Metaphor Detection with Cross-Lingual Model Transfer

What is a metaphor?

- “A type of conceptual mapping where words or phrases are applied to objects and actions in a way that do not permit a literal interpretation” (Lakoff and Johnson 1980)
- Estimated 5 to 20% of language is used through metaphors
- Two syntactic constructions of metaphors
  - Subject-verb-object (SVO)
  - Adjective-noun (AN)
- Examples
  - The snow is a white blanket
  - He is a shining star
  - The calm lake was a mirror

Motivation

Practical

- Translation between languages
- Dialog systems
- Sentiment Analysis

Scientific

- Hypotheses about language regarding metaphors can be more easily tested at a larger scale

Difficult Problem due to multiple factors (Context-dependent, subjective)

Authors Contributions

1. New state-of-the-art English metaphor detection system using conceptual semantic features
    a. Degree of abstractness (Ability to imagine the word)
    b. Semantic Supersenses (Semantic categories from WordNet)
2. New metaphor-annotated corpora for Russian and English
3. Using model transfer to show metaphors are conceptual in nature by detecting metaphors in Spanish, Farsi, and Russian

Methodology

- Each SVO (or AN) metaphor is represented with a triple (or duple in case of AN) where the vector consists of conceptual features
- Three main feature categories
  - Abstractness and imageability
  - Supersenses
  - Unsupervised vector-space word representation
- All features are computed for each word individually and also for pairs of the triple

Abstractness and imageability

- A subject that is more abstract with a verb that is more concrete is indicative of a metaphor
- Imageability is the ability to imagine the word
  - Vengeance brings up emotional images
  - Torture brings up emotional and visual images

Supersenses

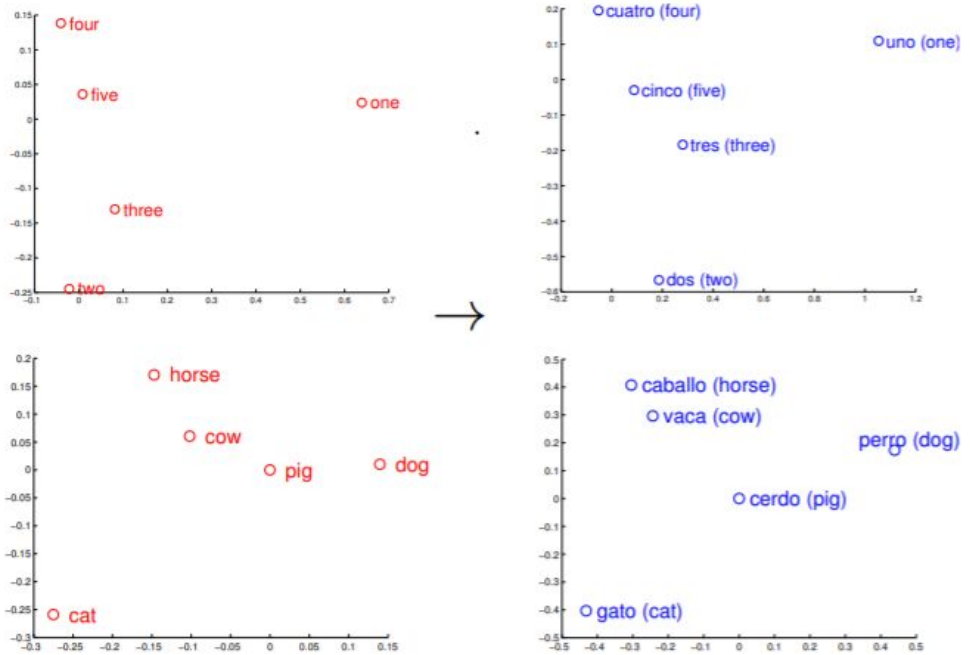
- 26 classes of nouns (noun.body, noun.animal)
- 15 classes of verbs (verb.consumption, verb.motion)
- Different classes appear together based on whether it is a metaphor or not
  - “Car drinks gasoline” (verb.consumption + noun.substance)
  - “Kid drinks juice” (verb.consumption + noun.food)
  - Preserved in translation

Vector space word representations

- Words are represented as a vector in some vector space
- Designed to capture lexical semantic properties
- Mikolov et al. (2013) found cross-lingual property of word representations
- Vector space models can be seen as vectors of semantic concepts that preserve meaning across languages

Mikolov et al. (2013) Cross-lingual property of distributed word representations

- Distributed word vector representations projected down to two dimensions using PCA
- Looked across multiple languages using a distance measure
  - Spanish
  - Czech
  - Vietnamese



Model and Feature Extraction

- A random forest classifier

Abstractness and imageability

- MRC psycholinguistic database gives ratings of abstractness and imageability to many words
- Logistic regression to give abstractness and imageability scores to all words in vector space representations

Supersenses

- Represented as a feature vector with each supersense representing an element in the vector

Experiments

10-fold cross validation

	SVO		AN	
	# FEAT	ACC	# FEAT	ACC
AbsImg	20	0.73*	16	0.76*
Supersense	67	0.77*	116	0.79*
AbsImg+Sup.	87	0.78*	132	0.80*
VSM	192	0.81	228	0.84*
All	279	**0.82**	360	**0.86**

Confirms hypothesis that conceptual features are effective in metaphor classification

Multi-lingual

Metaphors have similar properties across language

Collected and annotated metaphoric and literal sentences in four languages giving each dataset an equal number of metaphors and non-metaphors

	SVO	AN
EN	222	200
RU	240	200
ES	220	120
FA	44	320

	SVO	AN
EN	0.79	0.85
RU	0.84	0.77
ES	0.76	0.72
FA	0.75	0.74

Conclusion

- Show how to identify metaphors across languages
- Established benchmarks of metaphor detection in Spanish, Farsi, and Russian,
- Achieve state-of-the-art performance in English.

Neural Metaphor Detection in Context

Introduction

- Metaphors are pervasive in natural language
- Requires contextual reasoning about whether a specific situation can actually happen
- Metaphors classified into 5 categories: direct metaphor, indirect metaphor, implicit metaphor, personification, and borderline case

Related Work

- Previous approaches solely used SVO triples
- Providing full context supports more accurate prediction

Tasks

1) Given a target verb in a sentence, classify whether it is metaphorical or not

Classification of a binary label (metaphoricity of a word)

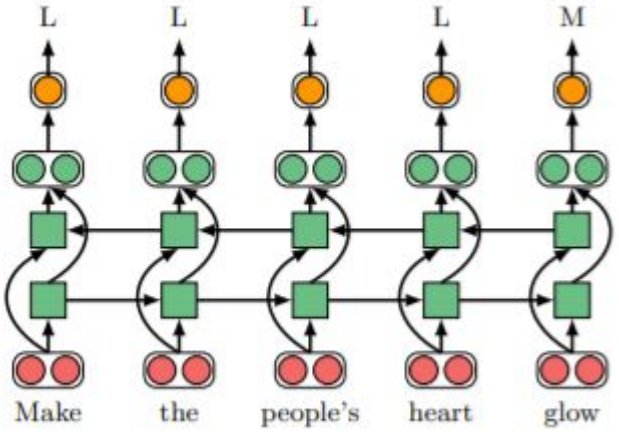
2) Given a sentence, detecting all of the metaphorical words

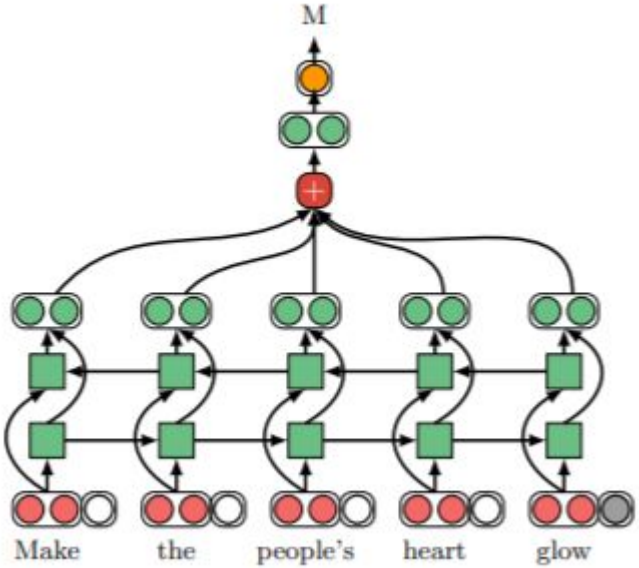
Sequence labeling. Given a sentence X_i, predict a sequence of binary labels for each word

Overall, given accurate annotations of all words in a sentence, sequence labeling model outperforms the classification model

Model

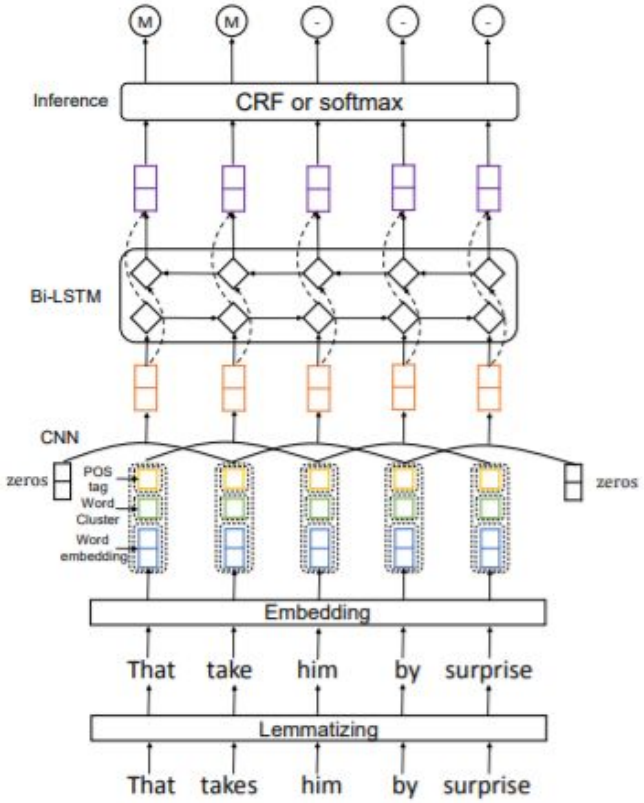
- Use of bidirectional LSTM to encode a sentence
- Feedforward neural network for classification





Neural Metaphor Detecting with CNN-LSTM (Wu 2018)

- Does sequential modeling by using CNN to extract local contextual information
- Then, uses a Bi-LSTM layer to extract long-range information from CNN feature maps to combine previous and future context information for prediction.
- Lastly, uses a softmax activation function to predict the metaphor label



Results

Sequence Labeling

- Model mainly improves recall
- Particles difficult to identify (“put down the disturbances”)
- Strong performance in dataset where annotations for all words in a sentence indicates predicting metaphor labels of context words helps to predict the target verb

Verb Classification

- Outperforms sequence labeling model where sentences are simple and only verbs are annotated

Error Analysis

- 100 errors sampled
- Sequence model outperforms Verb classification model in detecting personifications, indirect metaphors, and direct metaphors that involve uncommon verbs

CLS	SEQ	Sentence	Metaphor Type
✗	✗	To *throw* up an impenetrable Berlin Wall between you and them could be tactless.	-
✗	✗	In reality you just invent a tale, as if you were **sitting** round a fire in a cave.	direct metaphor
✗	✗	So they **bought** immunity.	indirect metaphor
✗	✗	During the early states of the phased evacuation the logistical problem **facing** the police was the street-by-street warning of the population to make ready for evacuation.	indirect metaphor
✗	✔	There are few things worse than being **bludgeoned** into reading a book you hate.	indirect metaphor
✗	✔	He thought of thick, fat, hot motorways **carving** up that land.	personification

Conclusion

- Use of BiLSTM models with contextualized word representations for metaphor detection
- New state-of-the-art results for detection
- Error analysis unveils remaining challenges
  - Allows for continuing research in metaphor detection

Discussion Questions

- How do the two research papers differ in model?
  - How does that affect the conclusions that the authors are able to make?

- Why do you think it's still difficult to implement a well-functioning chat bot?