Automatic ECG Classification with Convolutional Neural Networks

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Aims: This work provides a viable solution for the automatic identification of cardiac diseases from electrocardiographic recordings (ECG) in the scope of the Computing in Cardiology Challenge. For this purpose we employed a convolutional neural network (CNN), a type of deep learning architecture which is able to learn salient features of input signals in a data-driven manner.

Methods: This work employs a CNN architecture, comprised of convolutional, max pooling, global average pooling and fully connected operations. Batch-normalization and dropout (normal and spatial for fully connected and convolutional operations, respectively) was used as regularization alongside LeakyReLU non-linearities. The employed architecture is depicted in Figure 1. An ECG-tailored data augmentation consisting of white Gaussian noise, powerline noise (50 Hz), baseline wander (0.5 Hz) and voltage offset (1% of signal range) was applied in a *select-one* manner. The challenge database, comprising 6877 ECGs of 9 categories, was split into train and validation sets (75-25%) and windowed to segments of 18432 samples, edge-padding when necessary. The network was trained using stochastic gradient descent ($lr = 0.1$, momentum $= 10^{-4}$, lr reduction on plateau) with a batch size of 128 elements.

Results: The network obtained a F_2 score of 74.2% and a G_2 score of 53.5% in the validation set and a F_2 score of 74.7%, a G_2 score of 53.0% (geometric mean of 62.9%) in the independent test set, evidencing the viability of this approach as an initial solution for cardiac abnormality identification.

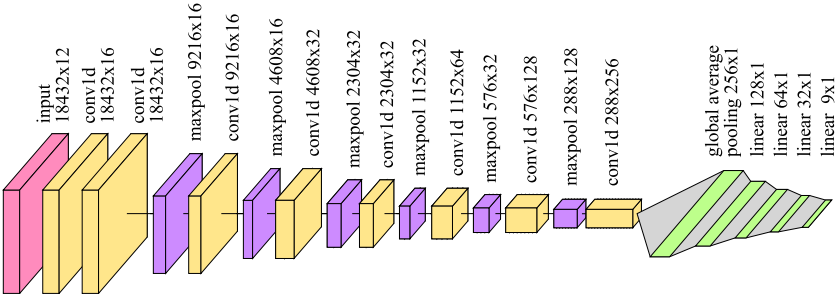

Figure 1. Architecture. Blocks represent output tensors of input (pink), convolutional (yellow), max-pooling (purple) and fully connected (green) operations.