Beyond word2vec

- word2vec is factorizing a word-context matrix.
- The content of this matrix affects the resulting similarities.
- word2vec allows you to specify a *window size*.
- But what about other types of contexts?

- Example: **dependency contexts** (Levy and Dagan, ACL 2014)
Bag of Words (BoW) Context

Australian scientist *discovers* star with telescope
Australian scientist discovers star with telescope

Bag of Words (BoW) Context
Australian scientist discovers star with telescope

Syntactic Dependency Context

Australian scientist discovers star with telescope
Syntactic Dependency Context

Australian scientist discovers star with telescope
Australian scientist discovers star with telescope

Syntactic Dependency Context:
- **nsubj**: scientist
- **dobj**: star
- **prep_with**: telescope
Embedding Similarity with Different Contexts

<table>
<thead>
<tr>
<th>Target Word</th>
<th>Bag of Words (k=5)</th>
<th>Dependencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hogwarts (Harry Potter’s school)</td>
<td>Dumbledore hallows half-blood Malfoy Snape</td>
<td>Sunnydale Collinwood Calarts Greendale Millfield</td>
</tr>
</tbody>
</table>

Related to Harry Potter Schools
## Embedding Similarity with Different Contexts

<table>
<thead>
<tr>
<th>Target Word</th>
<th>Bag of Words (k=5)</th>
<th>Dependencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turing (computer scientist)</td>
<td>nondeterministic</td>
<td>Pauling</td>
</tr>
<tr>
<td></td>
<td>non-deterministic</td>
<td>Hotelling</td>
</tr>
<tr>
<td></td>
<td>computability</td>
<td>Heting</td>
</tr>
<tr>
<td></td>
<td>deterministic</td>
<td>Lessing</td>
</tr>
<tr>
<td></td>
<td>finite-state</td>
<td>Hamming</td>
</tr>
<tr>
<td>Related to computability</td>
<td></td>
<td>Scientists</td>
</tr>
</tbody>
</table>
Embedding Similarity with Different Contexts

<table>
<thead>
<tr>
<th>Target Word</th>
<th>Bag of Words (k=5)</th>
<th>Dependencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>dancing (dance gerund)</td>
<td>singing, dance, dances, dancers, tap-dancing</td>
<td>singing, rapping, breakdancing, miming, busking</td>
</tr>
</tbody>
</table>

Related to dance

Gerunds

Online Demo!
Context matters

Choose the correct contexts for your application

- larger window sizes – more topical
- dependency relations – more functional
Choose the correct contexts for your application

- larger window sizes – more topical
- dependency relations – more functional
- only noun-adjective relations
- only verb-subject relations
Context matters

Choose the correct contexts for your application

- larger window sizes – more topical
- dependency relations – more functional
- only noun-adjective relations
- only verb-subject relations
- context: time of the current message
- context: user who wrote the message
Choose the correct contexts for your application

- larger window sizes – more topical
- dependency relations – more functional
- only noun-adjective relations
- only verb-subject relations
- context: time of the current message
- context: user who wrote the message
- ...
- the sky is the limit
Summary

**Distributional Semantics**
- Words in similar contexts have similar meanings.
- Represent a word by the contexts it appears in.
- But what is a context?

**Neural Models (word2vec)**
- Represent each word as dense, low-dimensional vector.
- Same intuitions as in distributional vector-space models.
- Efficient to run, scales well, modest memory requirement.
- Dense vectors are convenient to work with.
- Still helpful to think of the context types.