Timetabling Using Probability Collectives

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Introduction

The algorithm that we implemented is based on research in the area of Probability Collectives [1]. The course schedule is represented as a collective of agents that represent the individual events. Each agent is capable of making choices with the goal of minimizing the global cost. Global cost in this case is the distance to feasibility and the objective score.

Each agent has a probability distribution that covers all time slot and room combinations. In the initial setup, unsuitable rooms and unavailable timeslots are eliminated leaving a distribution representing the possible choices that each agent can make. For each iteration of the algorithm the agents Monte Carlo sample their respective distributions to generate moves. The objective cost of each move is calculated by determining the number of student conflicts occurring with other events that are scheduled in the same timeslot. The expected cost of each possible move is calculated and used to update that agent's probability distribution. After the optimization is completed, events are assigned time slots and rooms based on the resulting probability distribution.

Algorithm

1. Initialize the schedule
    a. Assign the starting probabilities for each agent.
    b. Select the number of Monte-Carlo samples (m).
2. Conduct the optimization
    a. Increment the iteration number, k.
    b. For each Monte-Carlo sample m,
        i. Jointly sample the system.
        ii. Evaluate the objective cost.
        iii. Compute the private utility for each agent.
    c. Compute the expected cost for each possible move.
    d. Update the agents' probability distributions.
    e. If time allows, return to step 2(a).
3. Finalize the schedule
    a. Sort the events by number of students assigned.

b. For each event, assign a time slot and room based on the probability distribution ensuring no conflicts.

References

1. Bieniawski, S., Kroo, I., and Wolpert, D. H., "Discrete, Continuous, and Constrained Optimization Using Collectives," AIAA Paper 2004-4580, *10th AIAA/ISSMO Multi-disciplinary Analysis and Optimization Conference*, Albany, NY, August 30-September 1, 2004.