Projects Day 2014

Celebrating 51 Years of Excellence:
1963–2014

Tuesday, May 6
10:30 a.m. – 6 p.m.

HARVEY MUDD COLLEGE

Projects Day is dedicated to
Jack Alford and Mack Gilkeson
for their foresight and
wisdom in the creation of the
Harvey Mudd College Clinic Program

44th Annual
Projects Day

The Computer Science, Engineering, Global, Mathematics, and Physics Clinics of Harvey Mudd College are pleased to present the work of our students.

Geoff Kuenning, Director
Computer Science Clinic

Erik Spjut, Director
Engineering Clinic

Qimin Yang, Associate Director
Engineering Clinic

Patrick Little, Acting Director
Global Clinic

Susan Martonosi, Director
Mathematics Clinic

Richard Haskell, Director
Physics Clinic

Harvey Mudd College
PROJECTS DAY
May 6, 2014

Program

10:30 a.m	Registration and Poster Viewing	Platt Campus Center
1:00 p.m.	General Session	Shanahan Center 1430

Welcome - Maria Klawe, President

Remarks - Richard Haskell, Director, Physics Clinic

Milestone Awards - Jeffrey Groves, Dean of the Faculty
Recipients:
Intel Corporation
Lockheed Martin

1:30 - 3:00 p.m.	Project Presentations	See Schedule
3:00 - 3:30 p.m.	Break	Shanahan Center: 1st Floor North Terrace & Thomas Garrett Plaza
3:30 - 5:00 p.m.	Project Presentations	See Schedule
5:15 - 6:00 p.m.	Poster Reception Guests, Faculty, and Students	Platt Campus Center

Schedule of Presentations

Project	Time						Location
	1:30	2:00	2:30	3:30	4:00	4:30	SHAN
COMPUTER SCIENCE CLINIC							
The Aerospace Corporation	X		X			X	3425
Augmented Reality Application with Enterprise Data Objects							
Apatite to Zircon, Inc.	X			X	X		2425
Automated Fission Track and Etch Pit Characterization in Apatite Crystals							
Blackberry	X	X			X		B-460
Collaborative Applications and Developer Tools							
Expedia, Inc.	X				X	X	3465
Travel Search Through Images							
HMC Online		X		X	X		3425
MuddX: Teacher-Mediated MOOCs from Harvey Mudd College							
Intel Corporation		X		X	X		2407
Intel Haswell: Improving Parallel GC Performance							
MITRE Corporation		X			X	X	1430
Content Based Image Retrieval							
Proofpoint, Inc.		X	X	X			3465
Highly Protective Email Client							
QUALCOMM Incorporated	X	X		X			B-450
Application-Layer DASH Client							
Rubicon Project			X		X	X	B-450
Respectful Cross-Device Conversion Attribution							
VMware, Inc.	X		X			X	2407
Interactively Visualizing VM Performance Data							
COMPUTER SCIENCE/ MATHEMATICS CLINIC							
Intel Corporation	X			X		X	3461
Data Visualization for Software Developers							
Lawrence Berkeley National Laboratory	X	X				X	2465
Cluster-Based Graph Algorithms for Biological Ontologies							
NationBuilder	X		X		X		1480
Predictive Behavior Modeling for Community Organizing							
Walt Disney Animation Studios		X	X		X		3461
Analysis and Visualization of Tool Usage in Animated Film Production							

Building Codes:
SHAN = Shanahan Center for Teaching and Learning Building

Note: The "B" in room numbers indicates "Basement Level."

Project	Time						Location
	1:30	2:00	2:30	3:30	4:00	4:30	SHAN
COMPUTER SCIENCE/PHYSICS CLINIC							
Lockheed Martin *Algorithms for Mapping Optimization Problems onto an Adiabatic Quantum Computer*	X			X	X		3460
ENGINEERING CLINIC							
Alfred E. Mann Foundation *MEMS Piezoelectric Actuator Drive Circuit*	X				X	X	2450
Amazon.com *Design and Implementation of a Robotic Test Apparatus for Kindle Fire Devices*	X		X	X			1430
Autodesk, Inc. *Maintaining the Cleanliness of Potable Water in Developing Nations*	X	X	X				B-442
Bio-Rad Laboratories, Inc. *Gel Electrophoresis and Imaging System*			X		X	X	2460
CareFusion *Low-Cost, High-Performance IV Infusion Delivery System*	X			X		X	2440
City of Hope *Design of a Novel Surgical Device for Minimally Invasive Brain Tumor Removal*	X		X	X			2475
City of Hope *Counting and Tracking Surgical Instruments in a Hospital Operating Room*		X			X	X	2475
Dart NeuroScience, LLC *Analysis and Redesign of Interactive Test Setup for Primates*	X		X		X		3421
Dave Larky *Mine the Brine*		X	X		X		2440
DIRECTV, Inc. *Android-Based Handheld Remote Control*	X	X	X				2454
Eaton Aerospace *Direct Drive Servo Valve*	X		X		X		3485
eSolar *Heliostat Wind Effect Instrumentation*	X	X			X		2461
Intel Corporation *Capturing User Experiences and Making Sense of the Data*	X	X		X			2460
Los Alamos National Laboratory *Data Center Utility Cost Management*			X	X		X	2461
MetCel, LLC *Re-Engineering a Semi-Truck Van Trailer for Increased Weight Capacity*		X		X		X	3485
Power Generation Solutions *Waste Heat Recovery Sterling Engine*	X	X			X		B-480
Project A Cappella *Characterization of Acoustic Noise Generated by Capacitors on Printed Circuit Boards*		X		X		X	1480

Project	Time						Location
	1:30	2:00	2:30	3:30	4:00	4:30	SHAN
Rambus, Inc.		X	X			X	2425
USB 3.0 to Multi-Protocol Interface Adapter							
SpectraSensors, Inc.		X		X		X	3421
Software Development of a Partial Least Squares Regression Analysis Program for Chemical Engineering Applications							
Technicolor			X	X		X	B-480
3D Audio Mixing Interface Design							
Teledyne Controls				X	X	X	2454
ARINC 830 Aircraft-Ground Communication System							
ENGINEERING/PHYSICS CLINIC							
Lawrence Livermore National Laboratory		X	X			X	3460
Efficient Calibration and Characterization of Segmented Antineutrino Detectors							
Sandia National Laboratories	X	X				X	3481
Studying Ferroelectricity in Barium Titanate Nanoparticles							
Sandia National Laboratories			X	X	X		3481
Verification and Validation of Computational Models for Enclosure Radiation							
GLOBAL CLINIC							
Intel Corporation in Collaboration with National University of Singapore (NUS)			X	X		X	B-460
Computer Vision for Parallel JavaScript							
MATHEMATICS CLINIC							
Palo Alto Research Center (PARC)			X	X	X		2465
Intelligent Workflow Diagnostics							

2013/2014 Clinic Sponsors

Computer Science
The Aerospace Corporation
Apatite to Zircon, Inc.
Blackberry
Expedia, Inc.
HMC Online
Intel Corporation
MITRE Corporation
Proofpoint, Inc.
QUALCOMM
Rubicon Project
VMware, Inc.

Computer Science/Mathematics
Intel Corporation
Lawrence Berkeley National Laboratory
NationBuilder
Walt Disney Animated Studios

Computer Science/Physics
Lockheed Martin

Engineering
Alfred E. Mann Foundation
Amazon.com
Autodesk, Inc.
Bio-Rad Laboratories
CareFusion
City of Hope (2)
Dart NeuroScience, LLC
Dave Larky
DIRECTV, Inc.
Eaton Aerospace
eSolar
Intel Corporation
Los Alamos National Laboratory (LANL)
MetCel, LLC
Power Generation Solutions (PGS)
Project A Cappella
Rambus, Inc.
SpectraSensors
Technicolor
Teledyne Controls

Engineering/Physics
Lawrence Livermore National Laboratory (LLNL)
Sandia National Laboratories (2)

Global Clinic
Intel Corporation in Collaboration with National University of Singapore (NUS)

Mathematics
Palo Alto Research Center (PARC)

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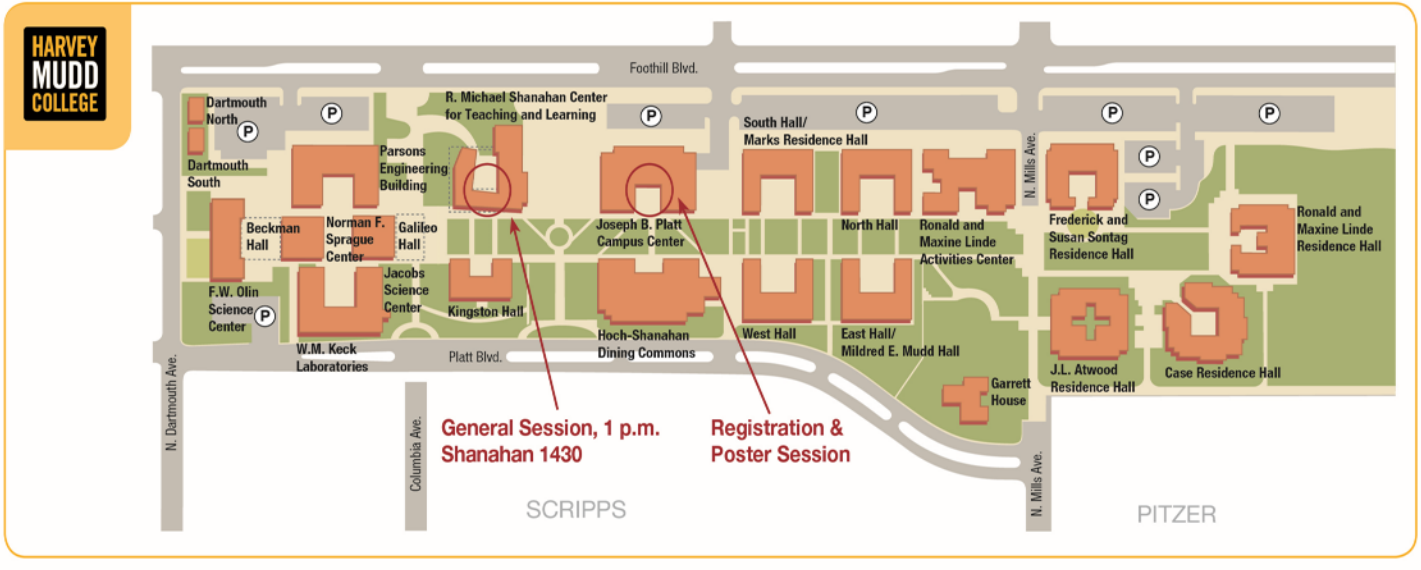
Susan Martonosi, *Director, Mathematics Clinic*
Richard Haskell, *Director, Physics Clinic*

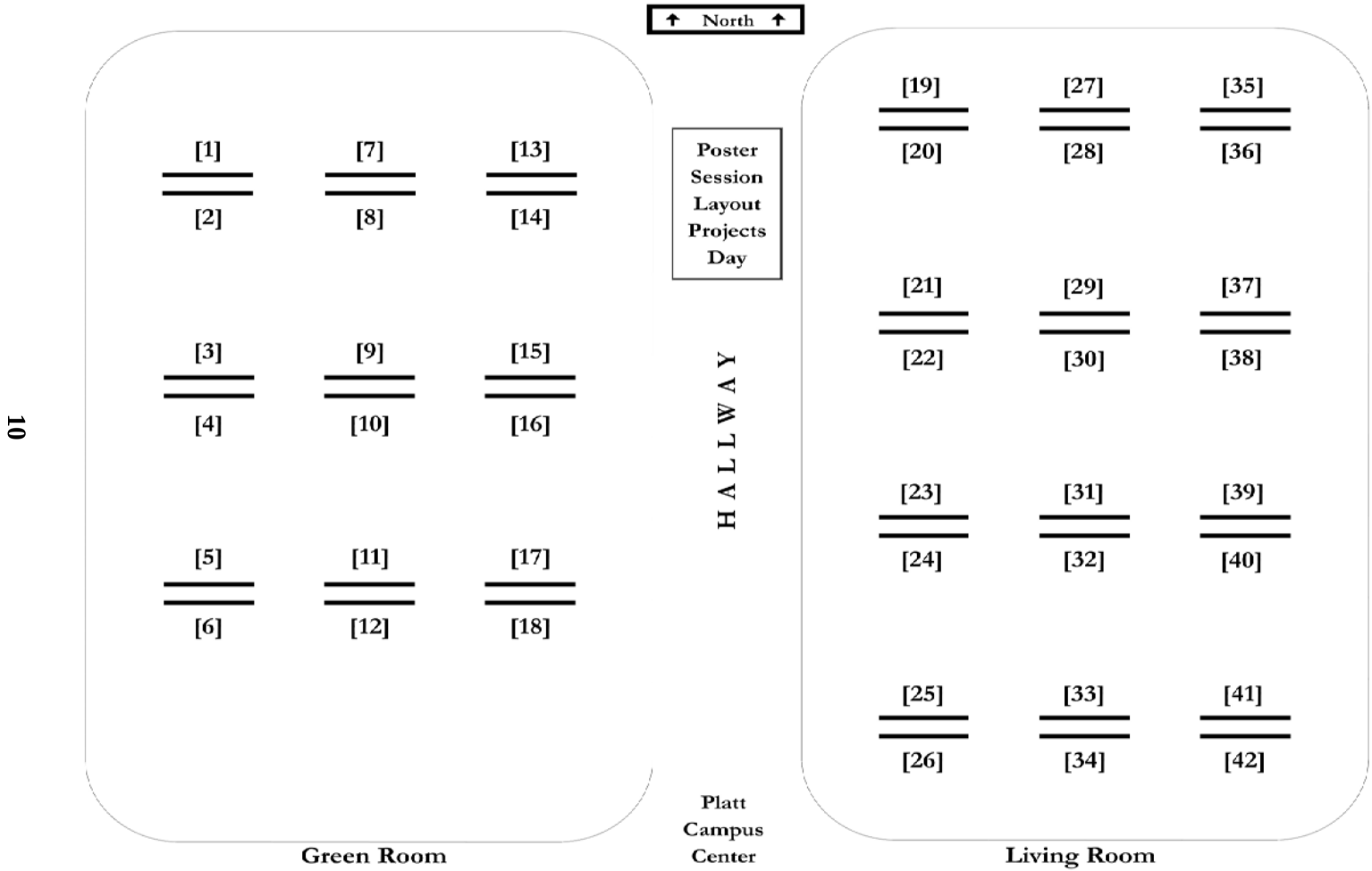
Personalized Projects Day Schedule

Please fill in the empty slots below with the presentations you would like to attend.

Time	Event	Location
10:30 a.m.	**Registration and Poster Viewing**	Platt Campus Center
1:00 p.m.	**General Session**	Shanahan Center 1430
1:30 p.m.		
2:00 p.m.		
2:30 p.m.		
3:00 p.m. - 3:30 p.m.	**Break**	Shanahan Center Thomas Garrett Plaza
3:30 p.m.		
4:00 p.m.		
4:30 p.m.		
5:15 p.m. - 6:00 p.m.	**Poster Reception**	Platt Campus Center



Ⓟ HMC Community Parking Only | Public parking is available on Foothill Boulevard and also on Platt Boulevard.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Poster Session Layout Projects Day
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Green Room
Platt Campus Center
Living Room

Key to Poster Session Layout

1. The Aerospace Corporation
2. Alfred E. Mann Foundation
3. Amazon.com
4. Apatite to Zircon, Inc.
5. Autodesk, Inc.
6. Bio-Rad Laboratories
7. Blackberry
8. CareFusion
9. City Of Hope– Cell Delivery
10. City Of Hope– Tracking
11. Dart NeuroScience, LLC
12. Dave Larky
13. DIRECTV, Inc.
14. Eaton Aerospace
15. eSolar
16. Expedia, Inc.
17. HMC Online
18. Intel Corporation (ENG)
19. Intel Corporation (CS)
20. Intel Corporation (CS/MATH)
21. Intel Corporation (GLOBAL)
22. Lawrence Berkeley National Laboratory
23. Lawrence Livermore National Laboratory
24. Lockheed Martin
25. Los Alamos National Laboratory
26. MetCel, LLC
27. MITRE Corporation
28. NationBuilder
29. Palo Alto Research Center
30. Power Generation Solutions
31. Project A Cappella
32. Proofpoint, Inc.
33. QUALCOMM
34. Rambus, Inc.
35. Rubicon Project
36. Sandia National Laboratories-FerroElectric
37. Sandia National Laboratories-RHT
38. SpectraSensors
39. Technicolor
40. Teledyne Controls
41. VMware, Inc.
42. Walt Disney Animation Studios

COMPUTER SCIENCE CLINIC

The Aerospace Corporation

Augmented Reality Application with Enterprise Data Objects

Liaisons: Joe Betser, Matthew Presley '89, Julia Yefimenko, Carl Yu '01
Advisor: Mike Erlinger
Students: Sean Adler, Alejandro Frias, Vivian Wehner (PM)

The Aerospace Corporation developed the Enterprise Data Objects (EDO) system to efficiently compose information from multiple data services. Pairing a mobile augmented reality application with EDO-backed web services proves useful in understanding situations reliant on geospatial data. We created an application backed by this data, which provides an intuitive way for users to understand their surroundings.

Apatite to Zircon, Inc.

Automated Fission Track and Etch Pit Characterization in Apatite Crystals

Liaison: Dr. Ray Donelick
Advisor: Zachary Dodds
Students: Lena Reed (PM), Ravi Kumar, Buike Ndefo-Dahl, Kevin Vigue

Our project seeks to design and implement algorithms for identifying features within microscopic images of apatite crystals. We built on the work of two previous clinics and refined their techniques to better identify etch pits and fission tracks — two features of interest found within apatite crystals. To this end, we utilized C++ and OpenCV to create modular tools employing pattern matching and custom algorithms. Additionally, we created a LabVIEW interface that fits our tools to our sponsor's workflow.

Blackberry

Collaborative Applications and Developer Tools

Liaisons: Johan Larsby, Cassidy Gentle, Sean McVeigh, Eduardo Pelegri-Llopart (F)
Advisor: Ben Wiedermann
Students: Prachie Banthia (PM), Seo Park, Younji Jeong, Alistair Dobke

Our liaisons at BlackBerry are interested in the BlackBerry experience for developers building collaborative applications for users in close proximity to one another. To this end, we are building collaborative applications ourselves. Further, we are building a cloud-based data structure to enable developers to more easily create these kinds of applications. We plan to open-source and publish our applications on BlackBerry World and release the data structure as a package to other BlackBerry developers.

Expedia, Inc.

Travel Search Through Images

Liaisons: Troy Seeborn, George Hatoun, Prashanth Kotte Prakasam, Suvendu Dash, Brian Gill
Advisor: Daniel Zimmerman
Students: Alana Shine, Jake Low, Haley Erickson, Jessica Schroeder (PM)

The Expedia team has created a vacation search Web application that allows customers to search for destinations implicitly by selecting evocative images. The application presents images in an iterative selection process, culminating in a ranked list of vacation recommendations. Vacation recommendations are derived from the attributes encoded in the customer selected image set, including geography, climate, activities, and themes. The application matches these attributes to actual vacation destinations using data derived from traveler review text analysis.

HMC Online

MuddX: Teacher-Mediated MOOCs from Harvey Mudd College

Liaison: Elizabeth Schofield '13
Advisor: Mike Erlinger
Students: Thomas Ashmore, Sorathan (Tum) Chaturapruek, Corinne Druhan (PM), Bridgette Eichelberger

Soaring higher education tuition catalyzed the development of MOOCs (Massively Open Online Courses). The HMC Online clinic team created an online platform, MuddX, to host two such courses. MyCS teaches Computer Science to middle school teachers, so they can introduce CS concepts into their classrooms. The other, How Stuff Moves, is based on Mudd's Physics 24. Our team will discuss our platform, the courses, and the plethora of challenges we (and all MOOCs) encounter.

Intel Corporation

Intel Haswell: Improving Parallel GC Performance

Liaisons: Todd Anderson, Neal Glew, Youfeng Wu
Advisor: Melissa O'Neill
Students: Joe Agajanian, Claire Murphy, Will Newbury, John Sarracino (PM)

Intel recently released the Haswell processor architecture. Haswell provides many new features, one of which is hardware support for a parallel execution model called transactional memory. In principle, hardware transactional memory can significantly improve the performance of parallel code. Our goal was to show performance gains in practice by improving the performance of garbage collection, a core technology at the heart of many computer systems.

MITRE Corporation

Content Based Image Retrieval

Liaisons: Nicholas M. Orlans, Mikel D. Rodriguez
Advisor: Zachary Dodds
Students: Aric Hunter (PM), Marissa Novak, Byron Callan, Neal Kemp

With the increase in tattoos over the past few decades, the biometrics team at MITRE is interested in developing reference software for tattoo recognition and methods for objective performance evaluation. The 2013-2014 clinic team has developed a flexible, simple, and efficient framework for tattoo-matching that uses a variety of computer vision algorithms. This framework enables quick exploration by comparing the relative accuracy of individual algorithms and their combination, and tuning and optimizing the parameters of individual algorithms against representative datasets.

Proofpoint, Inc.

Highly Protective Email Client

Liaisons: Robert Thomas, Otto Leung
Advisor: Geoff Kuenning
Students: Mark Mann (PM), Abigail Gregory, Margaret O'Keefe, Jason Yu

Proofpoint provides email security services to a multitude of corporations. Specifically, Proofpoint filters out dangerous emails before delivery. Some emails could be suspicious, but Proofpoint must deliver them in case they are false alarms. Unfortunately, there is currently no way for recipients to determine which emails Proofpoint suspects. These emails could be dangerous and harm recipients' computers when read. The Proofpoint clinic team built an Outlook plugin that distinguishes potentially threatening emails to inform users' reading decisions.

QUALCOMM Incorporated

Application-Layer DASH Client

Liaisons: Rashmi Keshava Iyengar
Deviprasad Putchala
Advisor: Colleen Lewis
Students: Cecily Hunt (F-PM), Justin Lim
Vijay Ramakrishnan (S-PM)
Linnea Shin (F)

Qualcomm Incorporated is a leading proponent of the MPEG-DASH standard for the streaming of media content over HTTP. Adoption of the standard has been slow, in part due to a lack of existing media players that support DASH. We created an application-layer DASH client and media player in the form of an Android app in order to increase adoption of MPEG-DASH and support future Qualcomm research.

Rubicon Project

Respectful Cross-Device Conversion Attribution

Liaisons: Saket Saurabh, Avinash Shahdadpuri
Advisor: Colleen Lewis
Students: James Kaplan (PM), Adam Belzberg,
Mars Park, Chet Weger

Rubicon Project operates a fully automated trading platform for the buying and selling online advertising, reaching 97% of the U.S. Internet audience. We are designing and building a system that will allow Rubicon Project to link devices that belong to the same person while respecting privacy. Our solution integrates with Rubicon Project's internal infrastructure and will need to be robust enough to handle the massive inflow of 7 billion new data points created daily.

VMware, Inc.

Interactively Visualizing VM Performance Data

Liaisons: Jim Chow, Avi Shai, Giri Rashiyamany,
Prashant Dhamdhere
Advisor: Melissa O'Neill
Students: Jane Hoffswell (PM), Minnie Lai,
Frank Liu, Rebecca Thomas

This project aims to create a data-visualization tool that developers at VMware can use to understand the performance of complex software systems. Our web-based tool provides a range of customizable visualizations, each developed with unique interactions to allow for flexible exploration of the data. Our system allows users to interact with multiple visualizations and statistics at a time, allowing for maximum comparative ability when extracting correlations from the data

COMPUTER SCIENCE/ MATHEMATICS

Intel Corporation

Data Visualization for Software Developers

Liaisons: Peggy Irelan, Cristiano Pereira,
Gilles Pokam
Advisor: Daniel Zimmerman
Students: Jason Wang (PM-S),
Miranda Parker (PM-F),
Rohitashwa Bagaria,
Sneha Viswanathan (F)

Intel Corporation is interested in creating tools that allow software developers to easily assess the performance or correctness of threaded programs. First, the clinic team explored ways to visualize aspects of threaded execution that would allow developers to easily diagnose performance or correctness issues. Subsequently, the team devised intuitive visualizations of these programs using data collected during program run. The project's end product is an Eclipse SDK plug-in that encapsulates proof-of-concept versions of the team's visualization ideas.

Lawrence Berkeley National Laboratory

Cluster-based Graph Algorithms for Biological Ontologies

Liaisons: Dr. Melissa Haendel,
Dr. Chris Mungall,
Dr. Nicole Washington ’99
Advisor: Andrew J. Bernoff
Students: Ki Wan Gkoo, Spencer Harris,
Marina Johnson (PM), Ileane O’Leary,
Kyle Roskamp,

Researchers catalog large volumes of data into *biological ontologies*, graphs that denote relationships between biological descriptors, such as indicating that cystic fibrosis affects the lungs. The Monarch Initiative developed a program that utilizes ontologies to compare genetic diseases across species. This Clinic focuses on designing and implementing a faster algorithm via thresholding, a method of reducing the required calculations by only looking at data that meets a given level of significance, which naturally lends itself to parallel computation.

NationBuilder

Predictive Behavior Modeling for Community Organizing

Liaisons: Brett Bevers, David Huie '11,
Dan Walmsley
Advisors: Susan Martonosi, Mohamed Omar (F)
Students: Michael Culhane,
Joey Klonowski (PM),
Greg Kronmiller, Mitul Verma

NationBuilder creates community organizing systems to help governments, businesses, nonprofits, and politicians manage their campaigns and communities. NationBuilder's clients generate vast amounts of data, much of which is currently underutilized. NationBuilder would like us to rank their clients' constituents by how likely they are to carry out specific future actions, such as donating in a future campaign or voting for a particular candidate. Ultimately, this will allow NationBuilder's clients to derive more value from the data they already collect.

Walt Disney Animation Studios

Analysis and Visualization of Tool Usage in Animated Film Production

Liaisons: Lawrence Chai '88/'89, Kevin Gambrel,
Evan Goldberg, Cathy Lam
Advisor: Talithia Williams
Students: Travis Athougies, Ben Corr (PM),
Michael Fox, David Scott

The technology department at Walt Disney Animation Studios logs large amounts of data tracking the actions of their tools and tasks of their users. They would like to mine this data for time-based patterns or correlations. To assist in extracting useful information from the data, we have created scripts that graph and visualize the data, and we have used these to investigate meaningful relationships between users and tool usage.

COMPUTER SCIENCE/PHYSICS CLINIC

Lockheed Martin

Algorithms for Mapping Optimization Problems onto an Adiabatic Quantum Computer

Liaison: Steve Adachi ’82
Advisors: Theresa Lynn, Jim Boerkoel
Students: Taylor Brent (PM), Tessa Adair,
Joel Ornstein, Sean Campbell

Quantum computation has the potential to revolutionize computing by taking advantage of quantum effects like superposition and tunneling. However, designing algorithms that can run on the unusual architecture of these machines is a major challenge. The goal of this project is to investigate methods for mapping optimization problems into a form that can be solved using Lockheed Martin’s D-Wave quantum annealing machine. The team is evaluating the performance of heuristic graph mapping algorithms and studying methods for improving solution quality.

ENGINEERING CLINIC

Alfred E. Mann Foundation
MEMS Piezoelectric Actuator Drive Circuit

Liaisons: Sam Bowman, Brian Dearden, Tom Lobl, Christian Merot
Advisor: Qimin Yang
Students: Emily Cheng (TL-S), Kerry Chin (TL-F), Robert McElwaine, Brianna Thielen, Cody Crosby (S)

AMF aims to produce a skull-mounted drug pump for drug delivery to targeted brain tissue. To manufacture a pump of the appropriate size, the new product will implement a MEMS piezoelectric actuator. The HMC project goals are to develop and characterize a drive circuit that generates a precise waveform to power the MEMS actuator. This circuit must also be energy efficient in order to maximize the battery life of the drug pump and must be compact to minimize pump overall size.

Amazon.com Inc.
Design and Implementation of a Robotic Test Apparatus for Kindle Fire Devices

Liaisons: Sabreen Lakhani '11, Vita Sheehy, Stephen Sanford
Advisor: Chris Clark
Students: Joshua Vasquez, Tyler Robinson, Sami Koo, Kristina Ming (F), Taylor Peterson (F), Cassandra Meyer (S), Josh Sanz (S)

The Amazon Clinic Team will design and build a testing apparatus to verify the performance of tablets and mobile devices. The apparatus' primary application is to verify the appropriate software responses of the Amazon Bookstore on an Amazon Kindle Fire. This apparatus will execute programmed tests autonomously with high precision for extended periods of time and indicate whether a device has passed or failed a given test.

Autodesk, Inc.
Maintaining the Cleanliness of Potable Water in Developing Nations

Liaisons: Sunand Bhattacharya, Glenn Katz, Thom Tremblay
Advisor: Gordon Krauss
Students: Brian Cheney (TL), Kate Spiesman, Victoria Feudo, Jake Dittes (S), Amanda Bennett (F), Graham Gordon (F)

The Autodesk team explored water purification methods during the fall 2013 semester. However, during a site visit to San Francisco, it was found that sanitation and the prevention of recontamination would be an area of focus that would generate more impact. The team developed a set of design alternatives utilizing Autodesk software, and settled on a design that focused on prevention of recontamination of water stored in jerry cans.

Bio-Rad Laboratories, Inc.
Gel Electrophoresis and Imaging System

Liaisons: Steve Swihart, Clayton McKee, Trey Marlowe
Advisor: Ruye Wang
Students: Emily Ross (TL-F), Alice Zhang (TL-S) Frances Su, Rachel Roley (F), Risa Egerter (S), Gourav Khadge (S)

Bio-Rad has tasked the team with exploring the possibility of a fully mobile SDS-PAGE electrophoresis and imaging system that, compared to current Bio-Rad systems, is more accessible for education and research applications. The team designed, built and tested iterations of prototypes to improve the user experience and incorporate an Android application. The final design is smaller and more mobile, more user friendly, and less expensive.

CareFusion

Low-Cost, High-Performance IV Infusion Delivery System

Liaison: Robert Butterfield
Advisor: Mary Cardenas
Students: Michelle Seguin (TL-F), Emma Frederick (TL-S), Neil Pearson, Annie Chung (S), Travis Beckman (S), Cleo Stannard (F), Brittany Borg (F)

The 2013-2014 CareFusion Clinic Team designed, built and tested a low-cost, high-performance IV infusion delivery system aimed for healthcare markets in developing countries. To reduce cost, the delivery system pumps on continuous PVC tubing and uses a rotary peristaltic drive. The delivery system counteracts the reduction of flow caused by tubing deformation by surrounding the pumping region with a controlled partial vacuum which restores the tubing to its full diameter.

City of Hope

Design of a Novel Surgical Device for Minimally Invasive Brain Tumor Removal

Liaison: Behnam Badie, MD
Advisor: Elizabeth Orwin
Students: Li Yip Koh (TL-F), Meghan Jimenez (TL-F), Katie Shepherd (TL-S), Rohaine Hsu, Cindy Angpraseuth (S), Jennifer Zheng (F)

The City of Hope Clinic team designed, built, and tested a device for use in minimally invasive brain tumor removal surgery. The device is inserted into the brain and used to fragment, cauterize, aspirate, and irrigate the site of a brain tumor, leaving a cavity for the delivery of anti-cancer macromolecules or cytotoxic cells. With this device, brain surgery will be made more efficient and effective, reducing both operation and patient recovery time.

City of Hope

Counting and Tracking Surgical Instruments in a Hospital Operating Room

Liaisons: Dr. Gagandeep Singh, Dr. Mark Wakabayashi
Advisor: Chris Clark
Students: Dot Silverman (TL-S), Sam Yim (TL-F), Christian Mason, Matt Tambara, Alberto Ruiz (S), Mengyi Tao (F)

Retention of surgical instruments occurs when a surgical item is inadvertently left inside a sealed patient at the end of surgery. Current practice is to have a circulating operating room nurse make manual counts of all instruments, but this takes time and is prone to error. This clinic team has been tasked by City of Hope Hospital to create an automated system to count with 100% accuracy all instruments in the operating room. The design uses a combination of metal detection, radio frequency identification, and fluorescent barcodes to achieve this goal.

Dart NeuroScience, LLC

Analysis and Redesign of Interactive Test Setup for Primates

Liaisons: Philip Cheung ‘96, Ronald Blandford ‘75, John McNeil ‘89
Advisor: Anthony Bright
Students: James McConnaughey (TL-S), Samantha Munoz (TL-F), Jaqueline Ong (F), Shreyasha Paudel, Jirka Hladis (S), Jingbin Yang(S)

Dart NeuroScience (DNS) is developing pharmaceuticals to enhance memory function. Though the pharmaceuticals are not ready yet, researchers are preparing for animal testing and training non-human primates to perform memory tasks using touchscreens. The accuracy and reliability of these experiments is paramount, and the touchscreens and reward pellet dispensers used are inaccurate and unreliable. The DNS Clinic team conducted testing to determine the best touchscreen technology for the application and developed a prototype of a superior pellet dispenser.

Dave Larky

Mine The Brine

Liaison: Dave Larky
Advisor: Mary Cardenas
Students: Anthony Chung (TL-S), Olivia Warren (TL-F), Abe Cass (POM), Patrick Loftus (POM), Angela Medina

Mr. Dave Larky is a career engineer and scientist with a number of patents in color television, radar tracking and heat transmission. He is currently interested in the extraction of chemical species from the brine of desalination plants. Given current attention to desalination, this project aims to identify the various chemical species that are obtainable and minimize the cost of extracting those species. Our team designed a system to extract targeted chemical species from seawater brine. The system was simulated through computer modeling and characterized using profitability analysis.

DIRECTV, Inc.

Android-Based Handheld Remote Control

Liaison: Stephen Dulac
Advisor: Ruye Wang
Students: Nicole Yu (TL-S), Jennifer Phuong (TL-F), Vyas Savanur, Demetri Monovoukas (S), Ivan Wong (S), Sophia Williams (F)

DIRECTV currently has a traditional remote control and mobile application for their latest set-top box. However, only customers with smart devices can take advantage of the many additional features offered by the mobile application, such as searching the TV guide using voice recognition. The DIRECTV Clinic team is designing a smart remote control that combines the capability of the mobile application with the familiarity of the traditional remote control.

Eaton Aerospace

Direct Drive Servo Valve

Liaisons: Joshua Lien, Melvin Alvarado, Galen Chui '05, Dan Roberts, Patrick Carroll
Advisor: Kash Gokli
Students: James Best (TL-S), Cierra Owens (TL-F), Emma Bodell, Michelle Liu, Peter Orme (S), Ji Su Lee (F)

In the 2013-2014 year, the Eaton Aerospace Clinic team replaced an existing electro-hydraulic servo valve with a direct drive servo valve for an aircraft hydraulic steering system. The team designed, prototyped, and tested valves that proportionately direct the hydraulic fluid. The team reached the stretch goal both semesters and created two working prototypes to compare against one another. The final valve design is more economical and increases reliability and manufacturability while meeting performance criteria specified by Eaton Aerospace.

eSolar

Heliostat Wind Effect Instrumentation

Liaison: David Gross '08
Advisor: Philip Cha
Students: Alex Flake (TL-S), Sarah Lichtman (TL-F), Katherine Anderson, Kyle Siegel, Thibaud Cochet (EX), Tony Lee (F)

The eSolar clinic team has been asked to design, build and test a data acquisition system to measure the effect of wind on an eSolar heliostat. This system must interface with existing heliostat design and withstand desert conditions. The system design will include sensor selection and calibration, data collection, data processing, and data visualization and storage.

Intel Corporation

Capturing User Experiences and Making Sense of the Data

Liaisons: Hannah Colett, Rina Doherty, Guiseppe Raffa
Advisor: Patrick Little
Students: Lauren Nishizaki (TL-S), Kate Kryder (TL-F), Fenxiao Chen, Charles Herbaut (EX), Sarah Stevens (S), Zachary Vickland (F)

The researchers within Intel Lab's User Experience Research (UXR) group are interested in evaluating the user experience associated with mobile device usage. Each Harvey Mudd Clinic Team member is using a different type of mobile device (tablet, Ultrabook, etc.) that collects usage data. The Clinic team has worked on developing a tool that would assist researchers in visualizing and extrapolating meaning from the data collected.

MetCel, LLC

Re-Engineering a Semi-Truck Van Trailer for Increased Weight Capacity

Liaisons: Jay Hanan, Brian Reed
Advisor: Kash Gokli
Students: Madeline Goldkamp (TL-S), Ginah Han (TL-F), Lisa Lam, Alex Lammers (POM), Ryland Miller (F), Aarthi Sridhar (S)

The 2013-2014 MetCel Clinic Team reverse engineered and redesigned a semi-truck van trailer to increase its weight capacity while maintaining adherence to all safety and performance requirements. In order to identify areas for improvement, the team characterized the weight of individual components within the trailer using a Pareto analysis. The team also created finite element models to compare different design alternatives using static stress analyses. One final design was selected for physical prototyping and future testing.

Los Alamos National Laboratory

Data Center Utility Cost Management

Liaisons: Dr. Josip Loncaric, Alynna Montoya-Wiuff, Amanda Bonnie, Michael Ferguson, Parks Fields, Cindy Martin
Advisor: Philip Cha
Students: Alexandra Wright (TL-S), Maya Johnson (TL-F), Carolina Reyes, Tamara Savage (S), Ryan Seldon (S), Ariel Willey (F)

The Los Alamos National Laboratory (LANL) Clinic Team designed a strategy to reduce operating cost and environmental impact of the LANL supercomputing data center by minimizing water and energy consumption. The team created a thermodynamic model of the cooling system, identified and optimized the key parameters, and evaluated this strategy against a fixed-setpoint temperature approach. The strategy capitalizes on the wide range of Los Alamos, NM weather conditions by operating the system at settings optimized for ambient temperatures.

Power Generation Solutions (PGS)

Waste Heat Recovery Sterling Engine

Liaisons: John Fletcher, Paul Davis
Advisor: Ziyad Duron
Students: Jason Bluhm (TL-S), Josh Edelman (TL-F), Por Katanyutanon, Varun Kanwar, Huy Nguyen, Julie Zhang (F)

The Power Generation Solutions clinic team is tasked with assisting in optimizing the design of a sterling engine for high-power waste heat recovery applications by constructing a test system for the intended heat engine's regenerator to test the regenerator performance. This information can then be used to inform future design iterations of the sterling engine to minimize cost without damaging efficiency.

Project A Cappella

Characterization of Acoustic Noise Generated by Capacitors on Printed Circuit Boards

Liaisons: Amanda Rainer '06, Jeff Thoma, Shawn Arnold
Advisor: R. Erik Spjut
Students: David Derry (TL-F), Margaret Thompson (TL-S), Dong-hyeon Park, Eric Kiss (F), Sachit Sood, Andrew Wells (S)

Audible acoustic noise generated by multilayer ceramic chip (MLCC) capacitors on printed circuit boards (PCBs) creates an undesirable phenomenon in consumer electronics. When a changing voltage is applied to MLCC capacitors, the internal ceramic material expands and contracts due to piezoelectric and electrostrictive effects causing the PCB to vibrate at audible frequencies. The Project A Cappella clinic team has characterized how placement and electrical stimulus affect the magnitude of the acoustic noise to inform future PCB design choices.

Rambus, Inc.

USB 3.0 to Multi-protocol Interface Adapter

Liaisons: Pradeep Batra, Julia Cline, Adrian Torres
Advisor: Josef Spjut
Students: Austin Chen (TL-S), Sean Velazquez (TL-F), Antoine Billig (EX), Chanel Chang, Obosa Obazuaye (CS), Jeffrey Steele (S)

Rambus Inc. uses a protocol adapter that provides the means to communicate with SPI, JTAG, I2C and other proprietary interfaces over a common USB 2.0 interface to a host computer. This adapter is used to test the throughput and performance of various Rambus products. The goal of this clinic project is to design a USB 3.0 adapter on a PCB that communicates between a device under test and existing testing software with higher speeds.

SpectraSensors, Inc.

Software Development of a Partial Least Squares Regression Analysis Program for Chemical Engineering Applications

Liaisons: Adam Chaimowitz, Gary Yeh, Sherry Liu
Advisor: Anthony Bright
Students: Sami Mourad (TL-S), Adam Parower (TL-F), Eric Storm (S), Leif Park Jordan (S), Gurchetan Singh (F), Michelle Wei (F)

The goal of this project is to develop a standalone software package written in C that is able to perform a partial least squares regression, prediction and cross-validation for chemical analysis. The software program should be optimized for accuracy and speed, and its performance should be comparable to that of commercially-available calibration engines.

Technicolor

3D Audio Mixing Interface Design

Liaisons: Claude Gagnon, Peter Jax
Advisor: Okitsugu Furuya
Students: Doug Hu (TL-S), Stephanie Fawaz (TL-F), Stephen Pinto, Julia Fox, Stephen Ibanez (S), Christopher Apple (F)

The Technicolor Clinic Team at Harvey Mudd College created a user interface for manipulating sounds in a three-dimensional environment. This allows an audio engineer to move the perceived location of sound tracks in various media with sound-mixing technology. A 3DConnexion mouse provides a user with control of the sound's location.

Teledyne Controls

ARINC 830 Aircraft-Ground Communication System

Liaisons: Wolf Sonnenberg, Claire Robinson '11
Advisor: Patrick Little
Students: Diana Mar (TL-S), Brent Stapleton (TL-F), Brett Manning, Tristan Fitch (S), Jessica Chen (F), Christopher Hirlinger (F), Huong Nguyen (F)

The Teledyne Controls Clinic team has developed a framework to demonstrate core functions define by the ARINC 830 Aircraft/Ground Information Exchange (AGIE), an emerging standard that seeks to achieve interoperability between different aircraft communication systems. Working in the application layer of communications, the designed system uses AGIE-level logic while leveraging the Advanced Message Queuing Protocol (AMQP).

ENGINEERING/PHYSICS CLINIC

Lawrence Livermore National Laboratory (LLNL)

Efficient Calibration and Characterization of Segmented Antineutrino Detectors

Liaisons: Dr. Nathaniel Bowden, Dr. Timothy Classen
Advisor: Tom Donnelly
Students: Anthony Corso (TL-S), Courtney Keeler (TL-F), Bryan Monroy, Vivian Steyert (S), Sean Messenger (F)

The Lawrence Livermore National Laboratory Clinic Team designed, built, and tested a method for calibrating the energy and position of an anti-neutrino event within a scintillator detector. The calibration method was automated so minimal human input is needed. Such detectors will be deployed near nuclear reactors and used in the search for the sterile neutrino. The team verified the calibration results using a particle interaction simulation which will also be used to predict the performance of future scintillator detectors.

Sandia National Laboratories

Studying Ferroelectricity in Barium Titanate Nanoparticles

Liaison: Dr. Todd Monson
Advisors: Richard Haskell, Adrian Hightower
Students: Eric Puma (TL-POM), Sun Hwi Bang, Nate Bean, Jean-Claude DeSugny, Robert Gambee

Barium titanate (BTO) is a ferroelectric material used in the production of multi-layer ceramic capacitors. At the nano scale, BTO exhibits bewildering structural and dielectric behavior. We develop a test bench to measure the permittivity of nanoparticles, employing a combination of electrochemical impedance spectroscopy and computational modeling. We compare our results to structural measurements, including Raman and x-ray experiments, for a variety of particle sizes and synthesis methods.

Sandia National Laboratories

Verification and Validation of Computational Models for Enclosure Radiation

Liaison: Dr. Dean Dobranich, Dr. Leslie Phinney
Advisor: Nancy Lape
Students: Tuan Nguyen (TL-S), Ray Hurwitz (TL-F), Brett Mills, Jonpaul Littleton (S), Chris Miro (S), Yeahmoon Hong (F), Chris Sugino (F)

Sandia National Labs uses computational models to simulate radiative heat transfer within enclosures of various geometries and materials. However, these models simplify the real radiative behavior by making gray (wavelength-independent) and diffuse (direction-independent) approximations. There is currently insufficient evidence to corroborate these modeling assumptions. To this end, the team has developed evidence for analytical verification and experimental validation of Sandia's modeling predictions.

GLOBAL CLINIC

Intel Corporation in Collaboration with National University of Singapore (NUS)

Computer Vision for Parallel JavaScript

Liaisons: Dr. Jaswanth Sreeram
Advisors: Robert M. Keller,
Wee-Kheng Leow (NUS)
Students: John Brooks, Zheng Duan,
Tiffany Lim (PM),
Nguyen Hien Linh (NUS),
Nguyen Truong Duy (NUS),
Nhu Dinh Tuan (NUS).

Intel Labs' Parallel JavaScript is a data-parallel programming model that allows JavaScript programs to use hardware parallelism such as multiple cores, vector instructions, and GPUs, which have previously been inaccessible to Web applications. In order to demonstrate the advantages of Parallel JavaScript, we have used it to create a fast, reusable, open-source computer vision library. We then used this library to build a real-time, interactive hand gesture detection application.

MATHEMATICS CLINIC

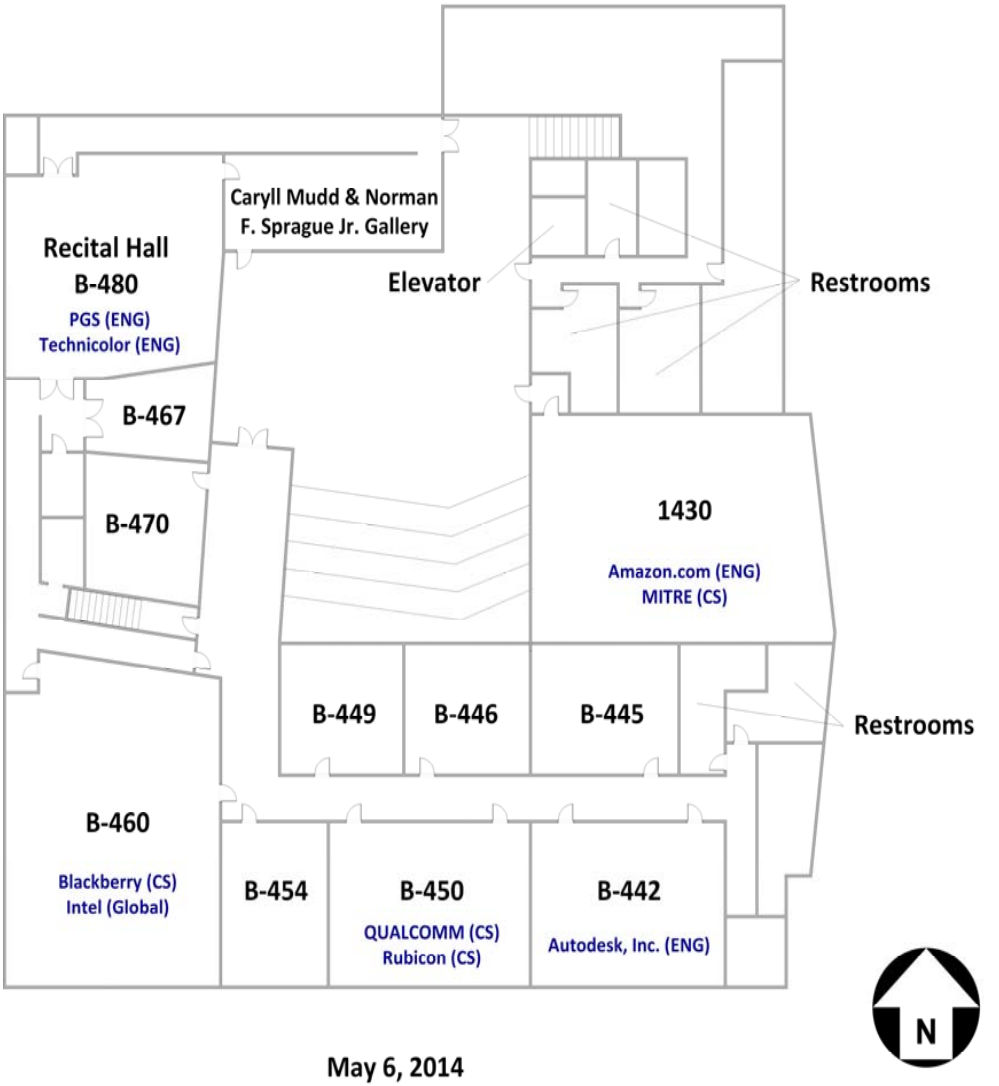
Palo Alto Research Center (PARC)

Intelligent Workflow Diagnostics

Liaison: Dr. Eric Huang '02
Advisor: Weiqing Gu
Students: Andrew Gibiansky, Yongqian Li,
Amanda Llewellyn (PM),
Jacob Morris-Knower, Patrick Meehan

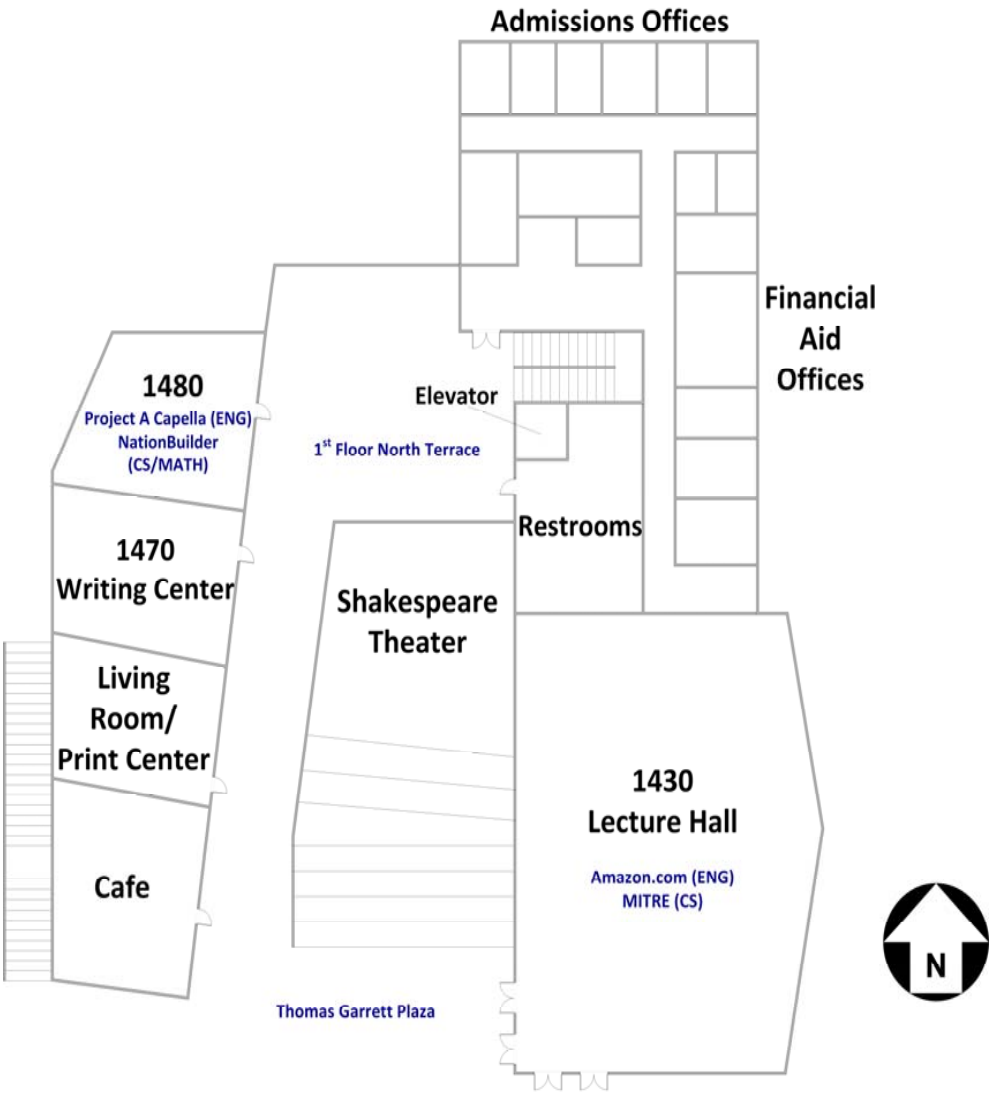
Processing big data often involves Extract-Transform-Load (ETL) workflows, whose operations clean, verify, and join multiple data sources into one output. For large input data, debugging these workflows becomes incredibly time-consuming. We designed a program, accessible to the data scientist user, which automates reasoning over and test performance for various parts of the workflow.

Shanahan Center for Teaching and Learning
Basement
Projects Day 2014



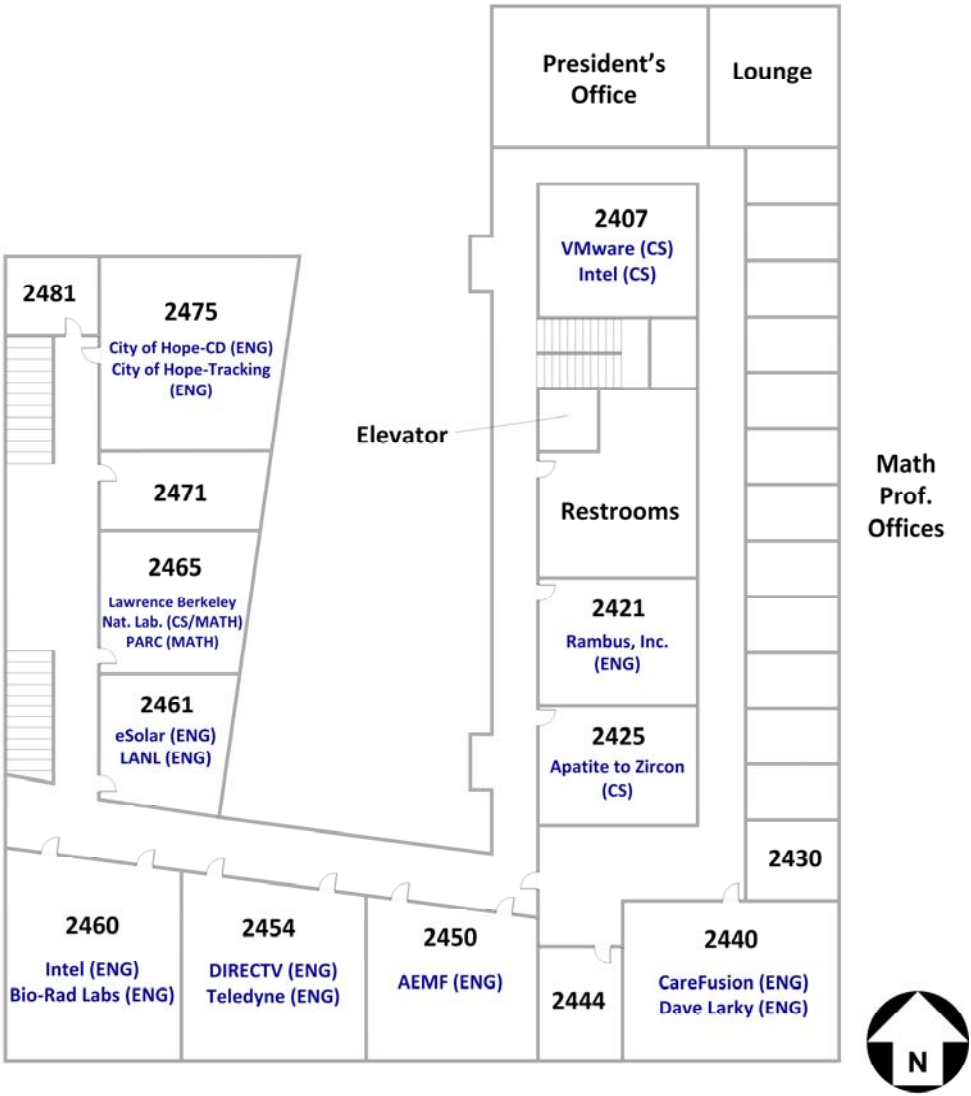
May 6, 2014

Shanahan Center for Teaching and Learning
First Floor
Projects Day 2014



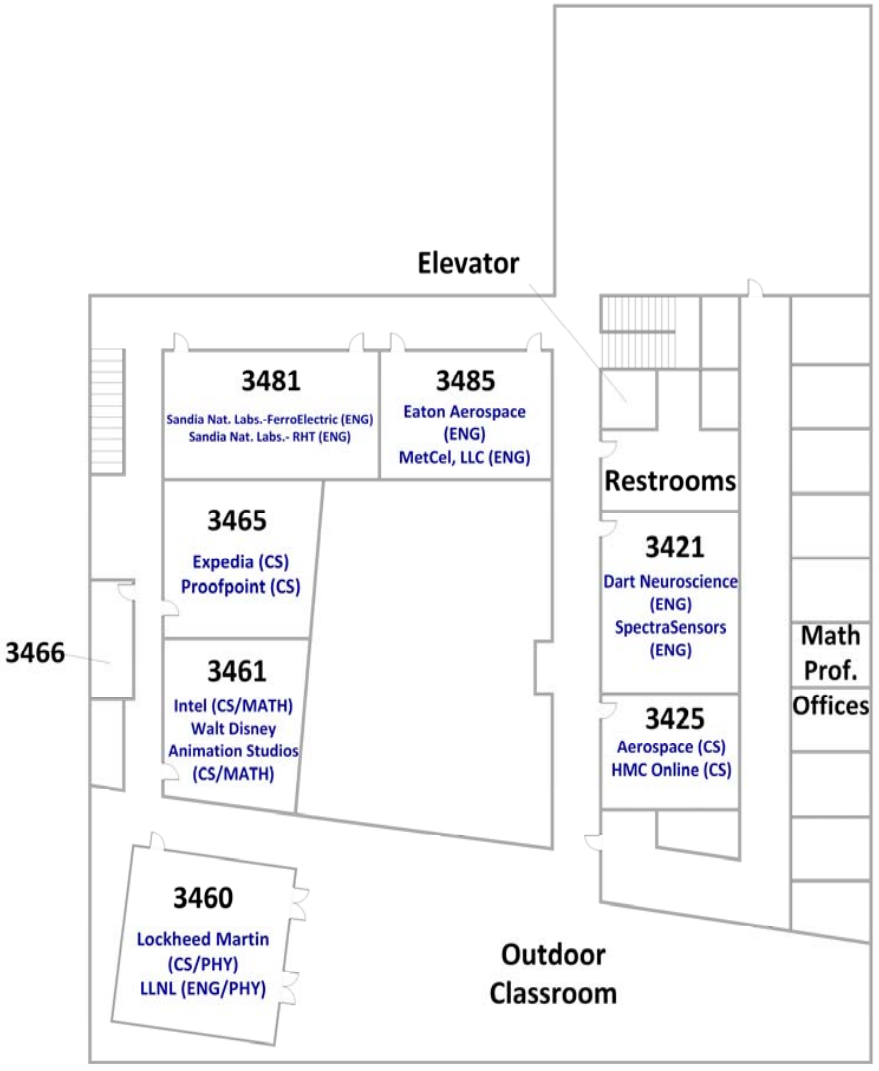
May 6, 2014

Shanahan Center for Teaching and Learning
Second Floor
Projects Day 2014



May 6, 2014

Shanahan Center for Teaching and Learning
Third Floor
Projects Day 2014



May 6, 2014

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To all Harvey Mudd College Faculty & Staff involved in the preparation of Projects Day

Notes:

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