League Championship Algorithm (LCA): An algorithm for global optimization inspired by sport championships

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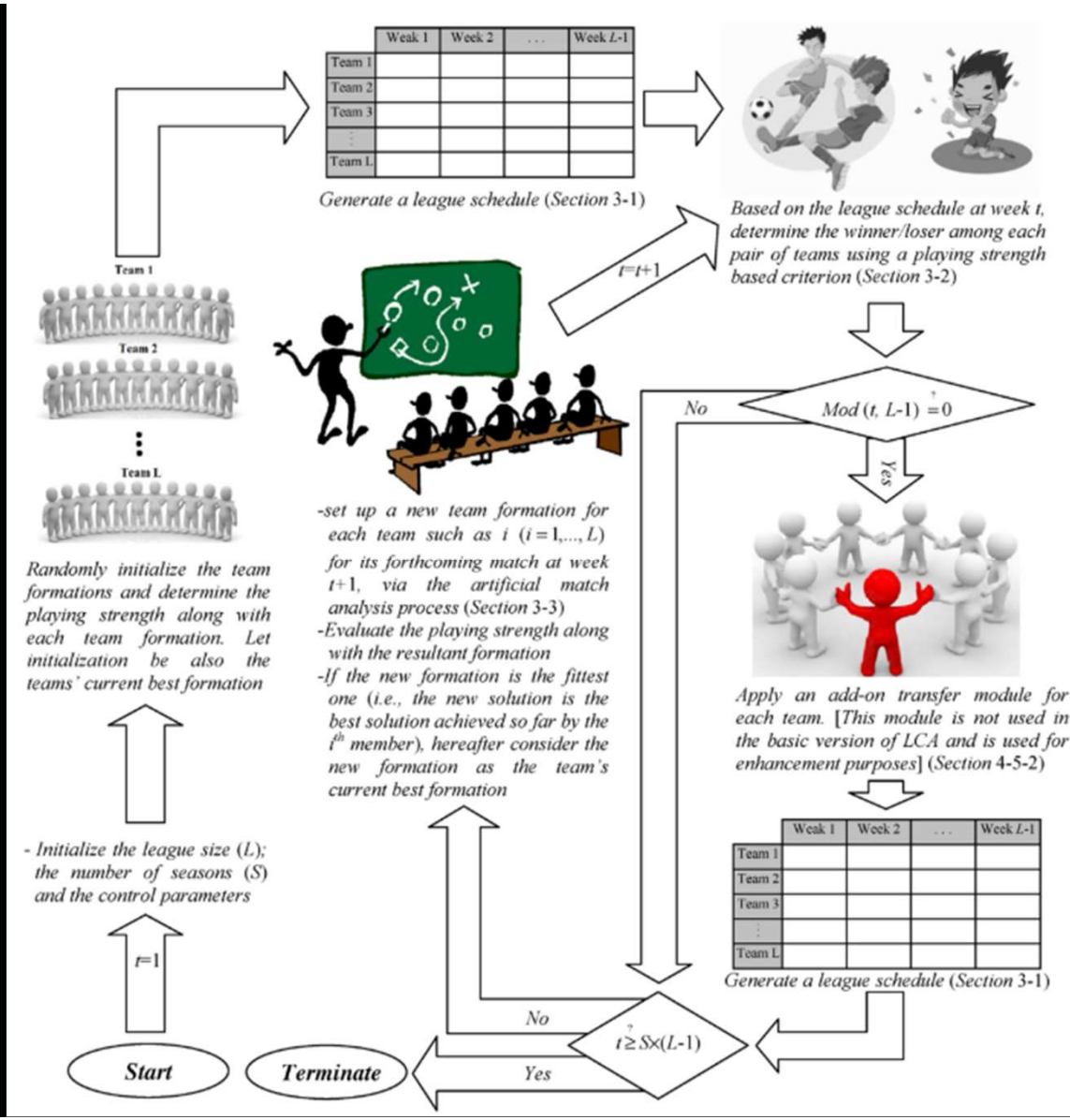
Inspiration of LCA

- LCA draws from the observation of sports leagues
- Their performances are evaluated at regular intervals during a season
- LCA uses a population of potential solutions competing in an artificial league


Start
- Initialize the league size (L); the number of seasons (S) and the control parameters
t=1
Randomly initialize the team formations and determine the playing strength along with each team formation. Let initialization be also the teams' current best formation
Team 1
Team 2
Team L
Generate a league schedule (Section 3-1)
Week 1
Week 2
Week L-1
Team 1
Team 2
Team 3
Team L
Based on the league schedule at week t, determine the winner/loser among each pair of teams using a playing strength based criterion (Section 3-2)
t=t+1
-set up a new team formation for each team such as i (i = 1,..., L) for its forthcoming match at week t+1, via the artificial match analysis process (Section 3-3)
-Evaluate the playing strength along with the resultant formation
-If the new formation is the fittest one (i.e., the new solution is the best solution achieved so far by the i^th member), hereafter consider the new formation as the team's current best formation
Mod (t, L-1) =? 0
No
Yes
Apply an add-on transfer module for each team. [This module is not used in the basic version of LCA and is used for enhancement purposes] (Section 4-5-2)
Generate a league schedule (Section 3-1)
t ≥? S×(L-1)
No
Yes
Terminate

Update Equations

- LCA utilizes four main equations to update solutions
- To enhance the diversification of solutions while allowing for intensification of search in areas with high potential

S/T Equation (Strengths/Threats)

- `x_new = x_current + rand() * (x_current - x_opp)`
- when both teams (i and j) involved in the match won their previous matches

S/O Equation (Strengths/Opportunities)

- x_new = x_current + rand() * (x_opp - x_current)
- Applied when a team won, but its opponent lost
- focuses on leveraging opportunities identified based on the weaknesses of the defeated team

W/T Equation (Weaknesses/Threats)

- x_new = x_current - rand() * (x_opp - x_current)
- Used when a team lost and its opponent won

W/O Equation (Weaknesses/Opportunities)

- `x_new = x_current - rand() * (x_current - x_opp)`
- Applied when both teams lost their matches

Diversification and Intensification

- Diversification means generating solutions that explore new areas of the solution space to avoid being trapped in local minimum
- Intensification involves focusing on areas where high-quality solutions are expected, increasing the likelihood of finding a global optimum

Comparison

- Rosenbrock Function
- Rastrigin Function
- Griewank Function

Results and Evaluation of LCA

- LCA was compared with algorithms such as genetic algorithms, particle swarm optimization (PSO), and differential evolution (DE)
- LCA often outperformed the other algorithms

Potential for Further Improvements

- LCA could also be modified or combined with other strategic approaches to improve its performance in specific types of optimization problems

Conclusion & Usage

- LCA offers an new approach to evolutionary algorithms
- This algorithm has the potential for further development and applications
- Tasks Scheduling Technique Using League Championship Algorithm for Makespan Minimization in IaaS Cloud

Thank you for your attention!

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