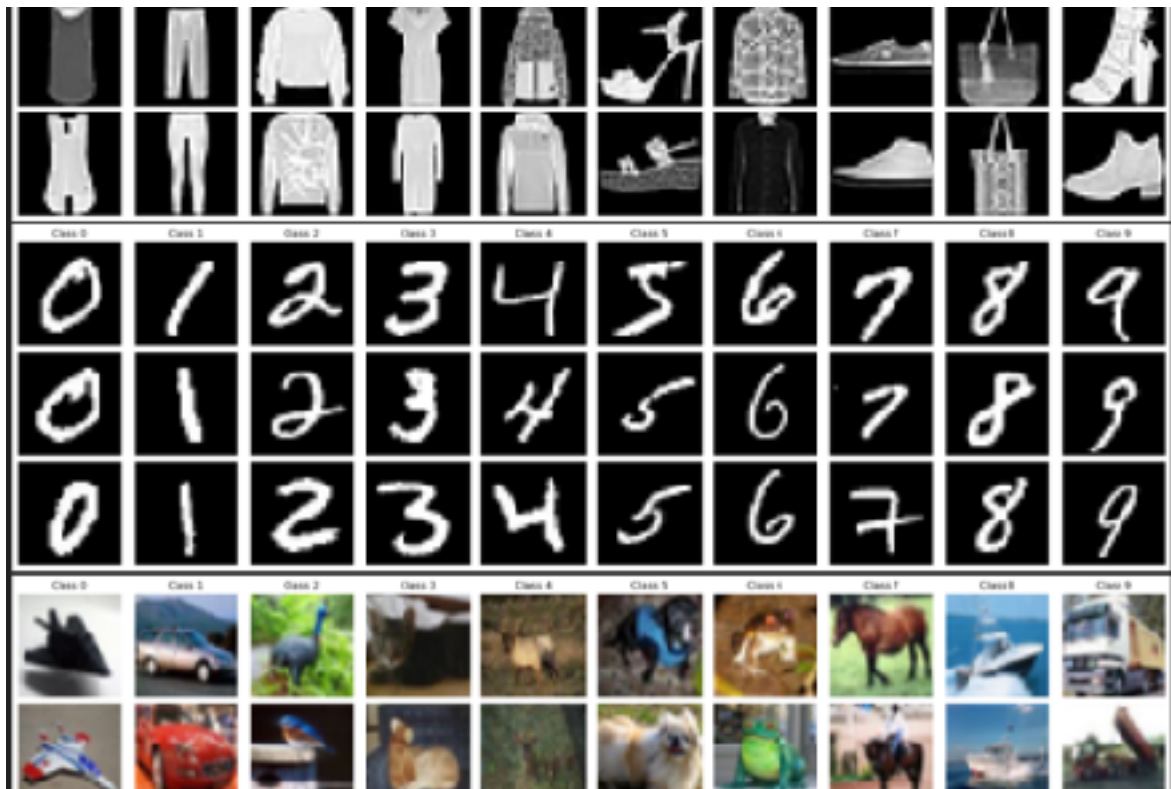


Thesis Report

Generative Data Augmentation using Multi-Agent Diverse Generative Adversarial Networks



Nicolas Reinhart [nro63]

WS24/25 - SS25

Supervision by

Prof. Dr.-Ing. Johannes Maucher & Prof. Dr.-Ing. Oliver Kretzschmar

How to read the document:

The report is merely summarizing the most important achievements, given the current phase. Each report has its dedicated page and is lead by an image of the project plan. The red dot in the project plan shows the current point in time.

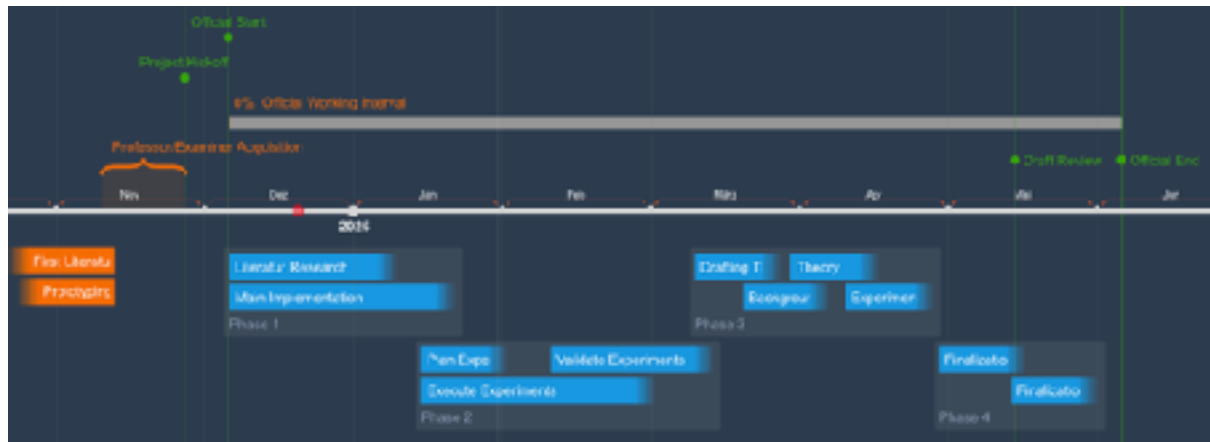
The project plan itself is separated into four phases.

1. Main implementation & Literature Research
2. Experimenting
3. Drafting & Writing
4. Finalization

A reports heading will be suffixed by its current phase. Overlapping phases will be listed and explained, if mandatory.

Markers:

- | | |
|---------------------|---|
| + (Positive) | A point that went well worked generally or can continue as planned. |
| - (Negative) | A point that does not hold true to its set timing, is not working as planned or must be left out of the initial plan. |
| # (Neutral) | Things to note. Adding further information to points above or adding general information that is noteworthy. |



Report 2024.12.20 - Phase 1 - Implementation

+ **Implementation is going very well**

The prototype has been expanded to a production like setup to support experiments in the future. Test-wise, experiments are already running to ensure full functionality with end-to-end testing.

repository: https://github.com/N10100010/mad_gan_thesis

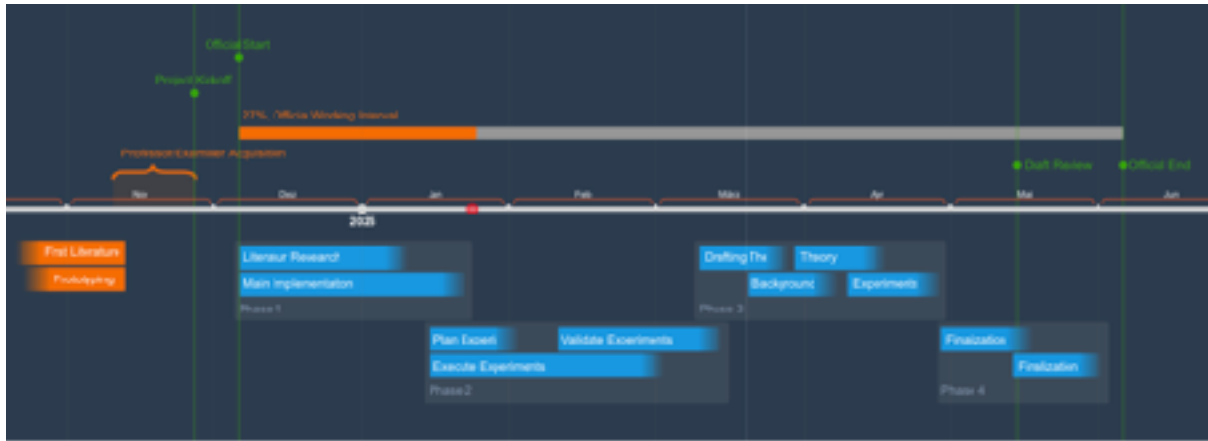
+ **Set up working environment on the HdM Servers of the IAAI**

- The setup was not straight forward and cost nearly 2 days to reliably spin-up a working conda environment.

- **Implementation of conditionality constraint worked**

Changing the objective functions altered the main research question, thus the adjustment will be omitted going forward.

Main literature research is scheduled for beginning of January



Report 2025.01.15 - Phase 1/2 - Implementation & Experimentation

+ **Implementation is 85% finished**

+ MAD GAN for the main datasets (mnist, moist-fashion and cifar10) is finished.

+ Vanilla GAN for main datasets (mnist, moist-fashion and cifar10) is finished.

+ Image generation for both, Vanilla- and MAD GANs created.

+ **Multiple papers have been set for research and references**

- More papers needed for final amount of papers for references.

- **Strong flow break**

- A strong flow with a week of fever held me off of my thesis for 2 weeks.

+ **Experiments/Models for mnist, fashion-mnist, cifar10 ran with differing number of generators**

- Difficulty creating coherent images with MAD GAN architecture for cifar10. The images look generally “good” (colours and general relation between colours), but are hard to be assigned to a class.

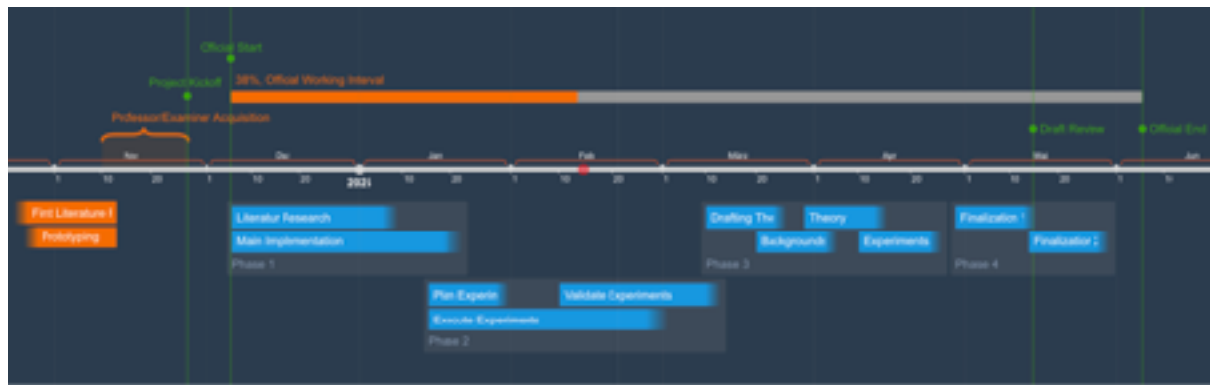
Open implementation tasks:

Classifiers for the three datasets.

Experiment settings, to test different setups like:

- Number of classes
- Number of images per class

MAD GAN architecture with less images in a given class to test the ability to withstand the mode-collapse problem



Report 2025.02.14 - Phase 2 - Implementation & Experimentation

+ **Implementation is 90% finished**

- + MAD GAN for the main datasets (mnist, moist-fashion and cifar10) is finished.
- + Vanilla GAN for main datasets (mnist, moist-fashion and cifar10) is finished.
- + Image generation for both, Vanilla- and MAD GANs created.

+ **Experiments are going well for the most part**

- + Data generation is finished MAD GAN
 - + mnist, fashion-mnist
 - + cifar10: MAD GAN model have been generated
- Vanilla GAN models struggle to not collapse
 - The models for mnist and cifar10 struggle to not collapse into:
 - $n\text{-modes} < n\text{-classes}$
 - (+) For fashion-mnist however, the vanilla model does not collapse



Report 2025.02.14 - Phase 2 - Implementation & Experimentation

+ **Implementation is 95% finished**

- + So far, only small modifications must be made to provide the final state of the code. These changes are not yet foreseen.
- + Scoring of generated images, with the Inception Score (IS) and the Fréchet Inception Distance (FID) is implemented
- + Data Generation is mostly finished

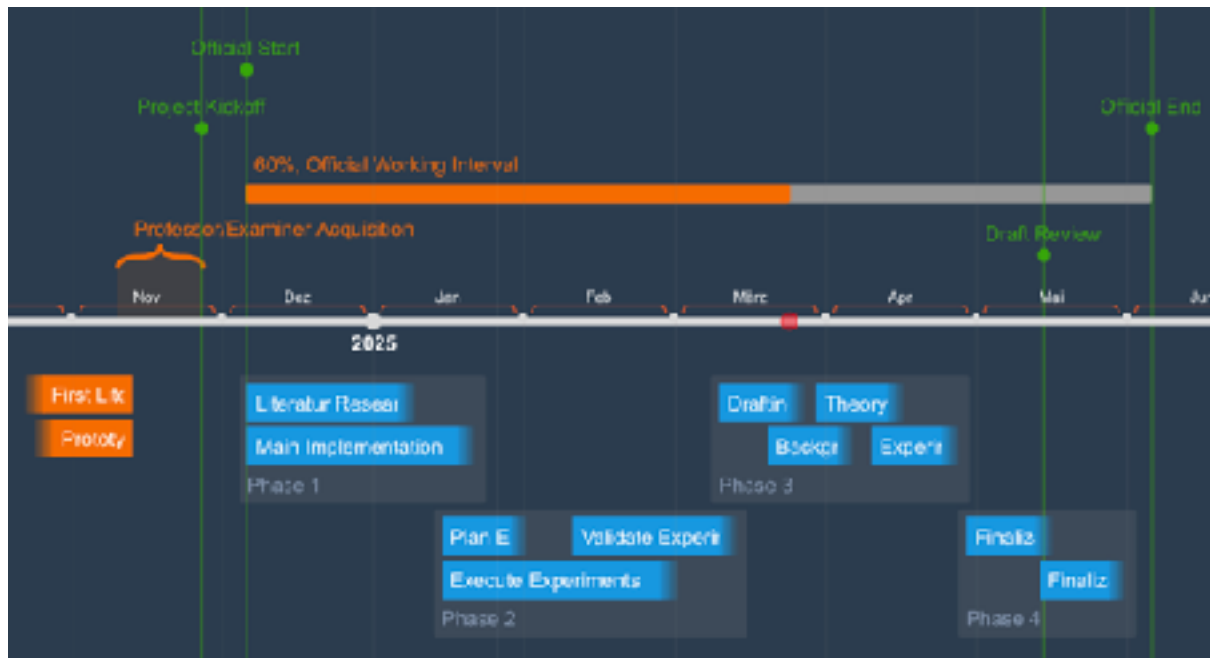
+ **Stratified Classification using a variable number of generated and real images**

- + Experiments using the mnist/fashion-mnist models are finished thus far

- **Vanilla GAN models struggle to not collapse**

- After many experiments, the vanilla setup does not converge to a satisfying result.
- + Potential Solution:
 - + A fairly simple fix is to use a Conditional GAN, instead of the Vanilla
 - > Will start to implement and wait for response from Prof. Maucher

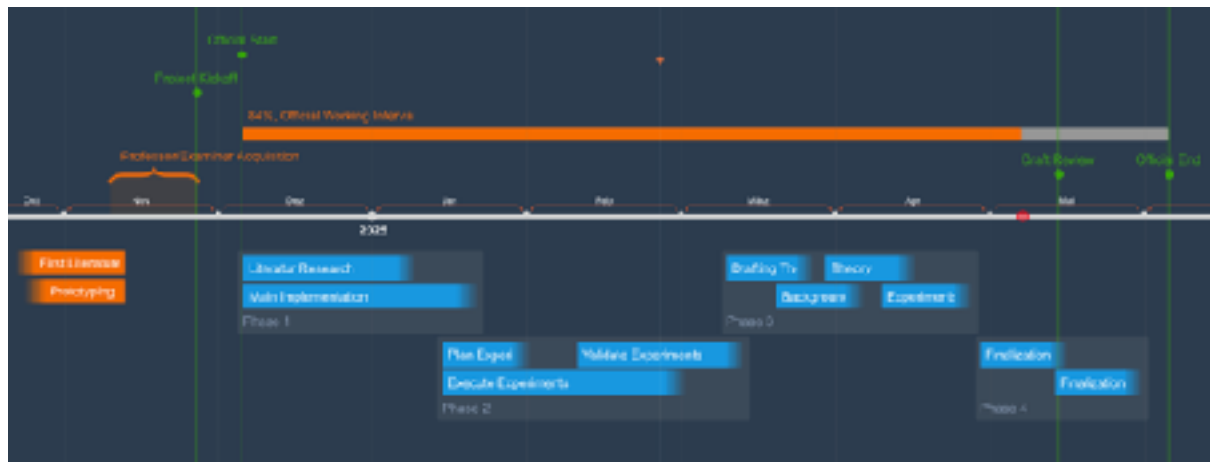
Note: 1 report is skipped, due to the first status meeting



Report 2025.04.24 - Phase 3 - Text drafting / Background and Theory

+ **Implementation finished**

- + So far, only small modifications must be made to provide the final state of the code. These changes are not yet foreseen.
- + Scoring of generated images, with the Inception Score (IS) and the Fréchet Inception Distance (FID) is implemented
- + Data Generation is mostly finished
- + Stratified Classifiers are mostly finished training



Report 2025.05.05 - Phase 4 - Text drafting / Finalization

+ **Implementation of Conditional MADGAN**

- + After some testing, a conditional version of the MADGAN architecture has been implemented and integrated into the thesis
- + Stratified Classifiers on MNIST and Fashion-MNIST showed promising results.

- **The adjusted architecture was designed to support the base MADGAN with the help of labels, hence the conditionality. This however failed on CIFAR10 as well.**

+ **Drafting and Writing**

- + All major chapters have been written. All experiments have been described.
- + Unsorted thoughts are present for the remaining chapter: Remarks, Outlook and Conclusion.

Refinement and polishing for official draft review on the 15th of May.