Abstract

Recently, automatic sentence generation by the computer has become an important topic of natural language processing field. However, it is difficult for computer to generate human-like sentences because computer cannot evaluate the quality of sentences. To introduce the human evaluation results into computers, Interactive Evolutionary Computation (IEC) has been proposed and reported lots of applications for design fields. In this paper, we proposed a novel interface of IEC for automatic sentence generation. To apply IEC for automatic sentence generation, 2-dimensional map type interface is helpful because human evaluates sentences by different type of features. We also created the GUI system of automatic sentences generation to confirm the effectiveness of proposed interface.

Keywords: Interactive evolutionary Computation, Mushroom Produce Atelier, 2-dimensional Map Type Interface

1 Introduction

Recently, automatic sentence generation by the computer has become an important topic of natural language processing field. It is becoming possible to generate short sentences or fix phrases automatically, but still difficult for computer to generate long story. It is also difficult to generate a short sentence with considering human preference because there is no criteria to evaluate sentence quantitatively. One of the most important point is that we feel differently about even seeing same sentence. In order to solve this problem, the novel evolutionary computation (EC) technique called Interactive Evolutionary Computation (IEC) [1] [2] [3] has been proposed and applied to fields such as design and music. IEC evaluates individuals of EC based on human evaluation. We use IEC for automatic sentence generation because IEC is powerful method to estimate human preference or sense. However, there exists a problem that users could not tried huge number of trials in selection phase of EC to reflect their preference.

In this paper, we proposed a novel interface of IEC for automatic sentence generator in order to estimate human preference in details. The proposed interface has two evaluation axis in 2-dimensional map. We can set the meaning of these axis such as positive/negative or formal/informal according to the target problem. We show the effectiveness of proposed interface by means of our automatic sentence generation system called “Namekoubou” (Mushroom Produce Atelier) [4].

We describe the outline of EC and IEC in section 2, and explain the outline of our proposed automatic explanation generator called Namekoubou in section 3. In section 4, we explain the setting of IEC. In section 5, we propose a novel interface of IEC, and show the experiment results in section 6. Finally, we conclude the paper in section 7.

2 Evolutionary Computation

Evolutionary Computation (ECs) are a search and optimization technique based on the mechanism of evolution. The Genetic Algorithm (GA) is one of the popular EC and have been researched in various fields. ECs have three main genetic operators called crossover, selection and mutation for search.

2.1 Interactive Evolutionary Computation

Interactive Evolutionary Computation (IEC) [1] [2] [3] is one of the interesting branch of EC. IEC decides individual’s fitness by human evaluation to solve the problem like music or CG art. IEC is expected to solve the problem with human emotion or sensitivity by user’s evaluations.
2.2 Applications of IEC
IEC is often applied to various fields such as design and music where evaluation strongly depends on user’s emotion. There have been reported lots of researches of IEC such as CG composition [5], creation of portrait [6] and GenJam which is a system evolving jazz [7]. However, there is few research of applying IEC to problem of natural language processing field.

2.3 Problems of IEC
To apply IEC for problems of human preference or sense, human interface for IEC selection is essential to obtain good results. In this paper, we try to estimate multi-objective human preferences in order to reflect detail human preferences to IEC evolution process.

3 Sentence Generation
Recently, lots of study have been reported about automatic sentence generation. However, to create a long story by computer has been still quite difficult because computer is hard to maintain the logical consistency of background of the whole story. Therefore, we focus on the short sentence of explanation under the specific situation.

3.1 Mushroom Produce Atelier
We focused on the popular smartphone application named “Touch Detective Mushroom Garden” and have proposed *Mushroom Produce Atelier* (Japanese title Namekoubou) [4] which can create the name and explanation of a new mushroom character based on the user’s input keyword. The produced explanation has only 1 sentence, and accepts surrealistic contents in order to reduce the difficulty of maintaining the logical consistency.

3.2 Outline
Figure 1 shows the outline of *Mushroom Produce Atelier*. User inputs a favorite noun to the system, then *Mushroom Produce Atelier* produces the name and explanation of new character related to input word automatically.

3.2.1 Human Evaluation
*Mushroom Produce Atelier* (MPA) makes several candidate sentences and user can select their favorite one. Current evaluation interface is the one slider bar to decide the fitness value of sentences. However, lots of user would like to input not only fitness but another features in this selection process. This is the one of the biggest problem of MPA.

4 Setting of IEC
In this section, we show the setting of IEC in MPA.

4.1 Individual
In this study, IEC individual represents a sentence of certain mushroom. Each individual is created by combining the sentence template and specific word. Followings are the example of templates.

- Mushroom who loves W.
- Is he W? No... he is also mushroom...

,where W is a specific word decided by the relation to user’s input keyword by means of the wikipedia thesaurus. We made 100 templates before simulation and assign randomly to all individuals in the initial population. Figure 2 shows the genotype of individual in this study.
4.2 Fitness

Proposed interface can represent 2-objective fitness value $f_\alpha$ and $f_\beta$ are defined as follows.

\[ f_\alpha = 0.2f_y + 1.6f_yf_x \]  
\[ f_\beta = 0.2f_y + 1.6f_y(1 - f_x) \]

Where, $f_x$ means a evaluation value obtained from $x$ axis and $f_y$ means a evaluation value obtained from $y$ axis, explained in section 5.

4.3 Genetic Operator

4.3.1 Mutation

In current setting, both related word $W$ and sentence template are the target of mutation. Alleles of sentence template are 100 sentence templates made before simulation, and alleles of $W$ are about 60 words from the related words of the input keyword by wikipedia thesaurus and wordnet. If we get $n < 60$ related words, the number of alleles is set to $n$.

4.3.2 Crossover

We create 2 individuals from 2 parents by one point crossover. Here, we represent 2 offsprings by $A$ and $B$. We choose a only 1 offspring with probability $P(A)$ and $P(B)$ from $A$ and $B$. $P(A)$ is the probability that individual $A$ is selected in this procedure. $P(A)$ and $P(B)$ are defined as follows.

\[ P(A) = \frac{2|f_A - f_B| + 1}{2} \]  
\[ f_A = \frac{f_{A\alpha} + f_{A\beta}}{2} \]  
\[ P(A) + P(B) = 1 \]

Where, $f_{A\alpha}$ means $f_i$ of individual $A$.

5 Proposed Interface

Evaluation of sentence is multi-objective problem. Some user may focus on words, and the other may select according to the template. The followings are the example of important objective functions of sentence.

- Total impression
- Sentiment of words
- Unpredictability

However, our previous system only consider the total fitness and can not evaluate other features of sentences. To solve this problem, we introduce 2-D map type interface for IEC. User only put a individual on adequate place to reflect their preference. User can easily change the type of axis. The result is feedback to setting of IEC genetic operators. Current version tried to evaluate words and templates separately, and result is reflected to parameters of mutation and crossover. There have been proposed several research about IEC interface such as making user model in computer or mapping all objective function space into 2-D plane. In this study, we proposed a novel interface of IEC for sentence generation. Figure 3 shows the example of proposed interface. We can evaluate each individual by arranging on 2-D map. The location of each icon on 2-D map represents fitness.

6 Computer Experiment

6.1 Experiment Method

To confirm the effectiveness of proposed method, computer simulation is carried out. Table 1 shows parameters of the IEC. We compared proposed method with previous version. Processes of the experiment is following:
Table 1. Parameters of the IEC

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Size</td>
<td>6</td>
</tr>
<tr>
<td>Crossover Rate</td>
<td>1.0</td>
</tr>
<tr>
<td>Mutation Rate (word)</td>
<td>1.0 - (f_\alpha)</td>
</tr>
<tr>
<td></td>
<td>1.0 - (f_\beta)</td>
</tr>
<tr>
<td>Selection Type</td>
<td>Roulette, Elitism</td>
</tr>
<tr>
<td>Number of Subjects</td>
<td>11</td>
</tr>
</tbody>
</table>

\(f_\alpha\) and \(f_\beta\) are obtained from user’s action on selection phase and both range are [0, 1].

![Image of a graph showing which interface could reflect your opinion to sentences?](image)

**Figure 4. Experiment Results**

1. A user tries MPA with previous interface to create a favorite sentence.
2. A user tries MPA with the proposed interface to create favorite sentence.
3. A user fills out a questionnaire about interactive process of MPA.

### 6.2 Experiment Results

Figure 4 shows the results of a questionnaire that “Which interface could reflect your opinion to sentences?”. This result shows that the proposed interface can reflect user’s opinion to sentences more than normal one. Therefore, we can search solution more efficiently than ever before.

### 7 Conclusion

In this paper, we proposed a novel 2-D map type IEC interface for automatic sentence generation system called *Mushroom Produce Atelier*. We showed the basic concept and GUI outline of the proposed interface. We explained that users can evaluate sentences subjectively by the proposed interface. Creating general sentences is important further study.

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### References


