

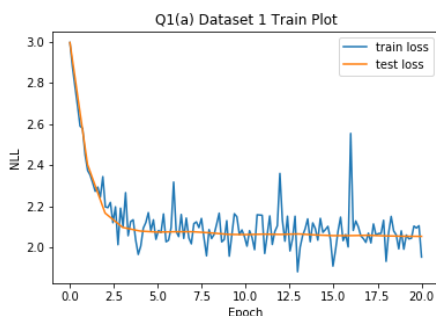
# Homework 1: Autoregressive Models

**Deliverable:** This PDF write-up by **Wednesday March 17th, 23:59pm**. Your PDF should be generated by simply replacing the placeholder images of this LaTeX document with the appropriate solution images that will be generated automatically when solving each question. The solution images are automatically generated and saved using the accompanying IPython notebook. Download your results from Google Colab and replace the images in the figures/ folder with your result images. Then, you will run the .tex file to generate your PDF file. Your PDF is to be submitted into Blackboard along with your notebook, please follow the instructions given in the GitHub page. This PDF already contains a few solution images. These images will allow you to check your own solution to ensure correctness.

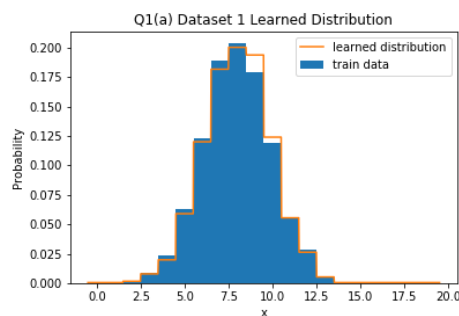
## Question 1: 1D Data

### (a) [10pt] Fitting a Histogram

Final test loss for dataset 1: 2.0553 nats / dim



(a) Dataset 1: Training curve



(b) Dataset 1: Learned distribution

Final test loss for dataset 2: **FILL IN HERE** nats / dim

Placeholder

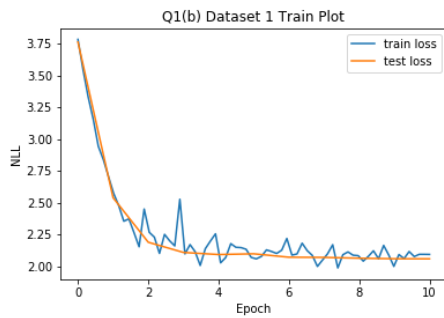
Placeholder

(a) Dataset 2: Training curve

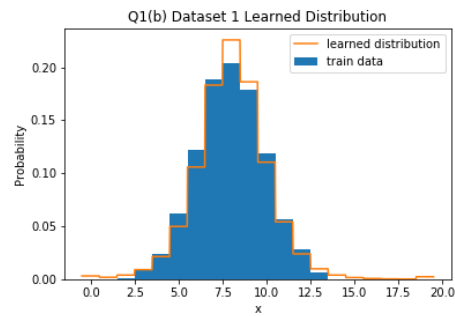
(b) Dataset 2: Learned distribution

## (b) [10pth] Fitting Discretized Mixture of Logistics

Final test loss for dataset 1: 2.0586 nats / dim



(a) Dataset 1: Training curve



(b) Dataset 1: Learned distribution

Final test loss for dataset 2: **FILL IN HERE** nats / dim

Placeholder

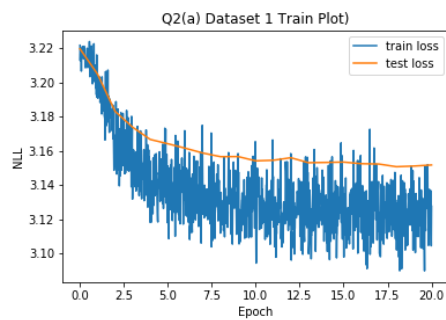
Placeholder

(a) Dataset 2: Training curve

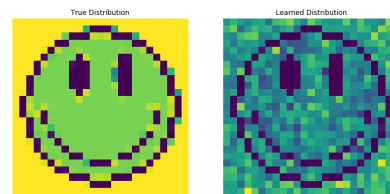
(b) Dataset 2: Learned distribution

**Question 2: MADE****(a) [10pt] Fitting 2D Data**

Final test loss for dataset 1: 3.1518 nats / dim



(a) Dataset 1: Training curve



(b) Dataset 1: Learned distribution

Final test loss for dataset 2: **FILL IN HERE** nats / dim

Placeholder

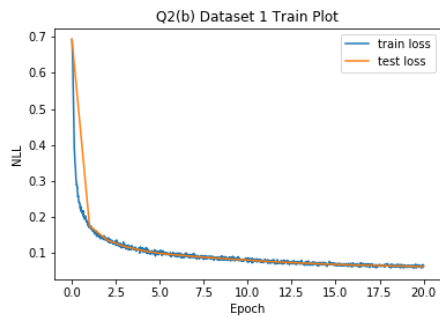
Placeholder

(a) Dataset 2: Training curve

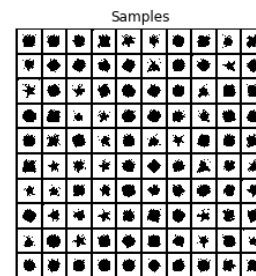
(b) Dataset 2: Learned distribution

## (b) [10pt] Shapes and MNIST

Final test loss for dataset 1: 0.0623 nats / dim



(a) Dataset 1: Training curve



(b) Dataset 1: Samples

Final test loss for dataset 2: **FILL IN HERE** nats / dim

Placeholder

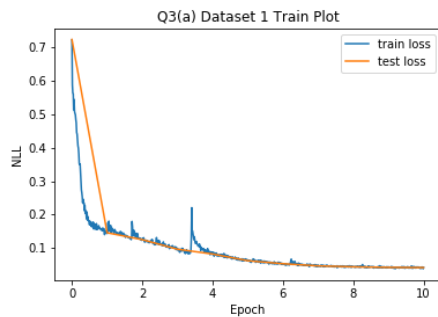
Placeholder

(a) Dataset 2: Training curve

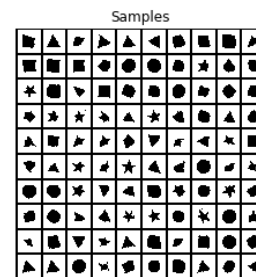
(b) Dataset 2: Samples

**Question 3: PixelCNNs****(a) [15pt] PixelCNNs on Shapes and MNIST**

Final test loss for dataset 1: 0.0420 nats / dim



(a) Dataset 1: Training curve



(b) Dataset 1: Samples

Final test loss for dataset 2: **FILL IN HERE** nats / dim

Placeholder

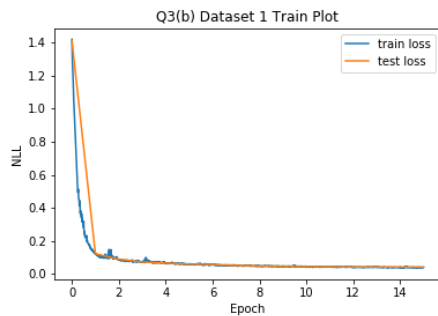
Placeholder

(a) Dataset 2: Training curve

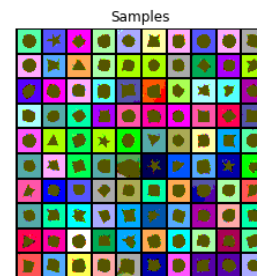
(b) Dataset 2: Samples

## (b) [15pt] PixelCNN on Colored Shapes and MNIST: Independent Color Channels

Final test loss for dataset 1: 0.0444 nats / dim



(a) Dataset 1: Training curve



(b) Dataset 1: Samples

Final test loss for dataset 2: **FILL IN HERE** nats / dim

Placeholder

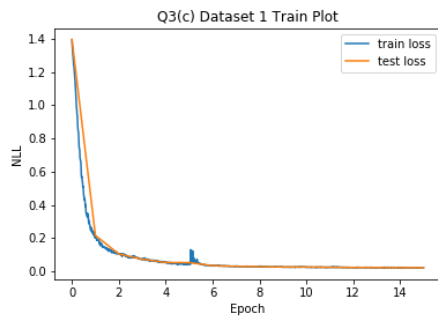
Placeholder

(a) Dataset 2: Training curve

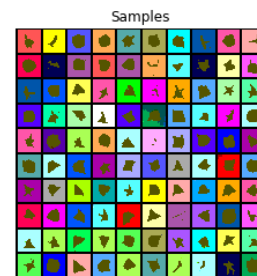
(b) Dataset 2: Samples

## (c) [15pt] PixelCNN on Colored Shapes and MNIST: Autoregressive Color Channels

Final test loss for dataset 1: 0.0236 nats / dim



(a) Dataset 1: Training curve



(b) Dataset 1: Samples

Final test loss for dataset 2: **FILL IN HERE** nats / dim

Placeholder

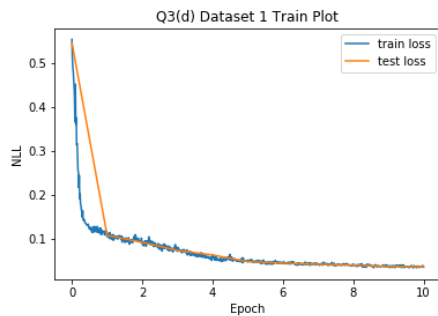
(a) Dataset 2: Training curve

Placeholder

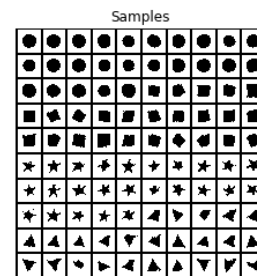
(b) Dataset 2: Samples

(d) [15pt] **Conditional PixelCNNs**

Final test loss for dataset 1: 0.0368 nats / dim



(a) Dataset 1: Training curve



(b) Dataset 1: Samples

Final test loss for dataset 2: **FILL IN HERE** nats / dim

Placeholder

Placeholder

(a) Dataset 2: Training curve

(b) Dataset 2: Samples



**Bonus Questions (Optional)**

1. [10pt] Gated PixelCNN

Final test loss: **FILL IN HERE** nats / dim

Placeholder

Placeholder

(a) Training curve

(b) Samples

2. [10pt] Grayscale PixelCNN

Final test loss: **FILL IN HERE** nats / dim

Placeholder

Placeholder

(a) Training curve

(b) Samples

3. [10pt] **Parallel Multiscale PixelCNN**

Final test loss: **FILL IN HERE** nats / dim

Placeholder

Placeholder

(a) Training curve

(b) Samples