Report for the summer semester 2002

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Field of Research:	Random walks, random discrete structures, probabilistic methods
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Field of research and results

The mixing rate of a triangulation walk

Consider a random walk, known as a triangulation walk, on a graph of triangulations of a convex n-gon such that two triangulations are adjacent if one can be obtained from the other by replacing a diagonal with the other diagonal of the same quadrilateral. In [3] we consider a triangulation walk with self-loops of high probability to find the upper bound of the mixing time, using the path coupling method by Bubley and Dyer [2].

The connectivity threshold for the min-degree random graph process

Let $\mathcal{G}_n = \{G_{\min}(n, M)\}_{M \geq 0}$ denote a min-degree random multigraph process in which $G_{\min}(n, M+1)$ is obtained from $G_{\min}(n, M)$ by connecting a randomly chosen vertex of a minimum degree with another vertex of the graph. We studied the probability that the random mutligraph $G_{\min}(n, M)$ is connected in [4]. We first investigated how the number of vertices of given degree and paths changes during the min-degree process. This random variables can be closely approximated by the solutions of some differential equations as observed by Wormald [6]. We showed that when the minimum degree of $G_{\min}(n, M)$ reaches three it is a.a.s. connected.

Generating random outerplanar and planar graphs

We showed in [1] how to generate labelled and unlabelled outerplanar graphs with n vertices uniformly at random. To generate these graphs, we

developed a new counting method using the decomposition of a graph along its block structure and computed the number of labelled outerplanar graphs. This is join work with Manuel Bodirsky, a member of CGC at Humboldt University, Berlin.

Similarly we would like to design an efficient algorithm which generates labelled and unlabelled planar graphs uniformly at random with given number of vertices and edges, using decomposition of a 2-connected planar graph into its 3-connected components (see for instance [5, 7]).

Activities

- Lectures and colloquia of CGC, with a talk on "Random walks".
- Tag der Informatik, 16 May 2002, HU Berlin, with a talk on "Random walks".
- Mostly Discrete, a birthday colloquium for Martin Aigner, 7 June 2002, ZIB Berlin.
- CGC review meeting, 24 June 2002, FU Berlin, with a poster presentation on "Generation of random outerplanar graph".
- Berlin-Poznań seminar, 28 June 2002, Poznań, with a talk on "Generating random outerplanar graphs using Markov chains".
- Visiting Adam Mickiewicz University in Poznań, 15-20 July 2002.

References

[1] M. Bodirsky and M. Kang, Generating random outerplanar graphs, manuscript.

[2] R. Bubley and M. Dyer, Path coupling: a technique for proving rapidly mixing in Markov chains, *Proc. 38th IEEE Symposium on Foundations of Computer Science*, IEEE Computer Science Press, 1997, 223–231.

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[4] M. Kang, Y. Koh, T. Łuczak and S. Ree The connectivity threshold for the min-degree random graph process, manuscript.

[5] T. Walsh, Counting unlabelled three-connected and homeomorphically irreducible two-connected graphs, *J. Combin. Theory B* **32** (1982), 12–32.

[6] N.C. Wormald, The differential equation method for random graph processes and greedy algorithms, *Lectures on Approximation and Randomized Algorithms* (M. Karoński and H-J. Prömel, eds.), PWN, Warsaw, 1999, 75–152.

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