神经网络第十五章

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Word Representation

NLP（自然语言处理）

V = [a, aaron, …, zulu, <UNK>]

|V| = 10,000

Man (5391) Woman King Queen …

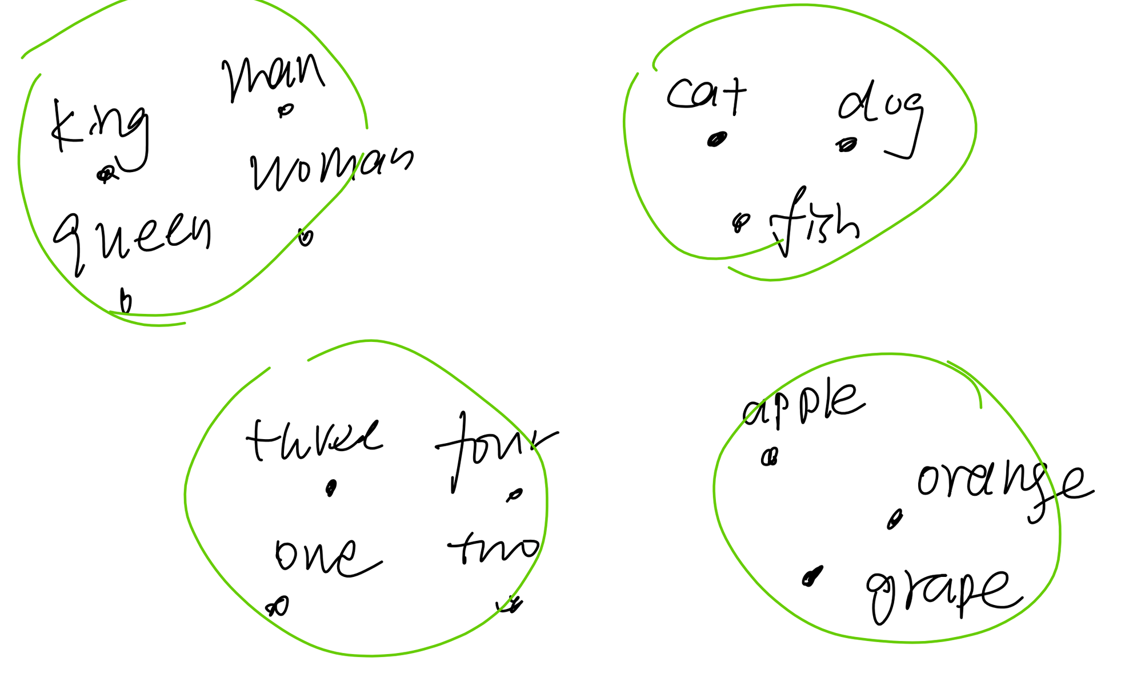
[0 0 0 0 … 1 … 0 0]

eg: I want a glass of orange juice
I want a glass of apple ____.

	Man (5391)	Woman (9853)	King	Queen	Apple	Orange
Gender	-1	1	-0.95	0.97	0.00	0.01
Royal	0.01	0.02	0.93	0.95	-0.01	0.00
Age	0.03	0.02	0.7	0.69	0.03	-0.02
Food	⋮	⋮				
⋮						
size						
cost						
	e_{5391}	e_{9853}				

Apple 和 Orange 向量都类似

300 维向量，画图 visualize



Using Word Embeddings

单词嵌入算法

→ 1B words — 100B words

→ 100k words

$e_1, e_2, \dots e_{10000}$

Properties of Word Embeddings

类比推理

man → woman or king → ?

$e_{man} - e_{woman} \approx \begin{bmatrix} -2 \\ 0 \\ 0 \\ 0 \end{bmatrix}$

$e_{king} - e_{queen} \approx \begin{bmatrix} -2 \\ 0 \\ 0 \\ 0 \end{bmatrix}$

$e_{man} - e_{woman} \approx e_{king} - e_?$

推导出 ? = Queen

Find word w: $\arg\max_w \; sim(e_w, e_{king} - e_{man} + e_{woman})$ 30~75%

$sim(u, v) = \frac{u^T v}{\|u\|_2 \|v\|_2}$

Embedding Matrix

[a aaron … orange … zulu <unk>] 300 × 10,000

[0 0 … 1 … 0]

Learning Word Embeddings

I want a glass of orange
4343 9665 1 3852 6163 6257

I → O_{4343} → E → e_{4343}
want → E → e
a … e
glass e
of e
orange … E → e_{6257}

→ [神经网络层] → softmax ← $W^{[2]}, b^{[2]}$
$W^{[1]}, b^{[1]}$

Word 2 Vec

I want a glass of orange juice to go along with my cereal

Content c ("orange") → Target t ("juice")

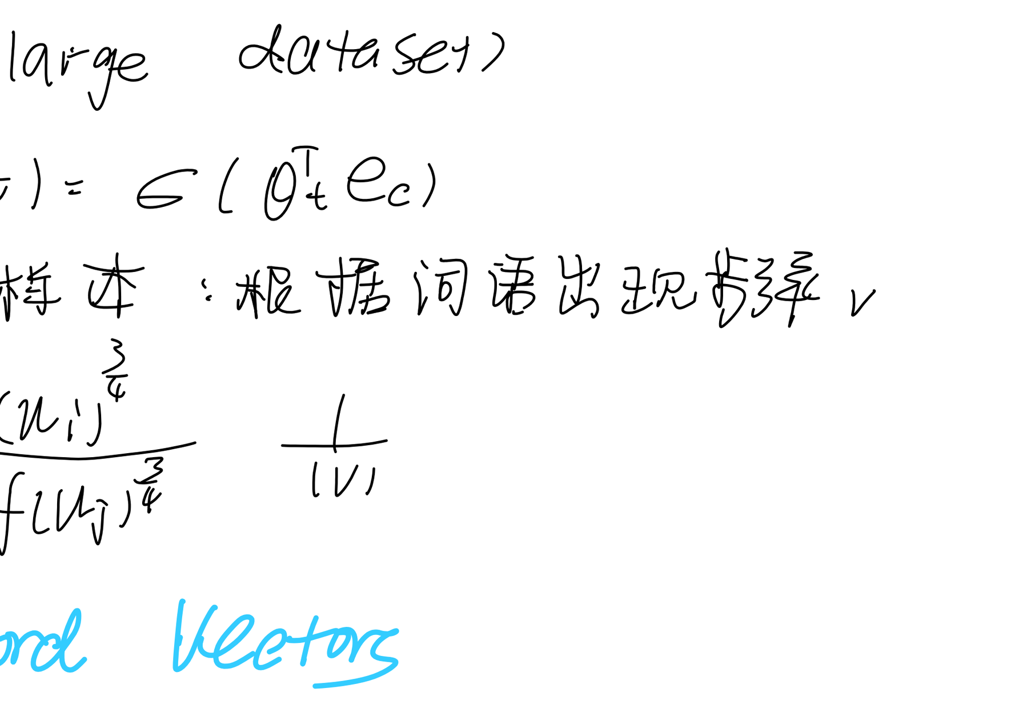
"one hot vector"

$O_c \to E \to e_c \to O_{softmax} \to \hat{y}$

Softmax: $p(t|c) = \frac{e^{\theta_t^T e_c}}{\sum_{j=1}^{10,000} e^{\theta_j^T e_c}}$ θ_t = parameter associated with output t

$\mathcal{L}(\hat{y}, y) = -\sum_{i=1}^{10,000} y_i \log \hat{y}_i$ $y = \begin{bmatrix} 0 \\ \vdots \\ 1 \\ \vdots \\ 0 \end{bmatrix}$ ← 4834

解决办法：
softmax 分层分类器



Negative Sampling

负采样法

context	word	target?
orange	juice	1
orange	king	0
orange	book	0
orange	of	0

→ 正样本（orange, juice）
→ 负样本（k 个）

K = 5-20 (smaller datasets)

K = 2-5 (large dataset)

$P(y=1 | c, t) = \sigma(\theta_t^T e_c)$

怎么选取负样本：根据词语出现频率

$P(w_i) = \frac{f(w_i)^{\frac{3}{4}}}{\sum_{j=1}^{10,000} f(w_j)^{\frac{3}{4}}}$ $\frac{1}{|V|}$

Glove Word Vectors

c, t

X_{ij} = # times t appears in context of j
(i ↑ t, j ↑ c)

$X_{ij} = X_{ji}$，给出出现/接近的频率

$e_w^{(final)} = \frac{e_w + \theta_w}{2}$

minimize $\sum_{i=1}^{10,000} \sum_{j=1}^{10,000} f(X_{ij}) (\theta_i^T e_j + b_i - b_j' - \log X_{ij})^2$

Sentiment Classification

情感分类

The dessert is excellent ☆☆☆☆

可用在 RNN 也可用嵌入词法

Debiasing Word Embeddings

如何消除"偏见"：