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# INTERACTIVE TIMETABLE PLANNING FOR THE CHARITÉ

Each semester Charité University Hospital Berlin has to draw up new timetables. To make sure that no time is lost, that all the marginal conditions are met, and that planers can respond rapidly to last-minute changes, the Charité deploys a constraint-based scheduling system developed by FIRST.

Five thousand students are enrolled in the human medicine program at Charité University Hospital in Berlin. This program covers a total of ten semesters and involves a huge number of lectures and seminars – including modules in biochemistry, anatomy, psychology, pathology and surgery. Over 200 professors teach at three main sites in different city districts. Juggling all these figures to produce a timetable acceptable to students and teaching staff alike seems like mission impossible at first sight. But that's still not all: a host of other marginal conditions also need to be taken into account to avoid clashes, so that mandatory lectures or seminars don't take place at the same time. Journey times between the different sites also need to be factored in. And of course all lectures and seminars must be held in appropriate rooms and with the appropriate equipment – after all, students in a human dissection course won't get very far if there's nothing to dissect. On top of this, teaching events are very different and can vary in time from one or one-and-a-half hours to a full three hours. Sometimes they admit large numbers of students; sometimes they can be limited to small groups of eight, as in practical exercises. Certain seminars are held once a fortnight, others, known as Blockseminare, are held on an irregular basis and then over a "block" of several days. On top of this, the special requirements of teaching staff in terms of time and rooms must also be addressed, even though these are frequently only known to timetable schedulers in particular departments. And finally, any last minute changes must be speedily addressed.

## The CharPlan for rapid timetable scheduling

Anyone faced with the manual scheduling of such a confusing range of conditions could well be excused for throwing in the sponge in sheer despair. They would have to spend weeks or even months shuffling cards with names and rooms around on a board. Fortunately, the Charité's Office for Student Affairs has received a helping hand in the shape of Fraunhofer FIRST's program for constraint-based curriculum scheduling. This "Charplan" software was specially developed by FIRST to meet the requirements of the Charité and was first deployed there in the 1998 summer semester. It enables schedulers to draw up a viable timetable within seconds which can then be further processed interactively. For instance, schedulers can key in any special wishes ("hidden constraints") from teaching staff or respond to any unexpected changes like the sudden absence of a lecturer and generate a timetable incorporating these changes in next to no time.

## The Constraints-Based Approach – what does it mean?

Constraint is a word meaning a limiting condition. In traditional types of programming, the seemingly endless variety of different combinations are first tried out one after the other. A check to see whether all the constraining conditions have been adhered to is only carried out after the run is completed. This is so extremely time-consuming that it has little practical value. The constraint programming paradigm, on the other hand, makes active use of the limiting conditions. The

search space for solutions is pruned by what are known as "constraint solvers" so that "impossible" solutions – like two lectures at the same time given by the same professor – are excluded from the outset. The search for the ideal timetable is thus conducted with a much smaller number of combinations. Constraint programming differentiates between "hard" constraints, which have to be respected in all circumstances (for instance, no overlapping of mandatory lectures or seminars) and "soft" constraints, which would be nice to have (for instance, no teaching on Friday evenings). Once all the hard constraints are satisfied, the search can then key in the soft constraints to meet the wishes of students and teaching staff wherever possible.

## The perfect timetable – for sure

Using CharPlan means much less stress for everyone concerned with scheduling: schedulers themselves now have to spend much less time and effort in reaching a solution, while teaching staff and students don't have to fight their way through overcomplicated schedules. "These methods help make the timetable better and much more efficient. All correctly input conditions are reliably met, and we didn't have this 'kind of assurance beforehand', says Hans-Joachim Goltz of Fraunhofer FIRST. The timetables produced with CharPlan are published as HTML documents and posted on the internet.

**1** As the constraint method factors in all the limiting conditions in timetabling, students can now attend all their set courses

**2** Every doctor was once a medical student and had a great deal to learn – biochemistry, anatomy, psychology and pathology are only few of the disciplines in the packed medical curriculum

For the organization of the timetables, students at the Charité are divided into "planning groups" of around 18-20 students per group. Each of these groups gets a guaranteed no-overlap timetable for all courses of the semester. In the pre-clinical study course preceding the "Physikum" (the preliminary medical exam) the division of students into groups is automatic, and each group gets its ready-made timetable just like they used to get in school. As individual constraints can be changed without having to reject the complete timetable, special cases – like when students have to retake credits for the successful completion of a course – pose no problems. The program automatically ensures that no hard constraints are violated when manual changes are made to limiting conditions – otherwise it could easily happen that a student would suddenly have to divide herself in two to be able to attend all the courses.

## New challenges for tried-and-tested software

The software has been under continuous development since 1998 to enable it to cope with ever more extensive remits. Further components have also been added that fulfill a broad variety of functions. Recently it was adapted to bring it into line with the new curriculum in which students have to take a particular combination of modules. At the same time work is going ahead to ensure that, in future, the program will automatically take account of a much greater range of constraints. "Collaboration with Fraunhofer FIRST is something we can rely on, given its proven expertise in the field of scheduling and timetabling", says Burkhard Danz, head of the Office of Student Affairs at the Charité. "The software developed by FIRST has given us truly invaluable assistance in optimizing our timetable production."