A Generative Adversarial Network for Brain Stroke Image Analysis

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Summary

Motivation

Ischemic stroke is caused by partial or total restriction of blood supply to part of the brain. During an acute stroke, prolonged ischemia results in irreversible tissue death.
2 Millon brain cells die every minute.

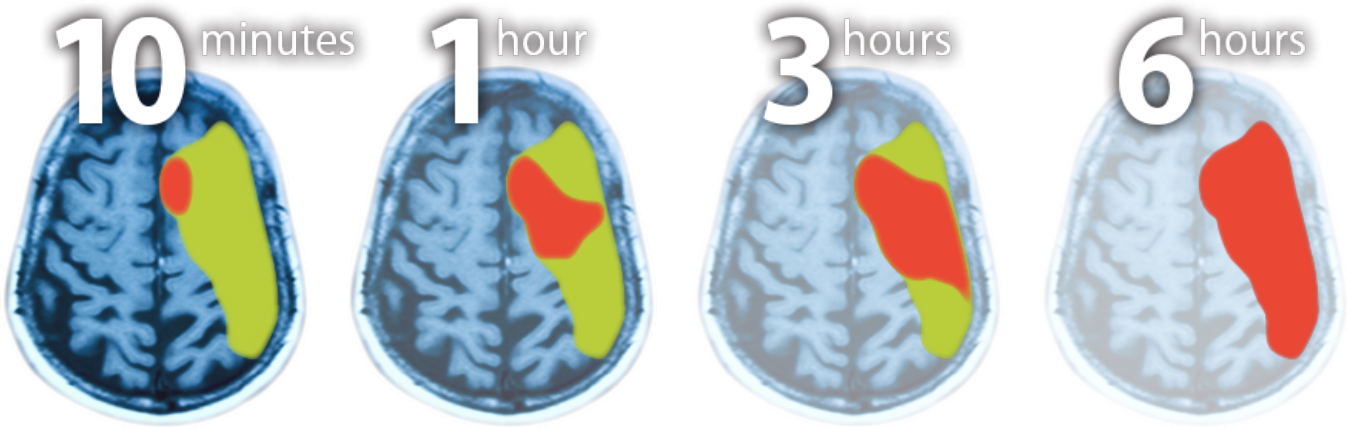

Figure: Source: https://outlook.wustl.edu/2014/jun/stroke

Motivation

Decisions about ischemic stroke therapy are highly time-sensitive and rely on distinguishing between the infracted core tissue and hypoperfused lessions.

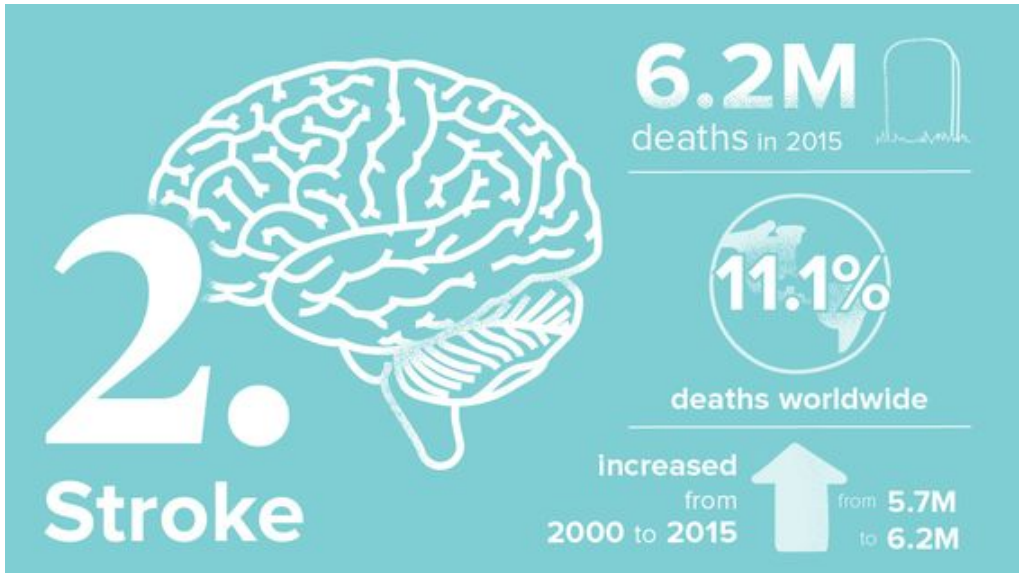

Figure: Source: https://www.healthline.com/health/top-10-deadliest-diseases

Motivation

Automated methods that can locate and segment ischemic stroke lesions can aid clinician decisions about acute stroke treatment.

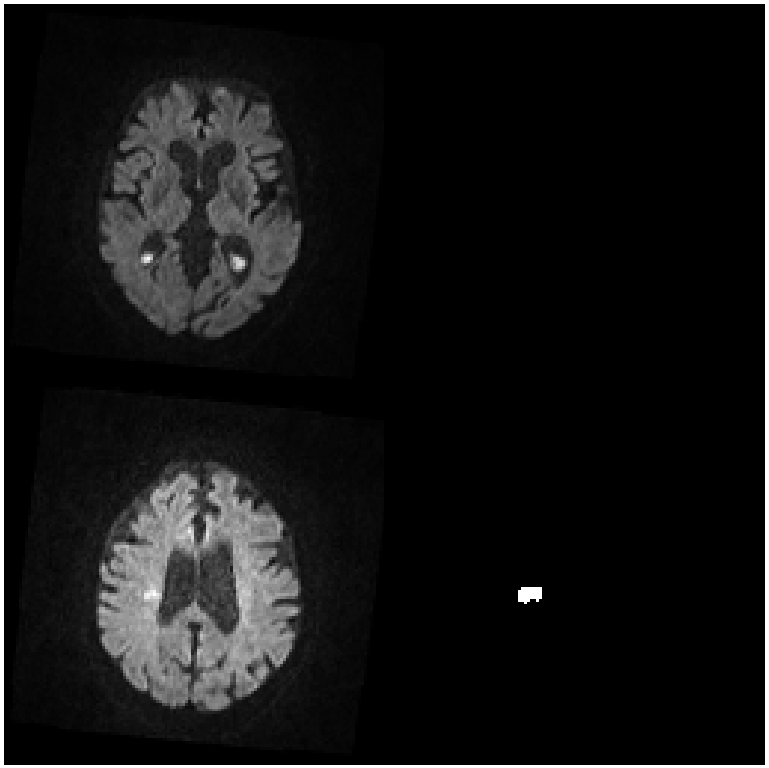

Figure: DWI of brain without and with stroke and the segmentation

Motivation

Generative Adversarial Networks are one of the hottest topics in Artificial Intelligence right now. These networks, are able to learn how to produce data from a dataset that is indistinguishable from the original data and generate segmentation mask from images.

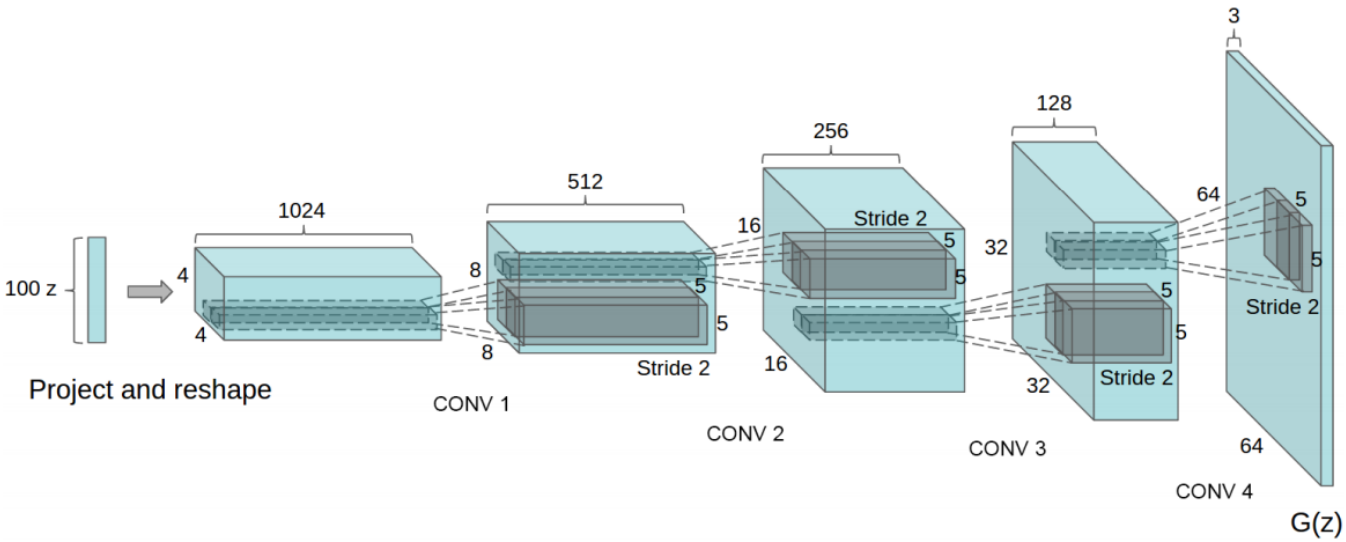

Figure: Source: [3]

Preliminary Objectives

1. Study the use of Generative Adversarial Networks for generating synthetic images of Brain Stroke.
2. Study the use of Generative Adversarial Networks for generating segmentation mask of Stroke from Brain Images.

Expected Results

1. Generate synthetic images of Brain Images preserving the condition of stroke using Generative Adversarial Networks.
2. Generate segmentation mask of Brain Stroke using Generative Adversarial Networks.

Dataset

1. Total Images: 13200
2. 75% train & 25% validation.
3. 82% without Stroke & 18% with Stroke.
4. Image Size: 128x128 px.
5. Image Type: DWI (Diffusion Weighted Resonance Magnetic Image).
6. Image Source: University Hospital Basel - Switzerland

*Advance

1. Study and implementation of recent models such as vGAN [1], vGAN [1], cGAN [2], DCGAN [3] y cDCGAN [2],[3] or the automatic generation of synthetic images of cerebral infarcts.
2. Reproduce and modify the models adding a resnet blocks [4].
3. From cDCGAN [2][3] with resnet blocks [4] produce a synthetic images of cerebral infarcts and segmentation.

*Current Status

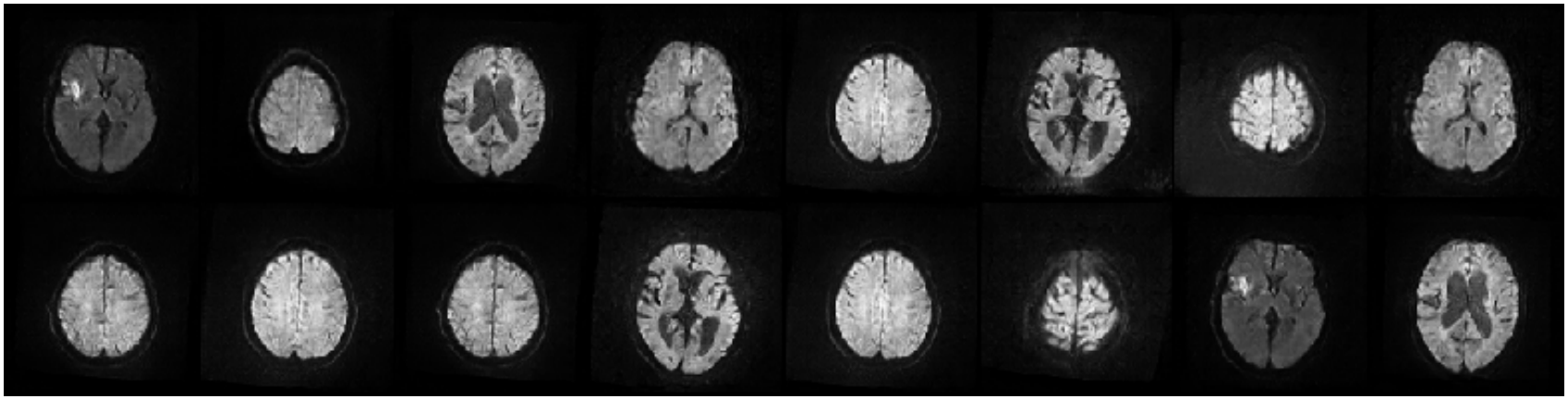

Figure: Original (1st row) and Generated (2nd row) CT Images

References

1. I. Goodfellow, et al., "Generative Adversarial Networks", Advances in Neural Information Processing Systems (NIPS), 2014, pp. 2672-2680.
2. M. Mirza, S. Osindero, "Conditional Generative Adversarial Nets", arXiv:1411.1784, 2014.
3. Alec Radford, Luke Metz, Soumith Chintala, "Unsupervised Representation Learning with Deep Convolutional Generative Adversarial Networks", arXiv:1511.06434, 2015.
4. K. He, X. Zhang, S. Ren, J. Sun, "Deep Residual Learning for Image Recognition", The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016, pp. 770-778.