Automatically Identifying and Correcting Errors in Learner Writing using a Word Cluster Approach

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Outline
- Background
  - Usefulness of error correction
  - Types of errors in learner writing
  - Automatic error identification and correction methods
  - AntError: A novel, automatic error identification and correction tool
- Design and Methodology
- Results
- Summary & Future Work

Background
- Is error correction useful for learners?
  - Error correction does not lead to improved writing
    - Truscott, J (1996); Loewen, S (1998)
  - Error correction is harmful
    - Truscott, J (1996)

- Types of errors found in student writing
  - lexical (e.g. What do you lik?)
  - syntactic (e.g. What does you like?)
  - pragmatic (e.g. What do you like sports?)
  - Sentence level errors (Beare, K, 2004)
    - tense
    - punctuation
    - word order
    - wrong word
    - missing word
    - spelling
    - grammar
Background

- Automatic Error Identification and Correction
  - Spelling and grammar checkers
    - Hong, W., & Davies, G. (1997)
  - Grammar checkers unable to deal with complex grammatical and stylistic problems
    - Hong, W., & Davies, G. (1997)
  - Most programs use ‘drill & kill’ exercises

- Software for checking key phrases used in writing
  - e.g. Jamieson, et al. (1993)

- Problems:
  - All key phrases have to be added to the system by hand
  - Domain specific

“AntError”

- A novel, automatic error identification and correction tool
  - Works at the sentence level
  - Does not require a pre-defined set of key-phrases or error tags
  - Does not require error tagged data
  - Domain independent

- Design
  - Redefine the error identification problem
    - Do not try to identify all possible errors in an learner’s sentence
    - Identify differences (errors) between a learner’s sentence and candidate sentences from a set of template “correct” sentences
  - Disadvantages:
    - Not suitable for “free writing” exercises, where template “correct” sentences are unavailable
    - Essay writing, diaries, unrestricted QA exercises

- Advantages:
  - Very suitable for most CALL systems
    - Multiple choice quizzes, restricted QA quizzes, simple translation exercises
  - Fast
    - Less than 2 sec for over 20 sentences
Methodology

- Create a set of template “correct” answers
- Compare learner’s sentence with each template sentence
  - If an exact match is found ⇒ no error
  - If no exact match ⇒ error
- If no exact match
  - Find the ‘most similar’ template sentence
    - using Levenshtein distance measure (http://www.merriampark.com/ld.htm)
    - using phrase distance measure (Dree, M., 2002)

Methodology (Example)

- Template “correct” sentences
  - What sports do you like?
  - Which sports do you like?
  - What sport do you like?
  - Which sport do you like?
- Learner’s sentence
  - What does you like sports?
- ‘Most similar’ template sentence
  - Exact match ⇒ no error
  - No exact match ⇒ error ⇒ What sports do you like?

Results (1) ～ これはいくらか？

- Template “correct” sentences:
  - How much is this? How much does this cost?
  - How much is it? How much does it cost?
  - How much money does this cost? …
- Learner sentences:
  - Total: 26 (with errors: 13, without errors: 13)
    - Error types: 13
- Examples
  - How cost dose it?
  - How many costs is this?
  - How much will you cost this?

Methodology (Example)

- Find largest clusters appearing in learner’s sentence and template sentence
- Check for redundant or missing clusters
- Give instructions for correction:
  - Replace the verb form
  - Reorder words

Results (1) ～ これ は いくらか？

<table>
<thead>
<tr>
<th></th>
<th>“Word” Spell/Grammar</th>
<th>“AntError”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error sent. marked with error</td>
<td>5/13 (38.5%)</td>
<td>13/13 (100%)</td>
</tr>
<tr>
<td>Non-error sent. marked with error</td>
<td>0/13 (0%)</td>
<td>0/13 (0%)</td>
</tr>
<tr>
<td>Time to complete</td>
<td>20 sec.</td>
<td>0.7 sec.</td>
</tr>
</tbody>
</table>
Results (1) “AntError” correction

Learner sentence:
- How much will you cost this?
- ‘Closest’ template sentence:
  - How much does it cost?
- Chunks: "How much", "cost"
- Error correction hints:
  - ‘How much’ (okay)
  - ‘will’ to a ‘3rd person singular form of verb’ (does)
  - ‘you’ to a different ‘personal pronoun’ (it)
  - ‘cost’ (okay)
  - ‘this’ (delete)

Results (1) “AntError” marking

- How much does it cost? SCORE: 0
- How much does this cost? SCORE: 0
- How much is it? SCORE: 0
- How much is this? SCORE: 0
- How much will it cost? SCORE: 4
- How does it cost? SCORE: 7

Results (2) “AntError” correction

Learner sentence:
- How long were studying in Okayama?
- ‘Closest’ template sentence:
  - How long have you studied in Okayama?
- Chunks: "How long", "in Okayama"
- Error correction hints:
  - ‘How long’ (okay)
  - ‘were’ to a ‘singular present form of verb’ (have)
  - ‘studying’ to a ‘personal pronoun’ (you)
  - ‘in Okayama’ (okay)

Results (2) “AntError” marking

- How many costs does this? SCORE: 8
- How many is this? SCORE: 8
- How cost dose it? SCORE: 10
- How many take it? SCORE: 10
- How many costs is this? SCORE: 11
- What is cost this one? SCORE: 14
- How much will you cost this? SCORE: 14

Examples
- What year have you been studying in the Okayama?
- What years do you study in Okayama?
- How long were studying in Okayama?
Results (3) — 彼は図書館で働いている。  
Template "correct" sentences:  
- He works in a library.  
- He is working at a library.  
Examples  
- I am working bookstation.  
- He works in liburey.  
- She works a library.

Results (3) — 彼は図書館で働いている。  
Template "correct" sentences:  
- How much do you weigh?  
- What is your weight?  
Examples  
- How much do you weigh?  
- What are you fat?  
- How many do you weigh?

Results (4) — あなたの体重は何ですか？  
Template "correct" sentences:  
- How many do you weigh?  
- What is your weight?  
Examples  
- How many do you weigh?  
- What are you fat?  
- How many do you weigh?

Results (4) — あなたの体重は何ですか？  
Template "correct" sentences:  
- How many do you weigh?  
- What is your weight?  
Examples  
- How many do you weigh?  
- What are you fat?  
- How many do you weigh?
Results (5) –  ‘年後’ に…をする。

Template “correct” sentences:
- in ten years
- in ten years time

Learner sentences:
- Total: 25 (with errors: 15, without errors: 10)
- Error types: 9

Examples:
- ten years after
- ten years later
- in the ten years
- for ten years

Summary & Future Work
- Developed an automatic learner error identification and correction tool
  “AntError”
- 100% accuracy when identifying errors
- 100% accuracy when “correcting” errors
- Fast (< 0.1 sec. per learner sentence)
- Flexible (can be adapted to any problem with template “correct” sentences
- Offers increasingly detailed corrections
- Offers possibility for automatic grading

Increase detail of error corrections
Improve “AntError” to be more useful with semi-free learner sentences
- e.g. allowing wildcard template sentence words and clusters
Develop an intuitive graphical user interface
- Similar to other “Ant” tools, such as “AntConc” and “AntMover”