

Using a Web-Based Tour Registration System to Track Student Preference and Attendance

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Abstract

The Introduction to Engineering and Science course at Clemson includes attending tours of selected engineering and science departments. A system using sign-up sheets, although it had been improved incrementally over years of use, still had significant drawbacks for students, faculty, and the General Engineering Program staff. A web-based registration system introduced in 2001 and improved in 2002 not only proved to be an elegant solution to these problems, but also provided more flexibility than ever before. The paper includes snapshots of the inputs to the registration system at various points in time and a description of the implementation of the system, including the database structure.

Clemson's Introduction to Engineering and Science Course

The Introduction to Engineering and Science course is the first course in Clemson's General Engineering curriculum. Clemson's General Engineering program has coordinated the common first-year engineering curriculum since 1985.¹ A closer relationship with the sciences has developed as a result of a reorganization that created the College of Engineering and Science in 1995.² Most recently, this relationship led to the addition of introductory science content and perspective to the Introduction to Engineering course to create an Introduction to Engineering and Science course.³ The course in this new format is required of all students in the General Engineering program and is described in greater detail elsewhere by Ohland, Sill, and Crockett.⁴

Tours as a Required Course Component

Each of the departments participating in the course offers "open house" tours during the semester. In 2001, students were required to visit at least three tours of engineering programs and two tours of science programs. In 2002, this requirement was changed to require attendance at five total tours, including at least one engineering and one science tour (this change had little effect on the overall distribution of attendance, but provided more flexibility to a minority of students.) Before the tours begin, other course elements help students to narrow their choices down to a few departments that most interest them. The tours then provide an opportunity to see a program in its own element—with its faculty, graduate and undergraduate students, and its facilities. Tours

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are conducted in the evenings and there are at least two opportunities to visit each department—at a minimum, departments hold tours on two days, one chosen from Monday, Wednesday, and Friday, and the other chosen from Tuesday and Thursday, and over a range of times from early afternoon through evening on both days. Students with conflicts are expected to make arrangements to attend the tours, and have ample time to accommodate this. Tour sizes are set by the department and range from 15 to 40, depending on facilities and on demand. Tour attendance counts significantly in the final grade, since each tour counts for 6 percent. Tour registration occurs about a month into the semester, once a complete tour schedule has been determined, and once students have enough information to select tours. The General Engineering and other departmental offices are not responsible for coordinating the tours.

Tour Management Using a Paper-and-Pencil System

In the fall semester of 2000, tour registration was managed by using sign-up sheets. Each department provided coauthor Collins with the number of tours they would host per day, the beginning times for each tour, and the number of students they could accommodate in each tour group. She used that information to make sign-up sheets for each department. Notebooks were created that sorted the sign-up sheets chronologically by department. Students were informed when the sign-up sheets were available, and students who wanted to take a particular department's tour would come to the General Engineering office, look in that department's notebook, find a date and time that was suitable, and sign up on the appropriate sheet.

At the end of the registration period, the sign-up sheets were photocopied and copies were given to the respective departments so that they would know how many students to expect per tour and so they could take attendance. Attendance was taken by having the the students sign next to their (printed) name on copies of the sign-up sheets. Students were told in advance (and reminded several times) that they were only guaranteed credit for attending a tour if they had previously signed up to attend that tour during that specific time slot. This allowed the departments the discretion of allowing students to sign in if there was room in a tour.

Difficulties with the Paper-and-Pencil System

In previous years, there were problems with students who signed up for full tours by writing their names on the back of the sign-up sheets or in the margins. In an attempt to prevent that, the sign-up sheets were printed front and back and left very little margin so that there was no blank space for to use to write in extra names. The students were warned in class and with written instructions posted at the registration desk that only names on numbered lines would be considered valid registration.

Another problem in previous years had been students showing up for different tours than the ones they had registered for, which made it impossible to prevent overcrowding, and defeated the purpose of having a sign-up sheet. Using the sign-up sheets as tour attendance roll sheets helped overcome that problem.

For the staff in the GE office, the primary frustrations with paper-and-pencil tour registration were managing the flow of 800 or so students who came by the office to sign up for the tours, and dealing with the pleas of those students who came by after the sign-up period was over. This system was also inherently unfair to students who heard that the lists were available later in the day, because some tour times would fill up quickly. As a result, students in the earlier classes would give their friends in later classes advance warning, thus worsening the problem of managing the flow of students.

Furthermore, establishing an accurate forecast of student tour attendance using the paper-and-pencil system required a review of all the pages in all the notebooks. This forecasting is essential to ensure tour availability for the students and to give planning information to the faculty who deliver the tours. The burden of manual review prohibits the discovery of a variety of more complicated errors in the sign-up sheets:

- Students signing up for tours with conflicting times
- Students failing to sign up for enough tours
- Students signing up for the wrong combination of tours (something other than 3 engineering and 2 science)
- Certain tour times go underfilled

The paper-and-pencil system also requires paper record storage, since these records must be used to investigate challenges by students who claim to have not received credit for a tour they attended. Students also refer to the sign-up sheets to verify that they had met the tour requirement, a redundant step taken by many grade-conscious students.

A New Web-Based System for Tour Management

In the fall semester of 2001, a web-based tour management system was introduced. This system was designed by the three authors and programmed by co-author Foreman during the summer of 2001 in order to alleviate the many problems inherent in the paper-and-pencil system. This system included a pre-registration component to help with forecasting and a registration component both to register students for the tours and to keep track of attendance. Students could visit the tour registration website directly or follow a link from the course WebCT site. Using the website, students indicated their tour preferences early in the semester, checked the tour schedule, signed up for tours, and confirmed that their attendance had been recorded.

The Pre-registration System

Early in the semester, a special module surveyed the students regarding which 3 engineering tours and which 2 science tours they anticipated attending. This information was used to help departments decide how many tours to offer. This provided important information to the science departments, who were giving tours for the first time, and did not know how many to expect. The pre-registration module only tracked students and their preferences, since tour schedules were not available. During registration, students were not required to maintain any correlation to their pre-

registration requests. This system was disabled in 2002 as a result of the data gathered on student preferences in 2001 and because of the predictability of student preferences as discussed later.

The Registration System

The General Engineering Tour Registration System consists of three modules. The three modules are respectively designed to perform the following functions:

- to download data from the Registrar's database on the mainframe and populates a table in a smaller database dedicated to tour registration;
- to allow students to register for tours, review their tour schedules, and change their minds about which tours they want as often as they wish;
- to enable administrators to monitor registrations, record attendance, and track compliance.

The tour registration system, like all computer programs, is capable of imposing certain restrictions with 100% compliance. Some of the criteria imposed by system design are:

- students cannot register for a tour beyond its capacity
- students are permitted to sign up for no more than 4 engineering tours and 3 science tours (one more than the minimum in each category)
- students do not appear on a tour roster unless they have registered

Platform

All three modules run under the Redhat Linux 7.2 operating system on an Intel platform. The database is MySQL. The programming language is Perl. Presentation to users is through a web interface, meaning no custom software is required on users' PCs and making it possible to connect to the system from any computer that is equipped with browser software. The web server software is Apache.

Operational Description

The download module runs five times per week so that adds and drops are reflected in the tour registration database. Downloaded data is limited to those students who are enrolled in the course. Populating the tour registration student table this way eliminates the requirement that the students enroll themselves in the tour registration system and ensures that the information used to track the students is accurate.

General engineering administrative staff populate the database with tour schedules for each department through a web interface. Attendance can be taken multiple ways:

- accessing the web-based system live at the tour;
- printing a roster to use as a checklist and recording attendance later using the web; and
- having students turn in a copy of their tour schedule.

The first method is paperless, and is clearly preferable. The second uses approximately two sheets of paper per tour. The last option uses one piece of paper per student per tour, or 3500 sheets.

The scheduled tours are visible to the students through their web interface. They register by clicking on the tours they are interested in. They can change their minds about the tours they want any time prior to the start of a tour. If they miss a tour they have registered for, they can register for other tours that happen later; i.e., the system only indicates they are out of compliance if they fail to register for and attend a sufficient number of tours, not if they fail to attend the tours for which they registered. There are system-imposed limits on the number of tours for which the students can register. The administrative web interface allows identification of all students who have not met tour registration or attendance requirements.

Data Structures

The student table (Table 1) is populated by the download module. The term is an identifier for the term during which the student is enrolled in General Engineering. This makes it unnecessary to clear the database from one semester to another.

Table 1. Student Table Data Structure

Student ID
Social Security Number
Computer User ID Name
Section Number
Term

The schedule table (Table 2) is populated by administrative staff through a web interface.

Table 2. Schedule Table Structure

Term
Department
Description
Start Time
Duration
Origin Point
Capacity
Available Positions

The term field is an identifier for the term during which the tour is offered, again making it unnecessary to clear the table from one semester to another. It is possible to put events into the schedule that are not tours. For example, the Chemistry department might put a chemistry exam on the schedule to make sure that other departments do not schedule tours during that time

period. An entry is created in the registration table (Table 3) each time a student enrolls in a tour. The attendance field is initially set to “no”. When an administrative staff member records attendance, this is changed to “yes”.

Table 3. Registration Table Structure

Student ID
Term
Department
Start Time
Attendance

Originally the system was designed so the registration can be deleted by the student until attendance for the tour is recorded, and the record is frozen. The term denotes the term during which the tour is taking place, making it unnecessary to clear the database each semester.

Needed Enhancements

There were several errors that students made that were frequent enough that system enhancements are warranted to make sure the students are protected. The tour schedule was presented in tabular form, and most students selected the first available date and time slot for any given tour, because it was the first one they saw. This caused the early tours to be booked to capacity while students registering later were limited to registering for the later ones, leaving them less attended. If the schedule were presented as a calendar grid, we believe the students would have been more likely to consider whether the date and time was appropriate for them.

The system had no protection from booking tours simultaneously. Some students booked conflicts, even though the conflicts were clearly displayed on their tour schedules. Some students also booked themselves in tours that were held while they were scheduled to take exams. It is definitely believed that using a calendar format that shows the dates and times of the common math and chemistry exams will alleviate this problem. In 2002, the system was modified to display a warning if tour times are adjacent and to prohibit scheduling tour times that overlap.

We believe compliance would have been improved if the system had been programmed to send e-mail reminder messages to the students informing them of up and-coming tours in which they had registered themselves. Another measure that would have improved compliance would have been to send reminder messages to students who had not met the minimum tour requirements near the end of the term. A reminder system was deployed late in the 2002 registration process.

In the 2002 implementation, it became clear that cancellation safeguards were needed. A large number of students registered for tours and cancelled at the last minute. Their original registration prevented other students from signing up, their late cancellation did not allow other students to join the tour, and the failure of the tour registration system to track cancellations made it impossible to assess which students were the cause of this problem and which students were

affected. Previous implementations of either the paper-and-pencil system and the web-based system in 2001 had not experienced this behavioral pattern, so the system was not designed to prevent it. While stopgap measures to manage this for 2002 were effective, a cancellation deadline will be applied to the system for the future.

The Success of the Web-Based System

Registration and attendance reporting features allowed the course coordinator (co-author Ohland) to send notices to students who had not registered for or attended the proper number of tours. This was of great service to the students, and will be of even greater utility when the process is incorporated as an automated feature. The web-based system is particularly useful for applying the established policies uniformly. In that manner, the system prevented many of the undesirable student behaviors observed previously. The implementation of a conflict checker will further ensure that students cannot make the errors they have made in the past.

The new system simplified long-term record storage—student tour attendance patterns can now be stored indefinitely. This will not only provide for continued improvement of attendance forecasting, but also allow for the study of student compliance. The current system's pre-registration module did an excellent job of forecasting tour registration patterns. In spite of the fact that what was originally scheduled as a single tour for Materials Science and Engineering was split into two separate tours—one for Ceramic and Materials Engineering and one for Polymer and Textile Chemistry—the pre-registration survey predictions had a correlation of more than 0.8 with the actual number of students signed up with the departments in the final registration process.

Pre-Registration Percentages Stabilized Early

What is even more interesting is that the pre-registration estimates stabilized very early, which gave departments more time to set their schedules. Table 4 shows the pre-registration survey data on a number of dates. With a class registration of 735, and with each student required to attend 5 tours, the expected number of student-tours is the product of these, or 3675.

Pre-registration began on September 6, 2001, and nearly all students had completed the pre-registration process by September 19, as measured by the fraction of the total number of student-tours ($3651/3675 = \text{over } 99\%$ by that date). Preliminary estimates of the number of tour slots needed from each department were issued on September 10, when the distribution appeared stable. Figure 1 bears out the legitimacy of that decision—at each sampling point, the height of the total graph adds up to 100% of all the preregistrations (although the total number of preregistrations is increasing). On September 6th (a.m.), we would estimate that Physics would need to provide approximately 10% of all student tour slots, or 370.

Table 4. Tour Pre-Registration Survey Data on Different Dates

Department or Program	9/6 a.m.	9/6 p.m.	9/10 p.m.	9/11 p.m.	9/14 p.m.	9/19 p.m.
Biosystems Engineering	43	59	131	147	183	200
Chemical Engineering	46	67	144	157	195	215
Chemistry	56	78	163	186	236	262
Civil Engineering	78	108	247	283	357	400
Computer Engineering	51	69	166	201	243	262
Electrical Engineering	71	95	222	259	325	357
Geological Sciences	45	60	148	174	214	234
Industrial Engineering	36	59	133	155	201	221
Materials Science and Engr.	51	68	151	177	223	242
Mathematical Sciences	59	85	192	224	268	288
Mechanical Engineering	96	139	310	357	444	484
Physics	92	137	304	352	439	486
Total registrations	724	1024	2311	2672	3328	3651

Above that, Mechanical Engineering spans from 10% to 25%, so the thickness of the Mechanical Engineering band is ~15%, so Mechanical Engineering should expect to provide over 500 tour seats. As more students preregistered, the thickness of each band is relatively constant, so the early estimates were very accurate.

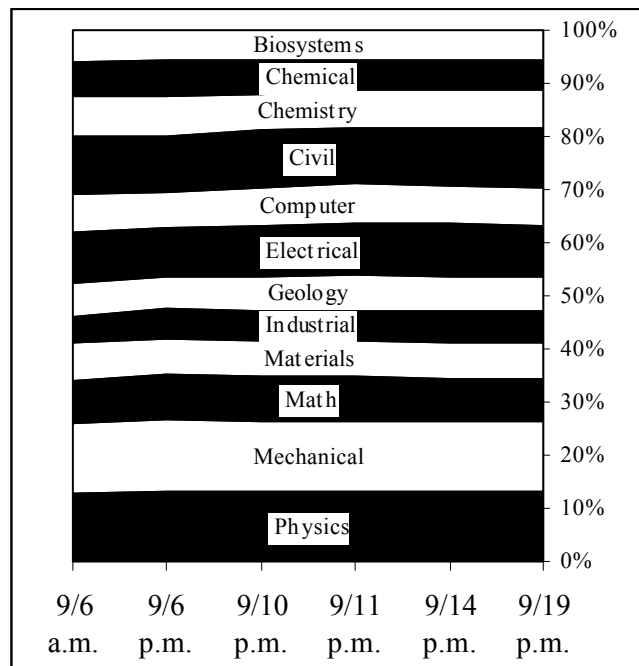


Figure 1. Distribution of Pre-Registration Requests by Department.

Conclusions

The web-based system is useful at improving the operation of the registration process. It also constrains student behaviors to encourage compliance with the requirement. In addition to the improvements to the design of the web-based system suggested earlier, the implementation could be improved in a number of critical ways. There was insufficient communication with the departmental chairs and tour coordinators and this, combined with some administrative changes that took effect just prior to the start of the fall semester, caused a number of problems:

- At least one department failed to take attendance in 2001
- More than one department was delayed in submitting its tour schedule (in both years), making it difficult for students to register and anticipate the full schedule
- None of the departments made a computer available for taking attendance, so taking attendance still involved the intermediary step of checking names on a printed roster

Increased wireless networking coverage on campus this past year did not encourage any departments to take attendance using the web-based system directly. The use of a card reader system for taking attendance was explored for 2002, but was not feasible due to cost constraints. Similarly, a bar code system is under consideration, but is not expected to be of sufficient benefit to justify the cost.

In response to difficulties in getting accurate attendance data in 2001, the system was modified in 2002 to allow for students to print their tour schedule to turn in as a “ticket” for attending the tour. This allowed the tour guide to confirm that a student was signed up for the tour, which was only necessary in the event that more people showed up for a tour than could be accommodated. This “ticket” significantly improved accuracy of attendance reporting—all departments took attendance at all tours, because the students knew their papers had to be collected to receive credit. Furthermore, the schedules had student userids clearly printed on them, which made it much easier to identify the students than in previous years, when students wrote their names on a sheet if they were not registered.

The tour registration website requires authentication, so the address of the website is not given. Readers who are interested in reviewing the content of the website are encouraged to contact us. Short-term test access will be provided within a reasonable time upon receiving a request.

Acknowledgments

A great many contributed to the success of this new effort, including the department staff who coordinated the tour schedule, the faculty, staff, and graduate assistants who delivered the tours, and Sarah Mahady, who processed a large number of tour rosters to record attendance. Although the authors had primary responsibility for the design of the tour registration system, the other General Engineering staff and faculty, namely Trish Nigro, Linda Law, Lib Crockett, Ben Sill, and Bill Park are due credit for defining the system that the web-based system seeks to model and improve.

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