# Unsupervised Morpheme Analysis with Allomorfessor

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# Outline

Modeling allomorphy

Allomorfessor

Results and discussion

# Allomorphy

**Definition:** One morpheme-level unit may have two or more morph-level surface realizations which only occur in a complementary distribution

Examples

- `/prettI/ pretty pretti-er`
- `/kenkä/ (shoe) kenkä kengä-n`

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**Observation:** Most allomorphic variation close to boundary between stem and affix.

**Solution:** Use a class of *string mutations* to encode the prior information.

## String mutations

Simplest thing that could possibly work:

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Solution:

- Allow only deletions and substitutions
- Begin from the end of the morph. Find the first matching letter, apply operation to that one ⇒ `k|g`
- Efficiently computed via Levenshtein algorithm

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- Allomorphic variations in linguistic gold standards:

| | *Morphemes* | *Allomorphs* | | *Mutation found* | |
|---|---|---|---|---|---|
| Eng lexicon | 21 173 | 10 858 | (51.3%) | 8 912 | (82.1%) |
| Fin lexicon | 68 743 | 56 653 | (82.4%) | 36 210 | (63.9%) |
| Tur lexicon | 23 376 | 646 | (2.8%) | 102 | (15.8%) |
| Eng corpus | 76 968 382 | 42 282 837 | (54.9%) | 14 706 543 | (34.8%) |
| Fin corpus | 73 512 023 | 61 583 251 | (83.8%) | 18 751 022 | (30.5%) |
| Tur corpus | 23 288 821 | 11 978 142 | (51.4%) | 225 708 | (1.9%) |

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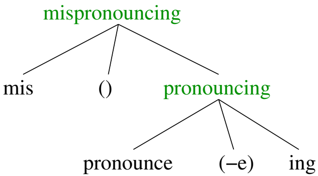
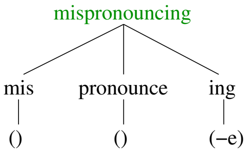


Allomorfessor Alpha
(Morpho Challenge 2008)



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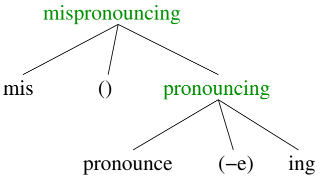

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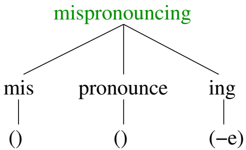

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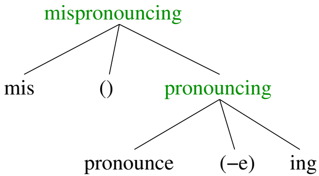

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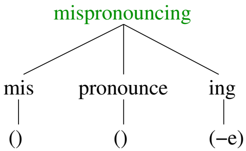

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- Now it's really like Morfessor Baseline.
- Viterbi-like algorithm for analyzing new words.

# Model definition

Task: Find the model which maximizes the posterior probability:

$$\mathcal{M}_{\mathrm{MAP}} = \operatorname*{arg\,max}_{\mathcal{L}_M, \mathcal{G}_M} P(\mathcal{L}_W | \mathcal{L}_M, \mathcal{G}_M) P(\mathcal{L}_M, \mathcal{G}_M)$$

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  → Most morphs (e.g., stems) give non-zero probability only for the empty mutation.

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# Search algorithm

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- Splitting a morph into prefix and suffix part includes a mutation (usually the empty one).
- Computational challenge: large amount of possible analyses.
- Implemented restrictions:
    - If non-empty mutation, preceding morph has to occur as a word.
    - If non-empty mutation, suffix has to be already in the lexicon.
    - Consider only maximum $K = 20$ analyses per morph.

# Evaluations

Results were good for most tasks and languages:

- C1: winner for English, moderate results for the rest (low recall)
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However, Allomorfessor not better than Morfessor Baseline.

- Sometimes even worse.
- But the differences were not statistically significant.

# Mutations

Almost all mutations included for English and Finnish were correct or at least useful. E.g.,

- `adhering = adhere (-e) ing`
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- Mostly due to a property of Morfessor Baseline: Morphs that occur in many word forms are often undersegmented.

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- Improving the efficiency of the search algorithm
- Obtaining analyses "deep" enough for common word forms
- Allomorphy in suffixes