Lecture 2: Writers’ aids: Spelling errors

LING-351 Language Technology and LLMs

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Language, writing, encoding

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- Language = writing?

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- Byte (8 bits): a bundle of 8 bits, the basic unit of storage
- Character encoding (UTF-8): rules that map bytes to code points

Lesson plan

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Key idea: ~~Spelling errors are annoying~~

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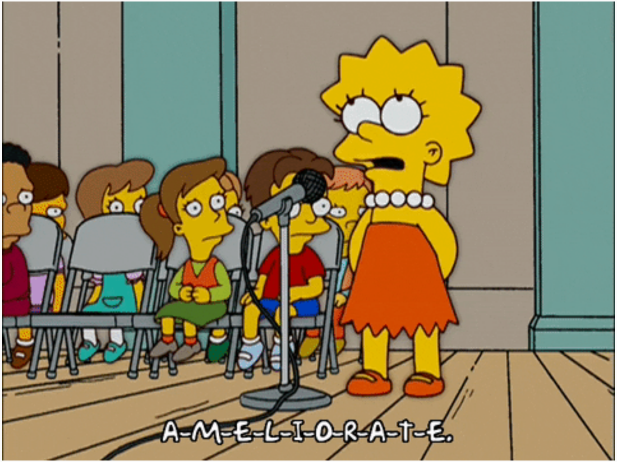
Key idea: ~~Spelling errors are annoying~~
Spelling errors vary by types (and even by languages);
there is no one-size-fits-all solution.

Spelling problems in writing


A-M-E-L-I-O-R-A-T-E.

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- Standardized spelling came much later...

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- Readers often focus on **word shape**, not letter-by-letter decoding

What if everyone spelled freely?

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Question

What are the benefits and drawbacks of having a standardized spelling system?

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- Enables searching and record-keeping

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Group discussion

- *(Put into the shared deck)* **Come up with at least one example**
- How often do you use tools to check the spelling errors?
- Which one do you rely on the most?
- Do they ever create problems (instead of solving them)?

Breaking down the problem

Not all spelling errors are the same.

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Not all spelling errors are the same.
To solve them, we need to consider **error types**.

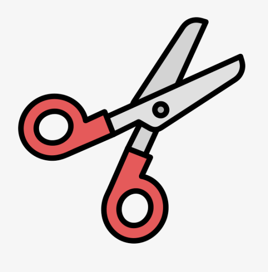
Different types of spelling errors

Spelling error types

- 1. Non-word errors
- 2. Real-word errors
- *Notes.* How common?

1. Non-word errors

- True confusion:



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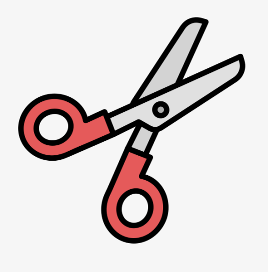

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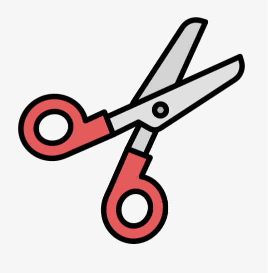

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- Typos: "*hte*" (keyboard slip)

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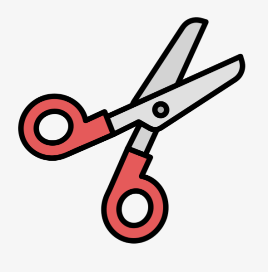

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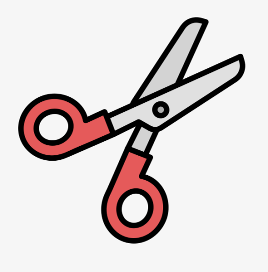

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- Minimum number of operations to transform one word into another

Edit distance: Basic operations

Each operation = 1 unit of cost

- **Insertion**: *aquire* → *ac<u>c</u>quire*
- **Deletion**: *argu<u>e</u>ment* → *argument*
- **Substitution**: *cal<u>e</u>nder* → *cal<u>a</u>ndar*
- **Transposition**: *con<u>cs</u>ious* → *con<u>sc</u>ious*
    - Sometimes counted as two substitutions

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    - e.g., *friemd* $\rightarrow$ *friend* (substitution: *m*→*n*, keys are adjacent → low cost)
    - vs. *friemd* $\rightarrow$ *fried* (deletion of *m*, more disruptive → higher cost)

Interim summary

Traditional method: Dictionary + Edit Distance: How it works

- Relies on a dictionary of correct words

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Q. What happens if the misspelled word is still a real word?

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    - Surrounding **context** must be considered

How common are spelling errors?

- About 2–3% of all typed words on a full-size keyboard are misspelled by proficient adults (Flor et al., 2015)

Table 2. Summary statistics for the ETS Spelling Corpus

	GRE Argument	GRE Issue	TOEFL Independent	TOEFL Integrated	TOTAL
Total essays	750	750	750	750	3,000
Essays without misspellings	60	21	18	21	120
Total Word Count	263,578	336,301	212,930	151,031	963,840
Average Word Count	351	448	284	201	321
Total count of Misspellings	5,935	7,962	7,285	5,230	26,412
Misspellings as % of all words	2.25%	2.37%	3.42%	3.46%	2.74%

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- On a mobile phone, however, about 40% of words are misspelled (Grammarly, 2019)
- More multi-error misspellings and real-word errors due to auto-complete (e.g., ***restaurant*** → typed as ***restuarnt*** → auto-corrected to ***restart***)

Building a simple spell-checker

Baseline spell checker (Peter Norvig)

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    - Output: **language**

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- We need a better model: **noisy channel**

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  - Noisy channel (frequency + typo likelihood) → **receive**

Thinking about a more complex spell-checker

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  - `put the cat before the horse` is not

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- `put the cart` is more frequent than `put the cat`

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Other approaches

- **Statistical Language Models (n-grams)** Use probability of surrounding context e.g., *I went to the shcool* → "school" is more probable

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- **Hybrid Approaches** Combine edit distance with language models; pick the highest probability candidate

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    - Example: *Their going to school* → all words exist, but grammar is wrong (*They're*)
- Modern systems therefore blur the line between spell checking and grammar checking, using **context-aware models** to handle both (which we'll talk about in the next class).

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Key idea: ~~Spelling errors are annoying~~
Spelling errors vary by types More questions to think about:

- What about the spacing errors?
- What about in other languages that have different encoding systems?