

# Automatic Feature Selection for Named Entity Recognition Using Genetic Algorithm

Huong Thanh Le  
Hanoi University of Science and Technology  
Hanoi, Vietnam  
huonght@soict.hut.edu.vn

Luan Van Tran  
Hanoi University of Science and Technology  
Hanoi, Vietnam  
tranvanluan7@gmail.com

## 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

# Automatic Feature Selection For Named Entity Recognition

**Sabri Arik, Tingwen Huang, Weng Kin Lai, Qingshan Liu**

## **Automatic Feature Selection For Named Entity Recognition:**

## Unveiling the Energy of Verbal Art: An Mental Sojourn through **Automatic Feature Selection For Named Entity Recognition**

In a global inundated with monitors and the cacophony of immediate conversation, the profound energy and emotional resonance of verbal beauty often fade into obscurity, eclipsed by the constant assault of noise and distractions. However, situated within the musical pages of **Automatic Feature Selection For Named Entity Recognition**, a fascinating work of fictional elegance that impulses with fresh emotions, lies an remarkable journey waiting to be embarked upon. Composed by a virtuoso wordsmith, this mesmerizing opus instructions viewers on a psychological odyssey, lightly revealing the latent potential and profound impact stuck within the complicated web of language. Within the heart-wrenching expanse of the evocative analysis, we will embark upon an introspective exploration of the book is key styles, dissect its captivating writing fashion, and immerse ourselves in the indelible effect it leaves upon the depths of readers souls.

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