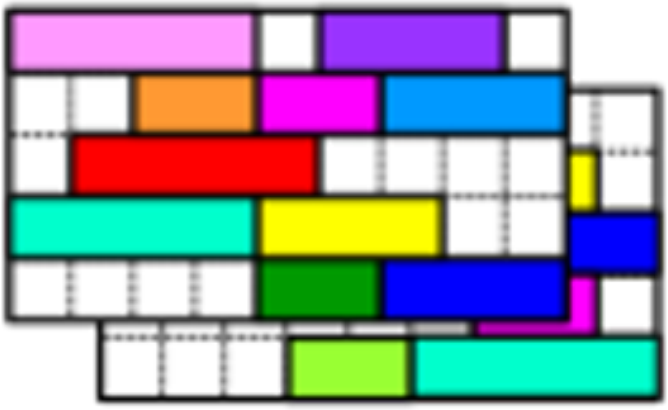


UniTime

Comprehensive University Timetabling System

http://www.unitime.org

Introducing UniTime

What is Educational Timetabling?

- The process of assigning classes (or exams) to times and locations
- A difficult optimization problem with many competing objectives: student conflicts, faculty requirements, space constraints

Why is it needed?

- Minimize student conflicts, thus help students receive degrees on time
- Help use resources effectively
- Make process easier to manage (knowledge transfer and cooperation)
- Fairness and satisfaction with the timetable
- What-if scenarios
- Ability to adapt to changes

What is UniTime?

- Comprehensive academic scheduling solution
- Four components: course timetabling, examination timetabling, student scheduling, event management
- Open Source (Apache License, Version 2.0)
- Web-based, written in Java using modern technologies
- Using state-of-the-art optimization algorithms
- Distributed data entry and timetabling in multi-user environments
- Easy to extend and/or customize
- Has been applied at large institutions
  (up to 40,000 students)
- Sponsored project of the Apereo Foundation
- Over 500k lines of code (including the constraint solver)
- Used by institutions around the world
  - USA, Czech Republic, Pakistan, Croatia, Poland, Turkey, Peru, Kuwait, …

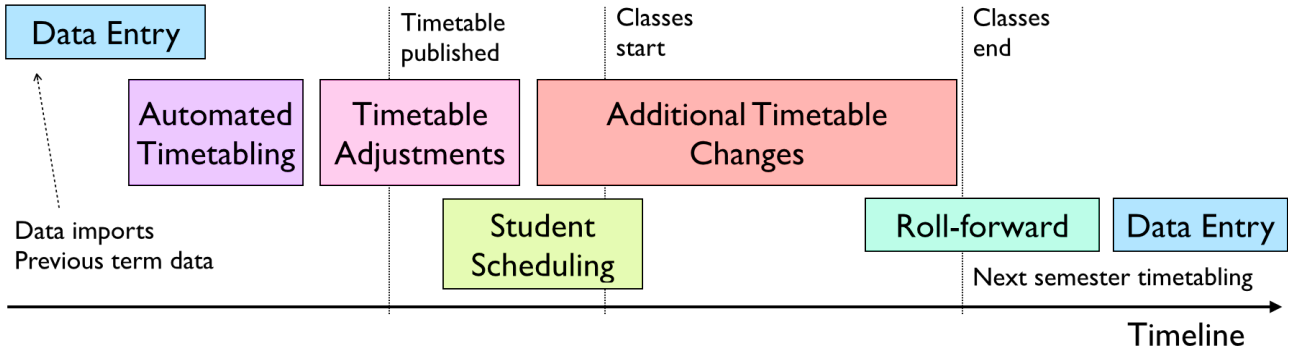
For more information…

- Web site: http://www.unitime.org
- Online demo: https://demo.unitime.org
- Source codes: https://github.com/UniTime
- Email: support@unitime.org

apereo

UniTime

Course Timetabling



Lifecycle of a course timetable

Goal

Assign class times and locations such that:

- All hard constraints and other requirements are met
- Desirable objectives are satisfied as much as possible
  - Minimize student conflicts
  - Accommodate time and room preferences
  - Allow preferred class time distributions
  - Fairness, minimize travel times, etc.

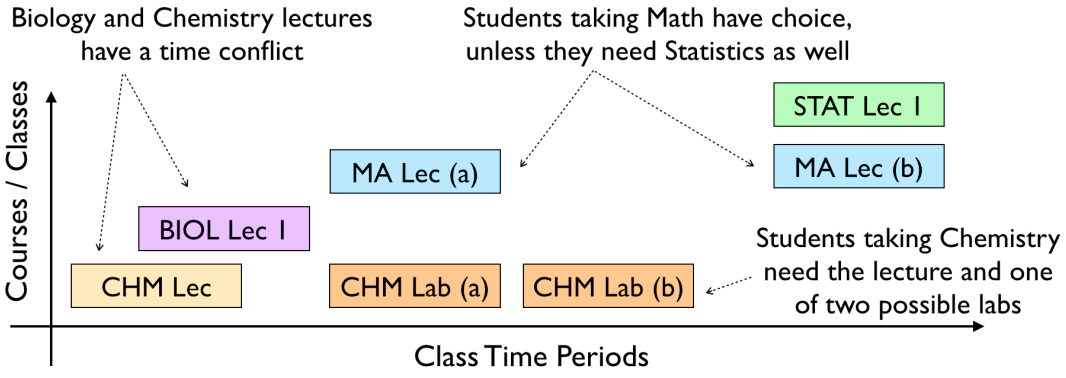
Constraints

- Room sizes, equipment, and availability
- Faculty time, room requirements and preferences
- Structures of courses that are to be offered
- Student course demands (curricula, pre-registration, etc.)

Student Conflicts

A student cannot take a combination of courses

1. Classes overlap in time
   (or one after the other in rooms that are too far apart)
2. There is not enough space in a non-overlapping combination of classes



Course Structure

Classes are organized by the course structure

- Intuitive data entry and display of classes and their requirements
- Helps to define how students can enroll into the course
- Additional relations can be derived from the structure

	Limit	Date Pattern	Minutes Per Week	Time Pattern	Time	Room	Distribution	Instructor
						----Preferences----		
MA 170 STAT 170	40	Statistics I Introductory statistics						
Lecture	40	Full Term	50	1 x 50		Classroom		
Laboratory	40	Full Term	150	3 x 50		EDUC CompPr	Same Room	
Lec 1	40	Full Term	50	1 x 50		ThtrSeat Classroom		G. Newman
Lab 1	20	Full Term	150	3 x 50		EDUC CompPr	Same Room	J. Smith
Lab 2	20	Full Term	150	3 x 50		EDUC CompPr	Same Room	J. Smith

Example of a course structure

Constraint-based Solver

- Can be used in modes between manual and fully automated
- Local search based framework using constraint programming primitives
- Winner of two tracks of the International Timetabling Competition 2007 (finalist of all three tracks)
- Applicable to a variety of constraint satisfaction and optimization problems

Suggestions

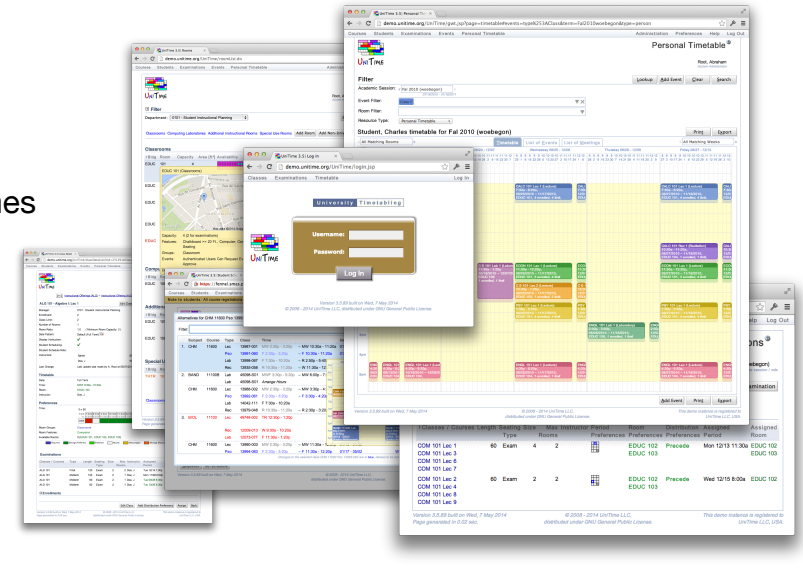
Score	Class	Date	Time	Room	Students
+15.2	POL 101 Lec 3	Full Term	TTh 12:00p → TTh 7:30a	BRNG 2280	+11
+31.7	POL 101 Lec 3	Full Term	TTh 12:00p → TTh 10:30a	BRNG 2280	+36 (h+3)
	HIST 342 Lec 1	Full Term	TTh 10:30a → TTh 1:30p	BRNG 2280 → BRNG 2290	
+36.6	POL 101 Lec 3	Full Term	TTh 12:00p → TTh 10:30a	BRNG 2280	+36 (h+4)
	HIST 342 Lec 1	Full Term	TTh 10:30a → TTh 7:30a	BRNG 2280	
+44.1	POL 101 Lec 3	Full Term	TTh 12:00p → TTh 10:30a	BRNG 2280	+34 (h+2)
	HIST 342 Lec 1	Full Term	TTh 10:30a → TTh 3:00p	BRNG 2280 → BRNG 2290	
	OBHR 330 Lec 4	Full Term	TTh 3:00p	BRNG 2290 → LWSN B155	

(all 1571 possibilities up to 3 changes were considered, top 4 of 17 suggestions displayed) Search Deeper

Interactive mode: solver provides suggestions

More features

- Course management
- Data exchange / roll-forward
- Room distances and travel times
- Date patterns
- Clustering
- …



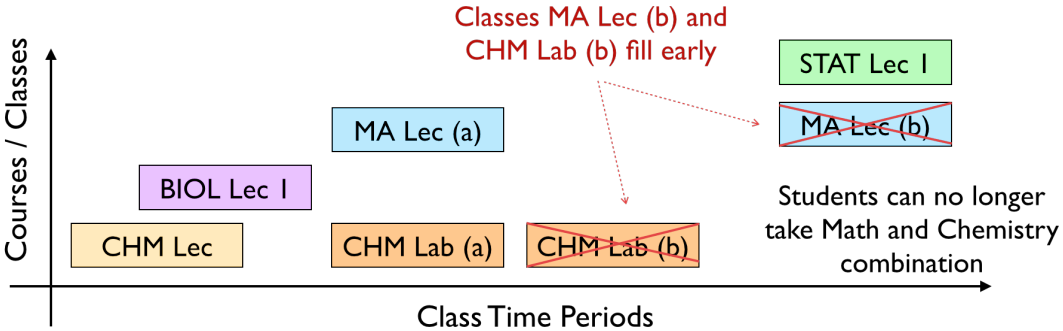
Student Scheduling

Goal: Enroll students to classes in a way that maximizes the ability of students to get the courses they need

- Students fills in course requests
- System suggests a schedule that best meets student needs
- Students can make later modifications to schedule

Why is it needed?

To ensure that students will be able to get the courses they need when multiple sections are offered.



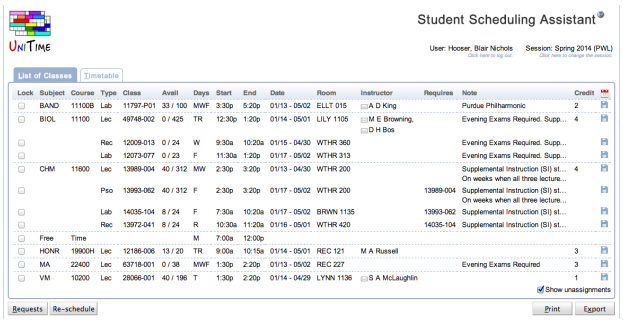
Earlier enrolling students may block later students

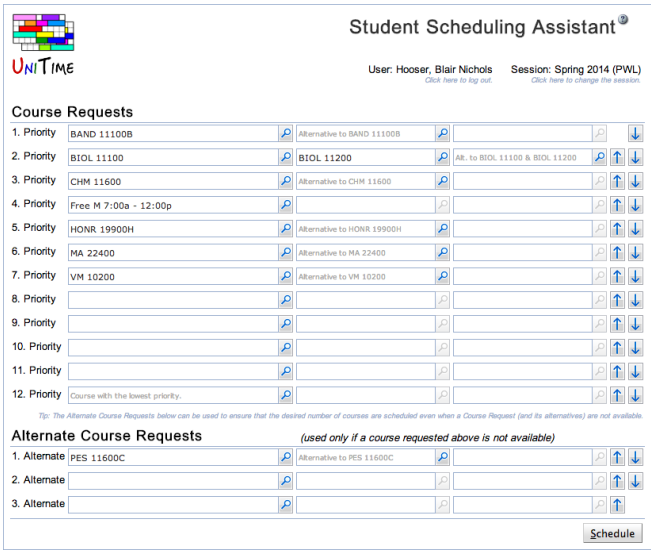
Batch Scheduling

- All students are scheduled at one time after the timetable is produced based on student pre-registrations
- An optimization process, using the student scheduling solver

Online Scheduling

- Students without pre-registrations can enroll online *(e.g., incoming freshmen)*
- All students can make adjustments to their schedules
- Automatically hold space in sections based on historical student demand
- Reservations, automated wait-lists, instructor consents, advisor roles, …

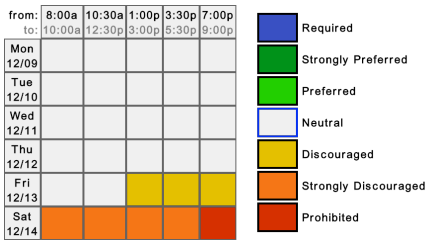




Examination Timetabling

Goal: Assign examinations to time periods and rooms

- An exam can be offered for a class, a course, or a combination of these
- No two exams in the same period and room
- Examinations must fit the period and room
- Room must be available and all period, room, and distribution requirements must be met
- Desirable objectives are to be satisfied as much as possible
  - Minimize student conflicts (direct, back-to-back, more than two exams on a day)
  - Period, room, and distribution preferences
  - Minimize room splits, distance to original room, large exams first, rotation, …
  - Student and instructor availability is considered

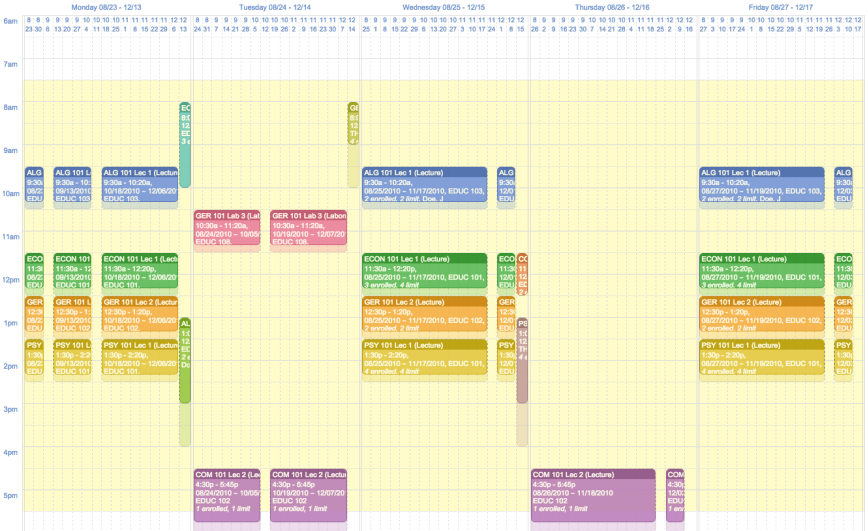


Period preferences example

Event Management

Management of the remaining classroom space

- Fully distributed, including an approval process
- Students and instructors can see their classes, examinations, course-related and other events through the event management; they can also request events for the event manager to approve
- Export to CSV, PDF, iCalendar, JSON with the ability to subscribe to a particular schedule



Example of a personal schedule