

	battle	horse	king	man	queen	..	woman
authority							
event							
has tail?							
rich							
gender							



	battle	horse	king	man	queen	..	woman
authority	0	0.01	1	0.2	1	...	0.2
event	1	0	0	0	0	...	0
has tail?	0	1	0	0	0	...	0
rich	0	0.1	1	0.3	1	...	0.2
gender	0	1	-1	-1	1	...	1

→

	battle	horse	king	man	queen	..	woman
authority	0	0.01	1	0.2	1	...	0.2
event	1	0	0	0	0	...	0
has tail?	0	1	0	0	0	...	0
rich	0	0.1	1	0.3	1	...	0.2
gender	0	1	-1	-1	1	...	1

→

King

1
0
0
1
-1

- man

0.2
0
0
0.3
-1

+ woman

0.2
0
0
0.2
1

=

	battle	horse	king	man	queen	..	woman
authority	0	0.01	1	0.2	1	...	0.2
event	1	0	0	0	0	...	0
has tail?	0	1	0	0	0	...	0
rich	0	0.1	1	0.3	1	...	0.2
gender	0	1	-1	-1	1	...	1

King

1
0
0
1
-1

- man

0.2
0
0
0.3
-1

+ woman

0.2
0
0
0.2
1

=

1
0
0
0.9
1

	battle	horse	king	man	queen	..	woman
authority	0	0.01	1	0.2	1	...	0.2
event	1	0	0	0	0	...	0
has tail?	0	1	0	0	0	...	0
rich	0	0.1	1	0.3	1	...	0.2
gender	0	1	-1	-1	1	...	1

King

1
0
0
1
-1

- man

0.2
0
0
0.3
-1

+ woman

0.2
0
0
0.2
1

=

1
0
0
0.9
1

Queen

1
0
0
1
1

Embeddings are not hand
crafted. Instead, they are
learnt during neural network
training

1. Take a **fake** problem
2. Solve it using neural network
3. You get **word embeddings** as a **side effect**

1. Take a **fake problem**
2. Solve it using neural network
3. You get **word embeddings** as a **side effect**

fake problem: fill in a missing word in a sentence

There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

Fake problem

_____ ordered his ministers

_____ ordered his ministers

There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

Fake problem

king ordered his ministers

emperor ordered his ministers

There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

Fake problem

king ordered his ministers
emperor ordered his ministers

Side effect



There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

Fake problem

king ordered his ministers
emperor ordered his ministers

Side effect

king $\begin{bmatrix} 0.7 \\ 0.4 \\ 1.2 \\ 3.8 \end{bmatrix}$ emperor $\begin{bmatrix} 0.7 \\ 0.5 \\ 1.2 \\ 3.8 \end{bmatrix}$ king ~ emperor

eating ____ is very healthy

table, angry, truck, apple, pizza, walnut

eating ____ is very healthy

table, angry, truck, apple, pizza, walnut

NASA launched ____ last month

table, angry, truck, rocket, apple, pizza

NASA launched ____ last month

table, angry, truck, **rocket**, apple, pizza

Meaning of word can be inferred by surrounding words

NASA launched ____ last month

table, angry, truck, **rocket**, apple, pizza

There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

Training samples

Lived, a → There

There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

Training samples

Lived, a → There

a, king → lived

There lived a king called Ashoka in India. After Kalinga battle, he converted to Buddhism. This mighty king ordered his ministers to put together a peaceful treaty with their neighboring kingdoms. The emperor ordered his ministers to also build stupa, a monument with Buddha's teachings.

Training samples

lived, a → There

a, king → lived

ordered, his → king

ordered, his → emperor

king ordered his

ordered

king

his

king ordered his

ordered

his

Ashoka

emperor

his

king

ordered

...

zone

0
0
0
0
1
...
0

king

Ashoka

emperor

his

king

ordered

...

zone

0
0
1
0
0
...
0

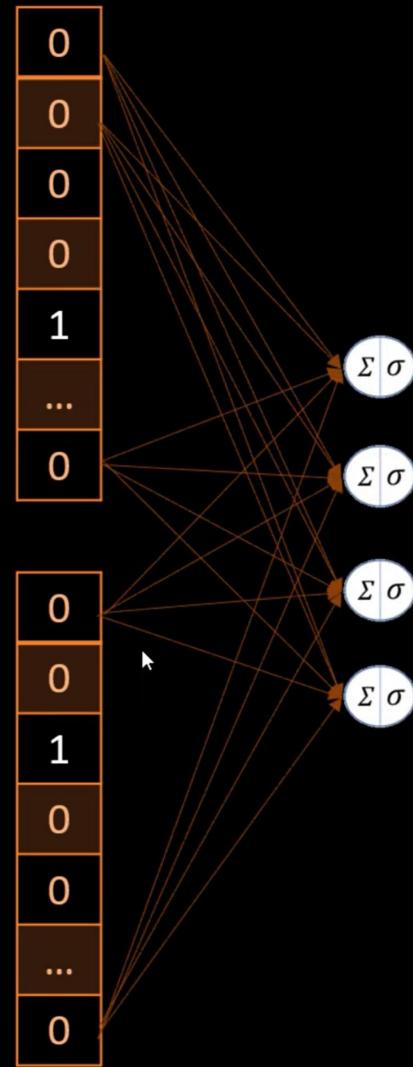


king ordered his

ordered

his

Ashoka
emperor
his
king
ordered
...
zone



king

king ordered his

ordered

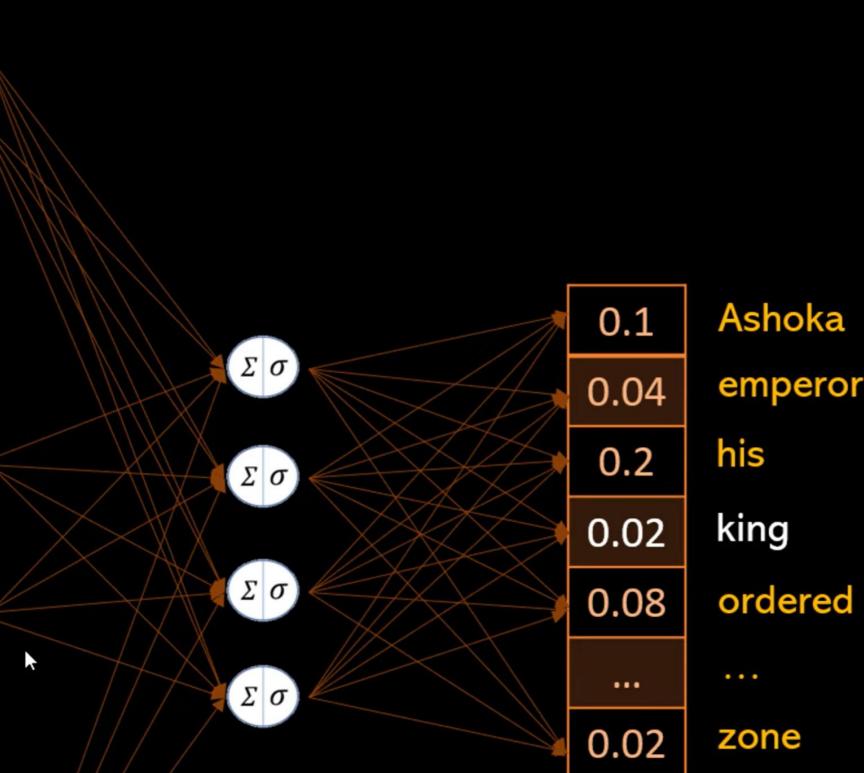
his

Ashoka
emperor
his
king
ordered
...
zone

0
0
0
0
1
...
0

Ashoka
emperor
his
king
ordered
...
zone

0
0
1
0
0
...
0



king ordered his

ordered

his

Ashoka

emperor

his

king

ordered

...

zone



Ashoka

emperor

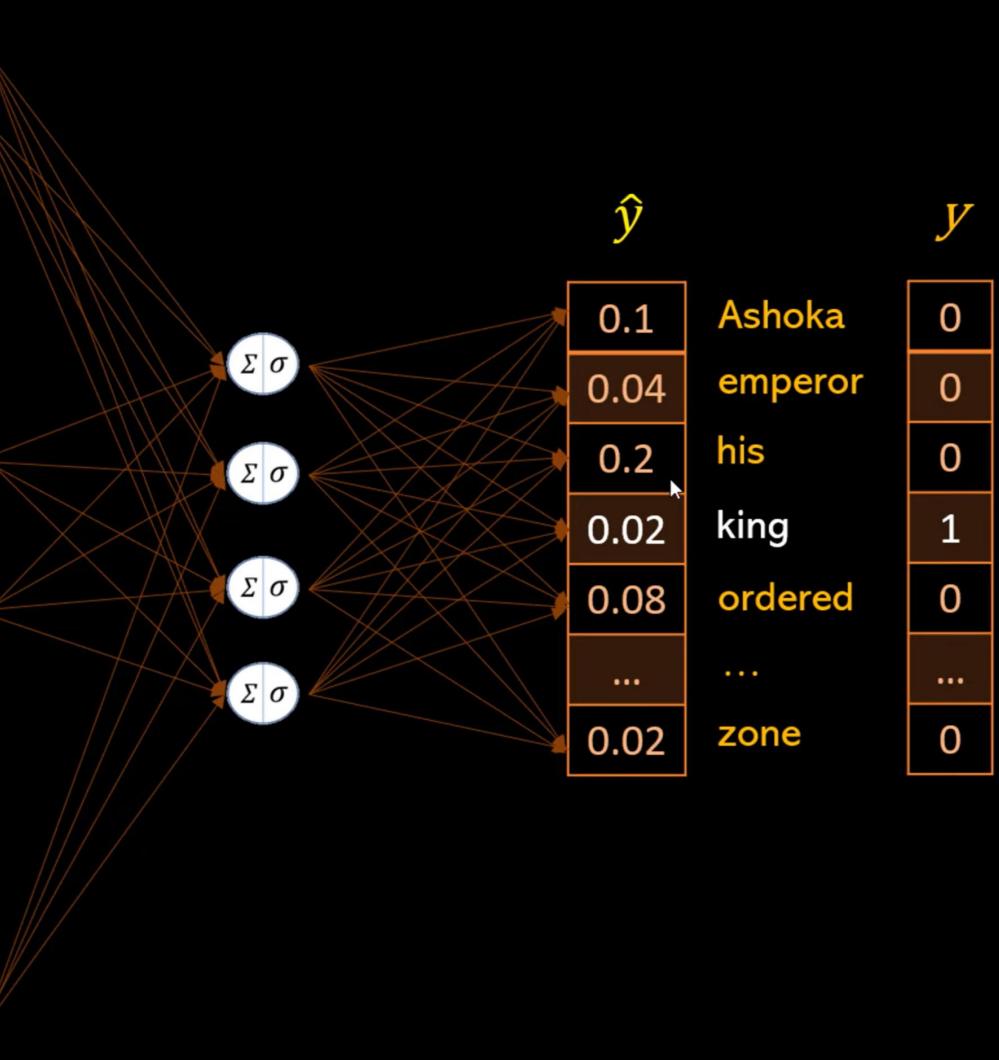
his

king

ordered

...

zone



king ordered his

ordered

his

Ashoka

emperor

his

king

ordered

...

zone

Ashoka

emperor

his

king

ordered

...

zone

Back propagation

\hat{y}

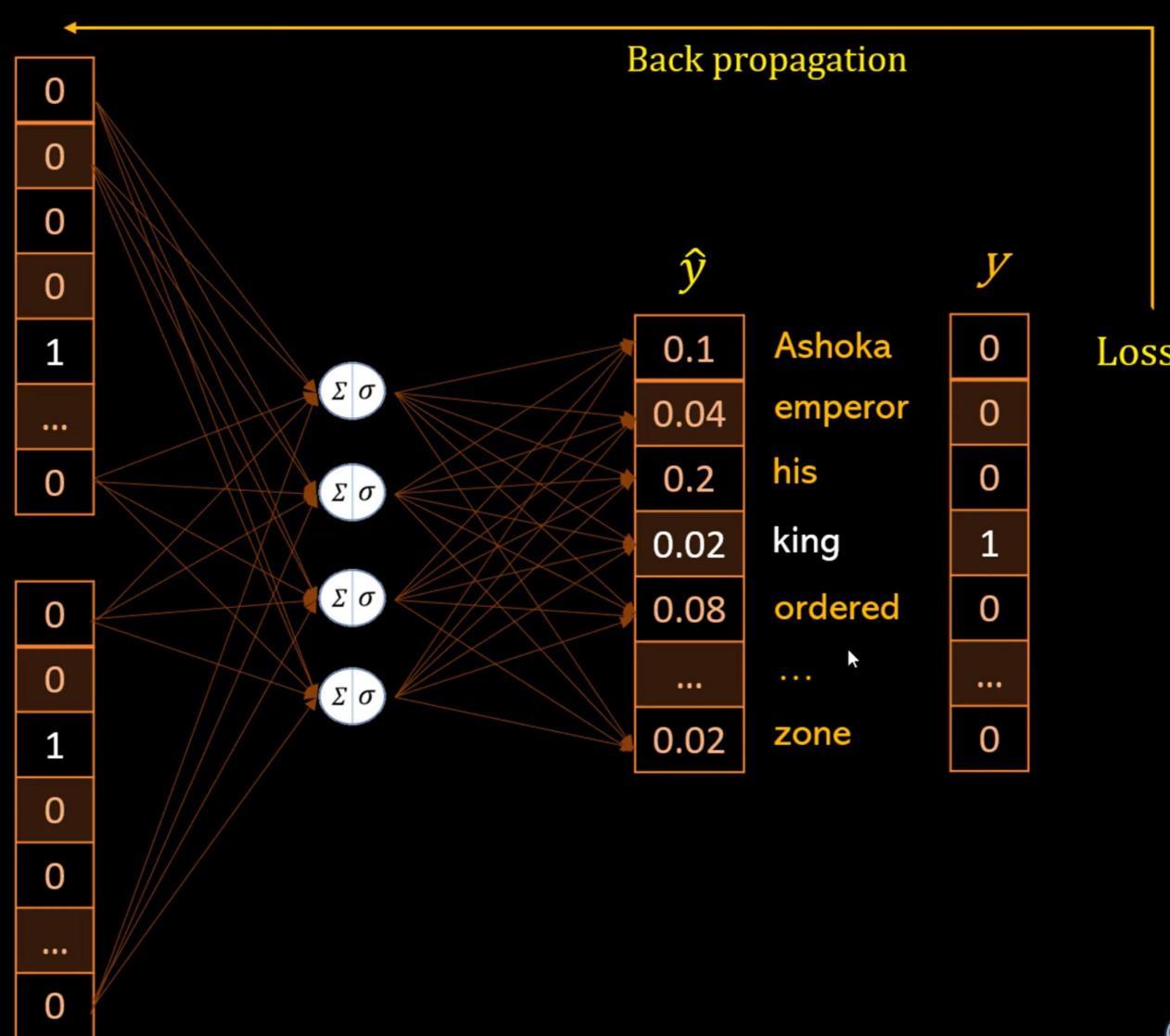
0.1
0.04
0.2
0.02
0.08
...
0.02

Ashoka
emperor
his
king
ordered
...
zone

y

0
0
0
1
0
...
0

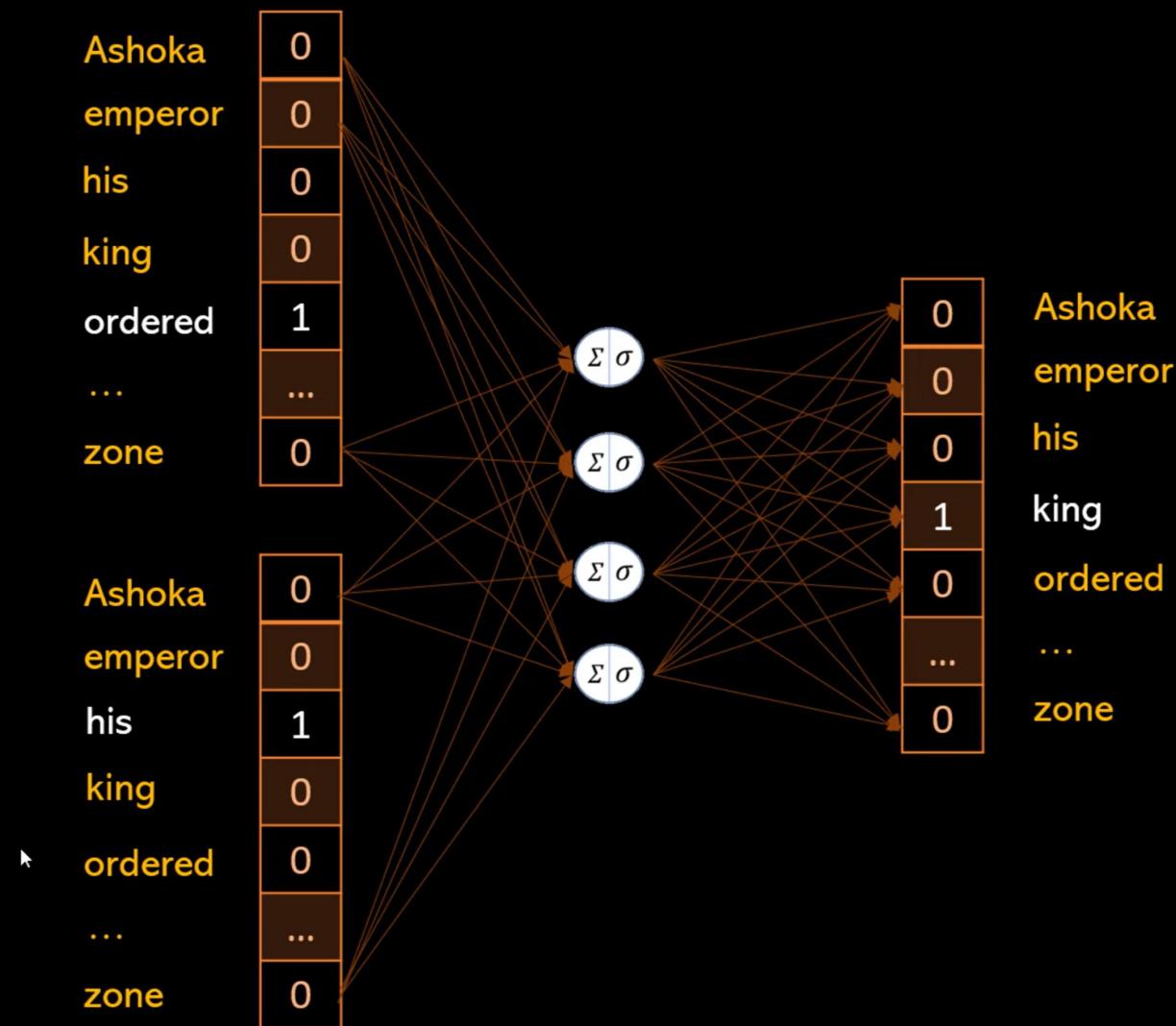
Loss



king ordered his

ordered

his



emperor ordered
his

ordered

his

Ashoka
emperor
his
king
ordered
...
zone

Ashoka
emperor
his
king
ordered
...
zone

Back propagation

\hat{y}

Ashoka
emperor
his
king
ordered
...
zone

y

Ashoka
emperor
his
king
ordered
...
zone

Loss



after kalinga battle

kalinga

battle

Ashoka

after

battle

kalinga

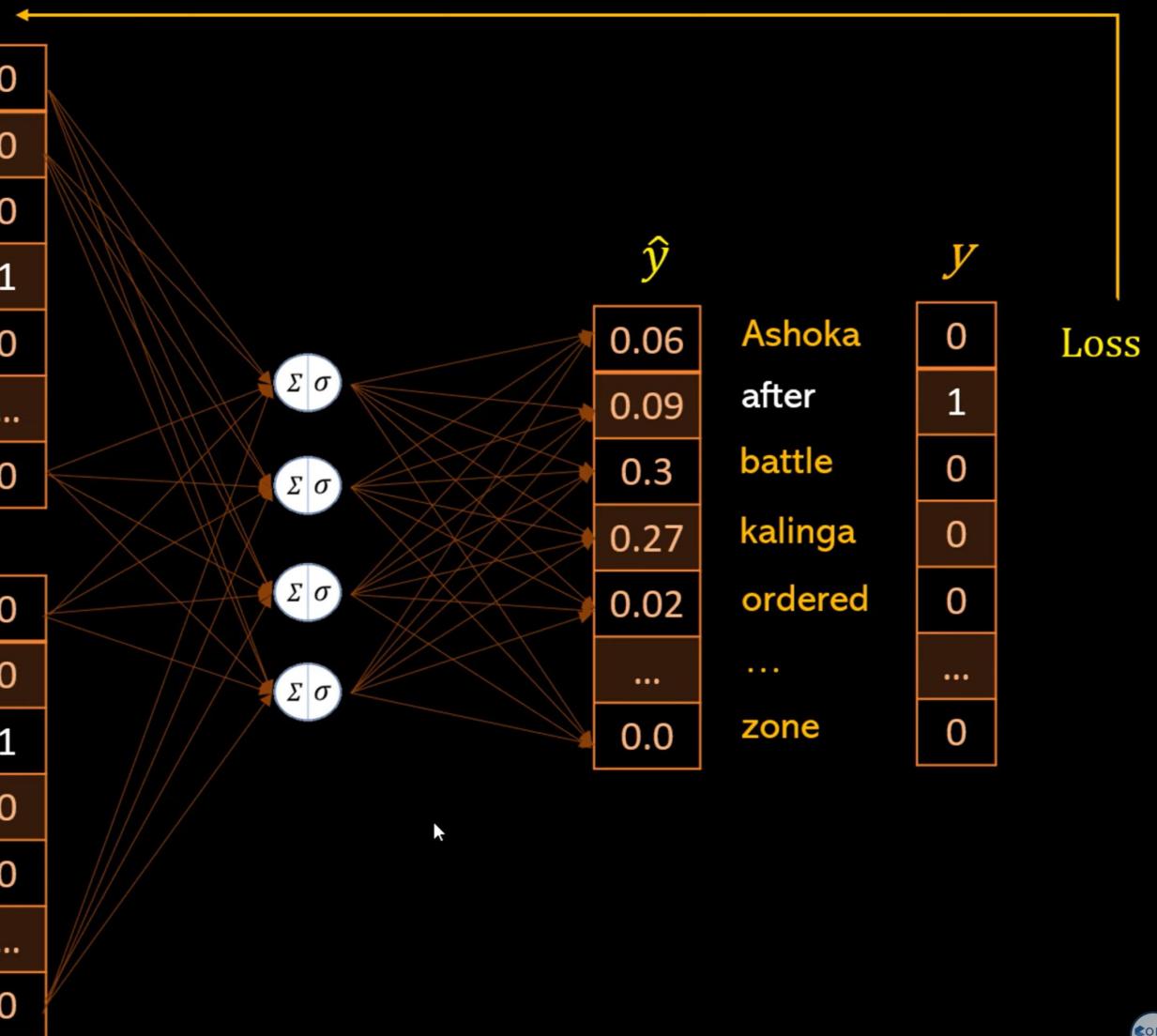
ordered

...

zone

0
0
0
1
0
...
0

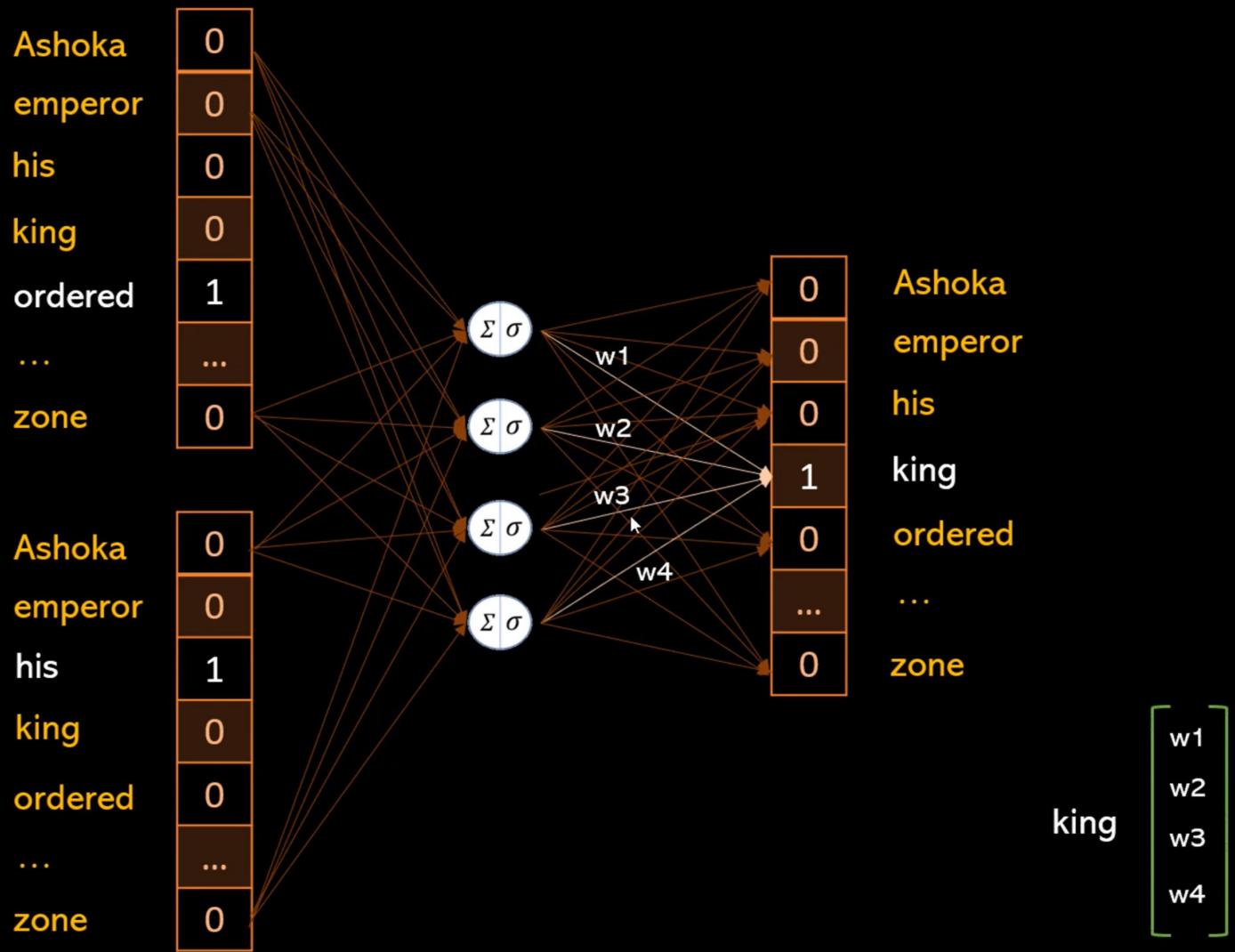
0
0
1
0
0
...
0



king ordered his

ordered

his



emperor ordered
his

ordered

his

Ashoka

emperor

his

king

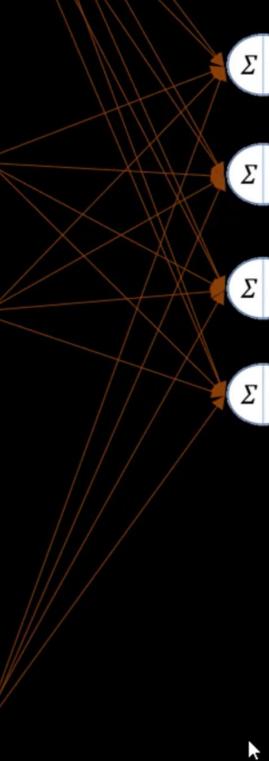
ordered

...

zone

0
0
0
0
1
...
0

0
0
1
0
0
...
0



Ashoka
emperor
his
king
ordered
...
zone

emperor

$$\begin{bmatrix} w5 \\ w6 \\ w7 \\ w8 \end{bmatrix}$$

CBOW: Continuous Bag Of Words

Given context words predict
target word

CBOW: Continuous Bag Of Words

Given context words predict
target word



CBOW: Continuous Bag Of Words

Given context words predict
target word



CBOW: Continuous Bag Of Words

Skip Gram

Given context words predict target word

Given the target predict context words



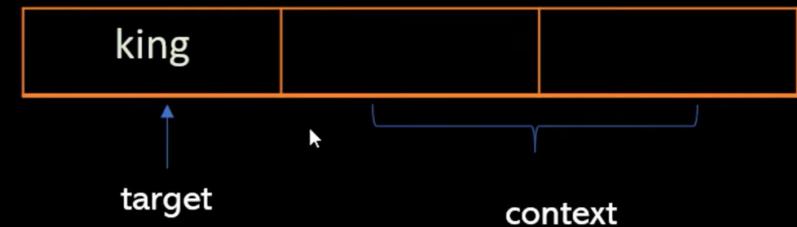
CBOW: Continuous Bag Of Words

Given context words predict target word



Skip Gram

Given the target predict context words



CBOW: Continuous Bag Of Words

Given context words predict target word



Skip Gram

Given the target predict context words

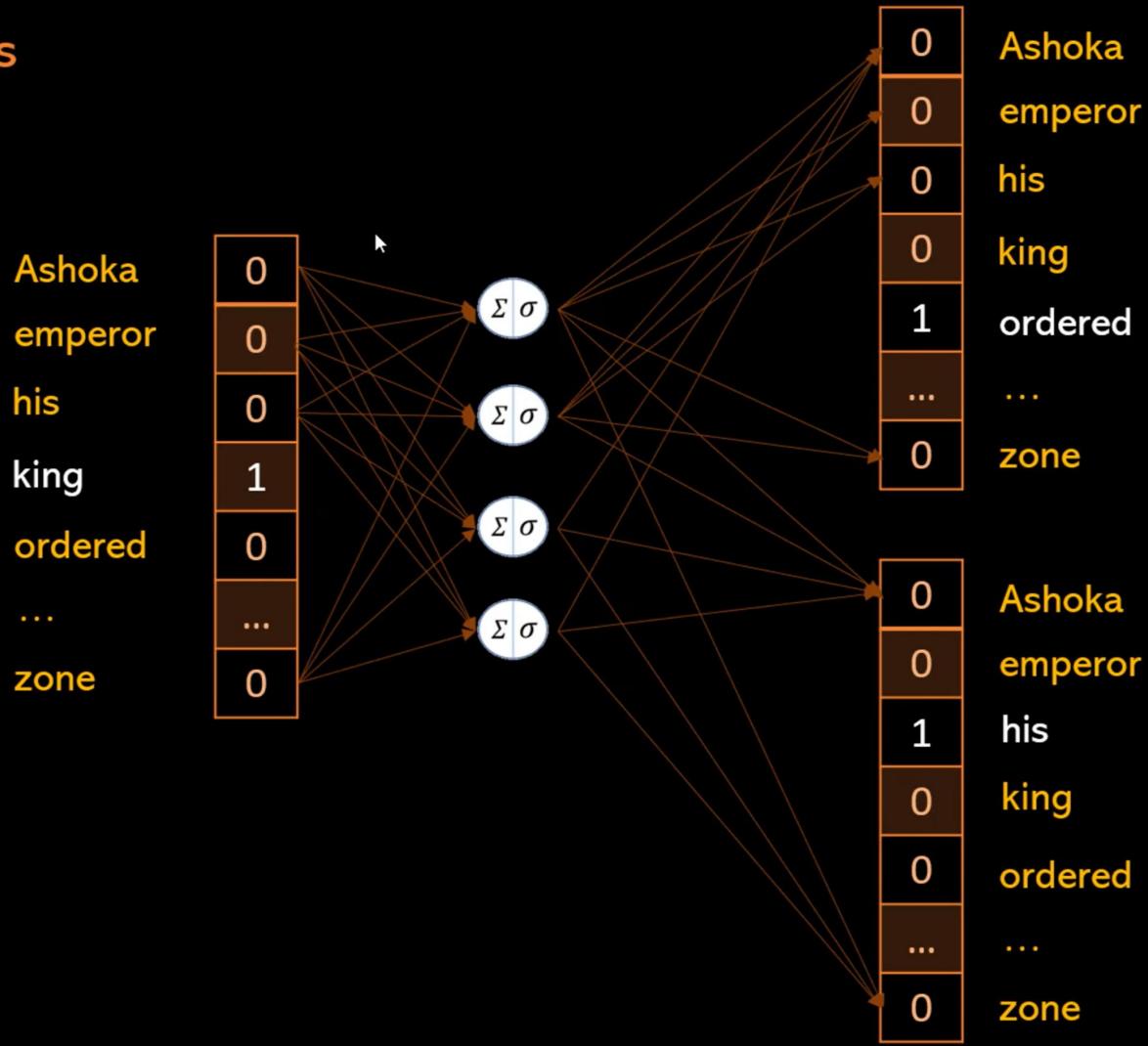


Word2Vec

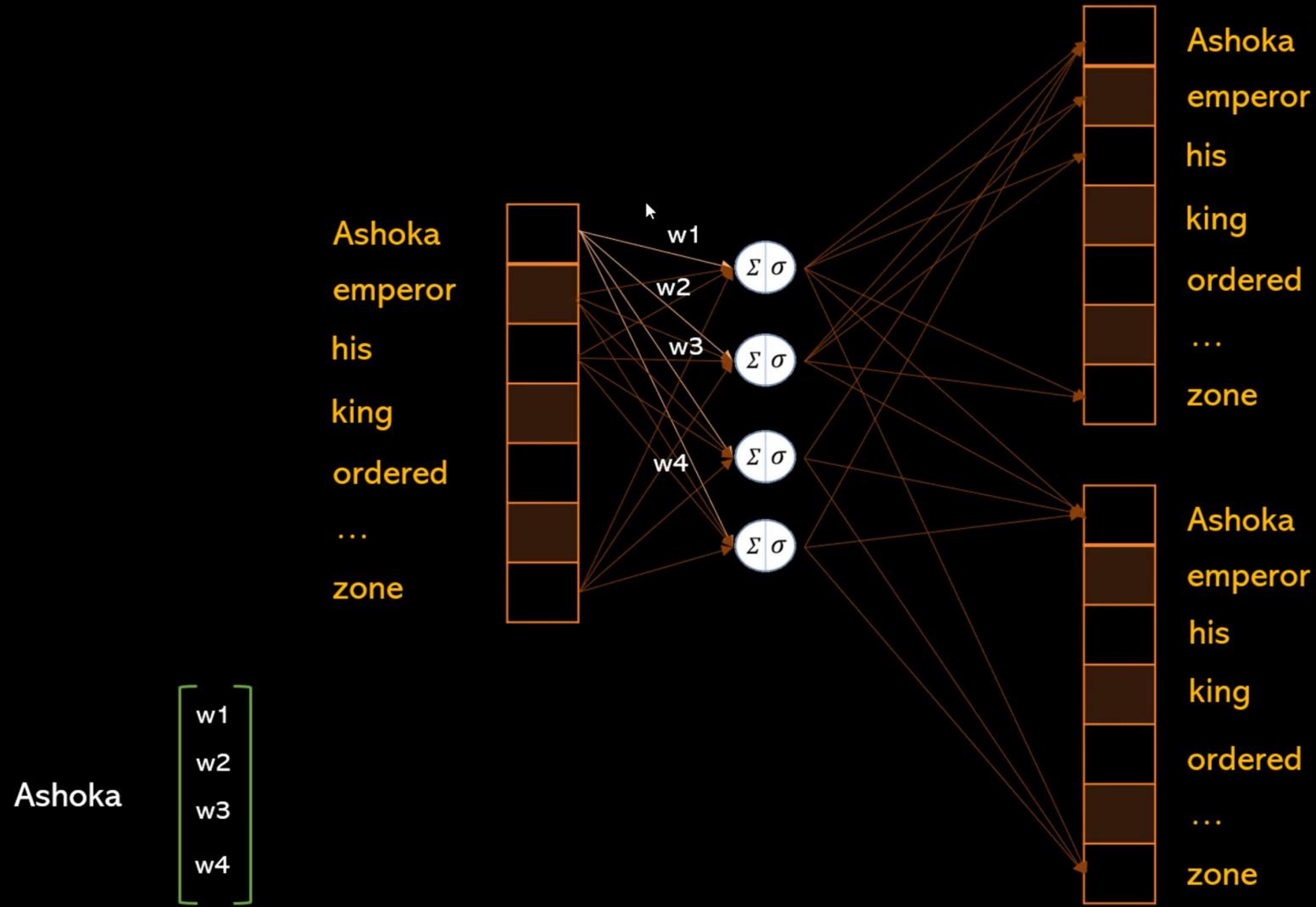
1. CBOW: Continuous Bag Of Words
2. Skip Gram

Skip Gram

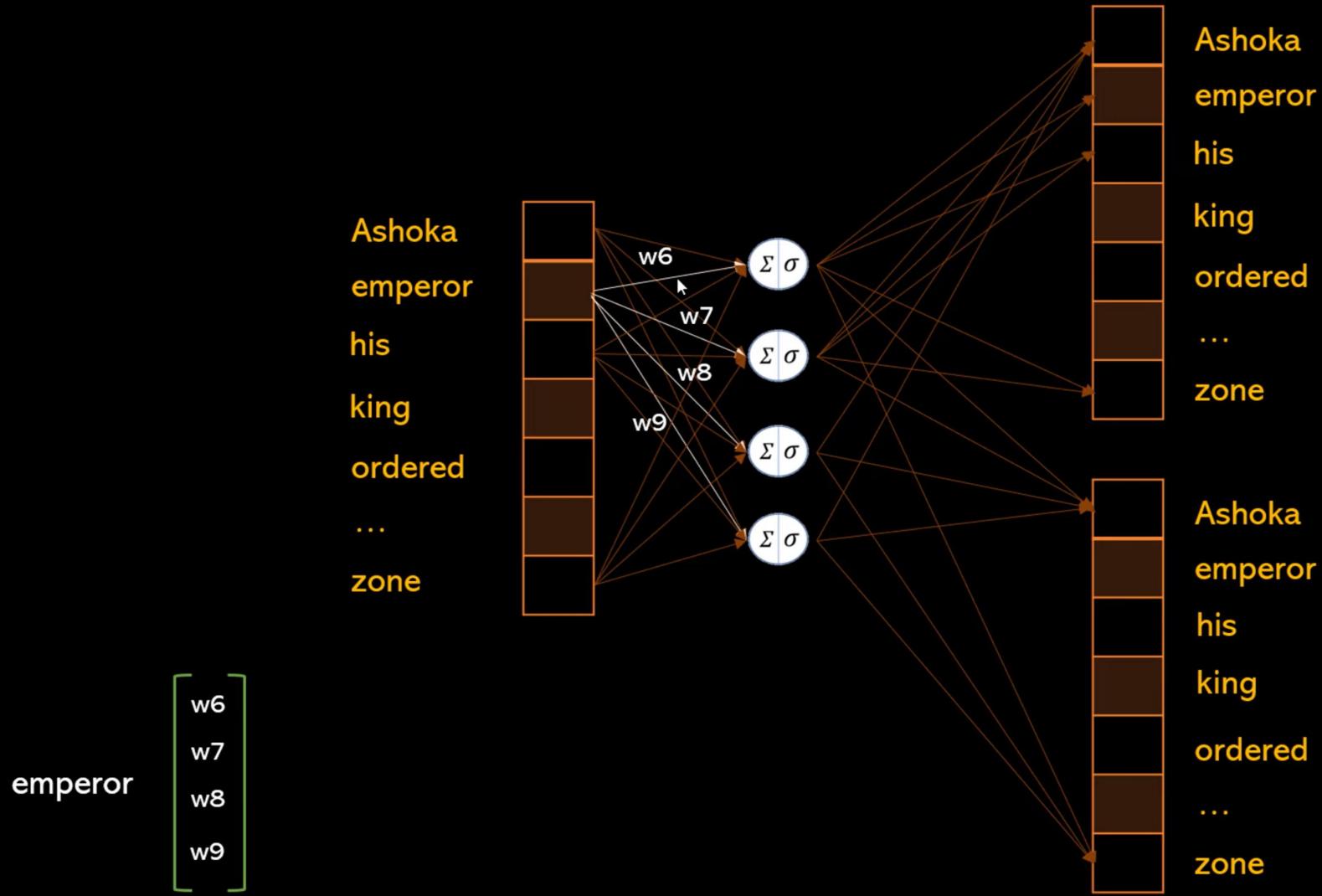
king ordered his



Skip Gram



Skip Gram



King – man + woman = Queen

USA – Washington D.C + Delhi

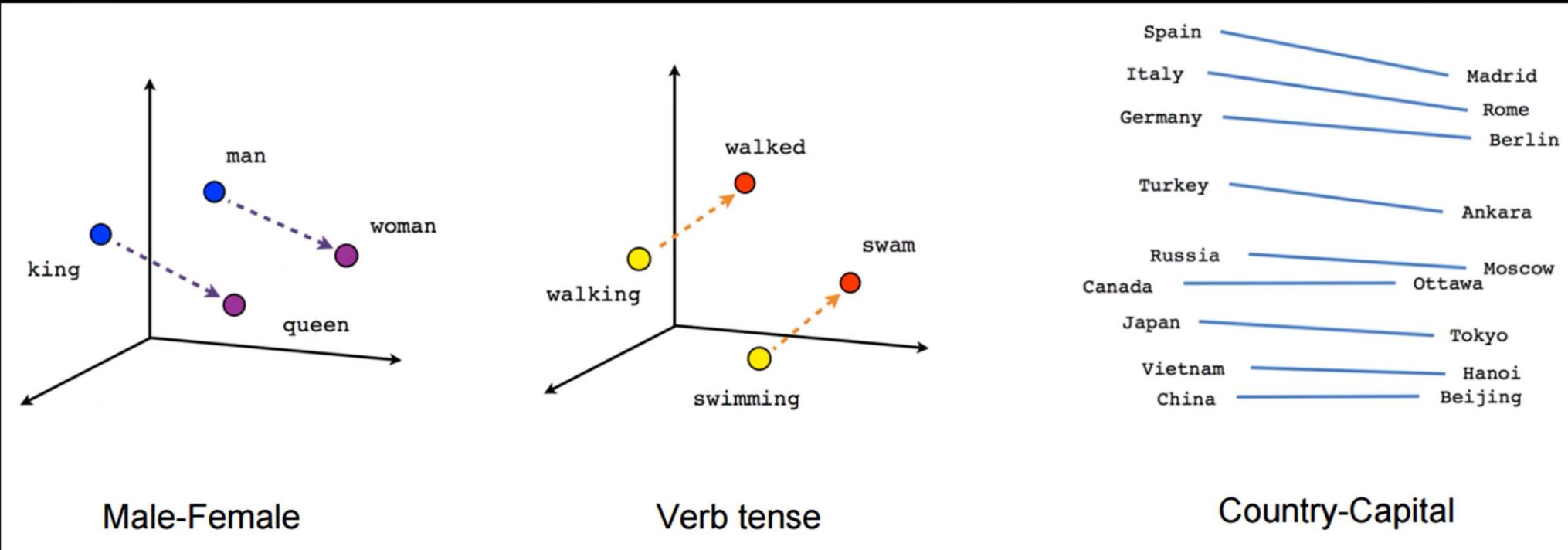


King – man + woman = Queen

USA – Washington D.C + Delhi = India

Samsun – Galaxy + iPhone = Apple





<https://towardsdatascience.com/creating-word-embeddings-coding-the-word2vec-algorithm-in-python-using-deep-learning-b337d0ba17a8>