Group Diversity and Scheduling with Genetic Algorithms

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The Problems

Create diverse groups of students

- Students split into 5 groupings called *houses*
- *Houses* contain 5 or 6 student *groups*
- *Diversity* is measured by age, gender, and undergraduate major

Enroll students into activity sessions

- A schedule is created for each of the 5 houses, one for each day of the week
- Activity sessions have complex enrollment rules and attendance requirements
- Schedules must be able to be rearranged during the year while still allowing all students to complete all requirements

Example activity and attendance rules

- Peer activities involve two students, each student performing a different task. All students must complete all tasks at least 3 times per semester. Peers should be matched with different students as often as possible.
- Overflow activities are available for students not attending another activity. The student must attend the overflow activity several times per year.

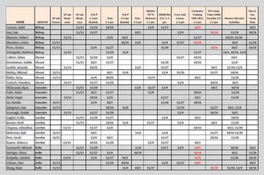
Current Approaches

Group Diversity

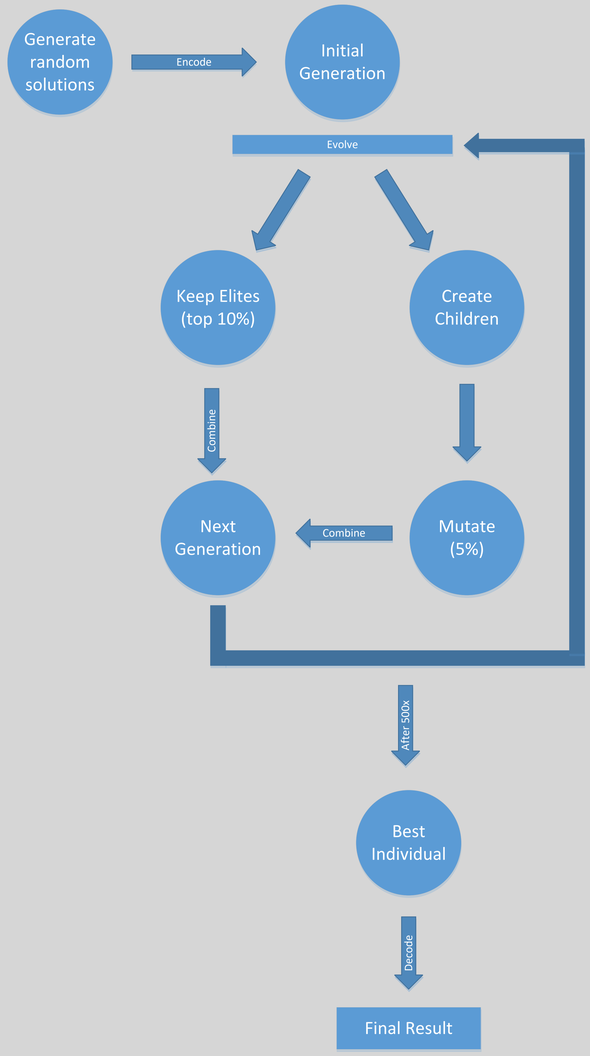
- Excel spreadsheet created for students
- Color helps visualize diversity
- Spreadsheet printed, each row cut out
- Rows laid out on a surface and manually moved around until it “looks about right”
- Process take hours to complete

Scheduling

- Excel spreadsheet maintained manually for each house
- Weeks of effort each year



The Solution: Genetic Algorithm



A genetic algorithm is a form of machine learning.

- Based on survival of the fittest
- New solutions are derived based on the best solutions from previous evolutions
- Mutation avoids local optima
- Highly parallel algorithm

Improved Group Diversity

Machine learning approach

- Elitist genetic algorithm
- Solution in less than 15 seconds on modest hardware
- Better diversity than manual approach
- Allows more complex diversity rules

Web interface allows

- Drag & drop to handle special cases
- View diversity by combined rules, age, gender, or major

Improved Scheduling

Machine learning approach

- Elitist genetic algorithm
- Solution in less than 90 seconds on modest hardware
- Better schedules with less conflicts, no over enrollment
- Ability to change student enrollment and update schedule with minimal impact on other students

Interesting challenges

- Encoding of individuals
- Fixing child and mutated individuals to ensure solution is still valid.
  - Removing conflicts
  - Fixing oversubscribed sessions
  - Removing overlapping attendance
- Calculating a fitness value to allow individuals to be compared.