UniTime

Comprehensive University Timetabling System

UniTime

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UniTime

Educational Timetabling

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

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Why is it Needed?

- Minimize student conflicts to help students receive degrees on time
- Help use limited resources more effectively
- Make process more transparent and sustainable (no one point of failure)
- Fairness and satisfaction with the timetable
- What-if scenarios
- Ability to adapt to changes (curriculum, facilities, etc.)

Introducing UniTime

Currently there is a Gap Between Research and Practice

- Practice: timetables are created manually
  - *Often reuse prior timetable as much as possible*
- Research: the problem has been extensively studied
  - *Subject of a lot of focus over the last two decades*
  - *Numerous useful algorithms have been developed that can be applied*
  - *Computers are becoming fast enough to solve large scheduling problems*

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- Practice: timetables are created manually
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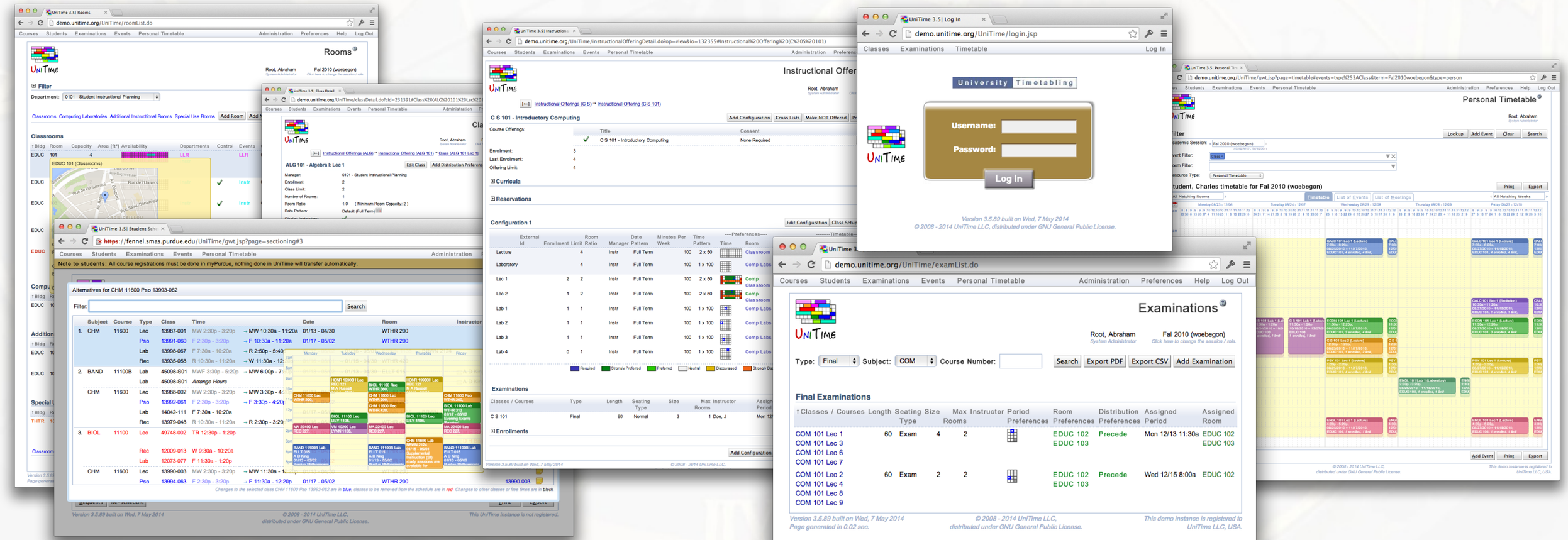
How UniTime Bridges this Gap

- Began as a research project in 2000
  - *Goal of producing an automated course timetabling solution for a large university*
  - *Makes use of latest timetabling research*
- Has become a useful enterprise system meeting university timetabling needs

Introducing UniTime

Comprehensive Academic Scheduling Solution

- Course and exam timetabling, individual student schedules, and events
- System uses state-of-the-art optimization algorithms
- Open Source, web-based, written in Java using modern technologies
- Distributed data entry and timetabling in multi-user environments



Course Timetabling

Constraints

- Rooms sizes, equipment, and availability
- Faculty time and room preferences
- Structures of courses that are offered
- Student course demands
  - Curricula, pre-registration, last-like course enrollments, etc.

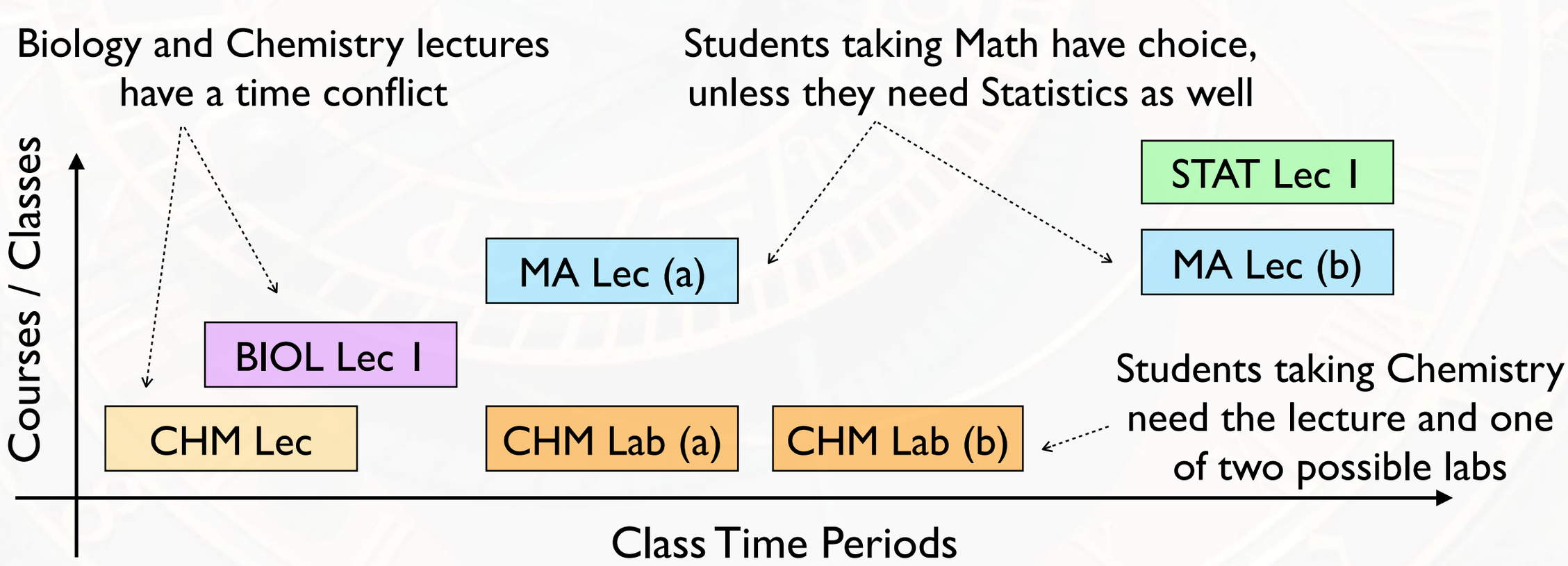
Goal

- Assign class times and locations such that
  - All required constraints are met
  - Other 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

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

						----Preferences----			
	Limit	Date Pattern	Minutes Per Week	Time Pattern	Time	Room	Distribution	Instructor	
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	

Required · Strongly Preferred · Preferred · Neutral · Discouraged · Strongly Discouraged · Prohibited

Timetabling Solver

Constraint-based Solver

- Can be used in modes between manual and fully automated
- State of the art methods
  - Work published in refereed journals
  - Winner of the International Timetabling Competition 2007
- Easy to extend

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	

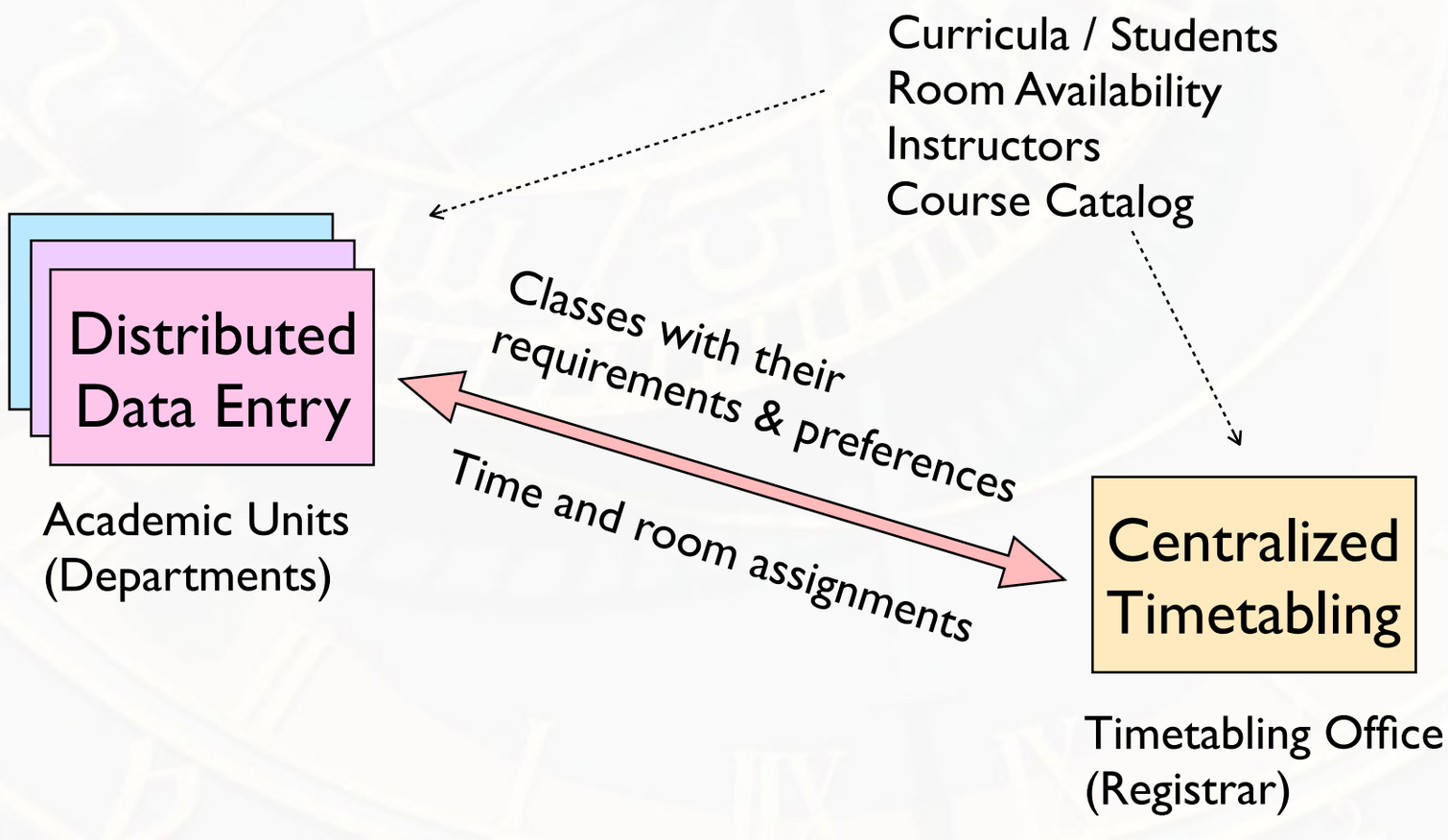
(all 1571 possibilities up to 3 changes were considered, top 4 of 17 suggestions displayed)

Search Deeper

Course Timetabling Application

Multi-user Environment

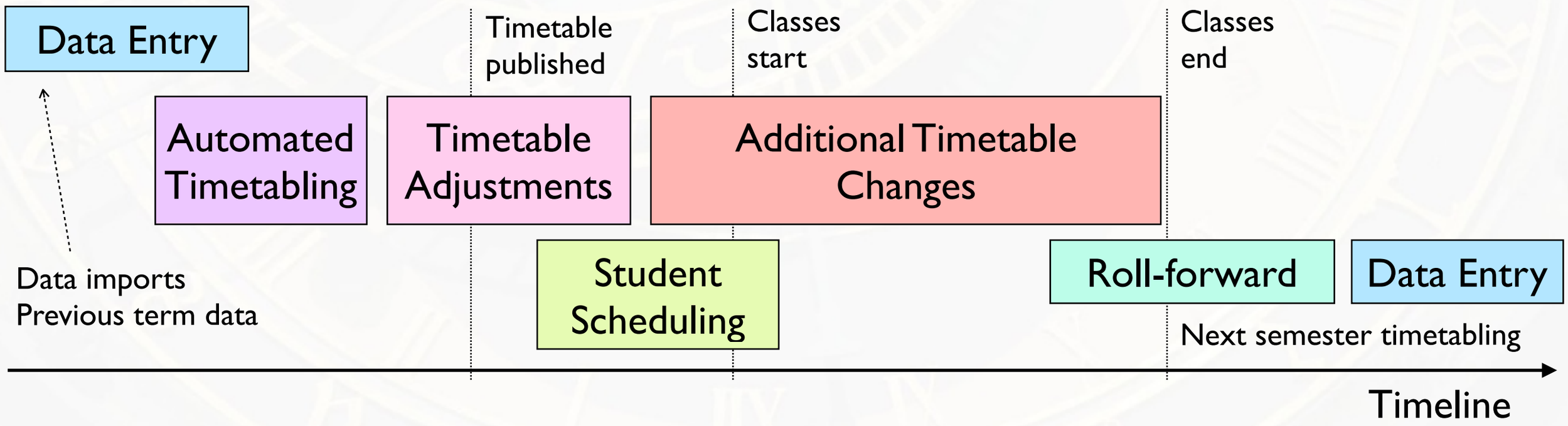
- Allows for distributed timetabling with sharing of resources
  - Rooms, instructors, and students
- Typical use: distributed data entry + centralized timetabling
  - Data are entered by schedule managers in each academic unit
  - Course timetable is produced by a central timetabling office



Course Management

Lifecycle of a Course Timetable

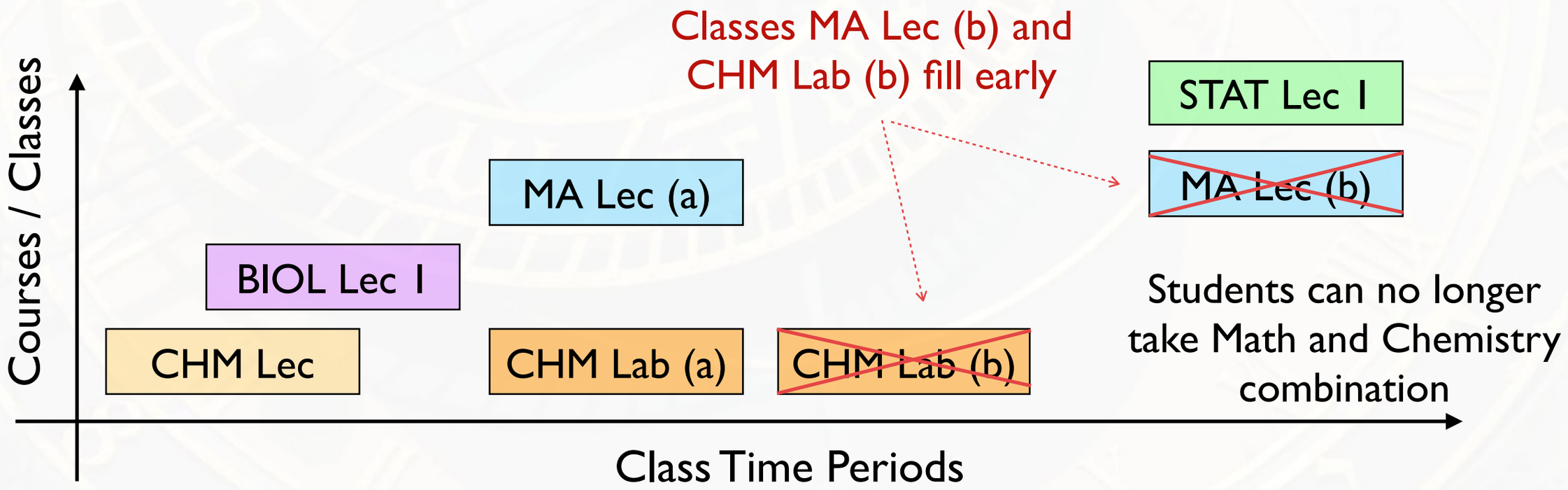
1. Data entry
2. Automated timetabling (solver is used to compute a timetable)
3. Timetabling adjustments (interactive changes)
4. Student scheduling, classes start
5. Additional, ad-hoc (mostly room) changes made throughout the term
6. Roll-forward of selected data into the next like term



Student Scheduling

Why is Scheduling 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 from being able to get needed courses*

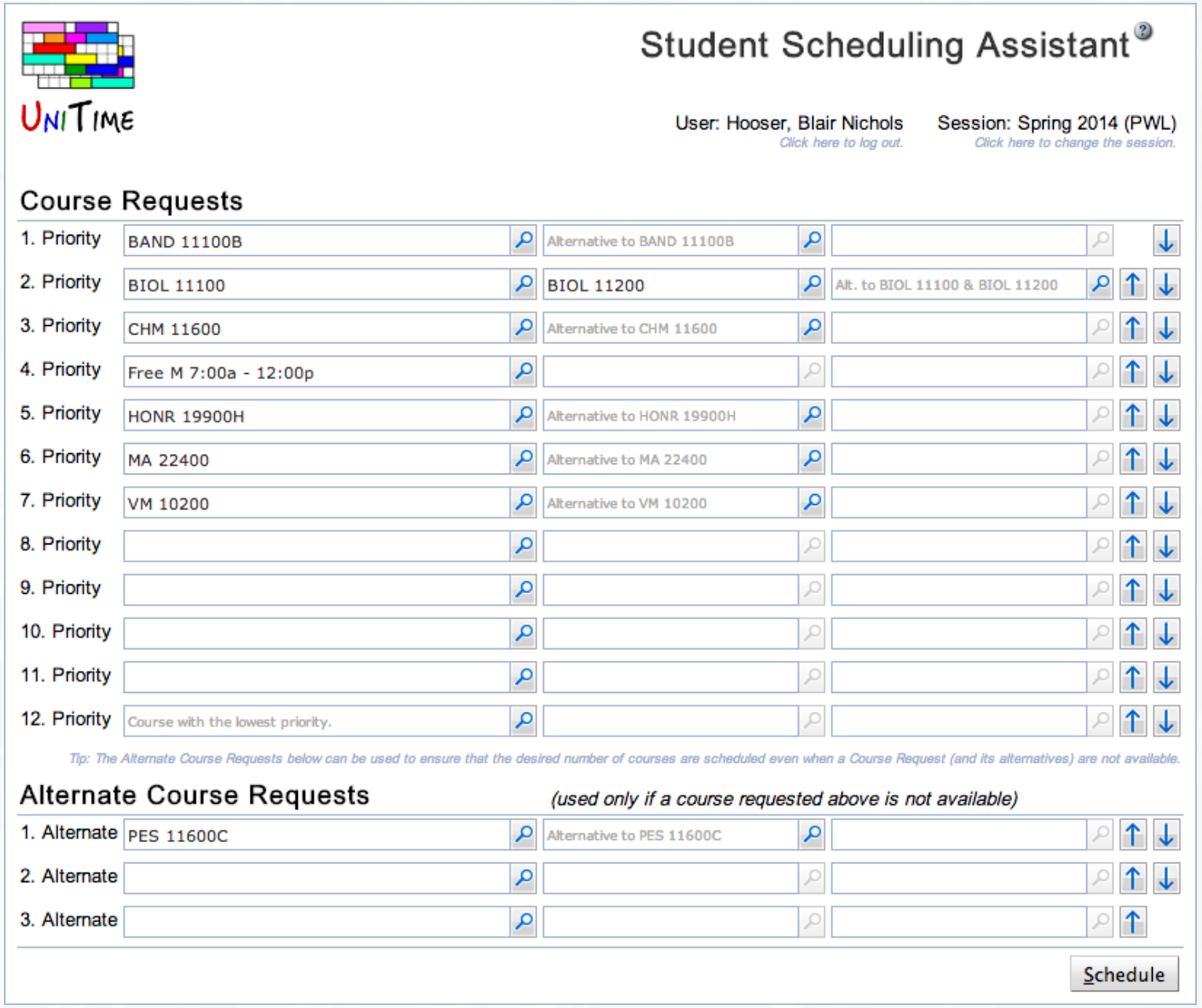


Student Scheduling

Goal

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

- Student fills in course requests
  - Including priorities, alternatives, and their own time availability
- System suggests a schedule that best meets student needs
- Students can make later modifications to schedule



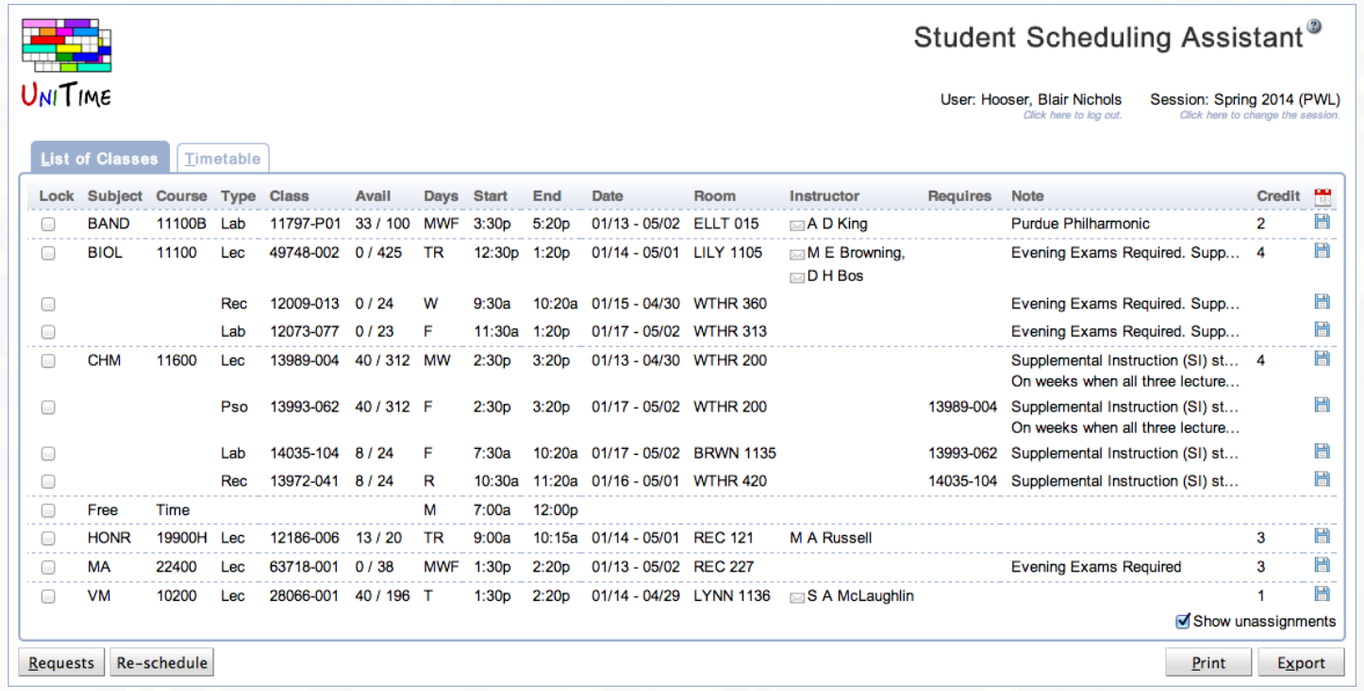
Student Scheduling

Option I: Batch (one time)

- 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

Option II: Online (real-time)

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



Other Features

Examination Timetabling

- An exam can be offered for a class, a course, or a combination of these
- Multiple examination problems (final exams, mid-term exams, etc.)
- Each exam is assigned to an examination period and one (or more) rooms
- Student conflicts are minimized
  - *Direct conflicts, more than two exams on a day, back-to-back exams*

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Examinations

Muller, Tomas (Administrator) Fall 2013 (PWL) (Click here to change the session / role.)

Type: Final Subject: AAE Course Number: 3* Search Export PDF Export CSV Add Examination

Final Examinations

↑Classes / Courses	Length	Seating Type	Size	Max Rooms	Instructor	Period Preferences	Room Preferences	Distribution Preferences	Assigned Period	Assigned Room
AAE 30100 10010-001	120	Exam	141	4	Frazho, A E		ARMS 1010 ARMS		Wed 12/11 8:00a	STEW 130
AAE 33300 10011-001	120	Exam	147	4	Alexeenko, A		MATH 175 MATH		Thu 12/12 10:30a	LILY 1105
AAE 33400 10023-001	120	Exam	59	4	Sullivan, J P		WTHR 160 WTHR		Thu 12/12 3:30p	WTHR 104
AAE 34000 10031-001	120	Exam	77	4	Howell, K		EE 170 EE		Tue 12/10 1:00p	EE 170
AAE 35200 52120-002	120	Exam	60	4	Sangid, M D		ARMS B071 ARMS		Fri 12/13 8:00a	PHYS 223
AAE 35200 62157-003	120	Exam	59	4	Chen, W W		ARMS 1109 ARMS		Mon 12/09 7:00p	ARMS B061
AAE 36400 10036-001	120	Exam	50	4	Hwang, I		FRNY B124 FRNY		Wed 12/11 8:00a	FRNY G140

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Examination Timetable

Muller, Tomas (Administrator) Fall 2013 (PWL) (Click here to change the session / role.)

Filter

Export PDF Refresh

Examination Timetable Legend

PHYS 112 (268)	8:00a	10:30a	1:00p	3:30p	7:00p
Mon 12/09	ECE 36800 17766-001 0, 0, 0	AGR 20100 10674-001 0, 1, 26	AAE 43900 10058-001 0, 0, 0	CE 20300 12822-001 0, 0, 11	PHYS 34400 27130-001 0, 0, 5
Tue 12/10	MGMT 41100 23824-001, 23825-002 1, 1, 10	MET 21300 34498-001 0, 1, 2	ECE 30862 56185-001 0, 0, 14	MA 37300 42982-001 0, 4, 20	CHE 45600 13886-001 0, 0, 1
Wed 12/11	ME 45200 0, 2, 3	PHRM 82600 56391-001 0, 1, 1	FR 10200 0, 3, 18	ME 30000 0, 6, 18	CS 35400 13241-LE1 0, 1, 7
Thu 12/12	HK 23300 0, 1, 4	ECE 30200 0, 0, 11	PHYS 21500 26987-001 0, 1, 3	PHYS 21900 27009-001 0, 0, 8	
Fri 12/13	IE 34300 50722-002 1, 0, 3	CHM 26505 36107-001 0, 1, 8	AAE 42100 10057-001 0, 0, 2	IE 54500 50788-001 0, 0, 8	TECH 32000 0, 0, 0
Sat 12/14	ECON 37000 2, 1, 13	CE 38300 12876-001 0, 1, 29			

Legend Examination Timetable

Assigned examinations:
- 0 student direct conflicts
- 1 student direct conflicts
- 2 student direct conflicts
- 3 student direct conflicts
- 4 student direct conflicts
- 5 student direct conflicts
- 6 or more student direct conflicts

Free times:
- Period not available
- No period preference

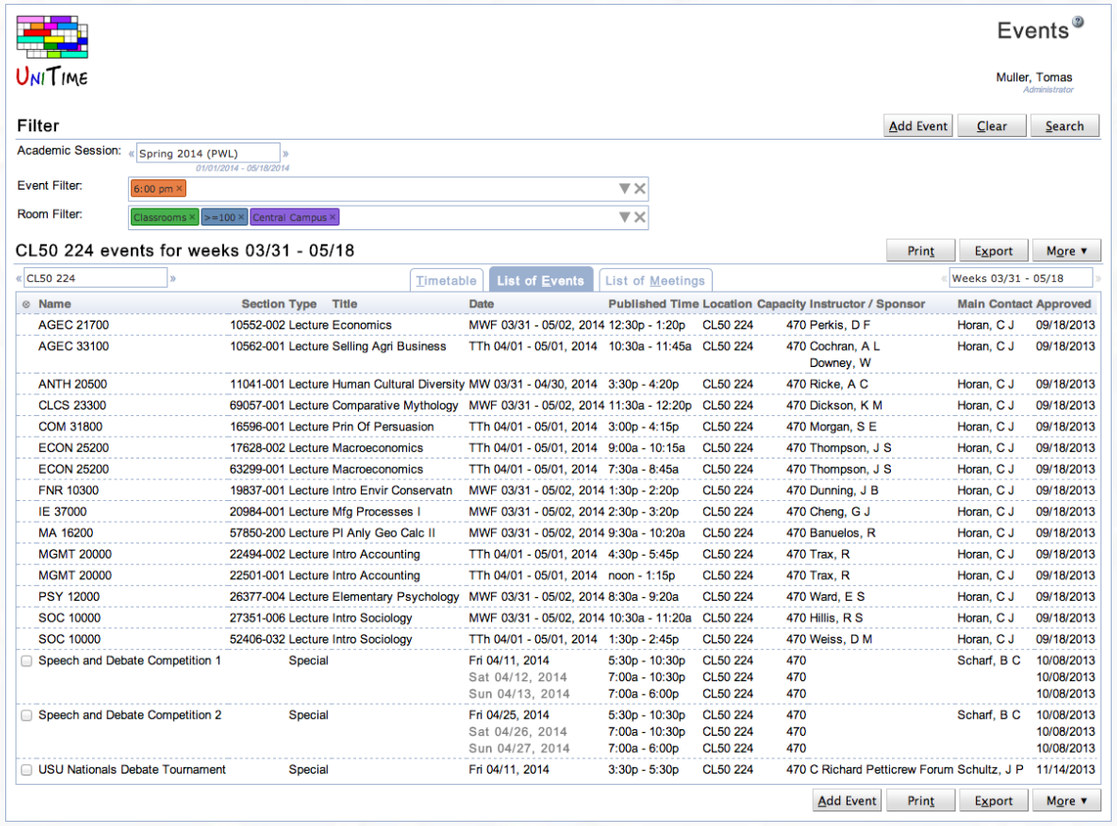
Other Features

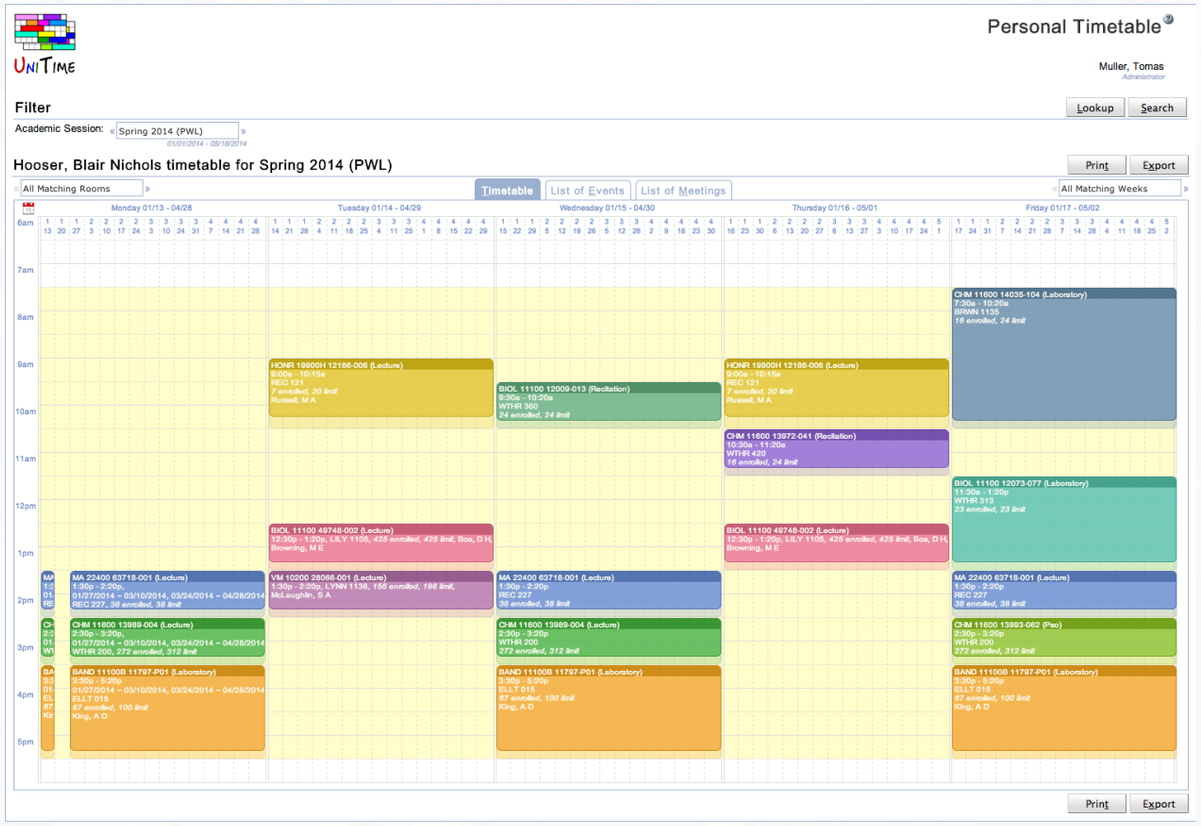
Event Management

- Management of the remaining classroom space
- Fully distributed, including an (optional) approval process

And more

- Data exchange, room distances (travel times), date patterns, …





Conclusion

UniTime Provides a State-of-the-Art Timetabling Solution

- Can be used for course timetabling, examination timetabling, student scheduling, and event management
- Is very general and can be used on many higher education institutions
- Is easy to extend and/or customize
- Has been applied at large institutions (up to 40,000 students)
- Is gaining interest from institutions around the world
- Has recently entered the Apereo incubation process

For more details, please see us at the conference

- Tech Demo Reception Tuesday at 5:30p
- Or visit www.unitime.org

An online demo is available at http://demo.unitime.org

Questions

Thank You