University of Camerino – International School of Advanced Studies

PhD program in Computer Science and Mathematics

Academic Year 2020/2021

APPLIED TOPOLOGY

Prof. Riccardo Piergallini

Lesson log

Lecture 1. (March 10, 2 hours)
Introduction to the course and planning of the activities.

Lecture 2. (March 17, 2 hours)
Metric spaces, isometries. Euclidean spaces, balls, cubes, simplexes and their boundary.

Lecture 3. (March 24, 2 hours)
Topological spaces, continuous maps, homeomorphisms, connected components.

Lecture 4. (March 31, 2 hours)
Relation between metrics and topology, continuity and uniform continuity.

Lecture 5. (April 7, 2 hours)
Compacteness. Topological equivalence of balls, cubes and simplexes (regular convexes).

Lecture 6. (April 14, 2 hours)
Homotopy, deformations and homotopical equivalence, contractible spaces.

Lecture 7. (April 21, 2 hours)
Abstract and topological graphs. Paths and cycles, homotopy of graphs, trees. Subgraphs, maximal subtree. Abstract and topological simplicial complexes, cubical complexes.

Lecture 8. (April 28, 2 hours)
Cellular complexes. Subdivisions, derivated and barycentric subdivision. Subcomplexes. Simplicial maps, cellular maps, approximation of continuous maps.

Lecture 9. (May 5, 2 hours)
Embedding theorem in Euclidean spaces. Homotopy of complexes, simplicial collapsings and cellular deformations.

Lecture 10. (May 12, 2 hours)
Simplicial, cubical and cellular homology with coefficients in Z, Q and R, subdivision invariance.

Lecture 11. (May 19, 2 hours)
Singular homology, functoriality and homotopical invariance. Exact sequences for pairs and triples, naturality. Equivalence theorem.

Lecture 12. (May 26, 2 hours)
Mayer-Vietoris exact sequence. Homology of spheres and tori, homology of surfaces.

Lecture 13. (June 9, 2 hours)
Approximation of spaces, Vietoris and Cech complexes, regular neighborhoods in Euclidean spaces.

Lecture 14. (June 16, 2 hours)
Filtrations of spaces and complexes. Persistent homology, persistence diagrams, bar-codes.