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Efficient Resource Use in Practical Course Scheduling via the Enhanced Welsh–Powell Method

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University timetabling poses unique challenges for practical course scheduling due to the high cost of consumable specimens and limited laboratory resources. Unlike lecture scheduling, which mainly seeks to minimize the number of time slots, practical course scheduling must also account for group execution and resource preservation. In particular, completing all practical groups of a course within consecutive time slots is more critical than simply reducing the total number of slots, as it helps minimize specimen waste and repeated preparation efforts. Additionally, universities typically accommodate only two practical sessions per day, further constraining feasible timetabling solutions. To address these challenges, this research proposes an enhanced graph coloring method based on the traditional Welsh-Powell algorithm. Results: While the original Welsh-Powell ranks courses solely by vertex degree (i.e., number of conflicts), our method introduces a more comprehensive metric called the Color Intensity Score (CIS). This score considers multiple factors beyond degree, including: the number of groups per practical course, the group index of each session, an added course factor indicating recent timetable insertions, and the traditional conflict degree. Courses are ordered by CIS, and groups are combined and scheduled iteratively to maximize efficiency. After scheduling each batch of course groups, CIS values are dynamically updated to reflect the changing constraints. By prioritizing the completion of grouped practical courses in close succession, the proposed method reduces redundancy in lab setup and conserves specimens. This method outperforms traditional coloring techniques, achieving both resource-efficient group scheduling and practical adherence to daily session limits, according to experiments conducted with real university data. The method offers a promising solution for institutions facing high demand for practical courses under limited laboratory infrastructure.

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