Introduction and background

The college housing process creates a great deal of anxiety for students, plus paperwork for administrators and student volunteers, particularly at Ezra Stiles College of Yale. A computerized system would greatly increase the efficiency of the process and make room selection a more pleasant experience for both students and administrators. I propose to create a system specifically to address the housing process in Ezra Stiles College at Yale, while hopefully keeping the code base general enough to be extensible to some of the other residential colleges of the university.

Currently, some of Yale’s residential colleges, including Ezra Stiles, conduct the room draw process in three basic steps:
(1) collecting information about students (such as year, gender, whether they plan to live on campus, etc.)
(2) using that information to assign a partially random ordering of these students (partial because of the existence of rules like those that give preference to upperclassmen over their younger colleagues)
(3) gathering students together and holding a “draft” in which students, in the order determined by (2), select rooms from those still available

Improvements possible

A computerized system could improve upon each of these three steps. Both (1) and (2) are naturally rote, algorithmic tasks that are best suited to machine processing. However, beyond avoiding paperwork and eliminating human randomization procedures that are sometimes corrupt, an online system does not provide any significant advantages (though both of the aforementioned improvements are worthwhile!). For that reason, my project will focus on the dramatic improvements to (3) that are possible from a web implementation.

Most obviously, gathering between 100 and 500 students in the same time and place presents scheduling hardships for students and difficulties for administrators. Once assembled, clear communication is difficult. More important, however, is the plight of students scheduled to select later in the draft. With very little knowledge of what rooms will be available by the time they are called upon to select, these students are forced to either (a) inspect and determine preferences for countless rooms, or (b) make an on-the-spot decision that will affect them for the entirety of the next academic year. Lastly, by moving the draft online, relevant information could be made available to students as they weigh their living decision. For example, pictures, current resident comments, and floor plans could all be visible to prospective residents.

An online system that required its users to simultaneously sign on and conduct the draft would do little more than minimize the hassle of assembling in one room. At the other extreme, if students were able to make selections at their leisure, the process could take weeks to complete. I propose to construct and evaluate a system in which students enter room choice “bids” and rooms are assigned dynamically according to these preferences and students’ assigned “lottery” number priorities. For example, the student with the 2nd lottery number (Brad) can enter his bids before the student picking first (Adam) has done so and then Brad need not continue to monitor the draft. Once Adam chooses a room, Brad will be allotted the first available room of the bids he made. If Chas, the student with the third choice, only entered the new rooms of Adam and Brad as his first two choices without selecting a third, then no more
rooms can be allocated until Chas makes a new selection. However, those with lower priorities can continue to enter bids that will be acted upon as soon as Chas makes his decision.

Parameters to investigate

There are a number of parameters to consider in designing the above bidding algorithm. Primary amongst them are:

- How many bids should students be able/required to enter?
- How can the system motivate students to keep the draft moving by entering their bids promptly?
  - The most likely incentive is to reduce student priorities in the draft if they do not make bids quickly enough…
    - How long should the algorithm wait before reducing a student’s priority?
    - By how much should the priority be reduced?
    - When should students be notified that some of their previously entered bids have been allocated to students with higher priorities?
    - How much time should these users be given to reenter bids before their priority begins to fall?
- Should students be allowed to change previously submitted bids? If so, under what conditions?
- What information about the bids of other users should students be able to access?

Testing and metrics on which to evaluate the system

What the optimal configuration of these parameters is, or even whether any configuration would be viable for real college use, is an open question. I hope to build a reasonable prototype of the system, with which I can begin to answer some of these questions by soliciting live user feedback and/or gathering simulation results. The primary question appears to be how long it would take the proposed bid algorithm to complete the room allocation under varying realistic conditions and algorithm parameters. Other questions that I plan to consider in the evaluation include:

- How often must a user must log on and reenter bids?
- What attempts might be made to “game” the algorithm?
- Would they succeed? How could they be prevented?
- What is the effect of modifying each of the parameters in the algorithm? Can they be used by administrators to achieve certain goals?

Deliverables

The broad deliverables for this project are two-fold, both with a number of different subcategories:
(A) The web application itself (code and website)
(B) The written report (pdf file)

(A) Since no reasonable software engineer can estimate with any accuracy the nature and difficulty of problems that might arise, it is important that the application code be separated into independent modules. Not only is this good coding practice, but it will mean that even if I am unable to complete the entire application, the individual pieces can still be analyzed and evaluated. I will still be able to demonstrate what progress I have made toward completing the application as a whole. The most important components will most likely be:

- The design and implementation of the database to store room information, student data, room assignments and bid preferences
- The user interface available via the web, by which students enter room bids and view relevant information
- The program that implements the bidding algorithm by monitoring and updating the database, assigning rooms when appropriate and notifying users of events or the need for action
Given the difficulties of engineering a (largely) bug-free system, I will frankly be pleased to complete the core application as suggested by the above three points with enough time left to conduct a number of informative simulations or live test runs. Should any further time remain, however, there are many other potential components to include. Extra time or future work could be devoted to:

- A program to automatically insert structured data into the database. Though seemingly trivial, this actually could involve specifying a number of complex conditions about what rooms are available to different student populations (gender, class, relation to other people living nearby, etc.)
- Adding content (pictures, maps, user comments, historical info, etc.) to the room view available to students
- Providing a web form by which this content can be entered into the database
- Making the main web application secure
- Designing a further web form that can collect the information required of students in step (1)
- Creating a program to replace step (2) and perform the partial random ordering of students
- Making a secure web form by which students can form “pin” groups with a designated member to conduct their room selection for them
- Improvements/additions to the system to deal with some of the more complex housing processes of some residential colleges

Finally, the website associated with this project should provide documentation to potential users of the system. This should explain the usage required, as well as known problems. The site should contain links to the written report and any demo pages available.

(B) First, the written report will attempt to state the general problem the algorithm is designed to solve and the advantages that a computerized system can provide over the status quo. I plan to describe the different housing processes used by some of Yale’s twelve residential colleges and the assumptions about these processes made by my system. The written report will also contain a description of the design process, difficulties encountered therein, and an evaluation of the system. This evaluation should include an analysis of weaknesses and strengths of the system, focusing on the questions outlined above in Testing and metrics on which to evaluate the system. I also plan to prove certain properties of the bid algorithm used to conduct the draft. Some comparison with other similar pieces of software could also be incorporated in the written report. Finally, it might be interesting to explore the question of an alternate allocation and reasons for taking the current random draft process (as described in Introduction and background) as given.

Summary

In addition to exploring the efficiency of the proposed bid algorithm, I hope to learn about a number of web and database technologies while creating this system. Furthermore, the design process and general engineering principles employed for a complex system like that suggested should prove educational. It is also my hope that, if successful, I could convince some residential colleges to adopt the system.