Exercise M5 VR: One-dimensional GAN

Master in Computer Vision, Course 2022-2023

Diego Porres

dporres@cvc.uab.es

Computer Vision Center, March 2023

Background

- Nowadays, GANs are able to synthesize realistic *high resolution* images
- As seen in the lectures, GANs have taken the area of unsupervised image generation by storm
  - And have no reason not to be able to scale, e.g., GigaGAN
- Moving away from face generation, in Figure 1 we show what can be achieved when training a SOTA GAN model on urban scenes

Figure 1: Using the Audi A2D2 dataset, we train a StyleGAN2 to generate RGB images of size 1024^2. The grid illustrates the style transfer properties of this GAN.

Goals of the Exercise

- Deeply understand the *training mechanism/loop* of a GAN using simple one-dimensional data
- Continue enhancing your `PyTorch` skills
- Discuss some of the pitfalls and difficulties one usually encounters whilst training a GAN

Resources

- The prepared notebook can be found here
- Please download the notebook to your local machine or make a copy in your Drive in order to continue working in Colab
- Do the assigned exercises in groups of up to 3 students
- The notebook itself is meant to be self-contained, so you will find many relevant articles and links in its main body
  - If you find any errata, please let me know as soon as possible!
  - If you have any questions, don't hesitate to email/find me at the CVC!

Exercise 1 - Why a GAN?

- Suppose you have a dataset $\mathcal{X}$ and you wish to generate *new* data samples belonging to this dataset
- Explain *why* would you choose a GAN over any other type of generative model to solve this task?
- Be as precise (i.e., select a specific dataset) or as general (i.e., talk about a specific usecase) as you deem necessary
- Some ideas on what to consider are found in the Colab notebook, but do not be constrained with what I write down
- **Marks:** 0.15 points

Exercise 2 - Training our 1D GAN

- Throughout the Colab notebook, our baseline model will fail to converge to the real data distribution as seen in the following figure

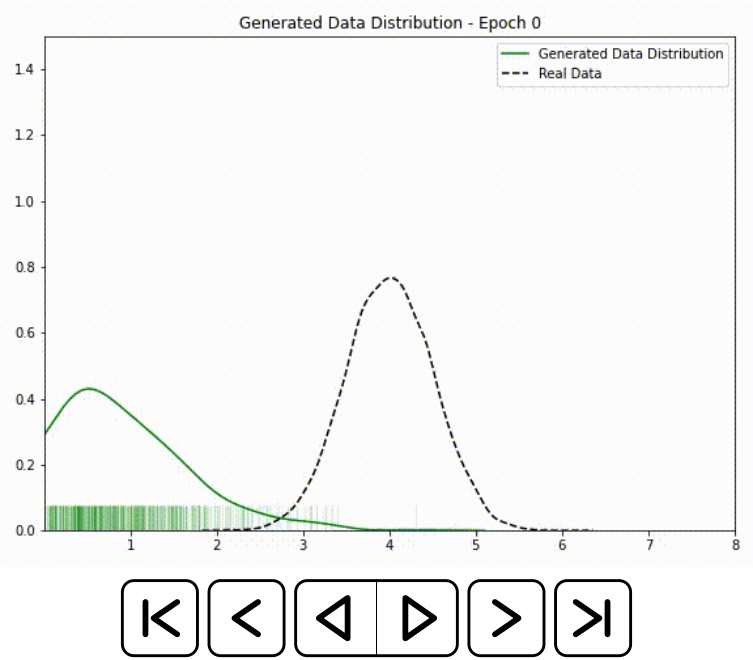
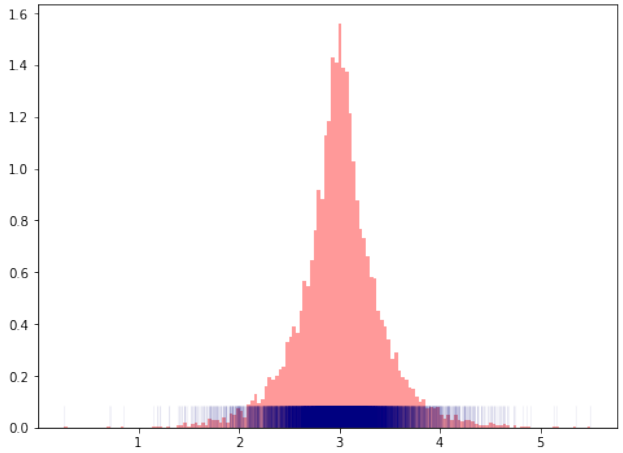


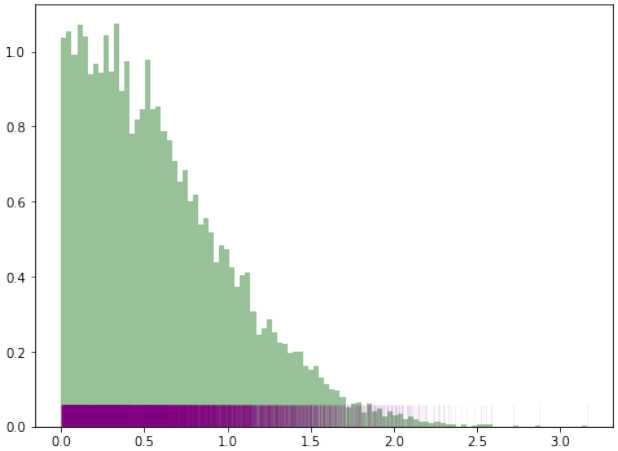
Figure 2: GIF of our 1D GAN training to imitate a dataset with Gaussian Distribution. The controls for this GIF only work on Adobe Acrobat.

Exercise 2 - Training our 1D GAN

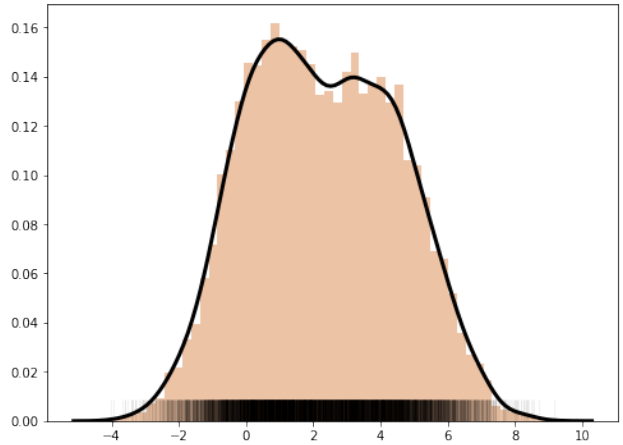
- Exercise 2 tasks you to find the correct set of parameters, hyperparameters, NN architectures, etc., in order to correctly mimic the real data distribution at the end of training
- Do the same as in the notebook but now you must select a *harder* distribution than the Normal distribution
- You are free to choose one of the three provided distributions or mix them up as you please
  - The code to generate each distribution is provided
- Note that the last distribution does not really exist, but was a machination of my mind in times of quarantine
- **Marks:** 0.35 points



Laplace distribution



Half-normal distribution



Petit Prince distribution

Instructions

- For Exercise 2, report any conclusions you arrive to during your trials.
  - For example, what happens if you train the baseline for longer, increase/decrease the latent dimension,increase/decrease the number of neurons per network, etc.?
  - A clear story of how you select each parameter should be shown (e.g., a GIF/video of the training process will help you here)
  - A list of suggested parameters/hyperparameters to tune is provided in the notebook

Instructions

- Upload to the Virtual Campus both a **presentation** (PDF, PPT, ...) containing your answers to both Exercises, as well as the **notebook** with your final set of parameters and hyperparameters that yielded a good result for both exercises
  - In your presentation, you can show your results in any way you so desire (plots, GIF, video...); remember you're telling a story!
  - For the notebook, you can either attach the `.ipynb` file or simply add the link to your Colab notebook in a slide of the presentation
- Don't forget to add your team member's names and emails!
- **Deadline:** April 17th at midnight