Open Apereo 2016

100% Open for Education

UniTime:
State of the Project

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Agenda

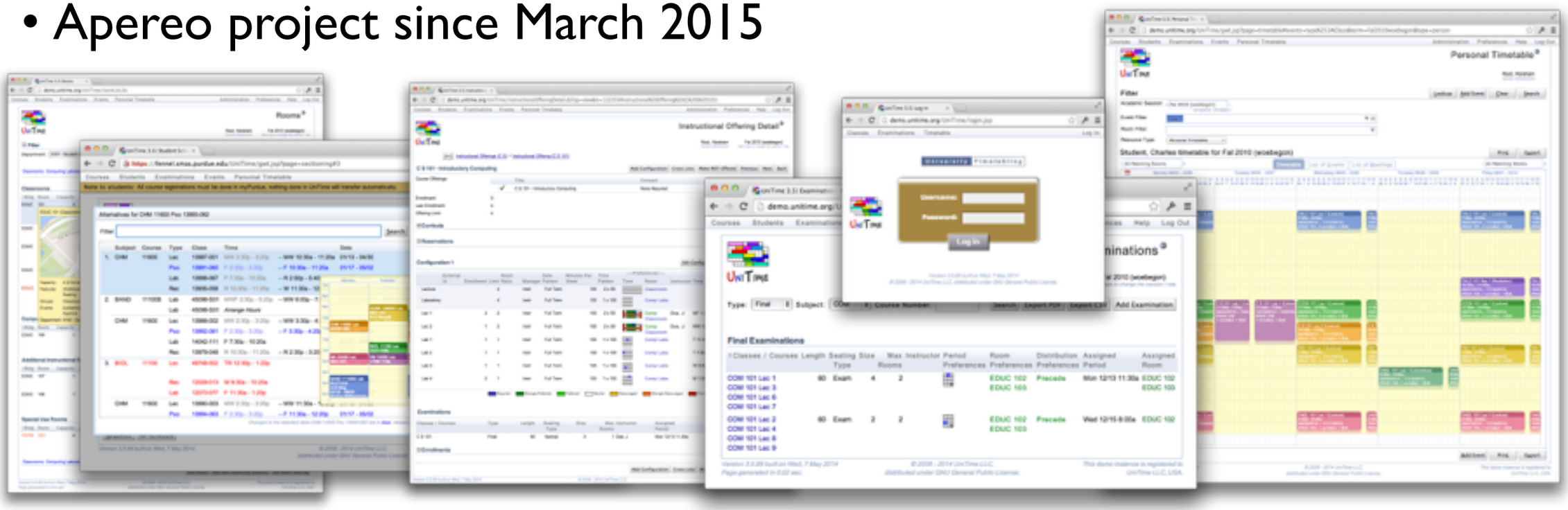
UniTime: State of the Project

- Short introduction and a few numbers
- Current release (UniTime 4.1)
- Next release (UniTime 4.2) & long term
- Walk through the new and planned features
- Course timetabling solver experiment

Introduction

What is UniTime?

- Comprehensive academic scheduling solution
- Four components: course timetabling, examination timetabling, student scheduling and event management
- Open source, web-based, written in Java using modern technologies
- Using state-of-the-art optimization algorithms
- Distributed data entry and timetabling in multi-user environments
- Apereo project since March 2015



State of the Project

Achievements

- UniTime 4.1 released in March 2016
  - Following a steady schedule of one release every 15 months
- UniTime 4.2 development is well on the way
  - Planned release mid 2017
- Over 500k of lines of code (almost 600k including the CPSolver)
- About 6,000 visits of unitime.org and about 1,000 monthly downloads
- 58 institutions from 30 countries filled our voluntary registration form during the last 12 months
- Steady increase in interest and adoption from literally around the world
  - USA, Czech Republic, Pakistan, Croatia, Poland, Turkey, Peru, Kuwait, Canada, Malaysia, Spain, UAE, Palestine, Zambia, Kenya,…

  … but still very little outside contributions

Current Release: UniTime 4.1

UniTime 4.1

- Released March 2016
- New room management
- Many improvements across all the components
- Integration with Ellucian Banner and Degree Works APIs
  - Student eligibility checking, enrollment synchronization, degree plans
- New RESTful APIs
- Translations can be provided using Zanata
  - English, Czech, Polish, Spanish *(in progress)*

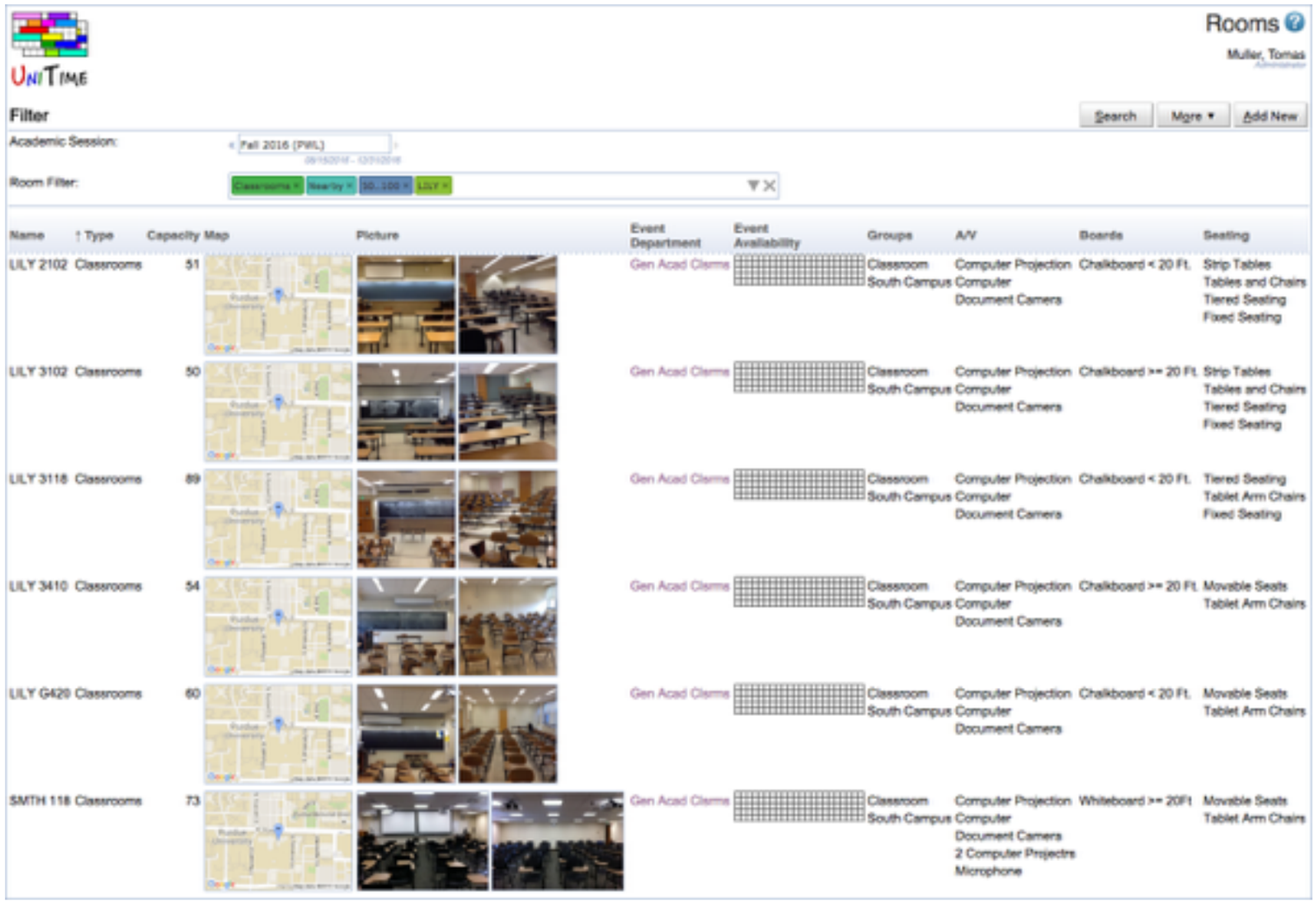
See https://goo.gl/uERUxR (UniTime 4.1 Release Docs) for more details.

See http://help.unitime.org/Localization for more details about translations.

UniTime 4.1: Rooms

Room Management

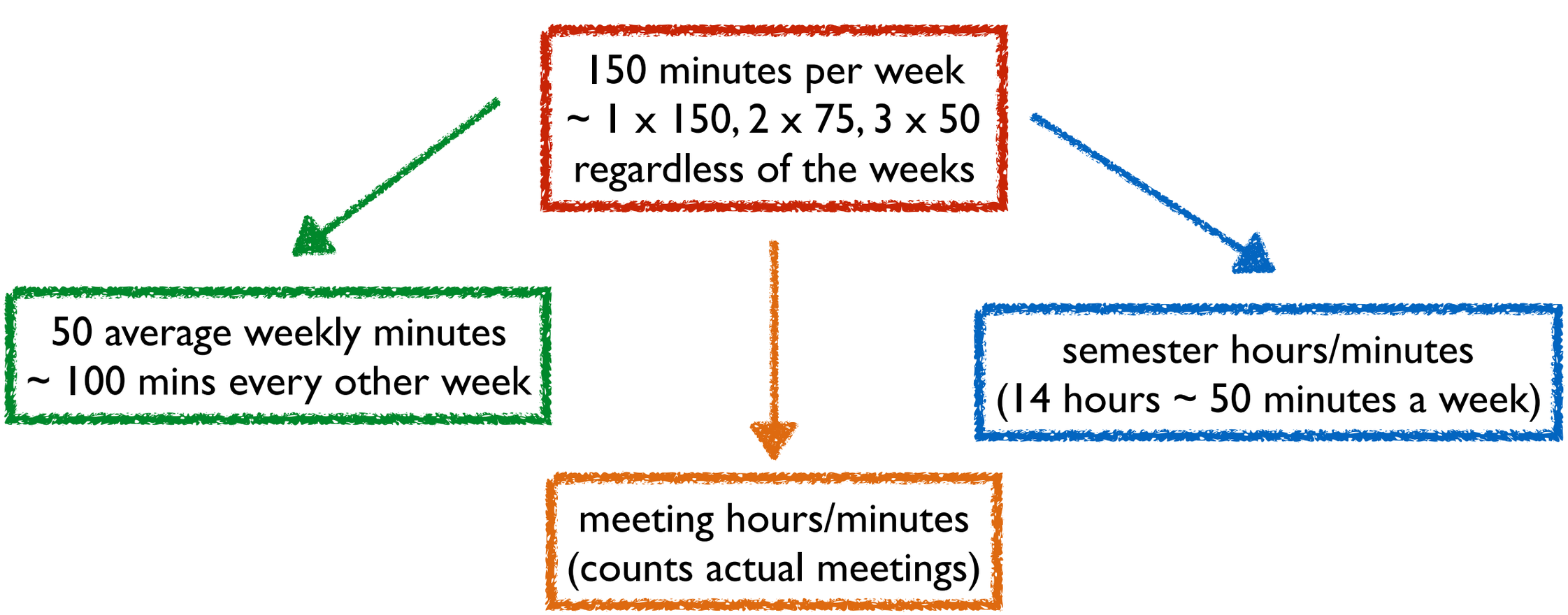
- New GWT-based pages
- Ability to update rooms across academic sessions
- Additional attachments (e.g., floor plans)
- Fully customizable table of rooms
- Room Edit page
- Better room search for event management
- New RESTful API



UniTime 4.1: Courses

Course Timetabling

- Class Duration Model
  - A class length can be specified in semester minutes or hours (not only minutes per week)
  - Computation can include holidays, alternative weeks, etc.



UniTime 4.1: Courses

Course Timetabling

- Cancelled Classes
  - Students can be moved away automatically or manually
  - A cancelled class can be reopen if needed (conflicts are indicated)
  - Only classes that have no students can be deleted

Configuration 1

Edit Configuration | Class Setup | Assign Instructors

	External Id	Enrollment	Limit	Room Ratio	Manager	Date Pattern	Minutes per Week	Time Pattern	----Preferences---- Time	Room	Instructor	--------Timetable-------- Time	Room	Room Cap	Subpart Credit
Lecture			4		Instr	Full Term	100	2 x 50		Classroom					
Laboratory			4		Instr	Full Term	100	1 x 100		Comp Labs					
Lec 1		2	2		Instr	Full Term	100	2 x 50		Comp Classroom	Doe, Joe	MF 1:30p-2:20p	EDUC 102	2	
⚠ Lec 2		1	2		Instr	Full Term	100	2 x 50		Comp Classroom	Doe, Joe	MW 12:30p-1:20p	EDUC 102	2	
Lab 1		1	1		Instr	Full Term	100	1 x 100		Comp Labs		T 11:30a-1:20p	EDUC 108	1	
Lab 2		1	1		Instr	Full Term	100	1 x 100		Comp Labs		T 7:30a-9:20a	EDUC 108	1	
Lab 3		1	1		Instr	Full Term	100	1 x 100		Comp Labs		W 9:30a-11:20a	EDUC 108	1	
Lab 4		*0*	*1*		*Instr*	*Full Term*	*100*	*1 x 100*				*M 1:30p-3:20p*	*EDUC 108*	*1*	

Required | Strongly Preferred | Preferred | Neutral | Discouraged | Strongly Discouraged | Prohibited | Not Available

UniTime 4.1: Courses

Course Timetabling

- Instructional Methods
  - Each configuration of a course can have a different instructional method (online, hybrid, traditional, etc.)
  - Students can see in their schedules

			--------Timetable--------		
	Limit	Time Pattern	Instructor	Time	Room
MA 170 STAT 170	50	Statistics I Introductory Statistics			
Configuration 1 (Traditional)	40				
Lecture	40	1 x 50			
Laboratory	40	3 x 50			
Recitation	40	1 x 100			
Lec 1	20	1 x 50	Newman, George	T 12:30p-1:20p	EDUC 103
Lab 1	10	3 x 50	Smith, John William	MWF 2:30p-3:20p	EDUC 102
Lab 2	10	3 x 50	Smith, John William	MWF 11:30a-12:20p	EDUC 102
Lec 2	20	1 x 50	Newman, George	T 1:30p-2:20p	EDUC 101
Lab 3	10	3 x 50	Doe, Joe	MWF 3:30p-4:20p	EDUC 102
Lab 4	10	3 x 50	Doe, Joe	MWF 1:30p-2:20p	EDUC 102
Rec 1	40	1 x 100	Newman, George	Th 9:30a-11:20a	THTR 101
Configuration 2 (Online)	10				
Distance Learning	10				
Dist 1	10	Arr 5 Hrs	Newman, George		

UniTime 4.1: Courses

Course Timetabling

- Multiple-Major Curricula
  - Useful for dual major programs, can inherit a common part
  - These can be overridden on the multiple-major level

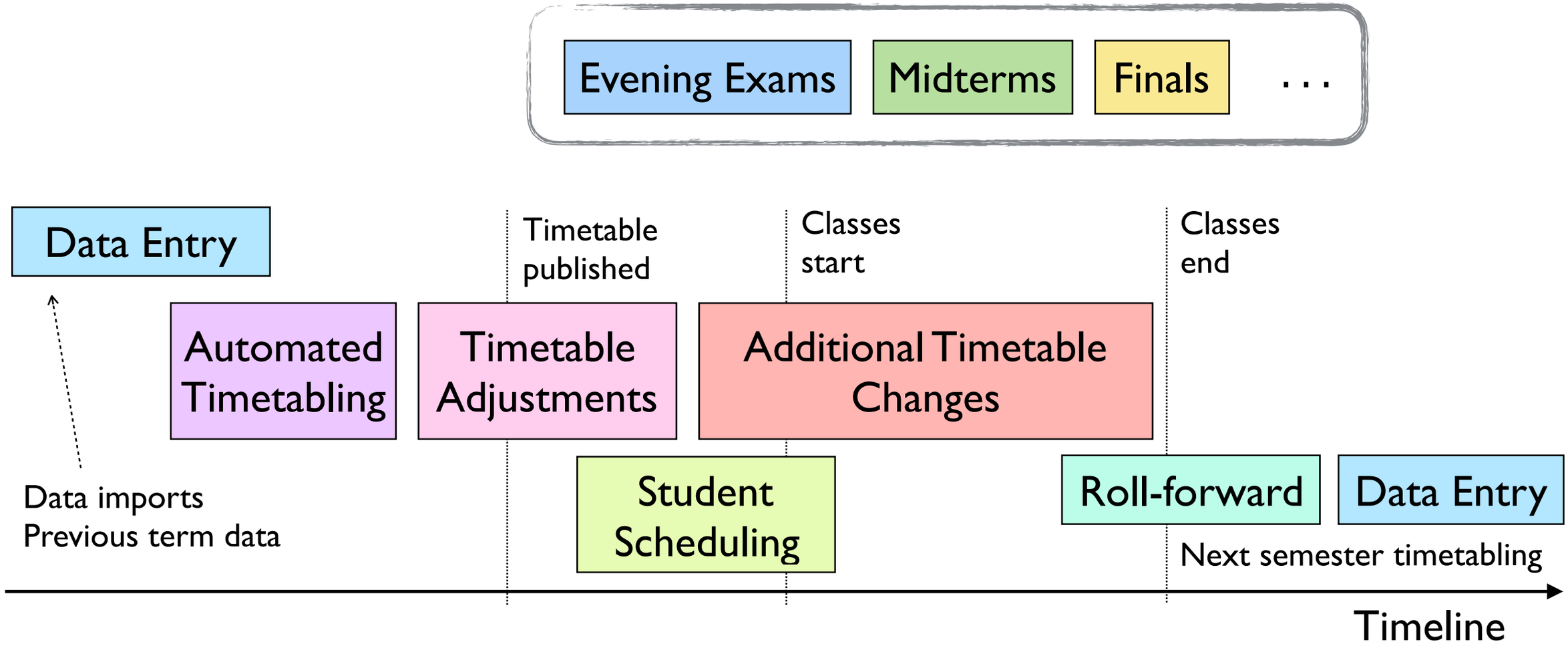
Example from College of Education, Masaryk University

- Each high school teacher has two approbations
- There are many possible combinations
- Curricula are created as a combination of
  - Common part (each student must have)
  - Specific courses for each major
  - There are exceptions

UniTime 4.1: Exams

Examination Timetabling

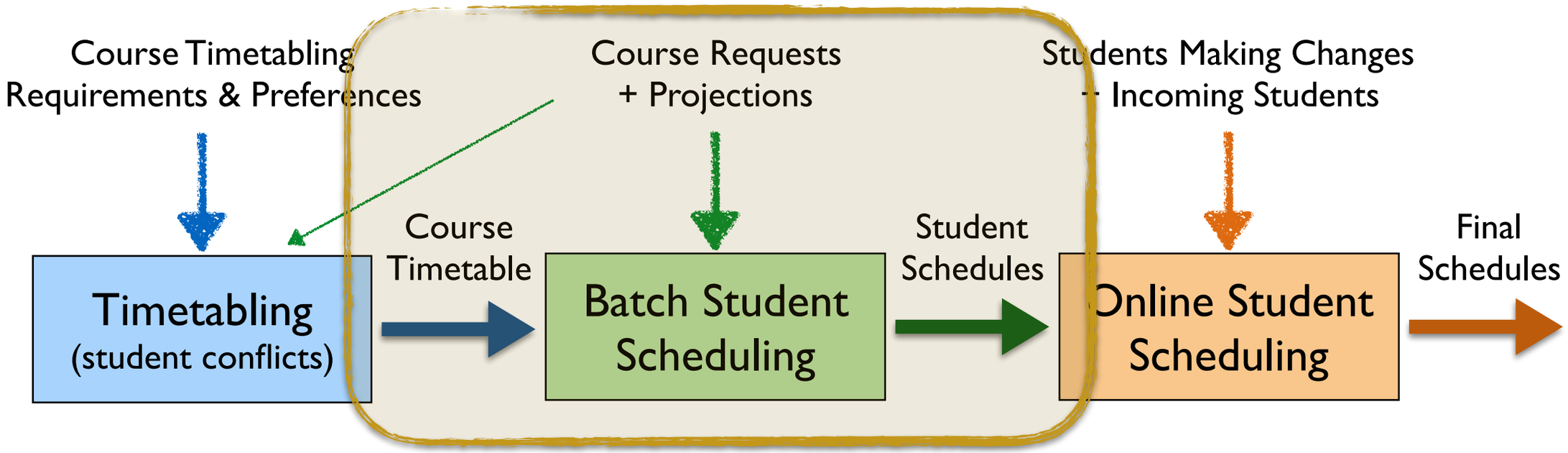
- Examination Status: Each examination problem can be timetabled and published at a different time
- Ability to associate examination managers with a particular problem



UniTime 4.1: Students

Batch Student Scheduling

- Minimal Perturbation Mode: minimize changes to existing students
- Request Groups: keep students of the same group together
- Interactive Changes: manual changes after the solver has been run
- Student Filter: ability to run the solver only for a certain group of students

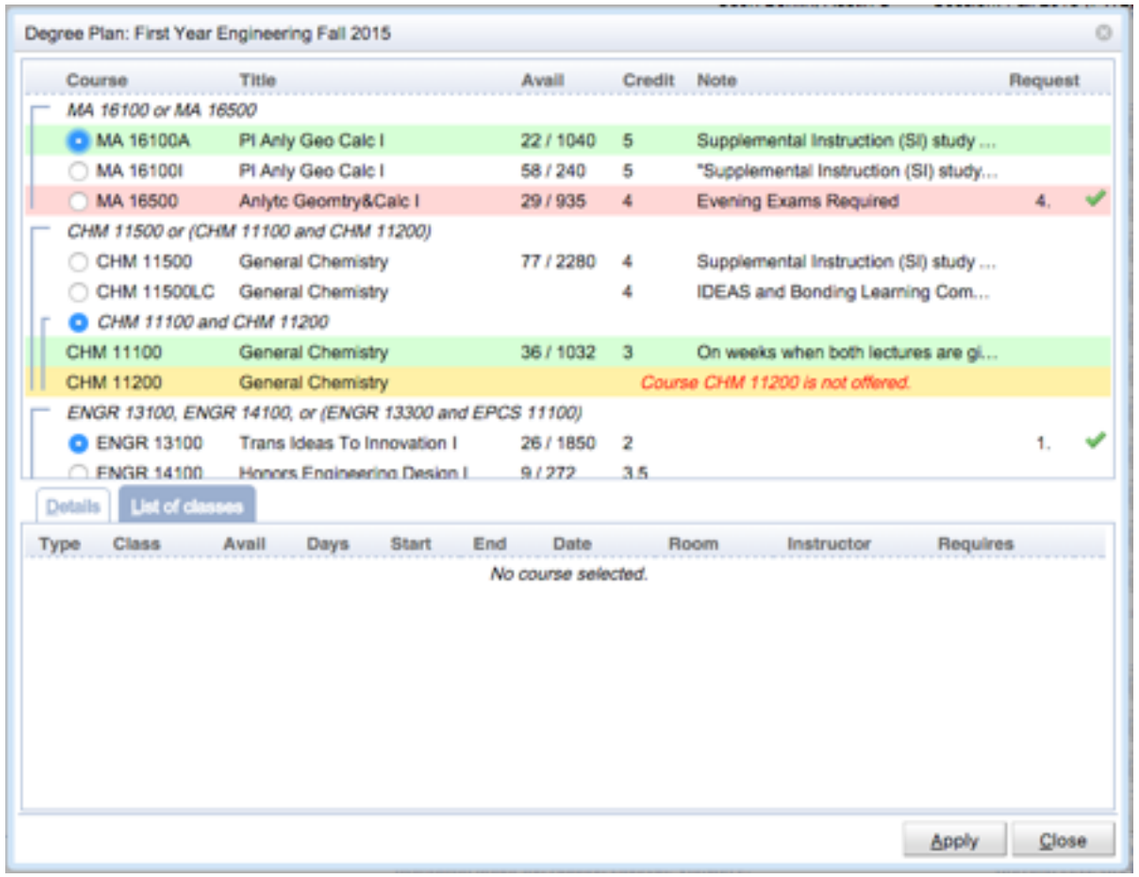


See the Student Scheduling in UniTime presentation on Wednesday, 11:45am in KC 912

UniTime 4.1: Students

Online Student Scheduling

- Many UI improvements in the Scheduling Assistant
- Quick Add/Drop: easy way to add/drop a single course
- Degree planning integration
  - Provides ability to retrieve degree plan from an external system
  - Build a schedule in just a few clicks
  - Initial implementation using Ellucian DegreeWorks



See the Student Scheduling in UniTime presentation on Wednesday, 11:45am in KC 912

UniTime 4.1:API

UniTime 4.1 APIs

- RESTful JSON APIs
- Using HTTP-simple authentication or an API token
- Retrieve instructor schedule, class information, enrollments, events
- Room management
- Online student scheduling
- Data Exchange XMLs
- GWT RPCs

```
GET api/instructor-schedule?term=Fall2016&id=<id>
GET api/class-info?classId=<id>
GET api/events?type=ROOM&r:text=EDUC+101&term=Fall2016
GET api/events?type=PERSON&term=Fall2016&ext=<id>
GET api/enrollments?classId=<id> (or courseId, examId, eventId)
```

See https://goo.gl/ikdOix (UniTime 4.1 API Specs) for more details.

Next Release: UniTime 4.2

UniTime 4.2 (in development)

- Planned release mid 2017
- Instructor Scheduling (TA Assignment)
- Student Group Scheduling (Learning Communities)
- Student Scheduling (XE/DegreeWorks API, Instructional Mode)
- UniTime Mobile (Responsive Design)
- Many additional improvements across all the components (e.g., consensus date reporting)

See https://goo.gl/Bv1qQw (UniTime 4.2 Specs) for more details.

UniTime 4.2: Instructors

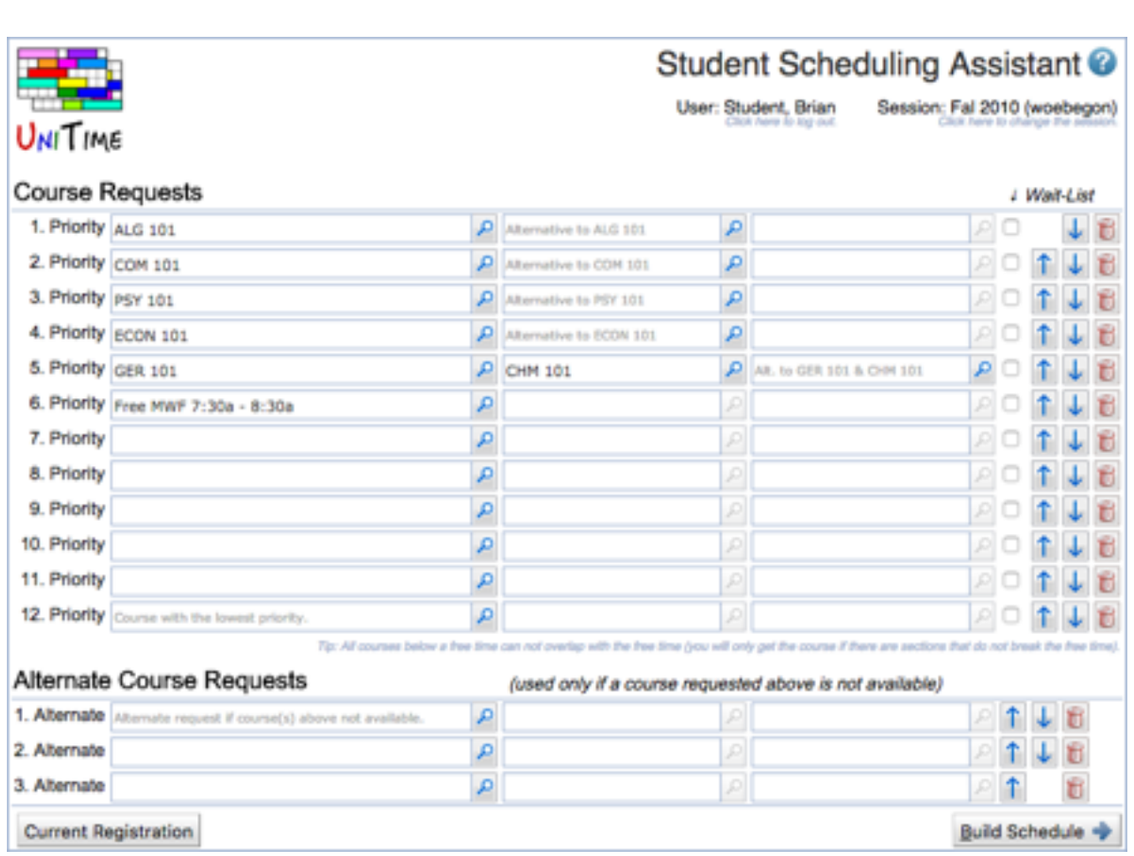
Instructor Scheduling

- Assignment of instructors to classes, respecting various constraints (availability, maximal load, required skills, same course, etc.)
- Modeled as a new optimization problem
- Instructors are to be assigned AFTER the course timetabling is done
- Typical use case: assignment of teaching assistants
- A lot of data already exist in UniTime
- On an instructor: teaching preference, list of attributes, maximal teaching load, course and time preferences
- On a course: indicate that instructor assignment needed, teaching load, attribute and instructor requirements and preferences
- UniTime will offer similar features as in course or exam timetabling (conflict statistics, interactive changes, reporting, …)

UniTime 4.2: Students

Student Scheduling

- Ellucian Banner XE interface (additional features have been recently implemented in the interface like course overrides or back-dating, asynchronous calls for automated waitlisting)
- Extension of the course request model to allow for the student to further specify which classes he/she wants to take
  - Instructional method (online, hybrid, traditional)
  - Preferred instructor
  - …



See the Student Scheduling in UniTime presentation on Wednesday, 11:45am in KC 912

UniTime 4.2: Groups

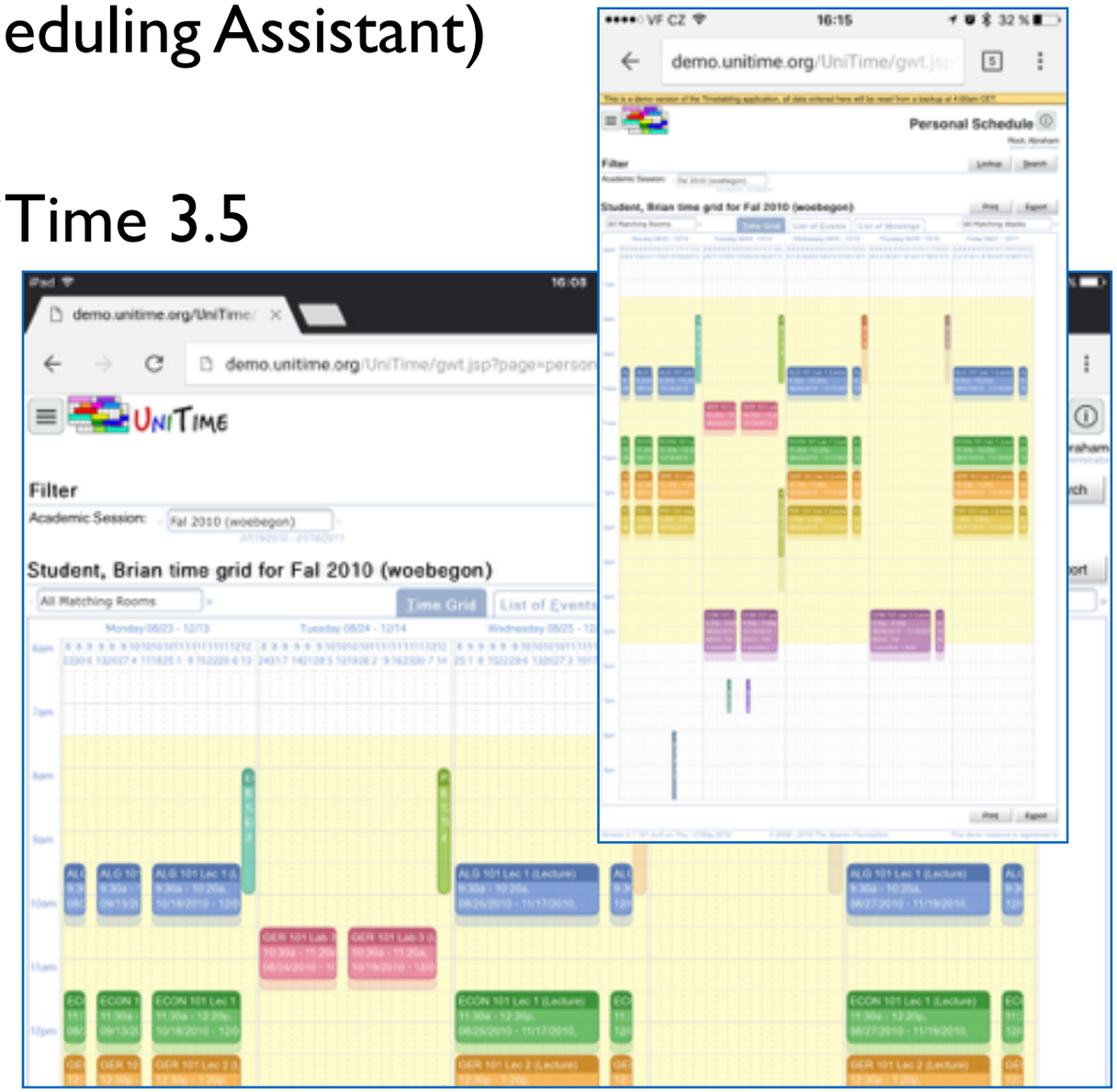
Student Group Scheduling

- UniTime allows for many ways how student conflicts can be minimized
- However, all these deal with individual student enrollments at the end
  - The solver can shuffle students around freely
- There are some universities that want to keep students together
  - For historic reasons
  - Or as a way of making students feel like there is a community
- Can be modeled with student groups, each with a list of students and courses that the group needs to take
- This information can be used in course timetabling as well as in student scheduling
  - E.g., to reserve a particular class of a course to a student group, while avoiding time conflicts within the group

UniTime 4.2: Mobile

UniTime Mobile

- Useful for pages that are accessible be students and instructors
  - Online student scheduling (Scheduling Assistant)
  - Event management
- We have some support since UniTime 3.5 (using MGWT)
  - There can be a different permutation of the client code for each platform (desktop, tablet, phone)
- Would like to revisit the current approach and, e.g., use the responsive design instead



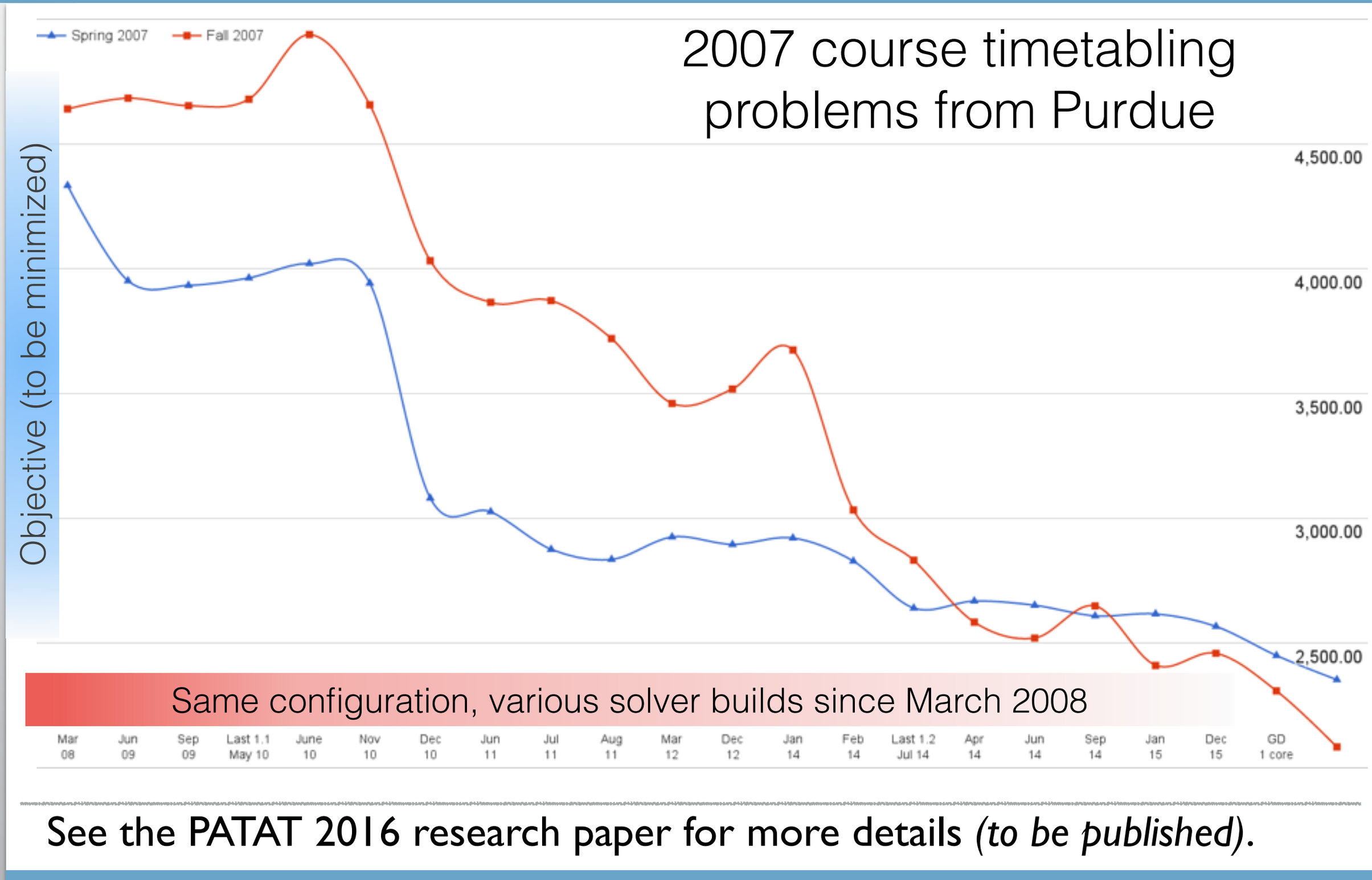
UniTime Solver Evolution

It is not just the user interface that keeps evolving

- A lot of changes has been done in the solver engine as well
- To demonstrate, we have taken 2007 benchmark data from Purdue, and run them through the various solver builds since the paper (March 2008) till the one released with UniTime 4.1 (Dec 2015)
- There was 50% improvement in the solution quality since UniTime 3.1
  - 33% less student conflicts
  - 15% improvement in time preferences
  - 40% in room preferences
  - 80% in distribution preferences
- Besides of these, there have been a lot of new constraints and other features added into the solver over the years.

For Purdue C8-2007 benchmark data sets see http://www.unitime.org/uct_datasets.php

UniTime Solver Evolution



See the PATAT 2016 research paper for more details *(to be published)*.

Conclusion

Long Term

- Constraint Solver: instructor and student group scheduling
- UI: moving from Struts to GWT, localization, documentation, mobile
- Interfaces: IMS Course Planning & Scheduling, more APIs and XMLs

For more details, please see us at the conference

- UniTime 101 (Sunday, 9 am - 12 pm in GC 261)
- UniTime: State of the Project (Tuesday, 3pm - 3:45pm in KC 912)
- Student Scheduling in UniTime (Wednesday, 11:45am - 12:30pm in KC 912)
- Or visit www.unitime.org

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