



NORTHERN ARIZONA
UNIVERSITY

College of Engineering, Forestry & Natural Sciences

Department of Mathematics and Statistics

Memorandum

To: Liz Grobsmith, Provost and Vice President for Academic Affairs

CC: Barry Lutz, Interim Dean, College of Engineering, Forestry and Natural Sciences

CC: Janet McShane, Chair, Department of Mathematics and Statistics

From: Nándor Sieben

Subject: Sabbatical Report for Fall 2007 – Spring 2008

Date: 11/06/2008

I spent the Fall 2007 semester in Budapest. I had an office at the Alfréd Rényi Institute of Mathematics, the premier mathematics research center of Hungary. During this period I worked on the following research projects:

- *Site-perimeter*: I worked with Gábor Fülep on the paper *Polyiamonds and Polyhexes with Minimum Site-perimeter and Achievement Games*. We considered polyominoes on triangular and hexagonal tilings, extending the results of my earlier paper *Polyominoes with Minimum Site-perimeter and Full Set Achievement Games* which considered polyominoes on the rectangular tiling. This new paper was submitted to the *Electronic Journal of Combinatorics*.
- *Snaky*: I tried to answer the long standing question about Snaky. Snaky is the only polyomino for which it is not known whether it is a winner or a loser in the polyomino achievement game. Most experts think it is a winner, but the best known convincing strategy, published by Heiko Harborth, has handicap number 2. A recent paper had a strategy with handicap number 1, but the given strategy was not given in an easy to verify format. My plan was to verify this claim with a computer using a variation of proof number search and threat space search. I was successful, I have found a handicap number 1 strategy which can be presented in the usual verifiable format. The paper *Proof Trees for Weak Achievement Games* describing the results was accepted by the journal *Integers*. My hope was to find a handicap 0 solution as well. I did not find such a solution but I think I am going to be able to do it with a modification of my algorithm. I plan to work on this in the near future.
- *Combinatorial games*: I visited András Pluhár in Szeged. His PhD advisor is Beck József who is a leading researcher in the field of combinatorial game theory. The meeting was very successful, we talked about many interesting problems. I am in contact with him through emails ever since. I was able to work on these problems with some success and I hope these results are going to be part of a paper in the future. While in Szeged, I visited Péter Hajnal at the Bolyai Institute and gave a talk about pebbling. Hajnal is a student of László Lovász and a leading researcher in combinatorics

- *Pebbling*: I worked with Gyula Katona in the Department of Computer Science at the Budapest University of Technology and Economics. While he was a visiting professor at ASU, I invited him to give a talk at NAU. We started working on a project while he was in Flagstaff. We continued working on this project with some progress. I also attended the weekly combinatorics seminar of his department.

I spent the Spring 2008 semester in Tempe at ASU. During this period I attended the weekly C^* -algebra seminar, I gave a talk at the MAA Southwestern Sectional Annual Meeting in Chandler and I worked on the following projects:

- *Graph rubbing*: We received the referee's report for the paper *Rubbling and Optimal Rubbling of Graphs*, cowritten with my former student Christopher Belford. The required changes were significant. We had to include several new sections with brand new results. Christopher lives in the Tempe area so we were able to meet and work together. We were able to answer the referee's research questions. The paper was accepted by *Discrete Mathematics*.
- *Polyomino set achievement*: After 2 years we received the referee's report for the paper *Rectangular Polyomino Set Weak (1,2)-achievement Games*, cowritten with my former student Edgar Fisher. After a moderate amount of changes the paper was accepted by *Theoretical Computer Science*.
- *Partial Difference Equations*: I worked with my colleagues John Neuberger and Jim Swift to finish and submit our third paper *Automated Bifurcation Analysis for Nonlinear Elliptic Partial Difference Equations on Graphs*. We used Skype to talk regularly through the internet. We worked on this project for several years and currently we are extending our results for partial differential equations.
- *West Coast Operator Algebra Seminar*: I worked with ASU professor Steve Kaliszewski on the organization of the West Coast Operator Algebra Seminar. We wrote a successful National Science Foundation proposal in the amount of \$26,280 to support conference participants. The conference was held successfully in September 2008 at NAU.
- *Graph pebbling algorithm*: I developed and implemented an algorithm to find the pebbling number of graphs. I used this algorithm to find the pebbling and rubbing number of every connected graph up to 8 vertices. The values are available at <http://webwork2.math.nau.edu/localdocs/pebbling/census.html>. The algorithm uses a generalization of pebbling numbers for weighted graphs. A paper describing this research is almost done. I plan to submit it in the Fall of 2008. Pebbling on weighted graphs seems to be a very promising new direction. I plan to work on this in upcoming projects in the near future.

I gave a department colloquium talk about my results on 10/28. I am grateful for the opportunity to take a sabbatical leave. It provided me the time to focus on my research projects, to see other universities and to grow as a faculty member.