



Final Project

Deep Learning From Theory to Practice

Christoph Brune, Len Spek
Applied Mathematics
Data Science, EEMCS
University of Twente

Generative Adversarial Networks (GANs) - analysing power and limitations -

The final project is a useful milestone at the end of our deep learning course. It is designed to evaluate your ability to conduct a research-related task close to one of the course key topics on a small scale and to show individual skills regarding *understanding, research reproduction, creativity and programming towards applications*. The scope of your final project is the area of Generative Adversarial Networks (GANs) with their power and limitations from theory to practice.

Groups. You can work in groups up to 3 people. Please form your group of choice in Canvas.

Topic. To choose your specific project topic you have two options. Either you choose

- **Option A:** and work on the 'standard', pre-structured project on *Style transfer via CycleGAN*, see the other document in Canvas, or you choose
- **Option B:** and select your own GAN application, e.g. classification and regression, image synthesis, image-to-image translation or super-resolution, see Chapter VI of the overview paper → Generative Adversarial Networks: An Overview.
Recommended reference papers and many python reference codes are available under → Really-Awesome-GAN. If you are searching for a specific GAN model, this website will help → The-GAN-ZOO.

Data Sets. Useful data sets for GAN applications:

- Fashion-MNIST dataset (simpler) <https://github.com/zalandoresearch/fashion-mnist>
- CelebA dataset <http://mmlab.ie.cuhk.edu.hk/projects/CelebA.html>

Project topic. (due Dec 20, 2019) Please submit one page to describe your project choice including your group, your focus paper (e.g. Option A), your dataset(s) and a first short description with the rough main idea or challenge.

Report. (due Jan 29, 2020) You should aim for a report at the end of this project with a maximum of 8 pages. An excellent report explains and discusses existing **theory** (modelling, analysis) of your (chosen) reference paper, **numerical aspects** (solution strategy, algorithms, programming) and **results**. Adding creativity via novel choices in the modelling or numerical realisation is for sure a plus. It is important that you report on your positive *as well as negative* experiences of getting your GAN to work, and why you took certain decisions in your model or software development. This will help you and us to better understand the power and limitations of GANs from theory to practice.

Guideline for report writing: Where applicable, depending on focus and creativity of your project, here are some topics that could be addressed in your report:

- Research background. Describe the research problem and some previous suggested solutions from the context of the research paper.
- Suggested model. Why has the model been chosen? Include both the authors and your view.
- Specific problem. If the paper suggests many models or variations - select one of them and investigate this model more thoroughly.
- Implementation. Implement the selected single problem - either by the implementation suggested in the paper or using your own method.
- Analysis. Analyse papers regarding your selected problem and use at least two test data sets. Analyse various parameters or check robustness, e.g. towards noise. If you know of a simple naive solution to the problem - compare the different approaches.
- Creative and suggested improvements. Suggest an improvement to the model. Following your analysis, see where the model fails, or is less accurate and try to correct it. This is an important part of the project where you can show creativity and abilities to perform research. Illustrate your solution with examples, e.g. showing: 1. Your solution is at least slightly better than the original paper on some images. 2. Your solution does not degrade the performance on other images (such as the ones shown on the analysis part).
- Conclusion. Summarise the goal, your analysis and suggested improvement.
- References. Bibliography cited within the report.
- Code. Please submit your Python code via a zip file on Canvas or by sharing a Github link in your report.

Poster. (week 5, 2020) In week 5 we will have a poster session where you can share your experiences on GANs with your colleagues.