**SMART TEAM SELECTION USING GENETIC ALGORITHM**

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In the realm of educational assessment, the allocation of students to examination rooms and benches while ensuring fairness, adherence to capacity constraints, and maximizing student satisfaction has remained a challenging problem. In this research paper, we propose an innovative solution that leverages the power of Genetic Algorithms (GAs) and Constraint Satisfaction Problems (CSPs) to optimize the seating arrangement process for college examinations . Our proposed system takes as input the classroom ID, the students to be accommodated, the number of benches in each classroom, and the capacity of each bench. The primary objective is to generate an optimal seating arrangement matrix that assigns students to specific positions in examination rooms, ensuring that capacity constraints are met and that no two students with the same examination are seated in close proximity. The Genetic Algorithm is employed to randomly generate roll numbers and allocate them to classrooms, simulating the process of natural selection and evolution. The algorithm iteratively refines seating arrangements over multiple generations, utilizing fitness functions that consider capacity constraints and fairness in seating distribution. To satisfy the constraint of maintaining a fair distance between students with the same examination, we employ Constraint techniques. A dedicated constraint mechanism is integrated into the genetic algorithm to ensure that students with identical exams are seated at an appropriate distance from each other, promoting an equitable examination environment. Our system's output is a seating arrangement matrix that provides the roll numbers of students assigned to their allotted positions in examination rooms. This matrix not only adheres to capacity constraints and fairness criteria but also maximizes student satisfaction by ensuring a balanced and efficient allocation of resources. Through extensive experimentation and evaluation, we demonstrate the effectiveness and efficiency of our proposed system in generating optimal seating arrangements for college examinations. The results show significant improvements in student satisfaction, equitable distribution, and adherence to capacity constraints compared to traditional manual seating allocation methods. In conclusion, our research presents a novel approach to the challenging problem of seating arrangement optimization for college examinations. By combining Genetic Algorithms and Constraint , we have developed an intelligent system that not only ensures fairness and capacity adherence but also maximizes student satisfaction, ultimately enhancing the overall examination experience.

**Abstract**—In the realm of educational assessment, the allocation of students to examination rooms and benches while ensuring fairness, adherence to capacity constraints, and maximizing student satisfaction has remained a challenging problem. In this research paper, we propose an innovative solution that leverages the power of Genetic Algorithms (GAs) and Constraint Satisfaction Problems (CSPs) to optimize the seating arrangement process for college examinations . Our proposed system takes as input the classroom ID, the students to be accommodated, the number of benches in each classroom, and the capacity of each bench. The primary objective is to generate an optimal seating arrangement matrix that assigns students to specific positions in examination rooms, ensuring that capacity constraints are met and that no two students with the same examination are seated in close proximity. The Genetic

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Keywords—Genetic Algorithm, Optimal team, Optimization

# **INTRODUCTION**

In today's dynamic organizational landscape, the efficient formation of project teams remains a pivotal factor in achieving successful outcomes. This research introduces an innovative solution, leveraging artificial intelligence through genetic algorithms, to intelligently optimize team composition. Focusing on the crossover of individual skills, the algorithm evolves teams over successive generations, addressing the complexities of individual expertise, interpersonal dynamics, and project requisites.

The research begins by defining the criteria for effective teams, encompassing individual skills, compatibility, and project requirements. The genetic algorithm incorporates operations such as initialization, selection, crossover, mutation, and replacement, guided by a meticulously designed fitness function. The termination criteria mark the point of optimal team performance.

Ethical considerations are paramount, with a focus on potential biases and their impact on team dynamics. Systematic testing using simulated scenarios validates the algorithm's effectiveness, comparing outcomes with randomly assembled or traditionally selected teams. The research aims not only to present a novel methodology but also to provide actionable insights for the seamless integration of AI-powered team selection into organizational project management, fostering continuous improvement in project success rates and overall productivity.

# **Key Features**

• **Genetic Algorithm Framework:**

Illustrate the foundational framework of the genetic algorithm, emphasizing how it mirrors natural selection principles in evolving potential project teams.Highlight the specific genetic operations employed, such as initialization, selection, crossover, mutation, and replacement.

•  **Skill Crossover Emphasis:**

Emphasize the unique emphasis on the crossover of individual skills as a central component of the genetic algorithm.

Explain how this feature enables the algorithm to create teams with evolving and complementary skill sets over successive generations.

**• Fitness Function Design:**

Describe the development of the fitness function, outlining how it quantitatively evaluates team effectiveness based on individual skills, compatibility, and project requirements.

Highlight how the fitness function serves as a guiding metric for the algorithm to converge towards optimal team compositions.

**• Problem Representation:**

Explain how individuals and teams are represented within the algorithm, detailing the granularity and accuracy of the representation.

Showcase how this representation captures the nuances of individual skills and compatibility dynamics.

**• Termination Criteria:**

Specify the criteria that signal the termination of the genetic algorithm, ensuring the team composition achieves an optimal level of performance.

Discuss how these criteria contribute to the efficiency and effectiveness of the algorithm.

# **RELATED WORK**

**B. Feng, Z. Jiang, Z. Fan, N. Fu, on their paper “A method for member selection of cross-functional teams using the individual and collaborative performances”.**

It reveals a gap in existing studies on member selection for cross-functional teams (CFTs), as they predominantly focus on individual performance metrics while overlooking collaborative performance. To address this gap, the paper proposes a method incorporating both individual and collaborative performance considerations. A multi-objective 0-1 programming model is introduced to address the NP-hard nature of the problem, and an improved nondominated sorting genetic algorithm II (INSGA-II) is developed for solving the model. The proposed approach is illustrated with a real-world example, and extensive computational experiments comparing INSGA-II with the nondominated sorting genetic algorithm II (NSGA-II) demonstrate the superior performance of INSGA-II. The literature survey emphasizes the innovative contribution of integrating collaborative performance metrics into member selection for CFTs.

**S. N. Omkar, on his paper “Cricket team selection using genetic algorithm”**

It proposes a solution using a genetic algorithm, known for its computational efficiency, to optimize team selection, specifically focusing on cricket teams. The approach extends existing quantitative methods, incorporating new attributes related to personal and team performances, making it applicable to a broader range of multiplayer games. Notably, the adaptation of an island genetic algorithm addresses conflicting constraints in team formation. The proposed methodology stands out for its versatility and efficiency, offering a potential improvement over traditional, subjective selection processes.

**G. Guttman, M. Shpitalni, on their paper “Linear Programming and Genetic Algorithms Methods for Creation of Groups in Networks of Excellence”,**

This paper underscores the complexities and potential biases in manual team selection processes for sports, particularly in basketball, which may lead to suboptimal outcomes in national and international competitions. Recognizing the absence of a scientific method, the research paper proposes leveraging Data Mining techniques to develop a software tool for objective team selection. The survey likely explores existing methodologies in sports team selection, the limitations of manual processes, and the role of data-driven approaches. It positions the proposed research within the context of addressing these challenges and enhancing objectivity in the team selection process, specifically tailored for basketball.

**M.D.I Song and M. Treiber. On their paper “An Introduction to Genetic Algorithms and Evolution Strategies.”**

It addresses the critical importance of selecting the most suitable cricket team for optimal performance, particularly in the context of winning matches. The focus is on individual player characteristics, including batting average, bowling average, and the number of wickets. The study specifically aims to detail the process of selecting the optimal one-day international squad for Sri Lanka in the 2015 World Cup in Australia, involving the choice of 15 players from a pool of 30. The proposed method for team selection involves the application of Genetic Algorithm, a computational optimization technique, implemented through MATLAB 7 software.

**D. Goldberg [1] in his paper on Genetic Algorithms in Search, Optimization and Machine Learning states,**

Genetic algorithms are probabilistic search procedures designed to work on large spaces involving states that can be represented by strings. These methods are inherently parallel, using a distributed set of samples from the space (a population of strings) to generate a new set of samples. Although there are several different types of genetics-based machine learning systems, this article [1] concentrates on classifier systems and their derivatives.

**Genetic algorithms,By J.F. Frenzel,01 Oct 1993-IEEE Potentials**

Genetic algorithms are exploratory procedures that can find near optimal solutions to complex problems .They maintain a set of trial solutions and evolve them towards an acceptable solution.The process involves four steps: evaluation, reproduction, recombination, and mutation .A representation for possible solutions must be developed . algorithm starts with an initial random population and improves each generation's ability to solve the problem . The author applied a genetic algorithm to train a product neural network for predicting the optimum transistor width in a CMOS switch .

**Genetic Algorithms, Mitsuo Gen, Runwei Cheng,01 Oct 1999-**

Genetic algorithms are probabilistic search techniques based on the principles of biological evolution .They follow a path of analysis to evolve a design that is optimal for the environmental constraints placed upon it .Genetic algorithms are used in the industrial engineering/manufacturing area to better design and produce reliable products of high quality .These algorithms are particularly useful for solving combinatorial and multiple-objective optimization problems encountered in industry.The book "Genetic Algorithms" by two internationally-known experts on genetic algorithms and artificial intelligence provides in-depth coverage of advanced optimization techniques applied to manufacturing and industrial engineering processes .

**Research on genetic algorithm,Xu Zhong, 01 Jan 2005-Journal of Shangqiu Teachers College**

Genetic algorithm is a random search and optimization method based on natural selection and genetic mechanisms of living beings .It has been successfully used in solving complex optimization and industrial engineering problems .Recent research on genetic algorithm has gained significant attention from learners at home and abroad .This paper discusses and surveys the research state and advances in genetic algorithm, outlining the basic algorithms, theory, and implementation techniques .The performance analysis of genetic algorithm is evaluated .The advantages of genetic algorithm in solving complex optimization problems are demonstrated through the example of the traveling salesman problem .

**Heuristic Artificial Intelligent Algorithm for Genetic Algorithm, Luo Lie, 01 Jun 2010-Key Engineering Materials (Trans Tech Publications)-pp 516-521**

Genetic algorithms are a type of search technique used in computing to find solutions to optimization and search problems. They are categorized as global search heuristics and are inspired by evolutionary biology, using techniques such as inheritance, mutation, selection, and crossover . Genetic algorithms have been successfully used to evolve various aspects of genetic algorithms themselves, such as connection weights, architecture, and learning functions. They are particularly effective in evolving the weights of neural networks, as they can explore a vast number of possibilities and converge to working weights within a relatively small number of iterations .

**Genetic algorithms, Colin R. Reeves, 05 May 1993-pp 151-196**

Genetic algorithms (GAs) are widely used for solving difficult combinatorial optimization problems. They have a rich history and offer theoretical insights. GAs involve encoding genotypes, selecting and managing populations, and using genetic operators to generate new populations. Guidelines for practical use are also provided.

**Genetic algorithms - An introduction and an overview of their capabilities, K. Krishnakumar1•Institutions (1),10 Aug 1992-**

Genetic algorithms are parameter search procedures based on the mechanics of natural genetics, combining survival-of-the-fittest with information exchange among artificial chromosomes. They have gained popularity as robust optimization tools in various fields such as engineering, science, economics, and finance. Genetic algorithms differ from other artificial intelligence techniques like knowledge-based systems (KBS) and fuzzy logic systems (FLS) as they learn from past performance rather than relying on a priori knowledge.They can be used to solve problems that are difficult for traditional techniques.

**An Improved Genetic Algorithm for Team Formation Problem, Hao Wang, Jiting Li, Yanjie Song, Jingbo Huang, Jichao Li, Yingwu Chen ,04 Dec 2022-pp 774-781**

It proposes a heuristic person-job matching algorithm (HPJMA) and an improved genetic algorithm (IGA) to solve the team formation problem (TFP). The HPJMA determines whether the job seeker meets all the job requirements, while the IGA uses real number coding to form individuals in the population. The algorithm also utilizes a heuristic method to obtain the initial population and employs the elite individual retention strategy to speed up convergence. Additionally, a population perturbation strategy is introduced to avoid local optimal solutions. The goal is to maximize the matching degree of the team as a whole. Experimental results show that the proposed algorithms achieve higher overall person-job matching degrees compared to three baseline algorithms, indicating their effectiveness in solving the team formation problem .

**Fuzzy based Quantum Genetic Algorithm for Project Team Formation, Arish Pitchai1, A V Reddy1, Nickolas Savarimuthu1•Institutions (1), 01 Jan 2016-International Journal of Intelligent Information Technologies (IGI Global)-Vol. 12, Iss: 1, pp 31-46**

It proposes a Quantum Walk based Genetic Algorithm (QWGA) to identify near optimal project teams that optimize fuzzy criteria obtained from initial team requirements. The algorithm defines an m-qubit chromosome as a vector representation of a qubit on the unit three-dimensional Bloch sphere. The proposed design is tested on artificially constructed instances and proves to be practical and effective in optimizing team formation for project completion.

**A Generic Approach for Team Selection in Multi–player Games using Genetic AlgorithmS. M. Aqil Burney, Nadeem Mahmood, Kashif Rizwan, Usman Amjad,29 Feb 2012-International Journal of Computer Applications (Foundation of Computer Science (FCS))-Vol. 40, Iss: 17, pp 11-17**

The paper proposes a generic approach for team selection in multiplayer games using a genetic algorithm. It combines existing quantitative approaches with new extensions, such as attributes regarding personal performances, team performance, and the combination of players. The approach is not specific to cricket but can be applied to other multiplayer games as well. The authors propose an adaptation of the island genetic algorithm to optimize the selection of multiplayer sports teams with multiple conflicting constraints and mixed crossover. The fitness of the common solution is used to drive the selection process . The paper discusses the use of genetic algorithms (GA) as an optimization technique for team selection problems in multiplayer games. GA is considered the best tool for optimization in such problems due to its computational power. The process involves initializing the population, making random selections using the fitness function, performing crossover, and optional mutation. The process is repeated until the fittest combination is found or the user intervenes. The paper also mentions the resolution of ties in the mating pool using fitness values and experience values of players or a heuristic .

**CBR-Genetic Algorithm Based Design Team Selection Model for Large-Scale Design Firms, Sung-Chul Park1, Kyo-Jin Koo2•Institutions (2),10 Sep 2011-Ksce Journal of Civil Engineering (Korean Society of Civil Engineers)-Vol. 15, Iss: 7, pp 1141-1148**

The paper proposes a CBR-Genetic Algorithm based design team selection model for large-scale design firms.The model aims to overcome the limitations of human judgment by considering influential factors and generating useful solutions through combinations of individuals.The model consists of Modules I and II, which were validated through real case studies.The results showed that the CBR-Genetic Algorithm model is superior to current selection processes as it can select appropriate design teams tailored for future projects by considering numerous criteria and combinations of design team possibilities .

**Conclusion:**

In summary, these papers present diverse applications of genetic algorithms in team selection, emphasizing their effectiveness in optimizing performance across various domains. From cross-functional teams to cricket and multiplayer games, these studies contribute innovative approaches, such as incorporating collaborative performance metrics, addressing conflicting constraints, and utilizing island genetic algorithms. The common thread across these works is the recognition of the computational power and versatility of genetic algorithms in tackling complex optimization problems, offering objective and efficient solutions in team formation and selection processes.

# **ALGORITHM**

Genetic Algorithms are a variety of complicated, adaptive algorithm that is commonly used to solve issues involving robust efficiency.

1. **Initialization:**

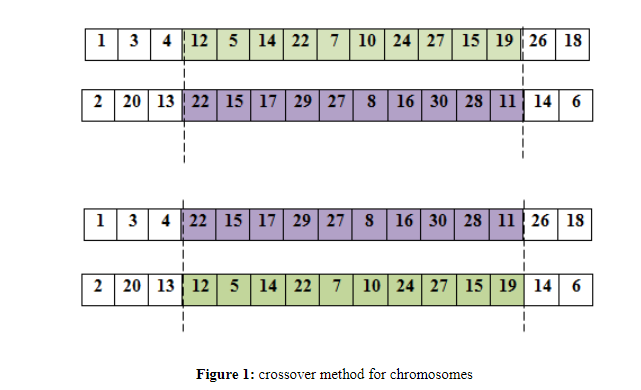
Forming an initial set of project teams by selecting individuals randomly, fostering diversity in skill sets.

1. **Selection:**

Evaluating teams based on fitness scores and choosing teams for the next generation, favoring those with higher fitness.

1. **Crossover:**

Combining skills from different teams to create new teams, promoting diversity in team composition.



1. **Mutation:**

Introducing random changes to individual teams to explore new possibilities and prevent premature convergence.

A diagram of a number

Description automatically generated

1. **Replacement:**

Replacing less fit teams with new offspring to continually refine team compositions.

1. **Termination Criteria:**

Assessing criteria, such as reaching a maximum number of generations or achieving a target fitness level, to determine when the algorithm should conclude.

1. **Integration and Usage:**

Seamlessly integrating optimized teams into organizational workflows, considering project requirements and existing team structures.

1. **Validation and Testing:**

Conducting testing, likely using simulated scenarios or historical data, to validate the algorithm's effectiveness against other team selection methods.

1. **Adaptation and Monitoring:**

Adapting to changing project requirements and implementing a monitoring system to track team performance over time, contributing to continuous improvement.

# **METHODOLOGY**

A diagram of a project

Description automatically generated

The methodology for the intelligent team formation project using genetic algorithms is systematically structured to align with the key components of the implemented code. Beginning with the initialization phase, the project initializes a diverse population of potential project teams by randomly selecting individuals based on their skills. The selection phase follows, where a fitness function is applied to evaluate each team's effectiveness, considering individual skills, compatibility, and project requirements. The crossover operation is then executed, combining the skills of individuals from different teams to create new offspring. Subsequently, the mutation operation introduces small, random changes to individual teams, fostering exploration and preventing premature convergence. The replacement operation assesses fitness scores and replaces less fit teams with new offspring, ensuring the continuous evolution of team compositions. The termination criteria are defined to check when the algorithm should conclude, based on reaching a maximum number of generations or achieving a target fitness level. The integration and usage phase involves seamlessly integrating the optimized teams into organizational project management workflows, considering project requirements and existing team structures. The validation and testing strategy utilizes simulated scenarios or historical project data to assess the algorithm's effectiveness, comparing outcomes with randomly assembled or traditionally selected teams. Ethical considerations are integrated into the algorithm, addressing biases in team selection and promoting fairness. Finally, the adaptation and monitoring framework is established to continuously monitor team performance and adapt the algorithm to changing project requirements, contributing to ongoing improvements in project success rates and overall productivity. This comprehensive methodology aligns with the structured code, ensuring a systematic and effective approach to intelligent team formation using genetic algorithms.

# **CONCLUSION AND FUTURE WORK**

In conclusion, the intelligent team formation algorithm, rooted in genetic algorithms, exhibits promise for enhancing project outcomes by systematically optimizing teams based on individual skills, compatibility, and project requirements. Ethical considerations and seamless integration into organizational workflows enhance its practicality. Future work should focus on comprehensive testing across diverse scenarios, dynamic adaptation to evolving project needs, real-world implementation feedback, optimization techniques, human-AI collaboration, scalability considerations, and long-term performance monitoring to refine and extend the algorithm's capabilities for broader applicability in dynamic organizational contexts.

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