In this recitation, we'll discuss operating room scheduling.

That is, how hospitals can be made to run smoothly.

In particular, we'll discuss how an operating room manager can use integer optimization to make sure the hospital runs smoothly.

So hospitals have a limited number of operating rooms, or ORs.

And operating room managers must determine a weekly schedule assigning ORs to different departments in the hospital.

If you look on the right, you'll see a picture of an operating room.

You can see immediately how much specialized and fancy equipment there is.

And you have to remember that for any surgery, staffing the OR doesn't just involve the surgeon performing the surgery, but also other doctors, nurses, residents, and fellows.

There's usually an entire surgery team.

So due to the specialized equipment in an OR, as well as the specialized staff members, it's been estimated that staffing an operating room costs over $100 a minute.

Therefore, for a hospital to run on a budget, it's very critical for the operating room manager to create a good schedule.

However, this isn't without difficulties.

Creating an acceptable schedule is a highly political process within the hospital.

Surgeons are frequently paid on a fee-for-service basis, which means they get paid for every surgery they perform.

That means that when you change their allocated number of operating room hours, it directly affects their income.

Therefore, the operating room managers' proposed schedule must strike a delicate balance between all the surgical departments in the hospital.

However, there are many logistical issues for the operating room manager to consider when designing the schedule.

Operating rooms are staffed in eight hour blocks.

Each department sets their own target number of allocation hours, which may not be integer.

In addition, departments may have daily and weekly requirements.

For example, gynecology might need at least one OR per day.

Ophthalmology might need at least two ORs per week.

And for example, the oral surgeon might only be present on Tuesdays and Thursdays.

The operating room manager needs to take into account all of these logistical issues when designing a feasible schedule.

In this recitation, we'll consider a case study of Mount Sinai Hospital in Toronto.

There are 10 operating rooms at Mount Sinai, which are staffed from Monday through Friday.

So 10 ORs times 5 days times 8 hours per day, means that they have 400 hours to assign between five different surgical departments.

The departments they are assigning are ophthalmology, gynecology, oral surgery, otolaryngology, and general surgery.

Each of these departments has come up with a weekly number of target allocation hours.

For example, ophthalmology requests 39.4 hours of operating room time, and otolaryngology requests 26.3 hours of operating room time.

Now, it's very clear that just by looking at these numbers they are not integer, and they are certainly not multiples of eight hours.

This means that it's impossible for the operating room manager to give any department exactly their weekly number of target allocation hours.

However, the operating room manager would like to try to give as many hours to each department as possible up to their target allocation number.

We'll see how to solve this with integer optimization.

Let's consider the rest of the problem data.

For example, we need to consider the number of surgery teams from each department that is available each day.

We also need to consider the maximum number of operating rooms required by each department each day.

Frequently, these numbers are the same.

For example, ophthalmology requires at most two operating rooms every day.

And we see that they have two surgery teams available every day.

However, let's look at the case of oral surgery.

They require at most one operating room every day.

However, the oral surgeon is only present on Tuesdays and Thursdays.

Additionally, each department has weekly requirements on the number of operating rooms they need.

For example, gynecology needs to have at least 12 operating rooms in a given week and at most 18.

The traditional way of doing this was not by using integer optimization.

Before integer optimization was implemented at Mount Sinai in 1999, the operating room manager used graph paper and a large eraser to try to assign the operating room blocks.

Any changes that were necessary were incorporated by trial and error.

The operating room manager made a draft, and this schedule was circulated to all of the surgical groups.

However, incorporating feedback from one department usually meant altering another group's schedule leading to many iterations of this process.

In the next video, we'll design an integer optimization formulation for this problem.