

Variational Inference with Normalizing Flows

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Introduction

- True posterior distributions of inference tasks is in most cases an intractable problem.
- Lots of research on approaches for efficient approximation of the posterior, however the resulting classes prove to be of limited expressiveness.
- The authors in [1] introduce the notion of normalizing flows, sequences of invertible transformations applied to a simple initial density, to efficiently create more expressive families of candidate posteriors to be used for variational inference.
- We compare the performance of different types of flows on the MNIST dataset.

Our Work

- Reproduced experiment on MNIST using Normalizing Flows
- Reproduced experiment on MNIST using NICE
- Extended the ideas of the paper and experimented with Invertible Convolutional Flows
- Created open-source Github repository with code and results: github.com/ATML-Group-12/normalising_flows

Theoretical Background

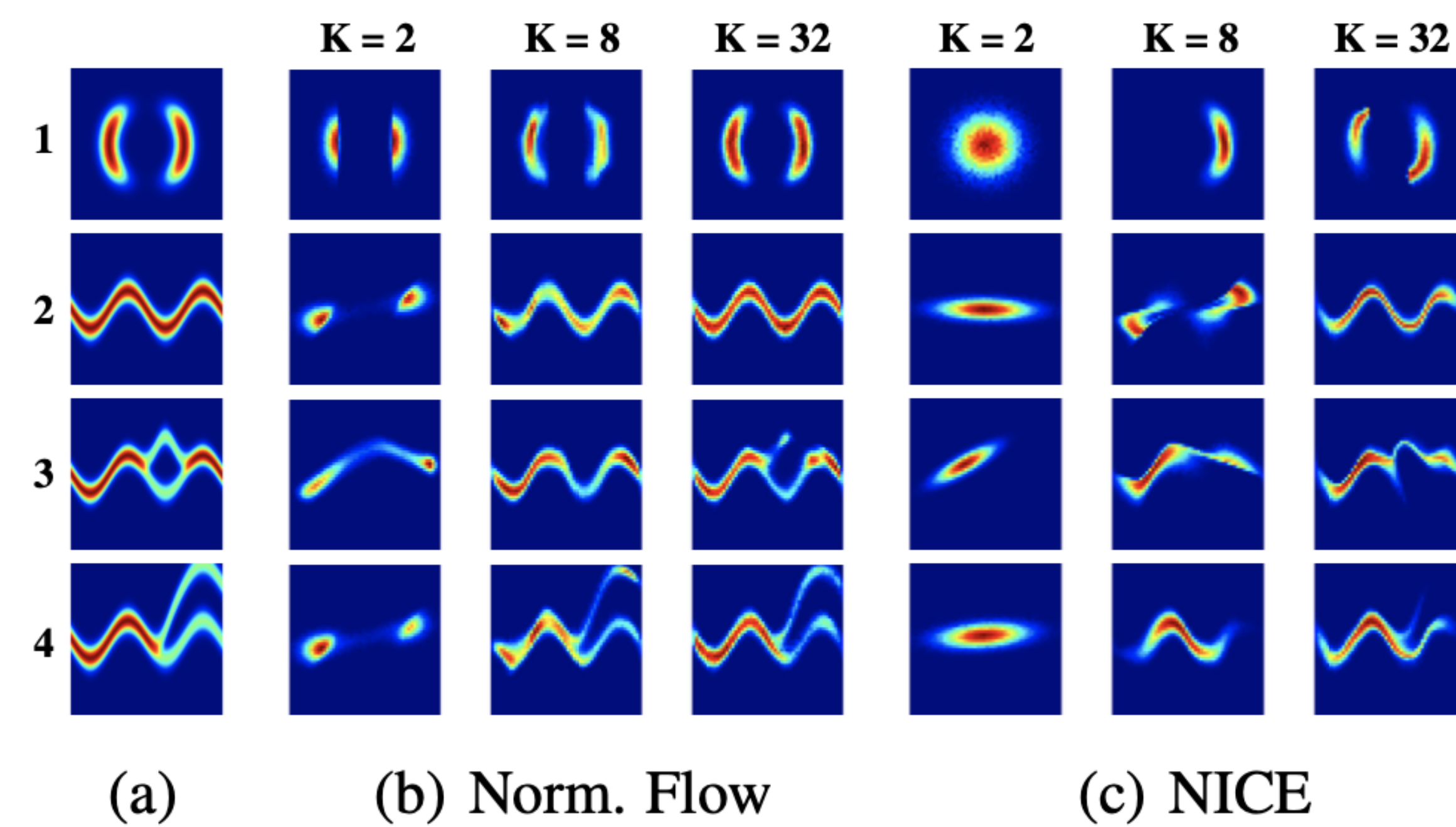
- **TODO!!!**
- Focus on theory between NFs here, specifically Linear NFs and NICE
- ELBO
- Stochastic Backpropagation
- Deep Latent Gaussian Models
- Flows
- Non-Linear Independent Components Estimation

Theoretical Background

TODO We formulate... $\mathcal{S} = \{s_1, s_2, s_3, s_4, s_5, s_6\}$

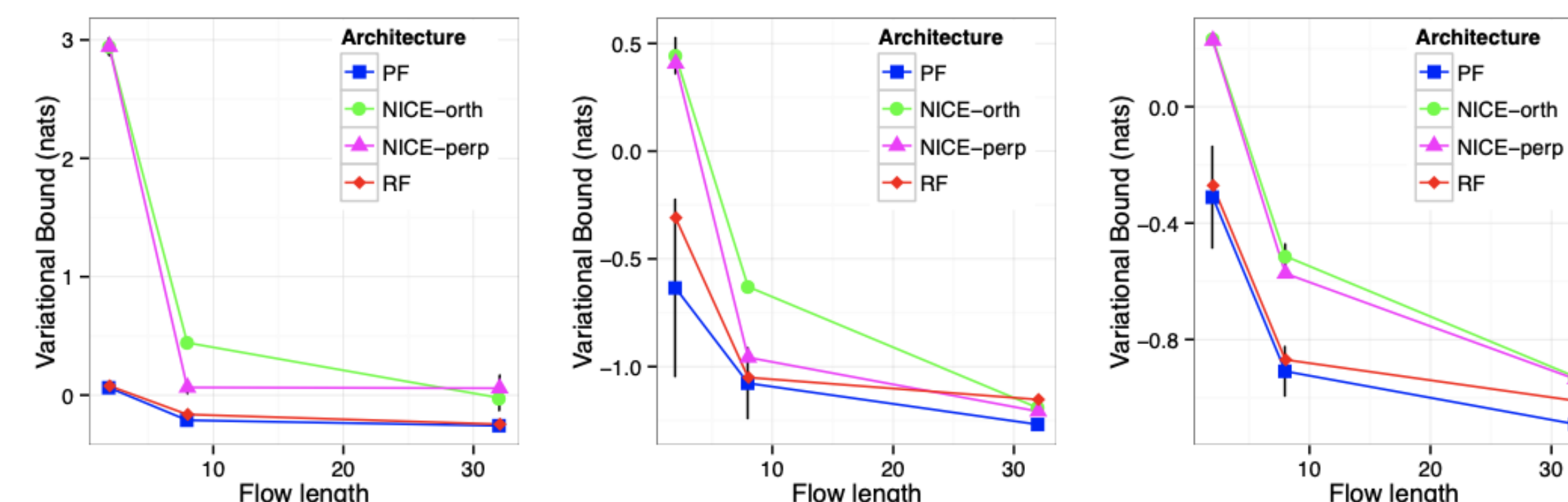
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Image example:



Experiments

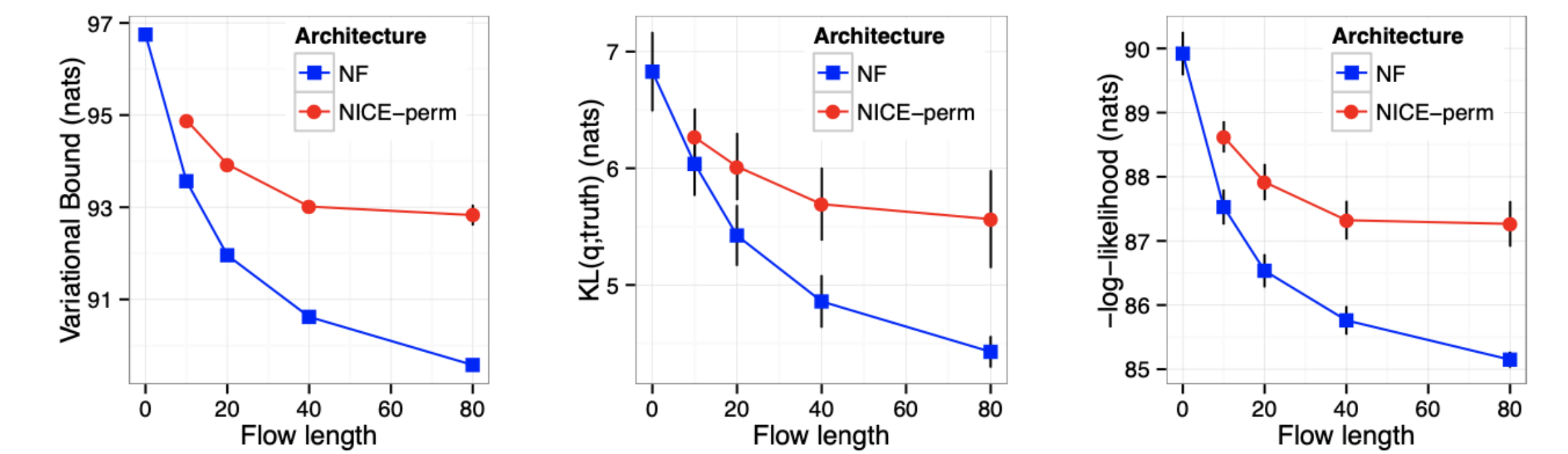
- DLGM + NF
- DLGM + NICE



(d) Comparison of KL-divergences.

Results

TODO!!! Results...



(a) Bound $\mathcal{F}(\mathbf{x})$ (b) $\mathcal{ID}_{\text{KL}}(q; p(z|x))$ (c) $-\ln p(\mathbf{x})$

Figure 4. Effect of the flow-length on MNIST.

Our Improvements and Extensions

TODO Pellentesque vitae dui velit. Aenean tincidunt eros facilis turpis tincidunt, non mollis ipsum venenatis. Praesent consectetur venenatis est, quis rutrum justo faucibus vitae. Nam id orci ex. Aenean id finibus libero. Nam tristique pellentesque eros et mattis. Proin vel nunc accumsan, aliquet leo ut, consectetur sem. Ut ut elit libero. Donec aliquet nulla ac venenatis egestas. Maecenas eu nunc hendrerit turpis dictum laoreet at ut velit. Phasellus tempus tellus id leo bibendum, ac rhoncus turpis molestie. Quisque commodo, quam vitae elementum fermentum, erat dolor hendrerit quam, bibendum malesuada lectus lacus sit amet nisi. In dignissim nisl elit. Aenean vitae enim ut ligula congue vehicula sed non lacus.

References

- [1] Danilo Jimenez Rezende and Shakir Mohamed. Variational inference with normalizing flows, 2015.
- [2] Laurent Dinh, David Krueger, and Yoshua Bengio. Nice: Non-linear independent components estimation, 2014.