

# Skip grams

Sentences = ["In the quiet hush of twilight's embrace",  
"Where the stars twinkle with gentle grace",  
"A world of dreams comes to life at night",  
"In the soft glow of the pale moonlight."]

## Algorithm:

1. Split the sentences into unique words and assign a random value to each word, we can assign value in any dimension for ex. 1D, 2D, 3D.  
eg. "Quiet": 0.35 in 1D, (0.34, 0.56) in 2D, (0.23, 0.45, 0.67) in 3D.
2. Decide the Window Size, let window size(d) is 2.
3. Calculate the probability of each word with word in window.

$$p\left(\frac{target}{window_i}\right) = \frac{\exp(target * window_i)}{\sum_{j=0}^d \exp(target * window_j)}$$

Here,

$target$  : word, we want to find similarity with other

$window_i$  : represents ith word of window

$window_j$  : each word in window

4. Calculate the error.

$$error = 1 - P\left(\frac{target}{window_i}\right)$$

5. Update the words using learning rate  $\alpha$ , here we have to update both target word and ith window word.

$$target_{i,new} = target_{i,old} - \alpha * error * window_i$$

$$window_{i,new} = window_{i,old} - \alpha * error * target$$

Where,

i : ith dimension of vector

**Window:** let we have sentence "Where the stars twinkle with gentle grace" and window size d then it represents words at d moves in left and right from the target word.

Let the target word is "twinkle"

Then window words will be "Where the stars twinkle with gentle grace".

## Solved Example

Sentences = ["In the quiet hush of twilight's embrace",  
"Where the stars twinkle with gentle grace",  
"A world of dreams comes to life at night",  
"In the soft glow of the pale moonlight."]

1. Split the words and keep only words having meaning, means remove punctuations. Lowercase all the words.

Sentences = ["quiet", "hush", "twilight's", "embrace",  
"stars", "twinkle", "gentle", "grace",  
"world", "dreams", "comes", "life", "night",  
"soft", "glow", "pale", "moonlight."]

2. Assign random value to each word, I'm assigning in 2D.

Vectors = [(0.98, 0.4062), (0.2329, 0.1593), (0.3098, 0.6074), (0.7886, 0.7417)  
(0.707, 0.2113), (0.3904, 0.4255), (0.7227, 0.56), (0.369, 0.9307)  
(0.0888, 0.702), (0.3962, 0.8433), (0.6567, 0.7637), (0.5786, 0.4583), (0.1737, 0.1334)  
(0.369, 0.757), (0.0678, 0.7056), (0.3484, 0.946), (0.6577, 0.0802)]

3. Select a target word(solving for only word). Let "gentle" is our target word and window size is 2.

"Where the stars **twinkle** with gentle **grace**." taking only words "twinkle" and "grace" because in left side we have word "with" that is not useful and in right side we have only 1 word.

4. Calculate the probability, solve  $(0.7227, 0.56) * (0.3904, 0.4255)$  with Euclidean distance.

$$p\left(\frac{\text{gentle}}{\text{twinkle}}\right) = \frac{\exp(\text{gentle} * \text{twinkle})}{\exp(\text{gentle} * \text{twinkle}) + \exp(\text{gentle} * \text{grace})}$$

$$\begin{aligned} p\left(\frac{\text{gentle}}{\text{twinkle}}\right) &= \frac{\exp((0.7227, 0.56) * (0.3904, 0.4255))}{\exp((0.7227, 0.56) * (0.3904, 0.4255)) + \exp((0.7227, 0.56) * (0.369, 0.9307))} \\ &= \frac{\exp(0.3636011689)}{\exp(0.3636011689) + \exp(0.5153469608)} = 0.462136181 \end{aligned}$$

$$p\left(\frac{\text{gentle}}{\text{grace}}\right) = \frac{\exp(\text{gentle} * \text{grace})}{\exp(\text{gentle} * \text{twinkle}) + \exp(\text{gentle} * \text{grace})}$$

$$p\left(\frac{\text{gentle}}{\text{grace}}\right) = \frac{\exp((0.7227, 0.56) * (0.369, 0.9307))}{\exp((0.7227, 0.56) * (0.3904, 0.4255)) + \exp((0.7227, 0.56) * (0.369, 0.9307))}$$

$$= \frac{\exp(0.5153469608)}{\exp(0.3636011689) + \exp(0.5153469608)} = 0.537863819$$

5. Calculate error.

$$error = 1 - \frac{gentle}{twinkle} = 1 - 0.462136181 = 0.537263819$$

$$error = 1 - \frac{gentle}{grace} = 1 - 0.537863819 = 0.462136181$$

6. Update the words vector value, assuming learning rate as 0.1

$$gentle_{new} = gentle_{old} - \alpha * error * twinkle_{old}$$

$$gentle_{new} = (0.7227, 0.56)_{old} - 0.1 * 0.537263819 * (0.3904, 0.4255)$$

$$= 0.7227 - 0.1 * 0.537263819 * 0.3904 = 0.7017252205$$

$$= 0.56 - 0.1 * 0.537263819 * 0.4255 = 0.5371394245$$

$$gentle_{new} = (0.7017252205, 0.5371394245)$$

$$twinkle_{new} = twinkle_{old} - \alpha * error * gentle_{new}$$

$$twinkle_{new} = (0.3904, 0.4255)_{old} - 0.1 * 0.537263819 * (0.7017252205, 0.5371394245)$$

$$= 0.3904 - 0.1 * 0.537263819 * 0.7017252205 = 0.3526988428$$

$$= 0.4255 - 0.1 * 0.537263819 * 0.5371394245 = 0.3936414421$$

$$twinkle_{new} = (0.3526988428, 0.3936414421)$$

$$gentle_{new} = gentle_{old} - \alpha * error * grace_{old}$$

$$gentle_{new} = (0.3526988428, 0.3936414421)_{old} - 0.1 * 0.462136181 * (0.369, 0.9307)$$

$$= 0.3526988428 - 0.1 * 0.462136181 * 0.369 = 0.332873809$$

$$= 0.3936414421 - 0.1 * 0.462136181 * 0.9307 = 0.3026956992$$

$$gentle_{new} = (0.332873809, 0.3026956992)$$

$$grace_{new} = grace_{old} - \alpha * erro * gentle_{new}$$

$$grace_{new} = (0.3904, 0.4255)_{old} - 0.1 * 0.462136181 * (0.332873809, 0.3026956992)$$

$$= 0.369 - 0.1 * 0.462136181 * 0.332873809 = 0.353616676$$

$$= 0.9307 - 0.1 * 0.462136181 * 0.3026956992 = 0.9167113175$$

$$grace_{new} = (0.353616676, 0.9167113175)$$