CodeCity

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June 28, 2008

Abstract

CODECITY is a visualization tool built to support object-oriented software reverse-engineering tasks. It provides a structural overview of the systems and the means to explore them within a 3D environment based on a city metaphor. Developed in VisualWorks Smalltalk, CODECITY uses Moose for system modeling and Jun for OpenGL rendering.

1 The City Metaphor in a Nutshell

Our metaphor depicts software systems as cities in which the buildings represent the classes of the software system, while the city's districts represent the packages in which the classes are defined. The visual properties of the city artifacts carry information about the software elements they represent. The properties able to reflect the values of a chosen set of metrics are the three dimensions (*i.e.,* width, length, and height), the color, transparency, and in some cases the position. The mapping used in the following is: the number of methods metric for the class is mapped on the building height, the number of attributes on the base size (both width and length). The nesting level of a package is mapped on the color saturation of the district, *i.e.,* deeply nested packages are colored with dark blue, while the shallow ones are light blue.

2 The Tool

CodeCity's views (See Figure 1) are made of: the interactive city, the information pane (*i.e.,* shows detailed information about the glyph pointed by the mouse and the model element it represents), the menu, a toolbar, and a selection status bar.
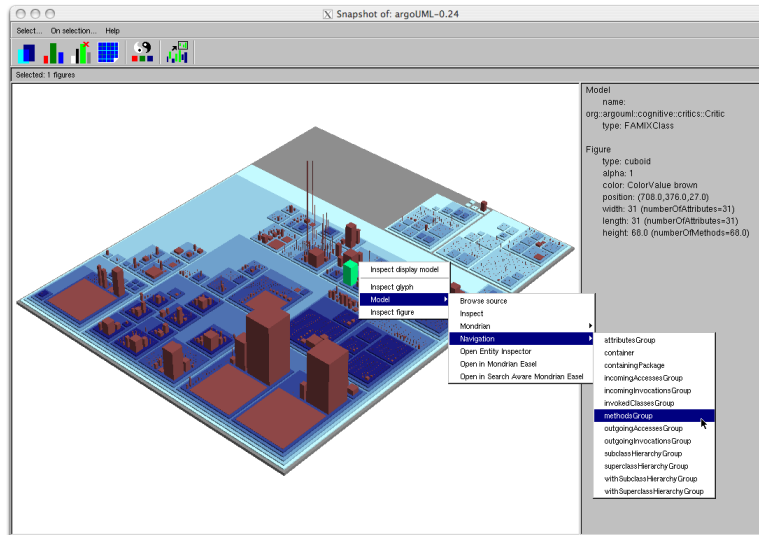

Figure 1: A CodeCity view of ArgoUML

Navigation is supported through basic movements, such as moving in various directions (*e.g.,* up, down, left, right) or getting further/closer (*i.e.,* back/forth), and more complex ones, such as vertical/horizontal orbiting around the city.

Every city artifact provides a contextual popup menu to interact with the model behind it. The elements can be queried using both a generic query language and predefined queries. There are two major query types: general queries (*e.g.,* all elements of a particular type, root classes, interfaces) and selection-related queries (*e.g.,* subclasses of the selected class, all components of a selection).

The actions which can be performed on a selection of artifacts have either local effect, such as the modification of transparency or color, or the application of disharmony maps, or they generate new visualizations, such as spawning a new view or bringing up a 2D class blueprint.

3 Configurability

CodeCity supports the diversity of the reverse engineering domain through its configurability, which is provided through the view configuration mechanism and a basic scripting language. A view configuration specifies for each model element type its visibility, the representing glyph, the mappings (correspondence between metrics and visual properties), and a layout for its components. These parameters can be tuned using the view configuration user interface (See Figure 2).
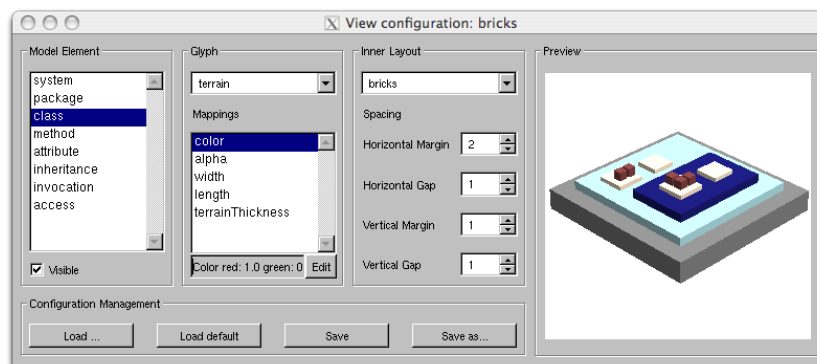

Figure 2: CodeCity's configuration panel

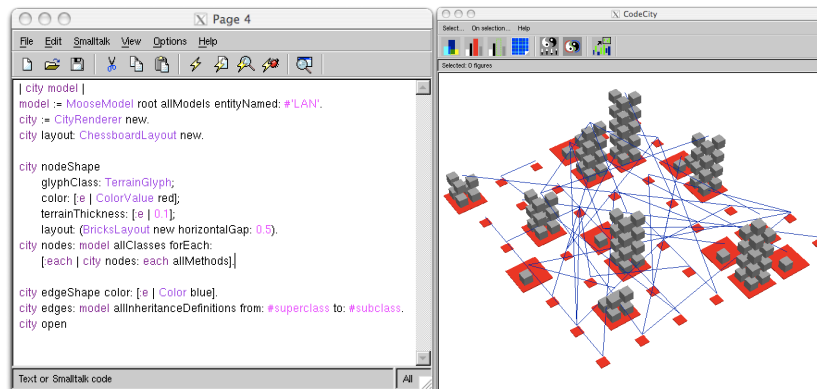Scripting allows building ad-hoc views, such as the example in Figure 3.

Figure 3: A CodeCity script (left) and the resulting view (right)

4 Application

We applied CODECITY to systems written in Smalltalk, Java, and C++.

System	Language	kLOC	Packages	Classes
ArgoUML	Java	137	144	2'542
Azureus	Java	274	457	4'737
iText	Java	80	149	1'250
JDK 1.5 core	Java	160	137	4'715
JHotDraw	Java	30	72	998
Jmol	Java	85	105	1'032
CodeCity	Smalltalk	18	129	291
Moose	Smalltalk	32	278	961
ScummVM	C++	105	329	1'331

Table 1: The systems analyzed with CodeCity

Figure 4, a proof of the scalability of our tool, presents a scripted visualization of 9 systems, comprising over 900 kLOC written in 3 programming languages, described in Table 1.
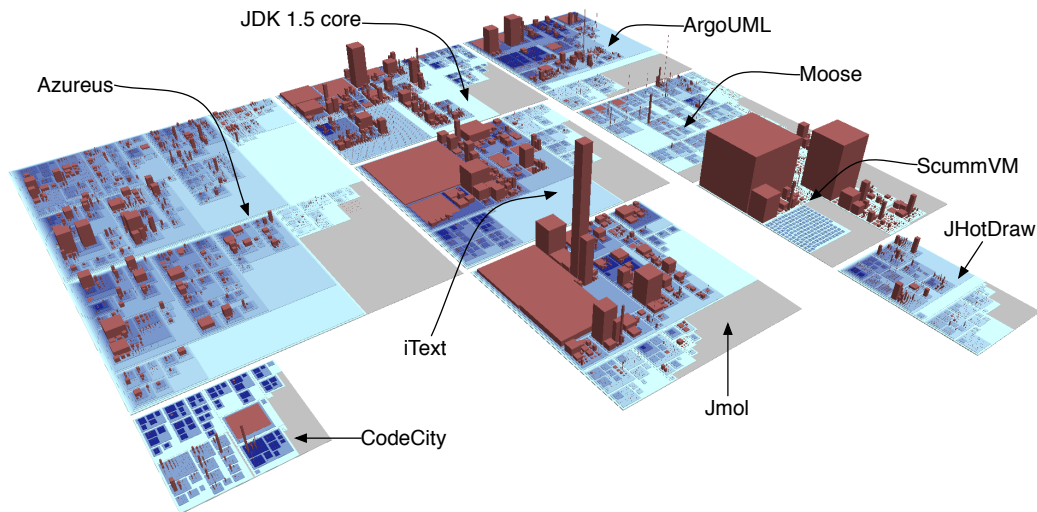

Figure 4: The code cities of 9 systems written in Smalltalk, Java, and C++

CodeCity is written in VisualWorks Smalltalk, runs on every major platform, and is freely available for download at:
http://www.inf.unisi.ch/phd/wettel/codecity-download.html