CCS Math 10: Combinatorial Game Theory

Time and Place: Room 494 145, Mondays and Wednesdays, 4:00–5:00 PM.
Student Instructor: Simon Rubinstein-Salzedo, email `complexzeta@gmail.com`.
Faculty Sponsor: Maribel Bueno Cachadina, email `mbueno@math.ucsb.edu`.
Office Hours: To be announced.
Website: `http://www.complexzeta.com/cgt.html`
Books:

- *Winning Ways for Your Mathematical Plays, Volume 1* by Elwyn Berlekamp, John Conway, and Richard Guy.
- *On Numbers and Games* by John Conway.

The goal of this course is to introduce the basic techniques of analyzing two-player games of complete and perfect information — that is, two-player games in which players move alternately, there are no "chance" elements such as dice or cards, and both players have a complete understanding of when a game is won and when it is lost. There are many interesting combinatorial games that people like to play. (Go and chess are probably the two most popular of these.) Eventually, one hopes to be able to learn more about these games that people care about through a mathematical study, but we will take on the more modest approach of trying to understand much simpler games — at least one of which is interesting enough to merit actual tournament play!

The first volume of *Winning Ways* forms the fundamental body of information needed to understand combinatorial games. The current plan is to cover as much of this material as is possible. However, I am open to suggestions — if several people are interested in some topic not covered in *Winning Ways, Volume 1*, I would be happy to spend some time on it. There are some links on the website relating to other topics.

Another possible approach would be to discuss the formal aspects of combinatorial game theory. This part of the theory is also very beautiful. For example, one can use games to give constructions of the real numbers, the ordinal numbers, as well as many other objects which we will call numbers! This part of the theory is a bit more technical (and is quite tedious at the beginning if you want to be perfectly rigorous about everything), but I would be happy to cover some of this material if there is interest.

Combinatorial game theory is best done with lots of colors. If you plan to take notes, it is strongly recommended that you have writing instruments in at least three (and preferably four) colors.