# Identifying Gateway and Bottleneck Courses

In this report, we describe our process for identifying bottleneck and gateway courses. By flagging these courses in [DawgPath](#), students can be strategic about when to take these important courses. Additionally, curriculum planners can use this information to adjust the timing and/or the number of sections that are offered in order to help students graduate in a timely manner.

## Gateway Courses

A gateway course is one that is early in a student's career and is either necessary for their degree or is an important prerequisite to many other courses. These courses are sometimes hard to register for due to the demand. Additionally, these are generally larger sized courses with many enrollments. Summer quarters are excluded as they tend to have a smaller set of course offerings and lower enrollment. We consider the following factors for determining gateway courses:
- typical proportion of first/second year students enrolled
- average number of students enrolled
- few, or no, prerequisite courses
- a course that serves as a prerequisite to many other courses
- a historically high number of unmet enrollment requests

To create a gateway score these six data points are min/max rescaled and then summed[1]. This scaling algorithm is simple with the advantage of being easily interpretable. The scale of the data changes, but not the relative meaning of higher/lower values. For a given variable $x$:
$x' = x - min(x) / max(x) - min(x)$. Each element has equal weight in the final score, the exception being courses having fewer than 5 students on average which are set to 0. For example, English 131 typically has 95% enrollment by 1st/2nd year students and averages 893 students/year. There are 3 'pre-req' courses that *preclude* students from taking English 131. These are subtracted from the total resulting in a unique prerequisite count of 0. It also typically has a high number of unmet requests. Chemistry 142, another course that scores highly, is similar in most respects but serves as a prerequisite for a large number of other courses while having a small average of unmet requests.

## Bottleneck Courses

A bottleneck course is one that can be major specific, difficult to register for, and is necessary for a student's completion of their major requirements. We only consider courses below the 400 level for classifying bottlenecks. Summer quarters are, again, excluded. Otherwise, any course below 400 that has been offered at least once since 2015 is included so long as it is still current (i.e., it has a last effective year of 9999). Although this captures courses that are offered very infrequently, we opt to cast a wider net with respect to courses that could be offered. Criteria for bottleneck courses include:
- whether a course is offered infrequently
  - this value is subtracted from the score so that lower frequency is considered a negative
- the number of prerequisites
- having many unmet requests; as a quarterly average

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[1] The data were accessed from the following UWSDB tables: time_schedule, sr_unmet_request course_titles, sr_course_prereq, transcript, transcript_courses_taken.

- a high proportion of majors enrolled
  - major enrollment is calculated by college, not necessarily matching department abbreviations
- the average number of 'secondary' sections offered per quarter (quiz sections, labs, etc.)
  - A bottleneck is not necessarily a course with high enrollment although more sections should mean a larger course; this variable is subtracted from the score, or reversed, so that more available sections lowers a course's score
- the number of times a course appears as a prerequisite for other courses
  - excluding cases where the prerequisite data indicates that taking course A precludes taking course B

The bottleneck score uses the same min/max interpolation as gateway courses. However, because the literature frequently considers a bottleneck as a major-specific limitation, the min/max interpolation is grouped by department abbreviation.[2] This has two main disadvantages: 1) scores can't be directly compared across departments, and 2) it does not directly capture cases where a prerequisite course sits between multiple curricula. For bottlenecks courses the number of times offered and the average sections count against the total score. The resulting scores can be sorted by their department abbreviation, for example Art History (ART H) 273 scores highly because it is offered infrequently, averages 63.6 unmet requests and has a large proportion of ART H majors (84.6%).

## References

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[2] Clearly some courses are bottlenecks because they are required for a cross-section of different majors. That level of admissions-requirement data by major or department is not available in a central location.