

# Degree Navigator™: The Journey of a Visualization Software

Guy-Vincent Jourdan<sup>1</sup>, Ivan Rival (1947–2002)<sup>1\*</sup>, and Nejib Zaguia<sup>2</sup>

<sup>1</sup> Decision Academic Graphics  
University of Ottawa  
gvj@DagSoft.com

<http://www.IvanRival.com>

<sup>2</sup>The School of Information Technology and Engineering,  
University of Ottawa  
zaguia@site.uottawa.ca

**Abstract.** In this paper, we follow the evolution of a tool that has its roots in academic research on visualization and graph drawing. From its ancestor *Order Explorer* (1994) and initial version of 1995, to its latest version of 2003, we analyze the significant steps of a software that has gone from being a relatively simple, very specialized research tool to being a successful, widely deployed, complex commercial software used for academic degree audits. As the tool has expanded over the years, the initial scope has been completely outgrown and finding back the original idea in the current version is not completely obvious. Never the less, Degree Navigator™ is a wonderful example of a research project that has gone a long way.

## 1 Order Explorer

At the root of the problem, in 1994, was the question of upward drawing of ordered sets, and more precisely the automatic, computer generated drawing of these sets. Although several methods were available in the literature (see e.g. [1], [3], [4], [5] for surveys of the question), none of the solutions were particularly satisfying. In fact, it was not even obvious to have a solution that was at least correct, if not aesthetic or practical. For example, most practical solutions, especially for large ordered sets would not prevent an edge between two vertices to go right through a third vertex, making it impossible for the viewer to know whether the third vertex was part of the relationships or not. Also, orders with large number of covering relations (i.e. with lots of edges to represent) were particularly difficult to render.

A simple and elegant solution was introduced with Order Explorer ([2]), an order manipulation tool that presented a rendering interface of a novel sort: Order Explorer simply omits the edges! With only vertices to draw, the problem became significantly easier. Of course, merely removing the edge doesn't quite resolve the problem. The

---

\* Ivan Rival passed away in January of 2002. He was a central actor and partner in the design, the development and the success of the software described here.

user still needs to access to the relationships information one way or the other. The way Order Explorer is providing this information is interactivity. By placing the mouse over a vertex, Order Explorer shows the adjacent vertices. The user has then to “explore” the order vertex after vertex to get a global view, if such a view was needed. Simple “mouse” clicks display comparabilities, adjacencies, upper and lower covers, etc. Order Explorer’s solution is particularly suitable when the main emphasis is to display local information about specific vertices.

## 2 The Introduction of Degree Navigator

A typical department in a North American University will routinely offer over fifty courses, sometimes more than one hundred. These courses have a relationship among themselves, the *prerequisites*. If a course is a prerequisite for another one, then the first course must be completed before one can enroll in the second one. In its simplest form, the prerequisite relationship is an order.

The first goal of Degree Navigator ([6]) was to display the map of the courses of a department, along with the prerequisite information: the *prerequisite map*. The concept developed for Order Explorer was particularly suitable in the context: an algorithm to display quickly and clearly a relatively large order was needed. An easy access to the relationship information was necessary, but focusing on local information rather than on the full picture at once. In addition, the notion of groups of vertices (corresponding in that case to courses of the same year) was introduced: the vertices of the same group were drawn inside a patch a color, which was presented as an *island*.

The second step was to provide a visual representation of the *requirements* of a degree: the *degree map*. The requirements create a much more complex relationship between the vertices of our graph, and an upward drawing is not an option anymore. The type of information that need to be displayed include data such as “*take all the courses in a list*”, “*take x courses/credits from a list*”, “*take x courses/credits from a list, with at least y courses/credits from a sublist*”, “*take either x courses/credits from this list, or y courses/credits from this other list*” and more.

In that visualization, we still use the metaphor of *islands* to group together the courses/vertices that belong to the same requirement. Because some of the requirements are broken down into sub-requirements, we generalize the concept and use *sub-islands*, or islands inside an island. Finally, in that map we may have to display a fairly large number of vertices inside one island and so we introduce the notion of *towers*, which is a stack of vertices of the same type grouped together on the same island.

The visual effect of the degree map resemble the visual chosen for the prerequisite map, and, as in Order Explorer, we make heavy usage of user interaction, mouse and click type of approach to extract the data out of a particular point.

### 3 The Evolution of Degree Navigator

The next step was to provide a web version of the product. A Java version of the drawing interface was introduced in 1998. The same user interactivity idea is used.

Note that the prerequisite relationship is usually more complex than the standard ordering relation. Never the less, similar idea is used, and multiple colors are used to distinguish the different prerequisites values.

It is worth noting that Degree Navigator generates all the pictures, including the course location and the island shapes in real time and doesn't store any rendering information in its database.

The current version of the software is a long way away for its primitive parent, but the original ideas are still present and effective. With hundreds of thousands of end users across North America and beyond, Degree Navigator is an encouraging example of a commercially successful product issued from the graph drawing research.

### References

1. G. Di Battista, P. Eades, R. Tamassia, and I. G. Tollis, "Algorithms for Drawing Graphs: an Annotated Bibliography," *Computational Geometry: Theory and Applications*, vol. 4, no. 5. pp. 235–282 (1994).
2. G.-V. Jourdan, I. Rival, N. Zaguia, "Order Explorer, A System to See and Do in Four Dimensions", *International Conference on Ordinal and Symbolic Data Analysis '95*, Paris, France, June 1995.
3. I. Rival, "Reading, drawing, and order", *Algebras and orders* (Montreal, PQ, 1991), 359–404, NATO Adv. Sci. Inst. Ser. C Math. Phys. Sci., 389, Kluwer Acad. Publ., Dordrecht, 1993.
4. I. Rival, "The diagram", *Graphs and order* (Banff, Alta., 1984), 103–133, NATO Adv. Sci. Inst. Ser. C Math. Phys. Sci., 147, Reidel, Dordrecht, 1985.
5. I. Rival, Graphical Data Structures for Ordered Sets, in *Algorithms and Order*, ed. I. Rival, pp. 3–31, Kluwer Academic Publishers, 1989.
6. <http://www.DagSoft.com/DegreeNavigator>