New Supervised Approach for Plant Leaves Classification using Artificial Social Bees

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ABSTRACT

Life is based on plants. They are the major source of oxygen, food, and medicines. And biology is one of the major research in last years, but scientists don’t stop on studying the biological life and understanding different mechanisms in life, they go further by inspiring from it, as organization on bee colony. This last is very impressive, especially in workplace. This work presents a new approach of supervised plant leaves classification using a meta-heuristic algorithm based on social bees. First, the authors used to represent leaves using three different features extracted from images: a fine-scale margin feature histogram, a Centroid Contour Distance Curve shape signature, or an interior texture feature histogram. Then the authors classified vectors by artificial social bees, and they evaluated the classification by its accuracy and error.

KEYWORDS

Bio-Inspired, Meta-Heuristic, Plants Leaves Classification, Social Bees, Supervised Classification

INTRODUCTION

For all forms of life, plants form the basic food staples, and this is just one reason why plants are important. They are the major source of oxygen and food on earth since no animal is able to supply the components necessary without plants. The fish we eat consume algae and the cattle we eat as beef feed on grass, so even if you are not a fan of salads, your food source relies on plants. Plants also provide animals with shelter, produce clothing material, medicines, paper products, reduce noise levels and wind speed, reduce water runoff and soil erosion. Coal is also produced from plant materials that were once alive. All that gives plants its important role in life on earth. For example, as natural resource managers, they must understand what they manage, and plant identification is a key component of that understanding. The ability to know, or identify plants allows them to assess many important rangeland or pasture variables that are critical to proper management: range condition, proper stocking rates, forage production, wildlife habitat quality, and rangeland trend, either upward or downward. Natural resource managers, especially those interested in grazing and wildlife management must be able to evaluate the presence or absence of many plant species in order to assess these variables.

In nature, plant leaves are two dimensional containing important features that can be useful for classification of various plant species such as shapes, colours, textures and structures of their leaf, bark, flower, seedling and morph. According to Bhardwaj and al (Bhardwaj, 2013), if the plant classification is based on only two dimensional images, it is very difficult to study the shapes of flowers, seedling and morph of plants because of their complex three dimensional structures.

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Biology is a very large domain, it contains a lot of sub-disciplines, and physiology of human body is one, with the big number of complex mechanisms that help life keep going. Understanding of these mechanisms is a principal source to inspire different algorithms and solution for problems in technology era.

The presented work proposes a bio-inspired algorithm for supervised classification, it applied for a multi-class problem to classify plant leaves, with different representations of it based on its Margin, Shape, and Textures; The organization of this paper is given as follows: section 2 provides a state of the art speaking first about bio inspired algorithms, section 3 gives details about the biological aspect of social bees colony, section 4 describe the artificial aspect of that. Used dataset, and discussion of the results will be shown in section 5 and comparison with classical methods, and finally in section 6 gives the overall conclusion and the scope for future research.

STATE OF THE ART

Machine Learning

Data mining is the core stage of the knowledge discovery process that is aimed at the extraction of interesting—nontrivial, implicit, previously unknown and potentially useful—information from data in large databases (Fayyad, Piatetsky-Shapiro, & Smyth, 1996). The relation between machine learning and data mining is summarized in “each one is a part of the other one”. Machine learning focuses on prediction, based on known properties learned from the training data. Data mining focuses on the discovery of (previously) unknown properties in the data. This is the analysis step of Knowledge Discovery in Databases.

Machine learning techniques devided to many types: association rules, clustering (unsupervised learning), regression, and supervised learning. This last requires manually etiqueted training data, it means, it requires a qualitative attribut that has a finite values that present the final decision for each example. One of the most known supervised algorithms, we find K nearest neighbour (K-NN). It is based on distance calculation to measure similarities among training data and new examples. By initialising the number K, K-NN looks for the most K similar examples in training data to a new example and classify it as the maximum class found in the K examples.

Bio Inspired and Meta Heuristic

In 21st century became NP-hard problems era, this kind of problems took a large space in research areas. Researchers work and invent a lot of solutions for these problems. Biologically Inspired Computation is one of the areas. It is computation inspired by biological metaphor, also referred to as Bio-mimicry, and Bio-memetics in other engineering disciplines. The intent of this field is to devise mathematical and engineering tools to generate solutions to computation problems. The field involves using procedures for finding solutions abstracted from the natural world for addressing computationally phrased problems. In following, we describe some known bio-inspired techniques:

- Tabu Search: It is based on saving specific changes of recent random moves within the search space in short memory, this strategy allows to prevent future moves from undoing those changes.
- The Genetic Algorithm is inspired by population genetics (including heredity and gene frequencies), and evolution at the population level. It belongs to Evolutionary algorithms. And it is based on three main steps: initialisation, where it generate randomly a population from the population size; During each successive generation, a proportion of the existing population is selected to breed a new generation in selection step; then it generate a new population of solutions from those selected in previous step through a combination of genetic operators, this step is called crossover and mutation; all mentioned steps are repeated until stop criterion is reached.
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