

Using General-Purpose Computer Labs for Online Testing

Dan Astoorian <djast@ecf.utoronto.ca>
Engineering Computing Facility

Alan Rosenthal <flaps@cs.toronto.edu>
Department of Computer Science

Getting rid of paper

In courses in Engineering and in Computer Science, we have replaced most use of paper with computerized versions:

- problem sets are distributed on the web
- student solutions are submitted electronically
- grading by TAs is done electronically in many cases
- return of course work to students is done on the web.

Tests and exams remain an exception to this, always being done on paper...

until now!

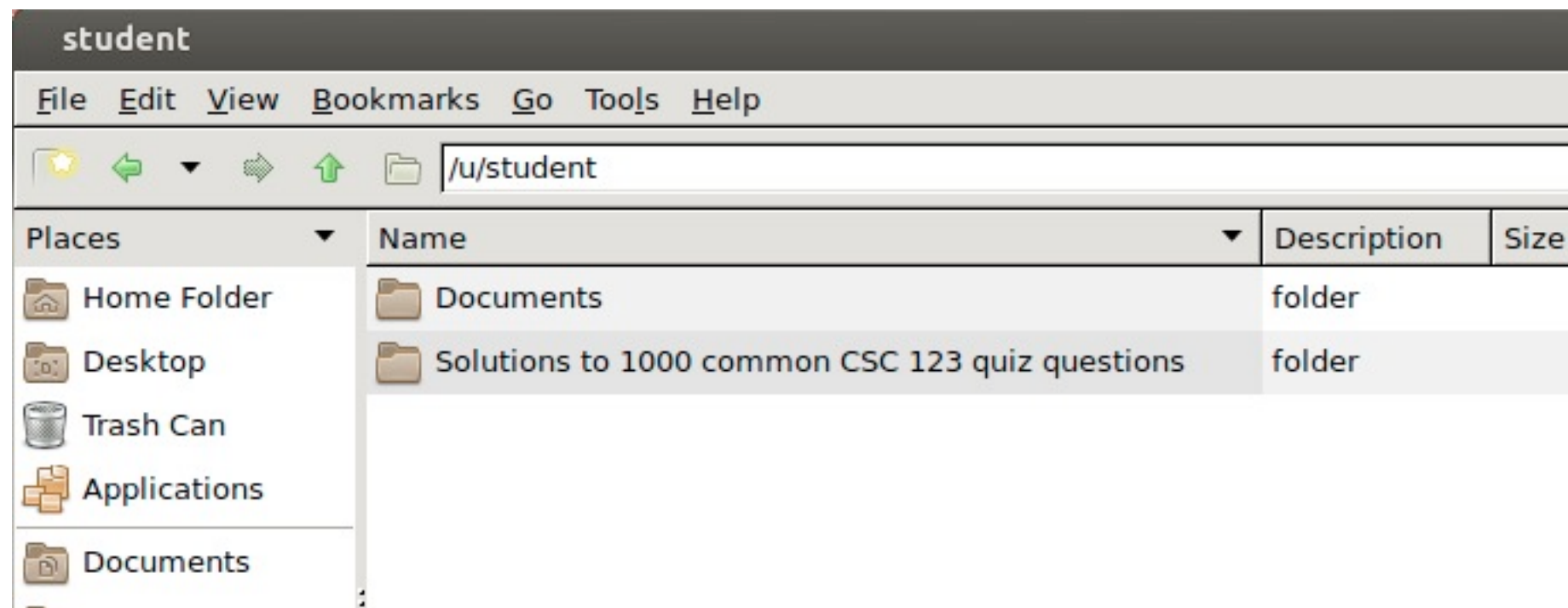
Online test facility

Objectives include:

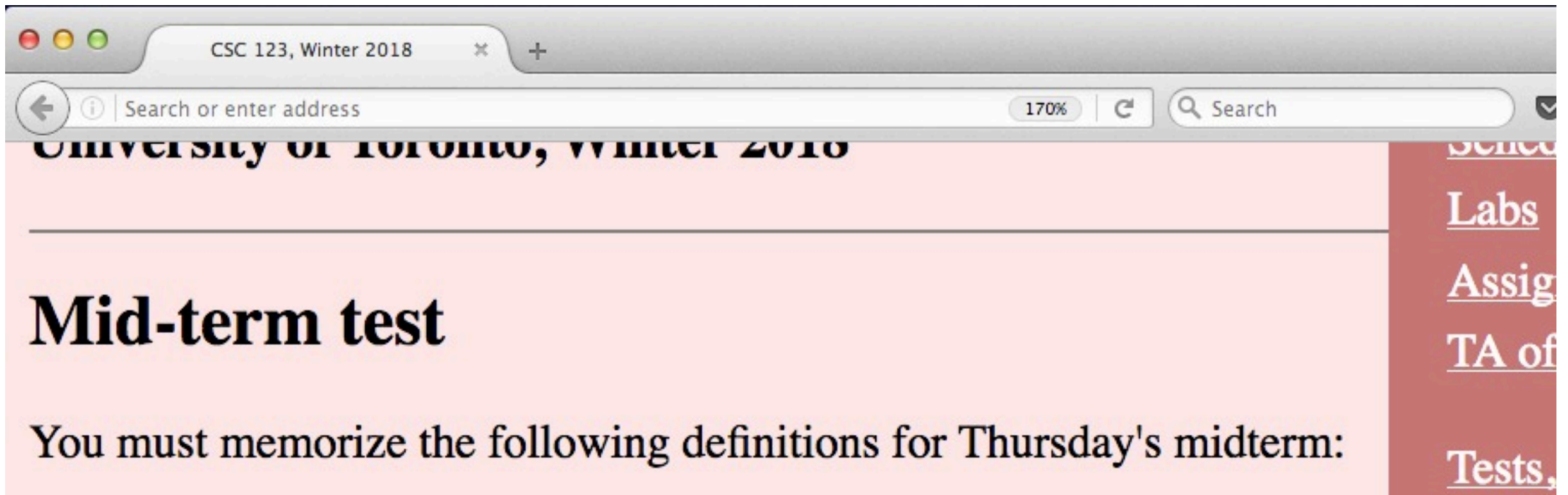
- a more realistic practical computer programming test
- have students write in word processors for on-line grading
- have students write on computer simply to avoid difficulty reading handwriting
- any of the usual advantages to computerizing a formerly paper-based process.

Exam security

The usual function of our computer labs is not exactly aligned with the security requirements of tests and exams.



Exam security



Exam security



Specialized exam rooms?

We *must* use our existing general-purpose labs for these tests and exams:

- no additional equipment money
- no additional space
- no additional staff to run new labs

More requirements

- Must look like a normal ECF/teach.cs workstation
- (for CS) Students can submit their work on MarkUs
- Nevertheless, no access to “the internet”, e.g. MarkUs
- Prevent running arbitrary programs
- Remove other access to contraband materials or communication channels
- Students should also not be able to send materials *out*

Different requirements

Different courses have different exam requirements, e.g.

- only allow a web browser
- allow word processing or other “light computing”
- full development environment

ECF environment

ECF has both Linux (Red Hat) and Windows labs

- Linux: 177 workstations across two labs
- Windows: 171 workstations across three labs
- Usually a course uses one platform or the other, although large courses (e.g. APS105) may require enough seats that we need to use both at once.

Special exam accounts

- Students mustn't be able to access their own files
- Two approaches:
 - One exam account per student; or
 - Shared exam account (isolated)
- ECF has used both approaches

“Exam Mode”

- Script to put workstations into “exam mode”
- Uses a shared exam account
- Exam mode home directory is only mounted while the workstation is in exam mode
- Exam account storage is associated with workstation
- Pro: Less bookkeeping
- Con: more preparation time and coordination

“Exam Mode” workstation restrictions

- Some filesystems unmounted or made inaccessible
- Normal ECF accounts disabled
- Mail submission is disabled
- Inbound SSH access is restricted to administrators
- USB and optical drive kernel drivers disabled
- Temporary directories cleared

Account restrictions (Linux)

- iptables rules are always in place for exam accounts
- Xsession startup script identifies “kiosk” accounts by the /etc/passwd shell field
 - normal desktop setup is bypassed
 - startup script tailored for the specific exam is run instead
 - typical: window manager, maybe a clock, and the main application(s) needed (e.g., web browser, LibreOffice, etc.)

Workstation restrictions (Windows)

- Individual exam accounts are created in AD, with group policy restrictions for USB, Internet, etc.
- Exam accounts have access to read/write home folder and write-only submit folder
- Students are responsible for copying and pasting their work to the submit folder to submit their exam

Before the start of the exam:

- Set up, customize, and test the account environment on one workstation
- Create a tar archive of the prototype home directory on the fileserver
- Run a script to generate copies of the home directory for each workstation to be used during the exam

Just before the exam:

- Disable printing
- Clear students out of the lab
- Run script to put workstations into exam mode,
e.g.: `/local/adm/examws start esc203`
- Reboot workstations

During the exam:

- Instructors usually have the students fill out a slip indicating which workstation and/or exam account they are using

After the exam:

- Ensure all students have saved their work and logged out
- Run script to take workstations out of exam mode,
e.g.: `/local/adm/examws stop esc203`

Accessibility

- The Exam Centre computers have the RDP client
- ECF provisions Remote Desktop computers dedicated to connections from the Exam Centre
- Linux (future): We would probably use VNC
 - Word-processing-only exams can be accommodated directly by the Exam Centre

Computer Science exam mode

- Just started this year
- So far, only weekly small quizzes
 - Some submitted on computer; some on paper but with computers available for testing
 - In both cases, need the full programming environment
- Rapid sessions
- Home directory data is lower value than in ECF's case

CS: Sysadmin requirements

- We're not willing to commit to being here evenings or weekends
- Careful permissions as to who can start and stop “exam mode”
- “Exam mode” must automatically terminate

CS: Basic technique

- “startexammode” checks permissions, creates file “/exammode”, reboots
- Early in the boot process, check for this file and take the machine into or out of exam mode
- No NFS mounts in exam mode
- Disable queueing new e-mail messages too...
- Create and pre-populate “examuser” homedir
- Heavy use of iptables rules

(continued)

CS: Basic technique (*cont*)

- Schedule an ‘at’ job to take the computer out of exam mode at the specified time
- User logout causes the homedir to be archived and a new empty one created
 - it’s our secret that we don’t actually just delete it
- command service (on a TCP port) allows the TA to log out all workstations, or to terminate exam mode

CS: “MarkUs”

- “MarkUs” is a web grading program much used in the Computer Science department
- Faculty want students to submit their completed quiz on MarkUs
- Nevertheless, must not be able to access MarkUs for their previous assignments, quizzes, etc, nor to access the quiz on MarkUs after leaving the exam mode lab
- Solution: A new MarkUs instance for exam mode...
- Exammode MarkUs checks that caller is on an exammode workstation...

CS: Exam mode startup woes

- Reboots aren't always clean...
 - NFS issues...
 - systemd configuration bug...
- Students enjoy switching workstations off, but `startexammode` can only start exam mode on workstations which are on...
- Spiffy do-everything script planned...

ECF: Exam mode woes

- Technical problems are rare...
- Students don't always follow instructions
 - fail to save their work as instructed
 - (Windows) forget to copy their work to the submit folder
 - we try to locate their files...