Graph-Drawing Contest Report

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Abstract. This report describes the Eleventh Annual Graph Drawing Contest, held in conjunction with the 2004 Graph Drawing Symposium in New York, USA. The purpose of the contest is to monitor and challenge the current state of the graph-drawing technology.

1 Introduction

This year's graph drawing contest had two distinct tracks: the graph drawing challenge and the free-style contest. The graph drawing challenge took place during the conference. The challenge was straight-line crossing minimization of 10 graphs with 20-100 vertices. The contestants were given one hour and were free to use custom designed software or a provided program for manual graph editing, GraphMan. The free-style submission offered the opportunity for participants to present their best graph visualizations. Ten teams of one to three participants submitted graphs to the challenge, and eleven teams submitted entries to the free-style contest.

2 Graph Drawing Challenge

The first three challenge graphs were generated by taking randomly-generated trees, augmenting them with additional random edges, and expanding each vertex into a clique of size 3-6. The next three challenge graphs were the unions of 2, 3, and 4 trees, respectively. The next two were random graphs with edge density 10% and 20%, respectively. The ninth challenge graph was the contest graph from 1998, category C. The tenth challenge graph was the contest graph from 1999, category B.

The team's submissions to the challenge were measured objectively by assigning scores between 0 and 10 to each participating team as follows: each of the 10 submitted graphs G_i was assigned a score: $s_i = \frac{\min_i}{\text{cur}_i}$, where $\min_i$ was the minimal number of crossings found for the i -th graph and cur_i was the number

Fig. 1. One of the drawings submitted by the winning team (the 10th challenge graph).

of crossings in G_i . The individual scores for the 10 graphs were added to obtain the total score for each team. The contest committee awarded one first prize and two honorable mentions.

The first place winner was the team of Andrei Grecu and Gunnar Klau; see Fig. 1. They used a custom-built tool called Grapla. Their tool is based on an evolutionary algorithm with four mutation operators, no recombination, and modified tournament selection. The mutation operators take a single node and move it to a new location on a fixed grid. Depending on the specific operator, the new location is either chosen randomly, with a probability according to the distance from the original position, randomly within a local window around the old position, or within a window whose size exponentially decreases with time. The population is realized by a multilevel hierarchy of different solutions whose constant size is maintained by a selection operator that moves solutions between different hierarchy levels or removes them. The tool gives visual feedback of the quality of the population and allows for interactively manipulating the operators as well as their parameter settings.

Two honorable mentions were given to Chandan Pitta and the team of Josh Cooper, Rob Ellis, and Reid Andersen. Both used a combination approach of automated and manual crossing minimization.

Fig. 2. Spectral Dance (original in color).

3 Free-Style Contest

Eleven submissions for the free-style category were received. The submissions consisted of individual drawings, SVG files, VRML files, papers, and movies. The contest committee awarded one first prize and three honorable mentions.

The winning submission was “Spectral Dance” by Ulrik Brandes, Daniel Fleischer, and Thomas Puppe; see Fig. 2. Each frame of this one-minute animation is a three-dimensional spectral layout of a square grid graph. Continuously changing weights on the edges yield continuous changes in the layout, so that no interpolation between layouts was necessary. The animation was used as background in the trailer for “Language of Networks”, a conference during the 2004 Ars Electronica Festival in Linz, Austria. This trailer was projected onto the facade of the “Museum of the Future”.

An honorable mention was awarded to Kim Hansen and Stephen Wismath for their submission “Arrangement for an Upright Bass”; see Fig. 3. The submission was an animation showing a representation of an arrangement graph in three dimensions, induced by seven planes. Arrangement graphs in 2D have been widely studied, but 3D arrangement graphs have been largely ignored as they are difficult to visualize. Viewing the structure of such graphs in 3D is best accomplished by means of animation. “Arrangement for an Upright Bass” explores the problem of arranging planes to create graphs in a modern computing context.

Fig. 3. Arrangement for an Upright Bass (original in color).

Fig. 4. Three Self-Similar Orthogonal Drawings.

Fig. 5. Euro 2004 Virtual Reality Scene (original in color).

An honorable mention was awarded to Maurizio Patrigniani for his submission “Three Self-Similar Orthogonal Drawings”; see Fig. 4. By looking at the drawing of a maximal planar graph with 5,000 nodes and 14,994 edges, its self-similarity may be appreciated. Small portions of the drawing seem to show the same patterns of empty regions as the whole. This intuition is reinforced by a more rigorous measurement of its box-counting fractal dimension, which is 1.70.

An honorable mention was awarded to Ulrik Brandes and Daniel Fleischer for their submission “Euro 2004”, a virtual reality scene; see Fig. 5. The matches of the 2004 European Football Championship are represented by a walkable three-dimensional layout of a graph, in which vertices correspond to matches and edges represent teams moving from one match to the next. The scene was prepared for a CAVE (Cave Automated Virtual Environment) and open to visitors of the “Museum of the Future” during the above mentioned conference.

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