

The Genetic Algorithm for Interoperability Cost Optimization: A Case Study of GIMAC Business Network

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Received 2 January 2025; Accepted (in revised version) 25 April 2025

Abstract. Interoperability cost analysis is a continuous trend in enterprise information systems. Researchers have made the most significant contributions in this field. The problem we address is to show how to optimize interoperability costs within a networked enterprise. To overcome this issue, we have used a genetic algorithm in which, the fitness function that we have defined is a new model for optimizing the interoperability cost. To show how organizations validate and verify the solutions obtained through interoperability cost analysis and what measures are taken to ensure the accuracy and reliability of the results, we have conducted a case study within a networked enterprise. The results of the interoperability cost analysis show that the inter-organizational business process studied is not adapted to the interoperable information system and does not allow the evolution of the network after a certain number of years.

AMS subject classifications: 05C50, 05C78, 65K10

Keywords: Genetic algorithm, interoperability cost analysis, model for optimizing interoperability cost, inter-organizational business process.

1 Introduction

Interoperability in socio-technical systems describes the ability of discrete and technically or organizationally heterogeneous systems to share services or resources with other systems [2]. The interoperability of information systems is defined as the ability of two or more information systems to interact based on multiple understandable requests initiated by useful web services which perform tasks of inter-organizational business processes, to achieve common goals defined by the networked enterprises. This collaboration is putting in place through an interoperable information system. With the rapid growth of industry, enterprises need to collaborate to improve their

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benefits and conquer new markets. This is done through the establishment of a set of partnerships for creating a networked enterprise. During the running time of the networked enterprises information systems for executing an inter-organizational business process, a lot of resources are consumed. This consumption of resources has a cost named: the overall cost of interoperability [3]. We consider that the overall cost of interoperability of information systems represents the total consumption of resources when the interoperation mechanism is carried out at the level of web services, which perform the tasks of an inter-organizational business processes in a network of enterprises, despite the environmental risks associated with their information systems. To improve the interoperability of information systems of networked enterprises in order to add a new partner to the network, the overall interoperability cost must be optimized for establishing and maintaining inter-enterprises collaboration. The optimization of the overall cost of interoperability is the issue that we intend to address in this paper. For that, in the second section we provide a set of basic definitions to clearly understand our work. Section 3 gives the problem description and the mathematical model. In Section 4, we describe the CostGA optimizer based on a genetic algorithm for interoperability cost optimization. In Section 5, we define the procedure of the program that runs inside the optimizer. Section 6: We conduct our case study, and we conclude our paper by the list of perspectives of our work.

2 Definitions

Genetic algorithm (GA) is an optimization algorithm that is inspired by natural selection and is a population-based search algorithm that utilizes the concept of survival of fittest [7]. The general principle behind genetic algorithms is to randomly select a population of individuals from a solution space. This population serves as candidate solutions for optimizing the given problem. The individuals in this population are evaluated using a fitness function. A selection mechanism is used to choose the individuals that will serve as parents for the next generation. These individuals are crossed and mutated to form an offspring. Finally, the next generation is formed by a learning mechanism combining the parent and child individuals. This procedure is repeated until a stopping condition is satisfied. In the next section, we provide the genetic algorithm basic concepts and the encoding schemes for most optimization problems.

2.1 Genetic algorithm concepts

Referring to the fact that a genetic algorithm is an algorithm inspired by the natural sciences, it is important to give a clear understanding of the concepts used like population, chromosome, individual, and gene, for solving a problem in another field different from computational science. So, a population is defined as a set of N individuals representing solutions to a given problem. Each individual can be represented by one or more chromosomes. When an individual is represented by a single chromosome,