



EECS Instructional Computing - Review and Plans
Fall 2014 / Spring 2015

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Strategic Goals

Increase our support of services that directly affect the instructors and students. Reduce our time spent on computer hardware maintenance, within existing budget limits. Develop WEB-based and other resources to provide new services quickly and to increase staff efficiency. Consider virtualization of servers, enable student-owned computers.

Implementation:

- Continue lab upgrades (330/349 Soda, 200 SDH, 105 Cory, 200 SDH).
- Virtualize servers, such as autograders and print spoolers.
- Virtualize desktops, provide VM images for students.
- Provide a VM hypervisor service for classes? (ESXi, OpenStack, UCB VPS, AWS, ...); Survey the faculty to gauge the demand, seek a funding model.
- Provide desktop computers in the labs that are capable of running student VMs for specific classes.
- Provide a secure Github server instead of our SVN server. Survey the faculty to get a vote for their preference.
- Evaluate department support for a plagiarism checker.
- Evaluate department support for an autograder such as GradeScope.
- Enable on-line computer account registration and grading services.
- Enable CalNet authentication and authoring tools for course WEB sites.
- Enable student-owned computers in our labs (provide access to printers).
- Simplify the management of computer accounts and cardkey access.



Priorities

- 1) 330 Soda: renovate like 2xx Soda (tables, network, carpet) (\$60K)
- 2) 105 Cory: renovate like 199 Cory (tables, network, carpet) (\$40K)
- 3) 200 SDH: need replacement plan for 30 MacPros (CS10, DeCals) (~\$90K)
- 4) Icluster: need replacement plan for 26 cluster nodes (Dell 1950s); used for Mapreduce, Synopsys, MarkLogic (CS61A, CS250, EE241); 7 years old, although new RAM and disk have been added (~\$60K). We are preparing a grant request for this (Oct 2014).
- 5) Larger lab(s): in 2013, we had requests for labs of 40+ (EE20) and 50 (CS61A) seats.
- 6) Virtualization: support for backend servers and VMs for students

Recent Improvements

Since Spring 2013, we have upgraded nearly all of the workstations in EE and CS labs and the related servers. This is possible because of increased spending by the department on these facilities as well as generous grants from TI, Intel, SanDisk and Yahoo. It has corrected many problems that became critical following the severe budget cuts in 2008/2009.

Highlights:

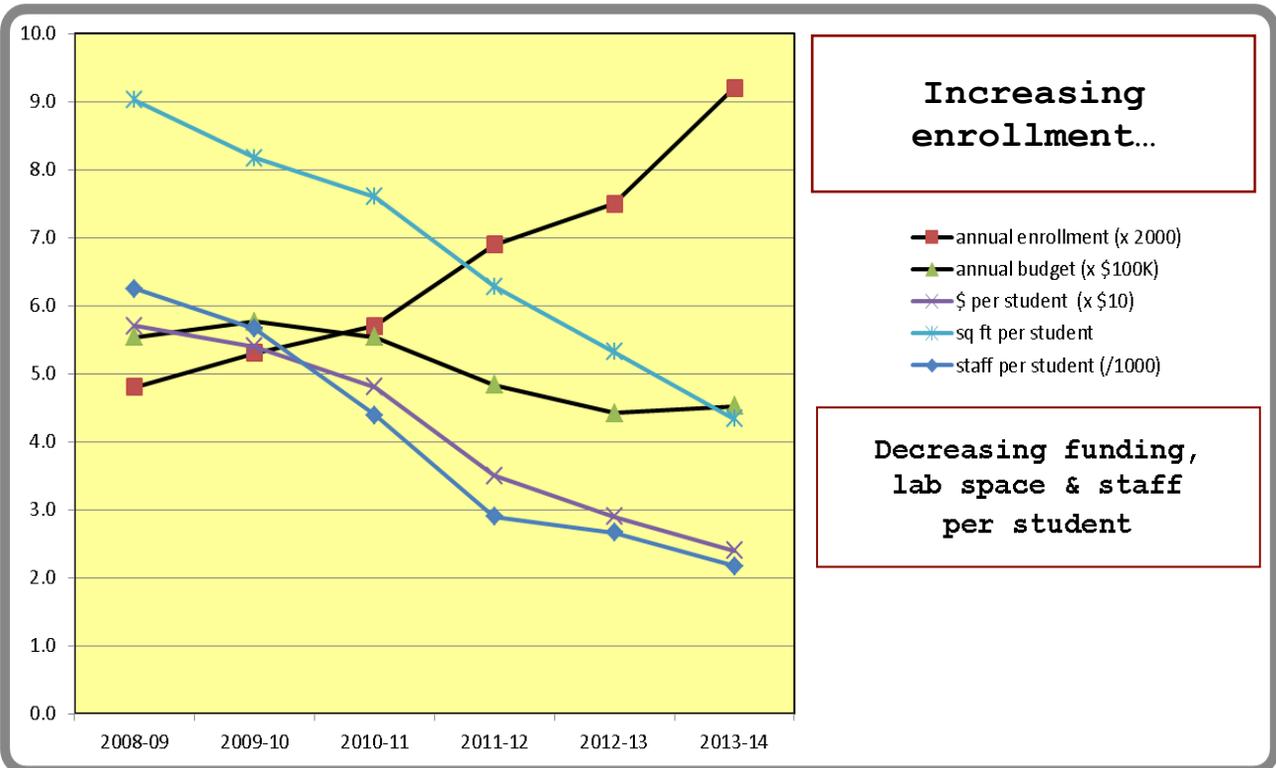
- 1) major lab renovations and new computers in 140 Cory, 199 Cory and the entire second floor of Soda. Most recently:
 - 330/349 Soda: purchased 46 new PCs with CUDA gpus for CS classes (\$72K, funded by dept); the renovation of the Soda third floor will provide these new computers and a large collaboration space in 337 Soda (<http://inst.eecs.berkeley.edu/~inst/3xxSoda/3xx-Soda-Renovation-Proposal.pdf>)
 - 125 Cory: installed 15 new PCs for EE classes (\$15K, funded by ISG)
 - 199 Cory: renovated lab (<http://inst.eecs.berkeley.edu/~inst/199Cory/>)
- 2) upgraded our servers used for CAD (Icluster, Hpse*), Windows apps (Wserver*) and programming (several Ubuntu servers).
- 3) largely converted our UNIX environment to Linux (Ubuntu and Centos).
- 4) added power and wired networking in several labs so that the desktop/laptop ratio in the labs now meets our goals for leveraging student-owned computers.
- 5) installed a virtual machine hypervisor (currently ESXi) for rapid deployment of servers for specific classes (CS162); provided a virtual machine image for instructors to distribute to their students (CS61B).



Budget Limitations

Our IT funding does not increase when enrollments increase:

- Since 2009, EECS course enrollments have increased by 43%
- Funding per student has decreased by 57%
- Staffing per student has decreased by 65%
- Lab space per student has decreased 52%



	annual enrollment (x 1000)	annual enrollment (x 2000)	annual budget (x \$100K)	\$ per student (x \$10)	ISG IT staff	staff per student (/1000)	lab space (sq ft)	sq ft per student
2008-09	9.6	4.8	5.53651	5.7	6	6.3	17327	9.0
2009-10	10.6	5.3	5.76364	5.4	6	5.7	17327	8.2
2010-11	11.4	5.7	5.53651	4.8	5	4.4	17327	7.6
2011-12	13.8	6.9	4.83183	3.5	4	2.9	17327	6.3
2012-13	15.0	7.5	4.42038	2.9	4	2.7	15962	5.3
2013-14	18.4	9.2	4.52048	2.4	4	2.2	15962	4.3



Analysis of the Repeated Downtime Events

Summary: Failure of the Instructional LDAP service caused our UNIX computers to be unusable for a total of about 45 hours over 7 incidents between September and November. Clock drift on the primary server may have started the problem. At first, we tried to repair the service. The incidents were exacerbated by slow recovery times for the server, the dependence of NFS on LDAP, the variety of the LDAP and NFS setups across multiple operating systems, and the occurrence of three incidents on a weekend or holiday. The symptoms to our users were

- frozen login sessions or the inability to login on all Solaris, Linux and MacOSX systems
- loss of access to UNIX home directories (including via Samba to Windows systems)
- loss of access to course WEB pages on <http://inst.eecs.berkeley.edu>
- delays in email delivery through icemail.eecs.berkeley.edu

Resolution: By Nov 12, we had completely removed our dependency on LDAP by installing static password and group files on each computer (clumsy but effective) and a static NFS netgroup file on the INST-FS filer. Our systems became stable again. We are working on a way to distribute password changes in this setup so that we can sustain it through the end of the semester if needed. We are preparing a new pair of servers running OpenLDAP. That is the same version that IDSG runs for the department, so we will be able to share expertise more easily.

We tried to inform our users via status reports on <http://inst.eecs.berkeley.edu/notices.html>, but the WEB server was often down. In the future, we will enlist students to post updates to the major Piazza sites.

Analysis: It is SUN LDAP running on 2 redundant Dell PowerEdge PIII 2GB-RAM servers, circa 2002. The Solaris and LDAP software has been patched and upgraded as needed. The LDAP service was a single point of failure for 2 functions:

- 1) **UNIX user authentication:** UNIX logins and file ownership
- 2) **UNIX file system access:** the IDSG-managed INST-FS filer got its NFS 'netgroup' from this ISG-managed LDAP service. In normal operation, this was a convenient way for ISG to directly edit the netgroup list on INST-FS without asking the IDSG staff.

The failures started when, without warning, LDAP would continue to accept requests but stop answering. This prevented the clients from failing over to alternate sources (such as the second LDAP server or local files on the client system). It took 30-60 minutes to restart LDAP as the server rebuilt its maps. It sometimes failed again soon afterwards. We believed that the primary LDAP server was causing the problem. After the initial failure in September, we discovered that the time daemon had failed on the primary server, and we suspected that clock drift had corrupted the data. Trying to avoid more downtime, we stopped replication between the 2 LDAP servers and reconfigured each of the client computers to use only the second server, which had been stable. This worked for about 3 weeks without incident. During subsequent incidents, we were able to speed up the restart time by



using 'tcpdrop' to change the state or drop open connections before restarting the LDAP server. We also tried shortening and coordinating the timeouts of these connections on the server and the clients, but that did not prevent the failures. Cutting the LDAP and NFS dependency required attention to these related mechanisms on the various operating systems:

- **/etc/{passwd,group,nsswitch.conf,auto_*,auto.*}**: change data sources from "ldap" to "files"
- **/etc/{ldap.conf,openldap/ldap.conf, pam_ldap.conf}**, **`ldapclient`**: reset LDAP config
- **/etc/{netgroup,exports}** : verify accuracy on the INST-FS NetApp filer
- **automounters** kept file systems mounted until an idle timeout, then could not remount them
- **NFS and LDAP caches**: clear or reboot

Incidents:

Fri Sep 12, 2014 10am-10:20am	Some UNIX systems froze, caused by a loss of connection to one of our LDAP servers. This was actually a successful LDAP failover: user authentication continued via the second server. The temporary loss of service was during the time delay for the NFS server to failover to our redundant LDAP server.
Fri Sep 26, 2014 noon-2:15pm	UNIX accounts were frozen. LDAP rebuilt its databases.
Sun Oct 19, 2014 11am - 10:45pm	UNIX accounts were frozen. LDAP rebuilt its databases. We worked from home to restore service.
Wed Oct 22, 2014 3:45pm - midnight	Lost both LDAP and NFS services again. We worked to isolate the clients to just 1 LDAP server and started to decouple NFS from LDAP.
Sun Nov 9, 2014 5pm-midnight	Lost both LDAP and NFS services again. We worked from home to restore service. User authentication was still using the second LDAP server.
Mon Nov 10, 2014 noon-midnight	The LDAP service was up and down again. We installed local files on the UNIX computers, which eliminated the dependence on LDAP for user authentication. This still (unexpectedly) broke NFS for some filesystems.
Tue Nov 11, 2014 8am-10:30am	The LDAP server and NFS went down again. We couldn't fix NFS on a holiday (Veteran's Day). Staff worked from home to restore both LDAP servers and some NFS service.
Wed Nov 12, 2014 midnight-12:30pm	The ongoing problem with NFS prevented the course WEB pages from being accessed through the WEB server, and stalled the email server. It was fixed by correcting the netgroup file on Inst-fs and flushing its cache.
Thu Nov 13, 2014	Logins, home dirs, email and course WEB sites are finally stable again.



Mission Statement

The EECS Instructional Support Group (ISG) installs and maintains networked computers that are used by EECS classes. ISG provides computer accounts for instructors and students in the Instructional labs and on Instructional servers. ISG purchases, installs and maintains application software needed for classes. ISG supports instructional labs in Cory Hall, Soda Hall and Sutardja-Dai Hall.

ISG wishes to anticipate and meet the computing needs of instructors and students in EECS courses and to provide support for new and innovative learning environments. We wish to be accessible and responsive to requests for service. We also wish to learn about new and interesting technologies that may be of value in this service.

Organizational Scope

The major, ongoing responsibilities of ISG are to manage:

- ▶ computer accounts for 9000+ students in 100+ classes each semester on the EECS instructional computers; cardkey access to the labs
- ▶ systems administration of Windows, Linux, Solaris and MacOSX operating systems and application software, including licensing and security
- ▶ servers for email, WEB, SVN, autograding
- ▶ 180 desktop computers in 7 CS labs (Soda Hall, Sutardja Dai Hall)
- ▶ 150 desktop computers in 8 EE labs (Cory Hall)
- ▶ 80 compute servers in 4 clusters (Icluster*, Bcom*, Hpse*, Wserver*)
- ▶ 12 compute servers (Ubuntu, Solaris) for CS lower division classes
- ▶ dynamic allocation of additional servers as needed for classes
- ▶ customized software support for instructors and student projects
- ▶ physical condition of 10 computer labs

These are functions in which ISG interacts with other UCB support groups:

- ▶ we use EECS department services (IDSG) for Active Directory, disk space, network access and security scans
- ▶ we synchronize our user accounts with the EECS department (IDSG)
- ▶ we obtain enrollments from the Registrar (Student Information Services)
- ▶ we obtain cardkey numbers from the CAL1 office
- ▶ we submit cardkey authorization to our labs in batch uploads to UCPD
- ▶ we bill students' voluntary printer charges to CARS
- ▶ we manage the computers in engineering labs with ESG
- ▶ we manage the licenses for Synopsys/TCAD/HSPICE with the Device Group
- ▶ we manage the licenses for Cadence with the BSAC group
- ▶ we manage the licenses for Maya and Renderman with the BCAM group



Notable Events

See <http://inst.eecs.berkeley.edu/notices.html> for current events.

For additional reports, please see <https://inst.eecs.berkeley.edu/reports>

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