MICAI 2013 Tutorial:
Hyper-Heuristics for Combinatorial Optimization

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Abstract:

Generally research into using artificial intelligence techniques to solve combinatorial optimization problems have involved identifying methods or hybrid approaches that produce the best result for one or more problems in a benchmark set. Hyper-heuristics, a fairly new field, instead aim at providing a more generalized solution for a particular problem domain. This is achieved by exploring a space of low-level heuristics or heuristic combinations which is mapped onto a solution space, rather than searching the solution space directly. These low-level heuristics can be constructive or perturbative. Metaheuristics such as simulated annealing, tabu search, genetic algorithms and genetic programming are commonly employed by hyper-heuristics to drive this search. Hyper-heuristics have been found to be effective in solving combinatorial optimization problems such us university course and examination timetabling, school timetabling, personnel rostering, packing problems and the travelling salesman problem, amongst others. This tutorial will provide an introduction to hyper-heuristics, illustrate its application and effectiveness in solving combinatorial optimization problems and highlight directions for future research.

Outline:

1. Introduction to Hyper-Heuristics

    - Description of hyper-heuristics
    - Aim of hyper-heuristics
    - Hyper-heuristics relate and artificial intelligence

2. Combinatorial Optimization and Low-Level Heuristics

    - Low-level heuristics in combinatorial optimization
    - Constructive low-level heuristics
    - Perturbative low-level heuristics

3. Types of Hyper-Heuristics

    - Selection constructive hyper-heuristics
    - Selection perturbative hyper-heuristics
    - Generation constructive hyper-heuristics
    - Generation perturbative hyper-heuristics

4. Artificial Intelligence Methods Employed by Hyper-Heuristics

    - Provides an overview of AI methods generally employed by the different types of hyper-heuristics.

5. Application of Hyper-Heuristics

    - Application of hyper-heuristics to combinatorial optimization problems
    - Combinatorial optimization domains that will be examined include educational timetabling, personnel scheduling and packing problems.

6. Theoretical Aspects

    - Why do hyper-heuristics work - a heuristic space vs. a solution space.
    - Hyper-heuristics and the no free lunch theorem.

7. Progression of the Field of Hyper-Heuristics

    - Development of the field since its inception
    - The cross-domain challenge
    - Future directions

Duration: 4 hours

Biography:

Nelishia Pillay is an Associate Professor in the School of Mathematics, Statistics and Computer Science at the University of KwaZulu-Natal. She holds a Phd in Computer Science from the University of KwaZulu-Natal. Her research areas include hyper-heuristics, combinatorial optimization, genetic programming, genetic algorithms and other biologically-inspired methods. She has published in these areas in journals, national and international conference proceedings. She has also established the NICOG (Nature Inspired Computing Optimization Group) and is a member of the IEEE Task Force on Hyper-Heuristics with the Technical Committee of Intelligent Systems and Applications at IEEE Computational Intelligence Society. She has served on program committees for numerous national and international conferences and is a reviewer for various journals.