

# 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.

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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## **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

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  - 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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