The Workshop on
Commutative Algebra and Related Topics, January 12-14, 2019
School of Mathematics, IPM, Tehran

Determinantal Ideals and Associated Simplical Complexes

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Determinants describe degeneracy loci of linear maps and appear prominently in invariant and representation theory of linear groups. This makes them objects of eternal relevance in algebra and geometry. Determinantal rings are coordinate rings of interesting varieties as, for example, Schubert varieties. Classical determinantal rings are defined by minors of a generic matrix, by minors of a generic symmetric matrix or by Pfaffians of a generic skew-symmetric matrix. A classical tool in the study of determinantal rings is the notion of Algebra with Straightening Law (ASL), which was born in the invariant theory and stands in the intersection among geometry, algebra and combinatorics. More recently Groebner bases theory has been successfully used to study classical and non-classical determinantal rings, allowing to deduce properties of the determinantal ideals by studying simplical complexes associates to their initial ideals. Aim of the course is to explain this tecniques and to show two applications to the study of cogenerated ideals of Pfaffians and of ideals of minors of symmetric matrices.

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Vanishing of (co)homology and Depth Formula

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In this talk, we will discuss about the vanishing of (co)homology over complete intersection rings. A remarkable consequence of the vanishing of homology over a complete intersection local ring R is the depth formula, $\mathsf{depth}_R(M) + \mathsf{depth}_R(N) = \mathsf{depth}(R) + \mathsf{depth}_R(M \otimes_R N)$, established by Auslander [1] when R is regular, and by Huneke and Wiegand [2] when R is singular. We will discuss about the depth formula over Gorenstein rings. We will show that the depth formula holds for nonzero finitely generated modules M and N in case certain Gorenstein relative and Tate homology modules vanish.

References

[1] M. Auslander, *Modules over unramified regular local rings*, Illinois J. Math. **5** (1961), 631–647.

[2] C. Huneke and R. Wiegand, *Tensor products of modules and the rigidity of Tor*, Math. Ann. 299 (1994), 449–476.

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Generic Initial Ideals and Local Cohomology Tables

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Generic initial ideals have been studied extensively during the last few decades, after the proof of the celebrated Criterion for detecting Castelnuovo-Mumford regularity by D. Bayer and M. Stillman, within the theory of Gröbner bases and graded free resolutions.

After discussing the notion of genericity and the definition of generic initial ideals, we recall some of their basic properties. We shall then focus on the Betti tables and local cohomology tables of generic initial ideals, and on some generalizations of Bayer-Stillman results. We shall also survey some questions which are still open in the field, and see how the theory of generic initial ideals contributed and may contribute to their solutions.

Some of the results we present are in collaboration with G. Caviglia (Univ. Purdue) and F. Strazzanti (Univ. Barcelona).

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Commutative Algebra via Simplicial Combinatorics

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Hochster's formula gives a connection between invariants for monomial ideals and simplicial cohomology. It has developed into a useful tool in combinatorial commutative algebra. I'll give an overview of both the connection, and of tools in topological combinatorics that are useful for combinatorial commutative algebra.