GOOGLE'S DEEPDREAM

COMPUTER VISION
PROJECT PRESENTATION

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- **Deep Dream is a computer vision program created by Google.**
- **It uses a convolutional neural network to find and enhance patterns in images**

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DeepDream's History

ILSVRC OR THE IMAGENET CHALLENGE

- The ImageNet Large Scale Visual Recognition Challenge (ILSVRC) evaluates algorithms for object detection and image classification at large scale. The most popular challenge is the ILSVRC 2012-2017 image classification and localization task.

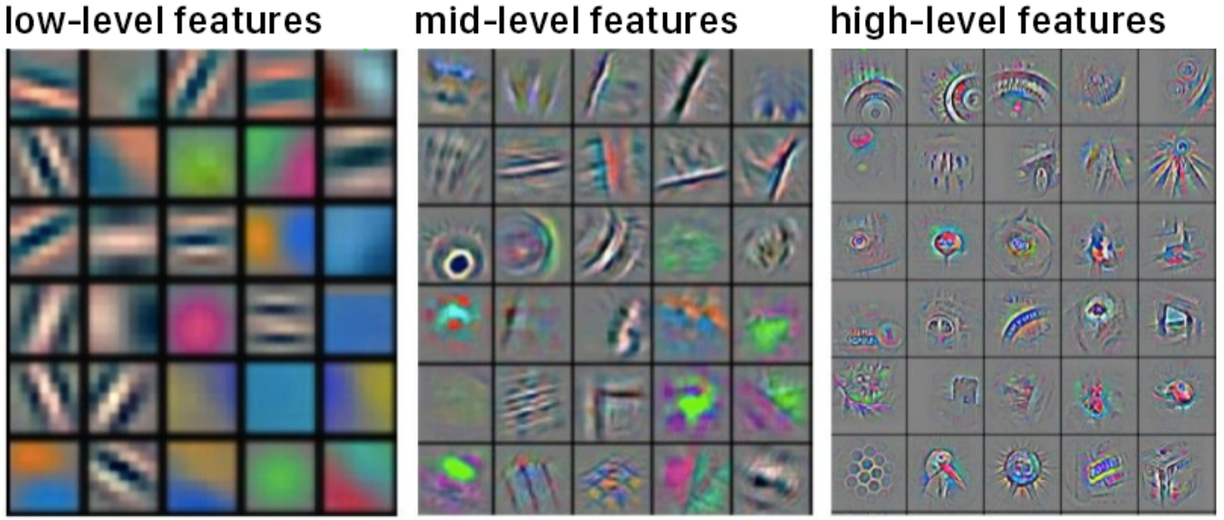
- In 2014, Christian Szegedy, et al. from Google achieved top results for object detection with their GoogLeNet model that made use of the inception module and architecture. This approach was described in their 2014 paper titled “Going Deeper with Convolutions.”

ALEXANDER'S BLOG POST

As described in a blog post by Alexander Mordvintsev, DeepDream is an experiment that visualizes the patterns learned by a neural network. Similar to when a child watches clouds and tries to interpret random shapes, DeepDream over-interprets and enhances the patterns it sees in an image.
It does so by forwarding an image through the network, then calculating the gradient of the image with respect to the activations of a particular layer. The image is then modified to increase these activations, enhancing the patterns seen by the network, and resulting in a dream-like image. This process was dubbed "Inceptionism" (a reference to InceptionNet)

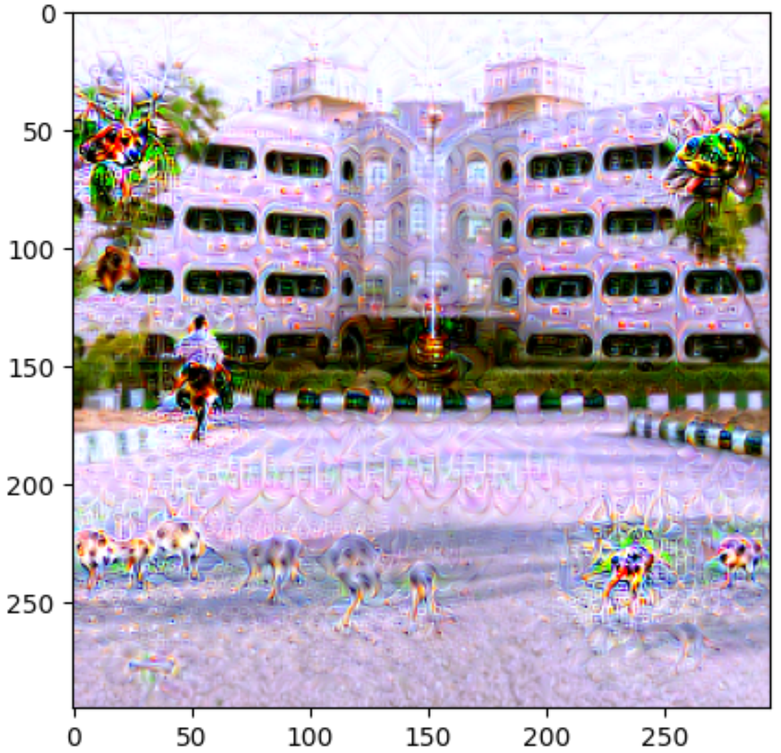
NEURAL NETWORKS ARE BLACK BOXES

One of the challenges of neural networks is understanding what exactly goes on at each layer. We know that after training, each layer progressively extracts higher and higher-level features of the image, until the final layer essentially makes a decision on what the image shows. For example, the first layer maybe looks for edges or corners. Intermediate layers interpret the basic features to look for overall shapes or components, like a door or a leaf. The final few layers assemble those into complete interpretations—these neurons activate in response to very complex things such as entire buildings or trees. [3]



DeepDream's Algorithm

we simply feed the classification network an arbitrary image or photo and let the network analyze the picture. We then pick a layer and ask the network to iteratively enhance whatever it detected. Each layer of the network deals with features at a different level of abstraction, so the complexity of features we generate depends on which layer we choose to enhance.
The image is then modified to increase these activations, enhancing the patterns seen by the network, and resulting in a dream-like image.

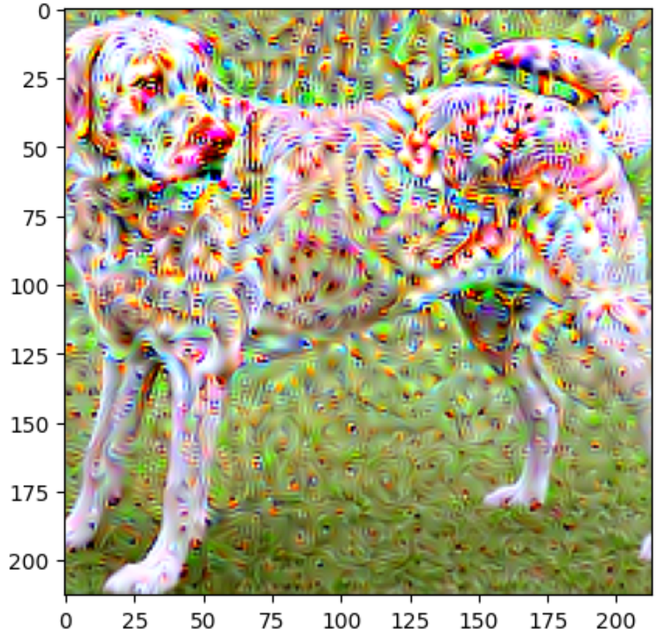


EXPERIMENTING WITH LAYERS

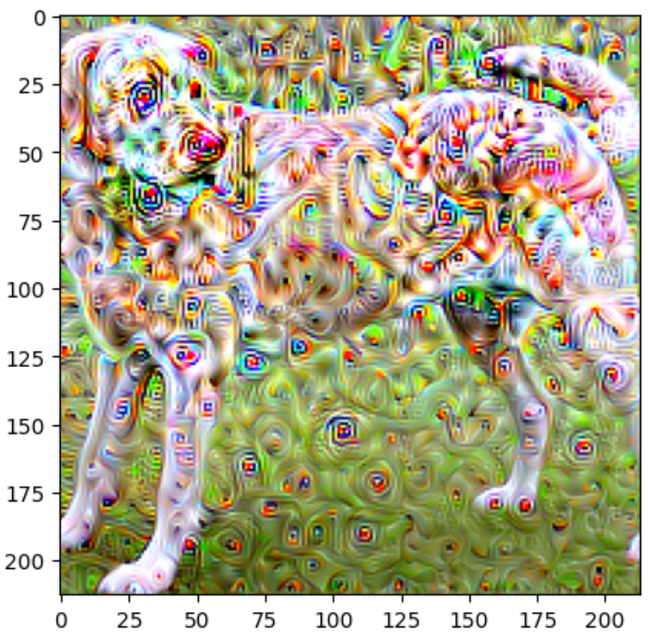
Results for optimizing different layers:

Observations :
If we choose higher-level layers, which identify more sophisticated features in images, complex features or even whole objects tend to emerge. Again, we just start with an existing image and give it to our neural net. We ask the network: “Whatever you see there, I want more of it!” This creates a feedback loop: if a cloud looks a little bit like a dog, the network will make it look more like a dog. This in turn will make the network recognize the dog even more strongly on the next pass and so forth, until a highly detailed dog appears, seemingly out of nowhere.

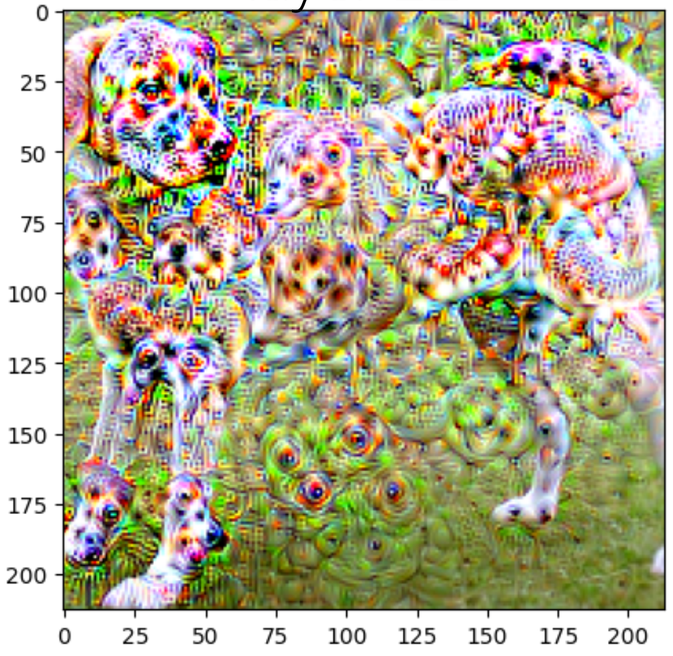
layer 6



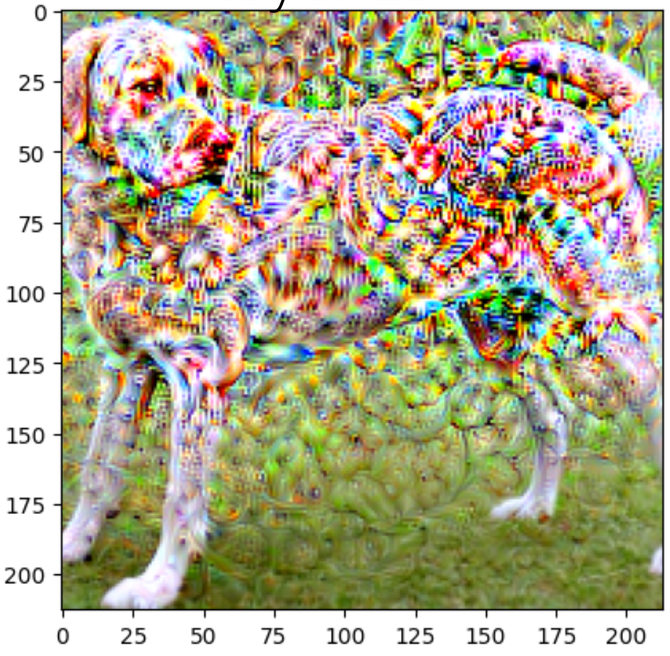
layer 8



layer 22



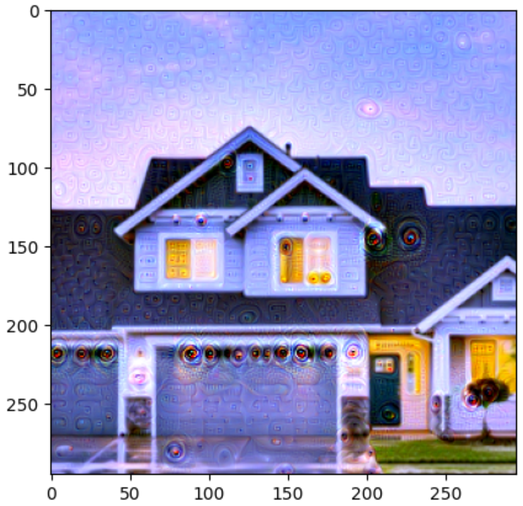
layer 29



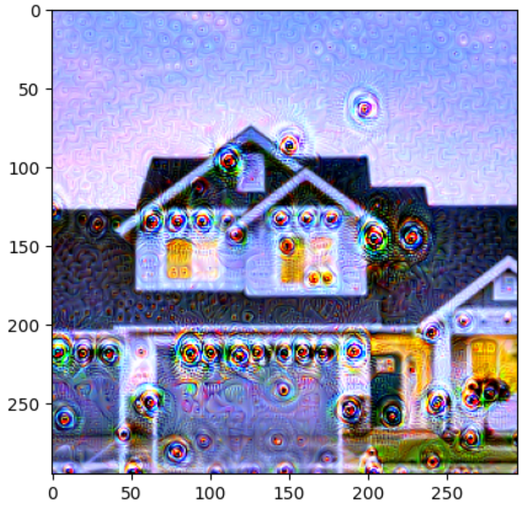
EXPERIMENTING WITH ITERATIONS

Results for optimizing for different number of iterations:

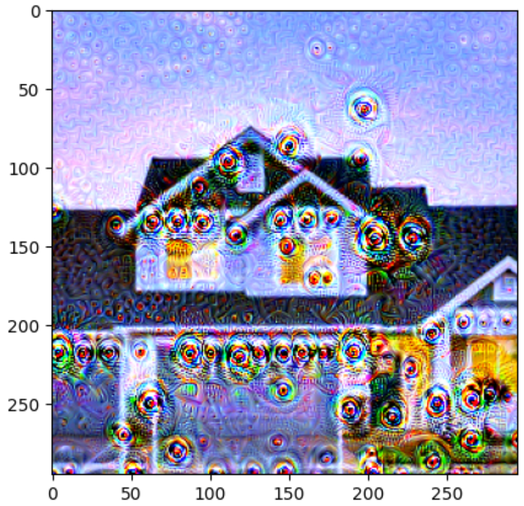
Obsevations :
As we increase the number of iterations the results of hallucinations become more vivid.



10 iterations



50 iterations



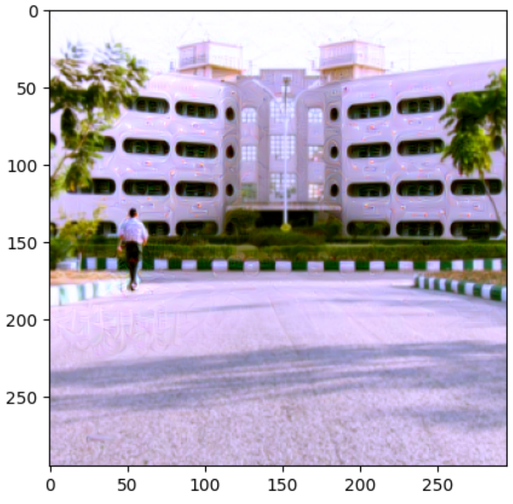
100 iterations

EXPERIMENTING WITH STEP SIZE

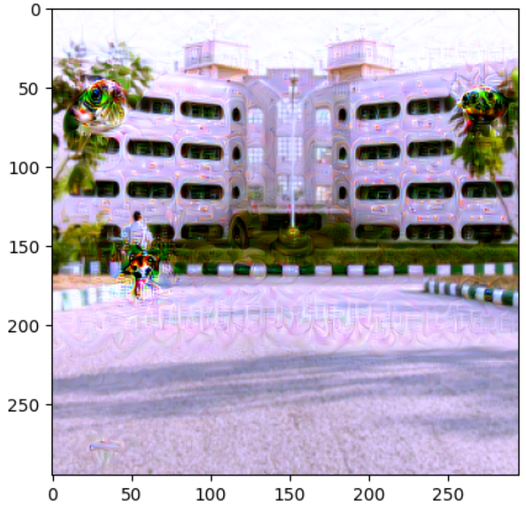
Results for optimizing with different step sizes:

Obsevations : the hallucinations are exaggerated and sharper for higher step sizes.

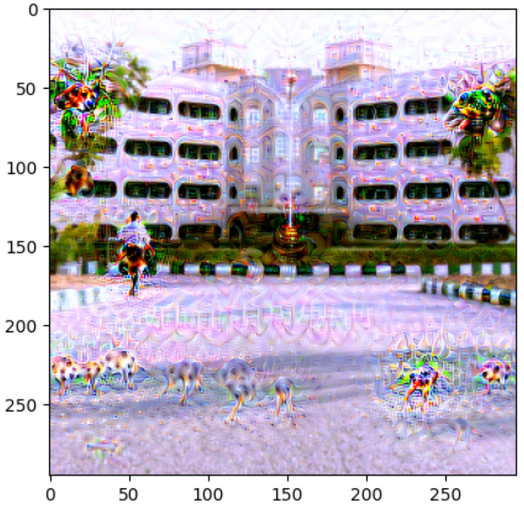
alpha = 0.01



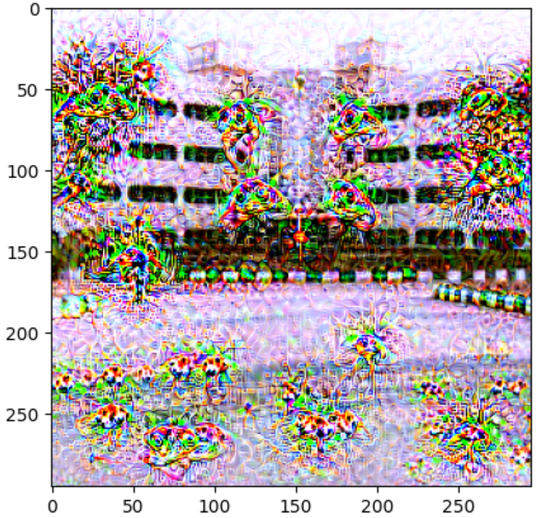
alpha = 0.04



alpha = 0.1



alpha = 1



Why DeepDream

The techniques presented here help us understand and visualize how neural networks are able to carry out difficult classification tasks, improve network architecture, and check what the network has learned during training. It also makes us wonder whether neural networks could become a tool for artists—a new way to remix visual concepts—or perhaps even shed a little light on the roots of the creative process in general.

DeepDream and Psychedelic Visuals

The cited resemblance of the imagery to LSD- and psilocybin-induced hallucinations is suggestive of a functional resemblance between artificial neural networks and particular layers of the visual cortex. [2]

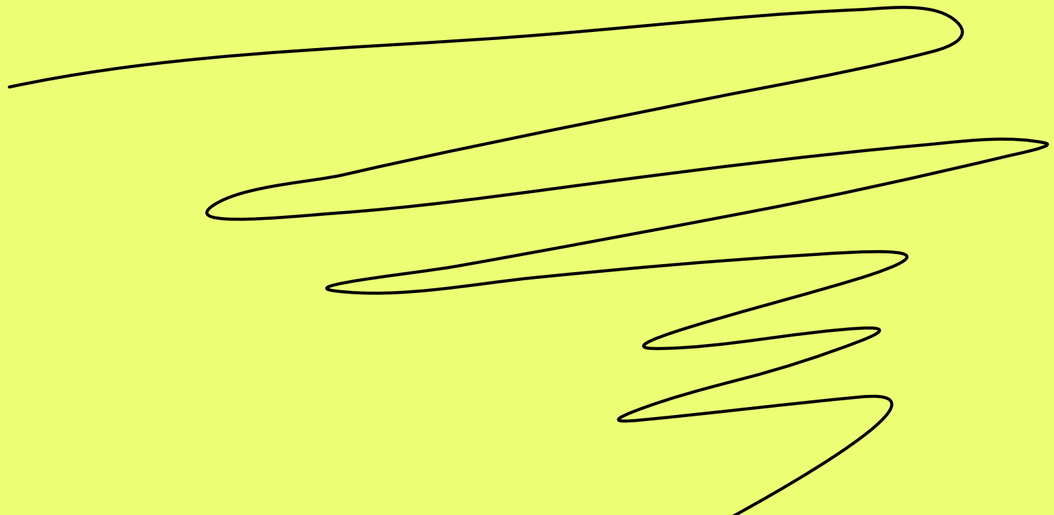
REFERENCES

[1] MORDVINTSEV, ALEXANDER; OLAH, CHRISTOPHER; TYKA, MIKE (2015). "DEEPDREAM - A CODE EXAMPLE FOR VISUALIZING NEURAL NETWORKS". GOOGLE RESEARCH. ARCHIVED FROM THE ORIGINAL ON 2015-07-08.

[2] LAFRANCE, ADRIENNE (2015-09-03). "WHEN ROBOTS HALLUCINATE". THE ATLANTIC. RETRIEVED 24 SEPTEMBER 2015.

[3] ZEILER, MATTHEW D., AND ROB FERGUS. "VISUALIZING AND UNDERSTANDING CONVOLUTIONAL NETWORKS." EUROPEAN CONFERENCE ON COMPUTER VISION. SPRINGER, CHAM, 2014.

THANK YOU



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