# Semantic Segmentation Alternative Technique: Segmentation Domain Generation

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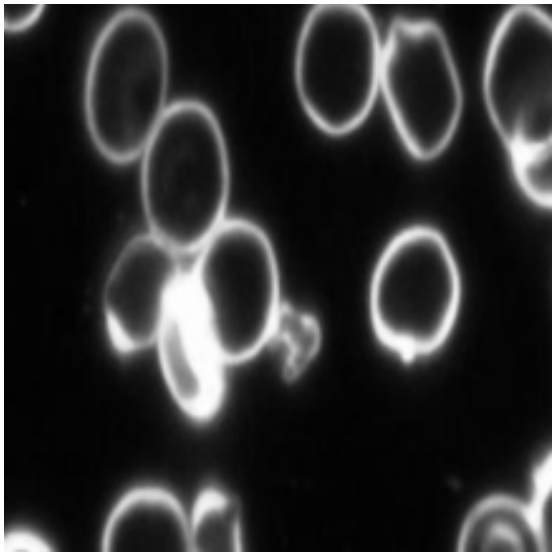
# Overview


1. Introduction
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# Introduction

- **Motivation:** The problem of automatic detection and segmentation of objects in images can be encountered in many domains, from sports to medicine or physics [RKH21];
- **Approach:** We propose a general method for automating the process of segmentation of desired objects in an image based on Generative Adversarial Networks (`GANs`) [Goo+14].

# Introduction



(a) Source image



(b) Segmentation mask

Figure: Problem description: given a dataset labeled for a segmentation task, the goal is to train a GAN to be able to transform (a) the source image into its corresponding (b) segmentation mask.

# Datasets

We seek to validate our methodology by testing it on two datasets:

- `Particles` contains 40 images of particles acquired using electron microscopy [RKH21];
- `Bacteria` contains 366 images of the *Spirochaeta* bacteria acquired using darkfield microscopy [Ngu20].

Both datasets have an associated segmentation mask corresponding to the location of the particles and the location of the bacteria respectively.

# Experiments 1: Conditional GAN

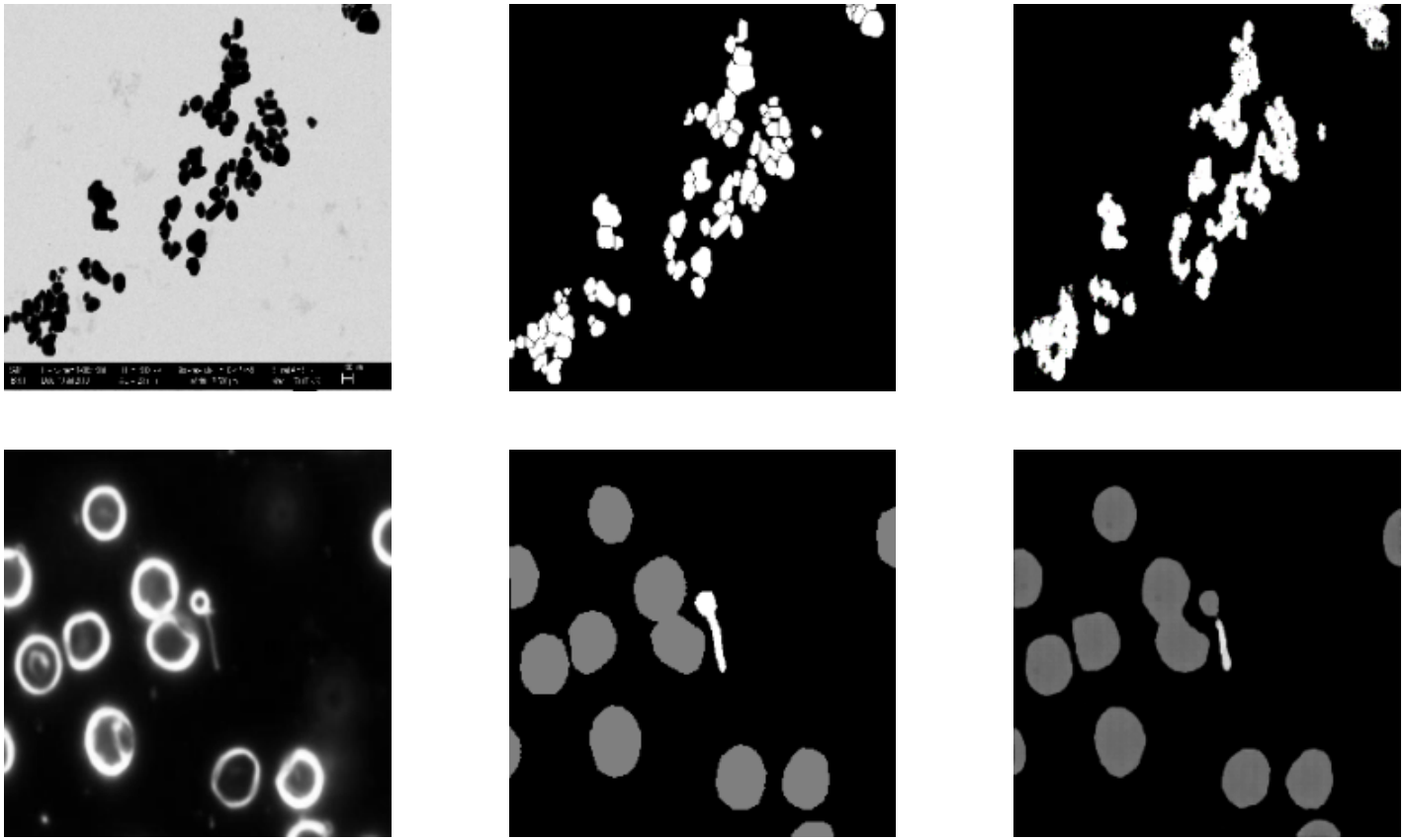


Figure: Segmentation masks generated using `Conditional GANs (CGANs)`. On each row we can see, from left to right: the real image, the ground truth segmentation mask and the generated segmentation mask. On the first and second row we can see examples from the `Particles` and `Bacteria` datasets respectively.

# Experiments 2: Cycle-Consistent GAN

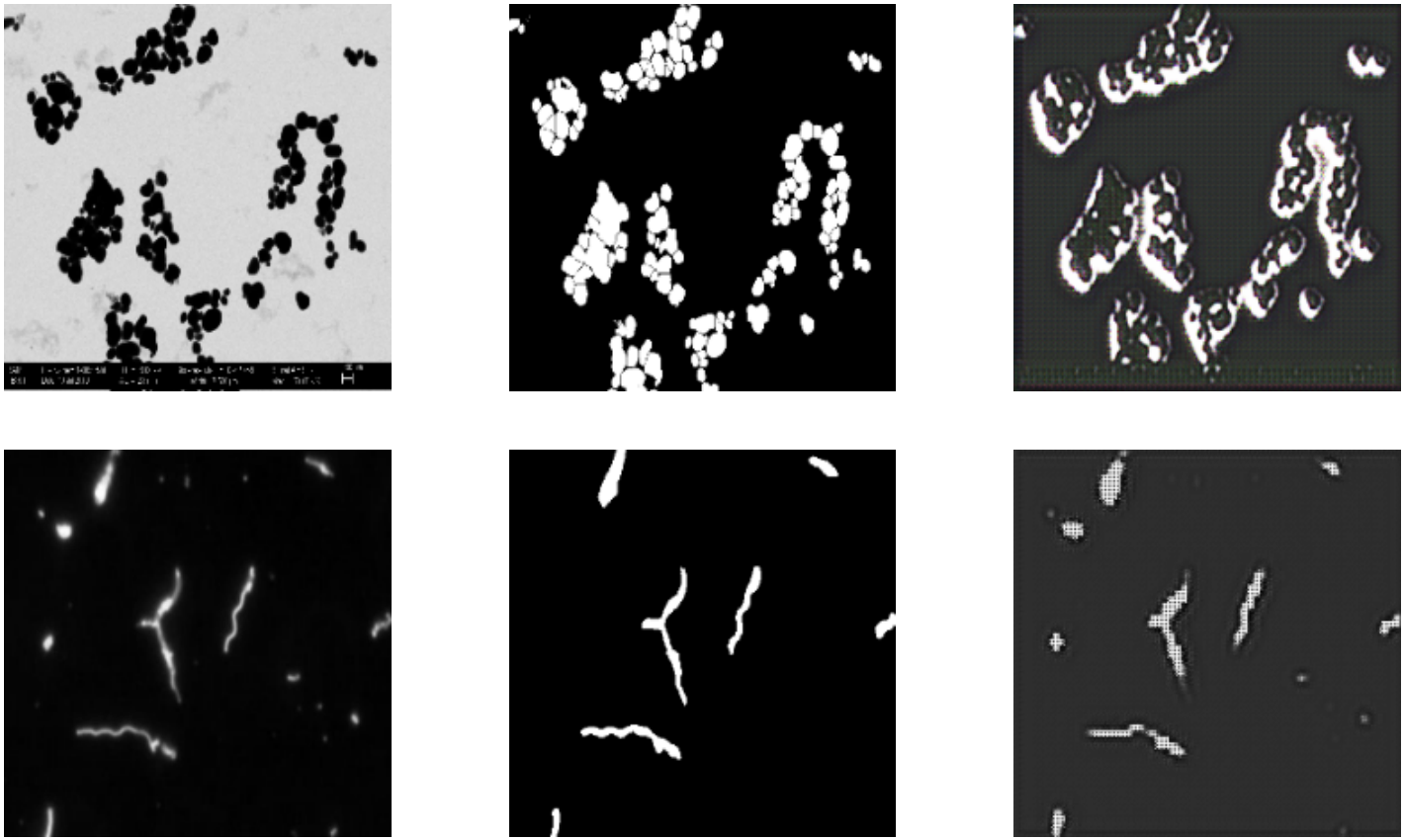


Figure: Samples of segmentation masks generated using `Cycle-Consistent GANs (CycleGANs)`. On each row we can see, from left to right: the real image, the ground truth segmentation mask and the generated segmentation mask. On the first and second row we can see examples from the `Particles` and `Bacteria` datasets respectively.

# Results validation

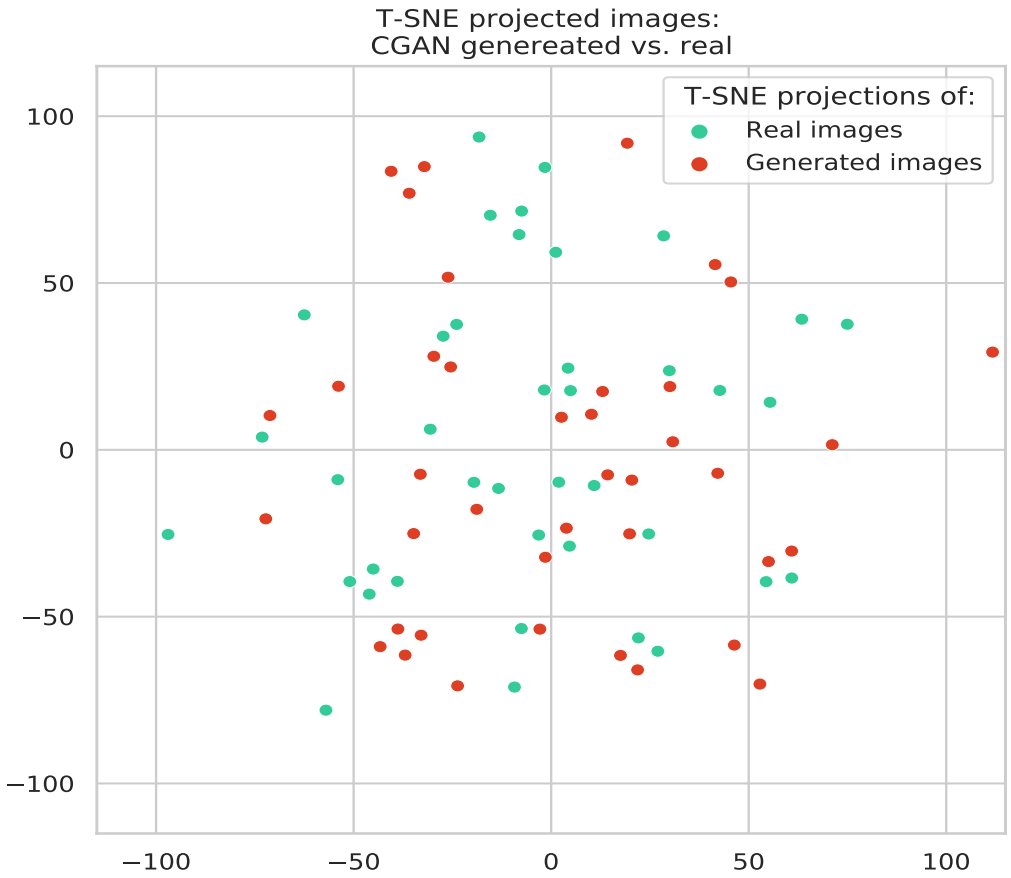



Figure: `T-SNE` 2D representation of the original and generated images for `CGAN`.

# Conclusions

- **Results**. We have shown in our experiments that the segmentation problem can be treated as a domain transfer task using the `Particles` and `Bacteria` datasets. We have observed that the results of a trained `CycleGAN` are inferior to those obtained by a trained `CGAN`.
- **Future work**. We aim to compare established segmentation techniques against our methods. We wish to investigate the feasibility of the reverse problem (i.e. generating true images from segmentation masks).

# The end!

*Thank you!*



# References




Ian J Goodfellow et al. "Generative adversarial networks". In: *arXiv preprint arXiv:1406.2661* (2014).



Long Nguyen. *Bacteria detection with darkfield microscopy*. https://www.kaggle.com/longnguyen2306/bacteria-detection-with-darkfield-microscopy. 2020.



Bastian Rühle, Julian Frederic Krumrey, and Vasile-Dan Hodoroaba. "Workflow towards automated segmentation of agglomerated, non-spherical particles from electron microscopy images using artificial neural networks". In: *Scientific reports* 11.1 (2021), pp. 1–10.