

Course Scheduling Optimization

R.M. Baur

Harvey Mudd College

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The Frosh Scheduling Problem

Given an incoming class whose course registration is fixed, how can we put the courses in timeslots and classrooms optimally?

“Optimally”?

Non-optimality is in the eye of the beholder.

Example

- ▶ Non-optimal to double-book professors.
- ▶ Non-optimal to make students late to class.

Integer Programming

Goal: *minimize* some nonoptimality function subject to logical constraints, requiring all variables to be integers. Can also require each variable to be 0 or 1.

Example

Minimize $c_1x_1 + c_2x_2 + \cdots + c_nx_n$ with constraints like $ax_1 + bx_2 \geq k$.

When Indicator Variables Attack

Implementation in a nutshell: massive sparse matrices, full of indicator variables.

Example

- ▶ ($\# \text{ students} \times \# \text{ courses}$)-matrix of enrollment info
- ▶ ($\# \text{ courses} \times \# \text{ courses}$)-matrix of distance metric info

Branch-and-Bound Method

Constrain a variable to be 0 or 1, then solve a “relaxed” problem.
Branch by constraining another variable if this solution is better than any previous.

Additional Complexities

- ▶ Adding more intricate distance metrics
- ▶ Allowing for flexibility in freshman scheduling
- ▶ The “Upperclass Scheduling Problem”

references

MATLAB Optimization Toolbox:

<http://www.mathworks.com/products/optimization/>

G.W. Graves, R.D. McBride, I. Gershkoff, D. Anderson, D. Mahidhara. Flight crew scheduling. *Management Science*, 39:6 (736-745), June 1993.