

# A Student-Directed Computing Community

Adam Bonner

Information and Computer Science

University of California, Irvine

Irvine, CA 92697-3425

abonner@ics.uci.edu

## Abstract

We describe a computing facility created, supported, maintained, and used entirely by undergraduate students. This facility exists outside of the instructional support system, so the usual constraints of reliability are relaxed, allowing relatively unrestricted installation of software and hardware. An active community has developed around this facility, providing broad technical experiences and enabling mentoring relationships.

## 1 Introduction

On many campuses, instructional computing resources are tightly constrained. A professional support staff manages the facilities, imposes disk space quotas, and prohibits installation of new hardware and software. Activities like running mailing lists, administering MUDs, and compiling an extensive webpage are not considered appropriate uses of computing resources and are officially discouraged. Since these activities are outside the scope of the resources allocated to support instruction, it is difficult to allow students to engage in these activities, even if the professional support staff was motivated to do so.

The Undergraduate Computing Facility (UCF) was formed in the spring of 1997. Students wanted to manage mailing lists, install experimental operating systems, play networked games, and in general work with systems at a depth incompatible with the operation of a production instructional lab serving over one thousand students such as the campuswide labs at UCI or the main labs for the ICS department. In addition, the support staff was already busy supporting the existing systems, and having professional support would have defeated the desire of some to learn system administration first-hand.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.  
SIGCSE '99 3/99 New Orleans, LA, USA  
© 1999 ACM 1-58113-085-6/99/0003...\$5.00

There were a few preliminary meetings where a small group of interested students, the chair of ICS, and the existing support staff met to discuss options. It was decided that a room designated for lab space but currently unused would be allocated as a facility where undergraduates could manage their own resources. The department donated some computer hardware, primarily unused or unique equipment that did not work compatibly in the production labs, and student-managed computing was born.

Currently, the lab has the following equipment:

- Two Sun SparcStation 10 computers; one was a unique item in the department that was too much trouble to support, the other donated by an alumnus.
- Five Sun IPX workstations that were somewhat out of date and unused by the department.
- Two PowerPC-based Macintoshes purchased by the department.
- Four Intel-based machines running Windows NT, one of which was an unused lab computer, two of which were built by a class in custom hardware configuration, and one of which was donated by a local business.
- A NeXT cube that has been outfitted to serve as the UCF and departmental Webster server, which gives dictionary definitions for arbitrary words. The software can only be legally run on a NeXT machine because of licensing restrictions, and as such is hard to maintain.
- Five Intel-based computers built with components donated by current students or donated. These are not high-end machines; most are 486-level or low-end Pentium machines. They currently run Linux, FreeBSD, and Solaris.

UCF has wide-ranging autonomy to conduct its activities in ways that the students find useful. The specifics and advantages of this system are discussed in depth later, but we use the term student-managed throughout to differentiate this concept from that of more conventional student-run computing services. Many schools allow students varying levels of freedom in running a cluster of

computers, or simply a web server; however, very few institutions have experimented with giving students broad autonomy in the configuration, administration, and usage of a computing space.

The goal of UCF is to enable students to gain experiences that were not otherwise available in the department. As a means to this end, students have been given control over their computing resources. This leads to greater exposure to both technical issues, like network management and system administration, and social issues such as leadership skills and mentoring. The department chair decided to focus this lab on undergraduates because grad students were already adequately served with office space, equipment, and support. The lab is managed by undergraduate computer science majors, and is primarily designed for their use. Non-majors, graduate students, and alumni are not entirely excluded, but instead accommodated on a case-by-case basis.

The original goals of the UCF are still used as guiding principles:

- Provide an environment for students to learn practical information about computers.
- Foster interaction and collaboration among ICS majors.
- Provide computing services to ICS majors and alumni.
- Experiment with and investigate new technology.
- Provide non-mainstream computing services.
- Showcase the accomplishments of ICS majors.
- Stimulate the use of computing resources outside of class assignments.

## 2 Other student-run labs

Some efforts at creating a similar facility exist; however, the purpose and scope of these facilities is different from the intent of the UCF.

Some labs are staffed by students working under an existing professional management hierarchy. In these cases the students do not determine the services the lab provides, but the students deliver those services. Sometimes the labs are set up in a highly structured way to try to achieve a certain goal [1].

At Caltech, the (Undergraduate Computer Science) UGCS [2] Lab is a large cluster of computers designed as a primary lab that undergraduates use for introductory CS classwork. There are no restrictions on planned projects or contributions. They have a paid student administrator who is in charge. They differ from the UCF in size and purpose. Both the startup and maintenance costs of a lab similar to theirs is much greater than for UCF. They also have a wider scope of users, including faculty, staff, and all enrolled students. The UCF provides a place for solely

independent work, separate from concerns of availability for classwork.

UC Berkeley maintains two labs that are run by students. The Open Computing Facility (OCF) [3] is funded by the Associated Students, and aims to provide computing for the whole campus. Many students check email through OCF. The OCF is more concerned with the general needs of a large, heterogeneous group of students, most of whom just want simple services. In contrast, the UCF caters to a small number of students who are all interested in computing, and is more concerned with experimental projects and community learning.

The Experimental Computing Facility (XCF) [4] is more similar to UCF (and was part of the inspiration for the name), in that it is a project-based, student-run facility. It has produced many useful projects. However, it has a different purpose and its users have less autonomy. The XCF is designed solely for medium to large projects. Its members are expected to submit a detailed report of what the computing resources will be used for, a timeline for completion of this project, and show work has been accomplished at regular intervals.

UCF provides space and resources to accommodate both large projects and small ones. Simply wishing to learn more about computing or experiment with a certain technology is sufficient to join and use UCF; the process is based more on building a community of technically involved users than getting any particular work done. Projects are completed, but they are not the only goal.

## 3 The Environment

The first summer that UCF existed, the major effort concentrated on installing systems and rearranging the space to make it usable. Making the room feel inviting and unlike the sometimes sterile lab environment was paramount. The workstations were arranged around the perimeter of the room, with an island of terminals in the middle. This configuration was chosen so that conversations could be held more easily, avoiding the front-facing rows of computers common in the instructional labs. Couches were donated by an alumnus and put against one wall. Whiteboards are available for impromptu discussions or notes.

Students gain access using a swipecard system that accommodates the magnetically encoded campuswide student ID cards. This is an easy way to allow access, as no special cards are needed. Students wrote the program that would run on a server to recognize the card swipes and open the door. The facility is open 24 hours a day, including weekends, holidays, and breaks when the regular labs are closed. The door shuts securely, and the strike is reinforced so it cannot be easily kicked in or otherwise tampered with. Logs are kept of the swipecard accesses, though happily to date there has been no need to consult them. In fact, nothing has been stolen from UCF. Instead,

various equipment appears on a regular basis, brought in by students who don't need it, want to play with it, or think that the equipment would be interesting to others. None of the systems are locked to tables, alarmed, or protected in any other way. This contrasts with the other labs on campus where even things that are chained to desks and alarmed are stolen.

Preventative measures include asking for community awareness and keeping doors closed most of the time so that only those with swipecard access can enter. There is very little opportunity for a stranger to break into UCF without someone noticing.

#### **4 Relationship with Administration**

The professional support staff needs to be informed of various issues and requests for equipment and services must be made. If each member of UCF made requests of the support staff individually, the requests would often be confusing or conflicting. For this reason, we designate a single contact person between UCF and the administration at large. Any information or questions that need to be answered are passed along to this person by both sides, and he or she is responsible for making sure that a response is gathered and delivered to the appropriate parties. This person also filters the requests so that conflicting ideas are resolved before requests are passed on.

A low-impact approach to interfacing with the support staff ensures they do not have to "baby-sit" the lab. If something goes wrong, it is handled internally, barring hardware failures that cannot be dealt with by undergraduates. This is mostly possible because of the wide-ranging autonomy that UCF is given. Allowing students to have more control reduces any administrative overhead resulting from UCF's existence.

One of UCF's innovative features is its autonomous, disconnected design. Nothing in the room is linked to or dependent on departmental systems, except for network connectivity and power. UCF maintains its own mail, web, file, print and every other kind of server, and is given full control over issues such as machine naming, DNS, physical layout and networking issues inside the room. A whole subnet is allocated to UCF, so we do not have to worry about conflicting with other systems.

#### **5 Internal Support Structure**

The main concept behind the internal support structure of UCF is to have as little of it as possible. Involved students usually have busy schedules, which complicates finding time to perform administrative tasks on a regular basis. A classic task-based concept where one person is in charge of each platform would be unworkable, as would a hierarchical setup where one person (or a few people) must constantly be around to help and approve any changes. Instead, students are given privileges as they show that they

can contribute in those areas, and they are simply trusted to not do things that they are not supposed to.

The UCF community is very tolerant of things not being "correct", a concession that allows for the experimentation of others. By not dealing with things that are inconsistent immediately, issues often get resolved by students who would not normally be considered "in charge". This reduces the workload of knowledgeable students. Since any student with initiative can fix almost any problem, issues get resolved quickly, even if not formally. It also can reduce administrator workload by being able to tell a student how to solve a problem instead of doing it for them. If a certain piece of software is not installed on a system, the administrator can give the person the CD and tell him or her to install it.

Another motive behind not providing as much support as other labs is the fact that students who do not know "the answer" will often learn more by being allowed to experiment and try to find the answer for themselves. This is possible because other users tend to disregard temporary instabilities while the student figures things out.

#### **6 Advantages of Having an Open System**

There are many advantages of having a system that is open to experimentation and is not constrained for other reasons. These advantages include practical experience not provided by courses, in-depth explanations in a comfortable setting, opportunities to use specialized systems, and non-artificial group work.

As already mentioned, giving students more opportunities frees others from supporting them. It also allows for learning that is seldom available in courses. Students take many classes that use the Solaris operating system extensively, yet few would be able to install and configure the operating system.

The more informal environment also encourages storytelling, and more complete explanations of issues than in a lab setting. Everyone who is interested in something can gather around, grab a chair, and take over part of the room. The informal and easygoing environment allows students to learn subjects more deeply. Students also see the fixes to small problems that aren't explicated by error messages and that, in a conventional environment, would be handled by filing a report with the support staff and receiving a reply like, "It's fixed now." (For example, user profiles not downloading in Windows NT may be caused by a full disk, or CGI may not work on a web page because it needs to be enabled in the configuration file.) If the person fixing these problems is present, and is a peer, the student will learn much more.

Students can investigate subjects that the support group may not have any knowledge of, which is an added advantage. For example, one student had heard about Be, an operating system that has good audio-visual capabilities and is designed to install smoothly on Macintosh

computers. Instead of having to allocate machines, hire someone knowledgeable about the operating system (or train them), and have a staff member install the OS, the student was just turned loose on a Mac and allowed to install and learn about the system. As a side effect, many others used it too, and learned about this system that never would have shown up in a lab setting.

Group skills are vital in the "real world," but achieving realistic teamwork in an academic setting is always constrained by term length, grading, and students' other commitments. UCF fosters teamwork naturally, since students know each other, are around to do things together, and have a common place to meet that is both technical and fun.

One major advantage of an open system is that those who would be excluded from helping in a conventional lab are encouraged and invited to continue sharing their expertise.

In the CS department, and in the campus computing clusters, students' accounts are deleted shortly after they are graduated. But alumni at UCF, especially those who were involved in UCF as undergraduates, are encouraged to participate. Many times, the most knowledgeable people are seniors, but it is hard to involve them when everyone knows they will leave. With this system, if they are still interested in helping they are more than welcome. Some alumni who were involved in the founding of UCF work at Sun Microsystems. Who better to ask about Solaris?

## 7 Lab Activities

There was initial concern by both students and administration that the lab would be used solely for gaming. This has proven to not be the case. Games are played at UCF, and are not discouraged; although by unwritten rule games have a lower priority than other sorts of work that everyone generally agrees are more productive. Games are useful as a way to motivate people who may have less computer experience to become more comfortable using computers, and in an environment such as UCF usually leads to doing things that are unrelated to the games themselves, such as configuring systems or chatting about the failures of the AI routines for computer players. Games also provide an opportunity for social interaction. There is also, however, some positive peer pressure among members to contribute back to the community in the form of projects or time.

Some of the ongoing or completed projects include:

- Running a qmail-based mail server that handles approximately 200,000 messages a day for the campus radio station mailing lists, among others.
- Assembling a Linux box out of parts to run software for a webcam.
- A full text searchable archive of the Toyota MR2 mailing list.

- An interest group in computer music that includes some very talented musicians.
- An interest group in graphics that uses UCF's resources for parallel rendering and collaboration.
- A weather page for the campus with current temperatures and forecasts.
- Administering the systems, and keeping them on the bleeding edge and functional.
- Various personal collections of photographs.
- A student-run lecture series on topics from writing graphics demos to music to administrative discussions.
- Various social outings, including BBQ's, parties, and sports (we also have our own indoor soccer team).

The interaction among students is also one of the major goals of UCF. Here, people feel comfortable relaxing, spreading their materials out on the tables and chatting with others. This interaction often leads to impromptu lessons on the whiteboards. This provides a useful contrast to the labs, where the atmosphere may be more like a library and people might feel uncomfortable about asking a question.

Finally, of course, the room and its computers must be kept in some sort of usable condition, or it would be impossible to get anything done. On their own initiative, students who are not directly involved in system maintenance often clean up the tables, organize random computer parts, reinstall software, or free disk space. All these are actions that are not requested formally by anyone, but instead just arise from a feeling of community.

## 8 Policies

Policy at UCF is largely unrestrictive, and the boundaries of unacceptable actions are common sense, for the most part. A guiding policy is that if you need something, you can have it. Students are encouraged to find innovative ways to solve problems; for example, if storage is too limited to house a large archive, students often resolve the problem by bringing in their own hard drives. Instead of rejecting a request for a unique or large amount of resources, the student is encouraged to figure out how we can grant the request.

At present, use of UCF is on a membership basis. All CS majors are invited to join. We hold orientation and sign-up meetings, at which we generally talk with each interested student. We explain how the facility operates, and what resources might be useful for any specific project they have in mind. Any CS major who can give some reason for wanting to use the facility is welcome to join; if a student's stated reason is only playing games or doing homework, we suggest that UCF has much more to offer. If they obviously do not care about learning about computing, we usually suggest that other facilities on campus might suit their needs better.

In most labs, the students are not trusted, but at UCF trust has been an effective policy for dealing with a wide range of issues. We keep backups in case someone does something destructive unintentionally, but for the most part everyone tries to do what is right. Even those who are not major contributors seem to realize that it is in everyone's best interests to keep things the way they are and not ruin the environment for others.

We have 140 members, roughly 20% of all CS majors, and about 50 of them spend more than an hour a week in the UCF. The most involved individuals may spend 20 hours a week or more at UCF. There is the possibility that UCF will become a victim of its own success, but we have not yet had to address that issue. The room is occupied 18 to 20 hours every day, which is another indication of its success.

## 9 Retaining Technically Skilled Individuals

To have a successful lab, the members must include a small core of gurus, students with broad, strong technical skills, a certain amount of free time to apply those skills, and the ability to interact with other students. These people are vitally important to having an environment that works.

The gurus we have usually try to focus on certain areas. What each one contributes:

- A few have very wide-ranging knowledge of Unix, PC, Macintosh, and esoteric hardware and software. They can handle almost any problem.
- Windows NT/95/98, especially hardware installation and domain issues.
- Network configuration and DNS; webmastering and CGI.
- Unix skills, including getting compilation of new releases and cutting edge software.
- MacOS, BeOS, Macintosh hardware, network configuration.

Less likely to succeed would be a group with interest but no broad technical knowledge. There must be some people who know how to recover a crashed mail server, fix that odd network failure, and can help teach others how to do the same. Usually, the problem is retaining these people, since they usually find interest in a variety of activities. Retaining bright talent is a problem in any organization.

With a student-managed lab, however, there are built-in incentives for gurus to stay. They can have wider access to interesting machines, can install programs they are interested in, and can do things that might not be allowed other places on campus. Because they know more than the average person in the facility, they also end up having a position of partial leadership. When people, including gurus, begin to feel ownership of their machines, they will help keep them running. Many people at UCF have all of their mail forwarded to UCF since they can run any mail

program they want, with whatever customizations they wish. UCF also has a high-quality mailserver running that allows them to run mailing lists. So, since the gurus have time and effort invested in the mail server and associated utilities and are hurt if it is down, we have very good uptime and reliability. The same follows for other systems and their associated machinery.

There is a lack of documentation of systems that are available at UCF. This is the result of students having the time and interest to construct a project, but not the energy to fully document it. This is a problem primarily for new members, who have not seen these systems take shape. We are encouraging members to write at least a short synopsis of their projects.

Some students who sign up to use UCF never do. We are uncertain why, but we have made an effort to make the UCF welcoming to all segments of the student population. The number of women versus men and the ethnic mix of the community using UCF is roughly comparable to the department as a whole.

Related is the issue of group politics and keeping the lab truly open to new people. An open atmosphere in general seems to keep most group politics at bay, as does the fact that all members belong to both UCF and to the department of computer science. This somewhat homogeneous group therefore shares a common bond that creates a community.

## 10 Conclusion

The UCF has been in operation for over a year, and has successfully met all of our goals. The room is used nearly 24 hours a day, even during holidays and the summer months. Students have successfully completed many interesting projects, and many have learned about computing in a unique way. We feel that the UCF is an example of a system that is enriching for both the students and the department.

## 11 Acknowledgements

The author wishes to thank department chair Michael J. Pazzani and the founding students for conceiving of the UCF and continuing to support it, the companies that have donated materials, all the current and past students that have made UCF a success, and David G. Kay for providing invaluable assistance in writing this paper.

## 12 References

- [1] Haller, SM and Fossum, TV. Retaining Women in CS with Accessible Role Models. SIGCSE Bulletin 29
- [2] Caltech UGCS webpage. <http://www.ugcs.caltech.edu>
- [3] Berkeley OCF webpage. <http://www.ocf.berkeley.edu>
- [4] Caltech XCF webpage. <http://www.xcf.berkeley.edu>