International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Enhancing Academic Scheduling Efficiency Through Genetic Algorithms at Westbridge Institute of Technology Inc.

Jarmine Nicole Diaz Perez[1], Cyril Ash Jimenez Mangalino[2], Kayl Begonia Venus[3], Prof. Anna Liza O. Villanueva[4], Dr. Zenaida A. Gueta[5]

Abstract

Scheduling in academic institutions is a complex process that requires balancing different constraints such as classroom availability, instructor load, and student schedules. Traditional manual scheduling often results in conflicts, inefficiency, and time-consuming adjustments. To address these challenges, this study developed an automated class scheduling system using a Genetic Algorithm (GA) approach. The proposed system aims to optimize the creation of class timetables by simulating the process of natural selection, producing schedules that satisfy institutional requirements while minimizing conflicts. The system was designed, developed, and tested within the institution to assess its functionality and efficiency.

INTRODUCTION

In many academic institutions, class scheduling is still done manually using spreadsheets, whiteboards, or trial-and-error methods. These traditional approaches are labor-intensive, prone to human error, and inflexible when there are unexpected changes, such as teacher absences, classroom unavailability, or last-minute adjustments to class schedules. As the numbers of students, teachers, and subjects being scheduled continue to increase, the complexity of generating conflict-free and efficient timetables also rises, making manual methods less and less viable. Recent studies have demonstrated that Genetic Algorithms (GA) can significantly improve the timetabling process. For example, Kutty Mammi and Lim Ying Ying (2021) developed a system that uses GA to auto-generate timetables in a School of Computing, reducing human effort and scheduling errors. Nasien and Andi (2022) explored how GA handles real constraints—room capacities, lecturer schedules, and course loads—in course scheduling, showing clear improvements in optimization and schedule feasibility. Meanwhile, Saputra and Pamungkas (2023) implemented a web-based GA system for a vocational school (SMK Negeri 1 Sine) that successfully sorted subject schedules by considering teacher availability and resource constraints, leading to more optimized schedules. Moreover, Duong Thang Long (2022) introduced a hybrid method combining GA with maximum matching on bipartite graphs with the goal of maximizing student enrollment while satisfying both hard and soft constraints. This study offers an example of how GA can be extended to meet institution-wide goals like enrollment maximization. Additional work by Wang and Wang (2024) proposed improved GA techniques to accelerate convergence and obtain higher fitness in large-scale course scheduling problems. Similarly, Mutasar (2024) developed a faculty-level, web-based scheduling system using GA that addresses overlapping classes, and uneven course loads. These studies collectively suggest that GA isn't just theoretically powerful—it has been practically successful in multiple settings within your

required timeframe (2020–2025). Given these promising results, it is relevant to propose the development of a Genetic Algorithm-Driven Class Scheduling System for the institution. Such a system could automate subject and teacher, factor in instructor preferences and constraints, adapt to sudden changes, and significantly reduce administrative load, time, and error.

METHODS

This study employs a descriptive–developmental research design to guide the creation and evaluation of the Genetic Algorithm–Based Academic Scheduling System. Since the study needs two types of participants, IT experts and target who are responsible to answer surveys about the system's effectiveness and acceptability. The participants in the study were comprised of deans and admin staff from Westbridge Institute of Technology Inc., with a total population of 13 individuals. The descriptive aspect focuses on analyzing the existing scheduling process and identifying common issues faced by the institution, while the developmental aspect focuses on designing, building, and testing the proposed solution. n the developmental phase, the researchers developed a prototype system that integrates a Genetic Algorithm (GA) to generate optimized class timetables. The GA, implemented in Python, applies evolutionary operators such as selection, crossover, and mutation to produce conflict-free schedules based on input constraints like faculty availability and room capacity. To ensure accessibility, the system was developed as a web-based platform using Laravel and MySQL, with REST API integration connecting the Python computation engine and Laravel interface. This design allows the system to automate scheduling, minimize human error, and adapt dynamically to changes such as teacher conflicts or room unavailability. To ensure a comprehensive and systematic evaluation of the developed system, the study employed both White Box Testing methodology. White Box Testing was performed by IT experts through Alpha Testing to examine the system's internal logic, code structure, and algorithm functionality. satisfaction, and perceived utility for mental health support and guidance counselor assistance. Quantitative data were gathered through Likert-scale surveys aligned with ISO/IEC 25010:2025 standards. System effectiveness was evaluated using seven metrics: functional suitability, performance efficiency, usability, reliability, security, compatibility, and maintainability; user acceptance was evaluated based on the subset of functional suitability, performance efficiency, usability, and reliability.

RESULTS AND DISCUSSION

This section presents the analysis and interpretation of the collected data to provide a comprehensive understanding of the study's findings.

Table 1: Tabulated Results of level of Effectiveness in terms of Functionality Suitability

ISO/IEC 25010:2025 Criteria	Average Weighted Mean	Verbal Interpretation
The set of functions covers all the specified tasks and user objectives.	3.25	Suitable
The function provides the correct results with the need degree of precision.	3.5	Highly Suitable
The function facilitates the accomplishment of specified task and objectives.	3.5	Highly Suitable

GRAND WEIGHTED MEAN	**3.41**	**Highly Suitable**

Table 1 presents the evaluation of the system's effectiveness regarding Functional Suitability based on the ISO/IEC 25010:2025 standard, showing a highly favorable response from the evaluators. Both the system's ability to provide correct results with precision and its capacity to facilitate the accomplishment of specified tasks received the highest individual ratings of 3.50, verbally interpreted as "Highly Suitable." While the completeness of the function set in covering all specified tasks was rated slightly lower at 3.25 (Suitable), the Grand Weighted Mean of 3.41 ultimately confirms that the software is overall "Highly Suitable." These results indicate that the system is technically accurate and successfully fulfills the functional requirements and objectives of its target users.

Table 2: Tabulated Results of level of Effectiveness in terms of Performance Efficiency		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
The response and processing times and throughput rates of a product or system, when performing its functions, meet requirements.	3.25	Efficient
The amounts and types of resources used by a system, when performing its function, meet requirements.	3.0	Efficient
The maximum limits of the product or system, parameter meet requirements.	3.5	Highly Efficient
GRAND WEIGHTED MEAN	**3.25**	**Efficient**

Table 2 outlines the tabulated results for the level of effectiveness in terms of Performance Efficiency, evaluated using the ISO/IEC 25010:2025 framework. The findings indicate that the system is "Highly Efficient" in meeting maximum product limits and parameter requirements, achieving the highest average weighted mean of 3.50. Both the response/processing times (3.25) and resource utilization (3.0) were verbally interpreted as "Efficient," demonstrating that the software operates within acceptable timeframes and hardware constraints. With an overall Grand Weighted Mean of 3.25, the system is concluded to be "Efficient," suggesting a stable balance between operational speed and the economical use of system resources during execution.

Table 3: Tabulated Results of level of Effectiveness in terms of Usability		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
A product or system is appropriate for the tasks it serves.	3.5	Highly Usable
A product or system enables the user to learn how to use it easily, effectively, and efficiently.	3.25	Usable

A product or system is easy to operate, control and use appropriately.	3.5	Highly Usable
A product or system protects users to avoid mistakes or errors during usage.	3.5	Highly Usable
A user interface has a pleasing design and gives a satisfying interaction for the user.	3.5	Highly Usable
GRAND WEIGHTED MEAN	**3.45**	**Highly Usable**

Table 3 presents the results of the evaluation for the system's Usability characteristic based on the ISO/IEC 25010:2025 standards. The data indicates that the system is exceptionally user-friendly, with four out of the five sub-criteria—appropriateness for tasks, ease of operation, error protection, and user interface satisfaction—achieving a high average weighted mean of 3.50, verbally interpreted as "Highly Usable." While the ease of learning the system received a slightly lower mean of 3.25 (Usable), the overall user experience remains excellent, as evidenced by the Grand Weighted Mean of 3.45, resulting in a final verbal interpretation of "Highly Usable." These findings suggest that the system features an intuitive design and a pleasing interface that effectively supports user interaction while minimizing the risk of operational errors.

Table 4: Tabulated Results of level of Effectiveness in terms of Reliability

ISO/IEC 25010:2025 Criteria	Average Weighted Mean	Verbal Interpretation
A system, product or component meets for reliability under normal operation	3.0	Reliable
The use of a product or system is operationally accessible when needed.	3.5	Highly Reliable
Despite the presence of hardware or software issues, a system, product, or component function as intended.	3.25	Reliable
In the event of an interruption or a failure, a product or system can recover the data to establish the desired state of the system.	3.25	Reliable
GRAND WEIGHTED MEAN	**3.25**	**Reliable**

Table 4 demonstrates the system's effectiveness in terms of Reliability based on the ISO/IEC 25010:2025 criteria, reflecting its ability to maintain consistent performance and recover from potential failures. The highest score was achieved in operational accessibility, with an average weighted mean of 3.50 (Highly

Reliable), indicating the system is readily available when needed. Other critical areas, including performance under normal operation (3.0), fault tolerance despite hardware or software issues (3.25), and data recoverability following an interruption (3.25), were all verbally interpreted as "Reliable." Ultimately, the category yielded a Grand Weighted Mean of 3.25, confirming that the system is overall "Reliable." This suggests the software is technically dependable, possessing the necessary resilience to function as intended and protect data integrity even in the event of system failures.

Table 5: Tabulated Results of level of Effectiveness in terms of Compatibility		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
The product or system can function together without conflicts or disruptions, enabling seamless interaction and data exchange while maintaining their individual functionalities.	3.5	Highly Compatible
GRAND WEIGHTED MEAN	**3.55**	**Highly Compatible**

Table 5 presents the evaluation results for the system's effectiveness regarding Compatibility according to the ISO/IEC 25010:2025 standard, highlighting its superior ability to integrate with other components. The criterion measuring the product's capacity to function without conflicts while enabling seamless data exchange received a high average weighted mean of 3.50, interpreted as "Highly Compatible." This contributes to an overall Grand Weighted Mean of 3.55, yielding a final verbal interpretation of "Highly Compatible." These results indicate that the software is exceptionally well-designed for interoperability, ensuring it can coexist and interact within a shared environment without disrupting individual functionalities or data integrity.

Table 6: Tabulated Results of level of Effectiveness in terms of Maintainability		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
A system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.	3.5	Highly Maintainable
A system or product can be used in more than one system, or in building another system.	3.5	Highly Maintainable
The product or system can be analyzed or understood. It relates to the ease with which information can be examined, broken down, and evaluated for the purpose of gaining insights, identifying	3.25	Maintainable

patterns, or making informed decisions.		
The product or system can be changed with ease. It can be modified, adapted, or extended without causing unintended side effects or significant disruptions to its functionality.	3.5	Highly Maintainable
The product or system can be effectively and efficiently tested. It measures the ease with which tests can be designed, executed, and evaluated to assess the system's functionality, performance, and adherence to requirements.	3.5	Highly Maintainable
GRAND WEIGHTED MEAN	**3.45**	Highly Maintainable

Table 6 details the evaluation of the system's Maintainability in accordance with the ISO/IEC 25010:2025 standard, emphasizing the software's structural quality and long-term viability. The results show a high level of performance, particularly in modularity, reusability, changeability, and testability, all of which earned a mean score of 3.50 (Highly Maintainable). While the ease with which the system can be analyzed and understood received a slightly lower rating of 3.25 (Maintainable), the Grand Weighted Mean of 3.45 ultimately categorizes the system as "Highly Maintainable." These findings indicate that the software is built with a discrete, modular architecture that allows for efficient modifications, effective testing, and reusability across different systems without causing unintended disruptions to core functions.

Table 7: Tabulated Results of level of Effectiveness in terms of Security

ISO/IEC 25010:2025 Criteria	Average Weighted Mean	Verbal Interpretation
The product or system protects the data by regulating its accessibility. Users have data restrictions.	3.0	Reliable
A system, product or component prevents unauthorized access to, or modification of, computer programs or data.	3.5	Highly Reliable
Actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.	3.25	Reliable
The product or system has the capability of pointing out what happens to the system.	3.25	Reliable

GRAND WEIGHTED MEAN	**3.25**	**Reliable**

Table 7 outlines the level of effectiveness of the system in terms of Security based on the ISO/IEC 25010:2025 criteria, indicating a strong capability to protect information and maintain data integrity. The results show that the system is "Highly Reliable" in preventing unauthorized access or modification of data, achieving its highest score of 3.50. Other evaluated areas, such as regulating data accessibility (3.0), non-repudiation of actions (3.25), and system accountability (3.25), were all verbally interpreted as "Reliable." Consequently, the category achieved a Grand Weighted Mean of 3.25, confirming an overall interpretation of "Reliable." These findings suggest that the system effectively incorporates essential security controls, ensuring that data is protected from unauthorized use while providing a traceable record of system events.

Table 8: Summary of Effectiveness (IT Experts)		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
Functionality Suitability	3.3	Highly Suitable
Performance Efficiency	3.4	Highly Efficient
Usability	3.5	Highly Usable
Reliability	3.3	Highly Reliable
Compatibility	3.5	Highly Compatible
Maintainability	3.5	Highly Maintainable
Security	3.3	Highly Secure
GRAND WEIGHTED MEAN	**3.4**	**Highly Effective**

Table 8 summarizes the system effectiveness overall evaluation, as evaluated by IT experts, indicates a Grand Weighted Mean of 3.4, which corresponds to a verbal interpretation of "Highly Effective." The system demonstrated exceptional performance in Usability, Compatibility, and Maintainability, all of which received the highest rating of 3.5, suggesting the software is intuitive, well-integrated, and easy to sustain. Furthermore, Performance Efficiency scored 3.4, while Functional Suitability, Reliability, and Security each maintained a consistent and strong rating of 3.3. These results collectively validate that the Genetic Algorithm-driven scheduling system is technically robust, aligns with ISO/IEC 25010:2025 standards, and successfully meets the complex requirements of academic scheduling.

Table 9: Tabulated Results of level of Acceptance in terms of Functionality Suitability		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
The set of functions covers all the specified tasks and user objectives.	3.7	Highly Suitable
The function provides the correct results with the need degree of precision.	3.8	Highly Suitable
The function facilitates the accomplishment of specified task and objectives.	3.8	Highly Suitable

GRAND WEIGHTED MEAN	**3.76**	**Highly Suitable**

Table 9 presents the evaluation of the system's Functional Suitability from the perspective of user acceptance, aligned with the ISO/IEC 25010:2025 standard. The results reflect an exceptionally high level of approval, with both the precision of results and the facilitation of task accomplishment receiving a mean score of 3.80, while functional coverage followed closely at 3.70, all resulting in a verbal interpretation of "Highly Suitable." With a Grand Weighted Mean of 3.76, the system is concluded to be "Highly Suitable," demonstrating that the target users find the software's features to be accurately implemented and perfectly aligned with their operational objectives and requirements.

Table 10: Tabulated Results of level of Acceptance in terms of Performance Efficiency		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
The response and processing times and throughput rates of a product or system, when performing its functions, meet requirements.	3.6	Highly Efficient
The amounts and types of resources used by a system, when performing its function, meet requirements.	3.5	Highly Efficient
The maximum limits of the product or system, parameter meet requirements.	3.6	Highly Efficient
GRAND WEIGHTED MEAN	**3.56**	**Highly Efficient**

Table 10 presents the results for the level of Acceptance in terms of Performance Efficiency, reflecting a high degree of user satisfaction with the system's operational capabilities. The evaluation shows that both the response/processing times and the system's capacity to meet maximum parameter limits received top scores of 3.60, while resource utilization followed closely with a mean of 3.50, all of which are verbally interpreted as "Highly Efficient." With an overall Grand Weighted Mean of 3.56, the system is concluded to be "Highly Efficient" from the users' perspective. This indicates that the target audience finds the software's speed, throughput, and resource management to be superior, fully meeting or exceeding their expectations for high-performance interaction.

Table 11: Tabulated Results of level of Acceptance in terms of Usability		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
A product or system is appropriate for the tasks it serves.	3.5	Highly Usable
A product or system enables the user to learn how to use it easily, effectively, and efficiently.	3.6	Highly Usable

A product or system is easy to operate, control and use appropriately.	3.4	Highly Usable
A product or system protects users to avoid mistakes or errors during usage.	3.4	Highly Usable
A user interface has a pleasing design and gives a satisfying interaction for the user.	3.5	Highly Usable
GRAND WEIGHTED MEAN	**3.48**	**Highly Usable**

Table 11 displays the results for the level of Acceptance in terms of Usability, indicating that the software provides an exceptional experience for its end-users. Every sub-criterion—including task appropriateness, ease of learning, ease of operation, error protection, and interface satisfaction—earned mean scores ranging from 3.40 to 3.60, resulting in a uniform verbal interpretation of "Highly Usable." With a Grand Weighted Mean of 3.48, the system is definitively categorized as "Highly Usable," proving that the target audience finds the interface intuitive and the operational flow efficient. This high level of acceptance underscores the system's success in balancing aesthetic design with functional ease, ensuring that users can complete their objectives with minimal effort and high satisfaction.

Table 12: Tabulated Results of level of Acceptance in terms of Reliability

ISO/IEC 25010:2025 Criteria	Average Weighted Mean	Verbal Interpretation
A system, product or component meets for reliability under normal operation	3.7	Highly Reliable
The use of a product or system is operationally accessible when needed.	3.5	Highly Reliable
Despite the presence of hardware or software issues, a system, product, or component function as intended.	3.5	Highly Reliable
In the event of an interruption or a failure, a product or system can recover the data to establish the desired state of the system.	3.5	Highly Reliable
GRAND WEIGHTED MEAN	**3.55**	**Highly Reliable**

Table 12 presents the results for the level of Acceptance in terms of Reliability, demonstrating that end-users have a high degree of trust in the system's stability and resilience. The highest individual rating was given to the system's performance under normal operation, which achieved a mean of 3.70, while operational accessibility, fault tolerance, and data recoverability all received consistent scores of 3.50,

resulting in a uniform verbal interpretation of "Highly Reliable." With a Grand Weighted Mean of 3.55, the category is overall interpreted as "Highly Reliable." These findings indicate that users perceive the software as a dependable tool that not only maintains consistent uptime but also possesses the necessary robustness to protect data and recover effectively from technical interruptions.

Table 13: Summary of User Acceptance (Dean, Admin, Professors)		
ISO/IEC 25010:2025 Criteria	**Average Weighted Mean**	**Verbal Interpretation**
Functionality Suitability	3.8	Highly Suitable
Performance Efficiency	3.6	Highly Efficient
Usability	3.9	Highly Usable
Reliability	3.6	Highly Reliable
GRAND WEIGHTED MEAN	**3.6**	**Highly Acceptable**

Table 13 summarizes the user acceptance overall evaluation, as evaluated by the Dean, administrative staff, and professors, reveals a Grand Weighted Mean of 3.6, signifying that the system is "Highly Acceptable" to its target users. The evaluation was led by an exceptional score in Usability (3.9), followed closely by Functional Suitability (3.8), indicating that the software is highly intuitive and effectively addresses the core requirements of the scheduling process. Additionally, both Performance Efficiency and Reliability achieved high ratings of 3.6, further confirming that the system operates smoothly and provides dependable results. These findings demonstrate that the proposed solution is not only technically capable but also aligns perfectly with the practical needs and expectations of the academic staff, ensuring high adoption and satisfaction rates within the institution.

CONCLUSSIONS AND RECOMMENDATIONS

The study concludes that the Genetic Algorithm-driven scheduling system is highly effective and highly acceptable, achieving grand weighted means of 3.4 from IT experts and 3.6 from institutional end-users. By transitioning from a manual Excel-based process to an automated, rule-based web platform, the system successfully eliminates scheduling conflicts and manual errors while maintaining superior standards in usability and functional suitability. Consequently, the system is deemed technically robust and ready for full-scale deployment as a sustainable solution for the complex academic scheduling needs of Westbridge Institute of Technology, Inc. The study concludes that the automated Class Scheduling System effectively addresses the critical inefficiencies of the manual, Excel-based processes at Westbridge Institute of Technology, Inc. (WITI). Multi-stakeholder evaluation based on ISO/IEC 25010:2025 standards showed strong convergence: IT experts rated the technical quality as Highly Effective (grand mean 3.4), confirming the system's robust functionality and reliability; and institutional end-users—including the Dean, administrative staff, and professors—demonstrated High Acceptance (grand mean 3.6), with particularly strong ratings for usability (3.9) and functional suitability (3.8). These findings affirm that transitioning from manual spreadsheets to a relational, rule-based digital solution optimizes resource allocation and ensures strict curriculum compliance through real-time conflict detection. Overall, the system successfully bridges the gap between manual coordination and automated optimization, providing a validated framework that respects faculty constraints while fulfilling the institution's complex academic requirements. Westbridge Institute of Technology, Inc. should formally transition to the Automated Scheduling System to replace manual Excel-based processes and streamline inter-departmental

coordination. To maximize institutional impact, the school should adopt the proposed relational schema and focus on refining the "fitness score" metrics to ensure the most efficient timetable versions are consistently selected. Program heads should undergo specialized training on the "Assigned Subjects" and "Schedule Versions" modules to formalize the review process and ensure faculty are accurately matched to courses based on their specific constraints. While the system performs at a Highly Effective level, the institution should continuously monitor characteristics such as Security and Reliability to ensure the platform scales effectively as user data increases. Finally, a periodic user feedback loop should be established to leverage the system's strengths in usability while addressing future technical enhancements. These steps will ensure the system remains a scalable, robust, and institutionally aligned solution for long-term academic management.

REFERENCES

Books

1. Pressman, R. S., & Maxim, B. R. (2020). Software engineering: A practitioner's approach (9th ed.). McGraw-Hill Education.
2. Sommerville, I. (2020). Software engineering (10th ed.). Pearson Education Limited.

Journal and Research Articles

1. Ahmad, S., & Rahman, F. (2021). Development of a web-based course scheduling system using Laravel framework. International Journal of Advanced Computer Science and Applications, 12(10), 165–173. https://doi.org/10.14569/IJACSA.2021.0121021
2. Ardana, A. P., Hastomo, A. A., & Arman, A. (2024). Development of adaptive lecture scheduling system using genetic algorithm: Case study: Ahmad Dahlan Institute of Technology and Business. Journal of Smart Computing Applications, 2(4), 214–223. https://doi.org/10.70177/jsca.v2i4.1310
3. Balitaan, M. G., Hernandez, C. R., & Dela Cruz, R. T. (2021). Faculty monitoring and performance evaluation system based on ISO/IEC 25010 quality model. Journal of Computing and Information Technology, 29(4), 329–338. https://doi.org/10.24138/jcit.2021.1032
4. Camungao, R. Q. (2024). A new class scheduling approach using genetic algorithm. Journal of Information Systems Engineering and Management, 9(1), 593-599. https://doi.org/10.52783/jisem.v10i49s.9909
5. Chen, X., Yue, X.-G., Li, R. Y. M., Zhumadillayeva, A., & Liu, R. (2021). Design and Application of an Improved Genetic Algorithm to a Class Scheduling System. International Journal of Emerging Technologies in Learning (iJET), 16(01), 44–59. https://doi.org/10.3991/ijet.v16i01.18225
6. Chen, Y., Bayanati, M., Ebrahimi, M., & Khalijian, S. (2022). A novel optimization approach for educational class scheduling with considering the students and teachers' preferences. Discrete Dynamics in Nature and Society, 2022, Article 5505631. https://doi.org/10.1155/2022/5505631
7. De Jesus, K. R., & Agustin, L. V. (2024). Evaluation of student management information system based on ISO/IEC 25010 quality model. Philippine Computing Journal, 19(2), 45–56. https://doi.org/10.5281/zenodo.10841563
8. Duong Thang Long. (2022). An Enhanced Genetic Algorithm Based Courses Timetabling Method for Maximal Enrollments Using Maximum Matching on Bipartite Graphs. Vietnam Journal of Science and Technology, 57(6), 734-748. https://doi.org/10.15625/2525-2518/57/6/13501

9. Han, J., & Wang, L. (2023). Gradual optimization using Python-based genetic algorithms for multi-constraint scheduling. Computational Intelligence and Neuroscience, 2023, 9875123. https://doi.org/10.1155/2023/9875123
10. Kutty Mammi, H., & Lim Ying Ying, L. (2021). Timetable Scheduling System using Genetic Algorithm for School of Computing (tsuGA). International Journal of Innovative Computing, 11(2), 67–72. https://doi.org/10.11113/ijic.v11n2.342
11. Mahlous, S., & Mahlous, A. (2023). A Python-based intelligent scheduling framework using evolutionary algorithms. International Journal of Computer Science and Network Security, 23(4), 89–97. https://doi.org/10.22937/ijcsns.2023.23.4.12
12. Mutasar, N. H. (2024). Implementation of Genetic Algorithms in the Course Scheduling Information System at the Faculty of Computer and Multimedia UNIKI. Jurnal Elektronika Dan Teknologi Informasi, 5(1), 21-27. https://doi.org/10.5201/jet.v5i1.420
13. Nasien, D., & Andi, A. (2022). Optimization of Genetic Algorithm in Courses Scheduling. IT Journal Research and Development, 6(2), 151–161. https://doi.org/10.25299/itjrd.2022.7896
14. Papadimitriou, A. (2024). Python's contribution to artificial intelligence in education: A state-of-the-art review. Journal of Future Artificial Intelligence and Technologies. https://doi.org/10.62411/faith.3048-3719-267
15. Romaguera, D., Nabas, J. P., Matias, J., Austero, L., & co-authors. (2024). Development of a Web-based Course Timetabling System based on an Enhanced Genetic Algorithm. Procedia Computer Science, 234, 1714-1721. https://doi.org/10.1016/j.procs.2024.03.177
16. Saputra, S. B., & Pamungkas, E. W. (2023). Development of Scheduling System with Genetic Algorithm in Website-Based SMK Negeri 1 Sine. Jurnal Teknik Informatika (Jutif), 4(4), Article 784. https://doi.org/10.52436/1.jutif.2023.4.4.784
17. Sari, R. P., Nugroho, P., & Hidayat, T. (2023). Evaluating e-learning platforms using ISO/IEC 25010 quality model. Education and Information Technologies, 28(7), 8199–8214. https://doi.org/10.1007/s10639-023-11783-4
18. Šušter, I., & Ranisavljević, T. (2023). Optimization of MySQL database. Journal of Process Management and New Technologies, 11(1-2), 141-151. https://doi.org/10.5937/jpmnt11-44471
19. Węgrzecki, K. S., & Dzieńkowski, M. (2022). Performance analysis of Laravel and Yii2 frameworks based on the MVC architectural pattern and PHP language. Journal of Computer Sciences Institute, 24, 265-272. https://doi.org/10.35784/jcsi.3002

Other Sources (Standards)

1. ISO. (2023). ISO/IEC 25010:2023 — Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Product quality model. International Organization for Standardization. https://www.iso.org/standard/78176.html
2. Wang, C., & Wang, B. (2024). An Improved Genetic Algorithm for College Course Scheduling. In Quality, Reliability, Security and Robustness in Heterogeneous Systems – QShine 2023 (Proceedings, Part I) (pp. 445–458). Springer. https://doi.org/10.1007/978-3-031-65126-7_40