An Improved Approach for Word Ambiguity Removal

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Abstract

Word ambiguity removal is a task of removing ambiguity from a word, i.e. correct sense of word is identified from ambiguous sentences. This paper describes a model that uses Part of Speech tagger and three categories for word sense disambiguation (WSD). Human Computer Interaction is very needful to improve interactions between users and computers. For this, the Supervised and Unsupervised methods are combined. The WSD algorithm is used to find the efficient and accurate sense of a word based on domain information. The accuracy of this work is evaluated with the aim of finding best suitable domain of word.

Keywords: Human Computer Interaction, Supervised Training, Unsupervised Learning, Word Ambiguity, Word sense disambiguation.

1. INTRODUCTION

Sometimes people are facing problems in understanding correct meaning of the sentence. Since, sentence comprised of ambiguous words. In such case, correct meaning is taken by the context of the sentence. Usually, it is found in English language. In other words, we can say that context uniquely identifies meaning of the sentence. Based on this interpretation the ambiguity of word, known as lexical ambiguity is disambiguated; which is called as a process of WSD. Manual method of meaning extraction uses approach of searching words correct meaning in typical or online dictionaries which had several drawbacks.

 To resolve an ambiguity in a sentence, natural language processing provides word sense disambiguation which governs a sentence in which the sense of a word or meaning is used, when the word has multiple meanings (polysemy). WSD is a process which identifies the correct sense of a word with the help of surrounding words in a sentence. The correct sense of a word is obtained from the context of the sentence. a different meaning of the single word is associated in each sentence based on the context, the remaining sentence gives us. Thus, if the word imagination appears near the word play, we can say that it is related to free_time and not related to a sport which is known as local context. Computers that read words, one at a time must use word sense disambiguation process for finding the correct meaning (sense) of a word. A disambiguation process requires a dictionary in which senses are to be specified and disambiguated. For identifying the correct sense of the word the 'WordNet' domain is used. A domain consists of different syntactic categories of synsets. It groups senses of the same word into uniform clusters, with the effect of reducing word polysemy in WordNet. WordNet domain provides semantic domain as a natural way to establish semantic relations among word senses. This functionality is used in creation of MySQL database. The system for disambiguation of ambiguity in a sentence aims to identify domain of intended sense of word. Basically, input provided to the system is a sentence with ambiguous words and the output is identified as domain of word.
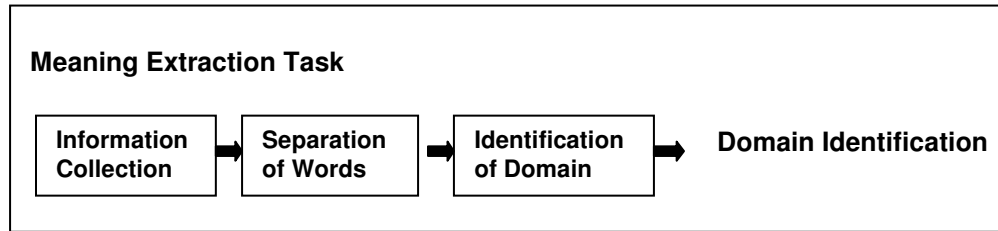
FIGURE 1 Context based meaning extraction task

2. LITERATURE SURVEY

For Word sense disambiguation, the first attempt effectively used by Michael E. Lesk was based on the Dictionary approach [1]. The problem with this algorithm is that, it defines context in a more complex way which is overcome by Simplified Lesk algorithm [2]. It can be effectively used with the WordNet lexical database. Such an attempt is made at Indian Institute of Technology, Bombay [3] and the results are promising. Navigili [4] had found that the right sense for a given word amounts to identifying the most "important" node among the set of graph nodes representing its senses. Ling Che Yangsen and Zhang [5] described a general framework for domain adaptation which contained instance pruning and weighting and the training instance augmentation. Agirre [6] described a thorough overview of the current WSD techniques and performance of systems on data sets, as well as a brief history of the field and some truly insightful discussions on potential developments. In [7] we find the most general and well-known attempt to utilize information in machine-readable dictionaries for WSD, that of Lesk , which computes a degree of overlap—that is, number of shared words--in definition texts of words that appear in a ten-word window of context.

3. SYSTEM MODEL

The system model has five stages:
POS Tagger
An English sentence with ambiguous words is given as an input to the project. From the sentence, content words are extracted and tagged by POS tagger [6, 7, 8] [22].
Distribute Domain
Then domains are distributed to Content words from the WordNet Domains which maintains domain distribution table [3, 4, 5] [22].
Pick the Target Word
The target word is selected by comparing WordNet, available domain and the domain of target word is displayed.
Identification of Domain
The accurate domain of the target word is identified by supervised and unsupervised training [1] [2] [22].
Obtain Sense of Word
The sense of target word belonging to the domain is obtained which is added to the domain distribution table i.e. the table is updated using supervised and unsupervised training [4].
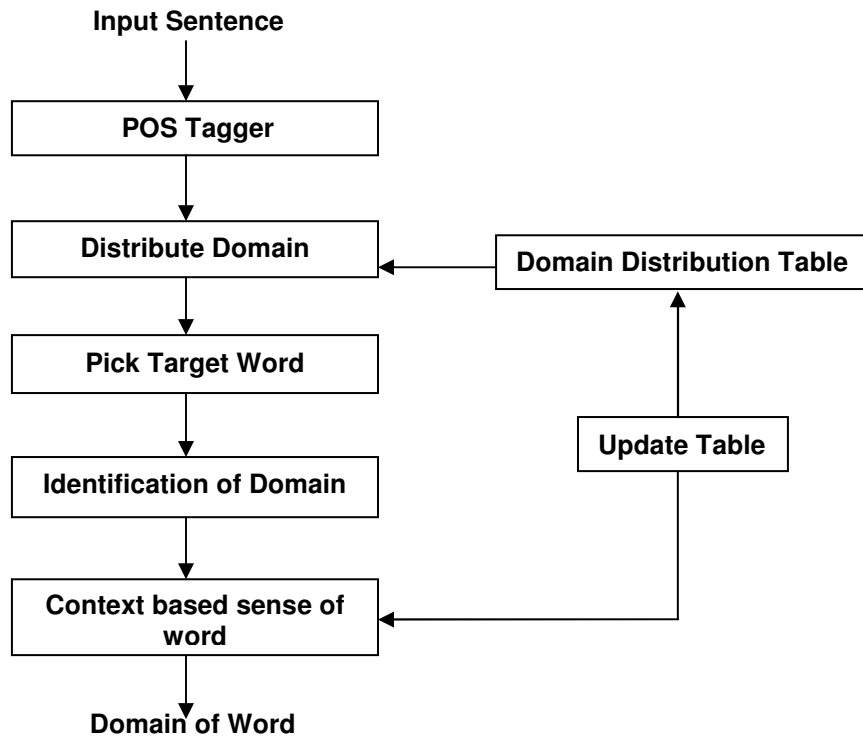
Input Sentence

POS Tagger

Distribute Domain ← **Domain Distribution Table**

Pick Target Word

Update Table

Identification of Domain

Context based sense of word

Domain of Word

FIGURE 2 System Model

4. WSD ALGORITHM

This algorithm is used in supervised and unsupervised training method and gives better performance than graph based algorithm. [13].It has following steps:
Step1: Create a database which can store the words and their meanings.

ID	field	ID	Word	ID	Word	FieldID
1	Computer	70	is	441	diving	2
2	Sports	71	the	442	racing	2
3	Medical	72	was	443	athletics	2
4	Engineering	73	that	444	wrestling	2
5	Factotum	74	on	445	boxing	2
6	History	75	of	446	fencing	2
7	Geography	76	for	447	archery	2
8	Games	77	where	448	fishing	2
9	Law	78	how	449	hunting	2
10	Biomedical	79	when	450	bowling	2

TABLE 1: Fields Table **TABLE 2:** General Words Table **TABLE 3:** Meanings Table

The three tables are created as fields, general words and meanings. TABLE 1 shows fields table in which ID and Domain name is stored. An ID is assigned to respective domain name. TABLE 2 shows General words table in which ID and general words are stored after separation of words. TABLE 3 shows Meanings table in which ID, words and respective domain ID assigned to words are stored. A unique ID and FieldID are assigned to the word which belonging to correct domain name.

Step 2: Separate the content words from the sentence using Part -of- Speech tagging (POS) process. This process is used for identification of words as nouns, verbs, adjectives, adverbs, etc, since it is used to tag or mark the text [11]. FIGURE 3 shows tags which are used to mark the content words and their separation. The separation is done with the help of Penn Treebank Tagset of Part of Speech tagging process which is shown in FIGURE 3 and FIGURE 4.

Example:

Play the stock market.

Tag	Description(Penn Treebank Tagset)
DTR	Determiner
NN	Noun,Singular or mass
VBD	Verb,Past tense
VBG	Verb present participle
NNS	Noun,plural

FIGURE 3 Penn Treebank Tagset

The |DTR fisherman |VBD went |VBG to |the |NN bank |NN.|.

Fisherman   went   bank
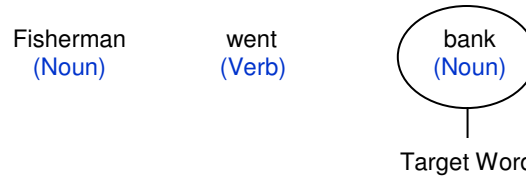(Noun)   (Verb)   (Noun)

Target Word

FIGURE 4 Example of POS Tagger Process

Step 3: Decompose the separation of sentence into three categories as C1, C2 and C3 for finding results i.e. displaying correct domain of word. In step 3, various comparisons are performed to find correct domain of words. It is required to detect correct sense of word with the help of most suitable domain for a word using various algorithms and finally the meaning of a sentence.

Fisherman (noun sense)	Fisherman (noun sense)	Went (verb sense)	Bank (noun sense)		Factotum
Went (verb sense)	Profession	Factotum	Factotum		Economy
Bank (noun sense)			Economy		Nature
			Nature		

C1   C2   C3

FIGURE 5 Contents of Category C1, C2 and C3

Step 4: Supervised training module to check if the given category of words are properly processed or not. In step 2, if the inputted sentence domain displayed by the system is free_time. But this may be a wrong domain if the context based meaning is considered. According to the context, domain of play is Commerce. Since stock market is whose work is related to Commerce.

In this case, supervised training is required to train the system to pick the correct domain as Commerce. Let us assume that the sentence is

<div align="center">The play of the imagination.</div>

The correct domain for the word play is Free_time. Since maximum count of comparison is 2 for domain free_time (ID 4).Suppose the next sentence is entered by user is

<div align="center">Play the drama.</div>

Here, the domain of the word play and drama is Entertainment. Previously, the same word has domain related to free_time [10, 12]. It is shown in TABLE 4 below.

FieldID	Word	Domain
4	Play	Free_time
5	play	commerce
4	imagination	Free_time

<div align="center">TABLE 4 Domain Comparisons</div>
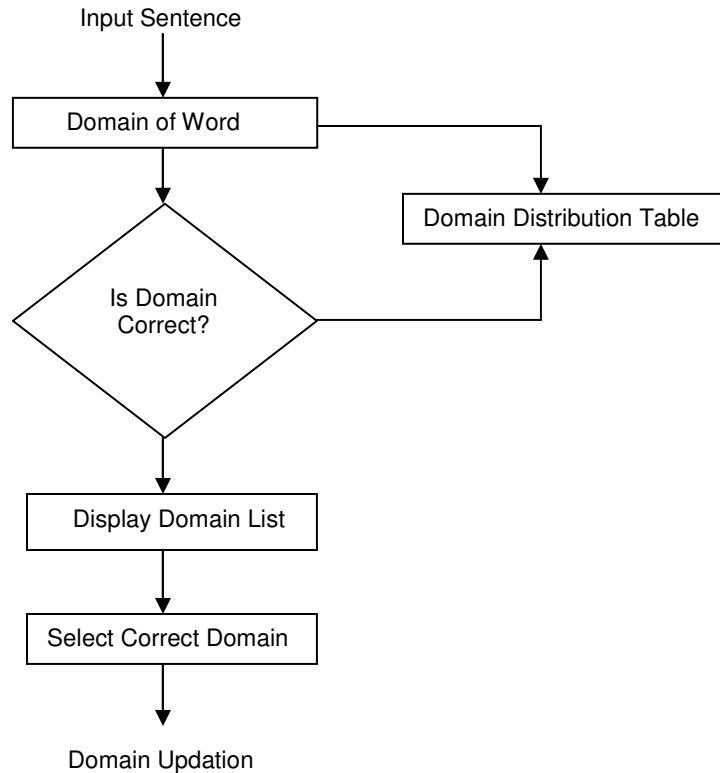

<div align="center">FIGURE 6 Supervised Training Flow</div>

Step 5: Unsupervised learning module to auto update the database with the selected sentences and word-meaning pairs. The flow is shown in fig. 7. If it is correct that is considered as correct domain of word (disambiguation) and this entry is updated in the database. Else, user has given the chance to input the sentence again. This flow is shown in Fig. 7. The knowledge acquisition bottleneck problem is overcome by unsupervised learning, since it is independent of manual work.
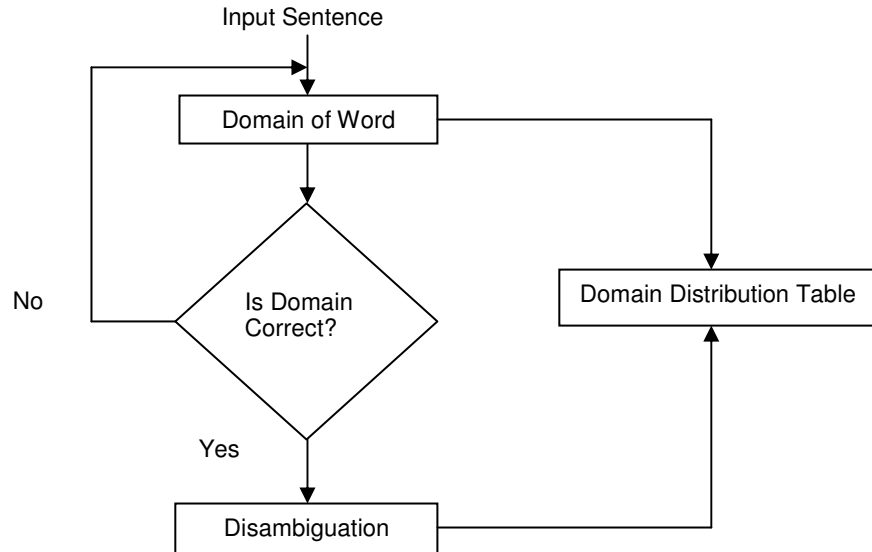
FIGURE 7 Unsupervised Learning Flow

The experimental setup is done by following steps and accuracy of Unsupervised, Supervised and Hybrid method is evaluated using mathematical formula as

$$\frac{\sum_t Number\ of\ Correct\ terms}{\sum_i Number\ of\ Input}$$

Where,   t =correct terms (Correctly disambiguated)
     &   i = input (Number of sentences)

Repeat the below steps for:
     i=1…number of sentences (n), n=1….15
   Where,   i indicate sentence and n indicates number of sentences.

Step 6: Finally, display the **correct** domain of the word. The correct domain of the word for given example is Commerce.

5. RESULTS

Stage 1: Part of Speech Tagger
The first stage "POS Tagger" of the system model is implemented. FIGURE 9 shows the snapshot of POS Tagger process. This stage is used to separate the content words and general words like noun, verb, adjective etc. from the sentence in step1 and Classification of separated words in three categories c1, c2, and c3.

Sentence- Play the stock market.
Separation-
Play
The
Stock
Market
Match: play: play clustered under – Commerce
Match: play: play clustered under – Free_time
Match: play: play clustered under – Entertainment
Match: stock: stock clustered under – Commerce
Match: market: market clustered under - Commerce

FIGURE 9 Result of POS Tagger Process

Stage 2: Unsupervised Learning
There are five steps to process the system. When the domain of word is identified; it is checked by the system for correctness if the identified domain is correct then out of five steps only four steps are processed to get the output. This is shown in FIGURE 10 with example.

Sentence: The play of the imagination.

Step 1: Separating All Words
Word: The
Word: play
Word: of
Word: the
Word: imagination.

Step 2: Finding Matching Domain
Match – play: play
Match – play: play
Match – play: play
Match – play: play
Match – play: play
Match – imagination: imagination
Match – imagination: imagination

Step 3: Checking for Best Probable Field
Field 11 found 2 times
Field 2 found 2 times
Max Value: 9 For field ID: 69
The Domain is Free_time

Step 4: Checking for Correctness
Is this the type of the sentence at input? Y/N
The new elements with selected domains have been updated…

FIGURE 10 Result of Unsupervised Learning of Implemented System

```
Sentence: Play the stock market.
Step 1: Separating All Words
Word: Play
Word: the
Word: stock
Word: market.
Step 2: Finding Matching Domain
Match – play: Play
Match – play: Play
Match – play: Play
Match – play: Play
Match – play: Play
Match – stock: stock
Match – stock: stock
Match – market: market
Match – market: market
Step 3: Checking for Best Probable Field
Field 11 found 1 times
Field 17 found 3 times
Field 2 found 2 times
Field 69 found 9 times
Max value: 9 for field ID: 69
The Domain is Free_time
Step 4: Checking for Correctness
Is this the type of the sentence at input? Y/N
Step 5: Supervised Learning
Your choice is: Commerce
So the new field of this sentence is set to: Commerce
Words to be updated:
```

FIGURE 11 Result of Supervised Learning of Implemented System

Stage 3: Supervised Learning
In stage 3, when the domain of word is identified; it is checked by the system for correctness if the identified domain is incorrect then all five steps of system are processed to get the output. This is shown in FIGURE 11 with example.

Stage 4: Spell Checker Utility
Sometimes, the sentence entered by the user will be incorrect or correct. So, here apart from above results one additional step as spell checker utility is implemented. In stage 4, the corrections in spellings of the entered sentence are corrected using online spell checker concept which requires internet connection before executing the system. The result of this utility is shown below in FIGURE 12.

```
Pla the stk makt.

Probable Spelling Matches found...

Play    Ply    Plum

stuck   stock  stick   wore   worm

marketing   market   making

Do you wish to change the input(y/n): y
```

FIGURE 12 Result of Spell Checker utility

Stage 5: Final Result of the System
The system is used for determining correct domain of word. First part of this system is sentence collection. It is required by the user to enter the sentence after that sentence is separated by POS tagger. Once the sentence is separated out, it will be processed through various steps like domain distribution, supervised learning, unsupervised learning, WSD algorithm. The final result for the implemented system is shown below in TABLE 5:

Sentence	Separation of Words	Target Word	Domain Identification	Comparison	Final Domain
Play the stock market	Play the stock market	Match – play: play Clustered under Match –stock: stock Clustered under Match – market: market Clustered under Match –play: play	Entertainment Commerce Commerce Commerce	Max Value :03 For field ID: 05	Commerce

TABLE 5 Final Result of Implemented System

Stage 6: Results of Accuracy of the System
Firstly, the unsupervised learning, supervised learning and hybrid training accuracy is evaluated shown in TABLE 6 and FIGURE 13.Then comparison of all learning approaches are done and observed that these approaches gives 63%,76% and 80% of accuracy respectively. Hence, the accuracy is improved using Hybrid training method shown in TABLE 7 and FIGURE 14.

Sentence	Target word	Disambiguated	Correctly Disambiguated	Accuracy (%)
1	2	2	2	100
2	3	3	2	66.67
3	1	1	1	100
4	1	1	1	100
5	2	2	1	50
6	2	2	2	100
7	2	2	1	50
8	1	1	1	100
9	1	1	1	100
10	2	1	1	100
11	3	3	2	66.67
12	1	1	1	100
13	3	3	2	66.67
14	1	1	1	100
15	2	1	1	50
Total	27	25	20	80.00

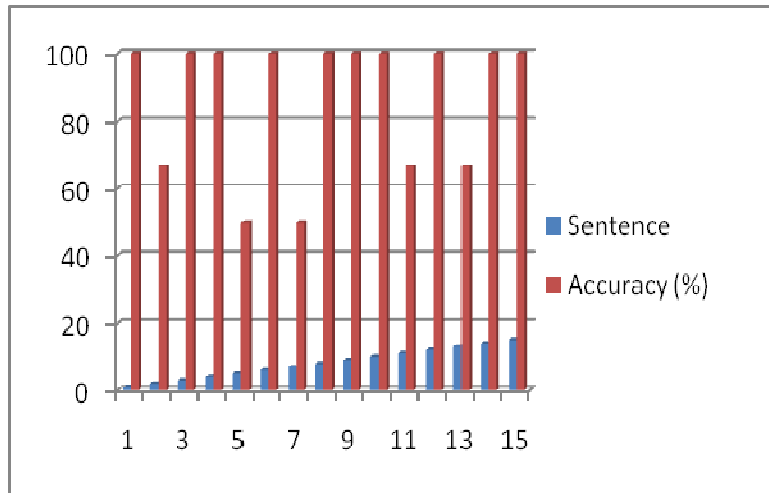**TABLE 6** Results of Hybrid Learning Method Accuracy of 15 Sentences

FIGURE13 Hybrid Learning Method Accuracy

Sentence	Target word	Disambi-guated	Correctly disambiguated	Supervised Accuracy (%)	Unsupervised Accuracy (%)	Hybrid Accuracy (%)
1	2	2	1	50	100	100
2	3	3	2	67	67	67
3	1	1	1	100	100	100
4	1	1	1	100	100	100
5	2	2	1	50	50	50
6	2	2	2	100	100	100
7	2	2	1	50	50	50
8	1	1	1	100	100	100
9	1	1	1	100	100	100
10	3	3	1	33	50	50
11	3	3	2	67	67	67
12	2	2	1	50	100	100
13	3	3	2	67	67	67
14	3	2	1	50	100	100
15	2	2	1	50	50	50
Total	31	30	19	63	76	80

TABLE 7 Results of Comparison of Unsupervised, Supervised and Hybrid Learning
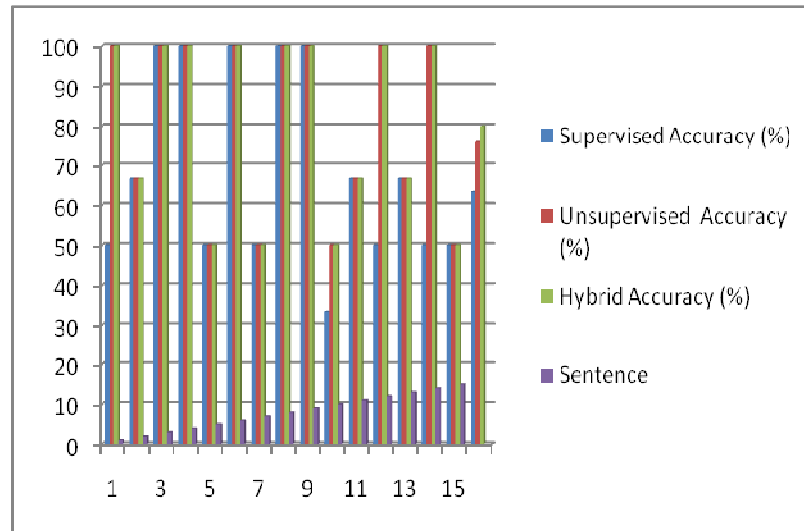
FIGURE 14 Comparison of Unsupervised, Supervised, Hybrid Accuracy

CONCLUSIONS

The system improves the self-learning process by obtaining correct sense of a sentence by resolving ambiguity from a word with full automation. The system requires correct domain of word identification from the sentence. Hence, sentence comprised of various content words like nouns, verbs, adjectives, adverb etc. Firstly, it is required to separate out content words from a sentence. By applying POS tagger process and WSD algorithm, domain is allotted to each word and each domain of word is compared to get correct domain of word. A count of comparisons is calculated, the domain which has the maximum count is assumed as correct domain. Also, this system improves the accuracy of identifying the correct domain of word. As per the Table 8 it shows that self learning language is improved by obtaining correct sense of a word by removing ambiguity from a sentence with full automation. Also, improves disambiguation process by obtaining appropriate sense of a word. The synonym relationship approach is used to identify intended domain of word. The system is trained using supervised training to check correctness of domain which gives 76% of accuracy; an unsupervised learning is used to update the database with the selected sentences and word-meaning pairs automatically. It gives 63% of accuracy. The hybrid method improves this accuracy up to 80% from Table 7. In this system, when the number of target word is correctly disambiguated system gives 100% accuracy. Else, the accuracy may be 66% or 50%. Hence, the overall 80% accuracy is evaluated. These results generated by the system are beneficial for Human Computer Interaction as it is motivating people to learn the language by themselves using computer in the absence of teacher. Additionally, the spell checker utility is implemented to avoid mistakes in words.

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