**Problem Statement**

- The University of Michigan Medical School offers residency programs across many disciplines.
- Schedulers must construct block schedules assigning residents to 2 week or 4 week 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.

**Outcomes**

**Generated Schedules Quickly**

- **1 – 2 Days to Generate the Inputs**
- **A Few Minutes to Solve the Model**
- **2 – 5 Construction Iterations**

**Benefits**

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

**Model & Solution Approach**

In mid Fall, we meet with the chief residents to understand each program’s service coverage and training program needs. Then, we transform the needs of each program into constraints.

In early Winter, we send a survey to the residents for their schedule preferences. In mid Winter, we first draft a schedule only including service coverage and training program requirements. Once feasible, we incorporate resident requests to the model as objective metrics.

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
    Deliver the results to chief residents for review;
end
```

In early Spring, the schedule is published to residents. On July 1, the schedule goes into effect for the next 52 weeks.

**Challenges**

Each year, building the annual block schedule presents challenges tied to communication and 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
- Develop additional tools to aid review process
- Improve automation of input files
- Automate reporting for denied requests

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