STASP

Sports Timetabling with Answer Set Programming

➤ Overview

SPORTS TIMETABLING PROBLEM is a classic combinatorial optimization problem that involves generating schedules under complex rules. This project investigates the suitability of **Answer Set Programming (ASP)**, a declarative logic programming paradigm that uses intuitive logic to model problems. We evaluate ASP's performance on two demanding case studies: the ITC 2021 benchmark and multi-stage tournaments modelled after the FIFA World Cup.

Objectives

Research Gap: Can declarative ASP provided both modeling expressiveness AND computational viability for sports timetabling?

1. Develop ASP models for ITC2021 and FIFA World Cup constraints.
2. Measure computational efficiency & solution quality.
3. Benchmark against state-of-the-art Simulated Annealing and CP-SAT.
4. Identify effective optimization strategies for ASP performance.

Approach

Answer Set Programming (ASP)

Declarative approach where WHAT the desired solution is defined instead of HOW to compute it.

1{scheduled(M,S) : slot(S)}1:- match(M)

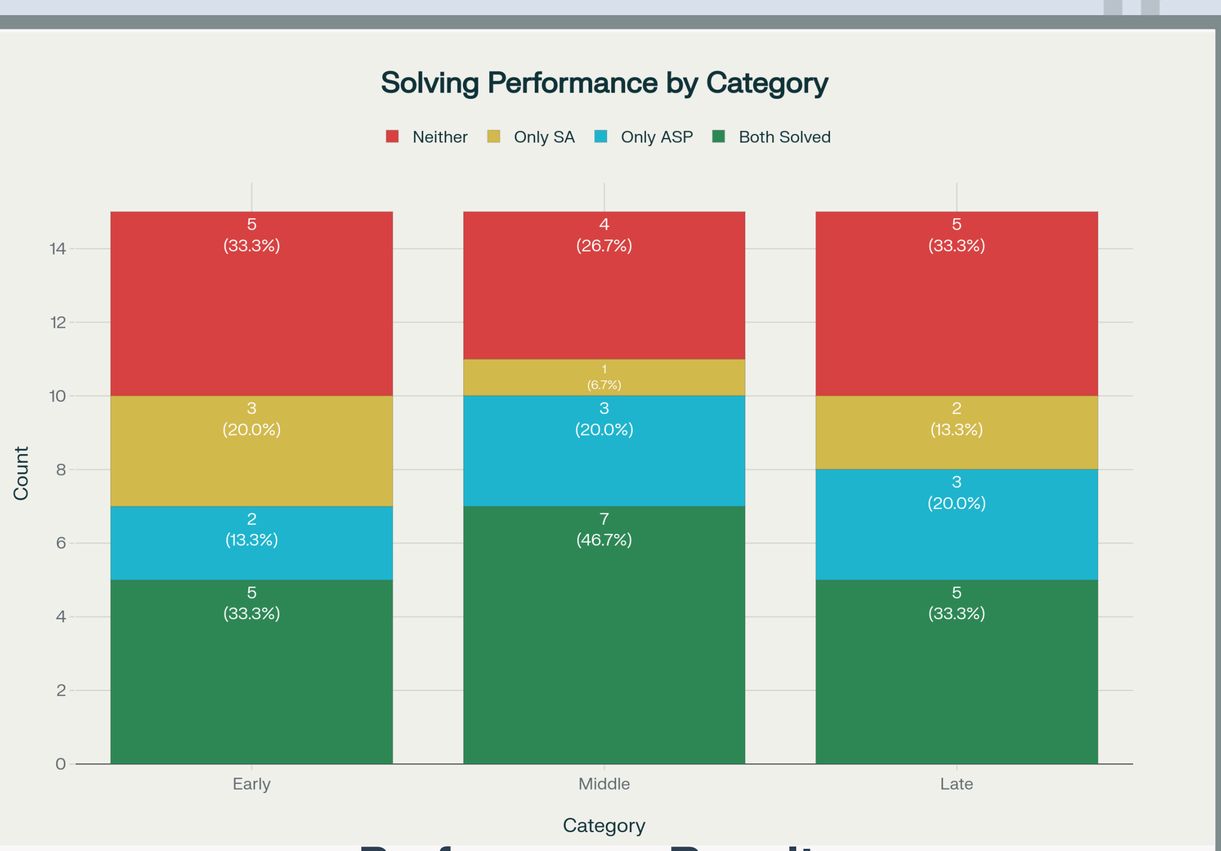
ITC2021 Benchmark

45 instances, RobinX XML → ASP facts, generate-test-optimize approach, compare with Simulated Annealing baseline.

Multi-Stage Tournament Modellling

FIFA World Cup group stage structure, encode real world constraints, multi-objective optimization system, compare with CP-SAT.

Key Findings



Performance Results

Multi-Stage: 100% optimal (8 teams), 33% solved (20 teams), faster initial solutions than CP-SAT; dynamic rescheduling: 91s vs 1435s.

ITC2021: 26/45 solved vs SA (23/45); 1 proven optimal. All ITC2021 & FIFA constraints succesfully encoded as declarative rules.

Computational Insights

Preprocessing: 58% faster solving, 5% better quality by eliminating invalid assignments early.

Standard optimization techniques (symmetry breaking, complex formulations) were counterproductive - conflicted with ASP's search mechanisms.

Complex formulations: overhead without benefit

Key Insight: ASP excels at rapid feasibility and adaptability, while metaheuristics excel at optimization quality. For ASP, domain-specific techniques outperform general-purpose methods.

Conclusions

- ASP demonstrates **viability for sports timetabling** with **distinct trade-offs**: strong feasibility and adaptability versus weaker optimization quality compared to metaheuristics.
- Provides selection guidance: **ASP for constraint-rich, dynamic problems**; metaheuristics for optimization-critical, large-scale tournaments.
- **Future direction**: hybrid approaches, improved modelling techniques and heuristics, extend evaluation to large scale tournament size.

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