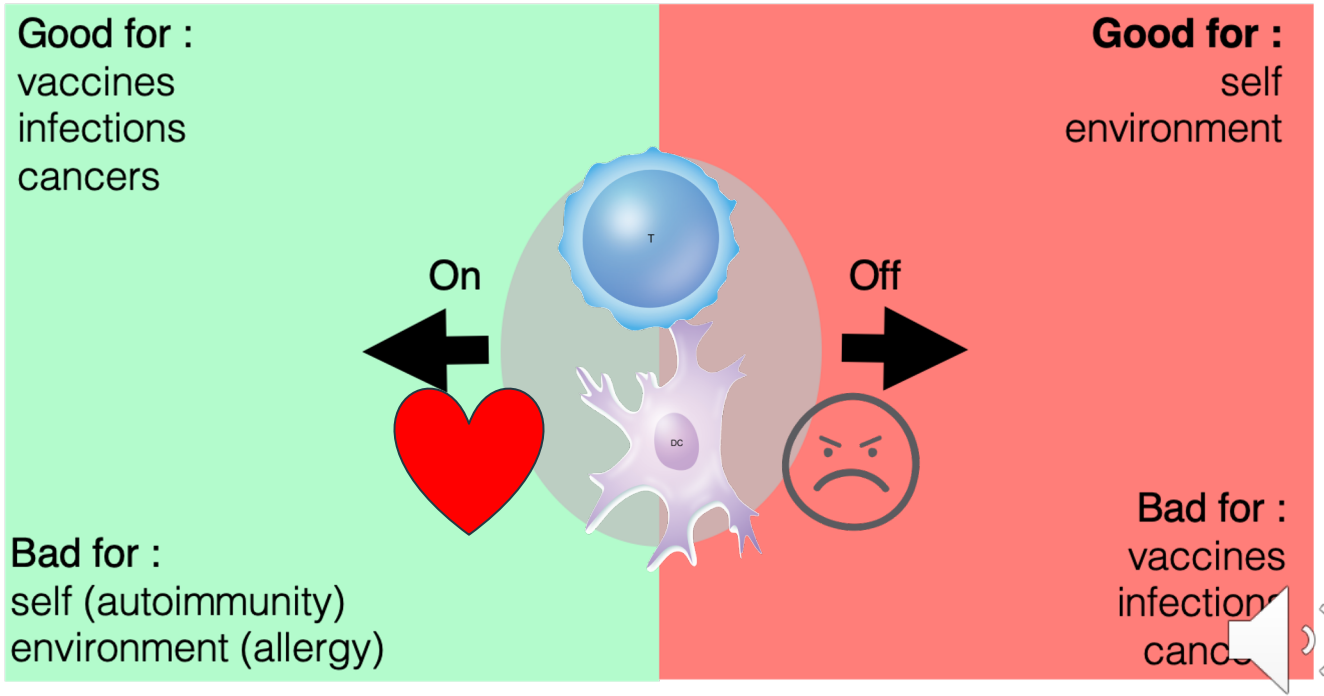
Deep learning for analysing immune cell interactions

Level 4 Honours Project – Leonore Papaloizos

Motivation

Let's talk about our immune system!



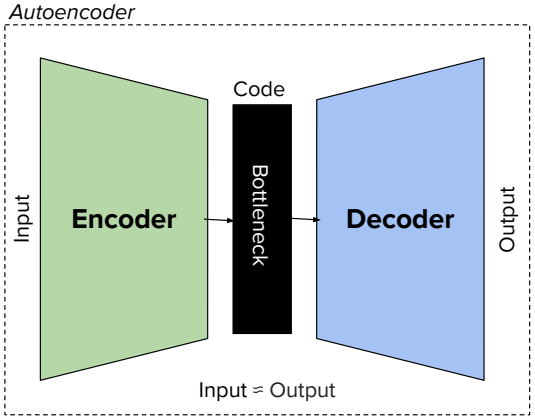
How can the interaction between immune cells be analysed with deep learning?

- We have a large amount of imaging data available
  - High-dimensional

- Previous research has shown neural networks are efficient in processing images
  - Recent advances have successfully applied deep learning to cancer research

How can the interaction between immune cells be analysed with deep learning?

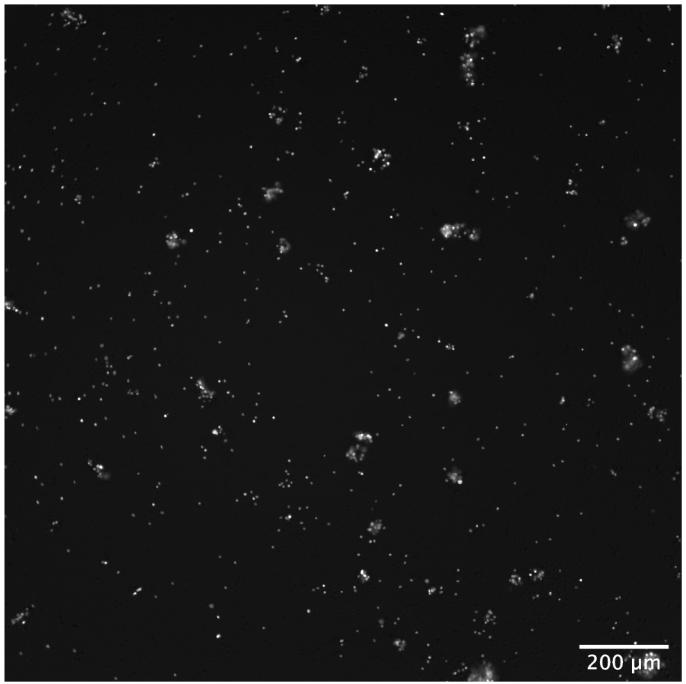
- We want to explore the use of autoencoders for analysing these images
  - Unsupervised learning ➜ visualisation of the data in 2D plane
  - Building block for supervised learning ➜ regression

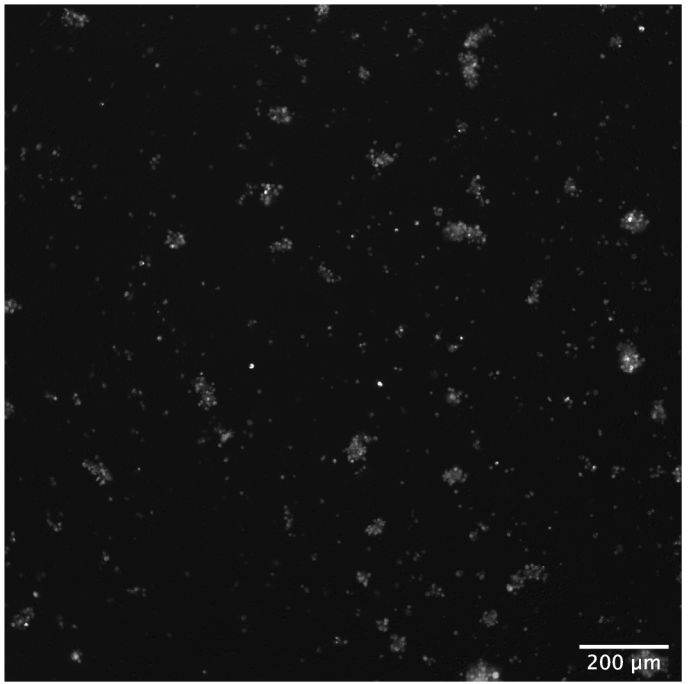


What are the aims of this research?

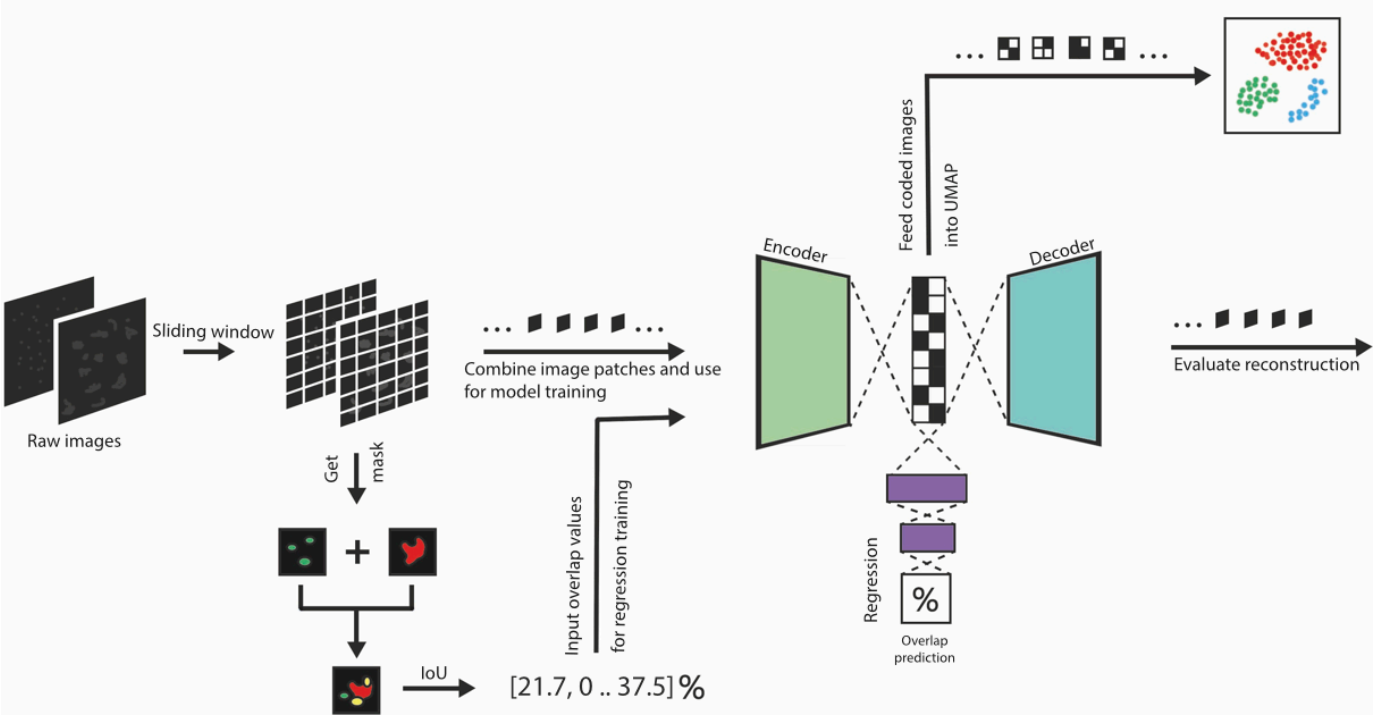
- Is there an underlying structure in images of immune cells under different experimental conditions?
- Can we quantify interaction from an image of immune cells?

Illustration

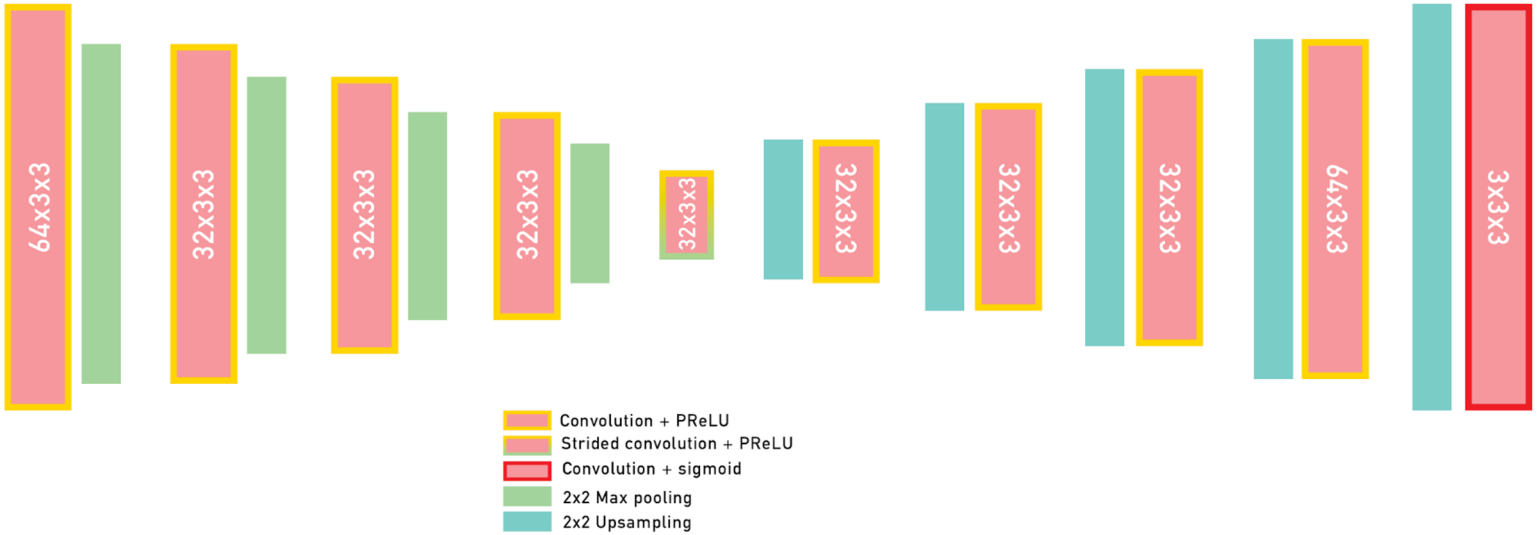




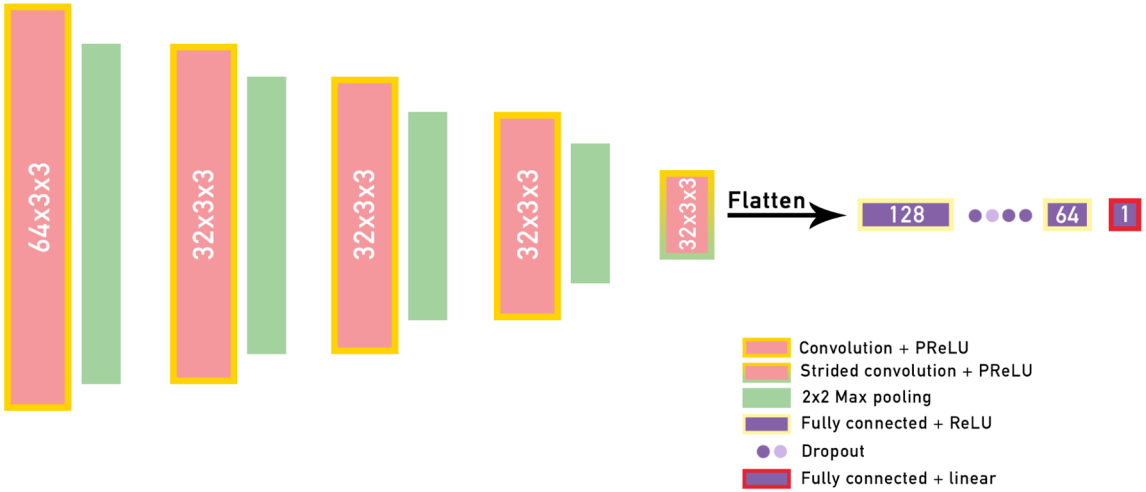
What was built?



What is the structure of the autoencoder?

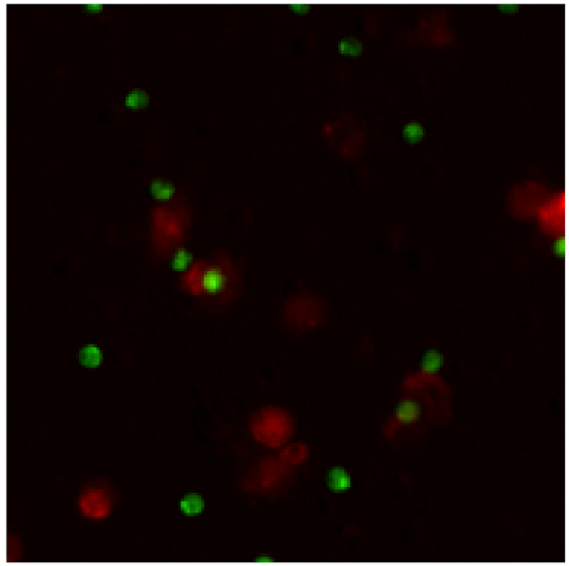


What is the structure of the regression model?

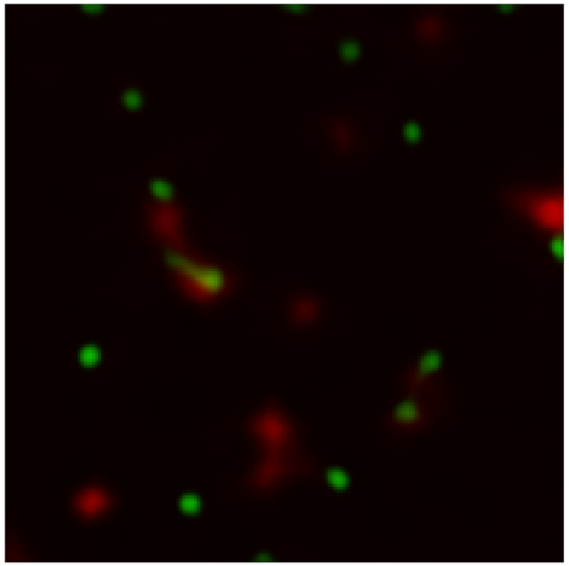


How well can we reconstruct images with an autoencoder?

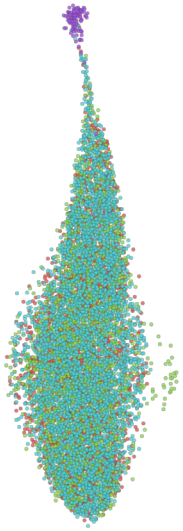
original image [index 9721]



reconstructed image

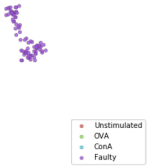


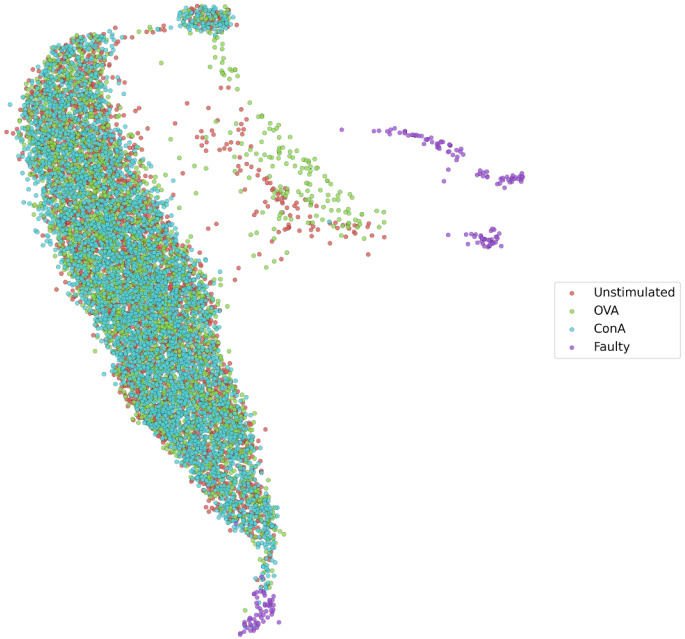
Can we find an underlying structure in the images of immune cells?



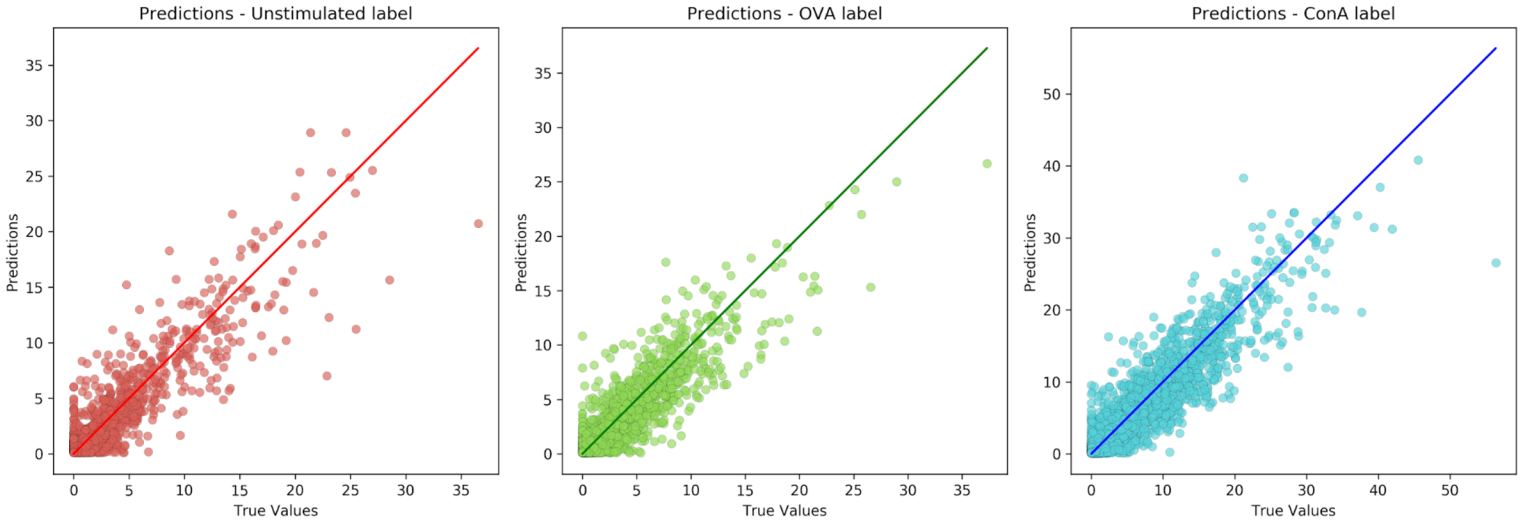
← non-reduced

reduced →





Can we quantify interaction in unseen images of immune cells?



RMSE score: 1.838, SD 4.583 (true SD: 4.853)

Summary

- Is there an underlying structure in images of immune cells under different experimental conditions? ➜ maybe...
- Can we quantify interaction from an image of immune cells? ➜ yes

Future work

- Deep segmentation models
  - Feature extraction
  - Morphology of cells: size, granularity
- Label-free experiments

Thank you for your time!