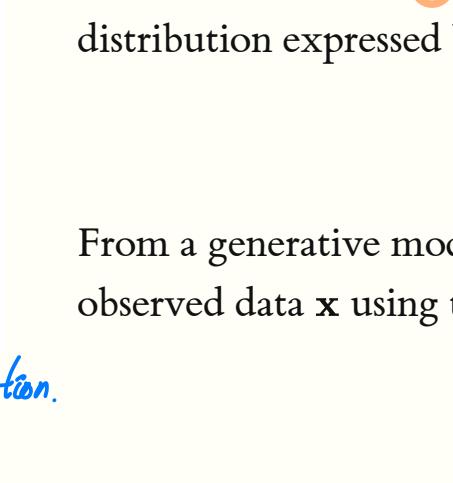


## Variational autoencoders

**Latent variable models** form a rich class of probabilistic models that can infer hidden structure in the underlying data. In this post, we will study variational autoencoders, which are a powerful class of deep generative models with **latent variables**.

### Representation

Consider a directed, latent variable model as shown below.



Graphical model for a directed, latent variable model.

• Only shaded variables **x** are observed in the data (pixel values)

• Latent variables **z** correspond to high level features

• If **z** is chosen properly,  $p(x|z)$  could be much simpler than  $p(x)$

• We have trained this model, then we could identify features via  $p(z|x)$ , e.g.,  $p(EyeColor = Blue|x)$

• **Challenge:** Very difficult to specify these conditions by hand

→ **Hypothesis**:  $z$  is composed of meaningful latent blocks of variation

→ **Unsupervised Learning**

→ **Generative Process**

→ **Hierarchical Generative Process**

→ **Generate a motion component  $b_i$  by sampling  $z_i$**

→ **Generate a data point  $x$  by sampling from that question**

→ **Sampling** → **Latent Variable Model**

→ **Latent Variable Model**