Word embeddings

BHI Youth Awards

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Representing words as vectors

- We need to pass numbers to our NLP models
- One-hot is a simple word-space vector representation. Words are represented by a vector encoding their position in an ordered vocabulary

```
aardvark          [1, 0, 0, 0, 0, …, 0, 0]
abacus            [0, 1, 0, 0, 0, …, 0, 0]
...               [...]
zumba             [0, 0, 0, 0, 0, …, 1, 0]
zygote            [0, 0, 0, 0, 0, …, 0, 1]
```

- As well as being necessary to represent our words numerically, it is also a step along the path of finding some abstraction of word meaning
- Alternatively, we could encode as the integer position in the vocabulary

```
aardvark          0
abacus            1
...               ...
zumba             n-1
zygote            n
```

Representing words as vectors

- Such a vector representation does not really encode meaning
- It is also high dimensional and sparse
- Can we encode meaning such a vector representation?
- Can we derive a low dimensional model of words?

- What about the context vectors we have looked at? Would they be an improvement?
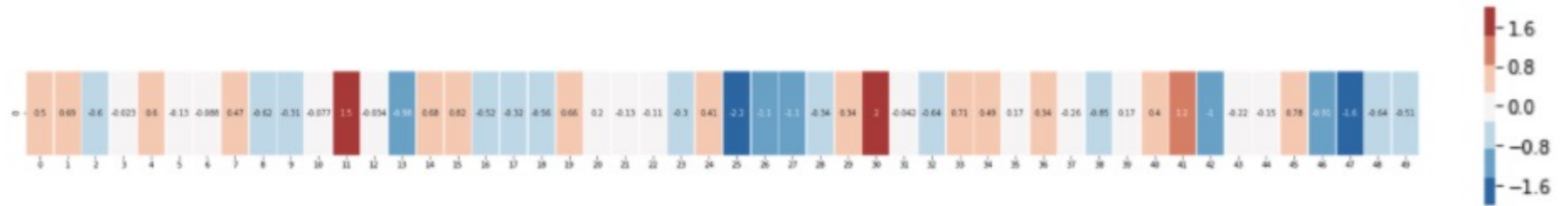
Intuition

Imagine a vector for the word "king", (GloVe based vector, trained on Wikipedia):

```
[ 0.50451 , 0.68607 , −0.59517 , −0.022801, 0.60046 , −0.13498 , −0.08813 , 0.47377 , −0.61798 , −0.31012 ,
−0.076666, 1.493 , −0.034189, −0.98173 , 0.68229 , 0.81722 , −0.51874 , −0.31503 , −0.55809 , 0.66421 , 0.1961
, −0.13495 , −0.11476 , −0.30344 , 0.41177 , −2.223 , −1.0756 , −1.0783 , −0.34354 , 0.33505 , 1.9927 ,
−0.04234 , −0.64319 , 0.71125 , 0.49159 , 0.16754 , 0.34344 , −0.25663 , −0.8523 , 0.1661 , 0.40102 , 1.1685 ,
−1.0137 , −0.21585 , −0.15155 , 0.78321 , −0.91241 , −1.6106 , −0.64426 , −0.51042 ]
```

Example from Jay Alammar, The illustrated Word2Vec:
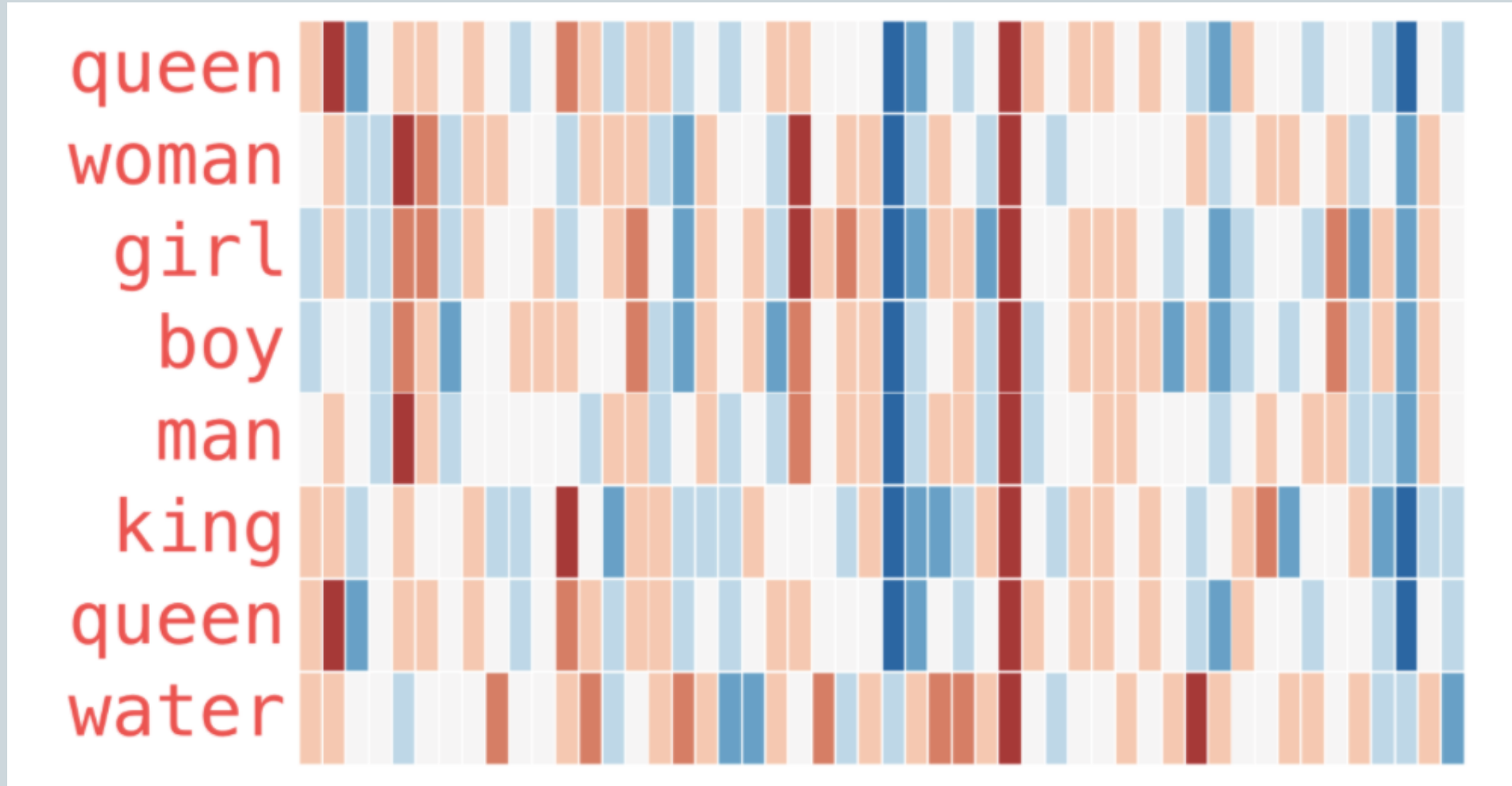*https://jalammar.github.io/illustrated-word2vec/*

Intuition

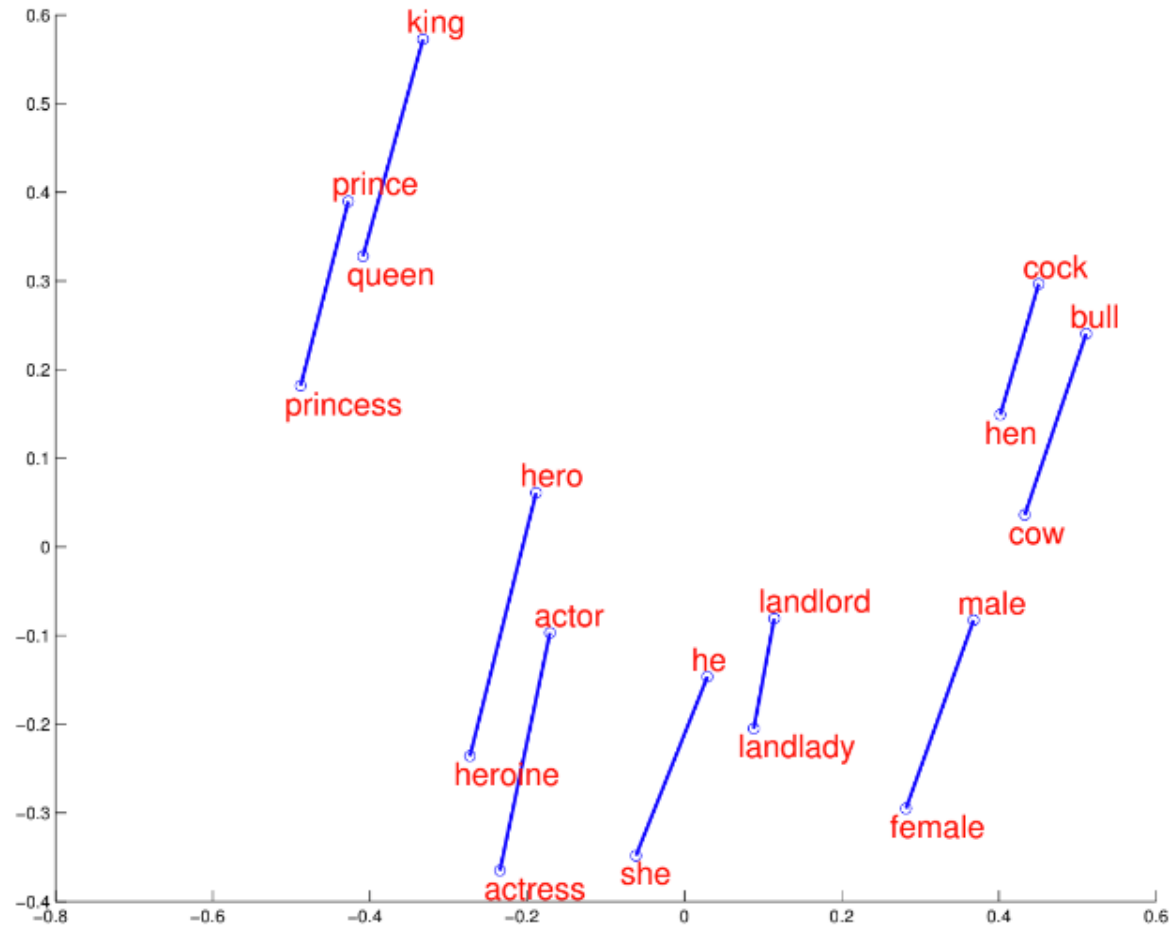We can visualise this as bands of different colours and intensities:

Intuition

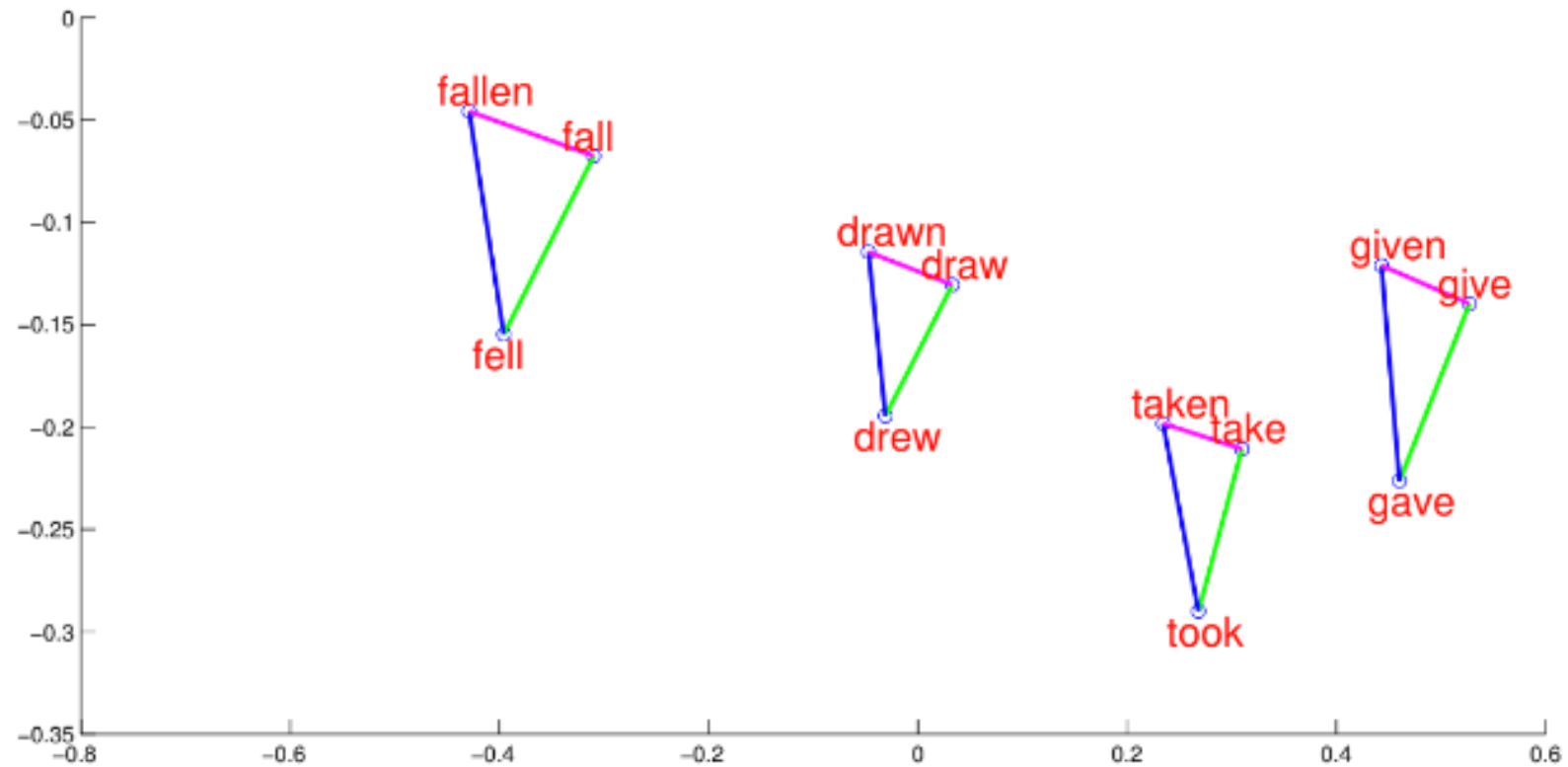Compare this word vector to vectors for other words:

Visualisation

2D projection from Mikolov et al, Google Research, NIPS 2013

Visualisation

2D projection from Mikolov et al, Google Research, NIPS 2013

Thank you

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