Siamese Ensembles for image data augmentation

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What is it?

Siamese → working in tandem on two different inputs

Ensemble → two networks combined into one classifier

We introduce Siamese Ensembles – a simple yet effective label-preserving data augmentation method.

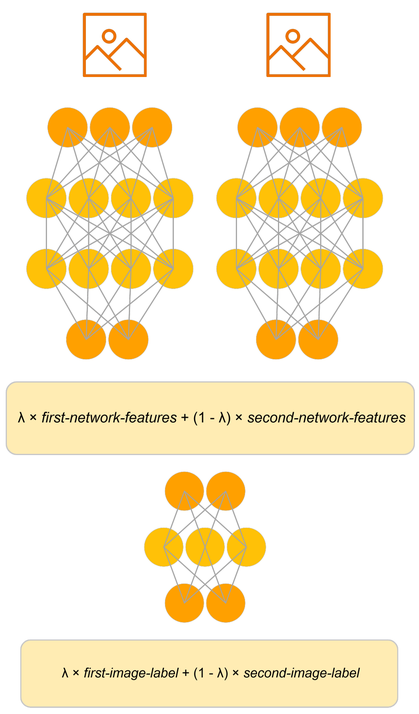
How does it work?

Two images from the same or different classes...

...are accepted by two differently initialized neural networks...

...their hidden representations are then combined using weighted averages...

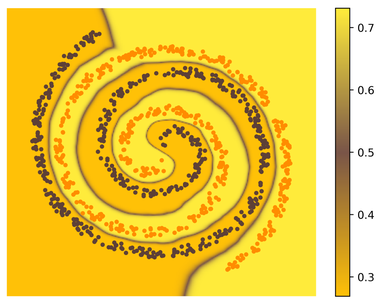
...as well as their labels, which produces a single output.



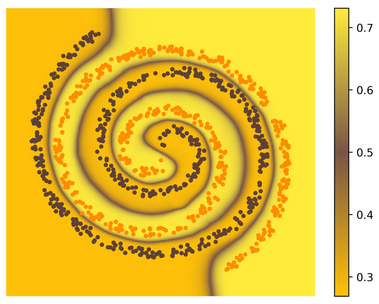
The abovementioned schema is used during training.
In the inference time, both inputs accept the same image.

Why does it work?

The proposed method smoothens decision boundaries, which improves the generalization ability of the network.



Sharp decision boundaries of a baseline network.

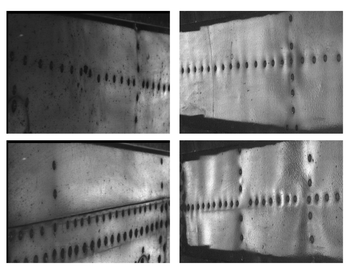


Smooth decision boundaries of a Siamese Ensemble.

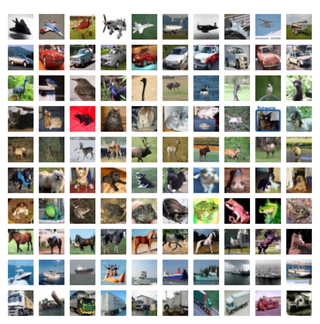
Using two subnetworks leverages the power of ensemble learning, where the performance of the ensemble is better than that of each of the subnetworks.

Siamese Ensembles in action

Datasets

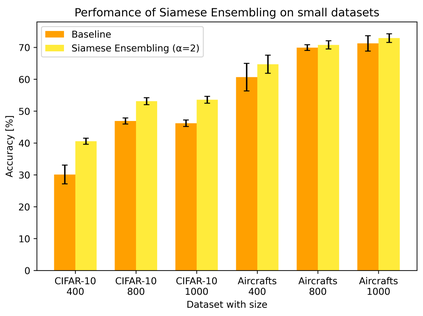


Aircrafts – a specific dataset containing 13075 grayscale images of the fuselage of aircraft structures, taken from 37 machines. The data has a resolution of 240x320 and is divided into two classes with corroded and non-corroded surfaces.

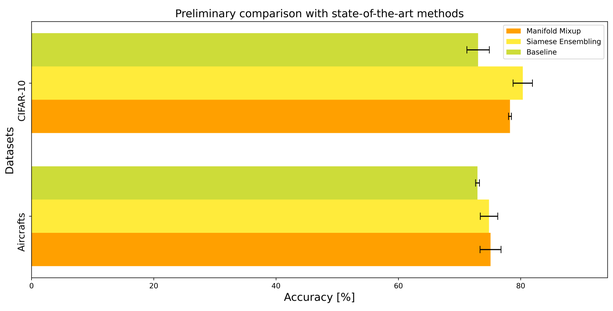


CIFAR-10 – standard baseline data. The dataset consists of 60000 32x32 colour images in 10 classes.

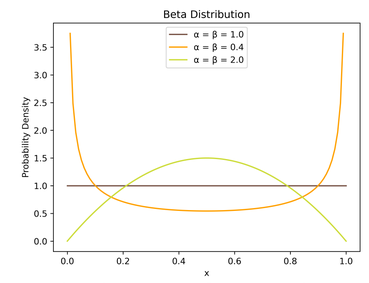
Results on small datasets



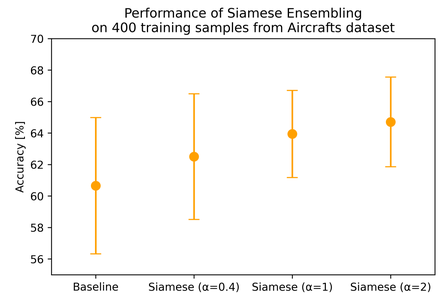
Preliminary comparison with *state of the art*



Alpha matters!



λ drawn from the Beta distribution



Takeaway

◈ Siamese Ensembles improve the performance of neural networks on image classification tasks. They help smooth the decision boundaries.
◈ The method preserves labels of the images and can be combined with other augmentation techniques.
◈ The preliminary experiments provide encouraging results in comparison with state-of-the-art methods!

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