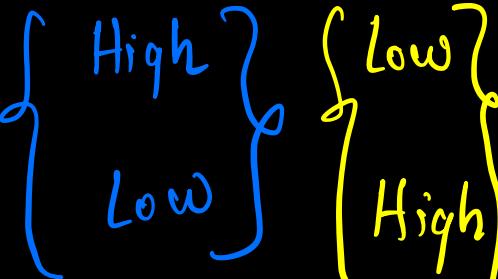


## Cosine Similarity

Purpose :- Calculate the distance b/w vectors

Cosine Similarity

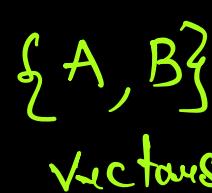


Cosine Distance

Inverse relationship

Formula :-

$$\text{Cosine Similarity} = \frac{A \cdot B}{\|A\| \times \|B\|}$$



$(\cdot)$  = sum of element wise multiplication

$\|A\|$  = length / Magnitude of the vector  $A = \sqrt{\sum a_i^2}$

$$\|B\| = \sqrt{\sum b_i^2}$$

Vector A

Vector B

|          | Action Rating | Romance Rating | Vectors<br>[5, 3] |
|----------|---------------|----------------|-------------------|
| Person A | 5             | 3              |                   |
| Person B | 10            | 6              | [10, 6]           |
| Person C | 1             | 5              | [1, 5]            |

Step 1 :- Dot Product

$$A \cdot B = (5 \times 10) + (3 \times 6) = 68$$

Step 2 :- Calc the Magnitudes

$$| |A| | = \sqrt{5^2 + 3^2} = \sqrt{34} \approx 5.83$$

$$| |B| | = \sqrt{10^2 + 6^2} = \sqrt{136} \approx 11.6$$

Step 3 :- Apply the formula

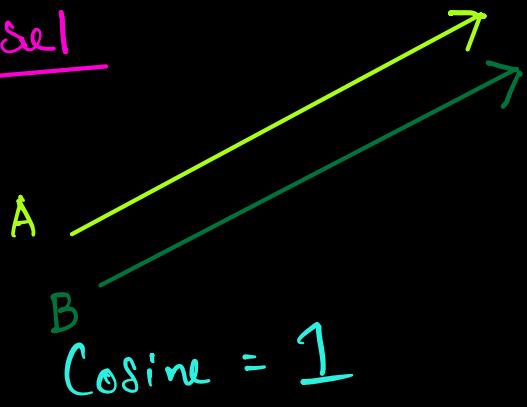
$$\text{Cosine Similarity} = \frac{68}{5.83 \times 11.6}$$

$$= \frac{68}{68.03} \approx 1$$

A and B are nearly identical.

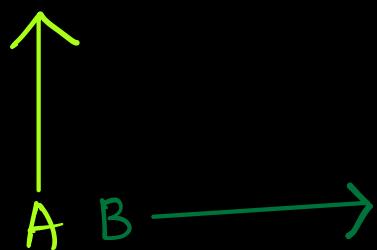
## Vector Visual

Cosine



$$\text{Cosine} = 1$$

Case 2



Perpendicular  
Cosine = 0

Case 3



Opposite  
Cosine = -1

$$\text{Value Range} = [-1, 1]$$

Person A to Person C

Step 1 :- Dot Product

$$A \cdot C = (5 \times 1) + (3 \times 5) = 20$$

Step 2 :- Magnitude

$$\|C\| = \sqrt{1^2 + 5^2} = \sqrt{26} \approx 5.1$$

Step 3 :- Apply the formula

$$= \frac{20}{5.83 \times 5.1} = \frac{20}{29.72} = 0.67$$

Person A & Person C have different taste

i) Euclidian Distance (L2)

Formula :-  $\sqrt{(a_1 - b_1)^2 + (a_2 - b_2)^2 + \dots}$

ii) Straight Line Distance

\* Manhattan Distance (L1)

✓ Sparse Vectors

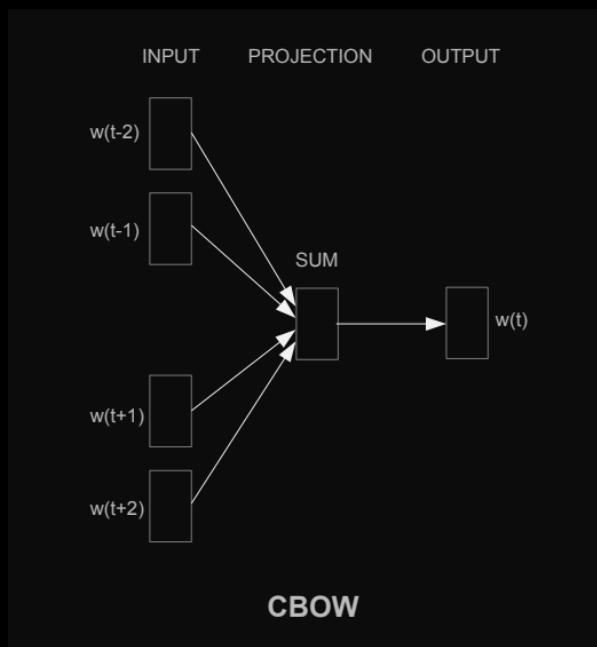
# Word 2 Vec

word embedding technique

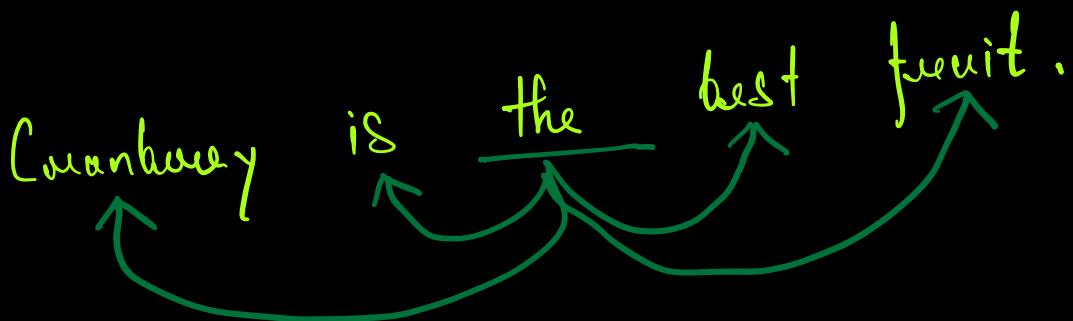
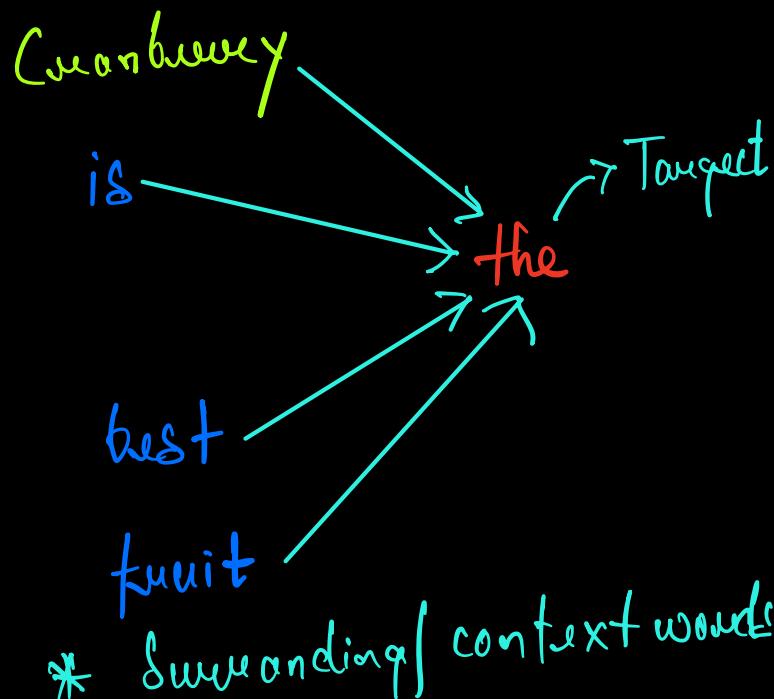
Two Architectures

1) CBOW

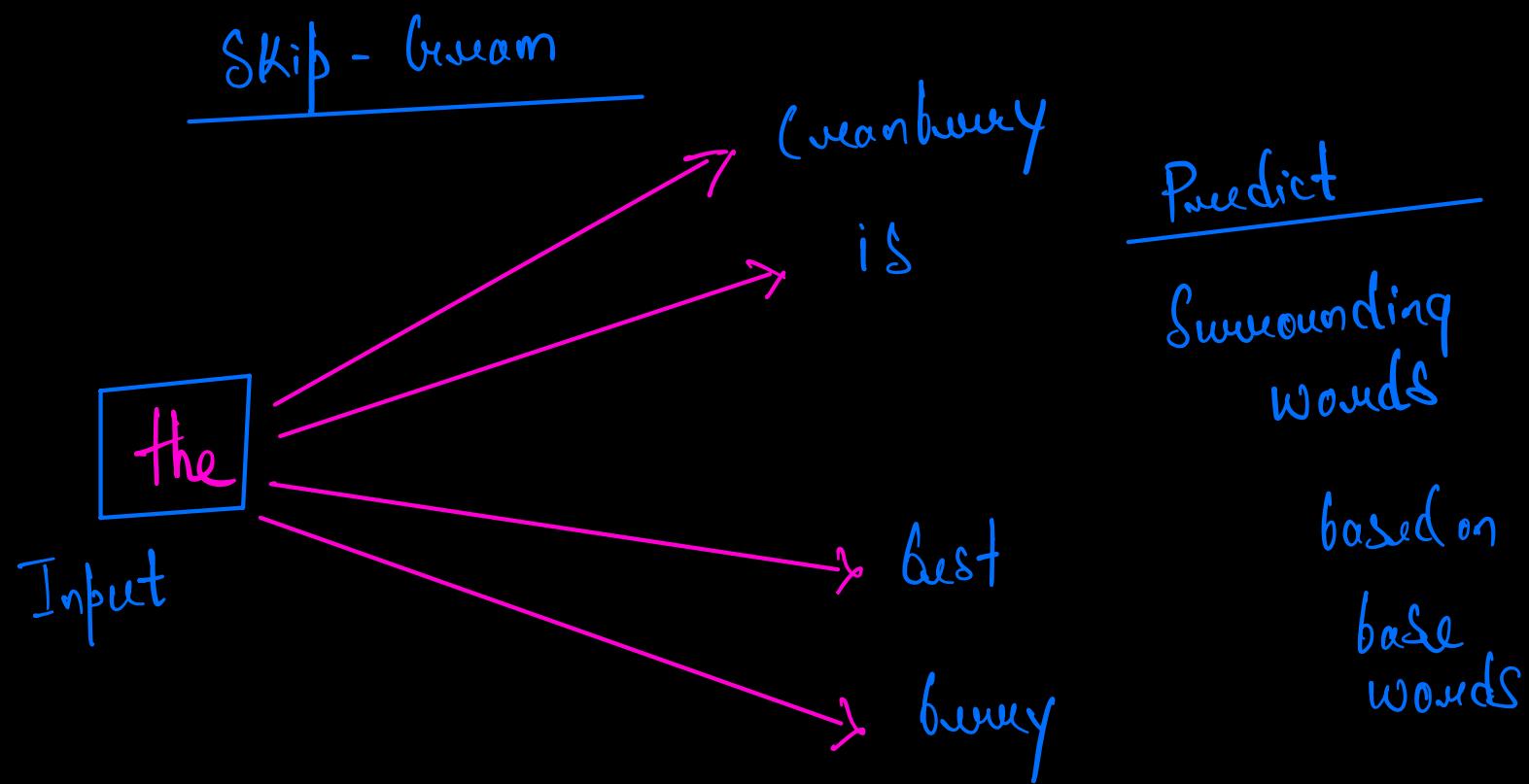
Continuous Bag of Words



2) Skip-gram



- 1) Very fast to train
- 2) Good with frequent words.  
X for rare word X



Benefits of Skipgram

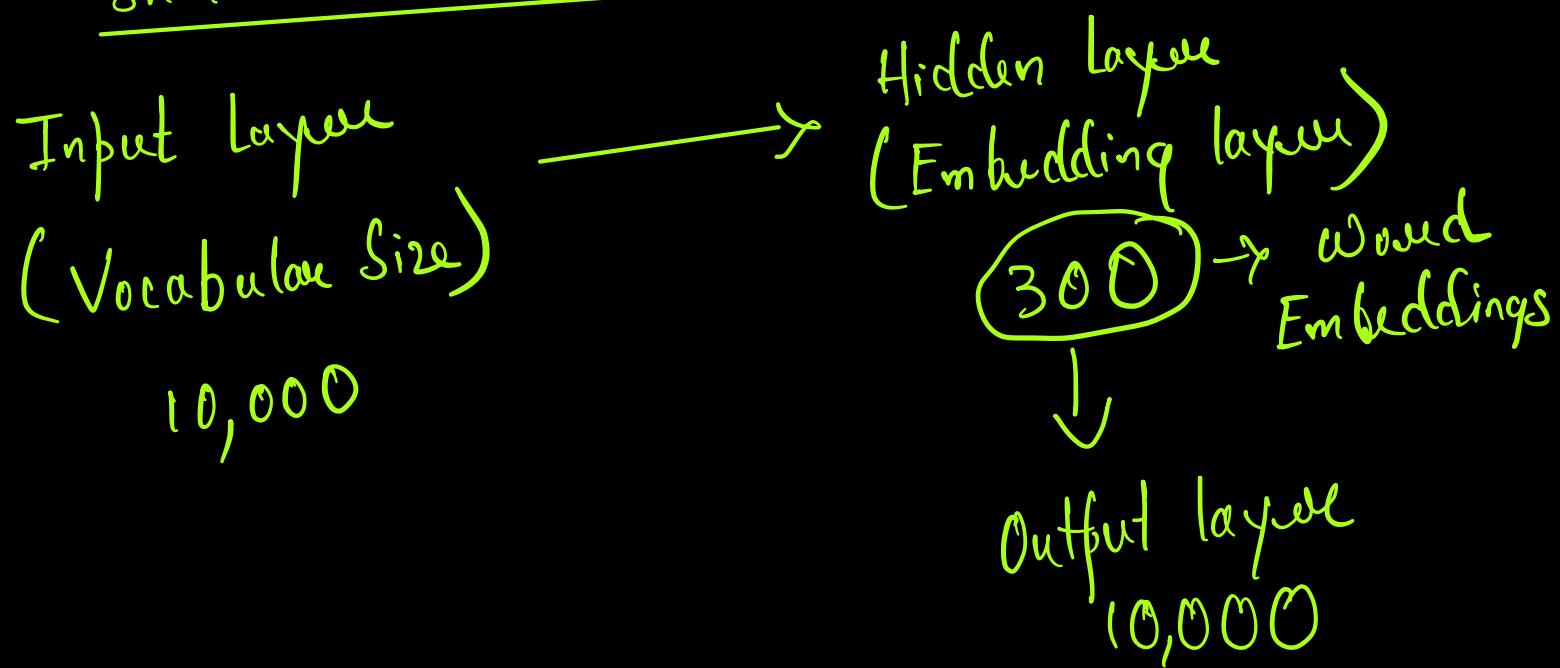
- 1) Rare words

Con:

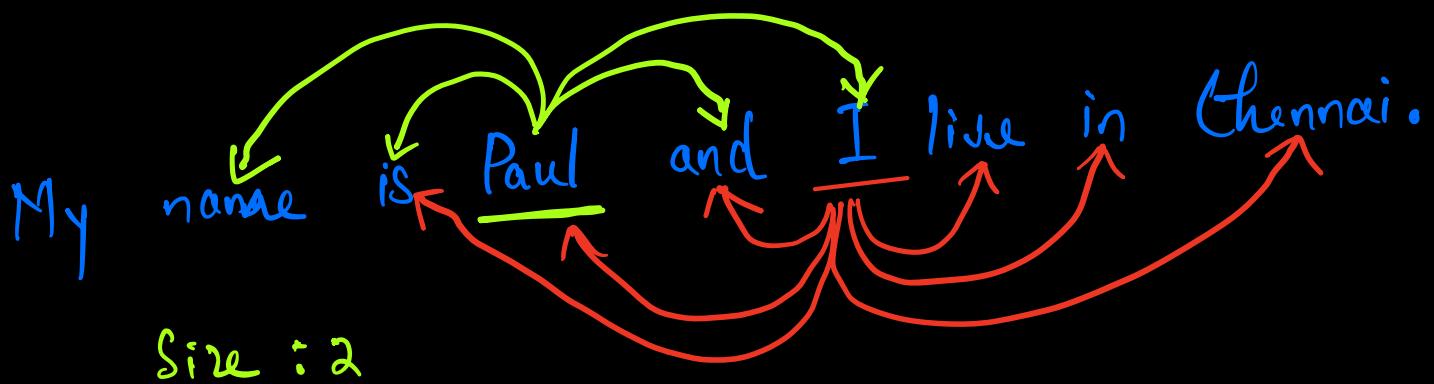
Slow to train as compared to CBOW

## Word2Vec (2013)

### Shallow Neural Network



### Context Window



Size: 3

## Training Set Sample

(BOW) (target word, context words)  $\text{Window} = 2$   
the {bearberry, is, best, honey}

(Skipgram)