

Automatic Feature Selection for Named Entity Recognition Using Genetic Algorithm

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ABSTRACT

This paper presents a feature selection approach for named entity recognition using genetic algorithm. Different aspects of genetic algorithm including computational time and criteria for evaluating an individual (i.e., size of the feature subset and the classifier's accuracy) are analyzed in order to optimize its learning process. Two machine learning algorithms, k-Nearest Neighbor and Conditional Random Fields, are used to calculate the accuracy of the named entity recognition system. To evaluate the effectiveness of our genetic algorithm, feature subsets returning by our proposed genetic algorithm are compared to feature subsets returning by a hill climbing algorithm and a backward one. Experimental results show that feature subsets obtained by our genetic algorithm is much smaller than the original feature set without losing of predictive accuracy. Furthermore, these feature subsets result in higher classifier's accuracies than that of the hill climbing algorithm and the backward one.

Categories and Subject Descriptors

G.2.1 [Combinatorics] - *Combinatorial algorithms, Counting problems*

General Terms

Algorithms, Measurement, Performance, Design, Reliability, Experimentation, Languages, Theory.

Keywords

Optimizing, genetic algorithm, feature selection, named entity recognition.

1. INTRODUCTION

Named Entity Recognition (NER) is the task of locating and classifying atomic elements in text into predefined categories (e.g., people, organizations, locations, expressions of time, quantities, etc.). NER is useful in many applications such as search engine, question-answering system, etc.

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Most NER's systems concentrate on machine learning approaches, whose performance relies on features being used. Selecting a subset of good features is an optimization problem of multiple objectives, such as number of features and accuracy. Using a small feature subset requires less computational time than using a larger one. However, the system's accuracy is lower than using a larger, suitable set of features. Another problem is, using more features increases the system complexity, but does not always increase the system's accuracy. A bad feature may even degrade the performance of the system. Most machine learning approaches for NER determine the features manually. In this paper, we propose a genetic algorithm (GA) to automatically select a minimal subset of features that can produce high accuracy for the NER system. Different aspects are discussed in order to optimize the GA learning process.

The rest of this paper is organized as follows. Section 2 introduces related work of feature selection using GA and the contribution of this paper. Section 3 describes our approach to apply GA in optimizing the set of features for NER system. Experimental results are discussed in Section 4. Finally, Section 5 concludes the paper and indicates some future research directions.

2. RELATED WORK

Feature selection is the process of selecting an optimal subset from original features. In a NER system, an optimal subset of features is the smallest subset that most contribute towards accuracy. The smaller size of the feature subset is, the faster the NER system runs. However, the size of feature's subsets is not proportional with the accuracy. Therefore, this is an optimization problem of multiple objectives.

Carrying out an exhaustive search in the feature space has a high computational cost, since the total search space for M features is 2^M , which is a NP-hard problem. Therefore, heuristic search is often used to deal with this problem.

Two approaches often used in single solution are forward selection [15,16] and backward selection [1,8]. The forward selection starts with no feature in the model. It tests the addition of each feature using a chosen model comparison criterion and adding the feature (if any) that improves the model the most. This process repeats until none improves the model. The backward selection starts with all candidate variables. It tests the deletion of each variable using a chosen model comparison criterion and deleting the variable (if any) that improves the model the most by being deleted. This process repeats until no further improvement is possible. The disadvantage of these strategies is, the searching process cannot go back to previous features. Therefore, if a

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Neural Information Processing Sabri Arik, Tingwen Huang, Weng Kin Lai, Qingshan Liu, 2015-11-21 The four volume set LNCS 9489 LNCS 9490 LNCS 9491 and LNCS 9492 constitutes the proceedings of the 22nd International Conference on Neural Information Processing ICONIP 2015 held in Istanbul Turkey in November 2015 The 231 full papers presented were carefully reviewed and selected from 375 submissions The 4 volumes represent topical sections containing articles on Learning Algorithms and Classification Systems Artificial Intelligence and Neural Networks Theory Design and Applications Image and Signal Processing and Intelligent Social Networks

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and learning theory school teachers and other professionals in the learning industry and further and continuing education

Advances in Body Area Networks I Giancarlo Fortino,Zhelong Wang,2018-12-29 This book presents the post proceedings including all revised versions of the accepted papers of the 2017 European Alliance for Innovation EAI International Conference on Body Area Networks BodyNets 2017 The goal of BodyNets 2017 was to provide a world leading and unique forum bringing together researchers and practitioners from diverse disciplines to plan analyze design build deploy and experiment with on Body Area Networks BANs 10th International Conference on Practical Applications of Computational Biology & Bioinformatics Mohd Saberi Mohamad,Miguel P. Rocha,Florentino Fdez-Riverola,Francisco J. Domínguez Mayo,Juan F. De Paz,2016-05-31 Biological and biomedical research are increasingly driven by experimental techniques that challenge our ability to analyse process and extract meaningful knowledge from the underlying data The impressive capabilities of next generation sequencing technologies together with novel and ever evolving distinct types of omics data technologies have put an increasingly complex set of challenges for the growing fields of Bioinformatics and Computational Biology The analysis of the datasets produced and their integration call for new algorithms and approaches from fields such as Databases Statistics Data Mining Machine Learning Optimization Computer Science and Artificial Intelligence Clearly Biology is more and more a science of information requiring tools from the computational sciences In the last few years we have seen the surge of a new generation of interdisciplinary scientists that have a strong background in the biological and computational sciences In this context the interaction of researchers from different scientific fields is more than ever of foremost importance boosting the research efforts in the field and contributing to the education of a new generation of Bioinformatics scientists PACBB 16 hopes to contribute to this effort promoting this fruitful interaction PACBB 16 technical program included 21 papers spanning many different sub fields in Bioinformatics and Computational Biology Therefore the conference will certainly promote the interaction of scientists from diverse research groups and with a distinct background computer scientists mathematicians biologists The scientific content will certainly be challenging and will promote the improvement of the work being developed by each of the participants *Social Computing with Artificial Intelligence* Xun Liang,2020-09-16 This book provides a comprehensive introduction to the application of artificial intelligence in social computing from fundamental data processing to advanced social network computing To broaden readers understanding of the topics addressed it includes extensive data and a large number of charts and references covering theories techniques and applications It particularly focuses on data collection data mining artificial intelligence algorithms in social computing and several key applications of social computing application and also discusses network propagation mechanisms and dynamic analysis which provide useful insights into how information is disseminated in online social networks This book is intended for readers with a basic knowledge of advanced mathematics and computer science *Collaborative Computing: Networking, Applications and Worksharing* Honghao Gao,Xinheng Wang,2022-01-01 This two volume set constitutes the

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