Student – Class Assignment Optimization

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USOS

- The *University Study-Oriented System* is an integrated student management information system for handling student affairs at Polish universities.
- Its development and deployment is coordinated and supported financially by the consortium of Polish higher education institutions.

Main problems to solve

Not enough “high quality” resources:

- lecturers
- exam and course slots
- interesting courses

We (USOS authors) cannot solve these problems.

In the press

Registration methods

1. Manual registration by dean's office.
2. Registration outside of the system.
3. Token based registration.
4. Preferences based registration.

Two-phase registration model

In **phase 1** students are registered by dean's office to courses.

Phase 2 consists of following steps:

1. Students define their preferences.
2. System is taken to read-only mode.
3. Engine performs student-class assignments.
4. Assignment results are shown to students.

Constraints

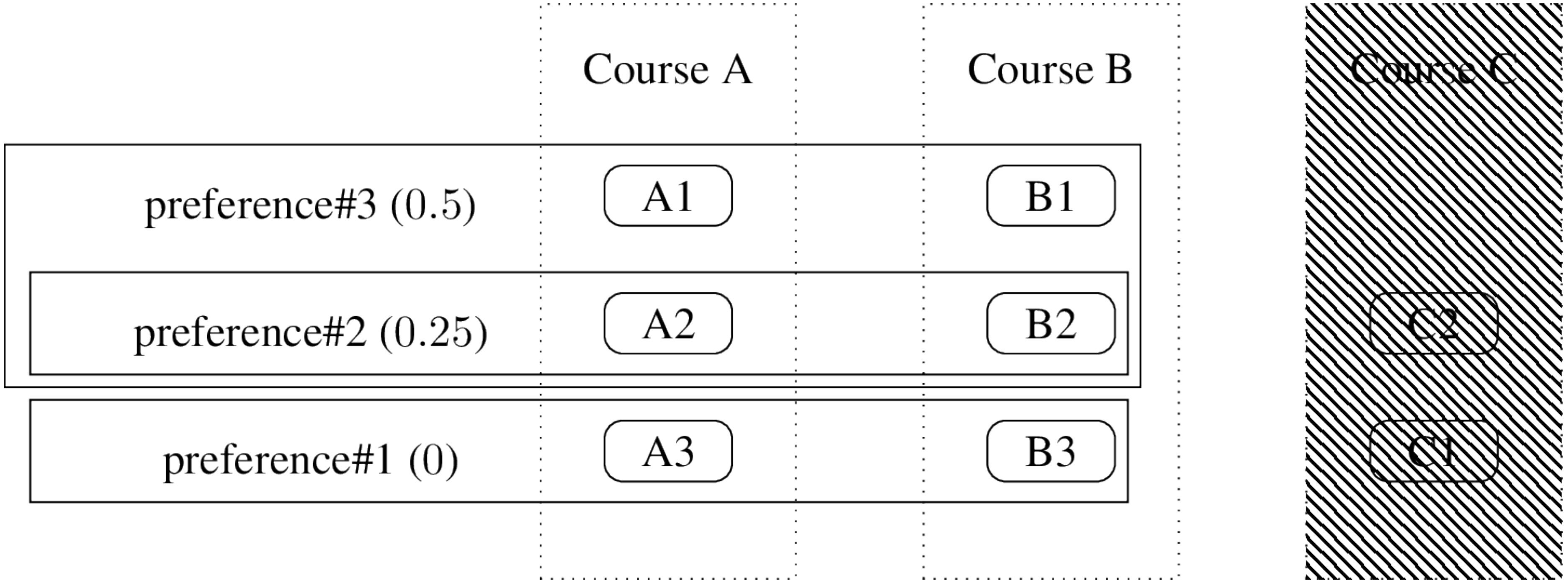
1. Each class has its own **schedule** and a **limit** on number of students.
2. Classes are in **conflict** one with another if their schedules overlap.
3. Some pairs of classes are **excluded**.

Students preferences

1. **Number of conflicts**, student may mark some courses as not important for him.
2. Students may **prioritize classes** of all his important courses. They define sequence of subsets of all classes.

Web based-self service system.

Preferences - example



Unsuccessful solution (greedy)

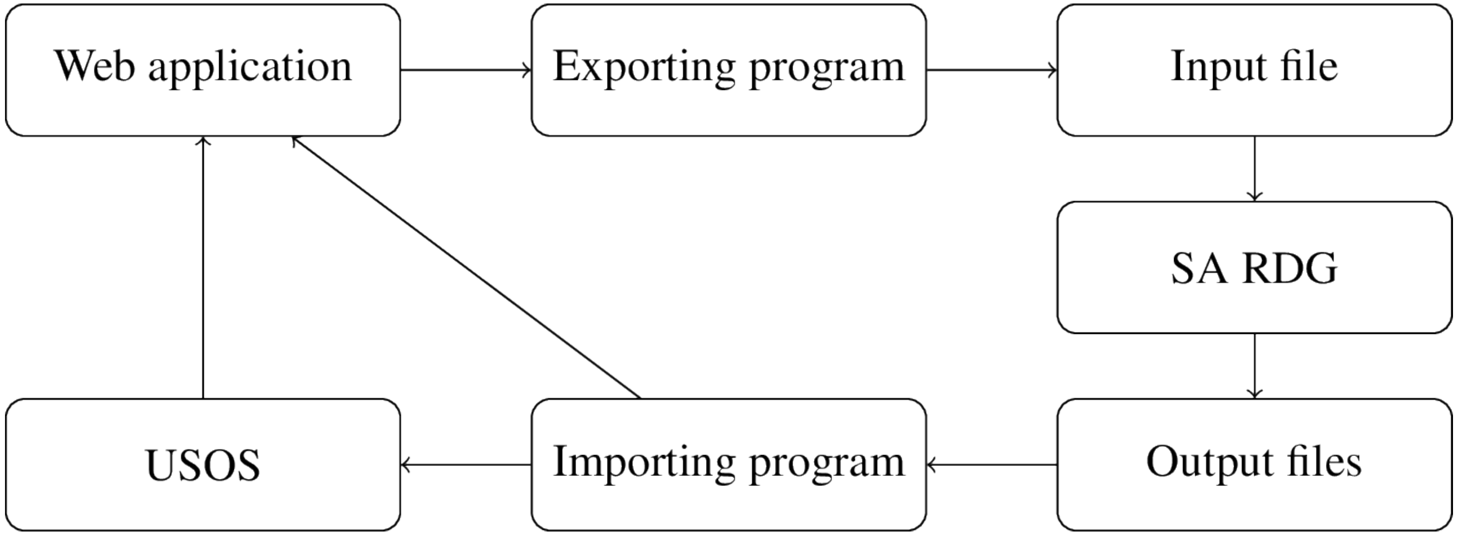
```
for all students:
    for all ordered preferences of current student:
        if matching preference does not exceed limits:
            assign student using preference
            take next student
    register student to least crowded classes without
            breaking exclusions
```

Unsuccessful - monolithic app

1. Java based application
2. Automatic memory management
3. Direct connection to database
4. User friendly interface

Bugs, bugs, bugs. Hard to debug (20 instances)

Successful - application architecture



SA RDG (engine) - command line app in C++

Successful solution (SA)

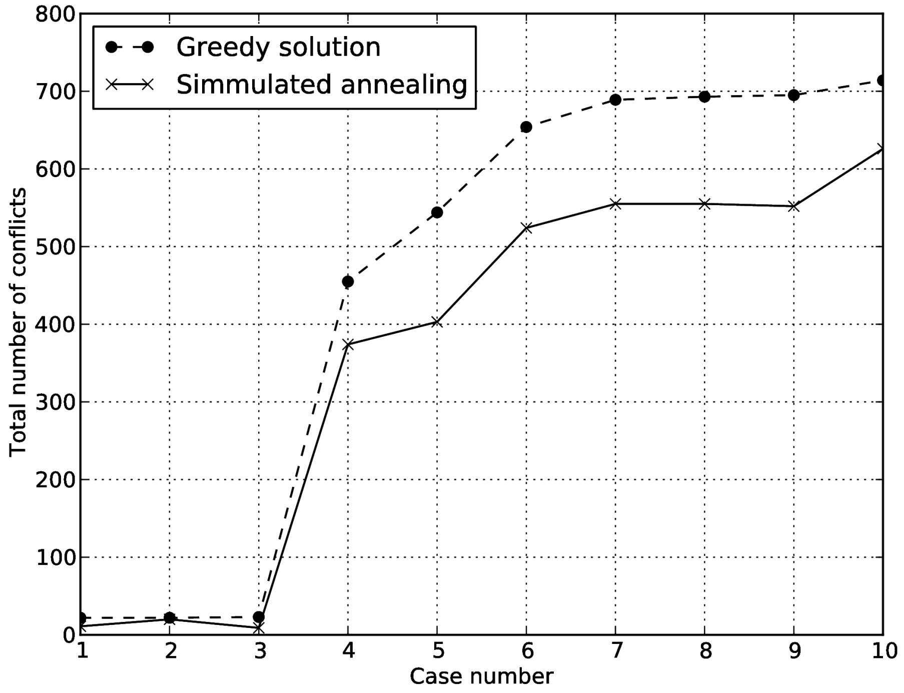
```
assign students randomly to classes
while we still have time:
    move random student from one class to another
    if move improves global happiness (*):
        commit move
    else:
        rollback move

(*) at the beginning we accept some not improving moves
```

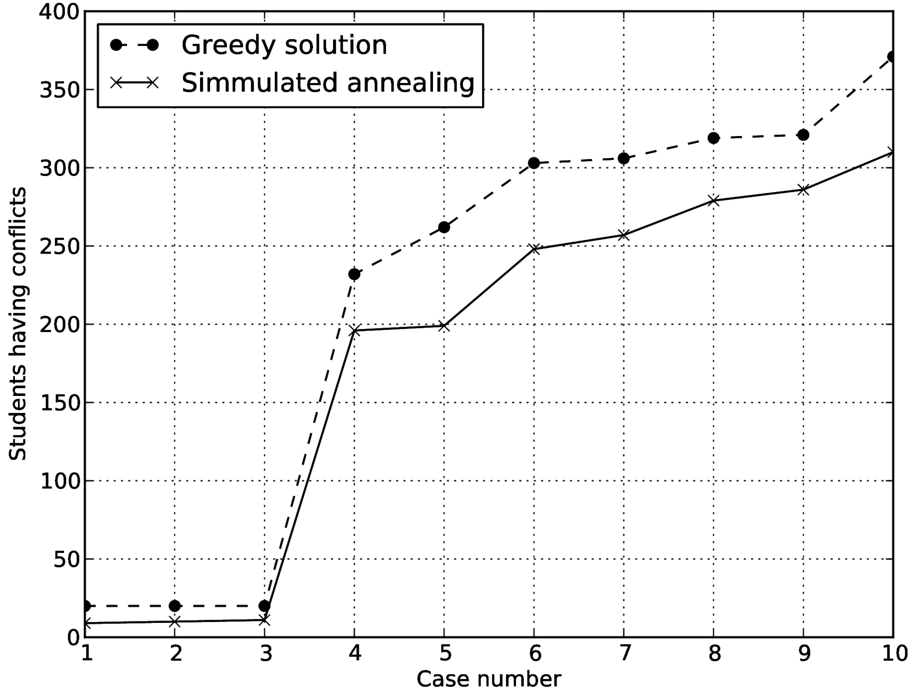
Penalty

- number of broken class exclusions (w: 4)
- number of broken class limits penalties (w: 2)
- number of all conflicts (w:1)
- sum of met students priorities (w:0.2)

Results - no. of conflicts



Results - students having conflicts



USOS - other optimizations

1. Class-course assignment
   a. global penalty
   b. penalty based on students ranking
2. Class exchange
   a. global penalty
   b. penalty based on students ranking
3. 5 minute rounds - exams registration

- Thank you!