



Collocated at  **OCX²⁶** OPEN COMMUNITY
EXPERIENCE

UniTime Overview: From Research to Practice

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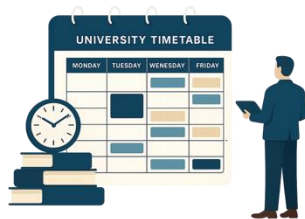
Education Timetabling

Process of assigning events in time and space

- Hard optimization problem
- Research since the 80s
- Mostly at departmental level, many differences

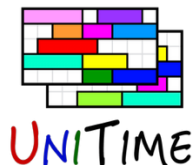
Why is it needed?

- Students get the courses they need
- Manage resources more effectively
- Make the process easier to manage
- Good timetables that are fair
- What-if scenarios
- Adapt to a change

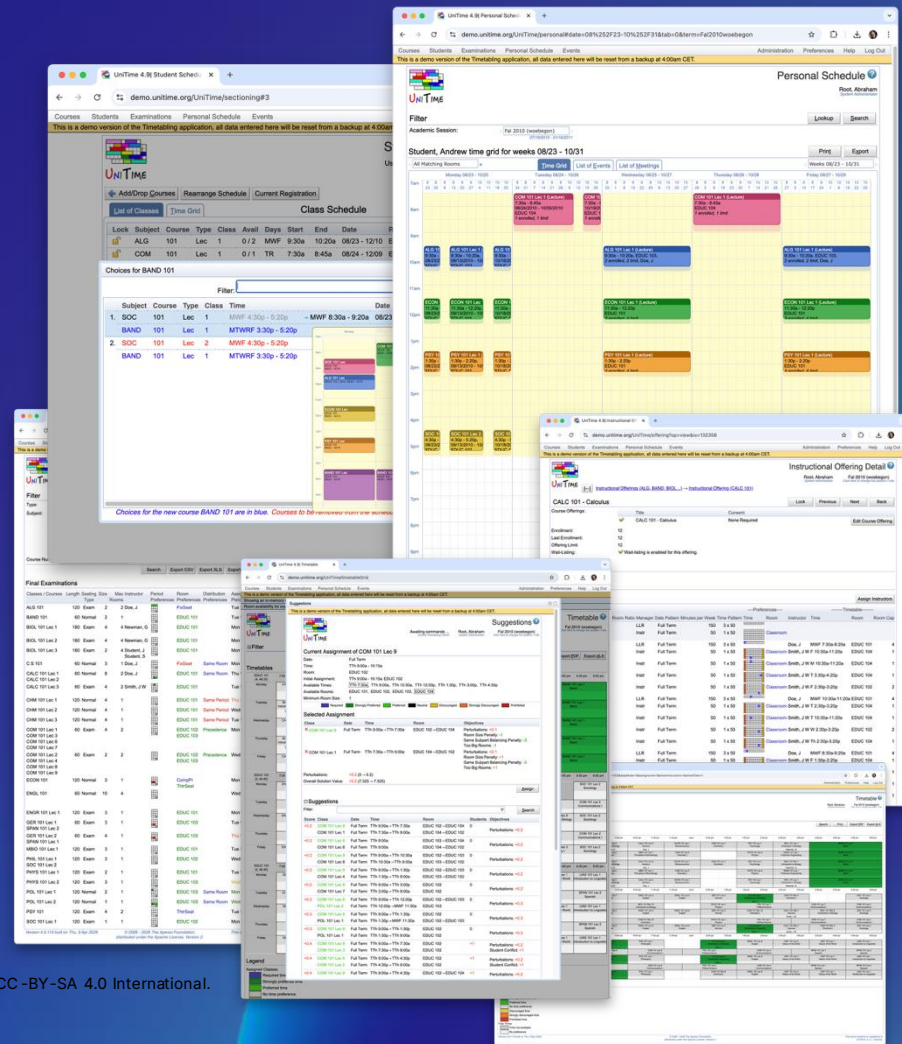


- Started as a research project in 2001
 - Cooperation between Purdue University and Masaryk University
 - Large-lecture room timetable at Purdue
- Became open-source in 2007
 - Joined the Apereo Foundation in 2015
- Enterprise system for many timetabling needs of a university

Introducing UniTime



- Comprehensive academic scheduling solution
- Five components
 - Schedule of classes
 - Individual student schedules
 - Teaching assistant assignments
 - Examination schedule
 - Additional (course-related) events
- Open-source, web-based, written in Java
- Distributed data entry and/or timetabling
- Using state of the art optimization algorithms
- Used by 100+ institutions around the world



Example: Examination Timetabling



- Problem: assing examinations in periods and rooms
 - Available rooms, periods
 - Exams with associated students & instructors, seating type
- Constraints Constraints
 - Examination size \leq room capacity
 - Period and room requirements
 - No two exams in a room at the same time and period
 - Student/instructor/room availability
- Objective: minimize student conflicts
 - Direct conflicts
 - More than two exams on a day
 - Back-to-back exams
- Other objectives
 - Instructor conflicts
 - Period and room preferences
 - Room splits, distances between rooms, large exams first, ...

	from: 8:00a	10:30a	1:00p	3:30p	7:00p
	to: 10:00a	12:30p	3:00p	5:30p	9:00p
Mon 12/09					
Tue 12/10					
Wed 12/11					
Thu 12/12					
Fri 12/13				Discouraged	Discouraged
Sat 12/14	Strongly Discouraged	Strongly Discouraged	Strongly Discouraged	Strongly Discouraged	Prohibited

- Required
- Strongly Preferred
- Preferred
- Neutral
- Discouraged
- Strongly Discouraged
- Prohibited



UniTime Solver

- Constraint Satisfaction Optimization Problem (CSOP)
- Open-source and written in Java
- Local-search based with various heuristics and multiple algorithms available
- Conflict statistics to escape local optima
- Works well on large instances, though it cannot prove optimality
- Winner of two of three tracks of ITC 2007
- Best results on the ITC 2019, if limited by time & hardware

Problems

Course Timetabling

Examination Timetabling

Instructor Scheduling

Student Scheduling

Constraint-based Model

Variables

Values

Constraints

Criteria

Solver

Configuration

Parameters

General

Problem Specific

Algorithms

IFS

HC

SA

GD

Neighbourhoods

UniTime Research

- Started as a research project
- Published number of papers
- PATAT conference series
 - Next one in Nottingham in August 2026
- Co-organized ITC 2019
 - Benchmark datasets for further research
 - Validation & best know solutions repo



- Course timetabling with student sectioning
- 30 problem instances of various sizes
- Real-world data from 10 institutions
- 750+ registrations
- 20+ solvers
- 5 finalists, one winner
- 20+ journal publications

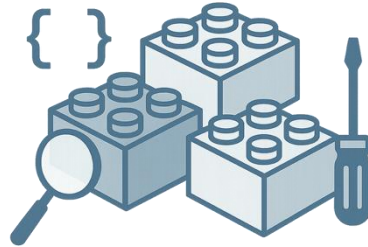
www.itc2019.org

A screenshot of the ITC 2019 website's 'Best solutions' page. The page displays a table with columns for Instance, Total cost, Student conflicts, Time penalty, Room penalty, Distribution penalty, and Solver. The table lists various problem instances and the solvers that achieved the best results for each. The top row shows 'itc2019_01' with a total cost of 1000, 0 student conflicts, 0 time penalty, 0 room penalty, and 0 distribution penalty, solved by 'MSA'.

How to contribute

- Timetabling research (check out itc2019.org)
- Student projects (proof of concept)
- Localization
- Integration
- Software development

github.com/UniTime





OCR

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FOR RESEARCH**

Thank you

www.unitime.org