How Non-Commutativity Helps Data Centers: Maximally Recoverable Codes from Skew Polynomials

- Date: 25.6.2024
- Time: 3:40PM
- Address: Sokolovská 83, Praha
- Room: K3
- Speaker: Venkatesan Guruswami (UC Berkley)

Abstract: Locally Repairable Codes (LRCs) allow for recovery from asmall number of erased symbols in a local manner based on just a fewother codeword symbols. A maximally recoverable (MR) LRC offers thebest possible blend of local and global erasure resilience,guaranteeing recovery from all erasure patterns which areinformation-theoretically correctable given the constraints of localrepair groups. This makes them attractive for use in distributedstorage systems where they have been deployed in certain parameterregimes.

Random constructions easily show the existence of MR LRCs over verylarge fields, but a major challenge is to construct MR LRCs, or evenshow their existence, over smaller fields, as well as understandinherent lower bounds on their field size. We will discuss aconstruction based on skew polynomials (a non-commutative analog ofpolynomial rings that dates back to (Ore, 1933)) that yields MR LRCsover the smallest known alphabets in many practically relevantparameter regimes, including matching a lower bound in an interestingcase.

The talk will introduce the concept of maximal recoverability, anddescribe skew polynomials and non-singular matrices constructed usingthem which lead to good MR LRCs. Time permitting, we will mention someexciting recent connections between MR codes and list decoding.

Based on joint work with Sivakanth Gopi (Microsoft Research).

The speaker: Guruswami's research interests span many areas oftheoretical computer science and related mathematics, includingerror-correction, approximate optimization, randomness in computing,and computational complexity. His work on list error-correction hasled to codes with minimum possible redundancy for correcting anydesired fraction of worst-case errors. His recent works includenotable progress on polar codes, deletion-correcting codes, codes forcloud storage, and constraint satisfaction problems.

Prof. Guruswami has served the theory of computing community inseveral leadership roles. He currently serves as editor-in-chief ofthe Journal of the ACM and editor for TheoretiCS, and was previouslyeditor-in-chief of the ACM Transactions on Computation Theory and onthe editorial boards of SIAM Journal on Computing, JACM, and IEEETransactions on Information Theory. He is Vice Chair of the IEEETechnical Committee on Mathematical Foundations of Computing and amoderator for arXiv cs.IT. He has served as program committee chairfor the CCC, FOCS and ISIT conferences, and is a former president ofthe Computational Complexity Foundation.

Prof. Guruswami is the recipient of a Simons Investigator award, thePresburger Award, Packard and Sloan Fellowships, the ACM DoctoralDissertation Award, and an IEEE Information Theory Society PaperAward. He was an invited speaker at the 2010 International Congress of Mathematicians. He is a fellow of the ACM (2017) and the IEEE (2019).