Convolutional Neural Network for Cardiac MRI Segmentation

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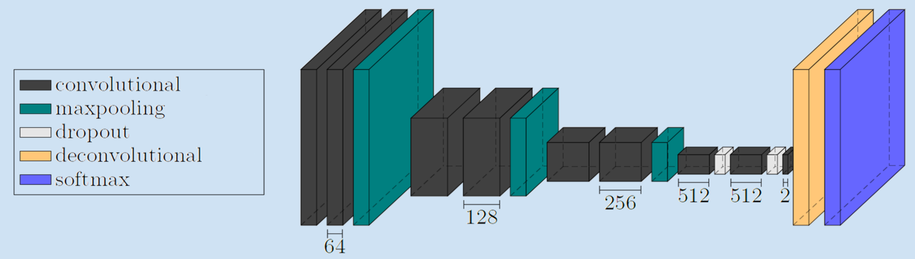
Motivation

- Cardiovascular disease is the leading cause of death in the US
- Segmentation of heart substructures in CMR is important to quantitatively assess the impact of cardiovascular disease
- Reducing the amount of effort spent on segmenting CMR images
- Extending the methods to possible precision medicine procedures

Convolutional Neural Network



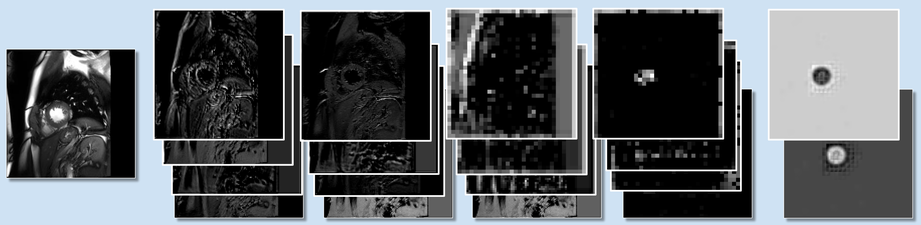
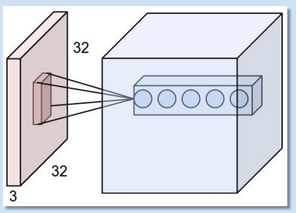
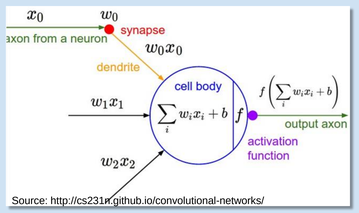


Image | MaxPooling 1 | MaxPooling 2 | MaxPooling 3 | MaxPooling 4 | Deconv

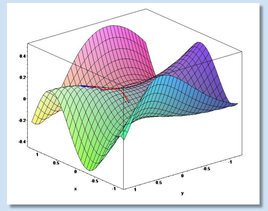




TensorFlow

Gradient Descend & Optimizer

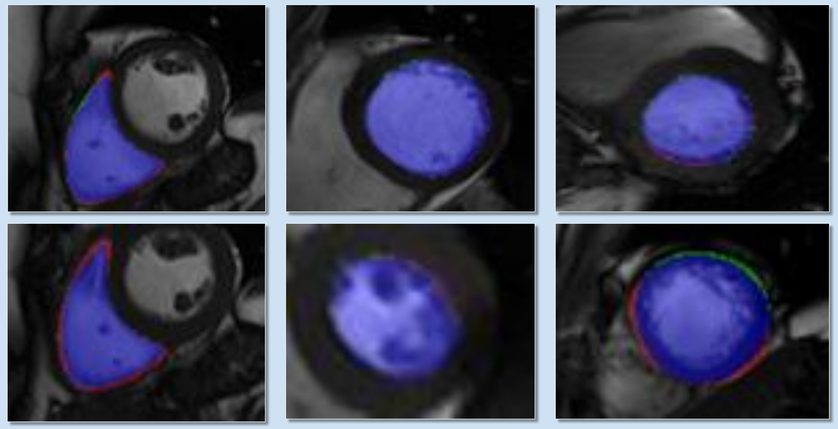
- Goal: Minimize Loss Function J(n)
- Several Methods to find the minimum: Random, Batch Gradient Descent,
- Gradient Descent Algorithms
- Blindfold hiker analogy
- Algorithms to optimize Gradient Descend



- An example of Gradient Descent in 3D space, There are only three variables to be optimized. The red Line is the route of the search for each iteration. In the real world, there could be many more variables than three.

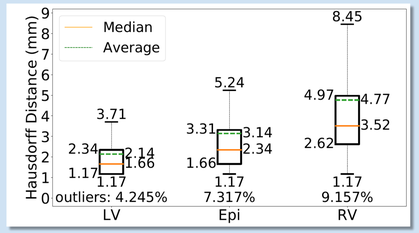
Application on CMR

- State of the art results on benchmark datasets
- Implemented a data pipeline for Cardiac MRI
- Successfully segmented Geisinger Cardiac MRI Data
- GIF visualizations
- Overlay Images

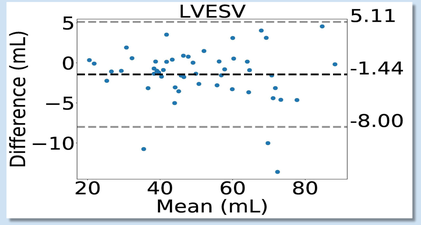


Validation Steps

- Parameters interested in: Hausdorff Distance, Dice Index, LVEF, LVEDV, LVESV, LV Mass, RVESV, RVEDV.
- Post validation tools: Box Whisker Plots, Bland-Altman Plots, Coefficient of Variation.



Box Whiskers plots are used to analysis Hausdorff distance and Dice Index, which are two important parameters to show the accuracy of our segementations.



An example of Bland-altman plot, difference vs mean. From this Bland-altman plot we can calculate CoV and compare that with the scholars.

Future Works and Acknowledgements

- Training changes:
  - Different preprocessing steps
- New networks:
  - Modification to the network
- Other plans:
  - Kaggle dataset
  - Pathology

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