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
Input Data: Distribution Preferences

- 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
Solver: Soft Constraints

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
 Solver: Soft Constraints

- **Optimization Criteria**
  - **Large Exams Penalty**
    - *Large exams (e.g., size \( \geq 300 \)) 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*
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

- 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