

Abstract

# GraphDraw—A Tool for the Representation of Graphs Using Inherent Symmetry <sup>†</sup>

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When drawing small graphs (with up to five or six vertices) we can use their underlying symmetry to represent them in a clear and natural way. For example, to draw a graph  $G$  with vertex set  $V = \{0,1,2,3\}$  and edge set  $E = \{(0,1), (1,2), (2,3), (3,0)\}$  it would be natural to use a square, or if  $V = \{0,1,2,3,4\}$  and  $E = \{(0,2), (0,3),(1,3),(1,4),(2,4)\}$  we might use a star to represent  $G$ . Even if the vertex labels were permuted, it would not be difficult to uncover the underlying shape. As the number of vertices increases, it becomes impossible to manually choose a suitable and informative representation, i.e., to choose where on the plane to place each of the vertices in order to produce a clear graph, rather than just a confusing mess. Existing graph drawing applications (like yEd) require the user to decide where to place the vertices.

In this paper, we present a tool—GraphDraw—which uses the underlying automorphism group of a graph ( $A(G)$ ) to draw graphs from an initial index array representation of  $G$ . Cycles in the generators of  $A(G)$  are used to place the vertices in such a way as to exploit the underlying symmetry in the drawing, thus producing a clearer and more intuitive representation. Parameter selection allows the user to choose from a range of representations and to optimise the graphs in terms of edge crossings or total edge length. We give a description of the tool and present a suite of example graphs, illustrating the effect of different parameter selections.



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