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Optimized Faculty and Class Scheduling Using Genetic Algorithm and Iterative Approach

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ABSTRACT: This study developed and evaluated an Optimized Faculty and Class Scheduling System for North Eastern Mindanao State University – Cantilan Campus. The developed system addressed scheduling concerns including timetable conflicts, unequal faculty workload distribution, and inefficient classroom utilization. The study employed a descriptive-developmental research design together with the Agile Software Development Life Cycle methodology. The developed system integrated Genetic Algorithm operations and iterative optimization techniques to generate organized and conflict-free schedules. System evaluation was conducted using the ISO/IEC 25010 software quality standards. Findings revealed that the developed system achieved favorable results in functionality, usability, reliability, maintainability, security, and performance efficiency. The results further indicated that the system improved scheduling operations, minimized timetable conflicts, and enhanced academic resource allocation within the institution.

KEYWORDS: Academic Scheduling, Genetic Algorithm, Optimization System, Faculty Workload, ISO/IEC 25010



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I. INTRODUCTION

Academic scheduling is one of the essential operational processes within educational institutions because it directly affects faculty assignments, classroom management, and student learning activities. In North Eastern Mindanao State University – Cantilan Campus, scheduling procedures were primarily conducted manually, resulting in timetable conflicts, imbalanced teaching loads, and inefficient utilization of classrooms and available time slots. Moreover, manual preparation of schedules required considerable administrative effort and consumed significant time.

Developing academic timetables is considered a complex optimization task because several constraints must be managed simultaneously, including instructor availability, room capacities, course offerings, and class schedules. Several researchers emphasized that optimization algorithms, particularly Genetic Algorithms, are capable of generating adaptive and efficient scheduling solutions. Despite advancements in automated scheduling technologies, only a limited number of localized systems were developed for Philippine state universities, especially institutions handling irregular student schedules and restricted academic resources.

To address these concerns, the researchers developed an Optimized Faculty and Class Scheduling System utilizing Genetic Algorithm operations and iterative optimization procedures. The developed system automated scheduling activities, minimized timetable conflicts, distributed faculty workloads fairly, and maximized classroom utilization.

The study provided practical benefits to academic administrators, instructors, and students by improving the efficiency and reliability of scheduling operations. Furthermore, the research contributed to future developments involving intelligent scheduling technologies and optimization-based academic management systems.

II. LITERATURE SURVEY

Several studies on academic scheduling highlighted the importance of optimization techniques in solving complex timetabling problems. Premananda et al. (2024) discussed how metaheuristic approaches improved schedule generation by minimizing conflicts and enhancing timetable quality. Their findings emphasized that optimization-based scheduling methods remained effective in handling multiple academic constraints.

Similarly, Bashab et al. (2022) explained that Genetic Algorithms are among the most reliable approaches for solving university timetabling problems because they efficiently search large solution spaces while adapting to changing scheduling requirements. Other researchers also noted that integrating multiple optimization strategies leads to better scheduling flexibility and performance.

Studies conducted within Southeast Asia further revealed the increasing implementation of hybrid optimization methods in academic scheduling systems. Zabidee and Muhammad Adnan et al. (2024) stated that combining optimization strategies often results in more adaptive and organized scheduling outputs. These findings supported the effectiveness of iterative improvement approaches in dynamic scheduling environments.

Local studies in the Philippines also identified limitations in traditional manual scheduling practices. Austero et al. (2022) emphasized that manual scheduling procedures frequently resulted in inconsistent faculty workloads and inefficient timetable management. Agustin et al. (2018) likewise demonstrated that Genetic Algorithm-based systems improved scheduling efficiency and reduced administrative burden in academic institutions.

The reviewed literature supports the idea that optimization algorithms and automated scheduling systems significantly improve timetable generation, workload balancing, and resource allocation in educational institutions.



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Table 1. Summary of Related Literature

No.	Paper Title	Author/s	Key Points	Remarks
1	Optimization Approaches in Academic Timetabling	Premananda et al., 2024	Metaheuristic approaches improved timetable quality and reduced scheduling conflicts.	Supports optimization techniques in scheduling systems.
2	Genetic Algorithm for University Timetabling	Bashab et al., 2022	Genetic Algorithms effectively managed multiple scheduling constraints.	Supports the integration of Genetic Algorithms.
3	Hybrid Scheduling Optimization Methods	Zabidee & Muhammad Adnan et al., 2024	Combined optimization approaches improved scheduling flexibility and performance.	Supports iterative optimization procedures.
4	Manual Scheduling Challenges in Universities	Austero et al., 2022	Manual scheduling procedures resulted in inefficient timetable management.	Supports the need for automated scheduling systems.
5	Automated Faculty Scheduling System	Agustin et al., 2018	Automated scheduling systems improved timetable organization and reduced workload.	Supports intelligent scheduling system development.

III. METHODOLOGY

Research Design

The study utilized a descriptive-developmental research approach in designing and evaluating the developed scheduling system for NEMSU–Cantilan Campus. The developmental component focused on the development of the automated scheduling system, while the descriptive component examined the effectiveness and operational performance of the developed system.

Development Methodology

The Agile Software Development Life Cycle methodology was adopted because of its iterative and flexible structure. This methodology enabled continuous improvement of the system through repeated cycles of planning, design, testing, deployment, and evaluation.

System Features

The developed system includes the following features:

- Instructor management
- Subject and course management
- Classroom and room allocation
- Conflict detection and prevention
- Faculty workload balancing
- Schedule monitoring and management
- Schedule filtering and sorting
- Report generation and printing
- User authentication and access control
- Database management for scheduling records
- Dashboard for schedule visualization and monitoring
- Constraint handling for faculty availability and room assignments
- Optimized classroom and time-slot utilization



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Respondents of the Study

The study involved 8 respondents composed of 1 Department Chair, 3 Program Chairs, and 4 IT experts. Respondents were selected using purposive sampling to ensure direct interaction and evaluation of the developed scheduling system.

Data Gathering Procedure

The researchers conducted interviews, observations, consultations, and survey questionnaires to gather system requirements and evaluate the developed system. Respondents performed actual system tasks such as generating schedules, detecting conflicts, assigning instructors, allocating classrooms, and viewing generated timetable reports.

Statistical Treatment

The following statistical tools were used:

1. Weighted Mean
2. Frequency and Percentage Distribution
3. Error Count and Performance Summary

The ISO/IEC 25010 Software Quality Model was used to evaluate functionality, reliability, usability, efficiency, maintainability, and security.

IV. RESULTS & DISCUSSION

The developed Optimized Faculty and Class Scheduling System successfully implemented its intended functionalities for automated academic scheduling and timetable optimization in NEMSU–Cantilan Campus.

Scheduling Dashboard

The system provided a centralized dashboard that organized instructor records, subject schedules, classroom allocations, and generated timetable reports. Administrators were able to manage scheduling operations efficiently through the system dashboard and monitoring modules.

Schedule Generation Feature

The scheduling module utilized Genetic Algorithm operations and Iterative Optimization techniques to generate conflict-free and balanced faculty and class schedules based on institutional scheduling constraints. The generated schedules minimized overlapping classes, optimized room utilization, and improved faculty workload distribution.

Conflict Detection and Load Balancing

The system implemented conflict detection and load-balancing mechanisms that identified overlapping schedules, duplicate room assignments, and excessive faculty teaching loads. The generated schedules ensured fair faculty workload allocation while maintaining organized class timetables.

Performance Evaluation

The system was evaluated using ISO/IEC 25010 software quality standards. Results revealed that the system achieved “Excellent” ratings across all quality characteristics.

Table 2. Performance Evaluation of the System

Quality Characteristics	Mean	Verbal Interpretation
Functionality	4.78	Very Great Extent
Reliability	4.72	Very Great Extent
Usability	4.81	Very Great Extent
Performance Efficiency	4.75	Very Great Extent
Maintainability	4.69	Very Great Extent
Security	4.73	Very Great Extent
Overall Mean	4.75	Very Great Extent



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The results indicate that the system is highly functional, reliable, secure, and user-friendly for academic scheduling operations. The optimization procedures also demonstrated effective scheduling performance in minimizing timetable conflicts and improving resource allocation.

The findings support previous studies which emphasized that optimization algorithms and automated scheduling systems improve scheduling efficiency, conflict reduction, and academic resource management. The developed system demonstrates that Genetic Algorithm-based optimization techniques can be effectively implemented in academic scheduling environments.

V. CONCLUSION

The study successfully developed and evaluated an Optimized Faculty and Class Scheduling System for North Eastern Mindanao State University – Cantilan Campus. The system effectively addressed challenges in manual scheduling by providing automated schedule generation, conflict detection, faculty workload balancing, and optimized classroom allocation.

The implementation of Genetic Algorithm operations and Iterative Optimization techniques enabled the system to generate organized and conflict-free schedules that improved scheduling efficiency and academic resource management. Evaluation results based on ISO/IEC 25010 confirmed that the system achieved “Excellent” ratings in functionality, reliability, usability, performance efficiency, maintainability, and security.

The findings demonstrate that optimization-based scheduling systems can significantly improve academic scheduling operations, reduce administrative workload, and support efficient timetable management within educational institutions.

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