



Morse Theory on Finite Spaces

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Monografía

The topology of a space and the kind of dynamics that can be defined on it are strongly interconnected. Precisely, both Morse theory and Lusternik-Schnirelmann theory arose to study this phenomenon. Accordingly, we devote the first part of this thesis to the study of Morse theory and Lusternik-Schnirelmann theory in some discrete settings - finite topological spaces, partially ordered sets, chain complexes, cell complexes, and certain small categories. We show the relation between different existing Morse theories in these settings, and we develop them in more depth. Among the results, we prove a set of Morse inequalities for non-necessarily gradient dynamics, involving torsion in the coefficients. Besides, we obtain a Lusternik-Schnirelmann theorem in this context. In the second part of the thesis, we introduce a new notion that we have called "homotopic distance", which generalizes classical homotopic invariants such as the Lusternik-Schnirelmann category and Topological Complexity. Moreover, it provides deeper relations between them

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