

Deep Learning

Episode 3

Natural Language Processing



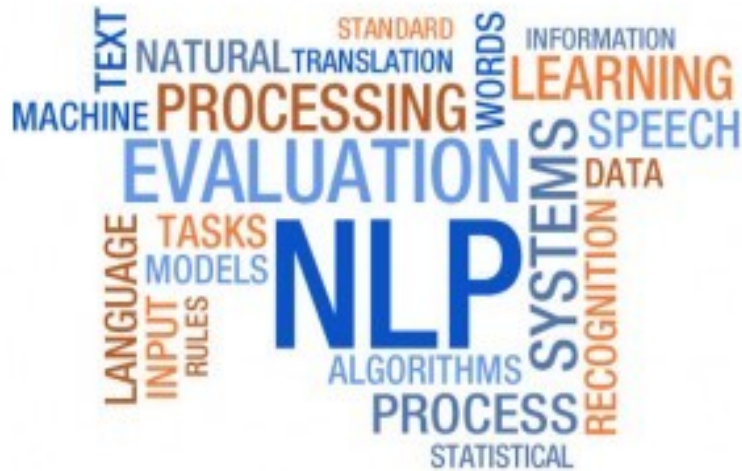
Yandex
Data Factory

LAMBDA 



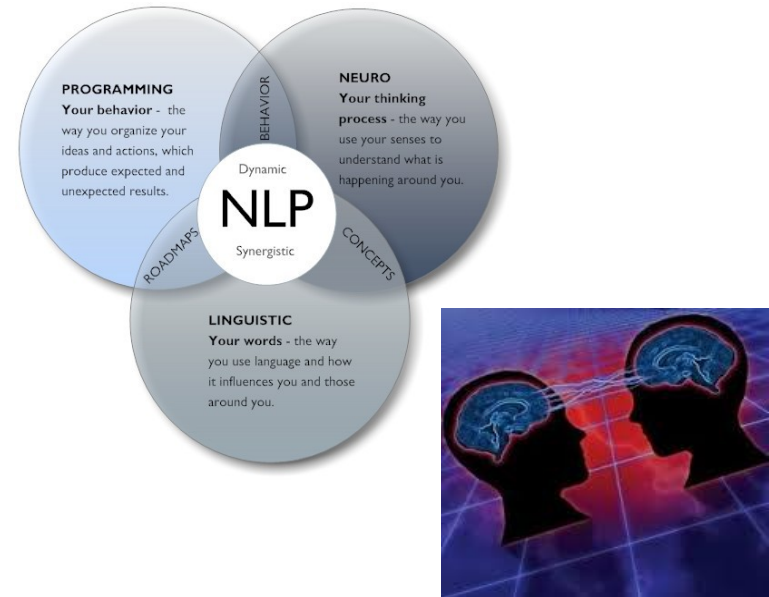
**British Hedgehog
Preservation Society**

What is NLP?



NLP

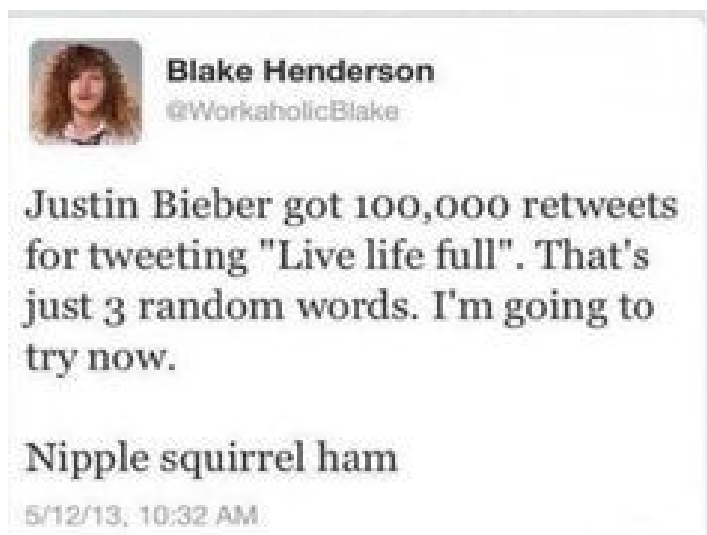
Light side of the force



NLP

Dark side of the force₂

Text classification/regression



Other usage:

- Adult content filter (safe search)
- Detect age/gender/interests by search queries
- Convert movie review into “stars”
- Survey public opinion for the new iphone Vs old one (SNA)

...

Text 101

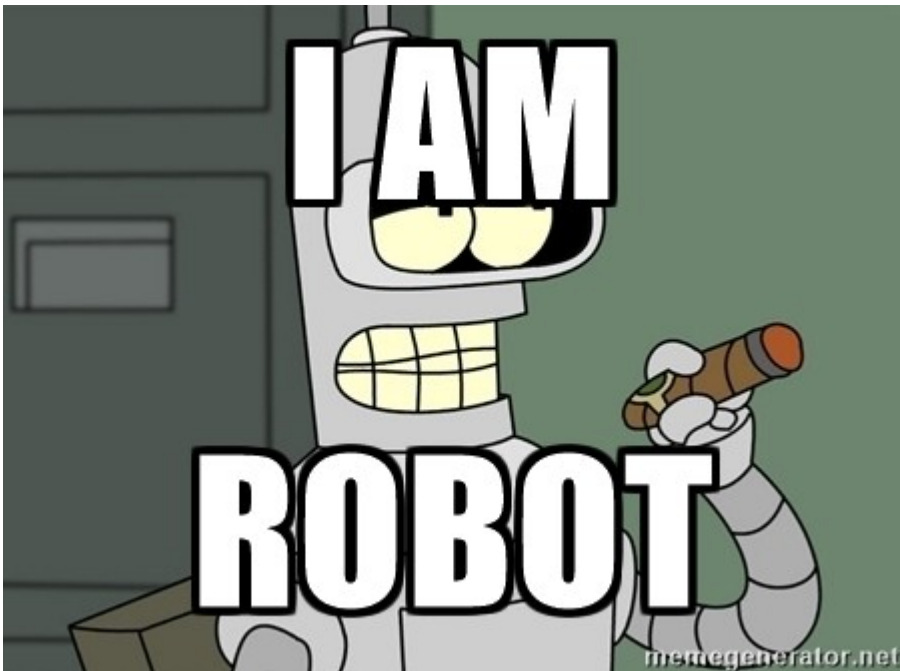
text

/tɛkst/ 

noun

1. a book or other written or printed work, regarded in terms of its content rather than its physical form.
"a text which explores pain and grief"
synonyms: written work, **book**, **work**, printed work, **narrative**
"a text which explores pain and grief"
2. the main body of a book or other piece of writing, as distinct from other material such as notes, appendices, and illustrations.
"the pictures are clear and relate well to the text"
synonyms: words, **wording**; **More**

Text 101: nlp perspective



Text:

A sequence of tokens(words).

Token/word:

A sequence of characters.

Character:

An atomic element of text.

(ツ)

Text 101: tokens

Evolution of the hyaluronan synthase (*has*) operon in *Streptococcus zooepidermicus* and other pathogenic streptococci

↓ Filtering

Evolution of the hyaluronan synthase *has* operon in *Streptococcus zooepidermicus* and other pathogenic streptococci

↓ Tokenization

Evolution

of

the

hyaluronan

synthase

has

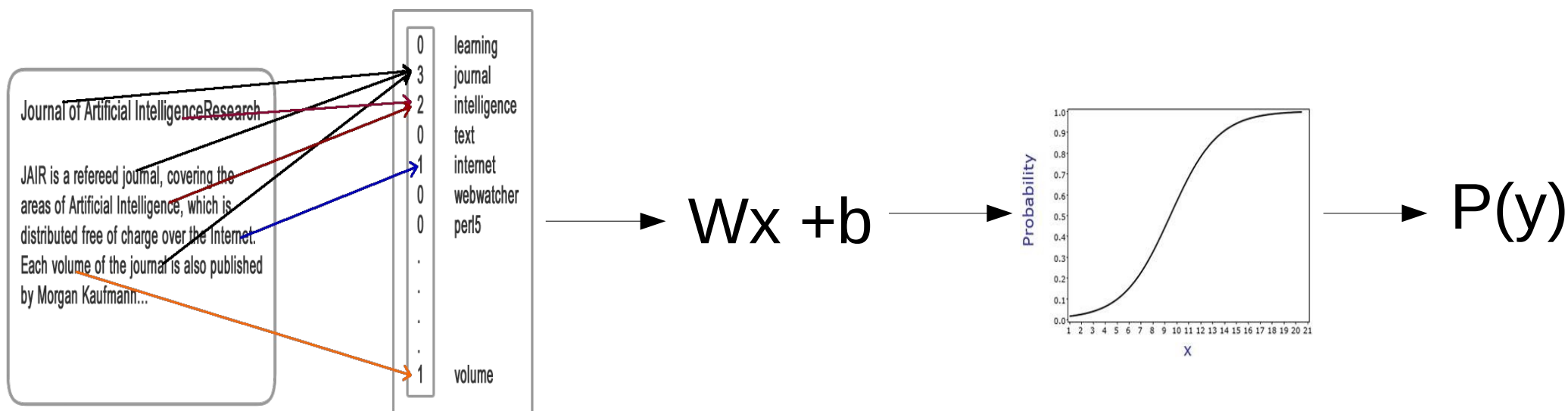
operon

...

What is a text 101: bag of words

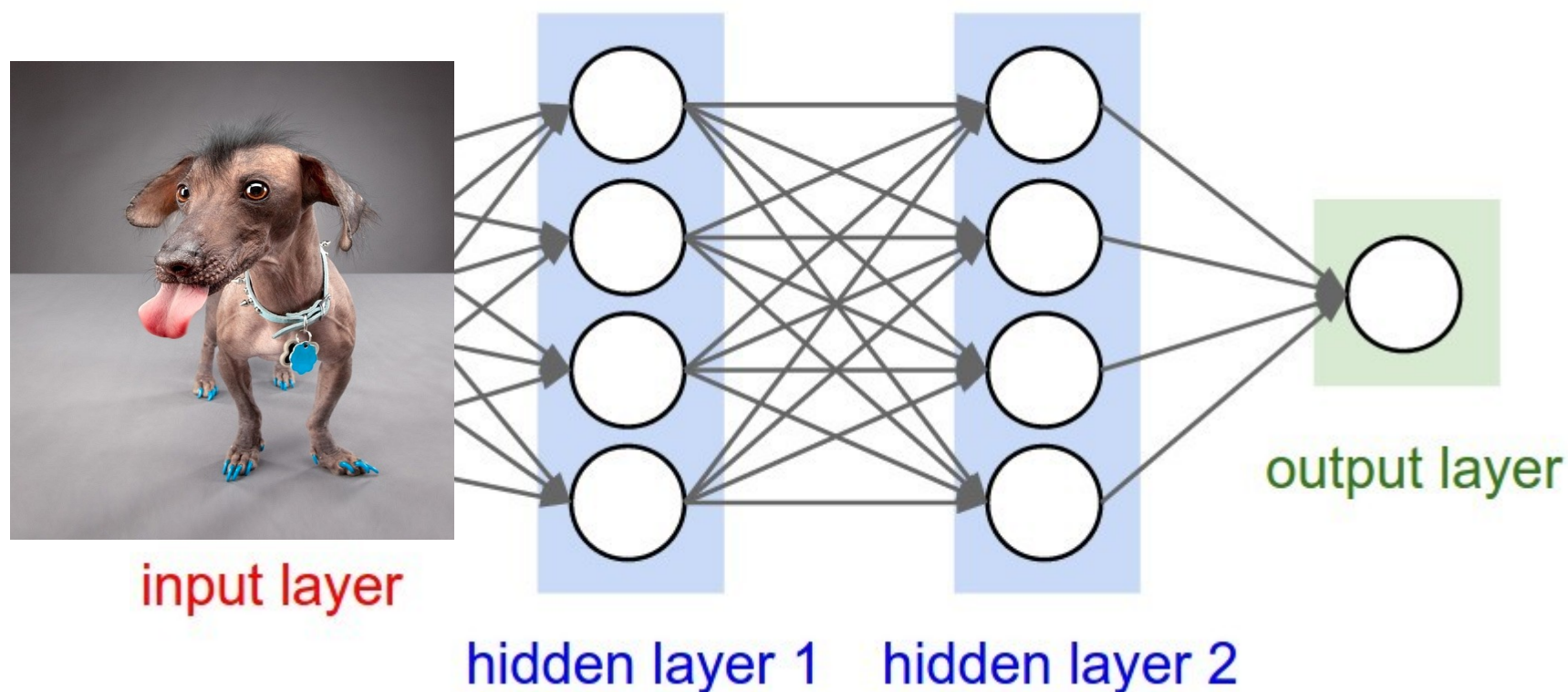


Text classification: BoW + linear



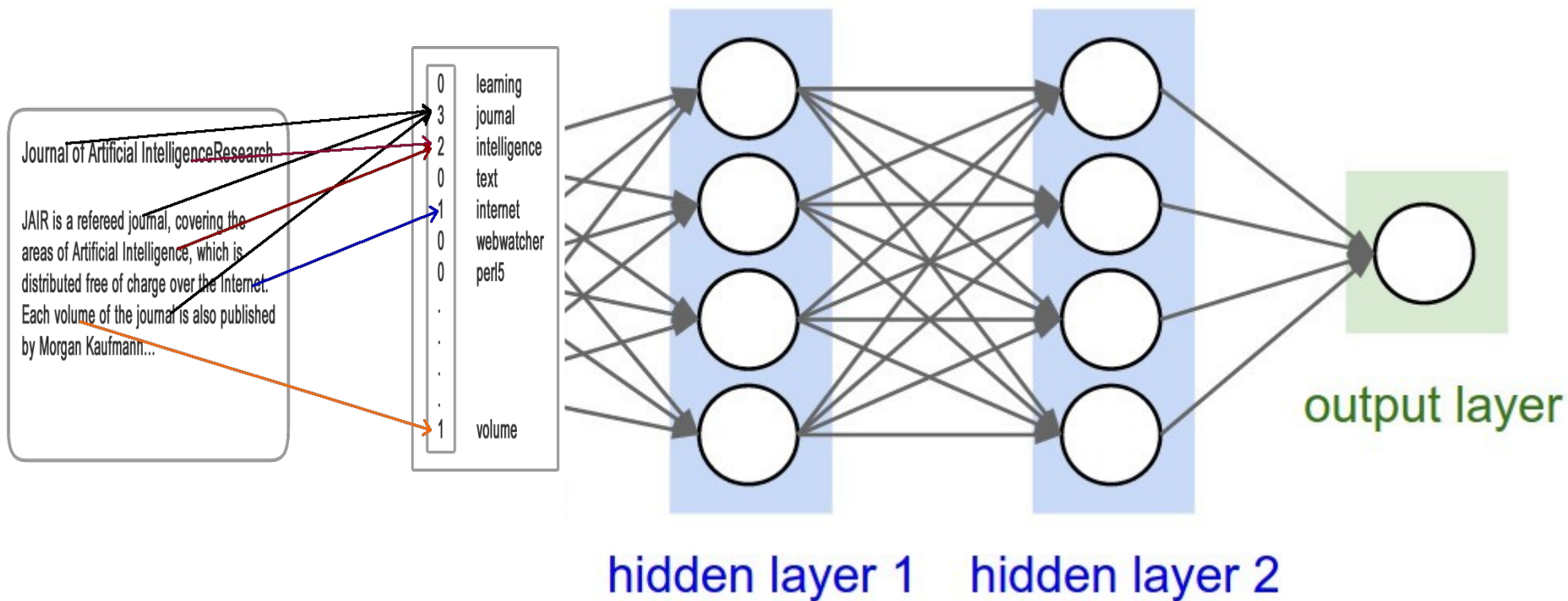
Divination: How many features (approx) will such model have?

Text classification: BoW + linear

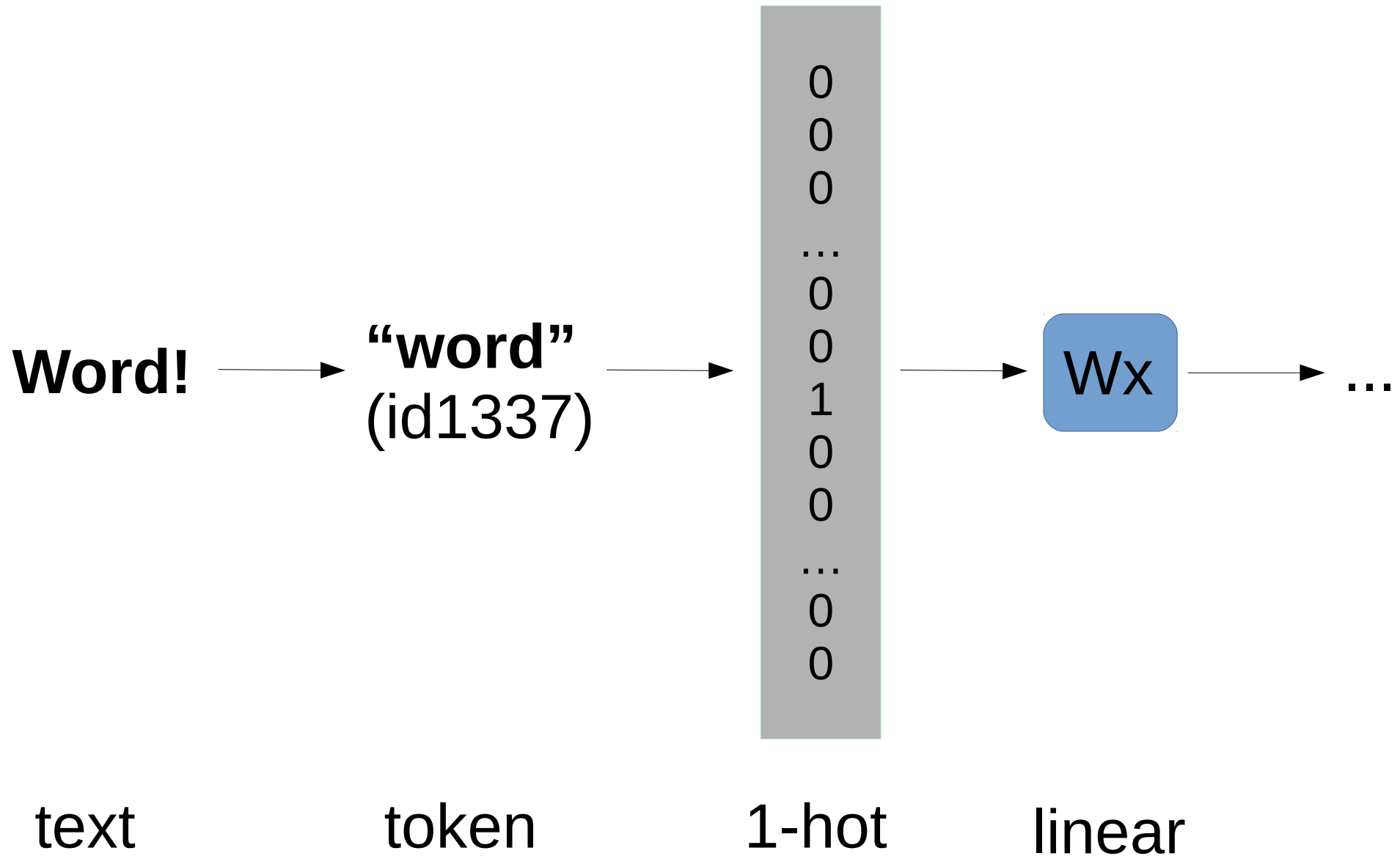


Oops... wrong slide...

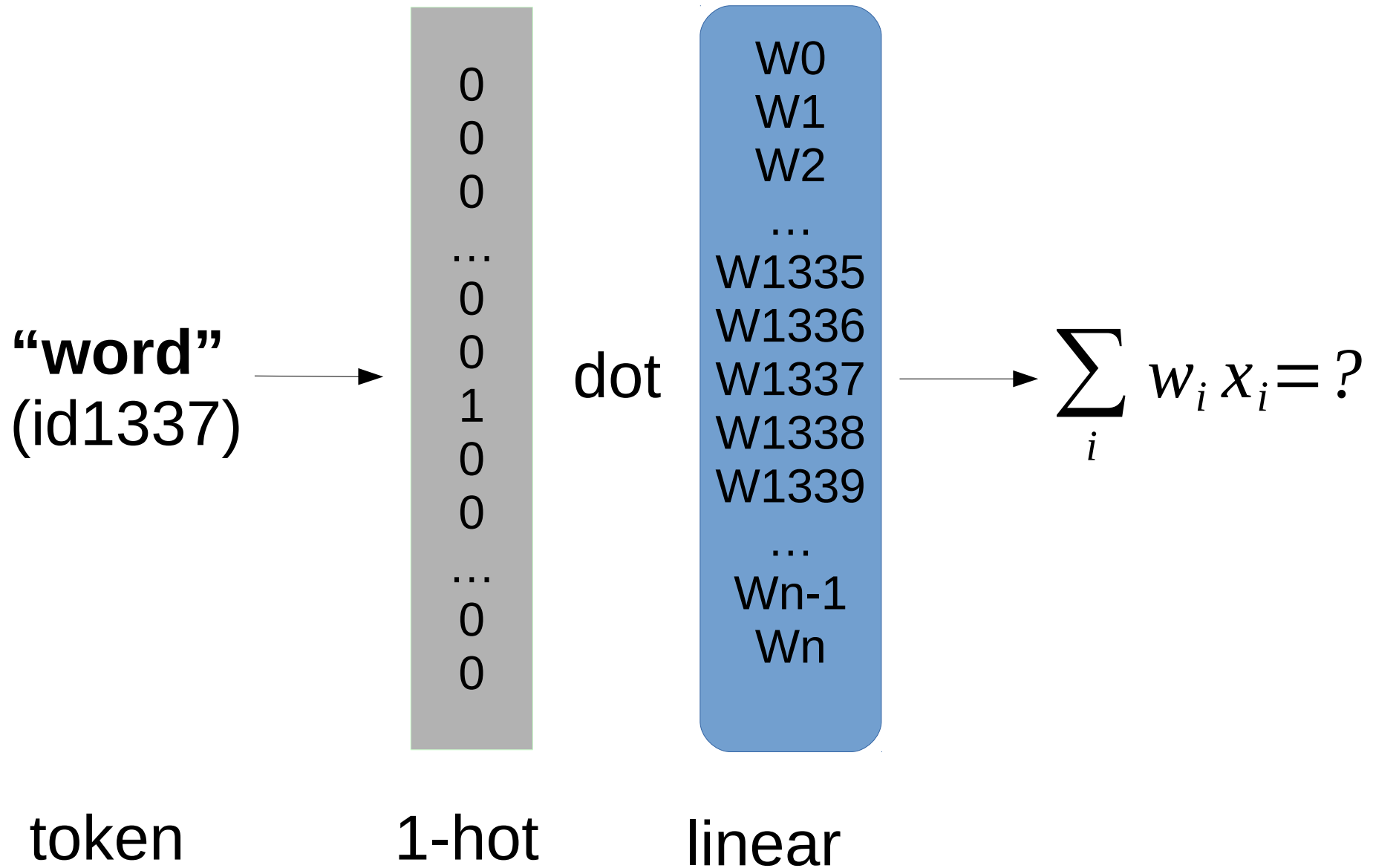
Text classification: BoW + linear



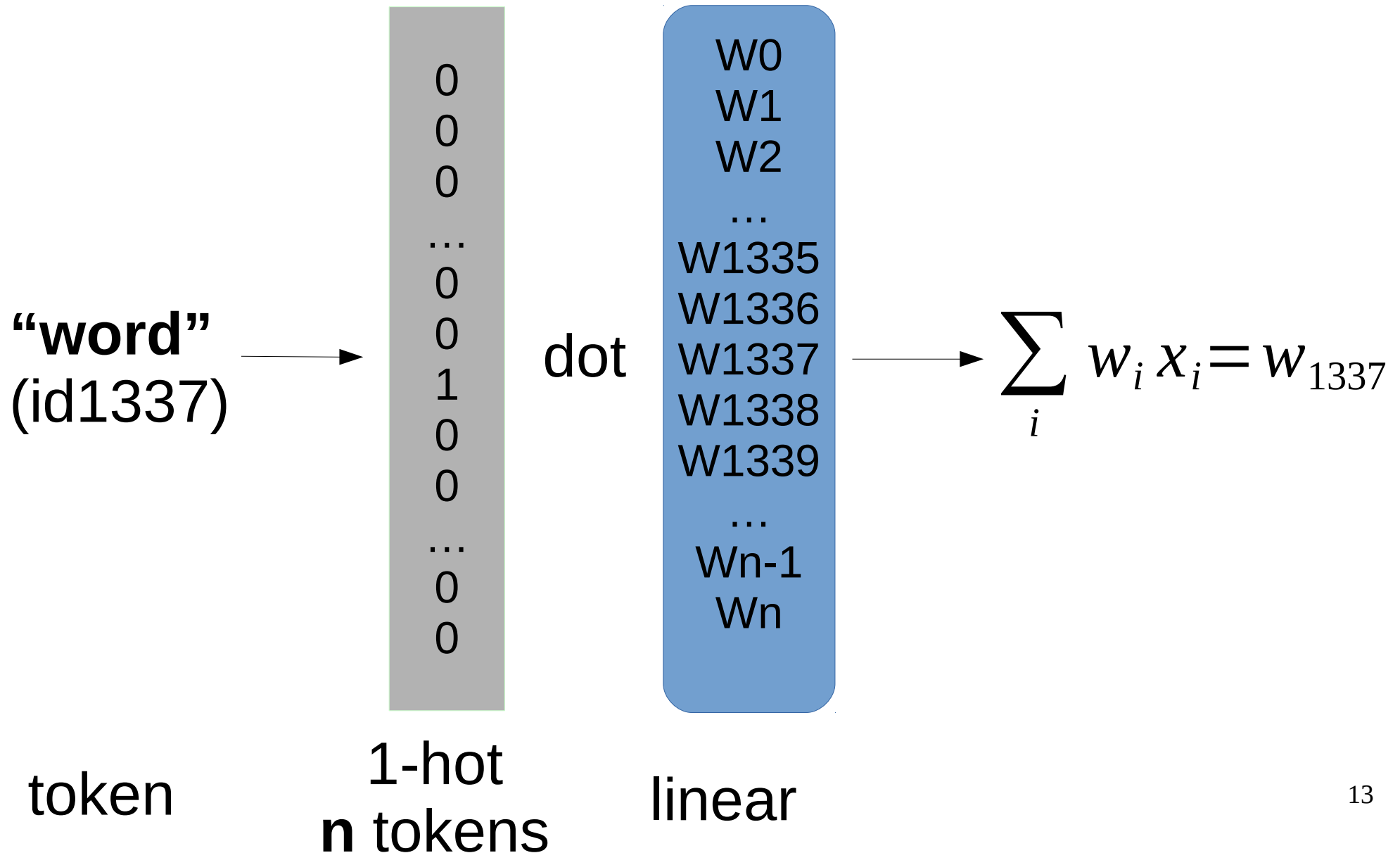
Sparse vector products



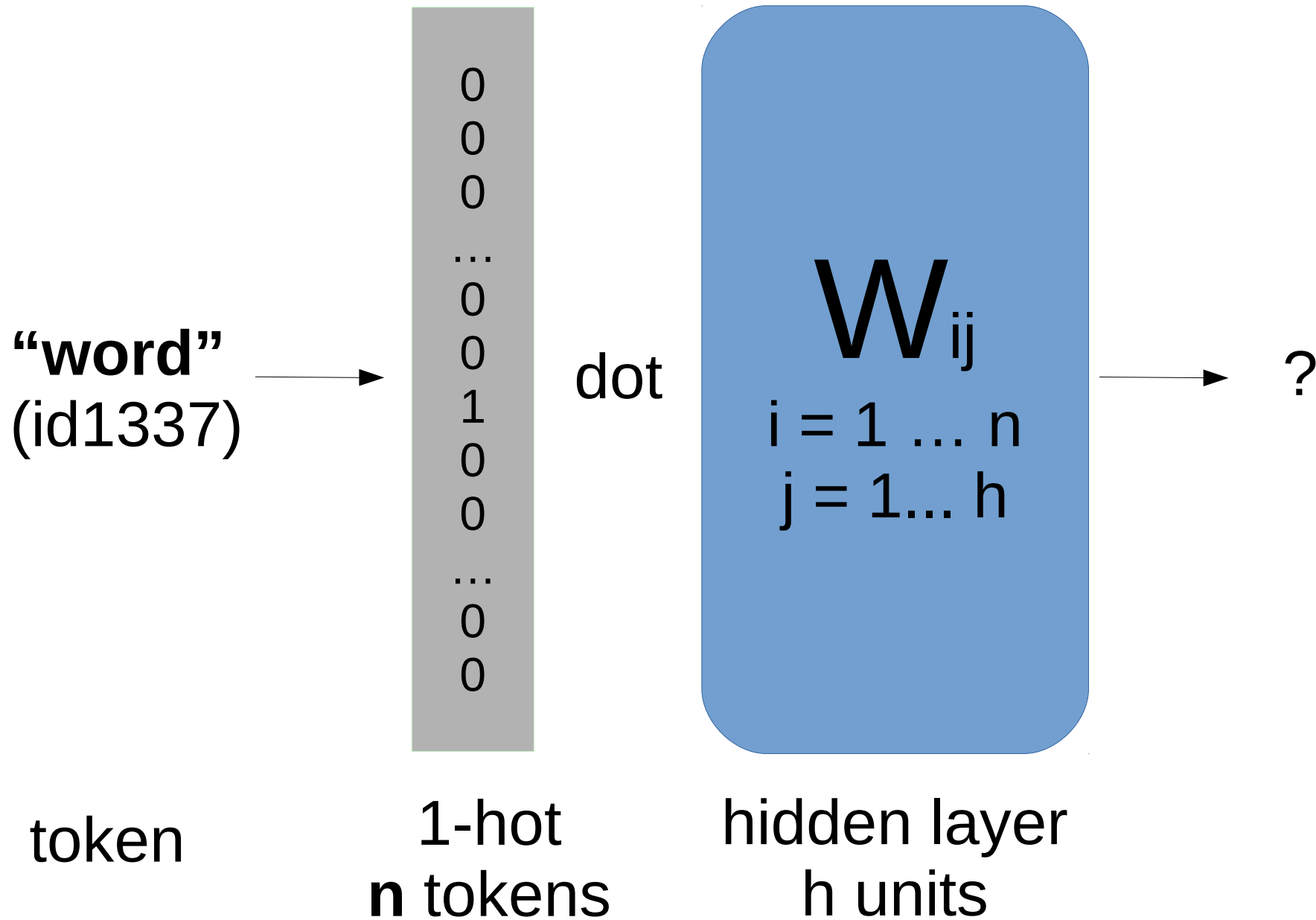
Sparse vector products



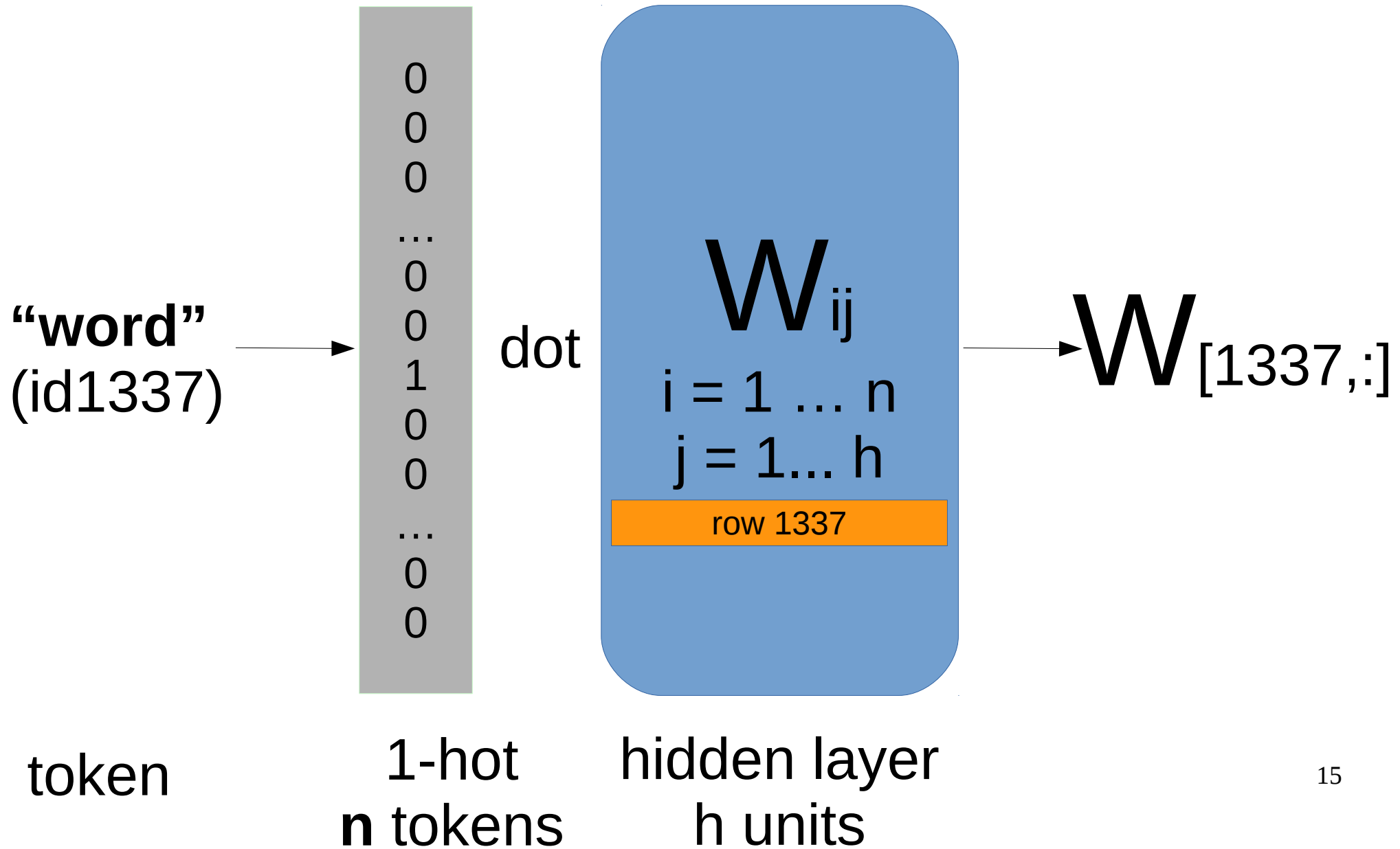
Sparse vector products



Sparse vector products

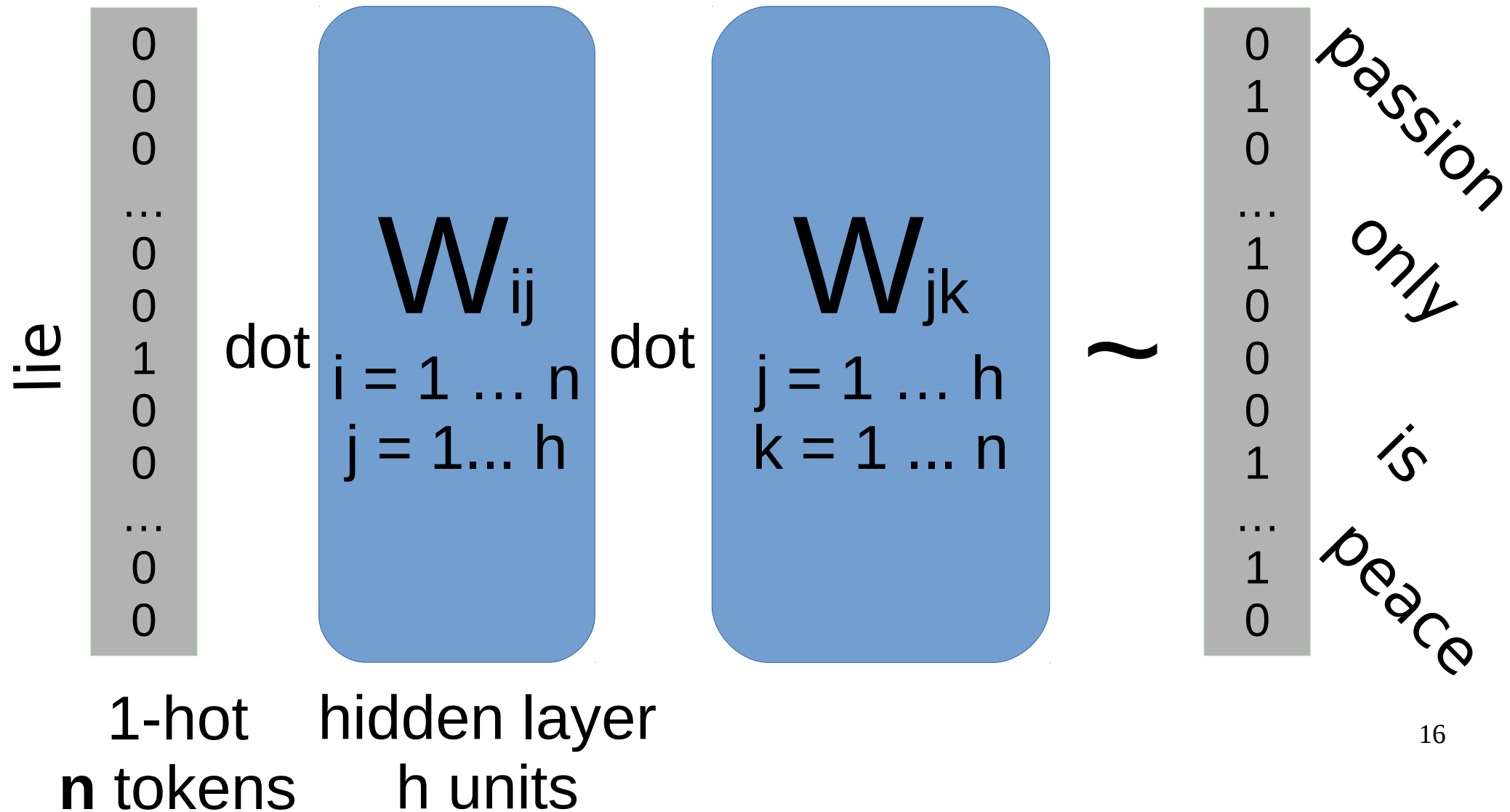


Embedding



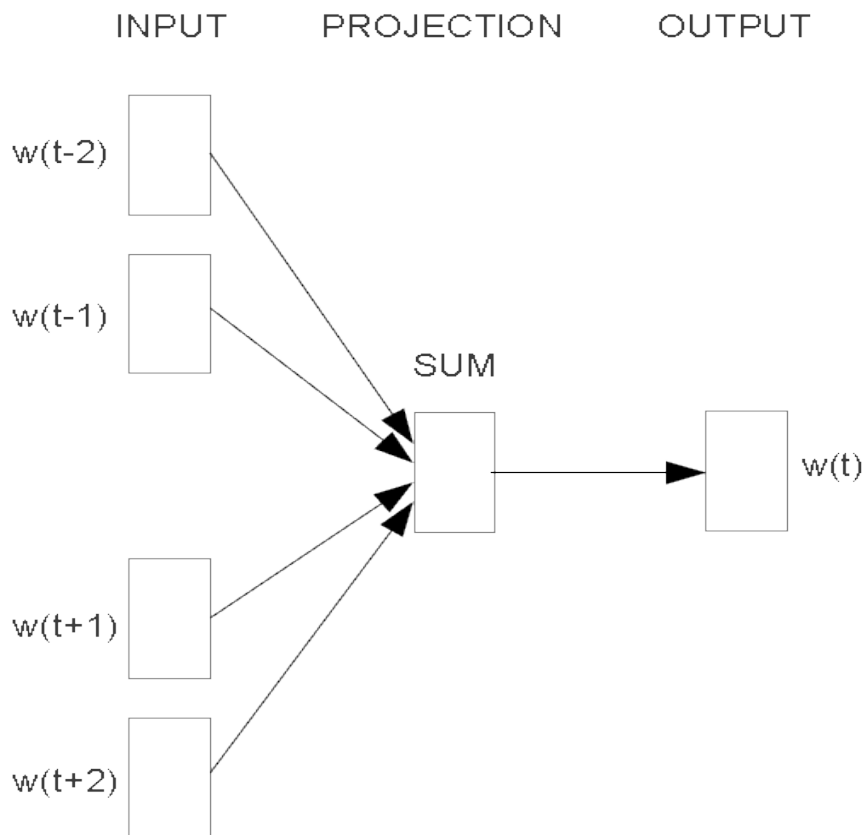
Embedding: word2vec

“Peace is a lie, there is only passion”

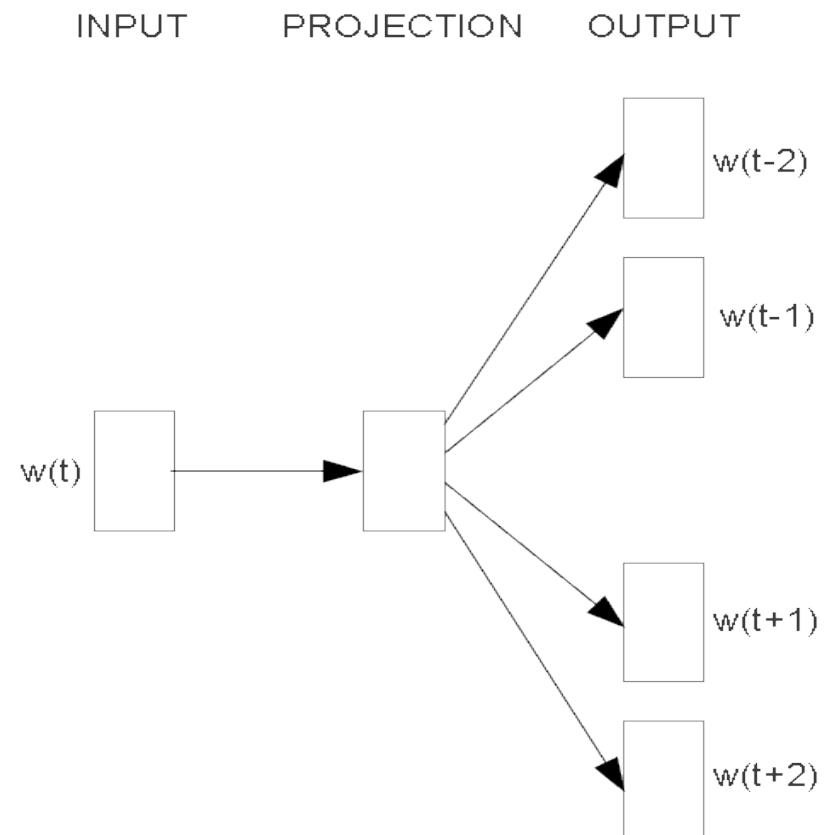


Embedding: word2vec

the *distributional hypothesis* : similar context = similar meaning



CBOW



Skip-gram

Embedding: word2vec

Side effect: synonyms

“nice” \sim “beautiful”

“hard” \sim “difficult”

Side effect: word algebra

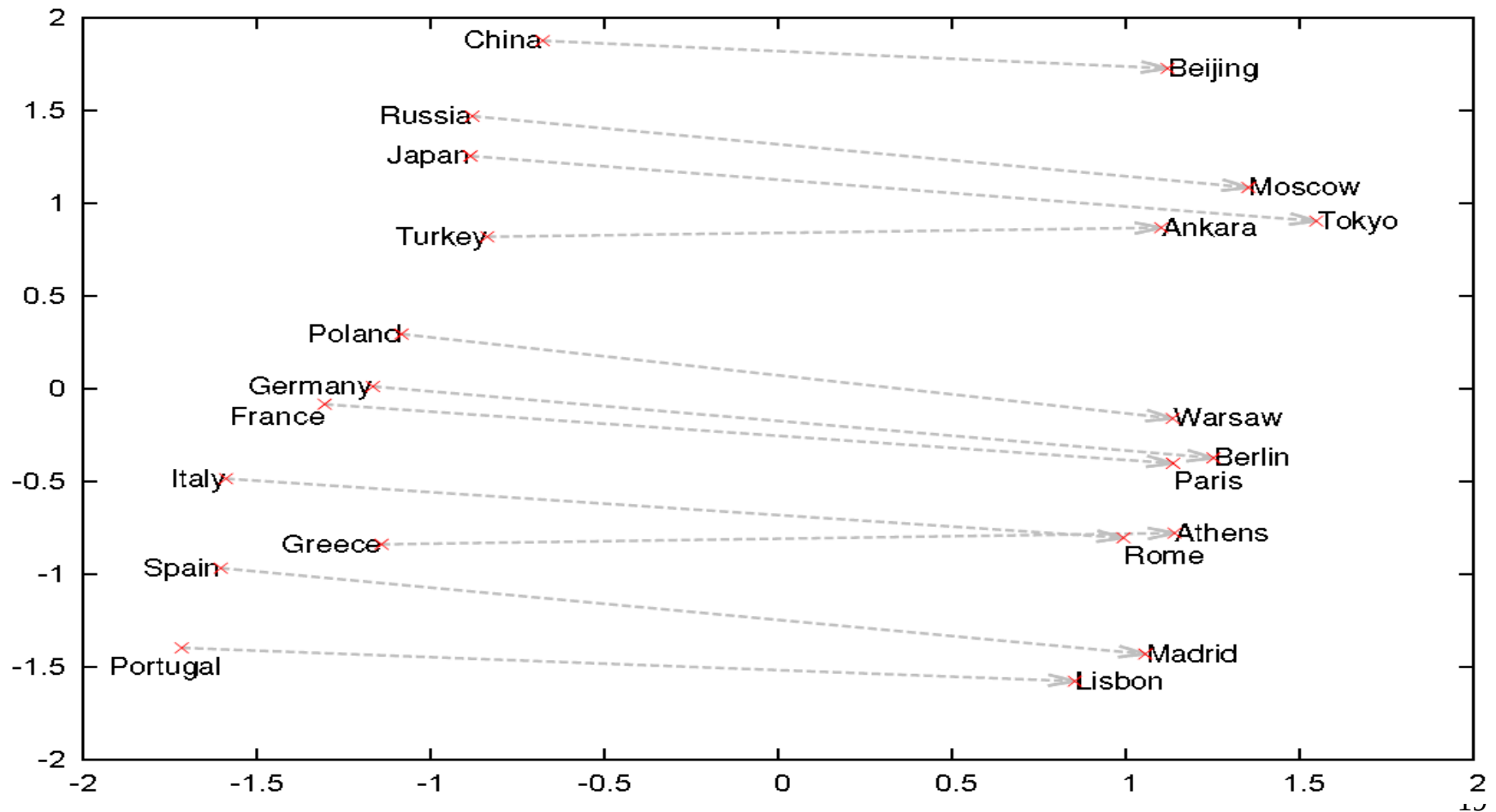
“king” - “man” + “queen” \sim “queen”

“moscow” - “russia” + “france” \sim “paris”

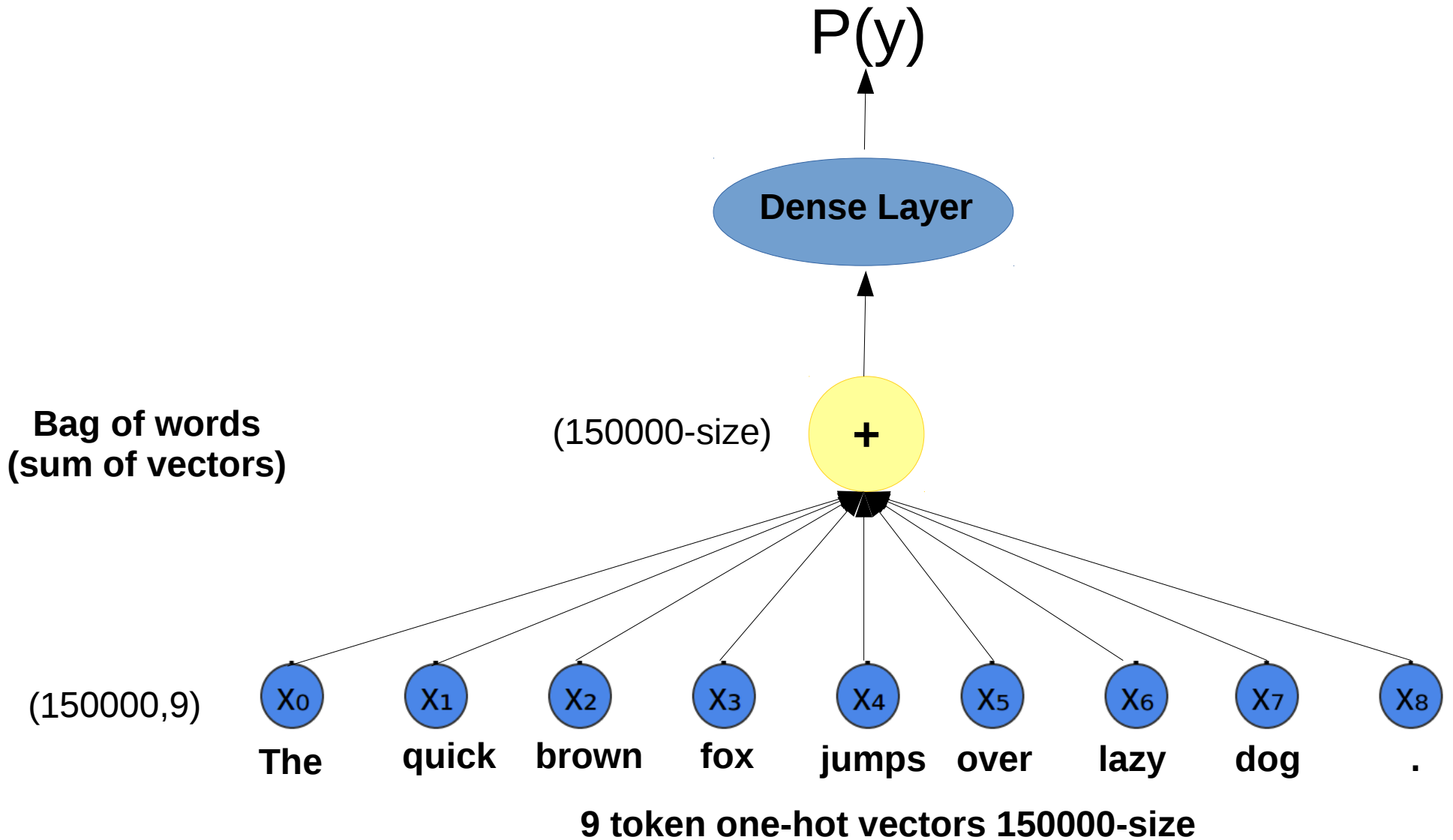
Embedding: word2vec

Side effect: word algebra

Country and Capital Vectors Projected by PCA

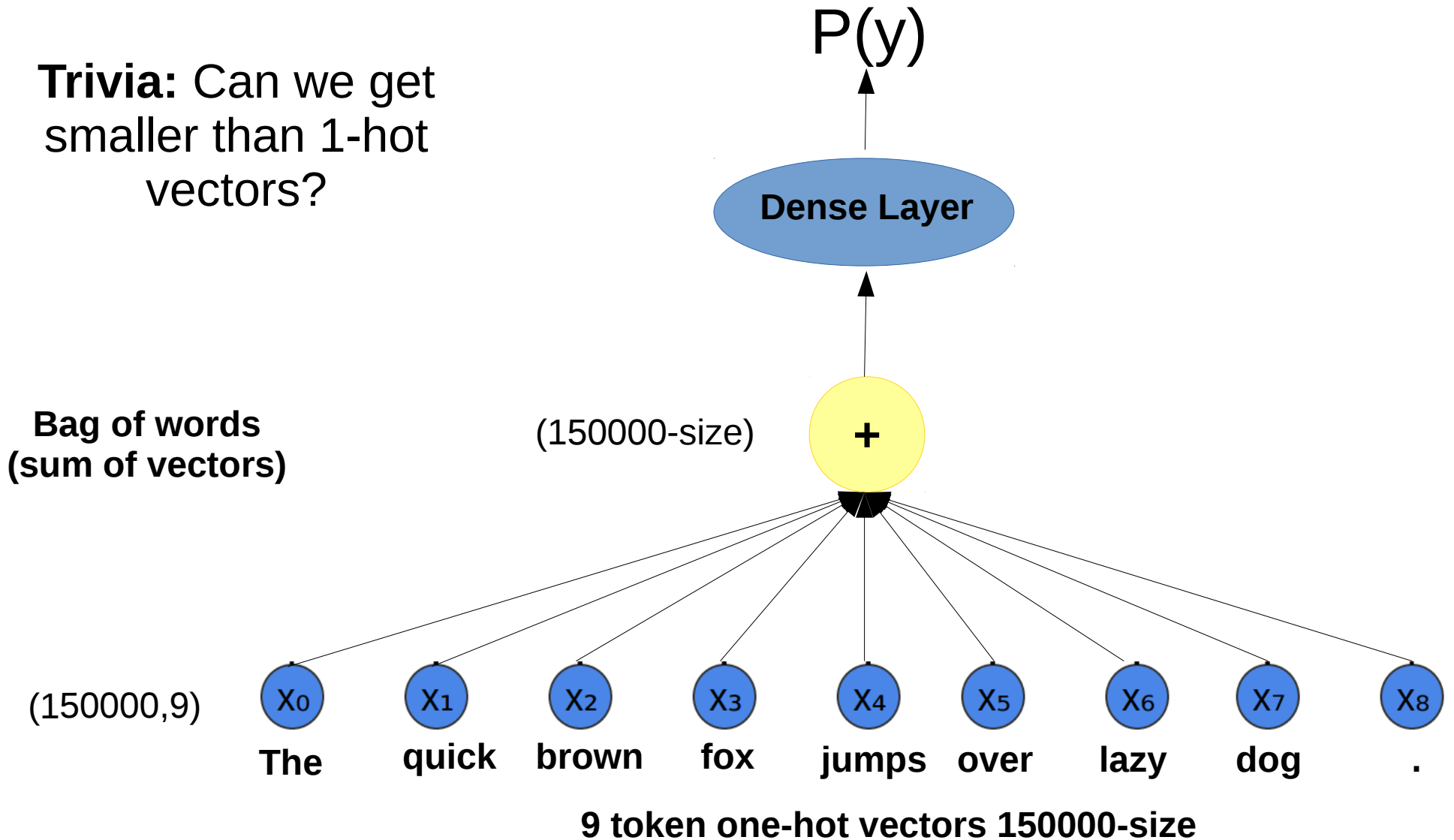


Text NN



Text NN

Trivia: Can we get smaller than 1-hot vectors?



Text NN

Option 1:

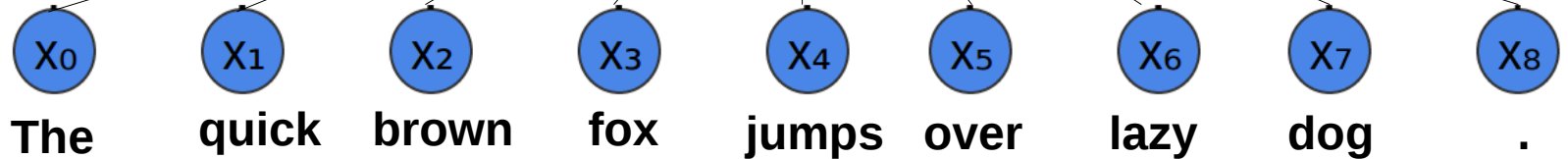
Use pre-trained embedding
(e.g. glove on wikipedia)

Option 2:

Train embedding
(regular backprop)

Bag of words
(sum of vectors)

(100,9)



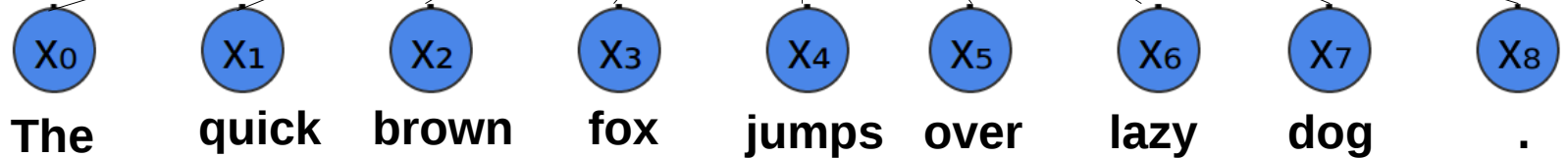
9 token embedding vectors 100-size

Text NN

Best of both worlds:
Start with pre-trained
embedding and train it

**Bag of words
(sum of vectors)**

(100,9)



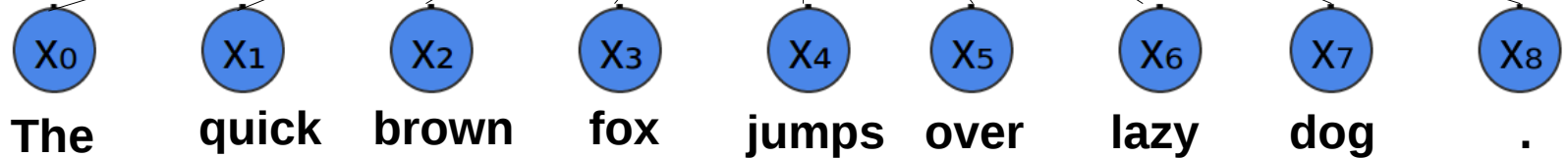
9 token embedding vectors 100-size

Text NN

Trivia: How to change the bag of words operation to compute not “how many such words are there” but “is there at least one such word”

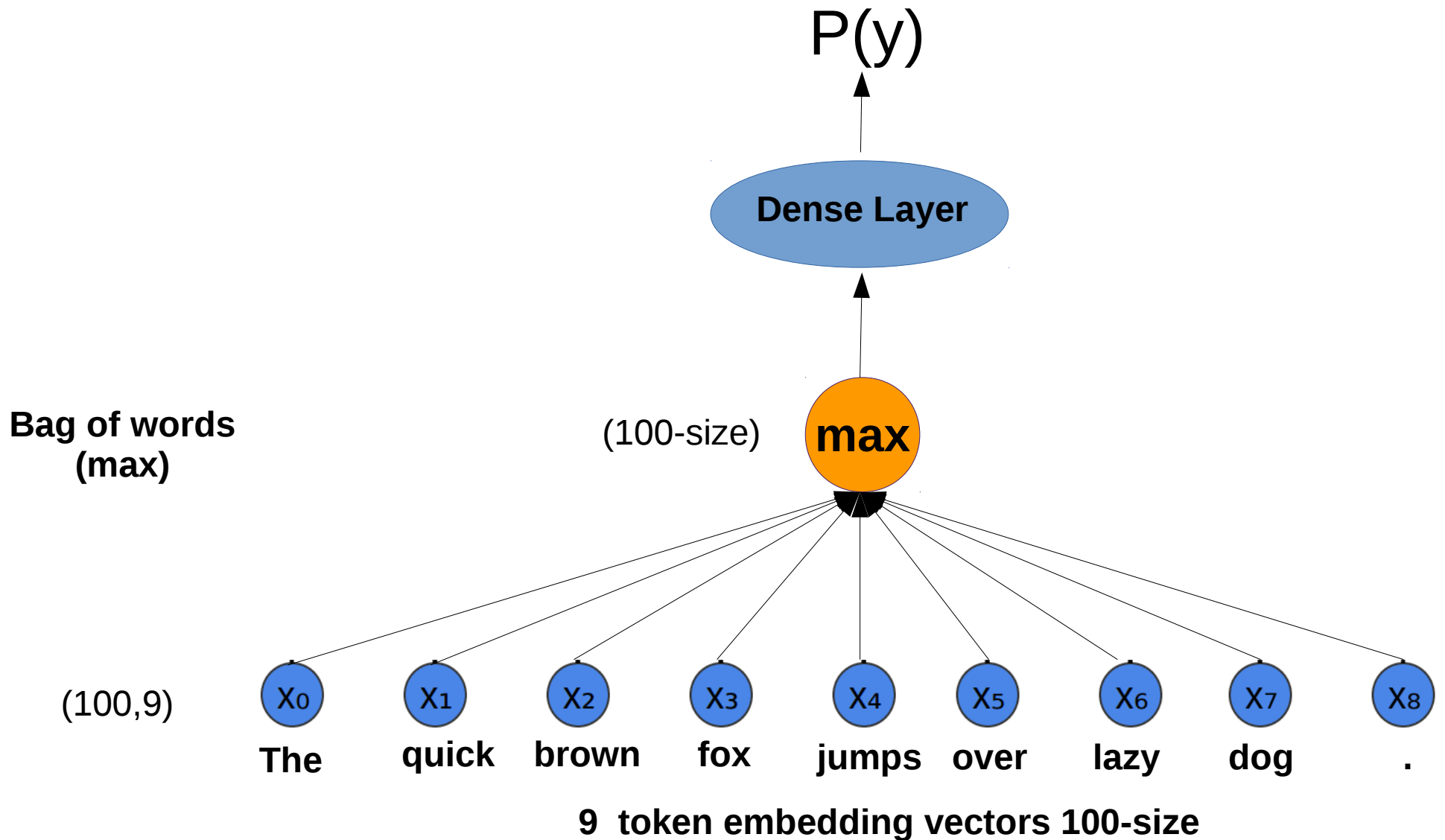
Bag of words
(sum of vectors)

(100,9)



9 token embedding vectors 100-size

Text NN



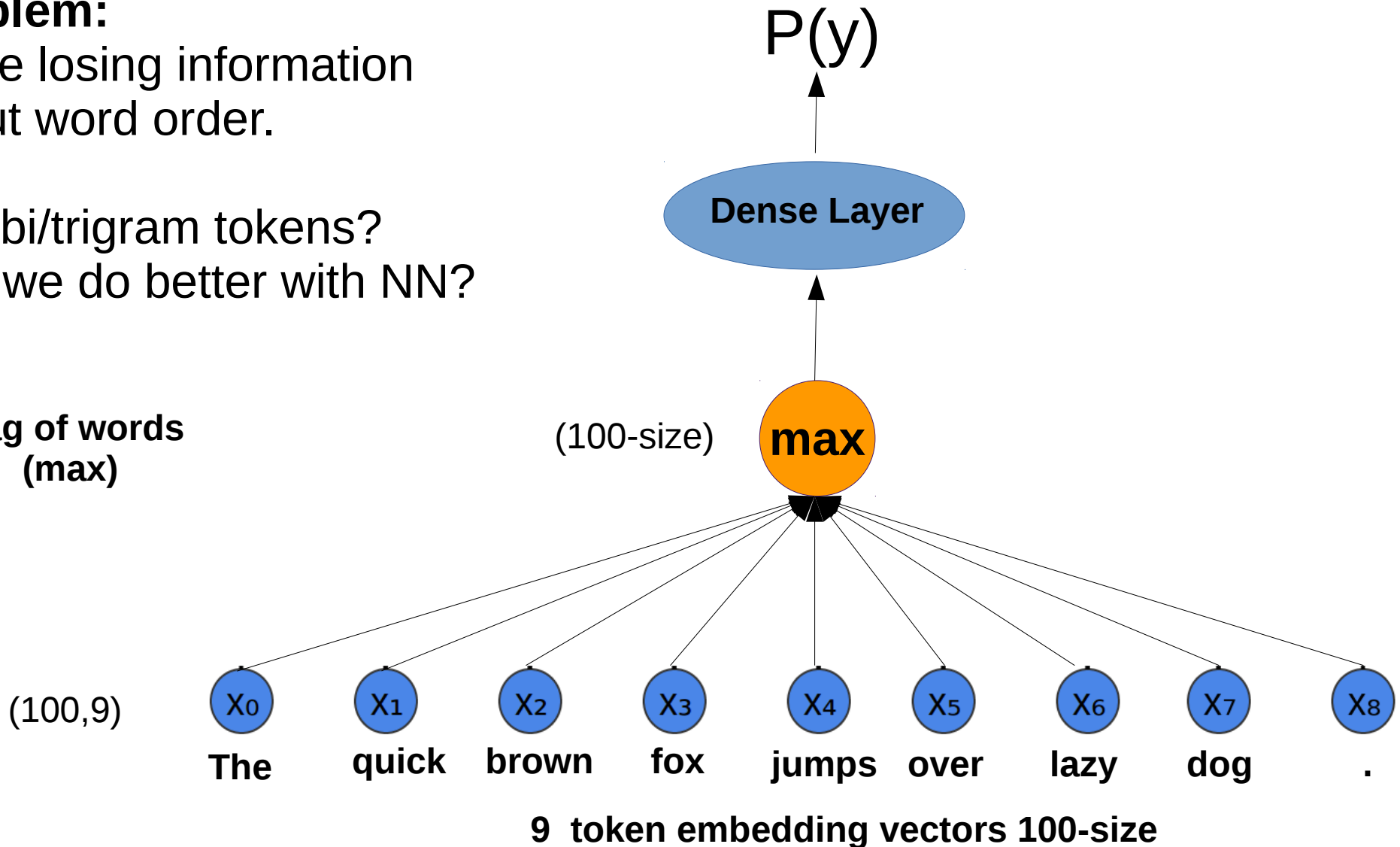
Text NN

Problem:

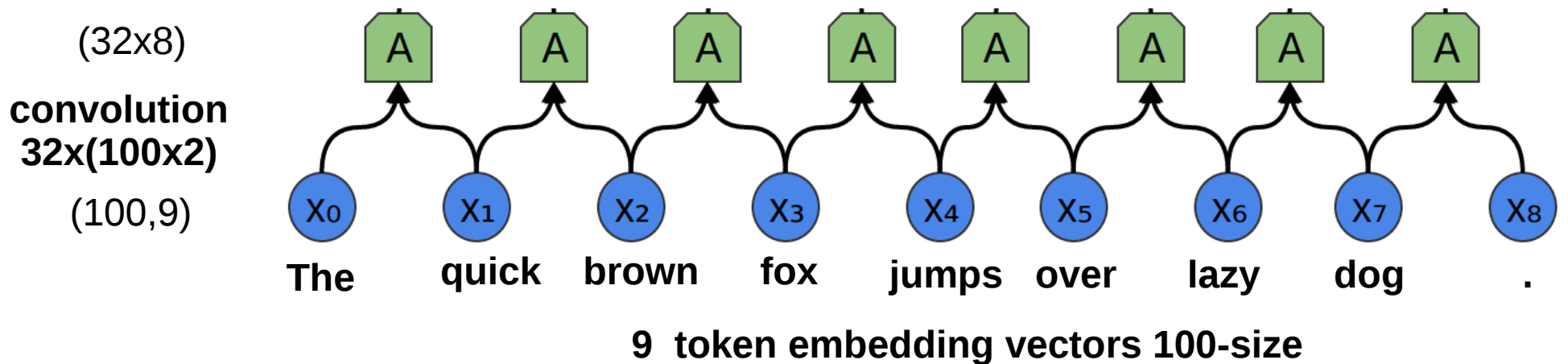
We're losing information about word order.

Use bi/trigram tokens?
Can we do better with NN?

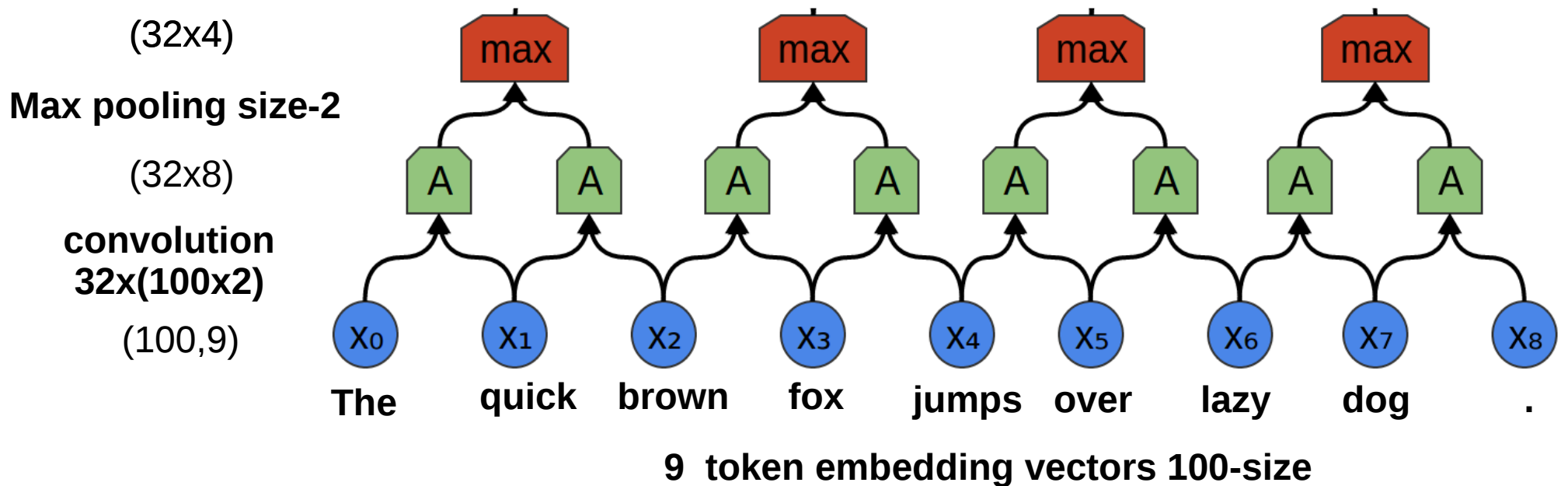
Bag of words
(max)



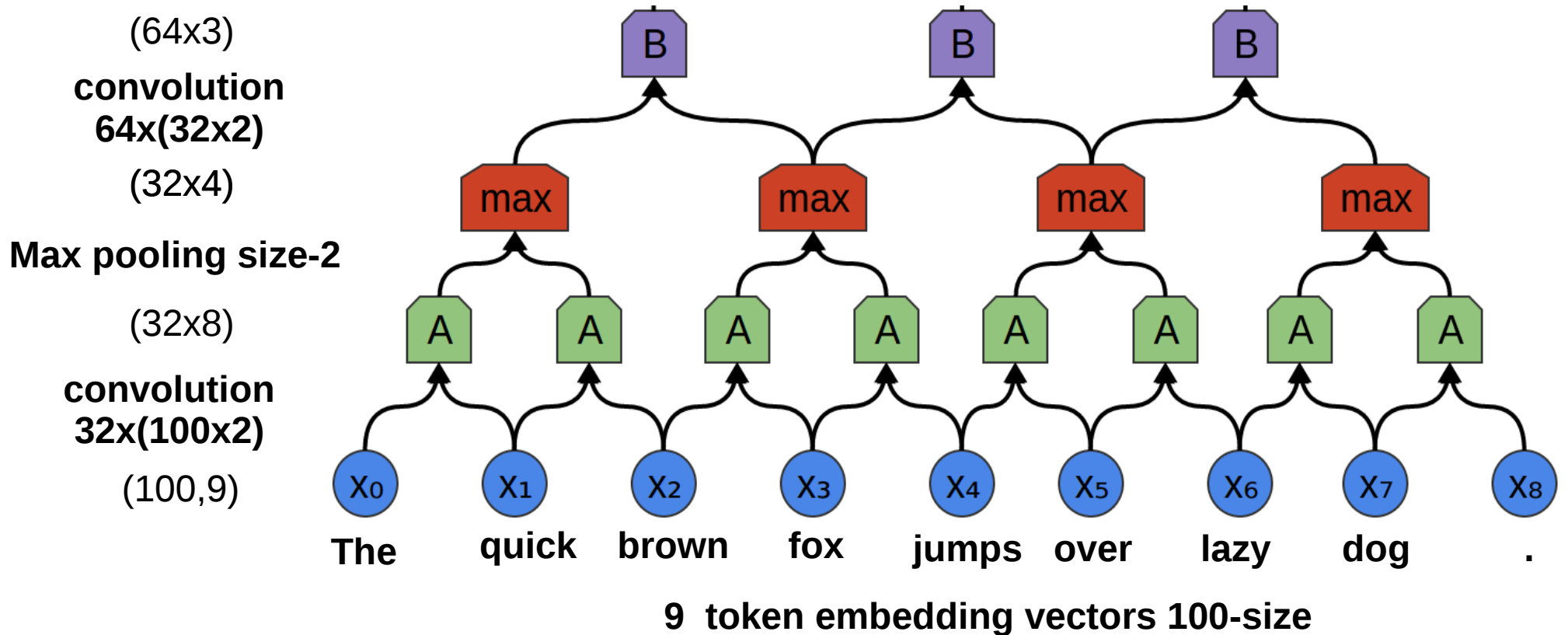
Text CNN



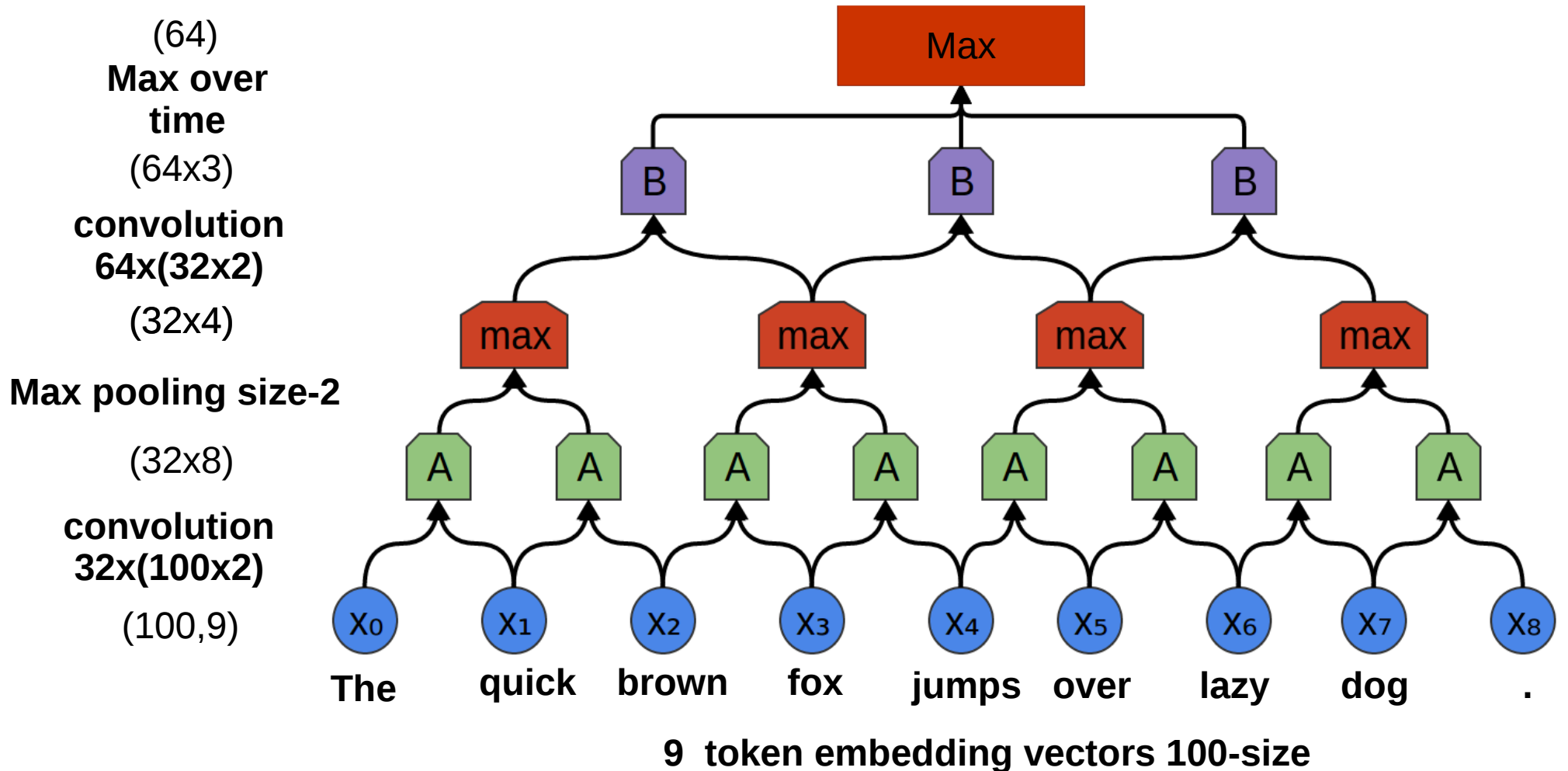
Text CNN



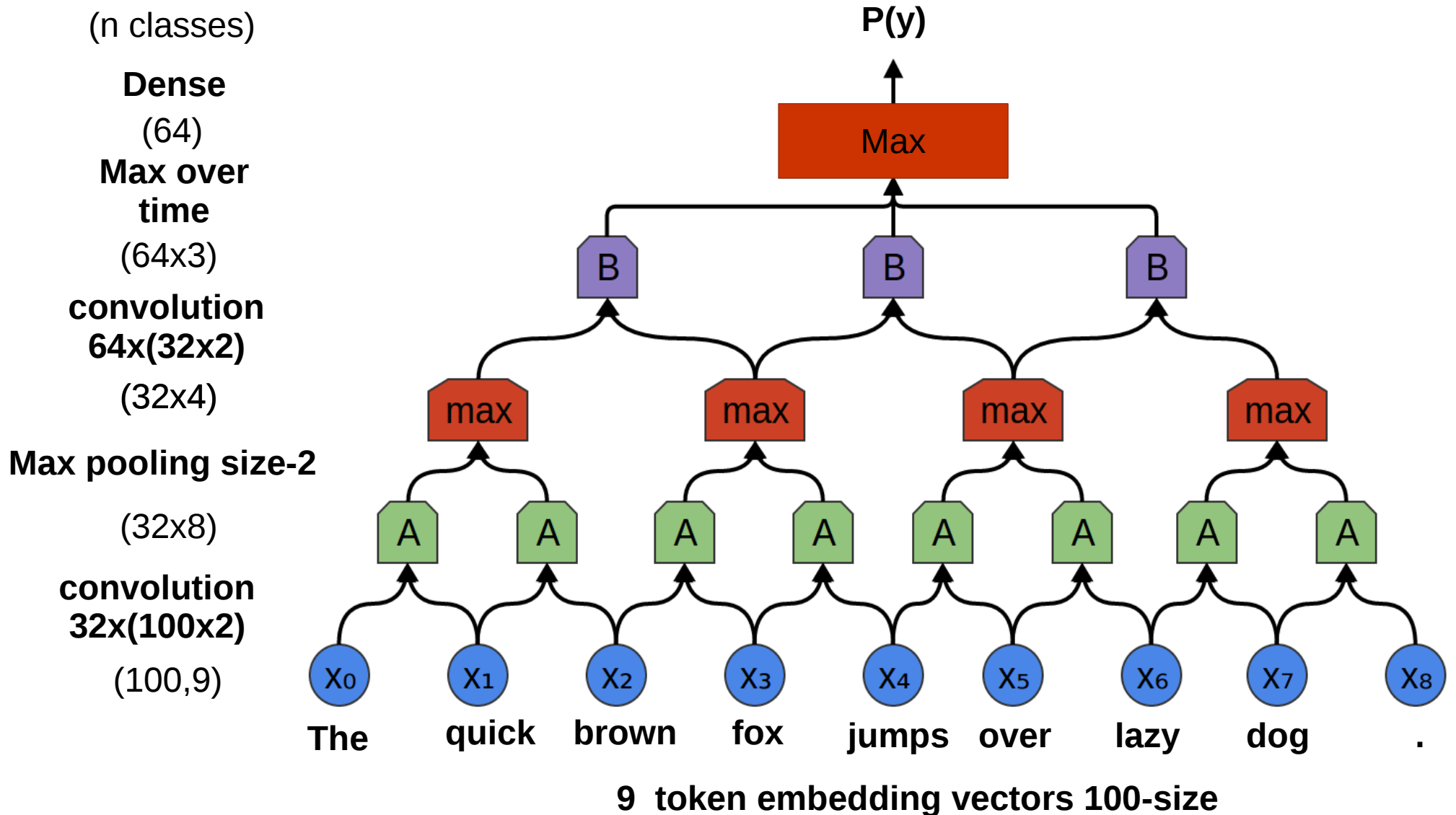
Text CNN



Text CNN

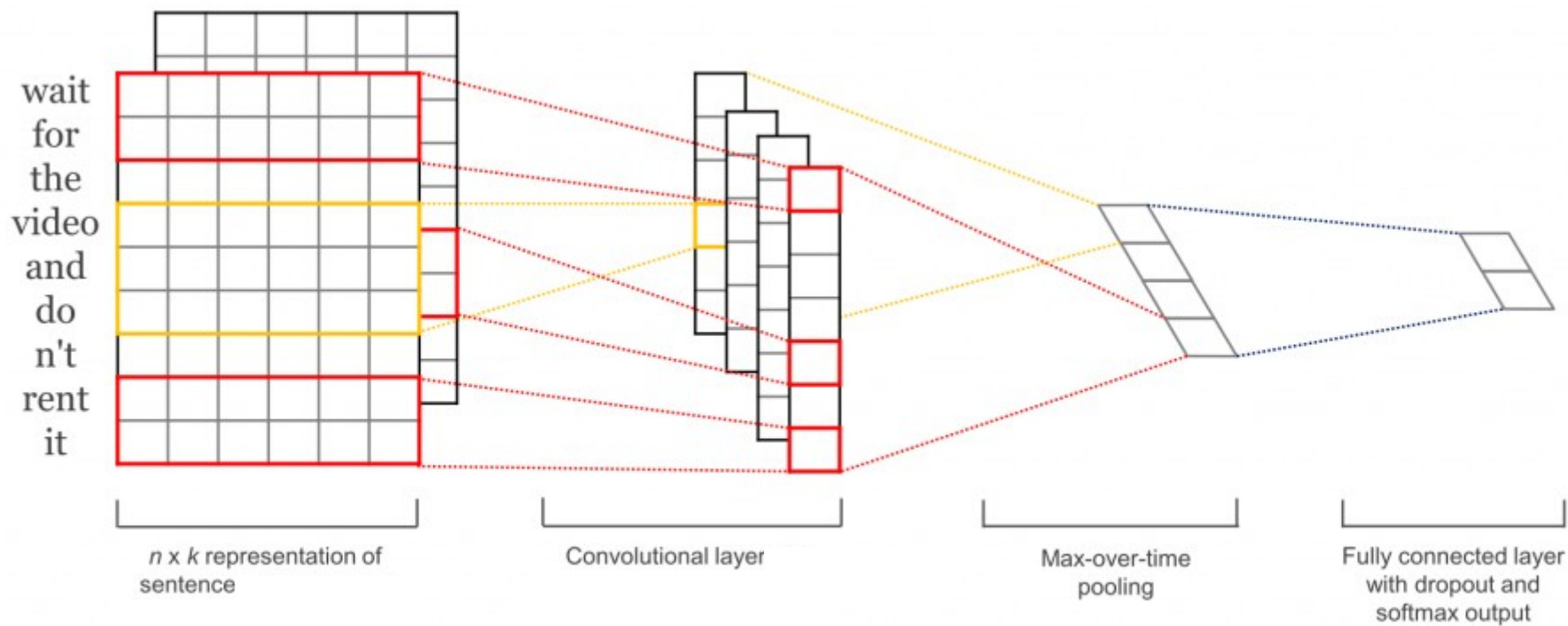


Text CNN

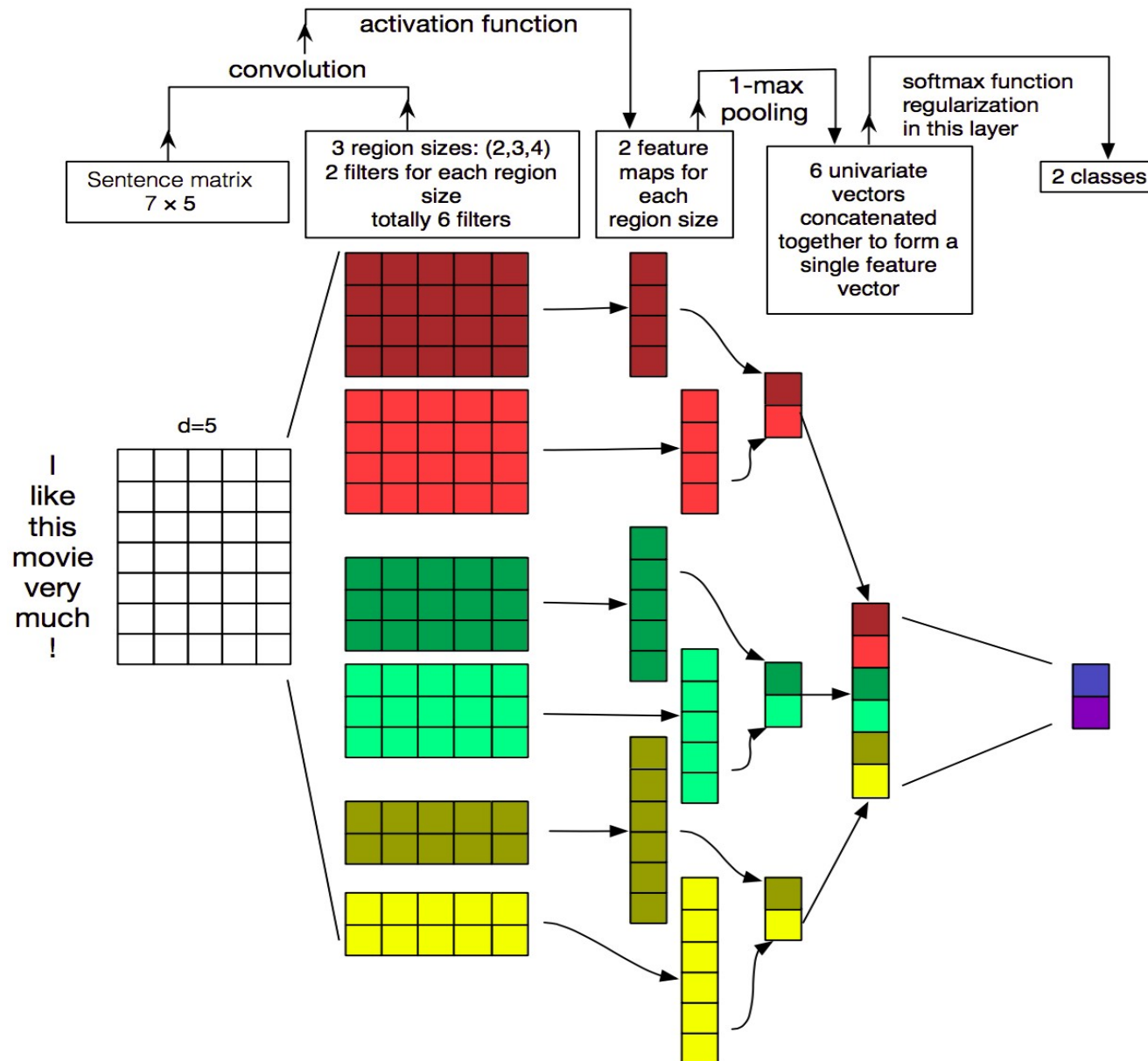


Text CNN

1-hot/emb



Text CNN: monsters



Text CNN: monsters

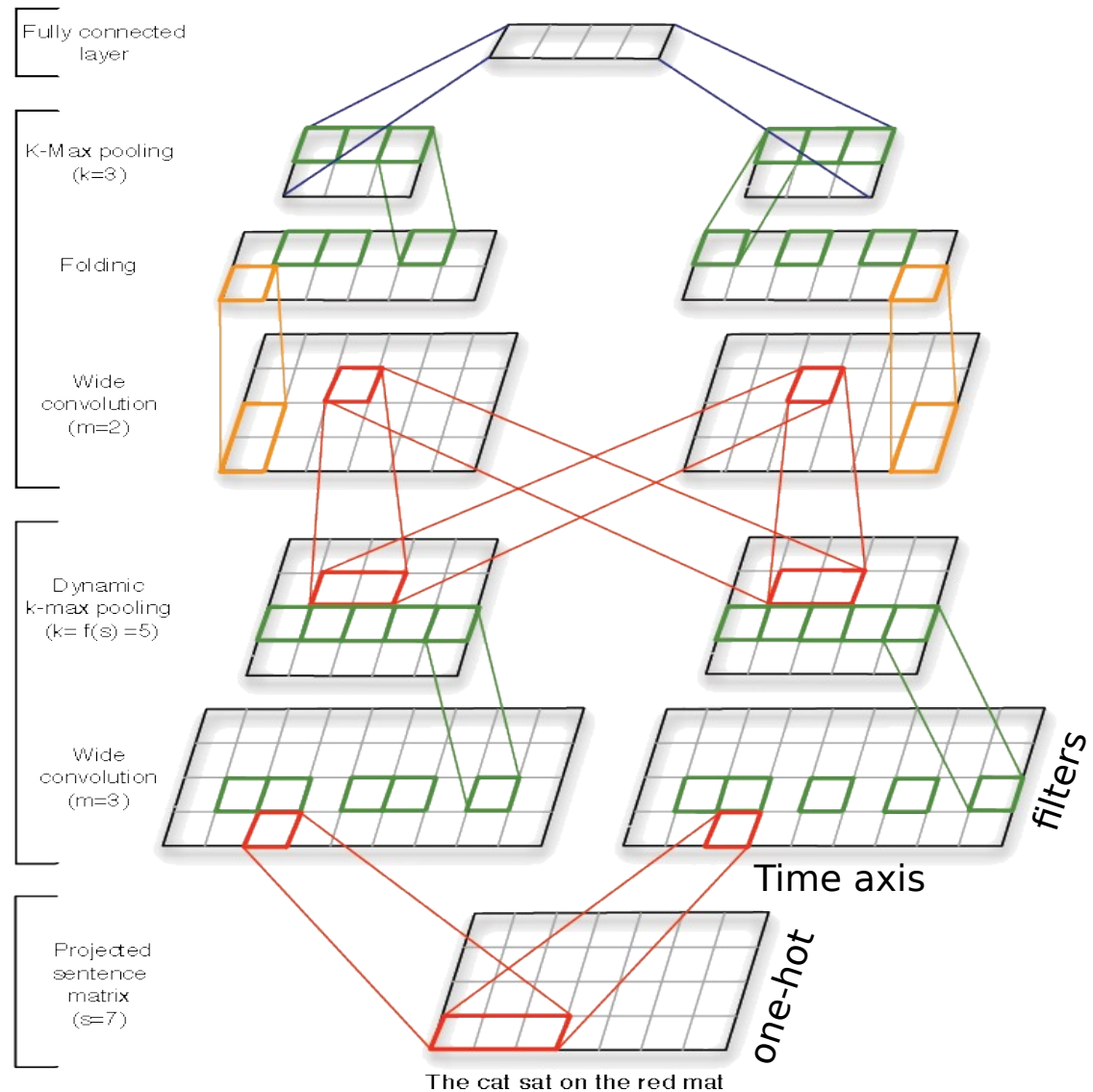
Dense layer

“Folding” = sum pooling along embedding direction

“K-max pooling” = take not 1 but k highest activations in their original order.
E.g. $(0,1,3,2,0,1,4,1) \rightarrow (3,2,4)$

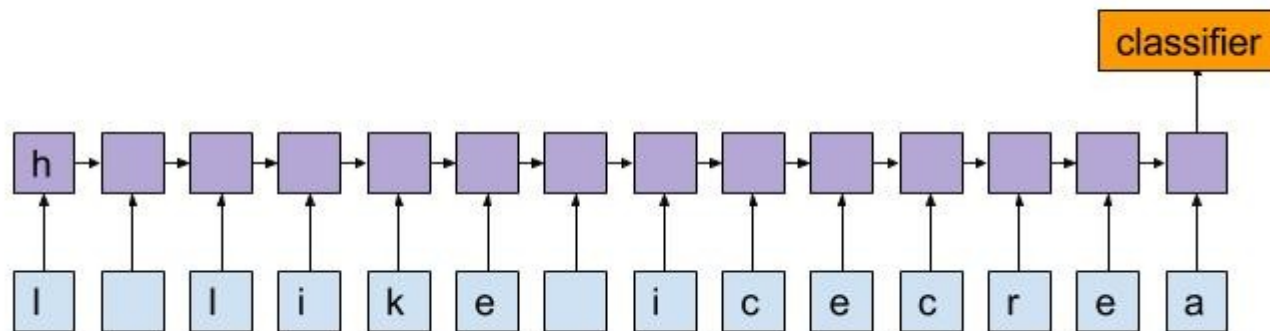
Wide convolution is convolution with full padding

Each word encoded with a vector (e.g. “one-hot”).



Other NLP problems
(coming soon)

Language model

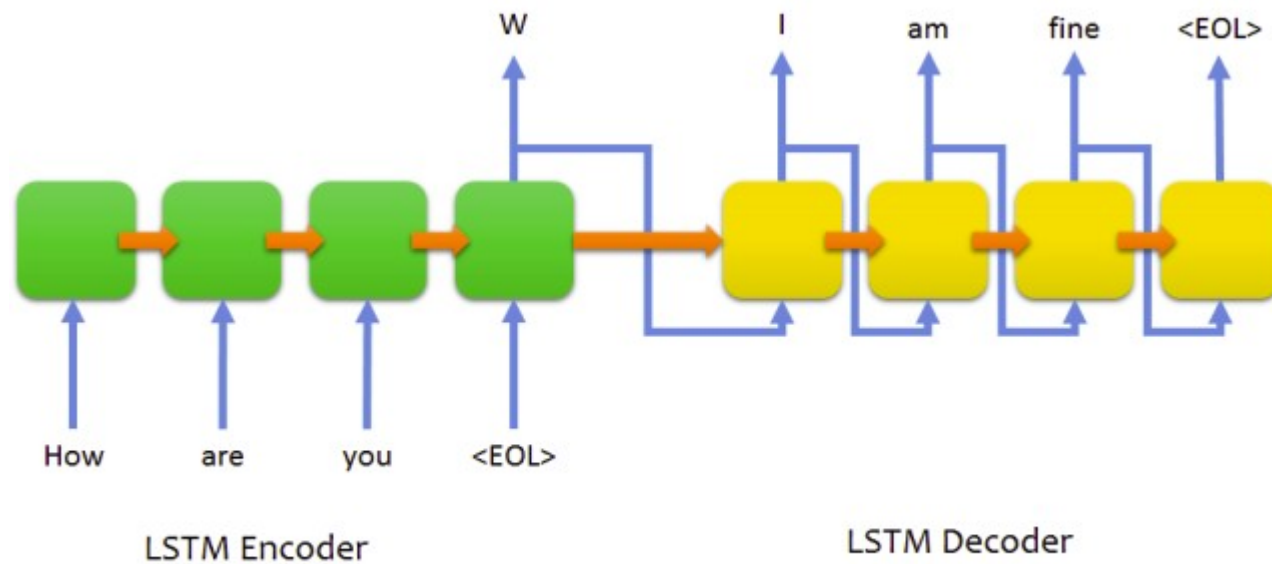


POS tagging

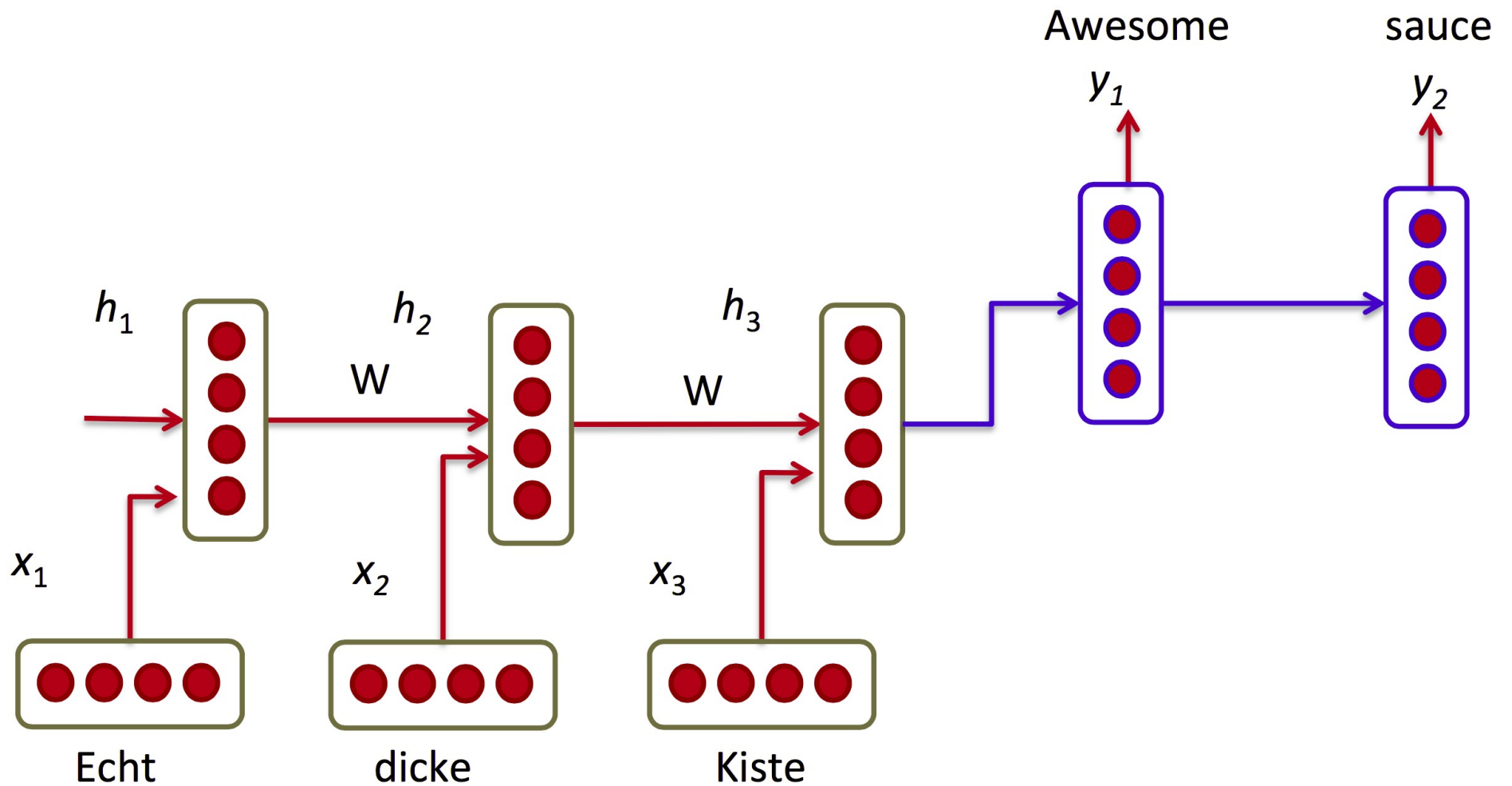
DT/ The JJ/ quick JJ/ brown NN/ fox NNS/ jumps IN/ over DT/ the JJ/ lazy NN/ dog

- -RRB- - Right bracket
- CD - Cardinal number
- EX - Existential there
- IN - Preposition
- JJR - Comparative adjective
- LS - List Item Marker
- NN - Singular noun
- NNP - Proper singular noun
- PDT - Predeterminer
- PRP - Personal pronoun
- RB - Adverb
- RBS - Superlative Adverb
- SYM - Symbol
- UH - Interjection
- VBD - Verb, past tense
- VBN - Verb, past participle
- VBZ - Verb, 3rd ps. sing. present
- WP - wh-pronoun
- WRB - wh-adverb
- CC - Coordinating conjunction
- DT - Determiner
- FW - Foreign word
- JJ - Adjective
- JJS - Superlative adjective
- MD - Modal
- NNS - Plural noun
- NNPS - Proper plural noun
- POS - Possessive ending
- PP\$ - Possessive pronoun
- RBR - Comparative adverb
- RP - Particle
- TO - to
- VB - Verb, base form
- VBG - Verb, gerund/present participle
- VBP - Verb, non 3rd ps. sing. present
- WDT - wh-determiner
- WP\$ - Possessive wh-pronoun

Conversation model



Machine translation



Nuff

Neural network won't write itself without you!
(except it will <https://arxiv.org/abs/1511.06279>)