

User Manual

Medtrics Automated Scheduling

by J.A.S.T Senior Design team

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04/30/2016

User stories overview

Completed User Stories

- As a coordinator, I want to be able to prefill the schedule.
- As a coordinator, I want a button so that I can interact with the server.
- As a coordinator, I want buttons so that I can pick different algorithms to schedule.
- As a coordinator, I want an algorithm that automatically schedules for a schedule with at least 90% satisfaction rate.
- As a developer and a coordinator, I want to visualize the resulting schedule to see it easier.
- As a coordinator, I want to edit the schedule after it's been generated.
- As a coordinator, I want to use less clicks to schedule rotation for each student
- As a coordinator, I want to keep track of how different rotations are represented.
- As a coordinator, I want to display additional information on the GUI so that I have a more comprehensive view on student and rotation requirements (when a rotation has too many people or when this students have too many rotations still required)
- As a coordinator, I want to save the resulting schedule into a file for further usage.
- As a coordinator, I want to upload all the trainees' data and requirements by uploading a file.
- As a trainee, I want the algorithm to be aware of my status of the progress of fulfilling all my requirements so that I can graduate.

Completed additional features

These features are requested by Medtrics after we began executing the project

- As a coordinator, I want to be able to prefill the schedule.
- As a coordinator, I want the scheduling algorithm to respect the prefilled information.
- As a coordinator, I want the schedule to solve combination of rotation requirements (such as a minimum number of either PGY1 or PGY2 trainees)
- As a coordinator, I want the schedule to handle rotations that allow quarter-blocks and half-blocks.
- As a coordinator, I want the schedule to force certain rotations to have a minimum length.

Incompleted

- As a coordinator, I want to be notified that if an optimal schedule can be found.
- As Medtrics, I want the algorithm to be integrated so that it works with existing infrastructure and doesn't break the system.
- As an Institution, I want the algorithm to be flexible with different constraints.
- As a coordinator, I want to have a way to change the scheduled calendar for the emergency.
- As a coordinator, I want the scheduling algorithm to solve more than 5 roles.
- As a coordinator, I want to include student location and vacation preferences.

Completed

As a coordinator, I want a button so that I can interact with the server.

As a coordinator, I want buttons so that I can pick different algorithms to schedule.

We included a menu bar on the top of our graphical user interface that include different functionalities available for the coordinator.



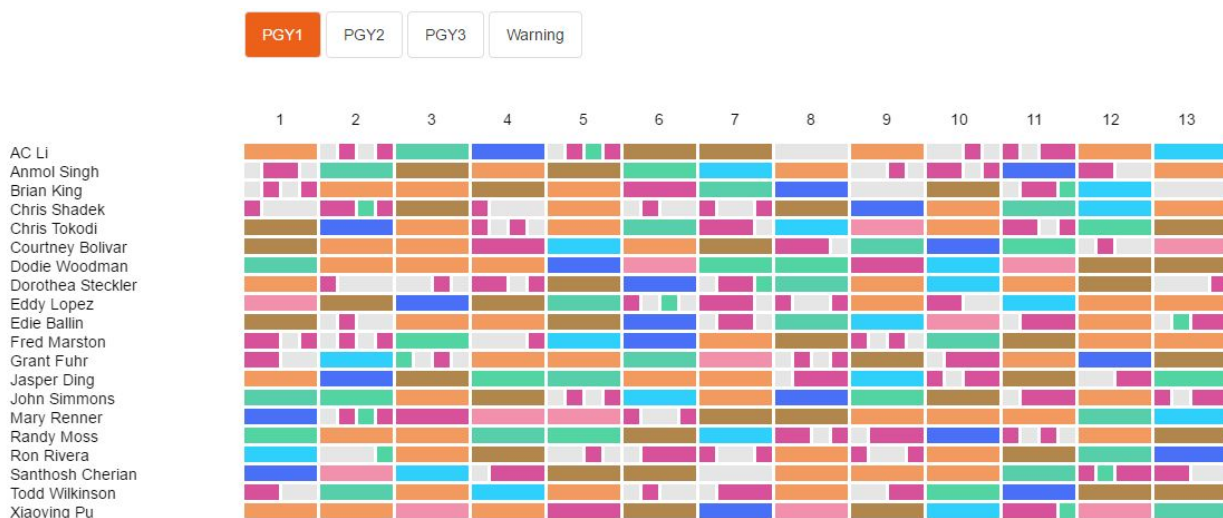
As a coordinator, I want an algorithm that automatically schedules for a schedule with at least 90% satisfaction rate.

We researched and implemented two scheduling algorithms for our client

- **Solver Algorithm:** Use Integer Programming to find any feasible solution given the constraint requirements. If there exist a schedule that satisfies 100% requirements, then the Solver will be able to find it.
- **Greedy Algorithm:** In case the Solver can't find a feasible solution, our greedy algorithm use some prioritized heuristics to solve the schedule. Experiments show that our scheduling algorithms already figure out 95% of the schedule.

As a developer and a coordinator, I want to visualize the resulting schedule to see it easier.

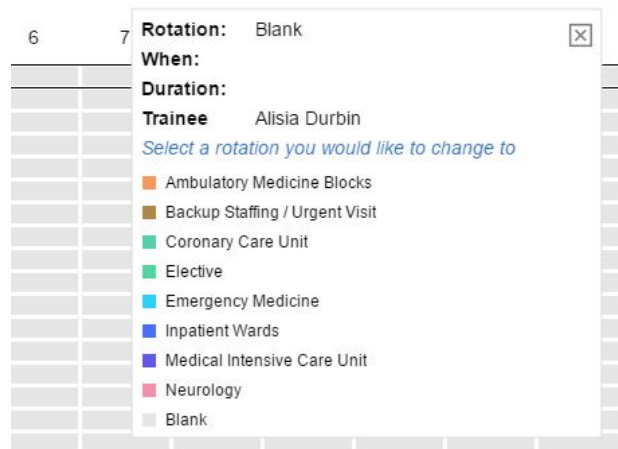
Our top-down view of the schedule shows which kind of rotation is taken at any given time by which trainee.



As a coordinator, I want to edit the schedule after it's been generated.

As a coordinator, I want to use less clicks to schedule rotation for each student

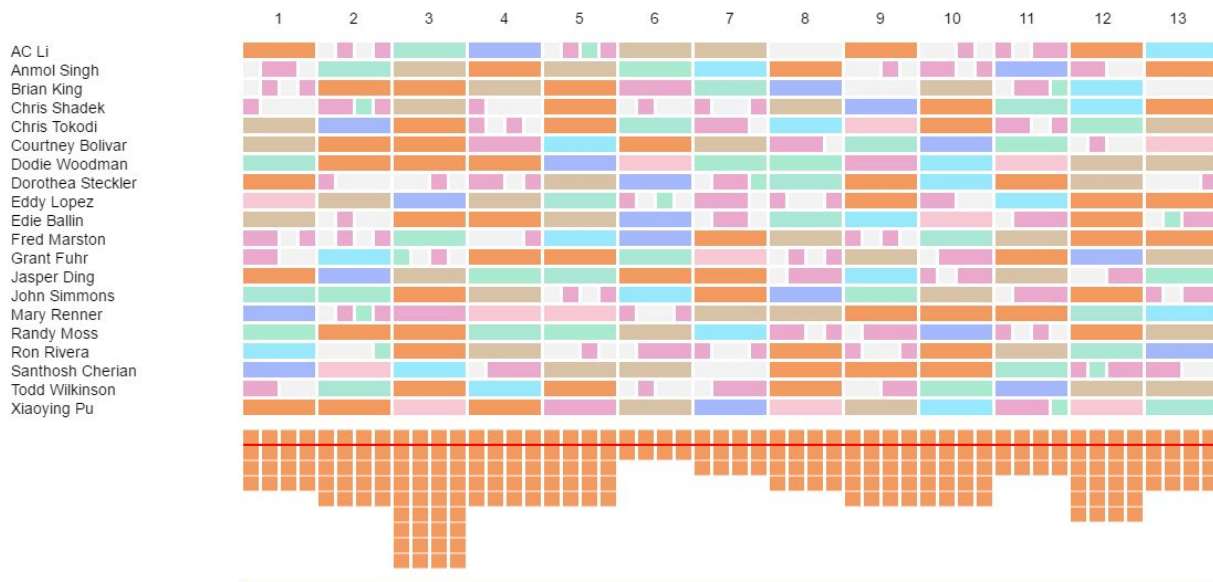
As a coordinator, I want to keep track of how different rotations are represented.



Our GUI allows two click scheduling and also works after a schedule has been generated. Each rotation is represented using a different color.

Potential problem: If there are more than 15 different rotations, many colors will start to look very similar to each other. While it is rare that a program has that many different kinds of rotations, Medtrics should take a look at its existing clients who potentially use our software to see if they too many rotations.

As a coordinator, I want to display additional information on the GUI so that I have a more comprehensive view on student and rotation requirements (when a rotation has too many people or when this students have too many rotations still required)



We allow an exploration mode so that the coordinators can explore the number of students in a rotation at any given week. Two red lines represent the minimum and maximum number of people needed by a rotation at any given in time. Most of time, our schedule algorithms will aggressively try to satisfy this rotation requirement.

As a coordinator, I want to save the resulting schedule into a file for further usage.



There is a “Save CSV” button on top right of the GUI to save the schedule

As a coordinator, I want to upload all the trainees’ data and requirements by uploading a file.

Coordinators can upload their own schedule if their schedule follow the specific format mentioned in README.md.

As a trainee, I want the algorithm to be aware of my status of the progress of fulfilling all my requirements so that I can graduate.



The Underdone section of the GUI shows the types and amounts of rotations that the trainee still have to do. On the other hand, the Overdone section shows the ones that the trainees have to take more than they are required to.

Completed Additional Features

As a coordinator, I want to be able to prefill the schedule.

As a coordinator, I want the scheduling algorithm to respect the prefilled information.

Our tool can essentially work as just a scheduling tool. Our coordinator can easily fill in specific rotations at specific blocks for a specific trainee. After the prefilling process, our scheduling algorithms will adapt accordingly.

As a coordinator, I want the schedule to solve combination of rotation requirements (such as a minimum number of either PGY1 or PGY2 trainees)

This feature is supported. However, we haven't been able to support more than 3 different roles at the same time.

As a coordinator, I want the schedule to handle rotations that allow quarter-blocks and half-blocks.

As a coordinator, I want the schedule to force certain rotations to have a minimum length.

This has been supported. Coordinator can prefill quarter blocks and the schedule can also take advantage of rotations that do have quarter blocks. If certain rotations can't be broken up, then our algorithm respect that fact as well.

Incompleted

As a coordinator, I want to be notified that if an optimal schedule can be found.

At the moment, if an optimal schedule is not found, then no completed schedule will be visualize, resulting in a blank schedule. Still, maybe a better approach is to actually notify the user that no schedule has been found so they will know to try the greedy approach later

As Medtrics, I want the algorithm to be integrated so that it works with existing infrastructure and doesn't break the system.

In order for this to work, Medtrics has to implement all the constraints of trainees and rotations inside Medtrics platform as well as REST API to ensure interaction between the Scheduling Server, the GUI and the Medtrics Platform.

Another approach is to implement a feature that converts existing schedule inside Medtrics platform into a text file that has format compatible with the scheduling software and the coordinator can just upload that data into the system.

As an Institution, I want the algorithm to be flexible with different constraints.

While this is not solved directly, we think that it's better to keep the algorithm fairly general. If there are any specific requirements, the coordinator can fill in according to specific hospital requirements and our scheduling algorithm will adapt accordingly to prefilled data

As a coordinator, I want to have a way to change the scheduled calendar for the emergency.

While there is no official support for changing the schedule in the case of emergency (assumed to be after the schedule has been used for some amount of time into the semester), this can easily be done by uploading an existing prefill schedule and use available tools to tweak schedule according to the need of the coordinator.

As a coordinator, I want the scheduling algorithm to solve more than 5 roles.

Our system can theoretically support 5 roles if each group of related requirements involves only 3 roles (which is mostly the case). Our code can be extended to more than 5 roles in a fairly straight forward manner but the effort is not trivial. Please contact us if you need our help on this problem.

As a coordinator, I want to include student location and vacation preferences.

This is currently not supported, but can be extended easily with both the Solver and the Greedy algorithm.

As a coordinator, I want a warning system to notify myself of conflicting constraints in my schedule so that I can fix these constraints accordingly.

The following constraints can obstruct the Solver algorithm from solving the schedule. Therefore, we think it would be helpful if future developers create a system that trigger warnings when the following conditions appear in the problem constraints.

- Sum of "Min PGY1" (2, 3 interchangeably) across rotations > Number of PGY1
- Sum of "Min PGY1/2" (1/3, 2/3 interchangeably) across rotations > Number of PGY1+2
- Sum of "Min Total" across rotations > Number of PGY1+2+3
- Rotation Limit < Requirement Count on any Rotation (e.g: PGY1 is required to take 1 Neuro but is limited to 0.5)
- Sum of Requirement Count < Number of Available Blocks (14 requirements but 12/13 available blocks)
- Min Block Length Does not match Requirement (e.g: min length 1 but req/limit 0.5, 1.25 etc)