

English Summaries

Alain Connes

Symmetries

The concept of symmetry goes well beyond that of simple geometric symmetries. From the fair organisation of the final stages of soccer competitions to the solving of equations, via the icosahedral game and Morley's Theorem, we'll discover the multiple aspects of this concept.

Keywords: symmetry groups, polynomial equations, Hamiltonian cycles, Morley's theorem.

AMS Subject Classification: 12-01, 20-01, 51-01.

Toni Guillamon i Grabolosa

An introduction to the mathematics of neural activity

In this paper, we want to provide the reader a first approximation of the rôle of mathematics in neuroscience, with a quick overview of the most classical models and showing recent applications. We start presenting the biophysics of the most known models of activity of a single neuron, generally using differential equations, pointing out the implications of the main physiological properties on the dynamics. While we emphasize on conductance-based models, we mention as well the usefulness of more simplified models like the "integrate & fire" or Morris-Lecar, and the existence of diffusion models like the cable equation. The modeling of populations of neurons, highly demanding computationally speaking, is illustrated in this paper through the description of two models of primary visual cortex. The last part of the paper is devoted, as an example of the use of mathematical tools different from differential equations, to a short description of visual receptive fields by means of minimizing certain functionals.

Keywords: computational neuroscience, equations of neuronal activity, receptive fields.

AMS Subject Classification: 92B05, 92C05.

Agustí Reventós i Tarrida

A new world created out of nothing, a world where the circle can be squared!

There is a vast literature on the fifth postulate. This presentation emphasizes the importance of Janos Bolyai's work. Starting from an axiomatic development equivalent to that of Euclides but changing the fifth postulate, he finds an expression for the element of length of this new geometry. In a then unknown language we would say that he introduces a Riemann metric with negative curvature in the plane. This frustrates the path undertaken by Gauss in his "Disquisitiones generales circa superficies curvas". Another remarkable fact is that the acceptance or rejection of the uniqueness of the parallel line implies that certain circles can be squared.

Keywords: fifth postulate, parallel lines, Euclides, Gauss, Bolyai, squaring, imaginary sphere.

AMS Subject Classification: 51-03; 53-03.
