



Potential of Swarm Intelligence in Big Data Analytics

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DESCRIPTION

Swarm intelligence is a set of search and optimization techniques. To search a problem domain, a swarm intelligence algorithm processes a population of individuals. Different from traditional single-point based algorithms such as hill-climbing algorithms, each swarm intelligence algorithm is a population-based algorithm, which consists of a set of points. Each individual represents a potential solution of the problem being optimized. The population of individuals is expected to have high tendency to move towards better and better solution areas iteration over iteration through cooperation and/or competition among themselves.

The big data is defined as the dataset whose size is beyond the processing ability of typical database or computers. Four objects are emphasized in the definition, which are capture, store, management, and analysis. The big data analytics is to automatically extract knowledge from large amounts of data. It can be seen as mining or processing of massive data, and useful information could be retrieved from large dataset. The properties of big data analytics can be concentrated in three parts: large volume, variety of different sources, and fast increasing speed, i.e., velocity. The algorithms should be effective to solve large-scale, dynamic big data analytics problems. The Knowledge Discovery in Databases (KDD) is the process of converting raw data into useful information. Data mining is the process that attempts to discover useful information in large data repositories. The data mining field includes many subfields, such as classification analysis, clustering analysis, and association analysis.

Big data can contain different types of unstructured or semi-structured data. This data needs to be converted to structured data. Some data attributes are converted to data features, so data examples are converted to vectors containing many features. The dimensions of the feature space correspond to the number of different attributes that can be displayed in the dataset. This shows that the dimensions of big data analysis problems are much larger than the dimensions of traditional problems. Data clustering techniques can also be applied to swarm intelligence.

The brainstorming optimization algorithm distributes each solution to the search space. Distributing the solution can be used

to clarify the situation of the problem. Search results can be obtained from the solution's clustering analysis.

Swarm intelligence in big data analytics

Data mining has been a popular academic topic in computer science and statistics for decades, swarm intelligence is a relatively new subfield of Computational Intelligence (CI) which studies the collective intelligence in a group of simple individuals. In the swarm intelligence, useful information can be obtained from the competition and cooperation of individuals.

In general, there are two types of approaches that use swarm intelligence as a data mining technique. The first category consists of how individuals in a herd move through the solution space in search of solutions for data mining tasks. This is a search approach. Swarm intelligence is used to optimize data mining techniques e.g., parameter adjustment. In the second category, swarms move data instances laced in a lower dimensional feature space to reach the appropriate clustering or lower dimensional mapping solution for the data. This is a data organization approach. Swarm intelligence is applied directly to the data sample e.g., data dimensionality reduction.

Swarm intelligence, especially particle swarm optimization or ant colony optimization algorithms, is utilized in data mining to solve single objective and multi-objective problems. Based on the two characters of particle swarm, the self-cognitive and social learning, the particle swarm has been utilized in data clustering techniques, document clustering, variable weighting in clustering high-dimensional data, semi-supervised learning based text categorization, and the web data mining.

In a swarm intelligence algorithm, there are several solutions exist at the same time. The premature convergence may happen due to the solution getting clustered together too fast. However, the solution clustering is not always harmful for optimization. In a brain storm optimization algorithm, the clustering analysis is utilized to reveal the landscapes of problems and to guide the individuals to move toward the better and better areas. Every individual in the brain storm optimization algorithm is not only a solution to the problem to be optimized, but also a data point to reveal the landscapes of the problem.

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