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An interactive tool for supporting university timetabling

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Introduction

- **University Course Timetabling Problem** (UCTTP) is a complex combinatorial optimization problem that consists of allocating events, rooms, lecturers, and students to weekly schedules while meeting certain constraints.
- This research focuses on **Curriculum-Based Course Timetabling** (CB-CTT), a variant of UCTTP that focuses on course scheduling.
- **FCUP's timetabling building process** is time-consuming, not automated, and suboptimal.
- **Monte Carlo Tree Search** (MCTS) chosen due to its effectiveness in games and optimization problems, as well as its ability to navigate large search spaces effectively (Figure 1).
- **Hill Climbing** (HC) used in simulation phase for local optimization.

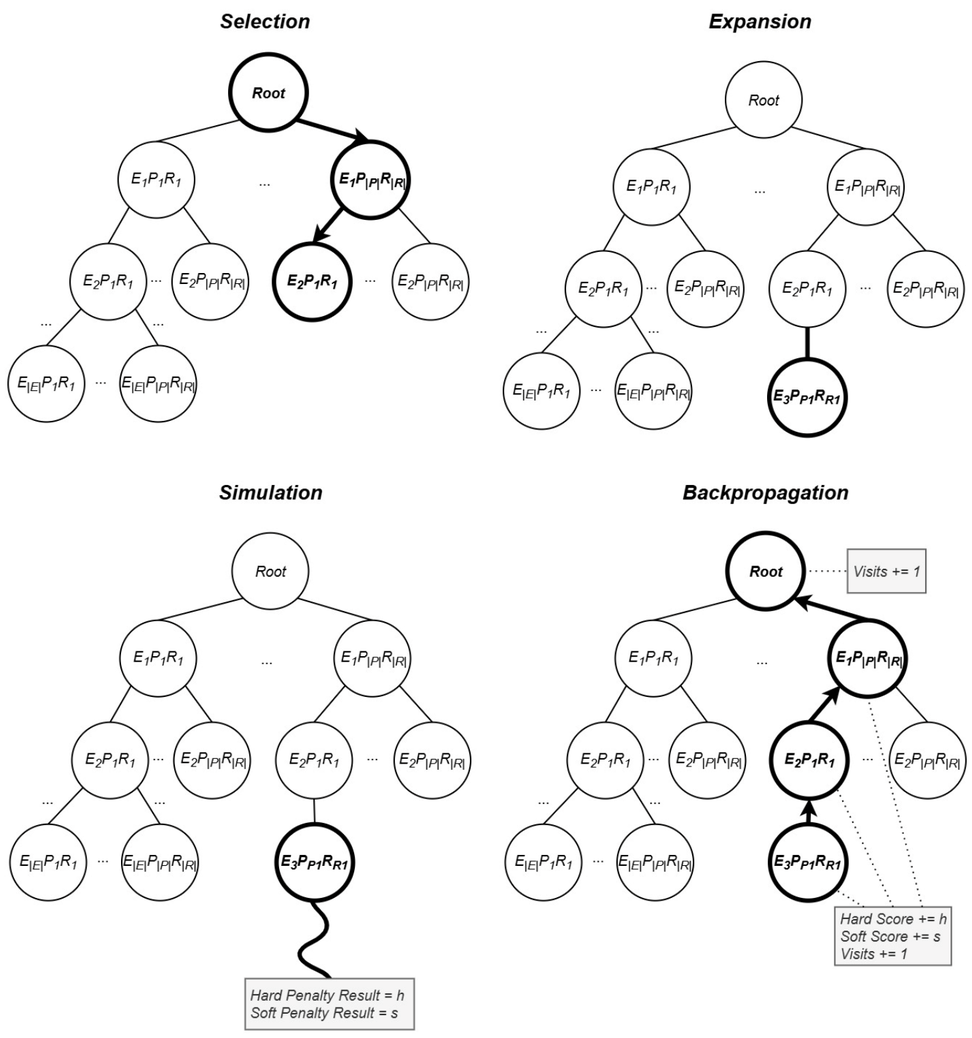

Figure 1 – Monte Carlo Tree Search steps.

Objective(s)

- Enhance the **efficiency** and **quality** of FCUP's timetabling.
- Provide step-by-step interactive **recommendations**.
- Detect potential **conflicts**.
- Integrate these functionalities into a timetable visualization **interface** that was previously developed using reactive programming.

State-of-the-Art

- Analyzed various **surveys** [1,2,3,4] and categorized UCTTP approaches based on their problem-solving strategies.
- **Metaheuristics** emerged as one of the most promising, particularly single-solution-based algorithms like **Simulated Annealing** (SA) and **Tabu Search** (TS).
- **Hybrid approaches**, like Müller's ITC-2007 approach [5], were also shown to be effective.
- Goh [6] study on the Post-Enrollment Course Timetabling Problem (PE-CTT) found that **TS outperformed MCTS**, despite improvements to the standard MCTS algorithm.
- MCTS and its hybridization remain unexplored in the context of CB-CTT, making this the **novel contribution** of our work.

Workplan

- Key tasks involve thorough **literature review**, **algorithms implementation**, system integration with **ITC-2007** (track 3) standards, and extensive **testing** (Figure 2).

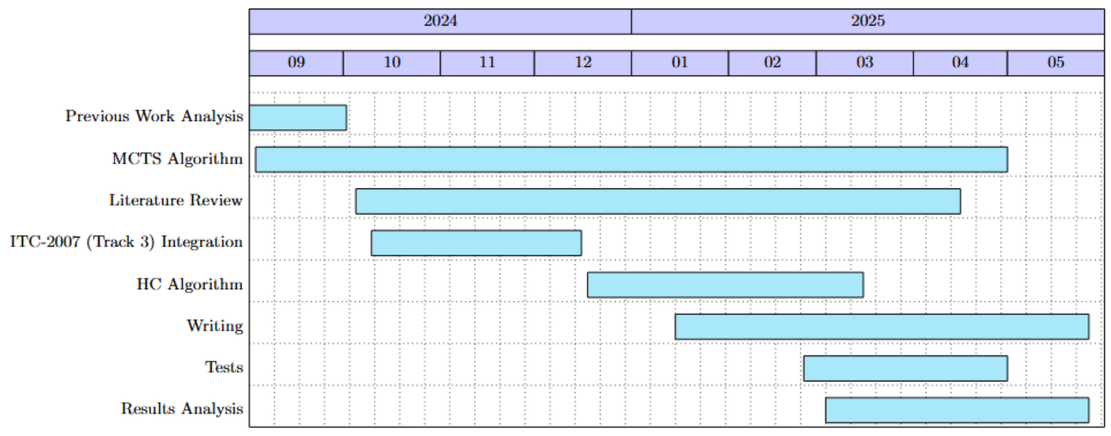

Figure 2 – Gantt chart with the project tasks and estimated duration

Preliminary results

- Tested **C** values (0.1 to 1000) in the **UCT formula** and in a **modified version** incorporating accumulated rewards for exploitation.
- So far, all the executed tests have found **feasible solutions**.
- C = 100 in the alternative UCT formula yielded the best results in most instances (Figure 3) but remains less competitive than top solutions.

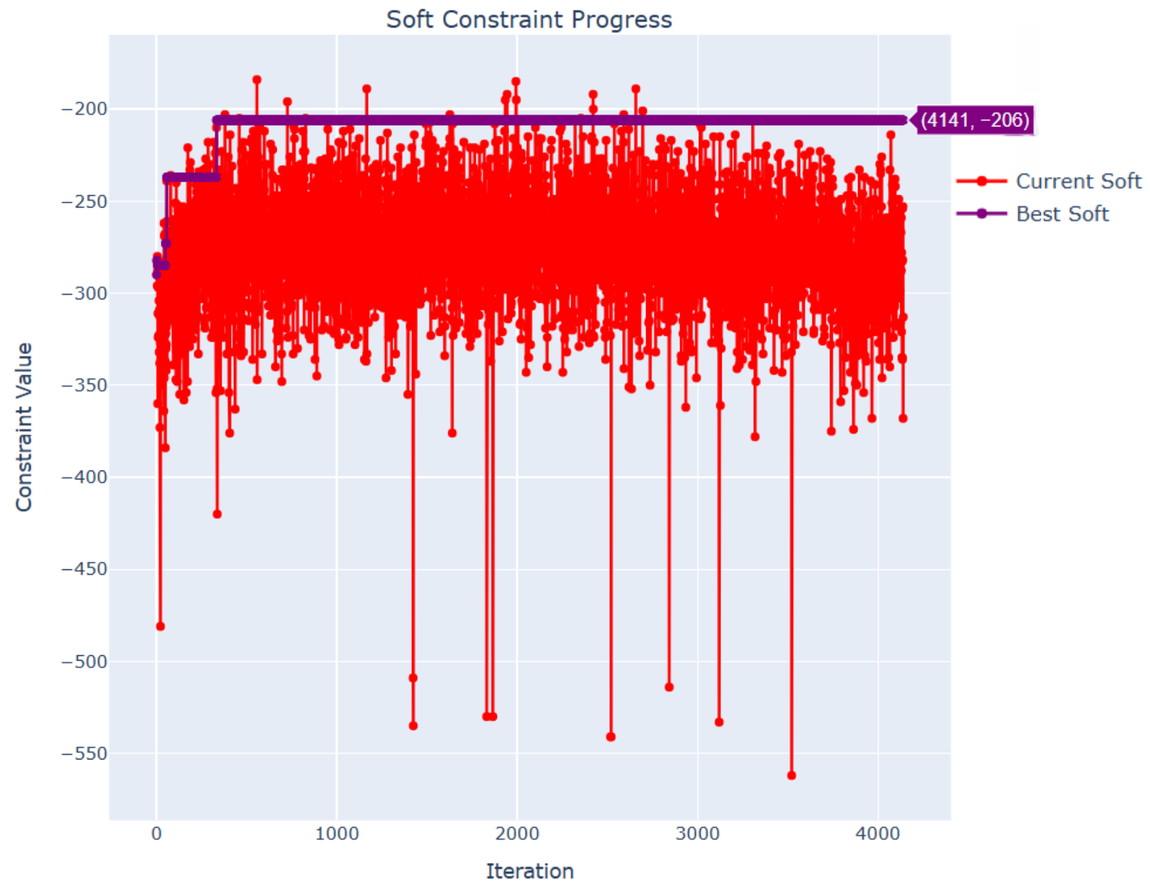

Figure 3 – Soft constraint progress for comp02 instance from ITC-2007.

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