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# Implementation of neural codes using a spiking neuron model

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## 1 Description

In real neurons spikes are used to code information. While different mechanisms of computation with spikes have been proposed [1, 2], their application to real world problems is rather limited. This is an open project that explores the application of spike coding to solve problems.

## 2 Objectives

The goal of the project is to implement one of the reported methods of computation with spikes (see [2] and references therein for examples of neural codes), or a new one, and demonstrate its application to a theoretical or practical problem. The project is open in the sense that the student can decide the problem or scenario where to apply the computation model, and how to implement it (always in Python).

The student should: 1) Conceive and/or implement the method for computation with spikes. 2) Select and describe the problem that is going to be “solved” using computation with spikes. 3) Run the experiments, describe the results and discuss these results.. As in other projects, a report should describe the characteristics of the design, implementation, and results. A Jupyter notebook should include calls to the implemented function that illustrate the way it works.

## 3 Suggestions

- Complete the two Jupyter Python notebooks available from Brian2 <https://brian2.readthedocs.io/en/stable/resources/tutorials/index.html>, they can help to illustrate how spiking neural networks work.
- Analyze carefully the computation models discussed in [2] and the original papers where they were proposed.
- Other Python libraries like `nengo` <https://www.nengo.ai/> could also be used.

## References

- [1] H  lene Paugam-Moisy and Sander Bohte. Computing with spiking neuron networks. In *Handbook of natural computing*, pages 335–376. Springer, 2012.
- [2] Filip Ponulak and Andrzej Kasinski. Introduction to spiking neural networks: Information processing, learning and applications. *Acta neurobiologiae experimentalis*, 71(4):409–433, 2011.