Compositional Generative Modeling

Introduction

Generative Models have had tremendous success in recent years, to train them to generalize in complex and changing environments is challenging, which is why compositionality is a desirable property.
What we want, is for two learned generative models(i.e. Diffusion, Flow Matching etc.), represented by their learned densities p_{D_1} and p_{D_2} on some datasets D_1 and D_2 to be able to sample from

$$p_{comp} \propto p_{D_1} \cdot p_{D_2}$$

where the normalization constant Z given by:

$$Z = \int_{\mathbb{R}^d} p_{D_1}(x) \cdot p_{D_2}(x)\, dx.$$

is not tractable in practice (if we assume data in $\mathbb{R}^d$ which is not too restrictive for now). To do this, multiple naive and more involved ideas exist, which we will try to explore in this document, focussing on toy datasets.