Adaptive Student Arrangement System for Enhanced Learning

Enhancing Learning through Algorithmic Optimization and Teacher Input

המכללה האקדמית להנדסה בראודה בכרמיאל

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INTRODUCTION

Why Classroom Optimization Matters:
Managing diverse classrooms requires adaptive seating solutions to accommodate varied needs like behavior, academic performance, and special needs. This project leverages a CSP algorithm and teacher input to optimize seating arrangements, improving classroom dynamics and learning outcomes.

METHODOLOGY

We collected student data, including behavior, academic performance, and attendance, along with teacher-defined constraints.

Using a Constraint Satisfaction Problem (CSP) algorithm, we optimized seating arrangements to balance student needs. The system was iteratively refined with real-time feedback from teachers, ensuring adaptability and efficiency.

ALGORITHM

Inputs:
Classroom layout, student data (behavior, academic level, special needs, teacher notes).

Preprocessing:
Group students by response data.
Calculate priority scores using:
Priority Score = -Academic + Behavior + Assistance + Adjustments.
Special Needs: Scores are multiplied by 1.5.

Weighted Scoring:
Academic Level: 1–5 (higher = better).
Behavior: 1–5 (lower = better).
Requires assistance: If true: 2 else 0.
Adjustments: Derived from teacher notes (GPT API).

Seating Arrangement:
High-priority students placed in front rows.
Avoid conflicts (e.g., Based on questionnaire).
Ensure academic diversity.

Regeneration:
Adjust arrangements dynamically using teacher feedback.

WORKFLOW

1. **Input Data**
   - Gather classroom layout, student details (academic, behavior, special needs) and teacher defined constraints.
2. **Weighting System**
   - Assign priority scores to students based on academic performance, behavior, requires assistance and special needs using weighted formula.
3. **Apply CSP**
   - Use the CSP algorithm to generate a seating arrangement that satisfies all constrains.
4. **Output Seating Arrangement**
   - Produce an optimized seating grid balancing behavior, academic diversity and special needs.
5. **Feedback Loop**
   - Collect teacher feedback to adjust constraints and refine the arrangement dynamically

TESTS

Functional Tests:
- Verified accurate seating arrangements based on academic performance and behavior traits.
- Checked dynamic updates to the seating matrix after teacher feedback.

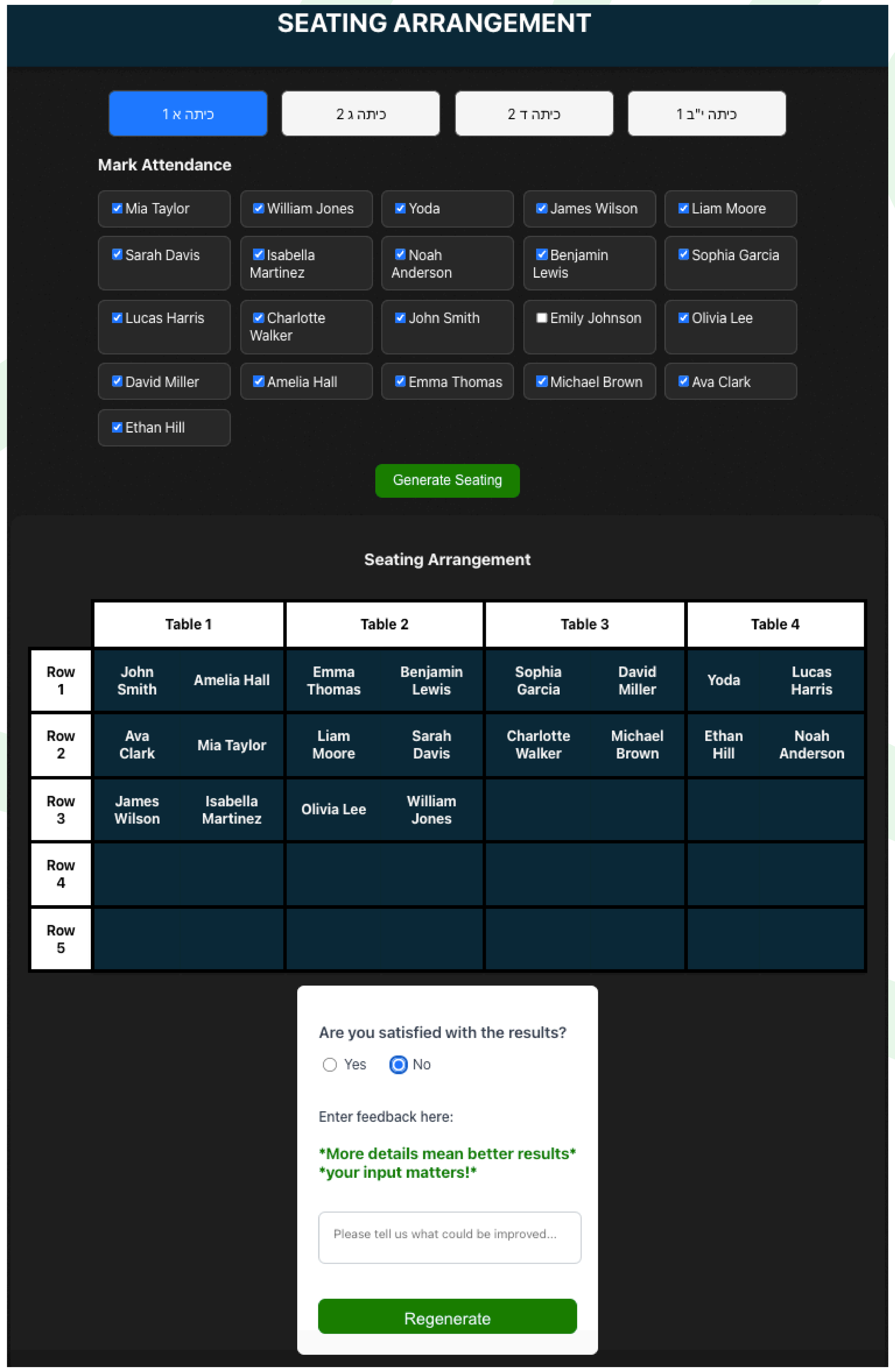
Non-Functional Tests:
- Verified stability of the CSP algorithm under high constraint loads.

Usability Tests:
- Confirmed that the seating arrangement is intuitive and visually clear for educators.

Accessibility Tests:
- Ensured the algorithm's outputs are easy to interpret for teachers with minimal technical knowledge.

RESULTS

- Optimized Seating: Generated seating arrangements successfully balanced behavior and academic performance while meeting all teacher-defined constraints.
- Behavior Balancing: Rows were optimized to ensure an even distribution of challenging behavior profiles.
- Efficiency: The CSP algorithm completed arrangements within seconds, even with complex constraints.



CONCLUSION

This project improves classroom management by optimizing seating arrangements with a CSP algorithm, balancing academic performance, behavior, and special needs. Real-time teacher feedback ensures flexibility and practical adjustments. The system efficiently processes constraints, generating results in seconds. Future enhancements include integrating AI-driven analytics and expanding support for larger, multi-class environments.