The Forward Forward Algorithm

Flutur Angelica-Costela, 341

Geoffrey Hinton

Geoffrey Hinton is a British-Canadian computer scientist and psychologist known for his work on **artificial neural networks**. He worked at Google and the University of Toronto from 2013 to 2023.

In 2017, he helped start the **Vector Institute for Artificial Intelligence** in Toronto, where he serves as the chief scientific advisor.

Forward Forward Algorithm

Innovative Training Method: Eliminates traditional backpropagation's forward and backward passes.

Two Forward Passes: Utilizes positive (real) data for the first pass and negative (synthetic) data for the second.

Objective Function per Layer: Maximizes "goodness" for positive data and minimizes it for negative data, using metrics like the sum of squared activities.

Forward-Forward-Forward…

Process: Three forward passes: First for positive data, second for negative data, and a hypothetical third for additional refinement or error correction without backward propagation.

Computation: Each layer's objective is to improve based on "goodness" metrics, potentially reducing the need for gradient computation.

Biological Plausibility: Potentially more aligned with natural neural processes, as it avoids the non-biological backward pass.

Efficiency: Could offer computational advantages by eliminating the need for backpropagation and allowing offline processing for parts of the learning.

vs. Backpropagation

Process: Involves a forward pass to compute the output and a backward pass to adjust weights based on error gradients.

Computation: Relies on gradient descent to minimize error, requiring storage and computation of gradients.

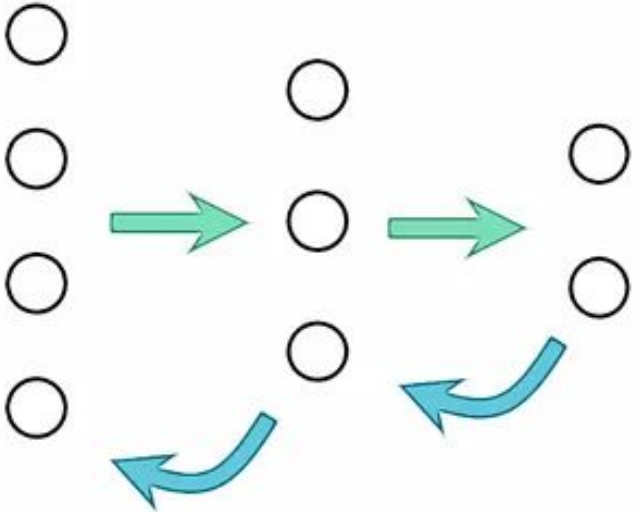
Biological Plausibility: Lacks a direct counterpart in biological neural systems due to the backward pass.

Efficiency: Can be computationally intensive, especially for deep networks with large datasets.

Fordward-Forward Algorithm by Geoffrey Hinton

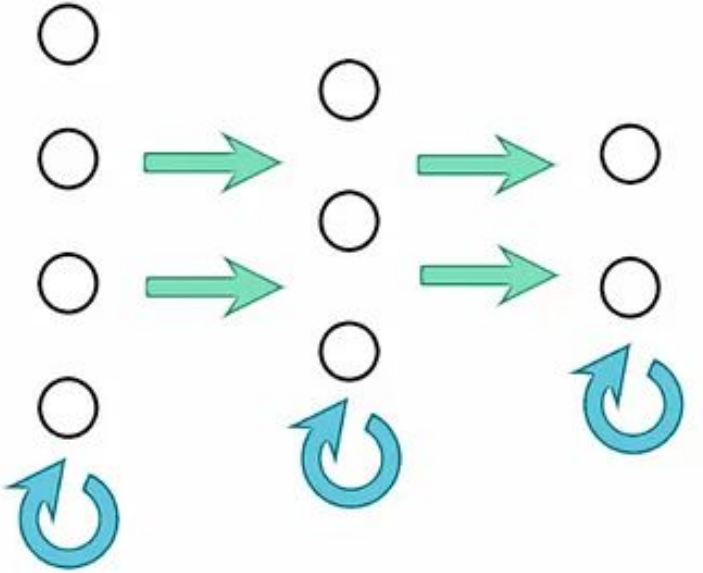
Backpropagation

Forward → Backward



Forward-Forward

Forward Forward → Local update



Nebuly AI

Why did I choose the CIFAR-10 data set?

Diverse Images: CIFAR-10 provides 60,000 color images across 10 categories, offering a wide variety of patterns for comprehensive learning.

Real-World Complexity: Unlike simpler, monochromatic datasets, CIFAR-10's color images better mimic the complexity of real-world visual data.

Testing on MNIST dataset

Testing on CIFAR-10 dataset

```
"C:\Users\Angi\Desktop\Anul 3\Semestrul 1\Arheologie\venv\Scripts\python.exe" "C:\Users\Angi\Desktop\Anul 3\Semestr
Files already downloaded and verified
Files already downloaded and verified
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
training layer 0 ...
100%|██████████| 1000/1000 [1:51:25<00:00,  6.69s/it]
training layer 1 ...
100%|██████████| 1000/1000 [28:25<00:00,  1.71s/it]

Process finished with exit code -1073741819 (0xC0000005)
```

Conclusion

Revolutionizing traditional training methods, the **Forward-Forward Algorithm** demonstrates remarkable efficiency on the MNIST dataset. Future research aims at scaling for larger datasets, optimizing negative data handling, and exploring biological plausibility. As capabilities expand, the algorithm offers novel insights into AI and our understanding of biological learning processes.

Thanks!

Contact us:

Your Company
123 Your Street
Your City, ST 12345

no_reply@example.com
www.example.com