Improving Generalization in Deep Learning with Denoising Diffusion Models



Deep neural networks (DNNs) are shown to be largely vulnerable to simple distribution shifts. At test time, unlike human visual perception, such changes in the image content (e.g., weather, style, brightness or contrast settings, etc.) can cause the input images to lie far from the in-distribution density introduced by the training set images, hence leading to a significant performance loss in terms of generalization. An example can be observed above with the *original* (leftmost) image being represented in *cartoon* (middle) or in *drawing* (rightmost) style, where both would lead to incorrect decisions by a classifier trained only on original versions of images. In this project we want to explore this phenomenon towards generalization and robustness in out-of-distribution settings. We will particularly focus on exploiting state-of-the-art generative deep learning algorithms based on denoising diffusion models (see our recent work on image restoration with diffusion models [1]).

[1] O. Özdenizci & R. Legenstein, "Restoring vision in adverse weather conditions with patch-based denoising diffusion models", arXiv preprint arXiv:2207.14626, 2022.

Goals & Tasks

- Review of the state-of-the-art on generative deep learning with diffusion models.
- Experimenting with existing out-of-distribution generalization methods.
- Developing and implementing novel diffusion models with new image datasets.

Qualifications

- Interest in deep learning and generative modeling with DNNs.
- Experience with Python based deep learning frameworks such as TensorFlow or PyTorch are beneficial.
- Registered to one of the following:

  ☐ **Bachelor Thesis**

  ✓ **Seminar Project**

  ✓ **Master Thesis**

Contact

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