

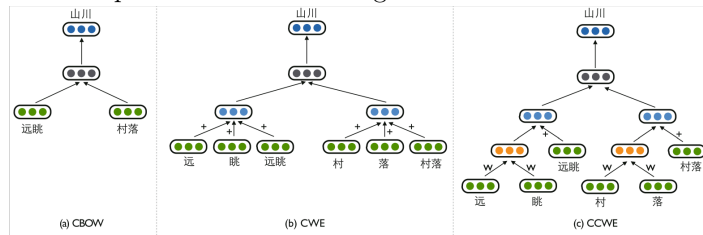
Original Hypotheses

- We can avoid maintaining a dictionary by man power
- We can catch more out-of-vocabulary words
- Chinese in character unit can have meanings
- We can find out valid 2-character words from frequency information

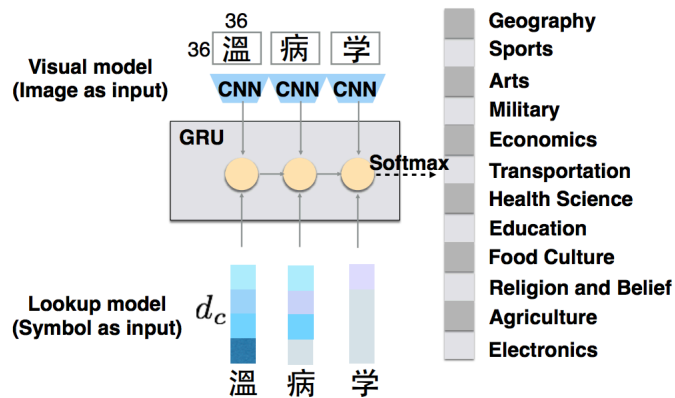
Related work

1. Morpheme & character-based word embeddings

- English
 - **Better Word Representations with Recursive Neural Networks for Morphology**, CoNLL 2013
 - **Compositional Morphology for Word Representations and Language Modelling**, ICML 2014
- Chinese
 - **Joint Learning of Character and Word Embeddings**, IJCAI 2015
 - * Internal characters + external contexts (CWE)
 - **Improved Learning of Chinese Word Embeddings with Semantic Knowledge**, CCL 2015 & NLP-NABD 2015
 - * New composition functions using the semantic relations between characters (instead of addition) (CCWE)



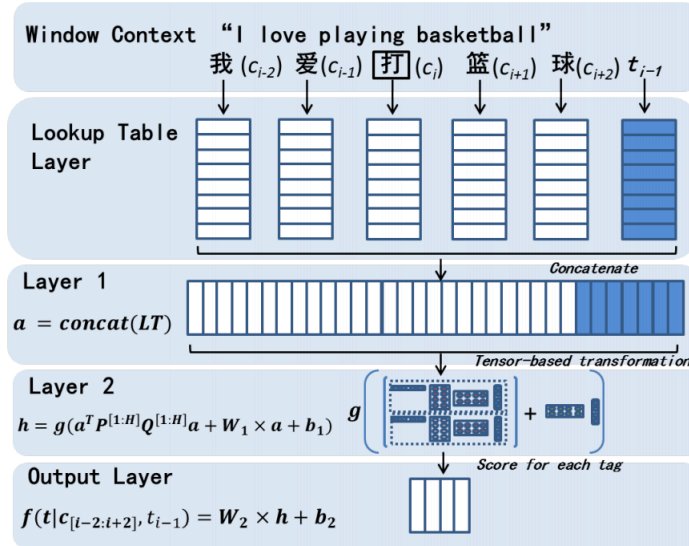
- **Learning Character-level Compositionality with Visual Features**, ACL 2017
 - * Adding shape of characters as feature



2. Chinese segmentation

- Summery
 - Purely dictionary-based
 - Purely statistical approach
 - Statistical dictionary-based
 - Supervised machine-learning
 - Neural network models
- Papers
 - **Chinese Word Segmentation as Character Tagging**, IJCLCLP 2003
 - **HHMM-based Chinese lexical analyzer ICTCLAS**, SIGHAN 2003
 - **Chinese Segmentation and New Word Detection using Conditional Random Fields**, COLING 2004
 - * Statistical sequence modeling framework
 - **Character-Level Dependencies in Chinese: Usefulness and Learning**, EACL 2009

- * Character-level dependency can be a good alternative to word boundary representation for Chinese
- **Parsing the Internal Structure of Words: A New Paradigm for Chinese Word Segmentation**, HLT 2011
- **Chinese Parsing Exploiting Characters**, ACL 2013
 - * Parsing character-level syntax trees for jointly performing word segmentation, POS tagging & parsing, using a CKY-style or shift-reduce algorithm
- **Max-Margin Tensor Neural Network for Chinese Word Segmentation**, ACL 2014
 - * Explicitly models the interactions between tags & context characters by exploiting tag embeddings and tensor-based transformation (MMTNN)



- **Segmentation-Free Word Embedding for Unsegmented Languages**, EMNLP 2017
 - * Training word embeddings on **word co-occurrence statistics** & **frequent character n-grams**

Proposed method

1. Train character embeddings
 - Is context-enhanced model still meaningful?
 - Component information, word context, etc.
2. Cluster results
3. Learn word list by counting
4. Build connections between words
5. Observe cluster-to-cluster connections
 - Linguistics knowledge?
 - Not semantically compositional Chinese words?
 - Transliterated words, single-morpheme multi-character word (聯綿詞), entity names, etc.
 - If not exhaustive enough, should we enhance with dictionaries?
6. Apply to Chinese word segmentation
 - Graphical knowledge or statistical knowledge?

Goals

- Avoid maintaining a dictionary by man power
- Catch more out-of-vocabulary words
- Embedding-based word segmentation
- Linguistic knowledge observation from patterns of distributed character representations

Difficulties

- Long studied topic with high-accuracy baselines
- New attempt, feasibility unknown
- Lack of experience