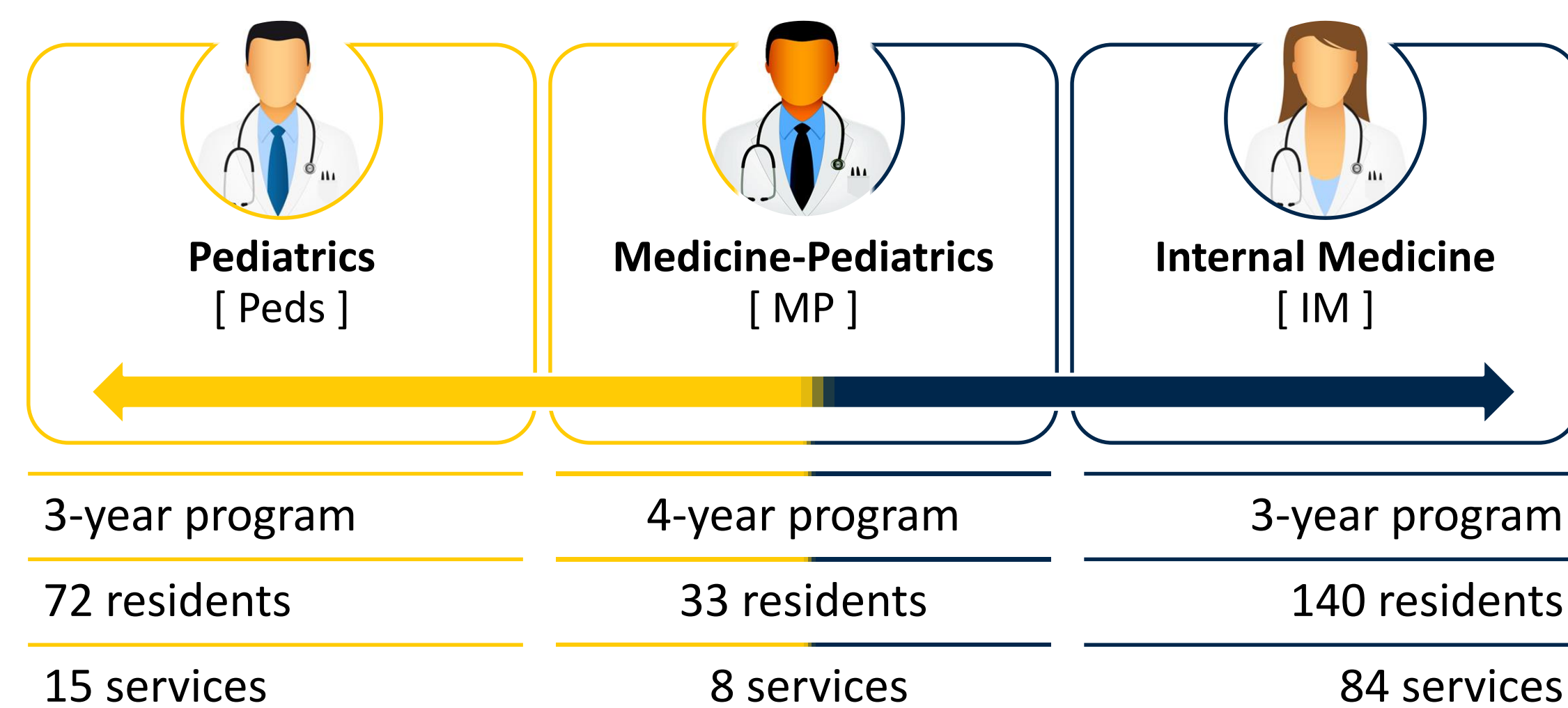


## Improving Residency Annual Block Schedule Quality with Automation

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### 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:

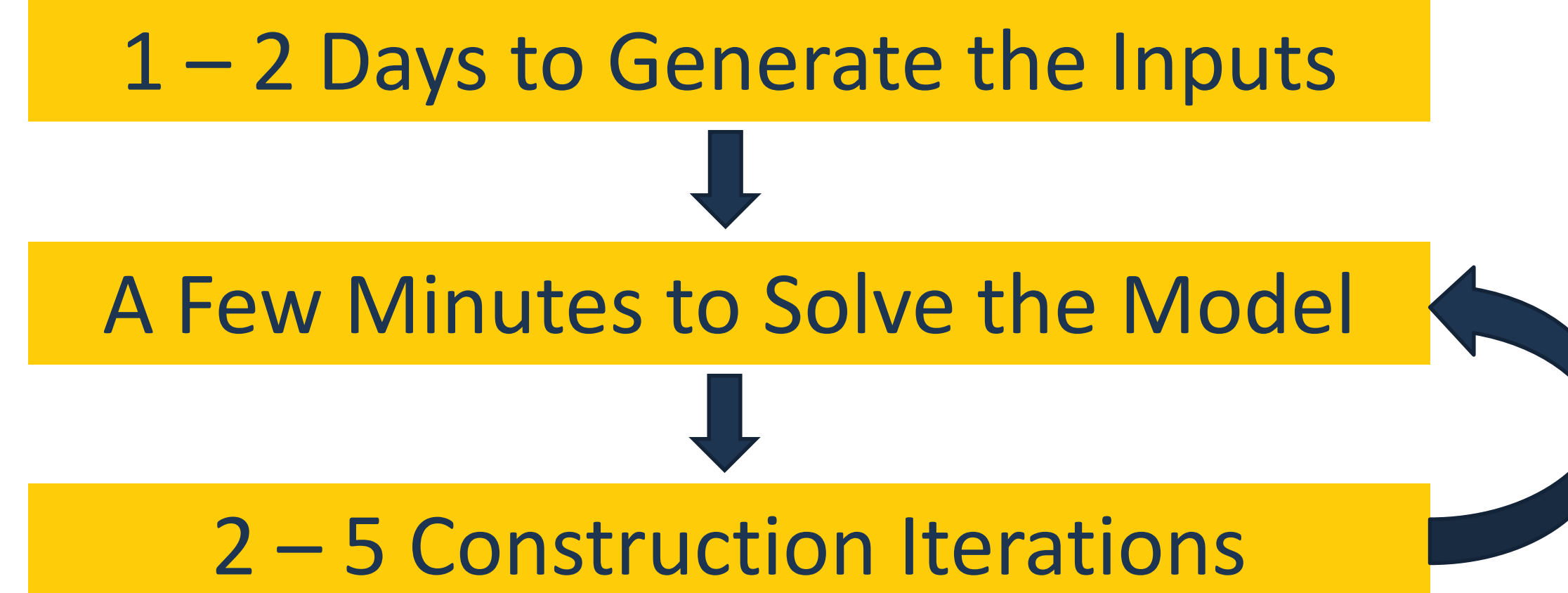
```

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 depreciating this metric
  from the optimal objective;
end
Deliver the results to chief residents for review;
end
  
```

### Outcomes

CHEPS has automated our partners' coordinated annual block schedules for the last three academic years. In that time, we have successfully generated their schedules quickly and improved the schedule quality.

#### Generated Schedules Quickly



- 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



Resident Requests

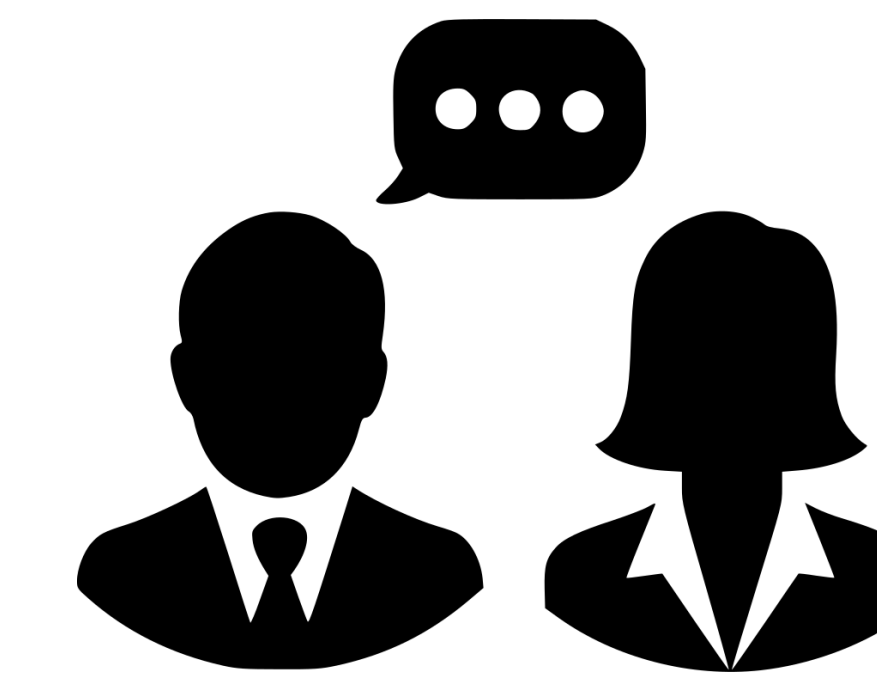


Program Balance

- 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

### Challenges

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



Communication



Evaluation

The residents, services, and rules may all change year-to-year. We are currently developing next year's model, which will have more residents and 26 two-week periods as opposed to 24 half-month periods. This change presents its own challenges:

- Conversion of "old" rules into the "new" rules correctly
- Addition of new residents and their unique rules

### 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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