Google’s DeepDream (Inceptionism)

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What is DeepDream?

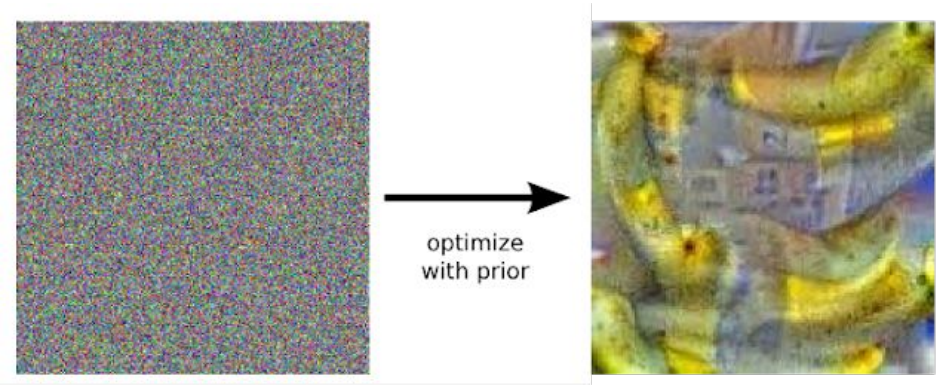
- In 2015, Google Post an article about the new method of understanding the inside of Deep Neural Network.
  - https://ai.googleblog.com/2015/06/inceptionism-going-deeper-into-neural.html
- It is well known as the painter AI.

What is Deep Dream?

Objective: What's going on inside the DNN? How to visualize the role of each layer?

- Approach: Visualize the gradient descent progress to the input images.

- Even from the random noise data, with repeated iterations to enhance the input image to elicit a particular interpretation, we can get right most image.



Gradually tweak the input image to the desired label.

Update the input image in such a way to the similar gradient descent value to the desired label's one.

What is Deep Dream?

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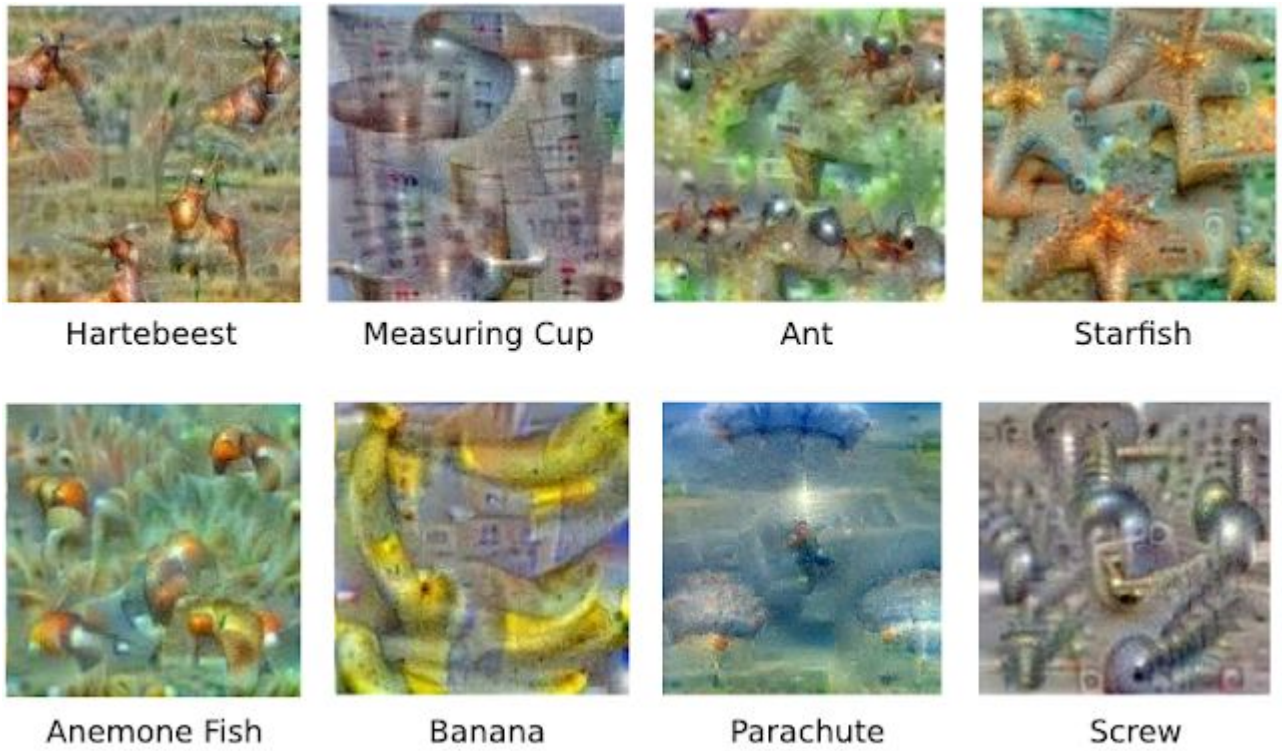


Google Called this kind of technique as "Inceptionism", which is named for the famous movie.

Usage of DeepDream

Usage: 1) It can help to visualize the network's representation

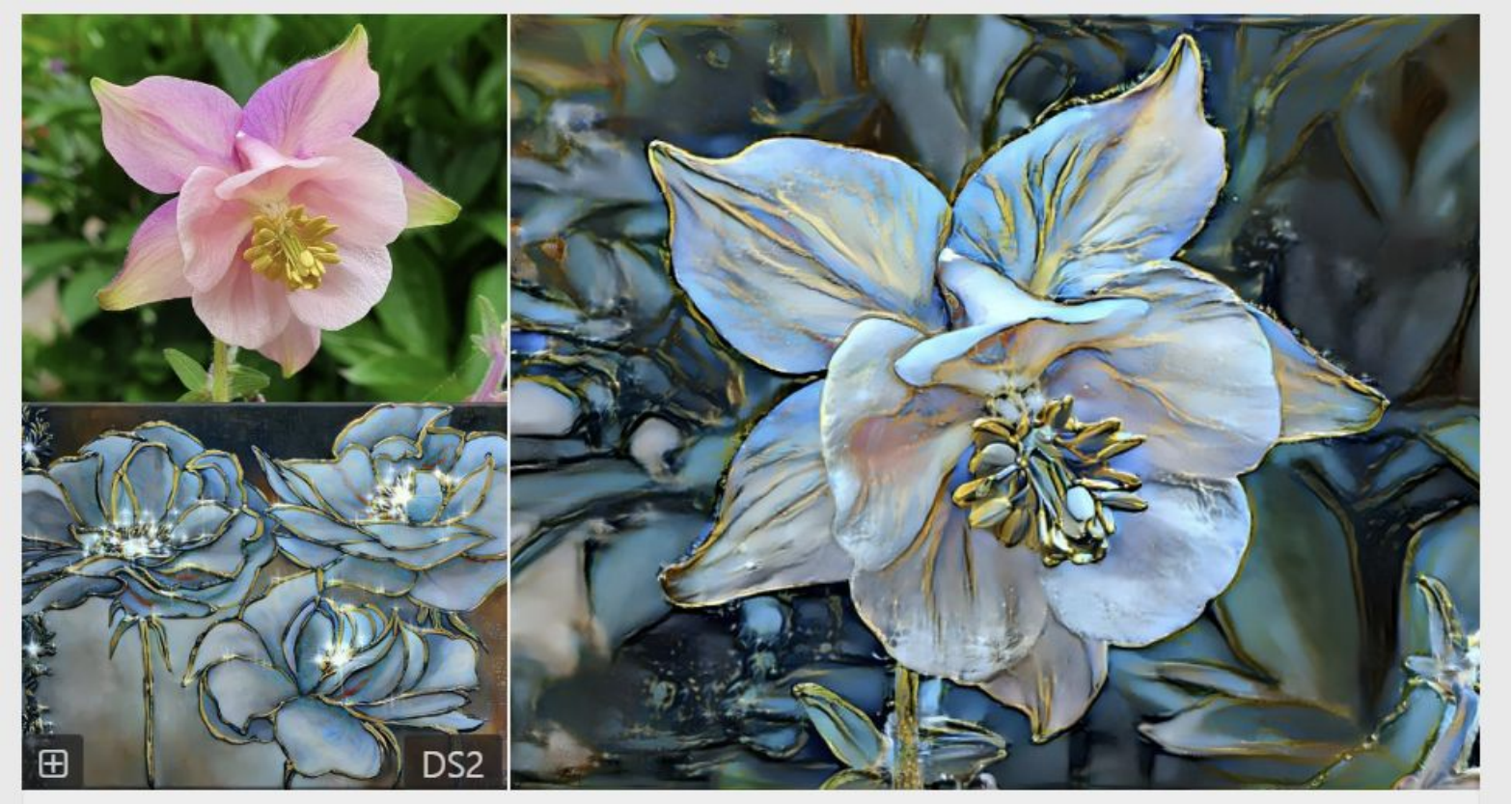
The model learned not a dumbbell, but a dumbbell with arms.

Usage of DeepDream

Usage: 2) Composition of the pattern image and the target image.

Input

Pattern

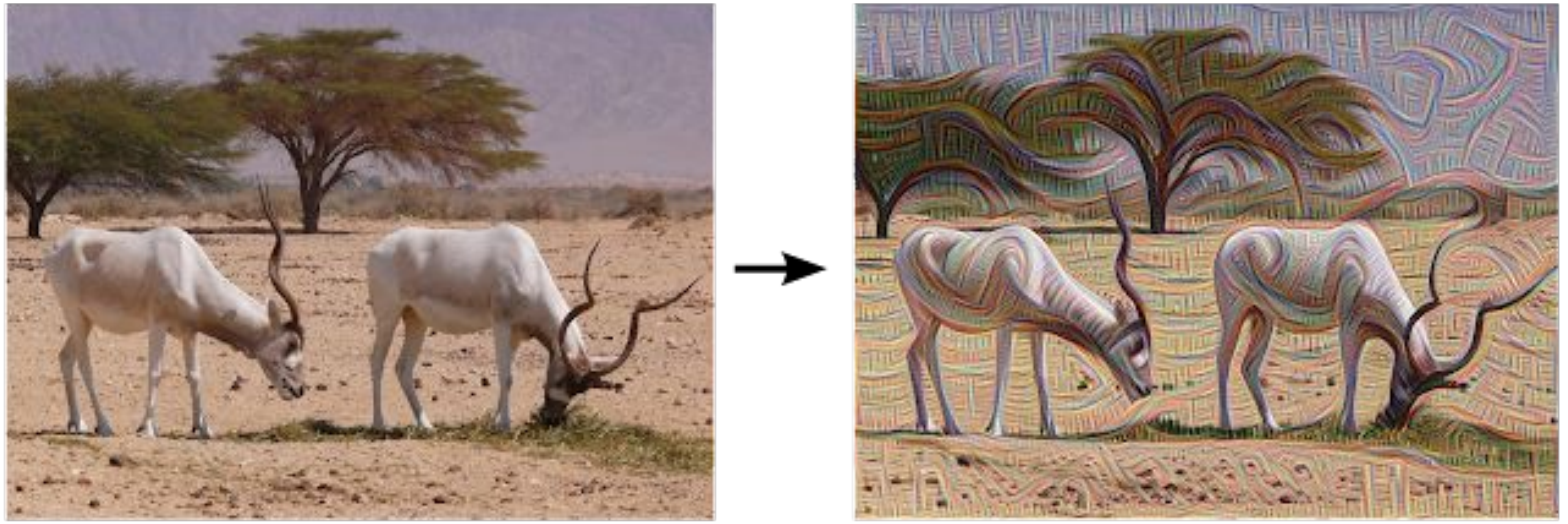


https://deepdreamgenerator.com/

Intuitions of Layers by DeepDream

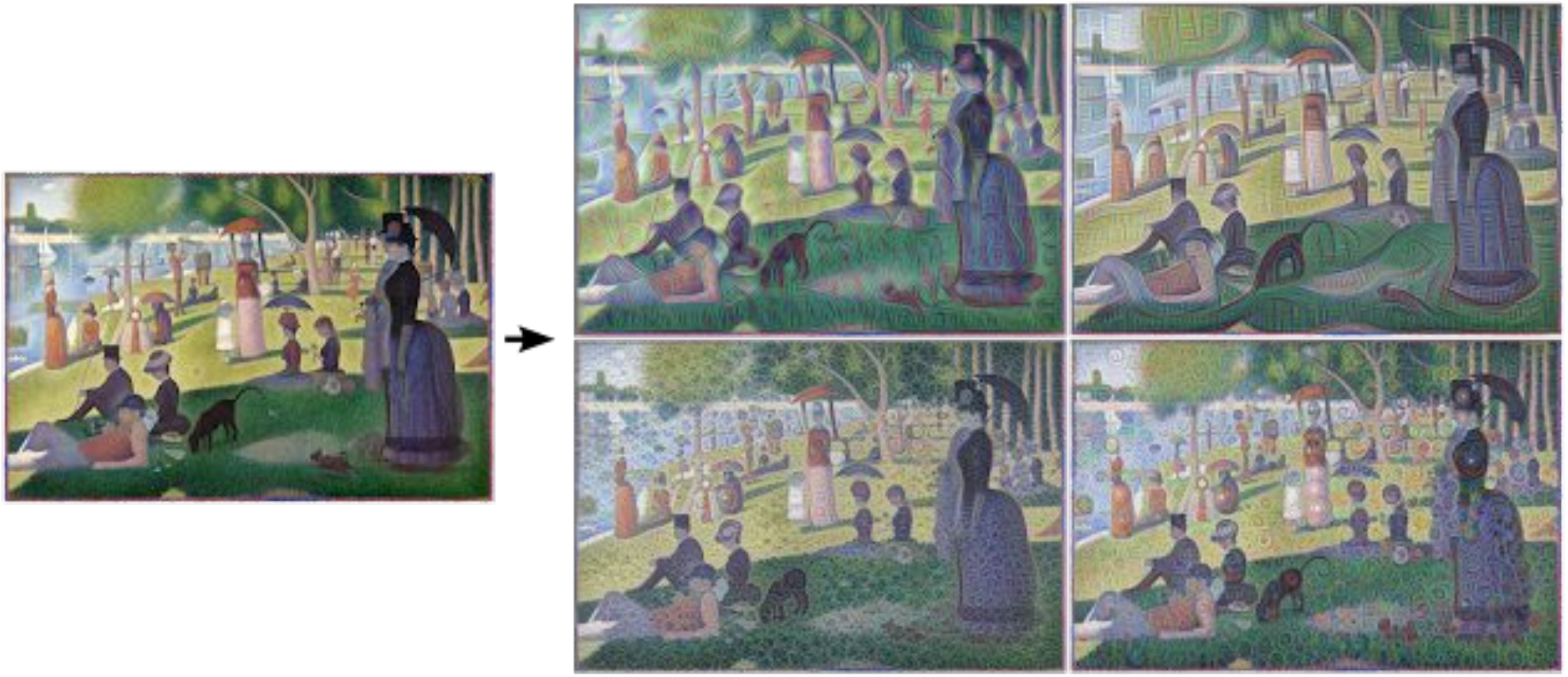
You can also update the input image **without the target label**!

- This means just blending the input image and the gradient value of the specified layer.
- Then, you can visualize the role of a specific layer.



lower layers tend to produce strokes or simple **ornament-like patterns**, because those layers are sensitive to **basic features such as edges and their orientations**.

Intuitions of Layers by DeepDream



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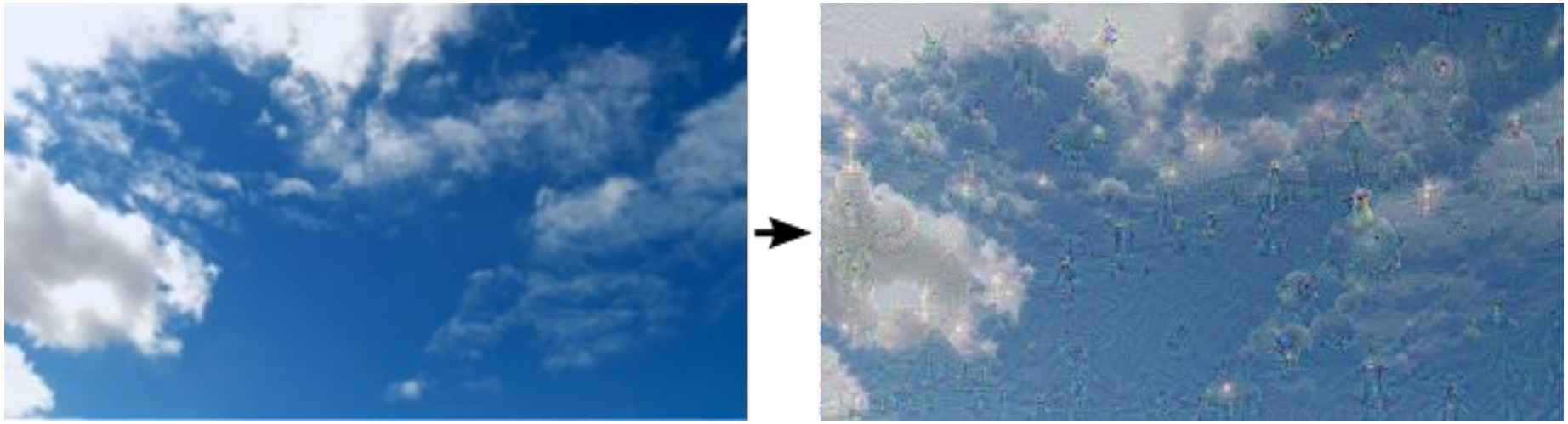
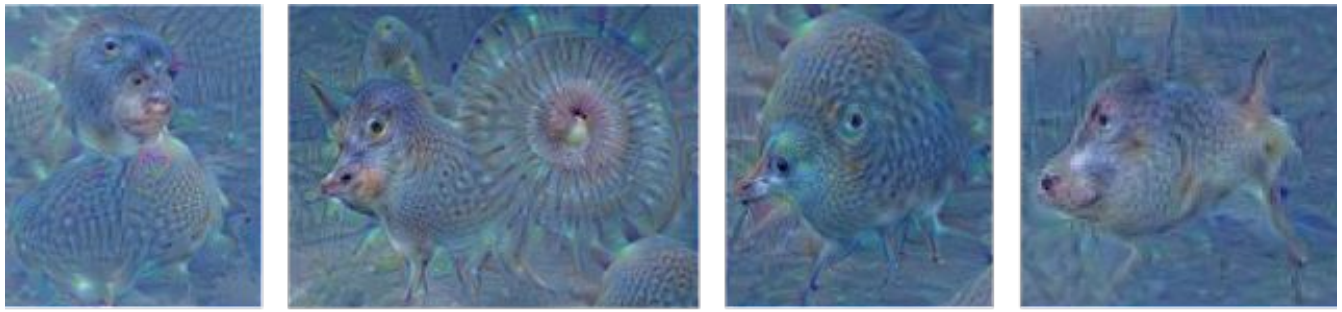
Intuitions of Layers by DeepDream





"Admiral Dog!" "The Pig-Snail" "The Camel-Bird" "The Dog-Fish"

If we choose **higher-level layers**, which identify more sophisticated features in images, complex features or even whole objects tend to emerge.

Intuitions of Layers by DeepDream

DeepDream and Human brain?

Is it a **coincidence** that the result of the DeepDream gives the impression of **being drugged**?

The result of Google's DeepDream is caused by forced misclassification.

And this is similar to the effect of drugs that confuse the sense organs.

So, maybe in the brain there exist some similar phenomena like DeepDream

when people are high or in sleep.

1) Timmermann, Christopher (2020-12-12). "Neural Network Models for DMT-induced Visual Hallucinations". Neuroscience of Consciousness. NIH. 2020 (1): niaa024. doi:10.1093/nc/niaa024. PMC 7734438. PMID 33343929.
2) https://gizmodo.com/this-is-your-brain-on-googles-deep-dream-neural-network-1728947099

Implementation and technique

Pseudo Algorithm in a nutshell - Without target image

1) Prepare the pre-trained model
2) Update the input image(x) until the specified layer(F_n).
3) Find the L2 norm of the input image the propagated to specified layer(F_n(x)).
4) Calculate the gradient descent of the L2 norm, and find the gradient of the input layer.
5) Blend the gradient of the input layer and input image.

Implementation and technique

To get high-resolution image -> downsampling and upsampling

1) Most image classification DNN has recommended input image size.
(For example, VGG16 need 244 * 244 size)

2) So in the case you need resize the input as recommended size, but this doesn't give good result.

3) To solve this, like making an snowball, we start from the downsampled image.

4) If we have an 732 * 732 size input, resize the input as 1*1 resolution and start it from

Implementation and technique

https://github.com/holywater2/DeepDream_Pytorch/blob/main/deep-dream.ipynb

Code reference

https://github.com/google/deepdream/blob/master/dream.ipynb

https://github.com/gordicaleksa/pytorch-deepdream

https://www.kaggle.com/code/paultimothymooney/pre-trained-pytorch-monkeys-a-deep-dream/notebook

https://github.com/Hvass-Labs/TensorFlow-Tutorials/blob/master/14_DeepDream.ipynb

Reference

https://ai.googleblog.com/2015/07/deepdream-code-example-for-visualizing.html

https://www.youtube.com/watch?v=ws-ZbiFV1Ms

https://deepdreamgenerator.com/u/1447264/account

Thanks