Language detection using character n-gram profiles

Inspiration from Cavnar and Trenkle (1994)

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Applying for: Scientific Researcher in NLP

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Overview

Motivation

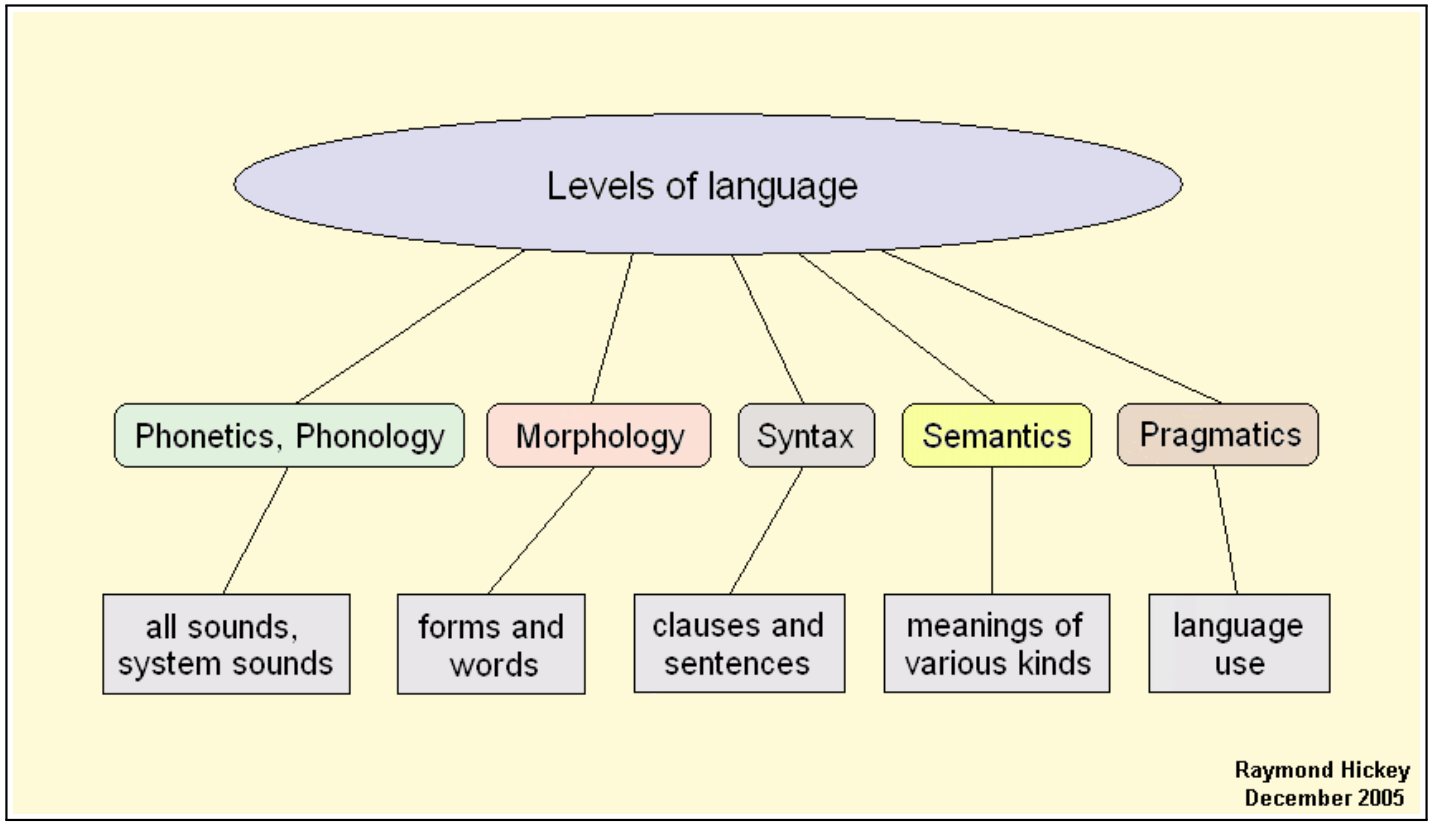

Figure 1: Levels/structures of languages; figure taken from Hickey (2005)

- Morphological profiling probably has lower data and compute requirements
- Makes sense given no external libraries are allowed

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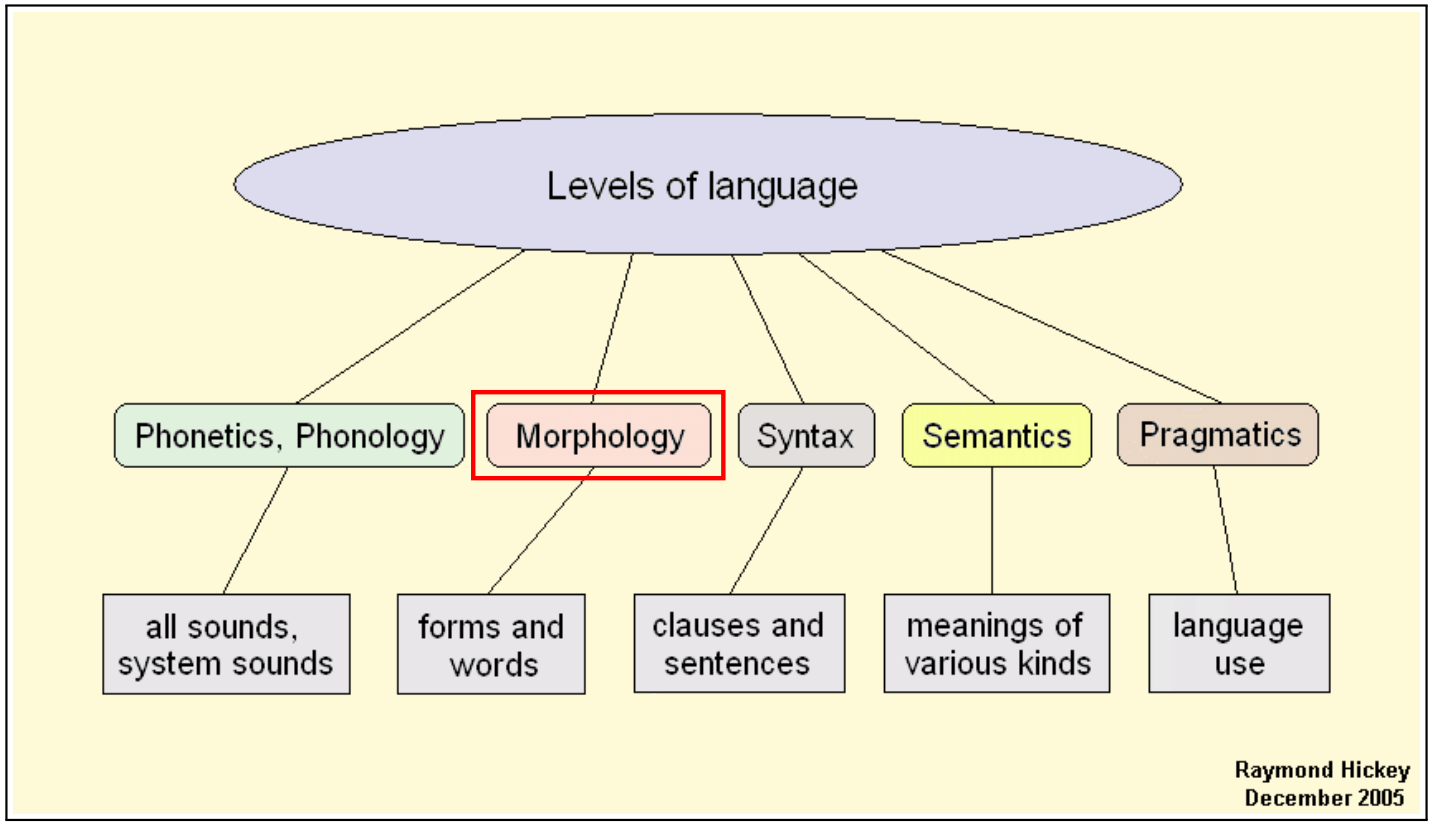

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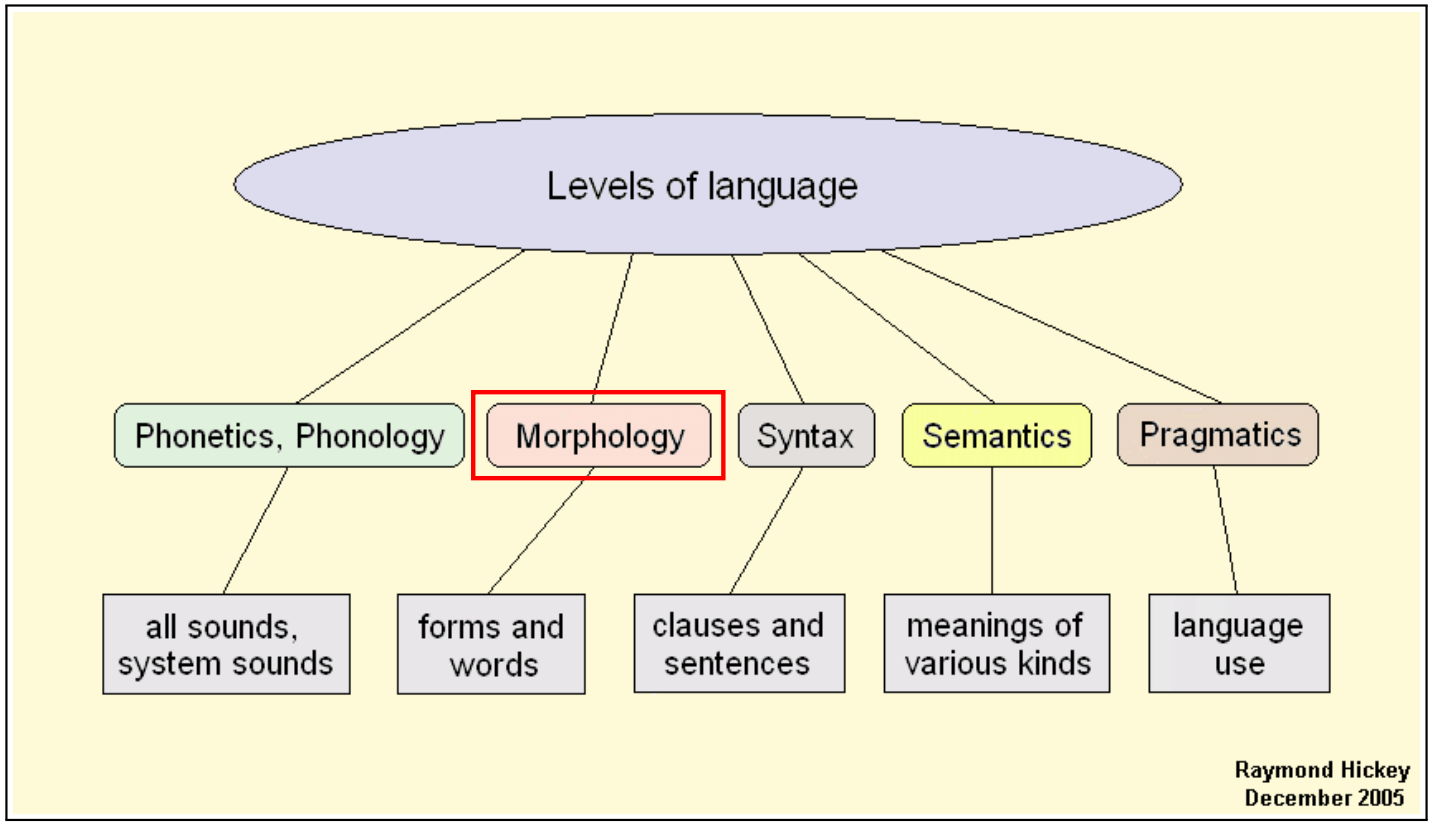

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Methodology

- Character n-gram profiling technique from Cavnar, Trenkle, et al. (1994)
- WiLI-2018 data set for 235 languages with 235,000 paragraphs (Thoma, 2018)
- **Similarities:** Data is lower-cased and punctuation/special-tokens are removed
- **Differences:** Use vector-based difference norm instead of out-of-place distance
- **Two hyperparameters:** character n-gram length and ranked n-gram cutoff

N-Gram-Based Text Categorization

William B. Cavnar and John M. Trenkle
Environmental Research Institute of Michigan
P.O. Box 134001
Ann Arbor MI 48113-4001

Figure 2: Excerpt from Cavnar, Trenkle, et al. (1994)

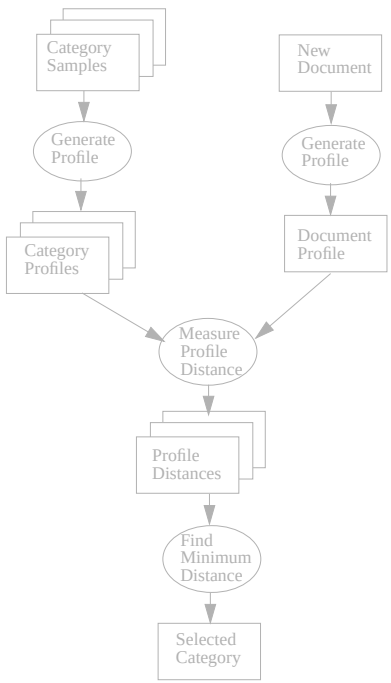

Figure 3: Flowchart from Cavnar, Trenkle, et al. (1994)

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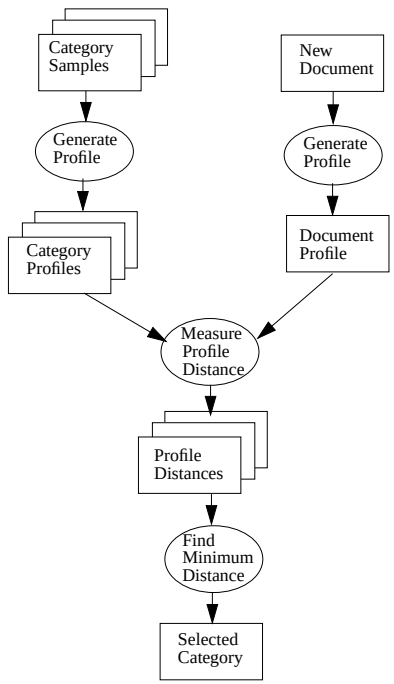

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Results

N-gram length	N-gram cutoff	Weighted test F_1	Best performing language	Worst performing language
2	100	0.865	Navajo (0.999)	Konkani (0.110)
2	300	0.893	Navajo (0.999)	Pampanga (0.235)
3	100	0.859	Dhivehi (0.999)	Chavacano (0.247)
3	**300**	**0.898**	Navajo (0.999)	Chavacano (0.304)

Table 1: Tabular summary of model performances; MLP from Thoma (2018) achieved an accuracy of 0.883

Language	N_1	N_2	N_3	N_4	N_5
English	*the*	*and*	*ing*	*ion*	*ent*
Deutsch	*der*	*sch*	*die*	*ein*	*che*
Italiano	*del*	*ell*	*ent*	*ion*	*lla*

Table 2: Tabular summary of top five character trigrams with highest relative frequency per language

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Gold language	Utterance	Predicted language
English	*What is this?*	Cantonese
Deutsch	*Was ist das?*	Chavacano
Italiano	*Cos'è questo?*	Asturian

Table 3: Examples of erroneous language detection for short phrases

Plenty of failing cases:

- Short phrases where language profile cannot converge
- Slang, colloquial or borrowed words
- Transliteration from non-Latin to Latin script

Plenty of workarounds:

- Word-level language identification with large-enough vocabulary
- Complex modeling over sequential subwords, for example using neural networks; such as in Bartz et al. (2017)

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Conclusions

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- Trained and tested on WiLI-2018 (Thoma, 2018)
- Best character trigram model achieved **89.8%** weighted F_1 test score
- Works well for medium-long length documents, likely robust to previously unseen words and spelling errors
- Known limitations on short length documents

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Bibliography I

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