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 systems, 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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Automatic Feature Selection For Named Entity Recognition:

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 *Bootstrapping Named Entity Annotation by Means of Active Machine Learning* Fredrik Olsson,2008 On the development of a method called BootMark for bootstrapping the marking up of named entities in textual documents **Advances in Computational Collective Intelligence** Marcin Hernes,Krystian Wojtkiewicz,Edward Szczerbicki,2020-11-20 This book constitutes refereed proceedings of the 12th International Conference on International Conference on Computational Collective Intelligence ICCCI 2020 held in Da Nang Vietnam in November December 2020 Due to the the COVID 19 pandemic the conference was held online The 68 papers were thoroughly reviewed and selected from 314 submissions The papers are organized according to the following topical sections data mining and machine learning deep learning and applications for industry 4 0 recommender systems computer vision techniques decision support and control systems intelligent management information systems innovations in intelligent systems intelligent modeling and simulation approaches for games and real world systems experience enhanced intelligence to IoT data driven IoT for smart society applications of collective intelligence natural language processing low resource languages processing computational collective intelligence and natural language processing *Knowledge Graphs and Semantic Web* Boris Villazón-Terrazas,Fernando Ortiz-Rodriguez,Sanju Tiwari,Miguel-Angel Sicilia,David Martín-Moncunill,2022-11-12 This book constitutes the proceedings of the 4th Iberoamerican Conference and third Indo American Conference on Knowledge Graphs and Semantic Web KGSWC 2022 which took place in Madrid Spain in November 2022 The 22 full and 3 short research papers presented in this volume were carefully reviewed and selected from 63 submissions The papers cover topics related to software and its engineering software creation and management Emerging technologies Analysis and design of emerging devices and systems Emerging tools and methodologies and others Collaborative Computing: Networking, Applications and Worksharing Honghao Gao,Xinheng Wang,2022-01-01 This two volume set constitutes the refereed proceedings of the 17th International Conference on Collaborative Computing Networking Applications and Worksharing CollaborateCom 2021 held in October 2021 Due to COVID 19 pandemic the conference was held virtually The 62 full papers and 7 short papers presented were carefully reviewed and selected from 206 submissions The papers reflect the conference sessions as follows Optimization for Collaborate System Optimization based on Collaborative Computing UVA and Traffic system Recommendation System Recommendation System Network and Security Network and Security IoT and Social Networks

Images handling and human recognition Edge Computing Edge Computing Collaborative working Deep Learning and application Deep Learning and application Deep Learning and application UVA **Genetic and Evolutionary Computing** Jeng-Shyang Pan,Jerry Chun-Wei Lin,Yongquan Liang,Shu-Chuan Chu,2020-03-12 This book gathers papers presented at the 13th International Conference on Genetic and Evolutionary Computing ICGEC 2019 which was held in Qingdao China from 1st to 3rd November 2019 Since it was established in 2006 the ICGEC conference series has been devoted to new approaches with a focus on evolutionary computing Today it is a forum for the researchers and professionals in all areas of computational intelligence including evolutionary computing machine learning soft computing data mining multimedia and signal processing swarm intelligence and security The book appeals to policymakers academics educators researchers in pedagogy 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 **Proceedings of the 2023**

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Table of Contents Automatic Feature Selection For Named Entity Recognition

1. Understanding the eBook Automatic Feature Selection For Named Entity Recognition
    - The Rise of Digital Reading Automatic Feature Selection For Named Entity Recognition
    - Advantages of eBooks Over Traditional Books
2. Identifying Automatic Feature Selection For Named Entity Recognition
    - Exploring Different Genres
    - Considering Fiction vs. Non-Fiction
    - Determining Your Reading Goals
3. Choosing the Right eBook Platform
    - Popular eBook Platforms
    - Features to Look for in an Automatic Feature Selection For Named Entity Recognition
    - User-Friendly Interface
4. Exploring eBook Recommendations from Automatic Feature Selection For Named Entity Recognition
    - Personalized Recommendations
    - Automatic Feature Selection For Named Entity Recognition User Reviews and Ratings
    - Automatic Feature Selection For Named Entity Recognition and Bestseller Lists

5. Accessing Automatic Feature Selection For Named Entity Recognition Free and Paid eBooks
    - Automatic Feature Selection For Named Entity Recognition Public Domain eBooks
    - Automatic Feature Selection For Named Entity Recognition eBook Subscription Services
    - Automatic Feature Selection For Named Entity Recognition Budget-Friendly Options
6. Navigating Automatic Feature Selection For Named Entity Recognition eBook Formats
    - ePub, PDF, MOBI, and More
    - Automatic Feature Selection For Named Entity Recognition Compatibility with Devices
    - Automatic Feature Selection For Named Entity Recognition Enhanced eBook Features
7. Enhancing Your Reading Experience
    - Adjustable Fonts and Text Sizes of Automatic Feature Selection For Named Entity Recognition
    - Highlighting and Note-Taking Automatic Feature Selection For Named Entity Recognition
    - Interactive Elements Automatic Feature Selection For Named Entity Recognition
8. Staying Engaged with Automatic Feature Selection For Named Entity Recognition
    - Joining Online Reading Communities
    - Participating in Virtual Book Clubs
    - Following Authors and Publishers Automatic Feature Selection For Named Entity Recognition
9. Balancing eBooks and Physical Books Automatic Feature Selection For Named Entity Recognition
    - Benefits of a Digital Library
    - Creating a Diverse Reading Collection Automatic Feature Selection For Named Entity Recognition
10. Overcoming Reading Challenges
    - Dealing with Digital Eye Strain
    - Minimizing Distractions
    - Managing Screen Time
11. Cultivating a Reading Routine Automatic Feature Selection For Named Entity Recognition
    - Setting Reading Goals Automatic Feature Selection For Named Entity Recognition
    - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Automatic Feature Selection For Named Entity Recognition
    - Fact-Checking eBook Content of Automatic Feature Selection For Named Entity Recognition
    - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends
    - Integration of Multimedia Elements
    - Interactive and Gamified eBooks

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