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Convolution and Pooling on 1D data for time series

Assuming a time series of length ‘n’, which is the number of timestamps and width ‘k’, which is the number of variables in a multivariate time series. For example, let’s take a weather time series having variables as temperature, pressure and humidity; here the width will be 3 because of the three available variables.

While the length of convolutional kernels can vary depending on different factors, their width will always remain the same as the time series. Due to this, the kernel does not keep on changing its direction, instead it keeps on moving in the same direction from beginning to the end of the time series.

The elements of the kernel are multiplied to the corresponding elements of the time series that they cover at any given point, the results of which are then added together and then a nonlinear activation function is applied to that value. The result of this will then be a univariate time series, and then the kernel will keep on moving forward along the time series to produce the next value. The number of the new time series will be the same as the number of convolution kernels. Depending on the length of the kernel, different aspects, properties and features of the initial time series get captured in each of the new filtered series.

After this, global max-pooling is applied to each of the time series vectors, in which case the largest value is taken from each vector. The new vector formed from these values and the vector of maximums is the final feature which is then used as an input to a regular fully connected layer. The whole process is illustrated in the picture below: