

## Deep learning for long sequential data representation

### Description for the general public

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The ability to fetch important information and experience from distant memories allows us to make highly accurate decisions. In other words, a rich representation of the current state requires taking into account the information collected in the past and the actions performed previously that affect the current state. Leaving aside such extreme examples, even the seemingly undemanding task of summarizing a movie requires us to filter the content and remember the important parts of the movie during the process of watching. A human being easily copes with this task and is able to describe the movie without any trouble (even without being assigned this task in advance).

In order for machines to be able to solve such tasks, it is necessary to design architectures that are capable of summarizing its current state taking into account all the important information from the past (even those obtained very long time ago). Unfortunately, the currently existing methods have difficulties with extracting and understanding long-term patterns. Therefore, the purpose of the study is to develop a new artificial neural network architecture that will be able to describe and summarize a long sequence of historical observations. The model has to be capable of focusing on the most important events and remember them as long as they remain in the group of the most crucial factors shaping the current state.

Artificial neural networks are mathematical objects inspired by the brain. They are a very general class of architectures that have been proven to be successful in solving a lot of real-life problems, such as image recognition, speech synthesis and cancer detection. Artificial neural networks have been recently researched very extensively. A particular type of artificial neural network is capable of analyzing and interpreting sequence of observations. Hence, I believe that this method is the most promising direction for my research problem.

The justification for tackling the research topic presented is not only the huge interest in this subject by scholars working on artificial intelligence, but also a number of potential applications. The following list presents a few real-life problems that would potentially incorporate the results of the aforementioned project idea.

- Representation of text documents would allow to answer questions asked in natural language (based on knowledge sources written also in natural language, i.e. encyclopedias).
- Determination of the state of the moving camera in order to construct a map of the surrounding area. Such a map may be used, for example, to generate instructions for the blind who are equipped with such a camera.
- Representation a given user (of a particular website) in order to prepare better recommendations. As a result, the process of purchasing (repetitive, often boring activity) would be significantly shorten.

Working on the presented problem is interesting also because even partial solutions are applicable to real-life problems. For example, the preliminary results for this project were used to create a system that digitally identifies dysgraphia among school children. As a result, a given child may get a treatment more quickly (if needed).