Resources :

Main resource:

https://github.com/bnsreenu/python\_for\_microscopists

Creating the model: [179 - Variational autoencoders using keras on MNIST data](https://www.youtube.com/watch?v=8wrLjnQ7EWQ&t=1671s&ab_channel=DigitalSreeni)

Others:

How to make an AutoEncoder: <https://pythonprogramming.net/autoencoders-tutorial/>

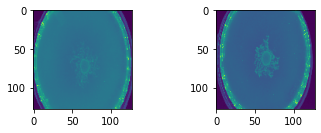
How to run the code:

Before running the code make sure that you change the directory location so that it points to the images of bacteria in your system.

Eg. *os.chdir('D:\some\_random\_folder\Bacteria')*

Creation of images may take some time so be patient. You do not need to run this cell once you have the pickle stored.

Image data size is 128x128 currently because of GPU limitations once we move over to SPORC we should be able to run higher dimension images like 256 by 256.



This is what 128 by 128 images look like. Even though we can see the general shape of the bacteria's growth, it's difficult to see the fractal patterns in the growth.

Model creation: The model is designed keeping in mind the GPU limitation for now. A 6GB VRAM gpu could handle a model with 250million parameters before crashing hence depending on the resources available the model could be scaled up accordingly.

At the time of training this model we only had 482 images and hence we don’t expect to see a very sharp output but we should see the basic shape of bacteria growth.

Total params: 67,403,425

Trainable params: 67,403,425

Non-trainable params: 0

Latent vector: This is the bottleneck of the VAE currently it’s size is 2048 which is similar to what world model had used. Speculation\*- making this bottleneck wider outputs a clearer image but this would eventually make the RNN + Controller more complex hence our goal is to keep this bottleneck as small as possible.

Training: We trained the model for 30 epochs after which the loss plateaued

Epoch 30/30

385/385 [==============================] - 2s 5ms/sample - loss: 0.5714 - val\_loss: 0.5346

Output:

|  |  |
| --- | --- |
| Actual output: | VAE output: |

As we can see it is able to capture the overall outline of the image with only 67million parameters which is not a bad outcome since we only trained it with 482 images.

Future work:

* We could make the model more complex to see if that produces better output by increasing the latent vector size which is not ideal or increasing the number of layers.
* Once we have enough images we can retrain the model to see if the model is able to further reduce the loss