Promoting Open Source Technology in Education

UML Modeling Tools

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Abstract
Unified Modelling Language (UML) is a collection of diagrams, terms, profiles, etc. that is used to design and develop complex software. There are many software, commercial as well as open source tools. IBM Rational Rose is the most popular commercial UML tool. But there are a number of open source alternatives like StarUML, AgroUML, UMLet, etc. which differ in pricing and features supported, which are important criteria to be explored when the tools have to be used for educational purposes.

Keywords
UML, Rational Rose, StarUML, Agro UML, Education

I. Introduction
The UML stands for Unified Modelling Language and is controlled by the Object Management Group (OMG) standards organization. It is a collection of diagrams, terms, profiles, etc. that is used to design and develop complex software. The current version of UML is 2.1. IBM Rational Rose is one of the most popular tools for building UML models. Microsoft published a UML designer visual modeler with their Visual Studio 6 Tools, but that wasn’t a success. StarUML is a fully fledged, open source, UML modeling tool that supports the ability to create software designs, from basic concepts, through to the coded solution. There are a number of other open source tools like AgroUML, UMLet, etc. This paper aims to analyse the suitability of various UML tools with respect to features offered, pricing, and learnability especially with regard to higher education.

II. IBM Rational Rose
IBM Rational Rose is one of many tools for building UML models. Rational Rose was the most accepted UML product from IBM. It became more popular after the integration with some popular development IDEs like Microsoft’s Visual Studio and Borland JBuilder. Rose is simple, powerful, and efficient, but the licensing is a bit costly. The problem with Rose is that it stopped with version 1.5 of the UML. There were some follow-on products (Rational refers to them as RSx). (www.ibm.com/software/awdtools/developer/rose)[6] Depending on your requirements there are many tools that are available. For example, if you are trying to design a complex system or trying to build a real-time or embedded application, Rational’s Rhapsody is a good choice. Rhapsody generates complete application code from class diagrams, state charts, activity diagrams and flow charts. The code it generates (C, C++, Java, and Ada) is very tight, easy to read and debug, and looks like the code you’d write by hand.

III. STAR UML
StarUML is an open source UML modeling application licensed under a modified version of GNU GPL. It helps in generating fast, flexible, extensible and freely-available UML/MDA platform running on Win32 platform. It is both a software modeling tool and a platform with a complete set of UML modeling features making it nearly a convincing replacement of commercial UML tools such as Microsoft’s Visio and IBM’s Rational Rose. Their latest version StarUML 5.0 is loaded with lots of features which can compete with Rational Rose in totality. It supports UML 2.0 specification and Model Driven Architecture (MDA). Code generation can be done for Java, C++ and C# and also supports the reverse engineering of the same. Moreover, documentation can be generated for all of the Microsoft Office suite programs such as Word, Excel and PowerPoint. StarUML is easily extensible through modules using a COM-based plug-in architecture StarUML very seamlessly imports from Rational Rose too [1]. The OMG (Object Management Group) also specifies UML profile standards for specific purposes.

- Profiles for specific programming languages (C/C++, Java, C#, Python, etc.)
- Profiles for specific development methodologies (RUP, Catalyst, UML Components, etc.)
- Profiles for specific domains (EAI, CRM, SCM, ERP, etc.)

A. StarUML - The Open Source UML/MDA Platform
StarUML is an open source project to develop fast, flexible, extensible, featureful, and freely-available UML/MDA (Model-Driven Architecture) platform running on Win32 platform. The goal of the StarUML project is to build a software modeling tool and also platform that is a compelling replacement of commercial UML tools such as Rational Rose, Together and so on.

- UML Support: UML is continuously expanding standard managed by OMG (Object Management Group). StarUML support UML 2.0 and will support lastest UML standard.
- MDA (Model Driven Architecture): StarUML is designed to support MDA and provides many customization variables like as UML profile, Approach, Model Framework, MDA code and document template and so on.
- Plug-in Architecture: A good tool must have a well-defined plug-in platform. StarUML provides simple and powerful plug-in architecture so anyone can develop plug-in modules in COM-compatible languages (C++, Delphi, C#, VB, ...)
- Usability: StarUML is implemented to provide many user-friendly features such as Quick dialog, Keyboard manipulation, Diagram overview, etc. thus enhancing its usability.

B. Features of StarUML
- Supports most of the diagrams specified in UML 2.0.
- Very rich feature set and formatting options.
- Ability to generate source code from the UML diagram.
- Reverse engineer the existing code into UML diagrams.
- Supported languages: C++, C# and Java.
- Fast load time/execution time compared with other UML tools.
- Familiar Visual Studio like user interface.
- Supports exporting diagrams into JPG/XMI formats, raster image format, and vector image format Windows Metafile.
- Supports import from XMI, and Rational Rose file format.
- Professional, inter-connected models can be created.
• Supports plug-ins for both importing and exporting.
• Code and documentation plug-ins provided with package.
• It's Free! the best feature.

C. What you cannot do with starUML
• Does not support exporting diagrams into SVG and PNG format.
• Complex for the beginner.
• No longer on a release cycle.
• Not cross platform.
• Supports code generation for the Windows COM model only.

IV. ArgoUML
ArgoUML is a leading open source UML modeling tool and includes support for all standard UML 1.4 diagrams. It runs on any Java platform and is available in ten languages. ArgoUML is distributed under the Eclipse Public License (EPL) 1.0 [7]

A. Features of argoUML[2]
• Written in Java, so runs in all the platforms where Java runs.
• Supports Code generation from the UML diagram / UML Diagram generation from the code.
• Currently supported languages are C++, C#, Java and PHP.
• Ability to manage ToDo list.
• Export UML diagram into XMI / JPG / SVG / PS formats.

B. What is not Good with ArgoUML?
• Does not fully support UML 2.0.
• Can’t Undo mistakes. You will have to redo all again.
• Written in Java, so run comparatively slower than starUML.
• Fewer formatting options as compared to that of starUML.

V. UMBRELLO
This was originally built for KDE and was ported to Windows. It seems like a decent tool. It seems like most of the screenshots are proving its cross-platform support as opposed to features, which is kind of disappointing [3].

A. Features of Umbrello
• Code generator for Java, C, C++
• Code generators (Perl, Python, SQL, Ada, ActionScript, JavaScript, IDL, XML Schema)
• PHP5, Pascal code generator
• Advanced code generator for Ruby, Tcl
• Auto-complete in parameter properties dialog in class diagram
• Nestable components and subsystems in Component diagram
• User interaction with UMLWidget improvements
• Import Rose model files
• Automatically fill useful info into the Perl writer heading template
• Export-to-docbook and Export-to-HTML documentation generator

B. What is not Good with Umbrello?
• Does not fully support UML 2.0.
• Though code generators are available for a number of languages reverse engineering facility is not seen.

VI. UMLet
UMLet is an open-source Java-based UML tool designed for teaching and creating the Unified Modeling Language. It allows users to perform many different operations within it. It is a drawing tool rather than a modelling tool as there is no underlying dictionary or directory of reusable design objects. UMLet runs on any Java platform, eg, Windows, Linux, and OS X. UML elements are modified using text input instead of pop-up dialogs. Elements can be modified and used as templates; this way, users can easily tailor UMLet to their modeling needs. UMLet allows users to create their own custom UML elements. An element’s look can be modified at run-time by changing a few lines of Java code; UMLet then compiles the new element’s code on the fly [4].

A. Features of UMLet
• Lightweight tool for rapidly drawing UML diagrams from within the Eclipse environment.
• Open-Source and no licence fee.
• Simple user interface.
• Runs on any Java platform, eg, Windows, Linux, and OS X.
• Export diagrams to eps, pdf, jpg, svg, and clipboard.
• Share diagrams using Eclipse.
• Availability to create new, custom UML elements.
• Reduced file-created size.
• Supports a variety of UML diagram types: class, use case, sequence, state, deployment, activity.

B. What is not Good with UMLet?
• No support for XMI or rational Rose formats.
• No evident code generators more a diagramming tool.
• Ready made templates not available.
• Comparison of Open Source UML Tools.
### Table 1: Comparison of Open Source UML Tools

<table>
<thead>
<tr>
<th>Feature</th>
<th>StarUML</th>
<th>AgroUML</th>
<th>Umbrello</th>
<th>UMLet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version</td>
<td>5</td>
<td>0.26.2, 0.32.2</td>
<td>2</td>
<td>11.3</td>
</tr>
<tr>
<td>Platform</td>
<td>Windows</td>
<td>Java VM</td>
<td>Linux, KDE, Windows</td>
<td>Java VM, Windows, OS X and Linux</td>
</tr>
<tr>
<td>Language used to develop</td>
<td>Delphi / Any</td>
<td>Java</td>
<td>C</td>
<td>Java</td>
</tr>
<tr>
<td>XMI</td>
<td>Import, Export</td>
<td>Export*, Import *</td>
<td>Import, Export</td>
<td>Import, Export</td>
</tr>
<tr>
<td>Rational Rose</td>
<td>Import</td>
<td>Import</td>
<td>Import</td>
<td>Import</td>
</tr>
<tr>
<td>Use Case</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Activity Diagram</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Class Diagram</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sequence Diagram</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Collaboration</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Deployment</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Output Formats</td>
<td>raster img, JPEG, Windows Metafile</td>
<td>GIF, PNG, PostScript, Encapsulated PS, PGML and SVG</td>
<td>PNG, HTML</td>
<td>JPG, SVG, PDF, EPS</td>
</tr>
<tr>
<td>C/C++</td>
<td>Forward / Reverse Engg</td>
<td>Forward / Reverse Engg</td>
<td>Forward Engg</td>
<td>Forward Engg</td>
</tr>
<tr>
<td>C#</td>
<td>Forward / Reverse Engg</td>
<td>Forward / Reverse Engg</td>
<td>Forward Engg</td>
<td>Forward Engg</td>
</tr>
<tr>
<td>Java</td>
<td>Forward / Reverse Engg</td>
<td>Forward / Reverse Engg</td>
<td>Forward Engg</td>
<td>Forward Engg</td>
</tr>
<tr>
<td>Other Code Generators</td>
<td>PHP, Ruby</td>
<td>Ada, PHP5, Ruby, Tcl, Python, XML, Perl, Pascal</td>
<td>Java VM</td>
<td>Windows</td>
</tr>
<tr>
<td>Load /Execution Time</td>
<td>Fast</td>
<td>Slow</td>
<td>Slow</td>
<td></td>
</tr>
<tr>
<td>Templates</td>
<td>Yes, (Word, Excel, and PowerPoint) generation</td>
<td>Perl Writer Heading</td>
<td>Java VM</td>
<td>Windows</td>
</tr>
<tr>
<td>MDA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Demo Screenshots</td>
<td>Yes</td>
<td>Yes</td>
<td>Very unfriendly</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Price comparisons of various Open source and proprietary UML tools

### Table 2: Price Comparison of Open Source UML Tools

<table>
<thead>
<tr>
<th>Company</th>
<th>Product</th>
<th>Features</th>
<th>Platform</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tigris</td>
<td>ArgoUML</td>
<td>open-source project, written in Java, run-time model critique, OCL, XMI reverse engineering for Java</td>
<td>Java VM</td>
<td>$0</td>
</tr>
<tr>
<td>Tigris</td>
<td>StarUML</td>
<td>open-source project, language support. (Java, C++, C#), High compatibility with (Rose, XMI modules)</td>
<td>Windows</td>
<td>$0</td>
</tr>
<tr>
<td>Oracle</td>
<td>JDeveloper</td>
<td>Class and activity diagrams, Java round-trip engineering, XMI export</td>
<td>Java VM</td>
<td>$0</td>
</tr>
</tbody>
</table>
VI. Conclusion

StarUML is a better alternative to Rational Rose says Renjith in his blog post http://todayslearnings.blogspot.com [5] and Peter Gordon in the Software Discussion group by Joel discuss alternative open source various options in UML tools [8]. NetBeans Editor also can be used with the NetBeans UML plugin. It has got very cool features like Reverse engineering, Design patterns documentation, applying design patterns, etc. There are many constraints to creating UML diagrams quickly; that being cost, ease of use, portability, and most importantly, the ability to quickly share the diagrams. In the education environment; the cost and complexity of maintaining a license server and handing out software programs with a large footprint would be too much money to spend if all that needs to be done is teach students simple UML modeling techniques.

UMLet is an open-source Java-based UML tool designed for teaching and creating the Unified Modeling Language. It allows users to perform many different operations within it. Using the drawing tool users can draw UML diagrams fast. Most experts after having used StarUML on small to midsized projects find it a great tool. It seems to rather good for creating projects using the Reverse Engineering for C#. It has C++, Java, and C# support for Reverse Engineering, and Code Generation. ArgoUML on the other side, seems to be short on the number of features. Ultimately, StarUML is amazing for UML diagrams. It is highly recommended tool for academics to use it for teaching and implementing Object Oriented Techniques. There is no need for any institution of higher learning to go for a proprietary Modeling tool by paying a high license fee since these open source alternatives come loaded with all the necessary features.

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References

Dr. Udai Vir Singh Teotia was awarded M.Sc (Botany & Microbiology), LL.B and Ph.D from CCS University, Meerut. He has established many higher education institutions in north India and worked as Director in many reputed Institutions beside that he is having 22 years of research and administrative experience. His main research interest are higher Education reforms in India and inducted new job oriented vocational courses in higher Education sector. Currently he is working as Professor cum Director (Life Sciences, Academic and Research) at Shri Venkateshwara University, Gajraula, Distt-J.P Nagar, UP, India.