



Machine Learning

Project 2: deep dreaming

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DNNs can dream

- Deep dreaming: technique to visualize what individual layer's activities represent
- Invented at DeepMind in 2016
- Shows that computers can create, long before prompt-based image generators
- For us:
 - interesting new take on gradient descent
 - new ways of using keras



DNNs can dream

- Procedure: take a **trained** DNN + a single sample (image)
- Leave its **weights** fixed but adapt the **image**
- Maximize the deep dreaming loss: $\mathcal{L}^{DD} = \sum_n \sum_i \left(A_{ni}^{(X)} \right)^2$
 - this loss will be high if all elements of layer X have high absolute values
 - maximize by computing gradient of \mathcal{L}^{DD} w.r.t. image ...
... and updating the image
 - “what input produces highest activities in layer X ?”
- Result strongly depends on choice of layer X



Expected project results

- Invocation: `python3 dream.py <image> <x> <n>`
- use MobileV2 model (pre-trained on ImageNet) without fully-connected parts
- load RGB `image`, resize to 224x224x3
- Perform `N` steps of GD, save/display image every 10 steps, maximizing activities in layer `x`
- save result to `dream_<image>`



Tools

- PIL for image loading, saving and resizing
- keras.applications for loading pre-trained models
- keras functional API for executing a model until layer X
- tf.GradientTape: gradients of loss w.r.t. image, perform GD “by hand”

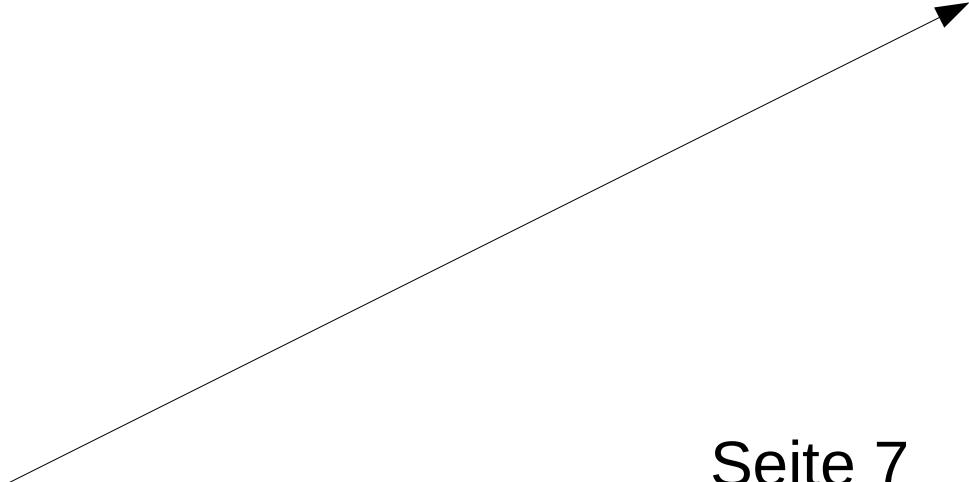


Refinements

- Perform dreaming in “octaves”
 - resize input image to 224,224,3
 - repeat:
 - do deep dreaming
 - up-scale image x2

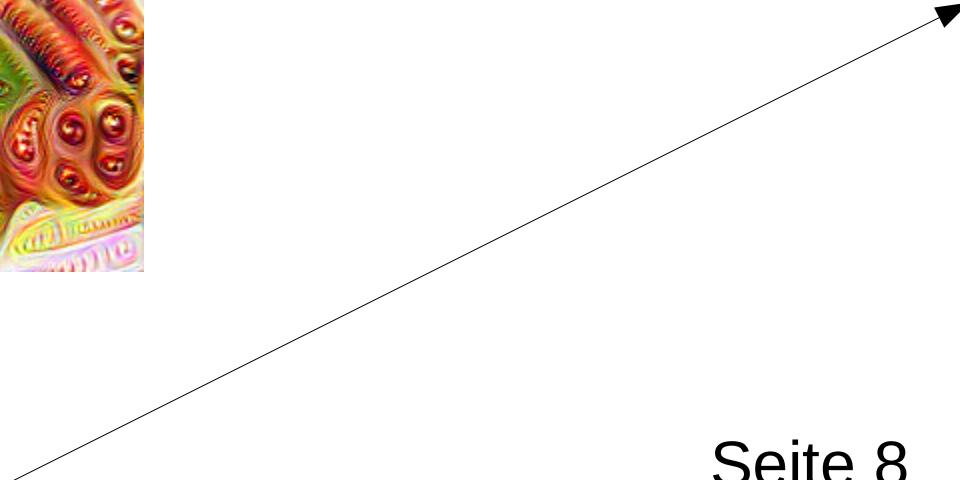


Deep dreaming examples





Deep dreaming examples



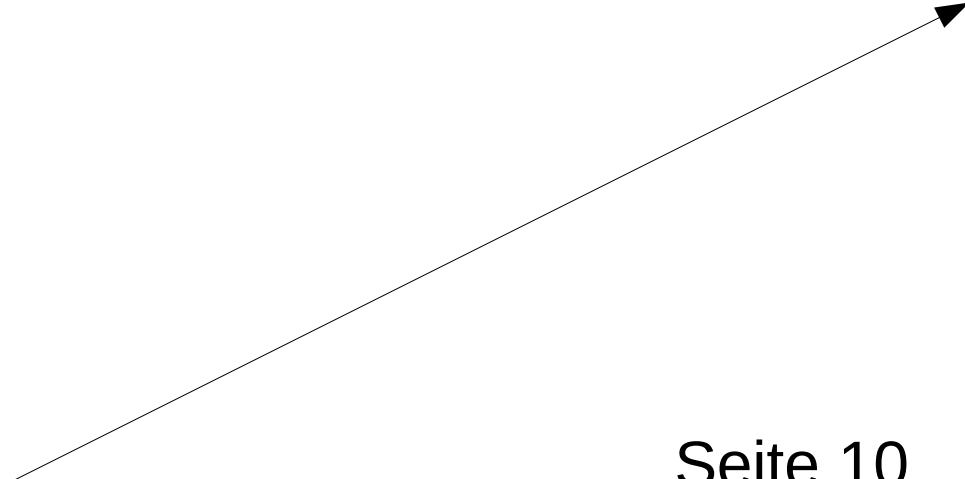


Deep dreaming examples



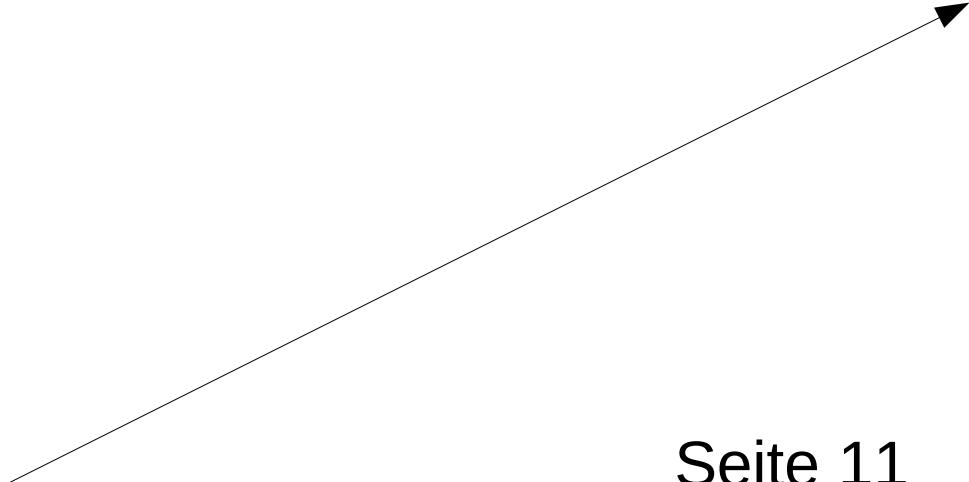


Deep dreaming examples



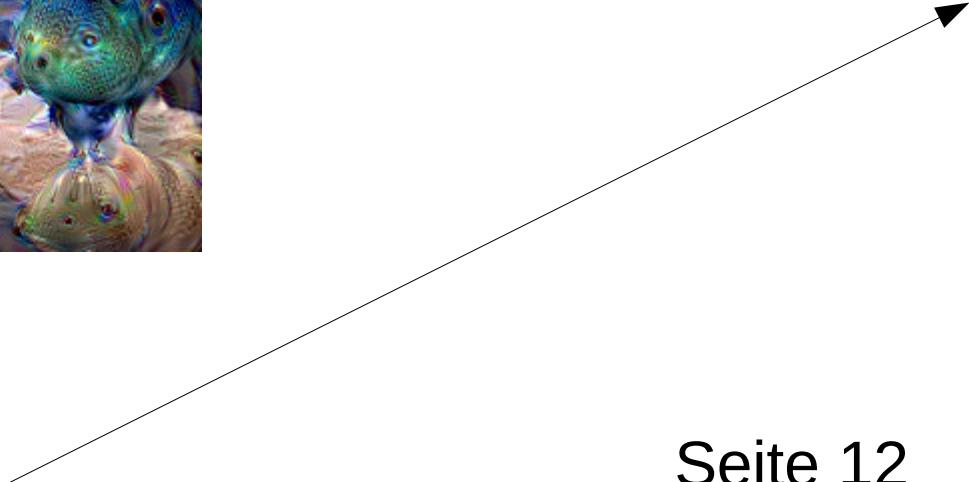
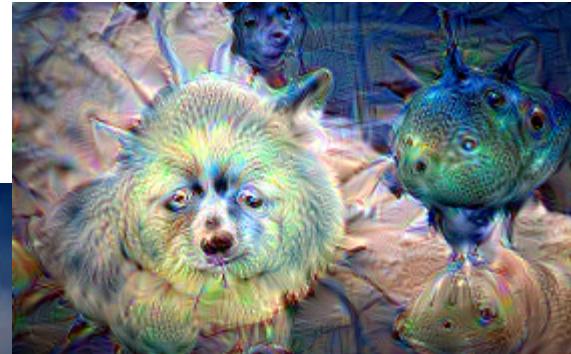


Deep dreaming examples



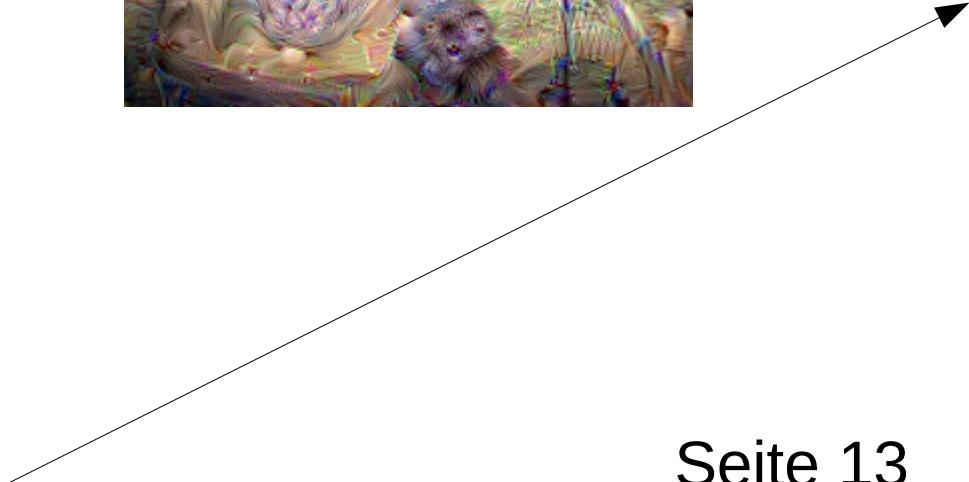


Deep dreaming examples



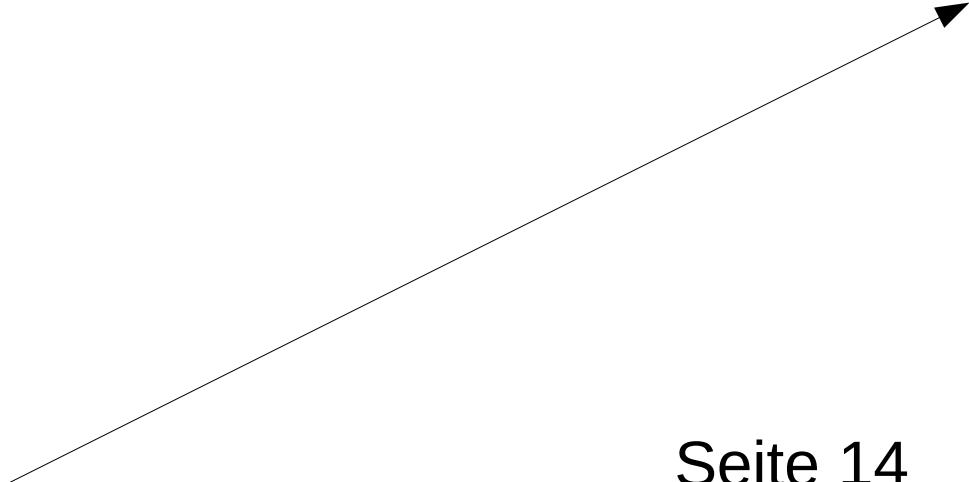
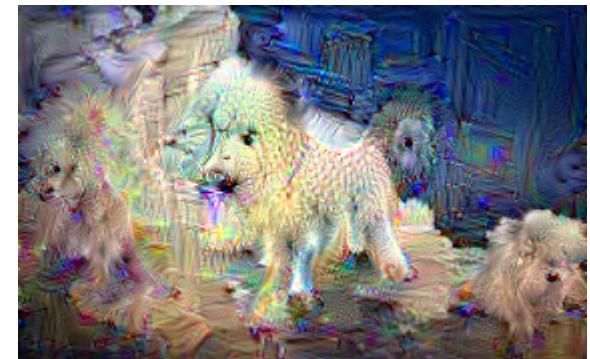


Deep dreaming examples



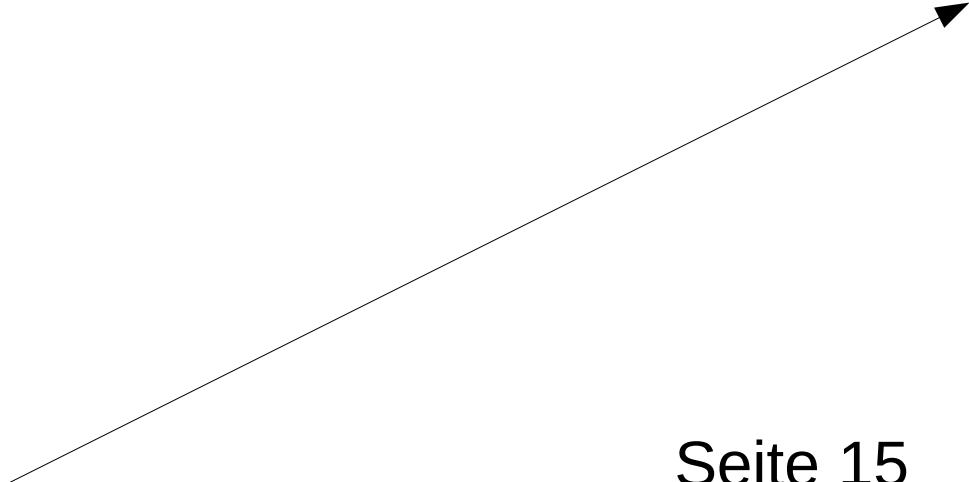


Deep dreaming examples



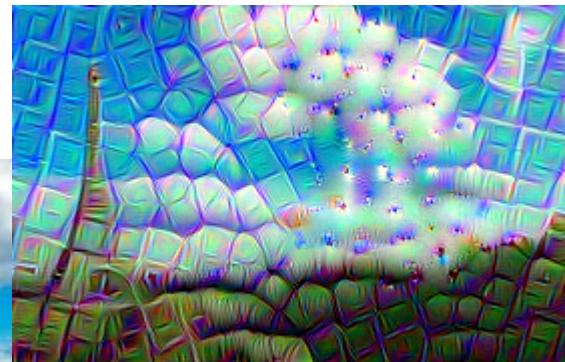


Deep dreaming examples



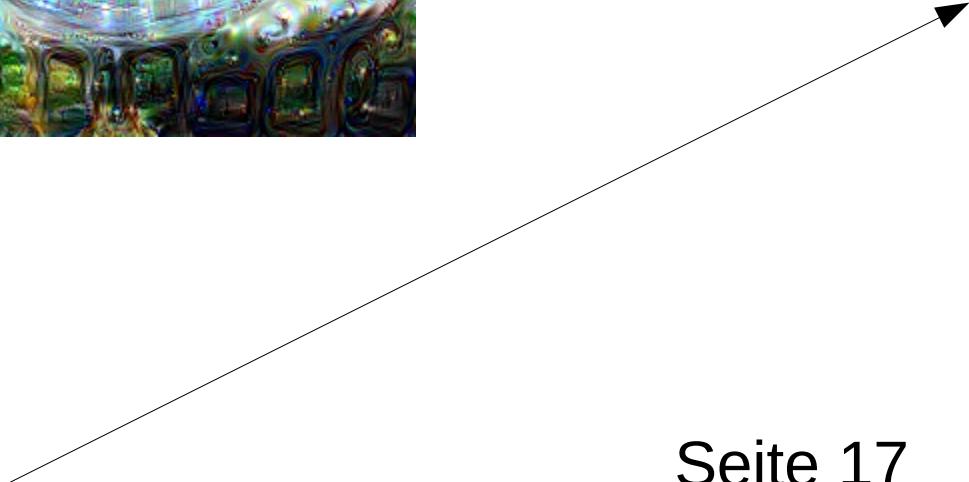


Deep dreaming examples





Deep dreaming examples



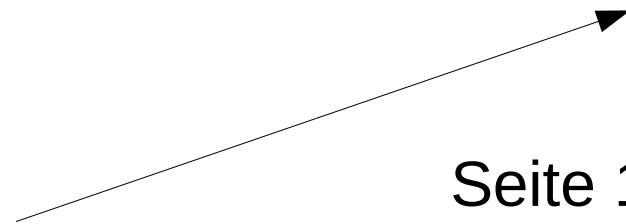


Deep dreaming examples



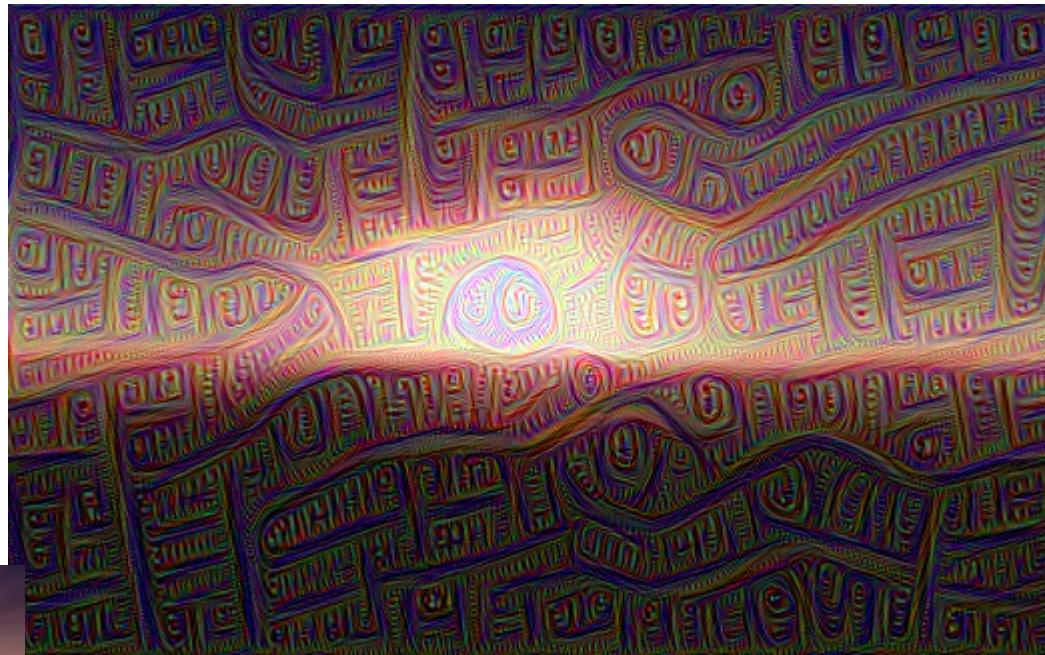


Deep dreaming examples



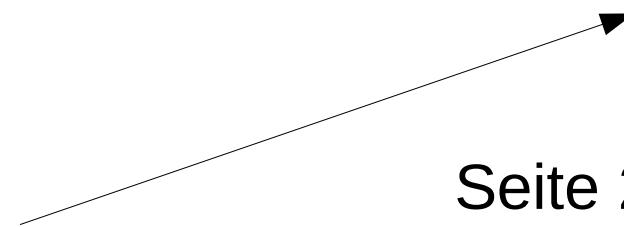


Deep dreaming examples





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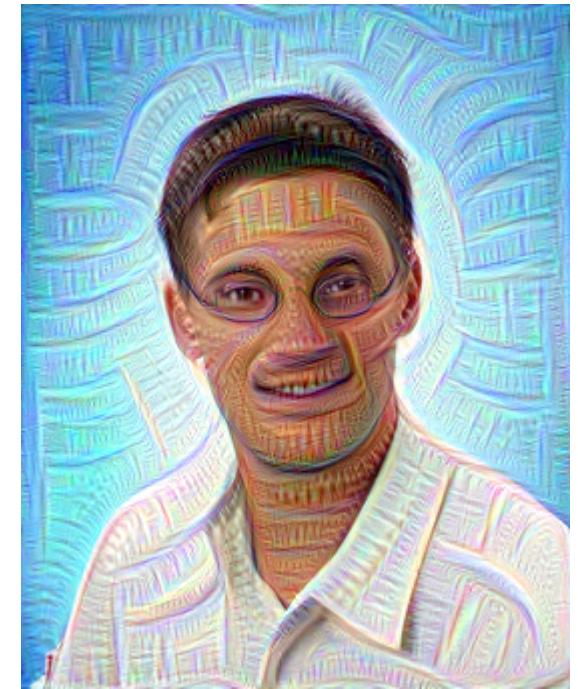


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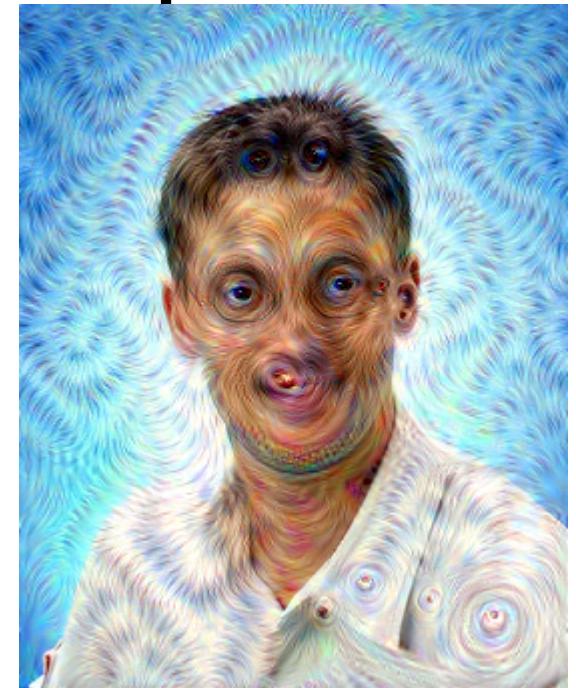


Deep dreaming examples



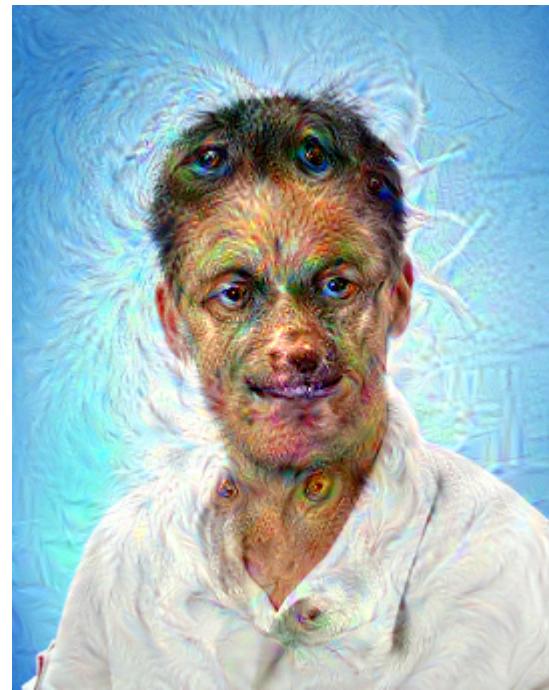


Deep dreaming examples



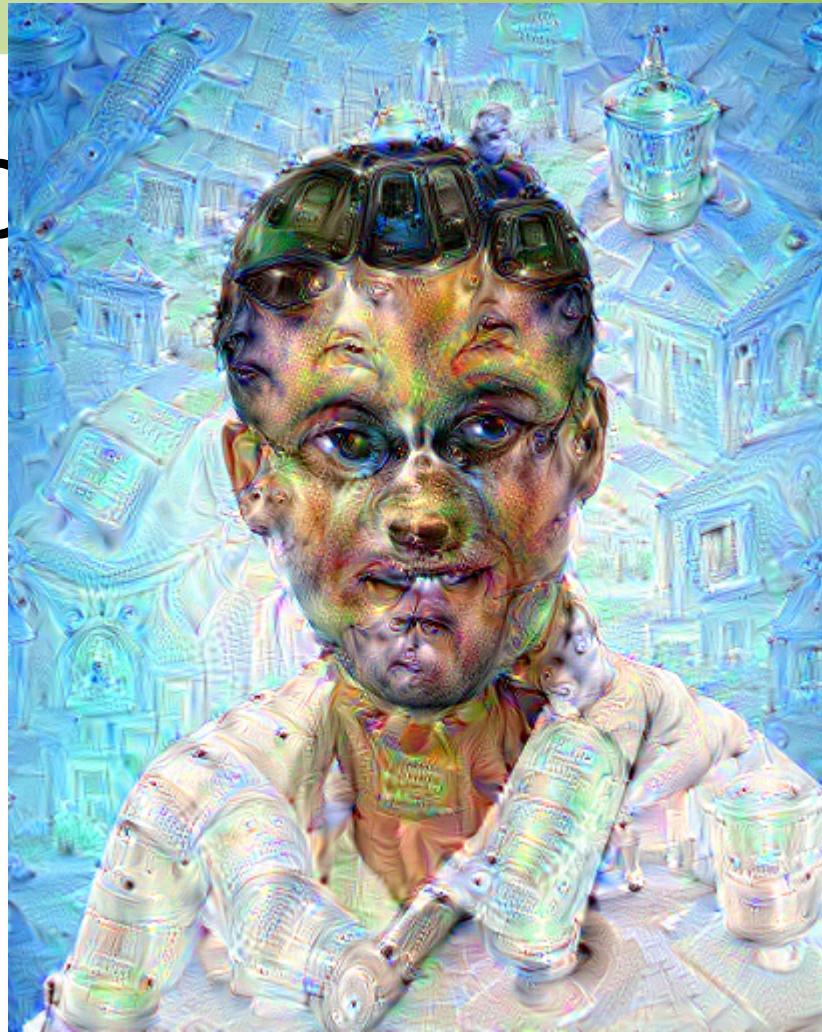


Deep dreaming examples





Digital examples



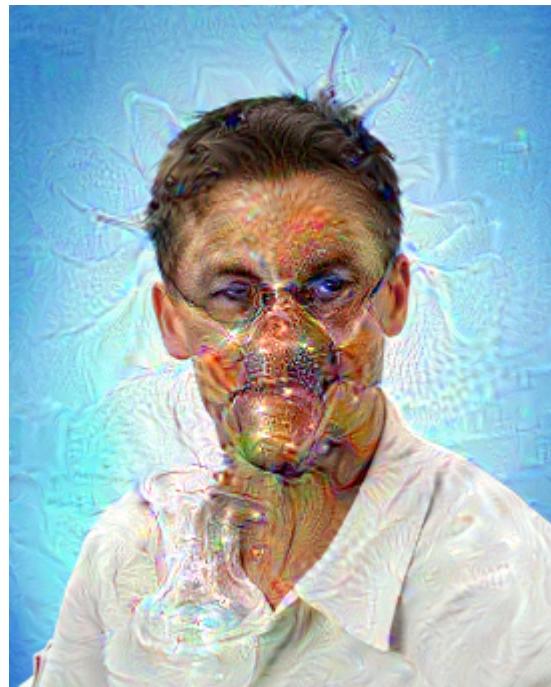


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