

Games@Dal 2015: Organizers S. Huntemann*, U. Larsson and R. J. Nowakowski.

*=student

Participants

International

Alda Carvalho, Portugal
Mike Fisher, USA
Aviezri Fraenkel, Israel
Silvia Heubach, USA
Carlos Santos, Portugal
Aaron Siegel, USA
Angela Siegel, Scotland
Gabriel Renault, Belgium
Craig Tennenhouse, USA
Simon Rubinstein-Salzedo, USA

National

David Isenor* (Undergraduate)
Melissa Huggan*
Svenja Huntemann*
Urban Larsson (PostDoctoral Fellow)
Neil A. McKay*
Richard Nowakowski
Paul Ottaway
David Wolfe

Talks:

1) Alda Carvalho, C. Santos, (Portugal): Oak, ordinal sums and the generalized mex function;

2) A. Fraenkel, Lior Goldberg (Israel): Extensions of the results of Duchene, Fraenkel, Nowakowski and Rigo (Extensions and restrictions of “Wythoff’s game preserving its P-positions”) to Generalized Wythoff ($|k-\ell| < t$, $t > a$ fixed integer).

3) Neil McKay* (Canada): Sums of Hackenbush Stalks

4) Gabriel Renault (Belgium): Invertibility modulo dead-ending no-P-universes

5) Simon Rubinstein-Salzedo (USA): Multi-pile Fibonacci nim.

6) Craig Tennenhouse (USA): New Bogus Nim variants

Workshop:

In particular, four problems caught the attention of subgroups. People wandered between subgroups and joined in the conversations. This allowed the students to interact with all the international participants. Each day concluded with the leader of each group giving a synopsis.

1: Atomic Weights are an approximation that are very useful but the approximations are hard to calculate. The group proved that in a game where, at each stage, at most one player has a non-terminal option then the nim-dimension is at most 2. The canonical forms can be complicated but it was discovered that the Atomic Weights are restricted to being integral, $-1/2$, $1/2$, and a switch of the form $\{-2 \mid x\}$ or $\{x \mid 2\}$. The subsequent conjecture, *if the game has finite nim-dimension then the Atomic Weights will also be restricted*, has attracted international attention. A paper is now in preparation, with authors: Fisher, McKay*, Nowakowski, Ottaway, Santos.

2: Complexity of Placement Games: A placement game has players placing pieces which then cannot be moved or removed from the board. Studying the underlying simplicial complexes has proved fruitful. The group however considered the complexity of placement games. Although not solved in general, the case for "Distance Games", for example COL and SNORT, was shown to be NP-complete. A paper has been submitted, with authors Burke, Heuback, Huggan* and Huntemann*.

3: Global Fibonacci Nim: This is a game introduced by Whinihan (1963) but was only solved for 1 heap. Larsson and Rubinstein-Salzedo, using Zeckendorf representations and fibonacci words, solved the two heap case and made inroads on the multi-heap case. A paper has been submitted, see [arXiv:1509.08527](https://arxiv.org/abs/1509.08527)

4: MEM games: originally proposed by Conway (see *Winning Ways* 1982 edition). Very little progress has been made until this Workshop. Larsson, McKay*, Rubinstein-Salzedo and both Siegels all worked on this and the results have been presented in conferences at MSRI and Israel. A paper is now in preparation.

Other Problems that were considered.

1: Blocking games. To convert a game to a blocking game allow the option for the previous player to forbid a particular option on the next turn. This led to an ongoing discussion of cellular automata generated by combinatorial games. In particular, Blocking Hex. Carvalho, Isenor*, Fisher, Larsson, Renault.

2: Many variants of Leapfrog: these arose out of a question raised by Richard K. Guy. Intriguing conjectures were obtained but no definitive progress as of yet. Everybody in the group joined in at some point.

Expenditures:

Travel: Dr Angela Siegel \$1,498.51

I am very grateful to AARMS for the grant. Even though the amount may seem small, it was used as evidence by others of the quality of the participants and the Workshop. I requested, and AARMS provided, travel funding for four participants. The institutions of three of those (Israel and Portugal), upon hearing that they had received AARMS funding, then provided travel funding.