scientific community, while revealing areas for continued improvement.
Project Description	This internship will support the analysis of Molecular Foundry impacts data, especially as it pertains to the quadrennial program review for the period 2019-2022. Specific tasks will emphasize the analysis of research outputs such as patents, book chapters, conference presentations, dissertations, awards, invited lectures, and similar. Depending on the language of the quadrennial review document, the work could expand to include quantification or characterization of trends in user access, outreach and inclusion, instrument usage, remote access, or journal publications.
Prerequisite Skills	Interns should be skilled with mathematical concepts of sums, averages, and slopes. Interns should have a basic understanding of graphing data. Interns should be able to analyze written documents and websites to gather data. Basic experience with spreadsheets such as Excel or Google suite spreadsheets is helpful.
Planned Weekly Meetings	• Monday: 10:00am - 11:00am Weekly Planning Meeting • Wednesday: 11:00am - 12:00pm Midweek Check-In Meeting • Thursday: 10:00am - 11:00am Quadrennial Review Planning Meeting

Experiences in research

Summer 2022 Internship Projects

AD06

Communications

Project Title: Composing a tutorial video for the TEAM Electron Microscope Stage

Mentors	Peter Ercius - Energy Sciences Laurie Chong - Energy Sciences
Background	The atomic structure of materials can be directly probed with transmission electron microscopy (TEM) imaging. At the Molecular Foundry, we have an electron microscope with a special sample stage built for advanced imaging. The stage is unique in the world and thus requires special knowledge for its operation. In order to increase scientific throughput and to improve the user experience we would like to develop tutorial videos on how to use the stage in order to reduce training time for new users.
Project Description	This project will be to develop a tutorial video on the most important aspect of using this special stage: sample insertion and extraction. The staff scientist in charge of the stage (Peter Ercius) has acquired several videos of all the necessary steps in the process. He and Laurie Chong (the Molecular Foundry's Director of External Relations and an expert in scientific communications) will assist students in composing a tutorial video about the full process. The project will involve learning how to use video editing software to create a tutorial video as well as how to communicate complicated scientific tasks and information to a broader audience. The final tutorial video will be used as part of user training and as a resource for all users of this advanced electron microscope.
Prerequisite Skills	• Basic experience with using a computer. • Interest in learning to use video editing software (Canva) • Interest in scientific communications
Planned Weekly Meetings	• Monday: 1 hour check-in meeting • Thursday: 1 hour check-in meeting

AD07

Communications

Project Title: Developing and Hosting STEM Career Talks

Mentors	Jeremy Snyder - Lab Directorate Faith Dukes - Lab Directorate Alisa Bettale - Lab Directorate
Background	Berkeley Lab's K-12 STEM Education and Outreach Team develops educational programs to teach and support the next generation of scientists. Our aim is to connect Berkeley Lab experts with students around the Bay Area to excite them about the world of STEM, help them explore STEM careers, and give them the experience to pursue STEM in college and beyond. One of our programs is STEM Career Talks. These themed talks allow anyone to learn about the wide diversity of STEM professions by hearing from experts in those fields. Each session features Berkeley Lab staff, Bay Area professionals, and other guest experts to talk about their careers and how they got there. Conversations are open to the public and recorded for later viewing.
Project Description	Interns will take part in the planning and preparation of the summer 2022 series of STEM Career Talks. Interns will come up with questions to ask scientists during the career talks and take part in meetings with scientists to help prepare them for their talks. Interns will also become familiarized with Berkeley Lab's research areas in order to find and invite scientists to take part in the career talks. As the series progresses, the interns will gain more experience in hosting, culminating with them hosting and organizing the final talk of the series fully independently. The K-12 team encourages the interns to bring in their ideas on how to structure the career talks and which media platforms to use.
Prerequisite Skills	• Familiarity with the Google platform (docs, slides) • Enthusiasm for science communication, including willingness to speak in front of a public audience
Planned Weekly Meetings	• Tuesday 12pm-1pm: Team Sync-up • Thursday 3:30-4:40pm (flexible): Weekly check-in

AD08

Communications

Project Title: Communicating Climate Science to State and Local Policymakers and Community Organizations

Mentors	Jennifer Tang - Lab Directorate Jim Hawley - Lab Directorate
Background	The Office of Government and Community Relations (GCR) advances Berkeley Lab's research, institutional, and good neighbor goals and objectives by engaging and partnering with federal, state and local government officials, community leaders and neighbors, and the K-12 STEM education community. In addition to driving the success of our research and development mission objectives, GCR focuses aggressively on building deeper partnerships with diverse communities and raising the Lab's visibility and profile among our many stakeholders at the local, state, regional, and national levels.
Project Description	Interns will work with Berkeley Lab's state and local government relations team to support the communication of policy-relevant climate research to key policymakers at the state and local level, and support efforts to broaden community engagement. Opportunities and tasks include: ● Outreach to policy maker offices to build contact lists ● Attend and summarize legislative and UC Center policy briefings (virtual) ● Shadow meetings with LBNL and policy maker staff ● Meet with California Council on Science and Technology fellows to learn about their program ● Literature review on best practices for community engagement and effective outreach to young people and other diverse audiences ● Assist in organizing one community-facing lecture related to climate science; assist in identifying and organizing one community service opportunity for Lab community ● Draft recommendations for effective outreach to young people and staff
Planned Weekly Meetings	● Monday: Weekly Check-In; Time TBD ● Wednesday: Typically 11:00am - 12:00pm Occasional participation in GCR team sync-ups

Coding Projects

CD01

Coding

Project title: Evaluation of Machine Learning Frameworks on CPUs and GPUs

Mentors	Doru Thom Popovici - Computing Sciences Area
Background	The goal of the project is to evaluate different Machine Learning (ML) frameworks for one or two ML algorithms. The rising interest in machine learning has sparked the development of myriad frameworks to help scientists be more productive. For example, Python is a widely used programming language, and frameworks for it like TensorFlow, PyTorch, JAX, TVM and more have appeared. All these frameworks allow users to express their machine learning algorithms and run them on different platforms from CPUs to GPUs to TPUs. However, each framework comes with benefits and drawbacks, and not all provide good performance.
Project Description	The goal of the project is to implement some code (e.g. a neural network) in the different frameworks and execute them on different systems. Learning about CPUs, GPUs and TPUs, one can try to understand where these frameworks go wrong and perform poorly. In addition, this will provide the opportunity to learn about software relevant to applying for future internships or even during undergrad and beyond. This project connects to my research on offering efficient implementations of machine learning and scientific applications for various users. We let the user write the code in Python using one of the above infrastructures, then make that application run quickly. Understanding where other frameworks fall short can give us an edge and provide an infrastructure that has a significant impact on the community. Interns will learn: • Working with Python and some of the above-mentioned frameworks • Basic understanding of some ML algorithms • Understand how to run experiments and gather data • Analyze results and reason about them
Prerequisite Skills	• Programming • Basic knowledge of linear algebra: what are matrices, matrix additions, matrix scaling, matrix-vector multiplication, matrix-matrix multiplication • Enthusiasm and eagerness to get hands dirty and code
Planned Weekly Meetings	• Monday: 10am – 10:30am: Check-in; 10:30am – 1:30pm: Task discussion for upcoming week – small presentations on different aspects like neural networks, hardware, python, and python-based frameworks – guided as a tutorial. • Wednesday: 10am - 10:30am: Check-in • Thursday: 10am - 10:30am: Check-in • Friday: 11am - 12pm: Group meeting

Experiences in research

Summer 2022 Internship Projects

CD02

Coding, Experimental Research

Project Title: Chemistry with Quantum Computer Simulators

Mentors	Wibe Albert de Jong (Senior Scientist, Computing Sciences Area) Niladri Gomes (Postdoc, Computing Sciences Area) Lindsay Bassman (Postdoc, Computing Sciences Area)
Background	Quantum computers have the potential to revolutionize computing and scientific discovery. Our team has been developing methods, algorithms and software tools to enable us to run simulations and get reliable results on the currently available noisy quantum computers.
Project Description	The main goal of the project is to use Qiskit, the AIDE-QC software stack, the publicly accessible IBM Q quantum computers, and Qiskit simulators to calculate the properties of small molecules. Comparing the simulator and noisy quantum computer results, we will assess the effect that quantum noise has on the outcome of calculations. The intern will develop small codes in Python that can be run locally on a laptop, on a workstation they will get access to, or on a publicly accessible quantum computer provided by IBM Q.
Prerequisite Skills	● Basic Python skills will be important. ● Familiarity with vectors, matrix-vector multiplication, vector-vector multiplication, and possibly solving systems of linear equations with matrices. ● Basic introduction to quantum computing (can be completed before start of internship), examples include: ○ IBM Quantum and Qubit by Qubit's programs: https://www.qubitbyqubit.org/programs ○ QuBES course from qBraid: https://account.qbraid.com/courses
Planned weekly meetings	● Monday: 3pm - 4pm: Every other week ACSD Group Meetings ● Wednesday: 10am - 10:30am: Quantum project progress meeting ● Thursday: 10am - 11am: Quantum team meeting ● Friday: 9:30am - 10am: Quick check-in with project team

CD03

Coding, Experimental Research

Project Title: Software Tools to Assist Researchers

Mentors	Kenny Higa (Energy Technologies Area)
Background	My work, primarily concerning battery engineering, has both experimental and computational aspects. Recently, this has included building experimental setups to study manufacturing processes, as well as software to simulate battery operation.
Project Description	Possible projects include development of software tools (such as schedulers) to assist in laboratory management, or experimenting with packaging of some of our open source software projects. Project specifics will be determined according to students' backgrounds and interests.
Prerequisite Skills	• Some coding experience is required, JavaScript or Python experience would be most relevant. • Familiarity with Linux would be helpful.
Planned weekly meetings	Schedule on all days will be negotiated with students.

CD04

Coding, Experimental Research

Project Title: Developing a User Interface for a Numerical Simulation Code

Mentors	Lead Mentor: LianGe Zheng - Earth & Environmental Sciences Area Support member: Sangcheol Yoon - Earth & Environmental Sciences Area
Background	In the Energy Geosciences Division, we have been using computation codes to conduct numerical simulations for underground processes. These codes are powerful, well-tested and extensively used. However, the core function of the codes was initially designed 40 years ago and they usually have an unfriendly interface. For example, the input files, usually a collection of parameters, are in text format and it is difficult for new users to locate the specific parameters and make changes when needed.
Project Description	In this internship project, we will develop a user-friendly interface so that new users can easily edit the parameters in the input files and execute the code.
Prerequisite Skills	• Coding with any language that can be used to develop the interface • Familiarity with using a PC operating system is a plus
Planned weekly meetings	Monday: 9am - 10pm weekly check-in

CD05

Coding, Experimental Research

Project Title: Visualization of Network Flow Data

Mentors	Lead Mentor: Jeremy Randolph (Energy Sciences Network)
Background	Network flow data is information periodically sampled and captured from different routers/interfaces in the ESNet network. Data points such as number of packets, who is the receiver, who is the sender, geographic location of the sender and receiver, and protocol versions are captured. Currently, flow data is viewed in the form of graphs on the visualization and analytics platform Grafana.
Project Description	Interns will create new methods of visualization that can tell the stories of network flow data within ESNet. The exact form of these visualizations is fairly open-ended; They can be Grafana plugins, javascript programs, gifs generated via code, or something else that interests the intern.
Prerequisite Skills	• Experience with coding. • Specific experience with javascript, python, or golang would be a plus.
Planned weekly meetings	• Monday: 10:30 to 11:00am: Team standup, 11:00 to 11:30am: Individual Check In • Wednesday (Every other week): 10:30 to 11:00am: Team standup, 11:00 to 11:30am: Individual Check In • Thursday: 10:30 to 11:00am: Team standup, 11:00 to 11:30am: Individual Check In

CD06

Coding, Administrative

Project Title: Workflow Automation to Support Green Industries & Technologies

Mentors	James Gardner - Biosciences Area Leah Sloan - Biosciences Area
Background	The Advanced Biofuels and Bioproducts Process Development Unit (ABPDU) works with industry, academic, and federal partners to scale up new technologies, support bioproduct commercialization, and hence help decarbonize the economy. The ABPDU interacts with many groups and has been key for over 65 companies collectively raising over a billion dollars in private finance, based on the crucial development support the team has offered for the companies' bioproducts. Automating steps of onboarding and project management makes collaboration more efficient so that we can support more companies & programs and reduce the cost of managing the work.
Project Description	Interns will build on the work of past interns and receive their mentorship to prototype, code, and automate business workflows by developing integrations with SmartSheet.com, Zapier.com, Google apps, Google cloud, and Python. The interns' main goal is to improve the onboarding of industry partners and project monitoring.
Prerequisite Skills	Familiarity with coding, use of spreadsheets, and working in a team.
Planned weekly meetings	Schedule on all days will be negotiated with students.

Data Science Projects

DS01

Data Science, Experimental Research

Project Title: Building an Application for Visualizing High-Throughput Transmission Electron Microscopy Data

Mentors	Alex Lin - Energy Sciences Peter Ercius - Energy Sciences
Background	The atomic structure of materials can be directly probed with transmission electron microscopy (TEM) imaging. While TEM imaging can provide detailed images of individual atoms, these images can only sample areas spanning tens of nanometers, which are well below the sizes of many materials and specimens that we are interested in understanding. To tackle this challenge, we have developed an automated method that can collect hundreds of images from a large defined area. This High-throughput TEM imaging typically generates large datasets in the HDF5 file format, which stores datasets in a hierarchical structure. The internal structure of a HDF5 file is similar to a collection of folders, subfolders, and files on a computer hard drive. Another important function of the HDF5 format is that we can attach metadata (information about the experimental parameters like time of acquisition) to every image in the structure, enabling us to generate files with all necessary information that can be efficiently shared with other scientists.
Project Description	The aim of this project is to use Python to understand how HDF5 files containing high-throughput TEM datasets are organized, and build an interactive application that can be used to visualize the contents of the datasets. Interns will learn how to use Jupyter notebooks in python to extract the relevant image datasets and associated metadata such as image locations, microscope parameters, and imaging pipelines. Then, they will be able to use their knowledge to build an application designed to display that information in an interactive graphical user interface using the Voila framework. This application will help simplify the process for microscope users to analyze and visualize their data.
Prerequisite Skills	• Basic experience with coding and Python • Interest in learning data analysis/visualization
Planned Weekly Meetings	• Monday: 1 hour check-in meeting • Thursday: 1 hour check-in meeting

DS02

Data Science

Project Title: Software Tools for Error Analysis of Protein Structures

Mentors	Asmit Bhowmick - Biosciences Jan Kern - Biosciences Junko Yano - Biosciences
Background	Proteins are biological molecules that are critical for many of the basic cellular functions in animals, plants etc. The molecules are typically made of several hundred repeating units of amino acids. Because proteins are extremely small in size (<10nm in diameter), their 3d structures are obtained using specialized techniques (like X-ray diffraction) and at this length scale have some error in the position of its atoms. We use software developed at Berkeley Lab (END/RAPID) to quantify these uncertainties. The software generates 100 modified structures by randomly modifying our measurements within the bounds of the experimental error. The final error estimates are determined by taking statistics over all the 100 structures. In this project we are looking to develop some python code to plot the results from these 100 trials in a convenient way and do further statistical analysis of these trials. We plan to use the data collected for the protein Photosystem II (PSII) that is responsible for producing all the oxygen that sustains life on Earth. The tasks in this project will help our team further improve the error analysis program leading to better imaging of this protein and consequently better understanding of how this protein functions.
Project Description	The main goal of the project is to write python code to help with analyzing and plotting the results of our error analysis program. We expect roughly the following tasks the intern will do: (a) Get familiarized with the input files, terminology and python libraries needed (matplotlib/numpy) (b) Write python code that will analyze the results from the END/RAPID analysis including code to read in the files from the trials and then plot the results (c) Time permitting, the intern can work on implementing simple statistical tools to better analyze the trials and compare the results across multiple states of the protein. We will provide guidance/training in Python coding where needed.
Prerequisite Skills	• Basic coding experience with Python preferred. • Good mathematical skills will help in making progress.
Planned Weekly Meetings	• Monday: 9-10am Check-In Meeting • Thursday: 9-10am Check-In Meeting

Experimental Research Projects

EX01

Experimental Research, Coding

Project Title: Probing the Morphology of Ion-Conducting Polymers Using Resonant X-Ray Scattering

Mentors	Sintu Rongpipi – Advanced Light Source Gregory Su – Advanced Light Source and Materials Science Division Ahmet Kusoglu - Energy Storage & Distributed Resources Divisions Ashley Bird - Energy Storage & Distributed Resources Divisions
Background	Ion-conducting polymers (ionomers) are used in energy conversion devices such as fuel cells. The nano-scale morphology, or arrangement of molecules, of ionomers plays an important role in their properties and performance. Very often, the morphologies of these ionomers are probed using X-ray scattering techniques. Resonant X-ray scattering (RXS) is an advanced X-ray scattering technique that provides structural information based on the distribution of elements in the sample. RXS of ionomers will help develop structure-property relationships in ionomers which are otherwise not possible through conventional X-ray scattering.
Project Description	The main goal of the project is to extract structural information from ionomers based on the distribution of specific elements in the sample. The expected outcome of the project is that RXS of ionomers will provide additional structural information when compared to conventional X-ray scattering. The intern is expected to complete the following tasks: ● Create 1D scattering data from 2D scattering images using python or ● dedicated scattering software packages ● Compare RXS and conventional X-ray scattering data from ionomers ● Summarize comparisons in the form of plots/charts or tabular forms
Prerequisite Skills	● Familiarity with data presentation and visualization in plots/charts ● Basic experience with coding (Python/Matlab/Mathematica) is preferred but not necessary
Planned weekly meetings	● Monday: 10am - 11:30am Team meeting ● Wednesday: 11:30am - 12:00pm Work update meeting

Experiences in research

Summer 2022 Internship Projects

EX02

Experimental Research, Data Science

Project Title: Ion Beam Spatial Uniformity Measurement

Mentors	Larry Phair - Physical Sciences Area Brien Ninemire - Physical Sciences Area Nicholas Brickner - Physical Sciences Area Alexander Donoghue - Physical Sciences Area
Background	The 88-Inch Cyclotron at Lawrence Berkeley National Laboratory is a cyclotron with both light- and heavy-ion capabilities that supports a local research program in nuclear science. It is also the home of the Berkeley Accelerator Space Effects Facility, which can simulate the space environment and constitutes an essential tool to develop radiation-hardened circuits and design techniques to avoid very costly loss of equipment from the aerospace industry. A Faraday Cup style detector is being developed to measure beam uniformity at the 88-Inch Cyclotron. When completed the detector system will be used as a tuning aid and for uniformity measurements for beams at the 88-Inch Cyclotron. Experimental data was collected with two different sized detecting elements in the detector system. This data needs to be analyzed to determine the final size of the elements in the detector system.
Project Description	The intern will perform the following tasks: ● Understand operation of a Faraday Cup detector ● Understand operation of a digital electrometer ● Analyze the collected data to determine relation between integrated current and detector element size ● Determine size of detector system based on analyzed data, balancing collected current and max number of collecting elements ● Produce drawing of frontal area of detector system with selected size of detector elements ● Present findings of work
Prerequisite Skills	● Proficient in Python ● Capable of understanding scientific principles. ● Good interpersonal, communication, and organizational skills. ● Ability to understand instructions regarding scientific procedures and then carry out those instructions with close supervision. ● Able to apply systematic and critical assessment of complex problems.
Planned weekly meetings	● Monday, Wednesday, Thursday, Friday: 9:00am - 9:30am Check-In ● Thursday: 1:00pm - 2:30pm Review current work and plan future work

EX03

Experimental Research, Data Science

Project Title: How Do We Use Energy in Our homes?

Mentor	Scott Young - Energy Technologies Area Revati Deshpande - Energy Technologies Area
Background	There are several sources of publicly available data on residential energy consumption in the U.S. Our department uses this data for many purposes. We have a number of research questions that can be used to focus the work by interns, such as: ● Which parts of the country use the most energy? The least? ● Who has bigger refrigerators, Californians or Texans?
Project Description	The goals of this project will be: 1. Learn how to access US residential energy consumption data 2. Develop research question(s) for the data 3. Answer those research question(s) with the data
Prerequisite Skills	● Excel, Google Sheets, or another program to access data in a simple way ● General understanding of mathematical concepts like averages
Planned weekly meetings	● Tuesday: 1:00pm - 2:00pm Check-In ● Thursday: 11:00am - 12:00pm Check-In

EX04

Experimental Research, Coding

Project Title: Modeling the Solvation Environment of Ions

Mentors	Yang Ha – Advanced Light Source Jinghua Guo – Advanced Light Source Wanli Yang - Advanced Light Source
Background	The goal of the project is to use computational chemistry software to study the behavior of ions in different solutions. This will bring insights in understanding drug delivery in our bodies, or ion migrations in batteries.
Project Description	For the first two weeks, interns will be taught to build initial chemical models, feed the input file to the computer, and visualize the output files. They will then build a series of models with different initial guesses, and run the calculations on their own. We will help them out if they encounter difficulty, and will analyze the output results together. Interns are also encouraged to apply the same methods on the systems they are interested in. System can be as simple as sodium chloride or calcium chloride in water, or ions in battery electrolytes. The expected outcome will be a comprehensive report on what we learned from this research. Depending on the quality of the outputs, we can incorporate the results into our manuscripts for journal publications.
Prerequisite Skills	• Basic skills with computers • Basic knowledge in chemistry and physics
Planned weekly meetings	• Monday: Weekly check-ins and training sessions on software. The schedule can be flexible.

EX05

Experimental Research, Coding

Project Title: Developing an Optical Sensor System to Control Automatic Windshield Wipers

Mentors	Siyun Chen – Physical Sciences Area Lauren Cooper - Physical Sciences Area Affiliate
Background	In our research, we often encounter complex opto-mechanical systems that rely on optical signals to provide feedback to mechanical control. Many of these systems require complicated algorithms to communicate between the detector and feedback system. However, similar types of problems occur in everyday life, and as such, these complicated algorithms can be simplified to accomplish analogous tasks. In this project, we will be using such algorithms to control windshield wipers on a car by sending, receiving, and interpreting optical signals interfered by rain droplets. The goal of the project will be to develop code that improves the efficiency of this simple system and form intuitions and ideas that will pave the way towards developing algorithms for more complex opto-mechanical systems.
Project Description	Interns will design and code a program that controls the speed of windshield wipers based on an optical sensor that detects how much rain is on the windshield. Students will need to assemble an optical detection system with input and output using materials that will be sent to their home. Interns will also develop algorithms for controlling the optical source, detector and output signals.
Prerequisite Skills	• Basic experience with C++ or Python coding • Basic circuit knowledge such as series/parallel circuits, diodes and LEDs
Planned weekly meetings	• Monday: 10 am - 11am Weekly Project Discussion

EX06

Experimental Research

Project Title: Resiliency of Underground Water Supply Systems

Mentors	Kenichi Soga - Earth and Environmental Sciences Area / UC Berkeley Civil and Environmental Engineering Shakhzod Takhirov, Llyr Griffith, John Kochan, Philip Wong - UC Berkeley Civil and Environmental Engineering
Background	UC Berkeley and the East Bay Municipal Utility District (EBMUD) are partners for the Center for Smart Infrastructure (CSI). CSI is a new research center that will apply the latest technology to address infrastructure challenges that local East Bay communities face due to climate change, natural hazards, and aging systems. One of the first projects of CSI is to investigate the engineering performance of pipelines when an earthquake happens. We will conduct a series of mechanical loading tests on pipeline specimens. Various innovative sensors will be used to measure the deformation of tested pipes and one of them uses fiber optic cable as sensors.
Project Description	For this project, our team is testing the best procedure for gluing fiber-optic sensing cables to coupons (small metal pieces to test welding on). We have conducted tests on 6 coupons to measure strain, which is the amount of deformation a material has when forces are applied to it. Each coupon was instrumented with conventional strain gauges, which measure strain. In addition, an innovative fiber-optic sensing technology was used to monitor the strain. A few different procedures were used for gluing the fiber-optic cables to the coupons. Interns will evaluate the best procedure for gluing the fiber-optic strain gauges (a device that uses fiber optical technology to measure the strain on an object) to polished coupons machined from ductile iron. Interns will compare the results obtained from the fiber-optic sensors to those obtained from the conventional strain gauges and develop a recommendation on the best procedure of gluing to use. A short research report is expected at the completion of the project.
Prerequisite Skills	Basic experience with coding using Matlab, such as opening text files and making plots based on the data taken from the text files.
Planned weekly meetings	• 1 to 2 check-in meetings per week