An Introduction to Mathematical Neuroscience

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The study of the brain has attracted the attention of scientists from different disciplines; amongst them, mathematics have sought tools and mathematical models for the study of this body. Mathematical neuroscience aims at understanding the fundamental mechanisms responsible for neuronal activity patterns observed experimentally. Modelling is important to interpret experimental data, test hypothesis, make predictions, and suggest new experiments.

The goal of this course is to introduce some basic mathematical models describing firing dynamics in neuronal systems, both at the single cell and network level, including the widely studied Hodgkin-Huxley and Wilson-Cowan models. We will analyse this models using tools from dynamical systems theory that will be reviewed alongside (bifurcation analysis, singular perturbation theory, averaging, ..). Finally, I will present some examples of applications of neuronal modelling to some describe cognitive tasks such as decision making.

References

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[3] S. H. Strogatz. *Nonlinear Dynamics and Chaos. With Applications to Physics, Biology, Chemistry, and Engineering.* Studies in Nonlinearity, Perseus Books, 1994.