yFiles – Visualization and Automatic Layout of Graphs

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1 Introduction

Viewing, editing, optimizing, layouting and animating – these are the general tasks for a software packet for the visualization of graph-like structures.

An extensive and reliable visualization system is crucial in application areas such as software engineering, database management and database modeling, WWW visualization, bio-informatics, business process engineering and networking. From the aspect of rapidly increasing amount of data and information, it becomes even more important.

Numerous tools have been developed for special purpose applications. These tools often lack extensibility and are hard to maintain. A major goal for us has been to keep the architecture flexible and extensible, so that additional features can be easily added and tools from diverse application areas can be realized.

Although most relational data can be modeled perfectly as graphs, in general however, this modeling step does not imply a useful view for these data. An automatic edit and layout facility which is user-friendly, customizable and is designed to be reusable and extensible provides the necessary basis to build applications that handle complex data and dependencies. This was the main challenge when we started the yFiles project.

yFiles has been designed and realized as a Java® -based library for the visualization and automatic layout of graph structures. Figure 1 shows the structure of the library and the main components.

Conceptually, the yFiles library consists of three cooperating components:

The yFiles Basic component contains essential classes and data structures. It provides very efficient implementations of advanced data structures like graph, trees and priority queues. It furthermore makes available a wide variety of graph and network algorithms.

The Viewer/Editor component is built upon the Basic component. It provides a powerful graph viewer component and other Java-Swing based graphical user interface (GUI) elements. Although it provides a wide range of functionality, the user interface has been kept intuitive and easy-to-use. The component is showcased in the yEd [27] graph editor demo application.
The \textit{yFiles Layout component} is also build upon the Basic component. It provides a large suite of graph layout algorithms. Some of them are described in the Section on layout algorithm. Diverse layout styles like hierarchical, orthogonal or specified aspect ratio, circular are supported by easy to integrate components that can be configured by an application programmers interface (API) to suit most layout demands.

The Layout as well as the Viewer/Editor component can be used as independent building blocks. The components have been designed to integrate easily into any Java-based application that either needs a viewer component or layout algorithms for graph structures or both.

Based on the single components, extension packages in different directions are available and can be added, like support for different data formats or special applications like biochemical networks.

\begin{figure}[h]
  \centering
  \includegraphics[width=0.5\textwidth]{extensions.png}
  \caption{The main components of the \textit{yFiles} library.}
\end{figure}

In the following, we give an overview on areas of possible and realized applications and the main layout algorithms as well, we provide a closer look to the main components of the \textit{yFiles} library and describe some prototypical applications.

\section{Applications}

Meanwhile, \textit{yFiles} has been successfully employed to numerous application domains and, thus, has already proved the high achievements of flexibility and usefulness.