Course title: **Greatest Hits of Theoretical Computer Science**
Instructor: Omid Etesami
Place: IPM (Institute for Research in Fundamental Sciences), Niavaran Building, School of Mathematics
Time: Thursdays (9:00 - 12:30), First day of class: 6th of Mehr: 28/9/2023.

In this course, we will study selected landmark works in the field of theoretical computer science.

For this year's year-long edition of the course, we will hopefully read 11 papers by 11 winners of the Abacus medal/Nevanlinna prize. We will spend around three weeks for each work, discussing the background information that helps in the understanding of the results of the paper as well as the techniques involved. We may also mention important later work related to that work, or other significant works of the author.

The list of papers for the Fall 2023 semester are:
1. Kleinberg, Jon M. "Authoritative sources in a hyperlinked environment." Journal of the ACM (JACM) 46.5 (1999): 604-632.
2. Sleator, Daniel Dominic, and Robert Endre Tarjan. "Self-adjusting binary search trees." Journal of the ACM (JACM) 32.3 (1985): 652-686.
3. Kearns, Michael, and Leslie Valiant. "Cryptographic limitations on learning boolean formulae and finite automata." Journal of the ACM (JACM) 41.1 (1994): 67-95.
4. Goldreich, Oded, Silvio Micali, and Avi Wigderson. "Proofs that yield nothing but their validity or all languages in NP have zero-knowledge proof systems." Journal of the ACM (JACM) 38.3 (1991): 690-728.
5. Arora, Sanjeev, Carsten Lund, Rajeev Motwani, Madhu Sudan, and Mario Szegedy. "Proof verification and the hardness of approximation problems." Journal of the ACM (JACM) 45, no. 3 (1998): 501-555.
6. Subhash Khot, Guy Kindler, Elchanan Mossel, Ryan O'Donnell. "Optimal inapproximability results for MAX-CUT and other 2-variable CSPs?." SIAM Journal on Computing 37.1 (2007): 319-357.

And hopefully we will continue in the next semester with the following list:
7. Shor, Peter W. "Polynomial-time algorithms for prime factorization and discrete logarithms on a quantum computer." SIAM review 41.2 (1999): 303-332.
8. Constantinos Daskalakis, Paul Goldberg, Christos Papadimitriou. "The complexity of computing a Nash equilibrium." SIAM Journal on Computing 39.1 (2009): 195-259.
9. Mark Braverman. "Interactive information complexity." SIAM review 59.4 (2017): 803-846.
10. Razborov, Alexander A. "Flag algebras." The Journal of Symbolic Logic 72.4 (2007): 1239-1282.
11. Marcus, Adam W., Daniel A. Spielman, and Nikhil Srivastava. "Interlacing families II: Mixed characteristic polynomials and the Kadison-Singer problem." Annals of Mathematics (2015): 327-350.

Active reading and discussion of the papers in class/seminar is the most important part of the class. To be eligible for a grade, one assignment for the students is to send three questions (and not answers) about the assigned reading at least two days before the class every week. This means that if you plan to attend the class, please send me an email at etesami@gmail.com with the subject title "[Greatest Hits of TCS]" with three questions about the first paper above at least two days before the first session of the class. You are free about the type of questions: you may ask about things of the paper you yourself really don't know/understand; on the other hand, if you understood everything, you can imagine that your questions are some form of test about the reading/paper.

Prerequisites: The most important prerequisite for the course is to accept the challenge of reading diverse papers in the field of theoretical computer science. One approach to deal with the background knowledge you need for reading the works is to acquire it no earlier than when you really need it. Knowledge of discrete mathematics, probability, and linear algebra plus familiarity with algorithms and theory of computation is enough for most of the papers. Some works also involve some algebra and analysis. To gain the necessary knowledge, besides friends and general online resources, you may find the following books useful: Rosen (Discrete Mathematics and Its Applications) for the very elementary material; Cormen, Leiserson, Rivest, Stein (Introduction to Algorithms); Sipser (Introduction to the Theory of Computation); Mitzenmacher, Upfal (Probability and Computing).