Breaking Words Better: Linguistically Guided Segmentation for Morphologically rich Languages

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Check our code here

Why Morphology Matters

Some languages pack meaning into word endings. One token can encode what English needs multiple words to express.

Example: talossanikin (Finnish) → also in my house (English)

- Morphological stacking → many surface forms per lemma
- Data sparsity: rare inflections are hard to learn
- BPE is frequency-based and doesn't produce linguistically meaningful units
- Morpheme-aware units to improve alignment + generation

Method: Data & Model

Task: Finnish → English translation
Model: Transformer (fairseq IWSLT-style)
Segmentation: BPE vs Morfessor variants
Metrics: sacreBLEU, COMET

Dataset splits (data from WMT)

- Train: 496,334 sentence pairs
- Dev: 3000 sentence pairs
- Test: 3000 sentence pairs

FAIRSEQ

fairseq (NLP) is a PyTorch-based toolkit from FAIR for training state-of-the-art NLP sequence models like transformers for machine translation, summarization, and language modeling.

Pipeline

text → segment → train → evaluate

Segmentation Pipelines Compared

Same Transformer, different segmentation. Which side should be morphology-aware?

Pipeline A) Baseline

raw text → bpe → Transformer → English

Pipeline B) Morfessor source only

raw text → morfessor → bpe → Transformer → English

BPE is applied to control vocabulary size and handle rare or unseen words by splitting text into frequent subword units.

BPE

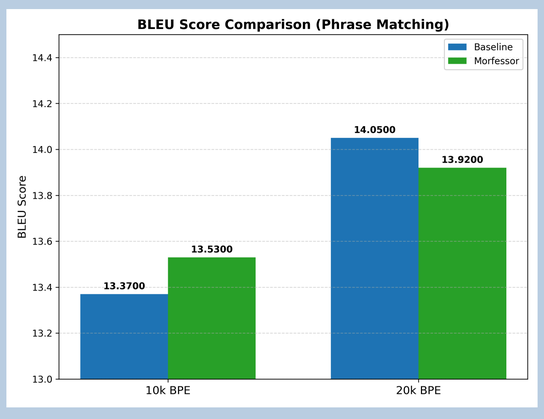
- BPE = subword tokenization
- splits into common chunks
- helps with rare words
- starts from chars
- merges most common pair repeatedly

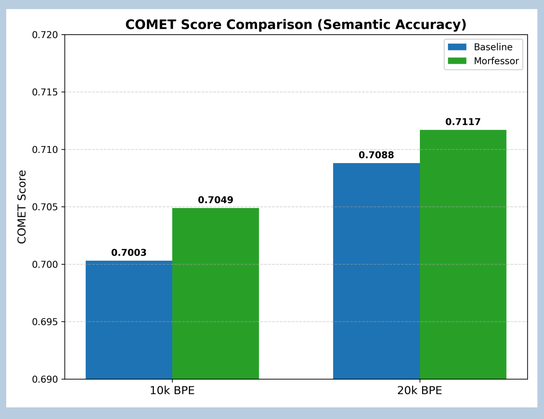
Morfessor

- Morfessor = unsupervised morphological segmentation
- splits words into morphemes
- targets linguistic structure
- unlike BPE (frequency-based)
- not mainly for compression

Morfessor is added to introduce linguistically motivated word structure, preserving meaningful units that BPE alone may miss.

Results





We compare two different vocabulary sizes: **10,000** & **20,000**

- **BLEU**: Measures n-gram overlap with reference translations; easy to compute and compare, but insensitive to meaning and fluency.
- **COMET**: Uses a neural model to assess semantic adequacy and fluency; aligns better with human evaluations, but is more complex.

Discussion & Takeaways

Morfessor helps by reducing sparsity and aligning subunits with meaning-bearing morphemes.

Key Takeaways

- We observe an improvement
  - in COMET scores
  - in BLEU scores for the 10K

Future work

- Tune Morfessor hyperparameters / vocab control
- Translating from English to Finnish
- Add human eval for inflection & aggreement errors
- Test Turkish / Hungarian /Estonian