

A decorative graphic consisting of overlapping colored squares (green, purple, blue) and a black crosshair.

UniTime 3.1 University Timetabling Application

Examination Timetabling Training

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Agenda

- Input Data Entry
 - Administration
 - Instructors
 - Rooms
 - Examinations
- Examination Solver
 - Automated Solver
 - Interactive Changes
- Reports
 - Examination Assignment Reports
 - PDF (legacy-like) Reports
 - Individual Schedules



Input Data: Administration

- Academic Session
 - Examination Begin Date
- Examination Periods
 - Two examination problems: Final, Midterm
 - Type, Date, Start Time, Length, Preference
 - Period Preferences:
 - Prohibited: period cannot be used (*never ever*)
 - Otherwise, act as default preferences for an examination
 - Dates are relative to session's examination date (easy roll-forward)
 - Midterm examination type is only displayed when there are midterm periods defined
 - **Periods cannot overlap in time!**



Input Data: Administration

- User Roles / Session Status
 - Dept. Schedule Manager (*Exam View*, *Exam Edit*)
 - No required, prohibited preferences
 - Examination Manager (*Exam Timetable*)
 - Administrator
 - View All (*Exam View*)
- Roll forward
 - **No examinations are automatically generated!**
 - An examination automatically is deleted if (and only if !) it is no longer associated with any instructional offering components
- Data exchange
 - Export Final/Midterm Examinations
 - Room availability



Input Data: Instructors

- Instructors
 - Still related to departments
 - This means that only instructors from the related departments (department of the controlling course) can be assigned to an examination.
 - Added list of examination assignments
 - *Final examinations are displayed in bold.*
 - Instructor preferences are NOT related to examination timetabling
 - This includes *Ignore Too Far* flag
 - Instructor IDs (PUIDs) are important
- New: Instructor has an email address



Input Data: Rooms

- Rooms
 - All Final/Midterm Examination Rooms
 - Examination Capacity (*the same for both problems*)
 - Period Preferences
 - Global Room Groups and Features
 - Non-University Locations may be used as well
 - How to add/drop an examination room
 - Edit Room Sharing
 - Edit Room (*also allows changing of period preferences*)
 - **Period Preferences**
 - Prohibited: cannot be used (*aka room is not available*)
 - Strongly discouraged: cannot be used, unless specified on an exam
 - Usage: *original rooms that are not classrooms*
 - Discouraged: usage of a room should be minimized
 - **Room Availability**

Input Data: Examination

- Examination
 - Name (*generated, can be overridden*)
 - *See examination naming conventions*
 - Type (Final, Midterm)
 - Length (*only periods with enough length can be used*)
 - Seating Type (Normal, Examination)
 - Maximal Number of Rooms
 - 0 means no room assignment (*aka Instructor Office*)
 - Size
 - Number of enrolled students
 - Class / course / offering limit (*Midterm examinations only*)
 - Notes



Input Data: Examination

- Examination
 - Average Period
 - *Roll-forward:* $\frac{1}{2} (\text{Period}_{\text{LastLike}} + \text{AvgPeriod}_{\text{LastLike}})$
 - Instructor (s)
 - *All expected to be present (~have conflicts)*
 - Instructional Offering Components (Courses / Classes)
 - A set of classes, configurations, courses or offerings
 - Preferences
 - Period, Room, Building, Room Feature, Room Group, Distribution

Input Data: Examinations

- Examinations (List)
 - Filter by Type, Subject, Course
 - Other pages with examination names, period and room assignments
 - Instructional Offerings
 - *Displayed on the appropriate level.*
 - Classes
 - *Transferred to classes (exams of the first scheduling subpart).*
 - Class Assignments
 - *Transferred to classes, contains only period and room assignments.*
 - List of all related examinations (*includes Add Examination button*)
 - *Examinations to be attended by the students attending the class/course etc.*
 - Instructional Offering Detail
 - Scheduling Subpart Detail
 - Class Detail
 - Instructors, Instructor Detail

- Distribution Preferences

- Same Period
- Different Period
 - ~ *discouraged, prohibited same period*
- Same Room
 - ~ *all rooms if multiple*
- Different Room
 - ~ *discouraged, prohibited same room*
- Precedence
- *Note: hard (required, prohibited) preferences may be overridden in the interactive mode (while the solver is not running)*



Solver: Hard Constraints

- Constraints

- Only one exam can be placed in a room at a time
- A room cannot be used during a period that is prohibited or unavailable
- An exam must be placed in room (or rooms) that are available for the exam and that are of enough size
- An exam cannot be placed in a period that is prohibited
- Required/prohibited distribution preferences must be met

- Optimization Criteria
 - Student and Instructor Conflicts
 - Direct Conflicts
 - *Other exam in the same period, classes for Midterm examination*
 - More Than Two Exams A Day, Back-To-Back
 - *Distance Back-To-Back may be used as well*
 - Period, Room, Distribution Penalties
 - Room Split
 - *0 for no split, 1 for 2 rooms, 4 for three rooms, 9 for four rooms, etc.*
 - *Minimize distances between rooms in the split*
 - Room Size
 - *Difference between room size (normal or exam seating) and exam size*
 - Rotation Penalty
 - *Period index × average period*

- Optimization Criteria

- Large Exams Penalty

- *Large exams (e.g., size ≥ 300) are discouraged from placing on a certain period or after*

- Perturbation Penalty

- *Distance of periods \times size of the exam*

- Midterm Examination

- Same courses/classes \rightarrow strongly preferred same room constraint



Solver: Automated Solver

- Same solver as for course timetabling, different model
 - State of the art, ITC 2007 winner !!!
 - Period and room are assigned together
- Phases
 - Construction
 - *Worst unassigned exam, find best available period and room(s)*
 - Iterative Forward Search with Conflict-Based Statistics
 - *Until a complete solution is found*
 - Hill Climbing
 - *Neighbor search, a random move is accepted only when improving*
 - Great Deluge
 - *Overall solution value cannot exceed a given bound that is decreasing*
 - Simulated Annealing
 - *Probabilistic acceptance criterion, driven by a decreasing temperature*



Solver: Automated Solver

- Notes

- Only one solution is stored in the database
- Except of PDF reports, the solution that is loaded is always displayed over the solution that is stored in the database
- Each user can have only one examination problem loaded in the solver at a time

- Solver Configuration

- Weights of optimization criteria
- Back-to-back distance
- Back-to-back over a day break
- ...

Solver: Solver Training

- Automated Solver
 - Load, (Clear), Start, Stop, Save, Unload...
 - Current/Best Solutions
 - Pages
 - Timetable, Assigned, Not-Assigned, Changes, Conflict Statistics
- Interactive Changes
 - Examination Assignment
 - Move an exam, swap two exams, etc.
 - Suggestions, Conflict-based statistics
 - The same without examination the solver running

Examination Reports

- All (ordinary) pages can be exported and serve as reports
 - E.g., Classes with exams, examination timetable
- Examination (Assignment) Reports
 - Describe individual reports
 - Filtering capabilities
- PDF Reports
 - For all exams (of given type) or by subject area
 - Generated on fly (available through download, or email)
 - ... or by a Java program (also includes email distribution)
 - Various options (and “Purduisms”)
 - Emails to deputies, instructors, students
 - May only include individuals with a change (in examination schedule) after a certain date
 - *E.g, can be generated nightly and send to people (involved in a change)*



Examination PDF Reports

- Abbreviated Schedule
 - 2 columns with rooms, 3 columns without rooms
 - Components of the same exam can be listed together
 - With or without itype (*external id*)
- Instructor Individual Schedule
 - May include class schedule
 - Includes a list of instructor and student conflicts
 - May be emailed directly to instructors
 - Only to instructors that have a change in the examination schedule since a given date
 - Also available online for instructors!
- Student Individual Schedule
 - Similar to instructor individual schedule
 - Contains only information related to the given student

Examination PDF Reports

- Student / Instructor Conflicts
 - Types of conflicts as option
 - Conflicts with classes are marked CLASS
- Period Chart
 - 5 columns without totals, 6 columns with totals
 - May exclude exams that are under a given limit
 - Room codes may be provided
 - LAMB F101:A,ELLT 116:E,STEW 183:L,STEW 130:F
- Schedule by Period
 - Components of the same exam may be printed together
 - Room assignments may be excluded
- Schedule by Room



Examination PDF Reports

- Verification
 - All classes are listed
 - Include cross-listed and meets with information
 - Class/course Limits and Enrollments may be excluded
 - May be used before exams are assigned,
 - Required / prohibited preferences are included
 - Or after exams are assigned
 - Period and room exam assignments are included

- Room Availability Report
 - Up-to-date information from an external system may be used
 - By default, the built in event management system is used
 - *This, at least, blocks the times that are taken by classes*
 - If linked with an external system, the room availability is periodically updated (when it is being use)
 - *First query may take a while (e.g., up to 10 minutes)*
 - *The room availability information is not older than X minutes*
 - Only events that overlap with examination periods are presented
 - May include appropriate examination events
 - Comparison with the examination assignments in the system
 - *Beside of this, some periods may be prohibited (or strongly discouraged) in certain rooms using examination period preferences on rooms*



Individual Schedules

- Any instructor or student can be authenticated using LDAP
 - Personalized class and examination schedules are provided
 - Including (direct, more than 2 a day, back-to-back) conflicts
 - Has to be enabled by appropriate academic session state
 - *No-Role Report*