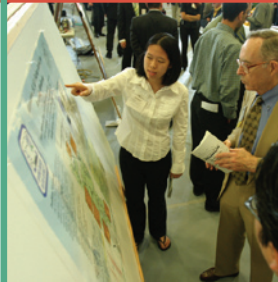
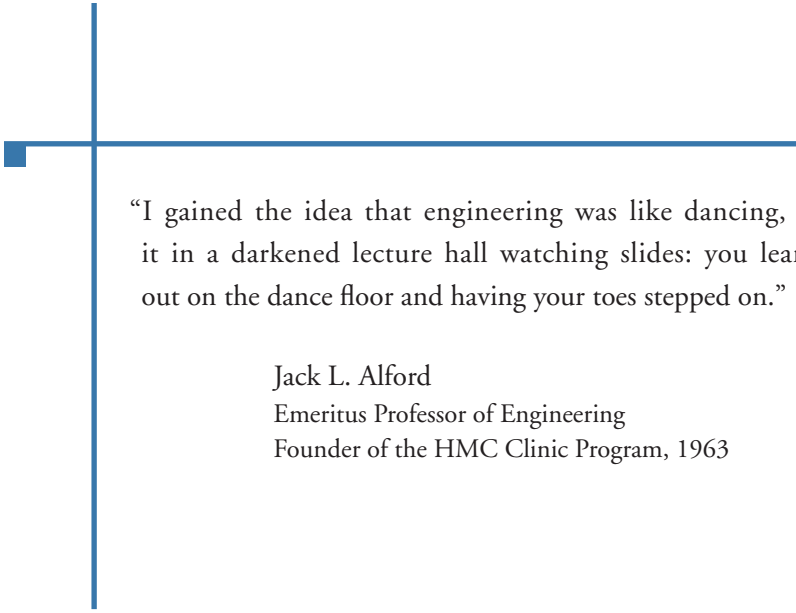


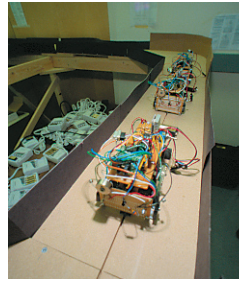
**The Harvey Mudd College  
Clinic Program**





“I gained the idea that engineering was like dancing, you don’t learn it in a darkened lecture hall watching slides: you learn it by getting out on the dance floor and having your toes stepped on.”

Jack L. Alford  
Emeritus Professor of Engineering  
Founder of the HMC Clinic Program, 1963



## The Harvey Mudd College Clinic Program At A Glance

### What is the HMC Clinic Program?

HMC student teams completing important, real-world Engineering, Computer Science, Mathematics, Physics or multidisciplinary projects.

- Teams of three to five students devote an average of over 1,200 person hours to a project over the academic year.
- Sponsor liaisons provide active guidance and domain expertise.
- Faculty members serve as advisers.
- Work occurs on the HMC campus with sponsor-site visits as needed.

Since 1963, well over 300 organizations have participated, resulting in more than 1,200 completed projects. Clinics have been conducted for sponsors that span the country, including IBM (Austin, Texas), Intel Corporation (Hillsboro, Ore.), Medtronic, Inc. (Los Angeles, Calif.), Northrop Grumman Corporation (Los Angeles, Calif.), QUALCOMM (San Diego, Calif.), and Sandia National Laboratories (Albuquerque, N.M.).

### What does the sponsor gain?

- Useful project results such as a hardware or software prototype, a device or program to be put into production, a mathematical analysis and research investigation, or a design proposal.
- Retention of all ownership rights of resulting outcomes—patents are common.
- Fresh insight by a highly talented team of students.
- High visibility on campus throughout the academic year, beneficial to recruiting efforts.

The high rate of sponsor return testifies to sponsor satisfaction and perceived value.

### What is the sponsor's involvement?

- Submission of Project Statement in the preceding spring.
- Appointment of liaison to guide team to desired results through weekly contact.
- Payment of Clinic fee in installments over the academic year.

To learn more, visit the Clinic Web site at [www.clinic.hmc.edu](http://www.clinic.hmc.edu) or send e-mail to [clinic@hmc.edu](mailto:clinic@hmc.edu) or call 909/607-7015.

### Calendar (See timeline, page 7)

#### ■ MARCH–JULY

Sponsors commit to the HMC Clinic Program by providing project statements.

#### ■ SEPTEMBER

Student teams formed, project work commences.

#### ■ OCTOBER

Students submit full proposal/work plan.

#### ■ OCTOBER–DECEMBER

Tuesday morning project discussions. Sponsors are encouraged to attend.

#### ■ DECEMBER

Midterm reports are prepared and sponsor-site presentations may occur.

#### ■ JANUARY–APRIL

Tuesday morning presentations. Sponsors and visitors are encouraged to attend student presentations discussing the status of their Clinic work.

#### ■ EARLY MAY—PROJECTS DAY

Sponsors, guests and the Harvey Mudd College community attend presentations to learn about project results.

#### ■ MAY

Final results, prototypes and reports delivered. Sponsor-site presentations are common.

“SS/L submitted a project to the Harvey Mudd College Mathematics Clinic that involved determining the additional amount of propellant that must be carried on board a geosynchronous satellite in order to compensate for launch vehicle errors and satellite thrusting errors. The students had to learn about the orbital equations of motion, which they had not studied in class. They also needed a good grasp of statistical processes. The students tackled the problem and did an outstanding job solving it. I would highly recommend the Mathematics Clinic for any type of mathematical problem that needs to be solved in an efficient manner.

Eugene Williams  
Supervisor, Orbit Dynamics Section  
Space Systems/Loral



**What is the Harvey Mudd College Clinic Program?** The HMC Clinic is an internationally recognized program initiated at HMC in 1963. It brings student teams together with sponsoring industry, government and nonprofit organizations to solve real-world industry problems in an academic setting. Since its inception, over 300 organizations have participated in the HMC Clinic Program, resulting in more than 1,200 completed projects.

A Clinic project is an academic-year-long graded course in which a team of three to five advanced students work on a problem posed by the sponsor. A faculty advisor oversees the project, while a sponsor-designated liaison monitors the work effort, provides regular feedback, and serves as a source of domain expertise on the specific problem addressed. The students make a series of presentations and written progress reports in the course of the year, gaining experience with this important aspect of project work.

Clinic projects are technically difficult problems for which no prior guaranteed solution exists. Thus they utilize and help build the exceptional mix of design, research and computing skills of our students. At the same time, the group structure and industrial exposure provide the students with valuable real-world technical and managerial experience, an asset to them and their eventual employers.

**What kind of projects are possible?** The project must have a major component in engineering, mathematics, computer science, physics or environmental science. Multidisciplinary projects are possible as well. If you have a challenging problem, chances are pretty good it could form the basis of a Clinic project. To see the variety of past projects, visit the Clinic Web pages at [www.hmc.edu/ProjectsDay](http://www.hmc.edu/ProjectsDay).

**What are the benefits to the sponsor?** The principal benefits of project sponsorship come in the form of the project deliverables, which might be a design proposal, a research summary, a feasibility study, a proof of concept, a systems analysis, a prototype of a piece of hardware or software, or a device or program to be put into actual production or use. Every Clinic project culminates in a formal presentation at our year-end event called Projects Day, as well as a written final report.

Projects often result in patents, which are always assigned to the sponsor. Indeed, the sponsor retains ownership of all intellectual property developed in the project. While some team presentations are open to the public, reports are confidential to the





“The HMC Computer Science Clinic has been a terrific participatory experience for us. The Aerospace Corporation has benefited from great research work and outstanding new hires over the past decades.”

Dr. Joseph Betser  
Senior Project Manager  
Business Development  
The Aerospace Corporation

sponsor, and all other forms of publication are subject to the approval of the sponsor at least to the end of the first year after project completion.

Our sponsors regularly attest that project results have dollar values that far exceed the Clinic fee. Perceived sponsor value is further evidenced by the fact that over half of our sponsors have returned to sponsor additional projects.

Indirect benefits of sponsorship include increased visibility on campus, which benefits recruiting efforts. External visibility can also be raised: recent projects have been mentioned in numerous media outlets including trade journals, company newsletters and major newspapers.

Past sponsors have also mentioned additional benefits of participation such as: access to fresh ideas; management training for the liaison and potential employees among the students; and an expanded talent resource.

**How does an HMC Clinic project get started?** The Clinic directors begin confirming projects for the following academic year in early spring. Throughout the spring and summer, sponsors submit a short project statement to the Clinic director of the appropriate department. The statement can be posed in just one or a few short paragraphs, but should be specific enough that the director can evaluate its educational merit and feasibility in terms of time, available skills and budget. If accepted, the project statement will be further developed late in the summer for presentation to the students. Clinic project slots are limited, so it is best to submit the project statement by early June for full consideration.

**What are the sponsor’s obligations?** The sponsor appoints a project liaison to serve as a source of expertise and to help provide guidance for the project team. While the liaison may spend as little as one hour per week communicating with the team, the liaison is the sponsor’s link to the project. Success will depend, in large part, on the quality of interaction between the liaison and the rest of the team.

In addition to appointing a project liaison, the sponsoring organization also pays a fee to support the program. Payments are typically made in three equal installments at intervals during the project year.

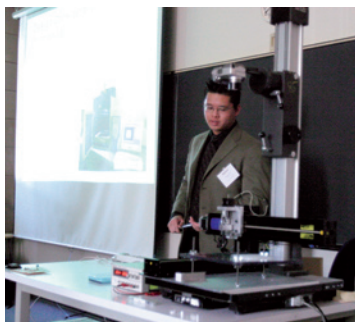


“The HMC Computer Science Clinic provided us with leading-edge support and quality work at a bargain price. The student team, faculty advisor and director were professional and enthusiastic.”

Kevin R. Martin  
Senior Research Project Engineer  
Information Sciences Lab  
HRL Laboratories, LLC

“The team did a fantastic job especially since I am working in France now. The instrument package built by the team which was sent to Dome C Antarctica was remarkable. Many professionals have failed where they succeeded. I am very impressed.”

Mark Swain  
NASA/JPL



**Recent project examples.** Students in the **Engineering Clinic** work on projects that encompass all engineering disciplines. Most projects are multidisciplinary by nature. Recent projects have included a Federal Aviation Administration (FAA) sponsored retrofit of the incandescent landing lights with LED equivalents that will increase visibility, reduce maintenance costs and lower energy costs by up to 80 percent. One team, working with Oregon Medical Laser Center, developed a device to deploy chitosan bandages to stop internal bleeding in patients. The Boston-based medical consortium CIMIT and The BioSTAR Group asked a Clinic team to develop a portable filtration system that will permit a combat medic to purify a combat soldier’s canteen water to injection grade. The Aerospace Corporation asked a team to develop a circuit board with an imager and GPS system that will fly on a picosatellite mission. For more than 10 years, Clinic teams have successfully completed a wide range of projects for the Metropolitan Water District (MWD) and Irvine Ranch Water District (IRWD). A team sponsored by Honeywell tested and developed new approaches to remove airborne water from airplane filtration systems. The solutions developed by the team are in further development at Honeywell and will find their way into future generations of aircraft.

**Computer Science Clinic** teams have engaged in a wide variety of projects, ranging from pure research to product development. There has been extensive work in computer security, ranging from first implementations of new protocols to work on using the human immune system as a model for intrusion detection and prevention. Artificial intelligence projects have included natural language understanding for Web chat boards, automating the translation of spoken speech into phonemes, recognition of forms by scanning devices, recognition of sung melodies, and classifying anomalies in satellite data. Wireless hand-held applications include a pilot’s assistant for displaying weather data, a data collection system for insulin pumps, and GPS cell phone applications. Computer graphics applications include automated means for making animations appear more natural and a commercial-length public service announcement for prevention of road rage. Algorithmic work has included scheduling for time-varying networks, parallelization of the Smith-Waterman DNA-matching algorithm, and genetic programming for generating decision trees.

Since the time of Newton and Leibniz, mathematics has remained at the core of science and technology, so that today mathematics and computer algorithms based on mathematics are applied to practically every area of human exploration and endeavor. As a result, the **Mathematics Clinic** in recent years has conducted research to improve algorithms for satellite-based geo-location systems, model singular solitons (peakons) in shallow water waves, improve Web search algorithms, optimize dynamic online surveys, assess consumer preferences to aid online purchase decisions, analyze and implement an elliptic-curve cryptography scheme, optimize control of low-thrust ion propulsion for satellite orbit raising, and analyze communication graphs to detect cohorts or suspicious investors involved in fraud. The areas in which mathematical modeling can yield beneficial results for science and industry, and where the Mathematics Clinic can serve a useful role, are unlimited.



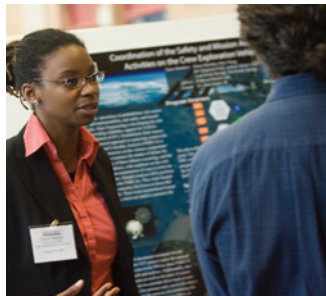


In the past few years, the **Engineering and Physics Clinics** have jointly designed, built and tested for the Jet Propulsion Laboratory (JPL) the infrared interferometer that combines the light from the world's two largest telescopes at the Keck Observatory on Mauna Loa, Hawaii. Another joint engineering-physics team modified a commercial laryngoscope to accommodate the sample arm of an optical coherence tomography instrument for the purpose of non-invasive imaging and early detection of laryngeal cancer. The work was sponsored by the Beckman Laser Institute and Medical Clinic on the campus of UC Irvine, and the instrument is now involved in clinical tests at the UC Irvine Medical Center. The synergy of the engineering and physics perspectives has proved to be remarkably effective, both in terms of project results and pedagogical value.

In a more recent JPL Clinic project, a **Physics Clinic** team measured the separation of two telescope corner cubes to within an atom's diameter for the Space Interferometry Mission. The Physics Clinic also worked on beam stabilization for the proton beam cancer treatment facility at Loma Linda University Medical Center. In a current two-year project, Sandia National Laboratories has asked a physics team to measure the optical properties of organically coated soot particles to determine their impact on regional air quality and long-term effect on global climate. It is often the case that Physics Clinic projects have a strong research component.

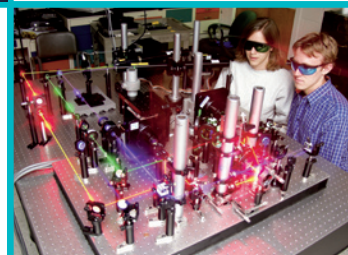
“Without the Clinic, we would not be able to send our students to Harvey Mudd College every year. They not only learn English but also participate in the Clinic. The utmost benefit for them is to get to know people of a different culture in a different country, and to some extent it is a culture shock to them which remains in their mind for the rest of their lives. After coming back to Japan, these students work harder and their job-finding rate is much higher. We have one exchange student coming from HMC every year who joins our industry-academia cooperative program similar to the Clinic, working together with our students. We would like to extend this relationship to a global scale in the near future through the Clinic Program.”

Okisugu Furuya, Professor, Ph.D.  
Director, Engineering Clinic Program Center of Kogakuin University  
Department of Basic Engineering in Global Environment  
Faculty of Engineering  
Kogakuin University, Japan



“Personally, I keep coming back because I enjoy working with the students on these projects. It is a real challenge to come up with a good project and then to see that this project gets supported throughout the school year. Projects Day is also an enjoyable day for me—a lot of interaction with the student body, and many interesting ideas to hear. From a DIRECTV perspective, the Clinic Program has primarily provided instant name recognition on campus, and through this we have had good success in recruiting. We have no trouble filling our interview schedules with good students. We have also been able to build good relations with the faculty, and this has led to valuable recommendations on students that we might pursue. Recruiting was a primary goal when we started our first Clinic project. Secondly, we really do get valuable work from the projects. For example, our first Clinic project is still in daily use here at DIRECTV monitoring the strength of our satellite transmissions. Our third Clinic project is about to become a test equipment product available on the open market, and the fourth Clinic project will likely be combined with the third in this same piece of test equipment. These are projects that we do not have adequate internal resources to complete, are important to our business, and fit well within the Clinic Program.”

Paul Anderson  
Former Manager, Systems Engineering  
DIRECTV



“The HNC Software-sponsored Mathematics Clinic at Harvey Mudd College was a great success. Working with some of the most talented students and outstanding faculty, we were able to successfully address complex real-world problems. The Harvey Mudd College team allowed us to undertake projects that would have otherwise required more resources on our part.”

Dr. Ayman Farahat  
Senior Staff Scientist  
Advanced Technology Solutions  
HNC Software



“Clinic really changed my life. I’ve learned so much about what I wanted to do in school and where I want to go afterwards. It wasn’t until I got to Clinic that I was able to see...the different directions in which I could go. All those opportunities just opened up to me.”

Adrian Urias '99/00

**The importance of the liaison.** The liaison advises and evaluates the ongoing work of the Clinic team from the perspective of the sponsor. The liaison is a crucial member of the team, contributing to the project in three ways:

- Helping to formulate the official work statement;
- Maintaining communication between the project team and the sponsor;
- Providing guidance for the project from the sponsor’s perspective.

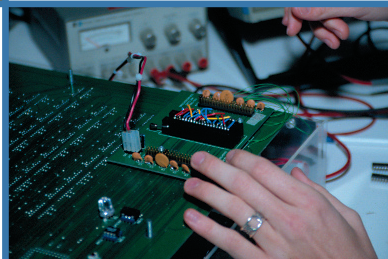
**The HMC Clinic’s origins.** The idea for the HMC Clinic Program originated in 1963 in the Department of Engineering to channel HMC student initiative, drive and intelligence into projects of a real-world nature. Founders Jack Alford and Mack Gilkeson felt that the best way to do this was to give students “clinical” experience like that which medical students receive as part of their training—thus, the name Clinic.

The Harvey Mudd College Engineering Clinic was born with initial funding from the Ford, U.S. Steel, and Sloan foundations. The Mathematics Clinic began in 1973 with funding from a National Science Foundation grant. The Computer Science Clinic began in 1993, the Physics Clinic in 1996 and the Environmental Studies Clinic in 2000.

**Harvey Mudd College.** Since its founding in 1955, Harvey Mudd College has been dedicated to educating a special breed of scientists, mathematicians and engineers with exceptional breadth in their technical education and a firm academic grounding in the humanities and social sciences. A student’s coursework is divided roughly in thirds, covering the humanities and social sciences, the Common Core (in biology, chemistry, computer science, engineering, mathematics and physics) and the student’s major.

Harvey Mudd College has earned national recognition for its accomplishments, and its faculty and students rank among the nation’s best. HMC has consistently been rated as one of the most selective colleges in the nation and traditionally recruits one of the highest percentages of National Merit Scholars of any school in the country. A low student-faculty ratio (9:1) enhances close interaction between students and the faculty, all of whom hold a Ph.D. degree or a terminal degree in their field and many of whom have industrial experience.

Located in Southern California, Harvey Mudd College is a member of The Claremont Colleges, a group of five distinctive undergraduate colleges and two graduate institutions.







## The Harvey Mudd College Clinic Program Timeline

| PRECEDING ACADEMIC YEAR                                    |     |     |     |     | ACADEMIC YEAR OF THE PROJECT |      |     |   |     |     |     |                                 |     |     |     |  | NEXT ACADEMIC YEAR |      |  |   |  |
|--|-----|-----|-----|-----|------------------------------|------|-----|---|-----|-----|-----|---------------------------------|-----|-----|-----|--|--------------------|------|--|---|--|
| JAN  | FEB | MAR | APR | MAY | JUNE                         | JULY | AUG | SEPT  | OCT | NOV | DEC | JAN                             | FEB | MAR | APR | MAY  | JUNE               | JULY |  |   |  |
| Identification of Prospective Projects for the Coming Year |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
| Viewing of Presentations from Previous Year                |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
| Closure on New Projects                                    |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
| Finalize Project Statements                                |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
| Letters of Agreement Signed                                |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     | Orientation Day (First Week)                  |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     | Background Research and Problem Understanding |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     | Work Statements Completed (First Week)        |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     | Research, Design and Development              |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     | Design Reviews and Progress Reports           |     |     |     |                                 |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     |   |     |     |     | Midyear Report (Second Week)    |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     |   |     |     |     | Winter Break                    |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     |   |     |     |     | Design, Development and Testing |     |     |     |  |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     | Project Status Presentations                   |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     | Projects Day All Projects Present (First Week) |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     | Final Report (Second Week)                     |                    |      |  |   |  |
|  |     |     |     |     |                              |      |     |   |     |     |     |                                 |     |     |     |  |                    |      |  | Advisory Committee Evaluation of Projects |  |

“We appreciate the hard work and enthusiasm that the students and faculty brought to the Clinic project. It’s invigorating to work with people who are undaunted by experimental obstacles and tackle these problems with energy that leads to innovative solutions. We’re looking forward to continuing this project next year.”

Andrew McIlroy '85 and Hope Michelsen  
Sandia National Laboratories

## Past and Current Harvey Mudd College Clinic Sponsors

|   |   |   |  |
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| California State Architect's Office                                     | Hewlett-Packard Laboratories                      | Octel Communications Corporation                      | Ultra-Violet Products, Inc.                        |
| California Tomorrow   | HIAC-Pacific Scientific                           | Operation Second Chance                               | Uncle Spanky's Bar-B-Q Sauce                       |
| Capital Group Companies, The  | HNC Software Inc.                                 | Opto 22   | Unisys   |
| Center for Integration of Medicine and<br>Innovative Technology (CIMIT) | Hoffman Electronics                               | Optivus Technology, Inc.                              | United Devices                                     |
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| Danbury School  | Isis Pharmaceuticals                              | Procter & Gamble Company, The                         | WolfeTech Corporation                              |
| Data Devices International  | ITT Industries, Inc.                              | PVP Advanced EO Systems, Inc.                         | WorldPort Internet, Inc.                           |
| Dataproducts Corporation  | IVAC Corporation                                  | Pyxis Corporation                                     | WorldQuant, LLC                                    |
| Defense Advanced Research Projects<br>Agency (DARPA)                    | Jacobs Engineering Group, Inc.                    | QUALCOMM  | Xerox  |
| Developmental Sciences  | Jet Propulsion Lab                                | Rain Bird Corporation                                 | Yahoo!   |
|   | John Crane Belfab                                 |   |  |



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