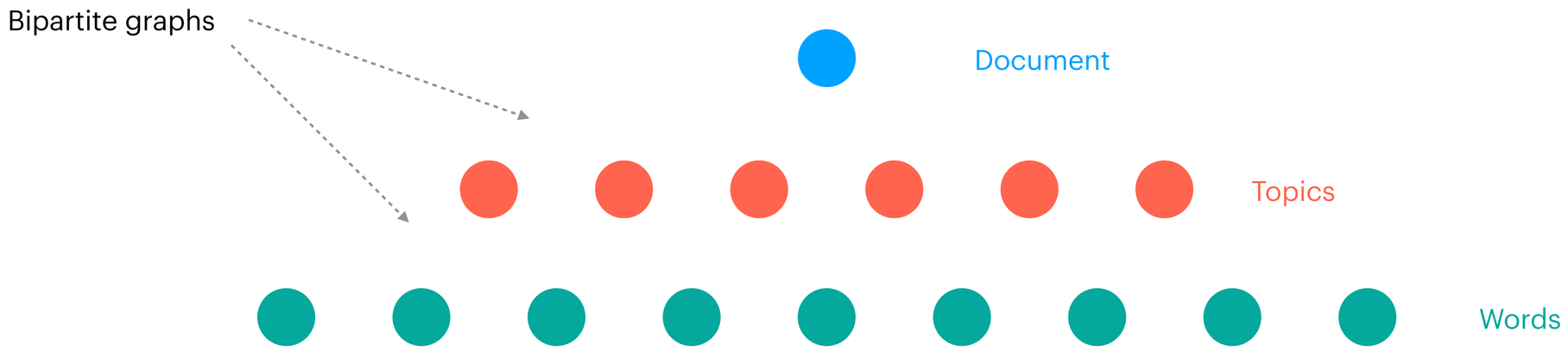
Latent Dirichlet Allocation (LDA)

- LDA is a generative model of text documents that defines a latent space, $\mathbf{z}$, which describes the relationship between words and documents probabilistically.

- In LDA, documents and words are related only through $\mathbf{z}$



[1] Blei, 2003

The Dirichlet distribution

- The Dirichlet distribution is often referred to the distribution of distributions. It is called so because it is the conjugate prior of the multinomial distribution, which is a common distribution used to describe multivariate random variables.

$$p(\boldsymbol{\phi}, \boldsymbol{\alpha}) = \frac{1}{B(\boldsymbol{\alpha})} \prod_{i=1}^{K} \phi_i^{\alpha_i - 1} \quad \text{where} \quad B(\boldsymbol{\alpha}) = \frac{\prod_{i=1}^{K} \Gamma \alpha_i}{\Gamma\left(\sum_{j=1}^{K} \alpha_j\right)}, \quad \Gamma(x) = (x-1)!$$

- The generative process in LDA is:

(a) $n \sim Poisson(\xi)$ — sample number of words from Poisson distribution (or another suitable distribution)

(b) $\phi \sim \text{Dir}(\alpha)$ — sample multinomial topic distribution from a Dirichlet distribution parameterized by α

(c) $\forall i \in \{1,...,n\}$ do: — loop through each word position in document and do:

(d) $z_i \sim \text{Mult}(\phi)$ — sample topic from multinomial distribution parameterized by ϕ

(e) $w_i \sim p(w_i \mid z_i, \beta)$ — sample word from multinomial distribution parameterized by ϕ and conditioned on the topic