School of Engineering - Computing Systems Innovation

Research Computing Infrastructure and Support

Major research computing services provided by the School of Engineering include:

File server:
engfiles00.ucmerced.edu runs as a virtual machine under OpenVZ. It shares the 6.0TB OpenVZ array to provide file service to users via WebDAV and SSH. Authentication of users is handled through the campus LDAP server, allowing anyone with a posixAccount entry to use the service. Over 2.0TB of user data is currently served on this machine.

We are in the process of setting up a new file server a Sun X4500, that runs Solaris 10 operating system. This computer has 4 physical duo-core cpu's (16 logical cpu's) and 16 GB of RAM. It provides 24 TB of storage on 48, 500 GB hard drives. There are four 1000 Mb Ethernet ports that this server as a multi-homed system to three different networks simultaneously.

This computer operating system provides the state of art file system access, reliability and data integrity. The files systems are designed to be redundant and highly available using raidz2 protocols. Additionally this server has hot swap spare drives ready to take over instantly for any hard drive failure and any of its hard drives can be replaced on the fly. This mean the server never needs to power down for these common types of repairs. The file server is also backed up up off-site, for extra data protection.

The Sun X4500 comes equipped with redundant A/C power supply's and we have added additional protection with our in-line UPS that maintains A/C power until the University's backup diesel generators power up.

Backup system: (engbackups01.ucmerced.edu) runs as a virtual machine under Xen. It has a dedicated 6.0TB array and already uses over 5.6TB. Another dedicated 6.0TB array has been added and will soon be in use. Backups of all other machines occur nightly using dirvish so that versions of each machine's file system are always immediately available for examination and restoration. Restorations are currently handled by administrative staff but a self-service (Web) user interface is planned.

Mail server:
(engmail00.ucmerced.edu) runs as a virtual machine under OpenVZ. It provides SMTP and IMAP mail services. A Web interface to mail is also available. User mail is stored in users' home directories as served by engfiles00.ucmerced.edu. An advanced spam-filtering SMTP proxy has also been developed.

Virtual servers:
We provide OpenVZ virtual machines upon request by users. Users are given root access to basic machines and are free to administer the machines as they like. These machines share a 6.0TB array and receive backups transparently. Right now, there are 31 virtual servers supported by the School of Engineering:

- 11 for individual faculty
- 9 for Information systems including the UC Camera System
- 5 web servers: We host more than 70 web sites (School of Engineering, Faculty, Research Labs, Graduate programs, Service Learning Program and teams).
- 3 servers to support the files and backups systems
- 2 Service Learning teams: Radio Merced and Yosemite
- 1 mail server

Web servers:
Engineering provides three primary Zope servers and others for special projects. These servers and others are accessed through front end Web servers so that they all appear as URLs with eng.ucmerced.edu or other custom domain names.

Instructional Computing Infrastructure and Support

The computing infrastructure provided to faculty by the School of Engineering as described above also supports most of the instructional computing needs of the School, though partitioned from research computing infrastructure. Installation and maintenance of instructional software is increasingly provided by the School such that more reliable service and maintenance may be provided to meet faculty needs. The School utilizes open source software to the extent possible in an effort to reduce costs, ensure efficient maintenance, and maintain software functionality and extendability.

A centerpiece of our computing innovation is reflected in our open source teaching/learning facility--Collaboratory--that has been designed and built by the faculty and staff of the School of Engineering represents an effort to provide an effective, relevant and flexible environment for educating the next generation of computer literate and technologically confident college graduates.

We believe that the following notable features make the Collaboratory a model for educational computing environments of the future:

- Complete reliance on Free and Open Source Software (FOSS)
- Minimal reliance on administrative intervention
- Commodity hardware
- Effortless remote access/interaction
- Effective student-to-student and student-to-instructor interaction
- Cost effective in terms of both initial hard-ware/software acquisition as well as operational costs
- Wireless and wired network interface

The central innovation of the Collaboratory involves the broad flexibility and accessibility afforded to students (and instructors) at virtually all levels of the laboratory environment. Many component technologies are needed to provide this open environment, and none of these components are particularly novel in isolation. While a primary feature of this laboratory is the comprehensive use of open source software, this is certainly not the first teaching environment to make use of such tools.

The utility of using open source software to teach computer science topics is well documented, with examples stemming from curricula in software design [1], operating systems [5], networking [4], security [3], and robotics [6]. Also, for many years, common courses in compiler design have made use of open source.

Our vision for the Open Source Collaboratory has been guided by the overarching goal of providing students a learning environment with minimal barriers. Our intent is for students to be able to manipulate their computing environments as needed without relying on administrative intervention and without running into administrative constraints. Students should also have tools available that will enable them to interact effortlessly with other people in the lab and beyond. Computing resources in the lab should always be viewed as tools and not hindrances. Part of achieving these goals will be complete reliance on Free and Open Source software (FOSS). Not only will this provide complete freedom in developing and maintaining our software systems, but it will enable transparency so that students (and others) can study and extend the capabilities we have developed.

The Collaboratory presently supports sixty seats for use by students during class instruction, and also for use outside class meetings, such as for completion of homework, research project involvement, and individual and group computing projects. The lab is also available for students in our Engineering Service Learning courses, and also for non-Engineering courses. The driving considerations in designing this lab were: (1) significantly enhanced usability, (2) strengthened security, and (3) efficient and effective systems maintenance.

Each seat in the labs is set for net-booting from a single boot-server. All machines are essentially identical, booting with a built-in PXE loader in roughly 73 seconds. An individual workstation acquires read-only NFS-mounted working disk space during boot-up. As part of the boot process UnionFS uses tmpfs to create a read-write root filesystem. Once a user logs in– another 23 seconds–she sees her home filesystem in /home/username, a link to the mount point.

Significantly, and due in large part to the open source systems being used to develop the Collaboratory, it is not only extremely cost effective, costing less than 25% that of a comparable computer laboratory, but is much less costly to maintain and expand. It is also extremely energy efficient, with the current collaboratories using about 20% of the energy of a conventional facility.

While our Collaboratory has already proven extremely valuable in supporting our rapidly emerging open source culture and our innovative new courses, there's plenty of work left to do. The facilities for session recording remain incomplete. We're exploring ways to accelerate display of remote sites, and building tools to simplify naive use of distributed resources. Security is, as always, a never-ending challenge. Quite a few small tuning opportunities remain: further reductions of boot-time; use of panning or scaling on the projectors to match the potential 1900x1200 resolution afforded by the workstation monitors; acceleration or replacement of VNC with NX or other technologies; integration of VoIP functions; innovations in collaborative processes; and automation of outbound VPN to peer sites are a few of the projects we might tackle.

School of Engineering Management Information Systems

School of Engineering Governance Committees Support System

This system originally developed in ZOPE provides the Curriculum, Resources and Academic Personal committees with a secure easy to use way to share existing or work in progress documents. The system was recently moved to Plone Content Management System (CMS).

Faculty Recruitment Information System (Wobble)

This information system consist of a database and reporting components for all applicants who had applied for faculty positions in the School of Engineering at UC Merced. The administration options include: assignment of committees members, internal/external reviewers, generate customized reports for individual applicants pools, and CAP packages for the selected candidates. This systems has been used for more than 5 years, it is an excellent repository of information of the faculty hiring process within the School of Engineering.

School of Engineering Faculty Meetings Management System

A general database driven meeting system that allows to post meeting agendas, minutes, documents and announcements for meetings. The system uses the central IT LDAP server for access control eliminating the need to create new login/passwords for faculty, the system has been used for more than 3 years.

Faculty Information System

A centralized secure object oriented database designed to keep research, grants, publications, teaching evaluations, awards and other information for individual faculty. The web interface allows each faculty to access their personal secure where they can update the information. This database is the core component o f the following reporting systems used within the School of Engineering:

- Faculty Biographical Information System (BioBib): This annual report is generated from the Faculty Information System Database for each faculty. In addition to the annual report, each faculty can generate a report for any given period of time.
- Faculty Merit and Promotion System: This report system creates individual access controlled websites dynamically for each faculty promotion case. A web interface allows the Academic Personal Chair to add/grant access to internal/external reviewers for each case.

Graduate Division Admission System (GDAS)

This system provides faculty with access to a database of applicants for graduate programs. The systems has a customizable workflow that helps faculty and staff with reviewing and evaluating process. The system is based in the integration of the graduate division application data collected by Banner system in admissions and the ZOPE database that provides the workflow functionality. The big challenge of this integration was to develop A SQL rely system needed to read the graduate division information from Operational Data Store (ODS) system implemented by central IT. The ODS system is developed in Oracle, our open source SQL rely server will allow users using other Database software (My SQL, Postgres, ZOPE database) to connect transparently to the ODS system. The system was developed and documented in house, it will will facilitate future developments of information systems that require access to multiple database platforms.

Users of GDAS will access it through a secure web interface developed in ZOPE. Roles are obtained from the central UC Merced LDAP, minimizing the maintenance of the system.

UC Merced Campus Web Camera System

The School of Engineering design and implemented and open source system to run four campus cameras located in SE1 building (2), Library (1), and residency hall (1). The systems allows the administrator of the system to setup predefined views for each camera, and capture from each of the cameras views in a full view of the camera. UCM CatCams

Data-Driven Website Development System

The goal of this ongoing project is to have the School of Engineering Websites generated dynamically from the UC Merced and School of Engineering existing databases. This projects had required the integration of diverse database technologies.

College One Website

This object oriented database website was developed in ZOPE. Along with general information, the site includes a Freshman Seminar system described below.

Freshman Seminar Proposal Submission System

The system consists of an object oriented database an a web interface that allows the online submission of proposal for freshman seminars by faculty and online revision by the committee members approving the proposals.

Service Learning Website & Document Archive

The School of Engineering is hosting the web site for the Engineering in Community Service program (EPICS). In addition is hosting the websites for all the Service Learning teams in each semester. The teams websites are created automatically by accessing the Office of the Registrar class roster for all the teams in real time. This interface to access the class roster was developed by The School of Engineering and it is planned to be used to control the access of specialized equipment for all classes taking place in the instructional labs managed by the School of Engineering. Each website provides the team with storage to share files related with projects and email tools to distribute information.

UC Merced Course Request Form Information System

The CRF Management System is intended to facilitate the development and processing or course request proposals at UC Merced. Developed initially by the School of Engineering with input from the Office of the Registrar, the system is designed for ultimate use by faculty from all academic Schools, with operational oversight and future design enhancements guided by the UC Merced UnderGraduate Council (UGC). The intent is for this system and its features to evolve to meet the ongoing needs of the UCM academic community. The content of this system will provide "official" data for use in developing the UC Merced course catalog in both on-line and print versions.

Use of the system and access to specific data and functionality will depend on the role, and associated permissions and access authority. After login in , access and edit authority will be immediately available based on the role that have been assigned to the user.

Teaching/Learning Assessment System and Database

This system was developed as an evaluation process to be cycled through as an integral aspect of each semester, visiting and revisiting the implementation of, and progress in, the SL program. This level of evaluation intensity can be sustained only through the inclusion of automated data management innovations. The system consist of an object-oriented database, which will be populated with objects representing the major conceptual units of the tracking effort: students, courses, service learning projects, student outcomes, etc.

Additionally, methods will be available that perform statistical analysis on objects such as calculating correlations between properties of object sets without returning individual object's data to the user. More generally, users will have access to the information in the database though a Web-based content management system built using an open source and scriptable applications development environment (such as Zope/Plone). Consequently, students will have the ability to design, develop, implement, and use their own personalized information systems supported by these data as appropriate. The system has been used also by The Office of Institutional Planning and Analysis to run two campus wide students survey during Fall 05 and Fall 06.