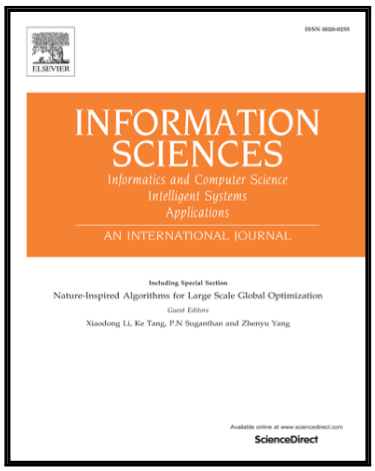

Optimal directed hypergraph traversal with ant-colony optimisation

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PII: S0020-0255(18)30676-5
DOI: https://doi.org/10.1016/j.ins.2018.08.058
Reference: INS 13902

To appear in: *Information Sciences*

Received date: 11 May 2018
Revised date: 13 July 2018
Accepted date: 25 August 2018

Please cite this article as: Marco Comuzzi, Optimal directed hypergraph traversal with ant-colony optimisation, *Information Sciences* (2018), doi: https://doi.org/10.1016/j.ins.2018.08.058

Optimal directed hypergraph traversal with ant-colony optimisation

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August 29, 2018

Abstract

Directed hypergraphs are an extension of directed graphs in which edges connect a set of source nodes to a set of target nodes. Unlike graphs, they can capture complex relations in network structures that go beyond the union of pairwise associations. They are widely applied in a variety of different domains, such as finding pathways in chemical reaction networks or minimising propositional Horn formulas. Calculating optimal paths in hypergraphs in the general case is an NP-hard problem, which can be solved in polynomial time only when utility functions hold specific properties. We present in this paper an approach to search for optimal hypergraph paths in the general case based on ant colony optimisation. Ant colony optimisation is an evolutionary meta-heuristic that is particularly suitable to combinatorial problems, such as optimal graph traversal. We present an experimental evaluation using artificially-generated hypergraphs and discuss innovative applications of the proposed approach in the domains of industrial engineering and chemical informatics.

1 Introduction

Recent advancements in computing and data storage technologies allow to collect enormous amounts of data to map and analyse relevant phenomena in science and engineering. Processing this massive amount of data may pose a challenge from a computational efficiency point of view, which can be addressed by either developing more efficient exact algorithms to solve the problems at hand or by devising appropriate computational intelligence techniques to achieve a reasonable computation runtime while maintaining a certain level of quality of the solutions found. In this paper, we propose a computational