Problem Statement

- The University of Michigan Medical School offers residency programs across many disciplines.
- Schedulers must construct block schedules assigning residents to longitudinal service rotations to provide personnel coverage and satisfy educational needs. They should also consider resident requests and program balance, making this problem difficult to solve.
- Previously, annual block schedules were manually built by program chief residents. The construction process was excessively time-consuming and the schedules often failed to meet stakeholder needs and preferences.

Model & Solution Approach

We formulated an integer programming model, incorporating hard rules like service coverage requirements and resident educational requirements as constraints. Preferences like resident requests and program balance are introduced to the model as objective metrics.

Using this formulation, the final schedules are constructed in the following iterative procedure:

```plaintext
while satisfactory schedules have not yet been produced do
    Modify the model or inputs based on the chief resident feedback, if applicable;
    for each metric, ordered by their priority do
        Solve the integer programming model with just this metric as objective;
        Add an additional constraint to the model to avoid deprecating this metric from the optimal objective;
    end
end
```

Outcomes

- Able to capture all service coverage and training program requirements (hard constraints)
- Improved schedule generation speed
- Greater specificity of resident and service needs

Improved Schedule Quality

- Improved satisfaction for requests related to:
  - Vacations
  - Elective/research offerings
  - Fellowship interview and graduation season

- Improved program balance with respect to:
  - Pacing
  - Potentially challenging rotation sequences

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<tr>
<th>Resident Requests</th>
<th>Program Balance</th>
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Challenges

When making any annual block schedule, there exist the following challenges:

- Communication
- Evaluation

Future Work

- Introduce additional rules and metrics to improve quality
- Improve the computational performance of solving the model
  - Develop efficient heuristic algorithms
  - Apply column generation (branch-and-price)
  - Explore constraint programming formulation
- Create mechanisms for faster input file creation
- Develop additional tools to aid review process

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