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An interactive tool for supporting university timetabling

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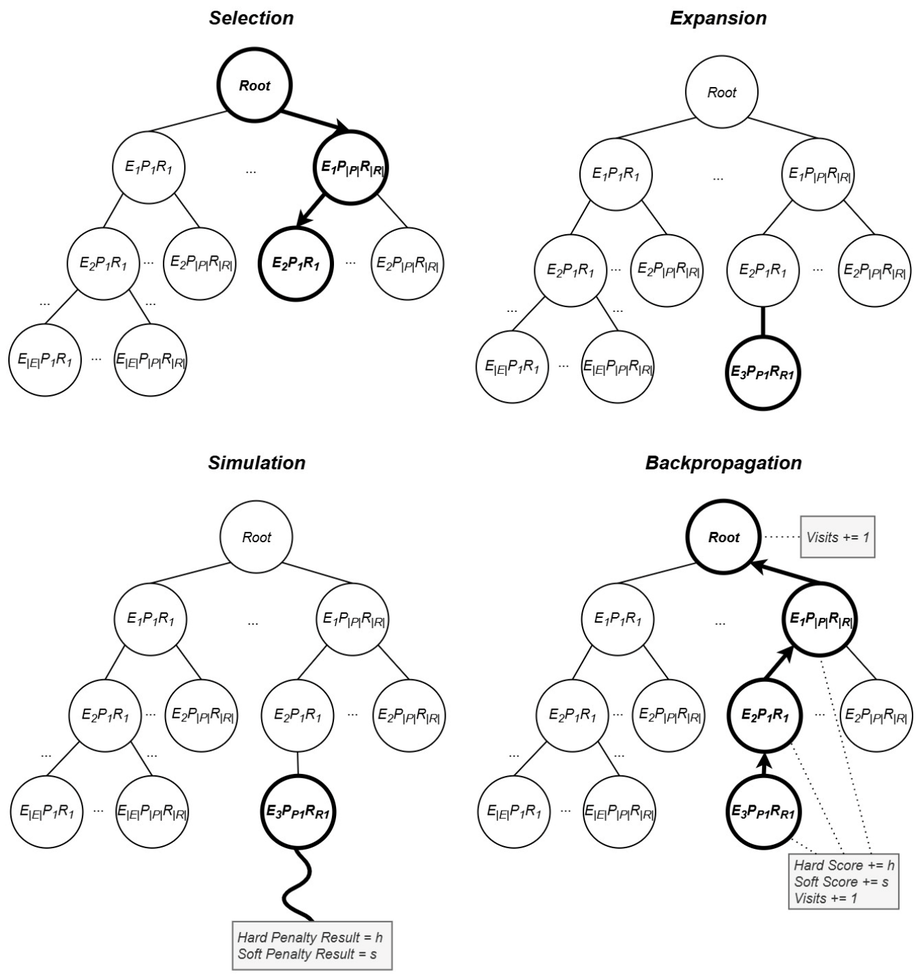
Introduction

- **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 the results are not the most satisfactory.
- **Monte Carlo Tree Search** (MCTS) chosen due to its effectiveness in games and optimization problems (Figure 1).
- **Hill Climbing** (HC) used in simulation phase for local optimization.



E - events to be scheduled
P - periods consisting of a day and a timeslot
R - rooms

Figure 1 – Monte Carlo Tree Search steps.

Objective(s)

- Enhance the **efficiency** and **quality** of FCUP's weekly timetable development.
- 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 solutions based on their problem-solving strategies.
- Among the approaches, **metaheuristics** emerged as one of the most promising, particularly single-solution-based algorithms like **Simulated Annealing** (SA) and **Tabu Search** (TS).
- **Hybrid approaches**, such as the one used by Tomáš Müller [5] in the **ITC-2007**, 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. This decision is driven by the potential of MCTS to effectively navigate large search spaces and its underutilization in this domain.

Workplan

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

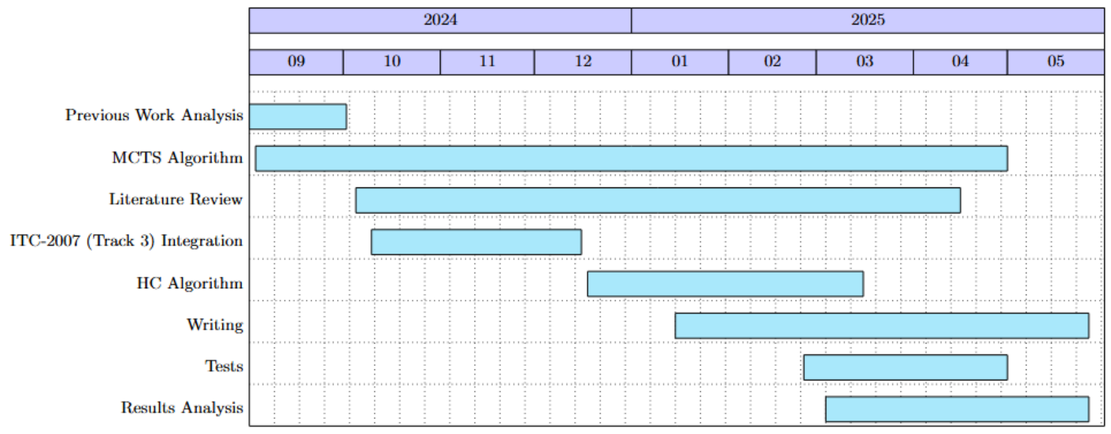


Figure 2 – Gantt chart with the project tasks and estimated duration

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.

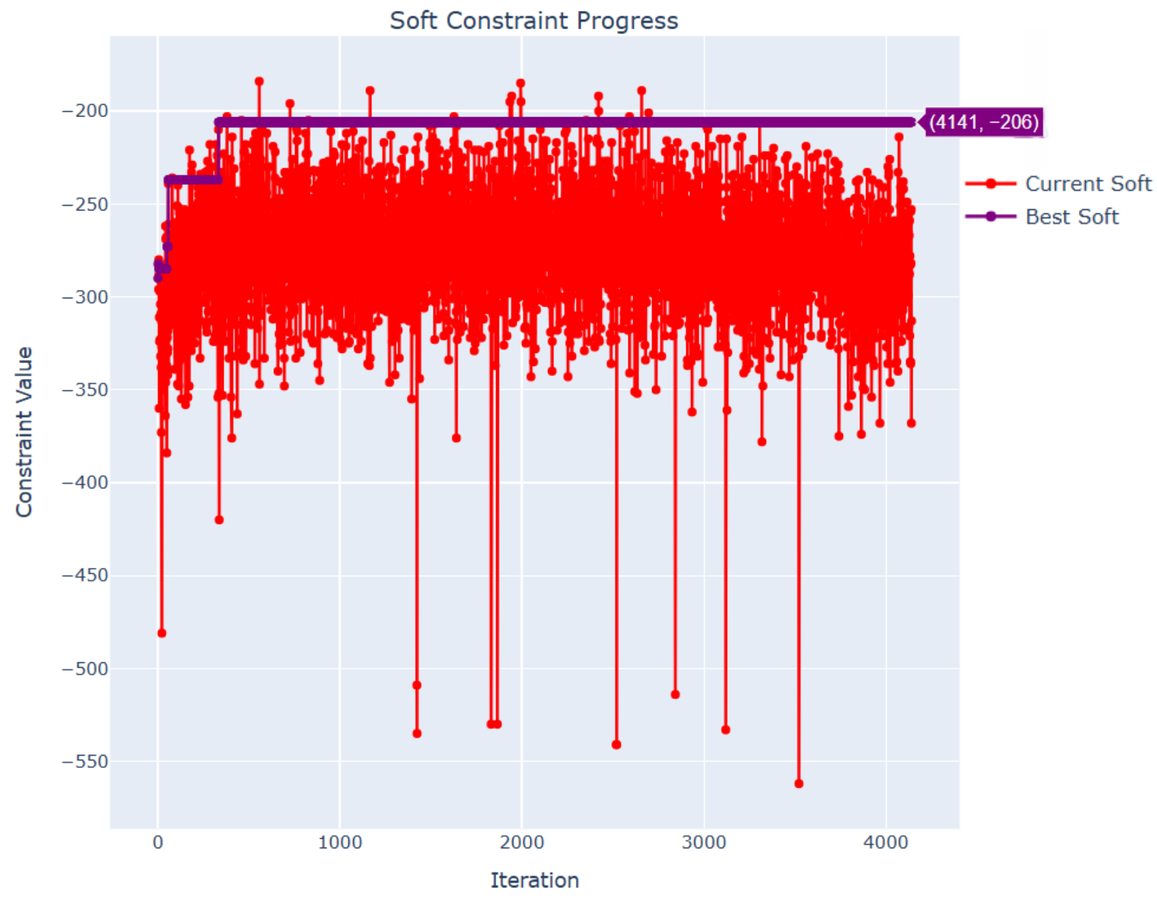


Figure 3 – Soft constraint progress for comp02 instance from ITC-2007.

References

[1] R. Lewis, "A survey of metaheuristic-based techniques for university timetabling problems," OR Spectrum, vol. 30, no. 1, pp. 167–190, Jan. 2008. Available: https://doi.org/10.1007/s00291-007-0097-0

[2] S. Abdipoor, R. Yaakob, S. L. Goh, and S. Abdullah, "Meta-heuristic approaches for the university course timetabling problem," Intelligent Systems with Applications, vol. 19, p. 200253, Sep. 2023. Available: https://linkinghub.elsevier.com/retrieve/pii/S2667305323000789

[3] H. Babaei, J. Karimpour, and A. Hadidi, "A survey of approaches for university course timetabling problem," Computers & Industrial Engineering, vol. 86, pp. 43–59, Aug. 2015. Available: https://linkinghub.elsevier.com/retrieve/pii/S0360835214003714

[4] M. C. Chen, S. N. Sze, S. L. Goh, N. R. Sabar, and G. Kendall, "A survey of university course timetabling problem: Perspectives, trends and opportunities," IEEE Access, vol. 9, pp. 106 515–106 529, 2021, conference Name: IEEE Access. Available: https://ieeexplore.ieee.org/document/9499056/?arnumber=9499056

[5] T. Müller, "Itc2007 solver description: a hybrid approach," Annals of Operations Research, vol. 172, no. 1, pp. 429–446, Nov. 2009. Available: http://link.springer.com/10.1007/s10479-009-0644-y

[6] S. L. Goh, "An investigation of monte carlo tree search and local search for course timetabling problems,", pp. 76–105, Jul. 2017. Available: https://eprints.nottingham.ac.uk/43558/

2024/25

Title

Candidate's name (First and Last)[1] | Supervisor's name[1]

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Introduction

- Provide some context
- What is the problem you are trying to solve?
- What is your main idea for solving it?

Objective(s)

- What is the explicit objective or objectives of your proposed work?
- Try to use topics or research questions

State-of-the-Art

- What was the methodology you used to review the state-of-the-art of your work?
- What did you find most promising?
- What decisions for your work did you make, based on this knowledge?

Note:
All above text boxes have 23.5 cm width, and the font is Arial Narrow, size 24.
Please respect these formatting rules.

Workplan

- What tasks do you need to accomplish to achieve your proposed goal?
- What will you do in each task?
- Include a small Gantt chart to make this clear.

Preliminary results

- Show some results
- Focus on what is more promising
- Show plots, visualizations, diagrams
- What are your expectations for the next developments?

Obs:
You can make your poster standout by using clear diagrams and figures. Try to keep the text to the minimum necessary while using several figures.
Try do develop a graphical introduction.
Your introduction and, possibly the preliminary results, should take about 50-70% of all the poster space.

Figure 1 – Description of Figure 1. Use figures, illustrations, diagrams, or whatever you think will be useful so people can easily understand your work..

References

- Key scientific references for your thesis, eventually cited in previous sections of this poster
- Pick a citation format and be coherent (Chicago, Vancouver, etc).
- Use Arial Narrow, size 20 for the references
- Try to use between the best 5 and 10 references