Detecting Organ Failure in Motor Vehicle Trauma Patients: A Machine Learning Approach

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Abstract

Background and Solution
Motor vehicle accidents are prevalent throughout the U.S.; over five million crashes occur annually. Normally, patients are appropriately diagnosed only after being transported to medical centers, which currently takes 7-15 minutes on average. This project aims to expedite this diagnostic process by training neural networks on Intensive Care Unit data to predict future injuries in accidents.

Methods
Data was aggregated from Beth Israel Deaconess Medical Center in Boston, Massachusetts via the Medical Information Mart for Intensive Care III database, which includes patients' electrocardiogram, electroencephalogram, and respiratory rate reports among other basic clinical information. Natural Language Processing was used to isolate the patients of interest and classify them based on area of injury, i.e. any of eight combinations of the three vital organs: brain, heart, and lungs. Upon isolation of the waveform data, noise was filtered out via normalization, Butterworth and forward-backward filter application, and Fast Fourier transformation. The Artificial Neural Network (ANN) contained 23 dense layers with the number of neurons decreasing per 2 layers with ReLU activation. The Convolutional Neural Network (CNN) had 2 convolution, 4 pooling, 1 flatten, and 2 dense layers with softmax activation. Both models used AdamOptimizer and 10% dropout.

Results
The CNN and ANN produced F1 scores of .82 and .56 respectively, suggesting the CNN could perform relatively accurate early detection of injury area and expedite hospital treatment of trauma patients. The F1 score for ANN suggests that additional tuning is necessary to determine if it's a viable model.