

Publishing Formal Specifications in Z Notation on World Wide Web

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Abstract

This article presents Z Browser Plug-in, Netscape Navigator plug-in and ActiveX control which enables the usage of WWW clients for viewing HTML pages with embedded LaTeX documents containing Z specifications.

Keywords:

formal specification, Z notation, Netscape plug-in, ActiveX control, WWW, LaTeX

Introduction

The formal specification notation Z (pronounced "zed") is based on set theory and first order predicate logic. It has been developed by the Programming Research Group (PRG) at the Oxford University Computing Laboratory (OUCL) and elsewhere since the late 1970s, inspired by Jean-Raymond Abrial's seminal work.

Z is now used by industry as part of the software (and hardware) development process in both Europe and the US. It is currently undergoing international ISO standardization.

It has been previously difficult to display properly Z specifications in World Wide Web browsers. There were problems displaying schema boxes and many symbols of Z like maplet, relational image, bag and sequence display and many others. Currently, there is a work in progress to add mathematical extensions to HTML+ including support for Z.

There has been many documents written in LaTeX using `fuzz.sty` or `zed.sty` styles, or in the compatible styles `oz.sty` and `mz.sty`. The number of LaTeX documents will be growing also because most of the Z type checkers like *fuzz* [2] and ZTC type checker [3], and theorem provers like Z/EVES [4] use this format as an input format. Some other tools like Formaliser [5] and CADiZ [7] are able to process Z specifications in LaTeX. Many books on Z including *The Z Notation A Reference Manual* by Mike Spivey [1] were prepared using LaTeX.

This article describes Z Browser Plug-in - a Netscape plug-in and ActiveX control, which are able to display Z specifications in LaTeX as embedded objects of HTML pages. Displayed Z paragraphs are seamlessly integrated with the rest of the HTML page and they appear in the same form as when printed by LaTeX. In order to be displayed, the LaTeX documents do not need to be modified or pre-processed.

About the Z Notation

The formal specification in Z is decomposed into small pieces called *schemas* [1]. By splitting the specification into schemas, it can be presented piece by piece. Each piece can be linked with a commentary which explains informally the significance of the formal mathematics. In Z, schemas are used to describe both static and dynamic aspects of the system.

The most representative summary of applications of Z in industrial projects can be found in [8]. Another overview can be found in [9]. Among other applications, Z was used for specification of the IEEE Floating Point Standard, a scheduler for the T-800 Transputer, for respecification of IBM's Customer Information Control System and for specification of the Airbus A330/340 cabin illumination system.

Z Browser Plug-in

Plug-ins are software modules that are seamlessly integrated into Navigator, appearing simply as supplemental capabilities [10]. Z Browser Plug-in is a Microsoft Windows dynamic link library (DLL) which acts as a Netscape plug-in in Microsoft Windows. It can process and display embedded LaTeX documents. Z Browser Plug-in further recognizes following attribute used with the EMBED tag, which further specify which portion of the LaTeX document will be displayed:

- `PARAGR_NUMBER="paragr_number"` defines what Z paragraph of the LaTeX document will be displayed.

Here is a small example of a HTML file with two embedded LaTeX documents:

```
<html>
<head>
  <title>Specification of Phone Book</title>
</head>
<body>
<h2>Specification of Phone Book</h2>
<h3>Invariant </h3>
<p><embed SRC="phbook1.zed" WIDTH=320
HEIGHT=150</embed></p>
<h3>Initial State</h3>
<p><embed SRC="phbook2.zed" WIDTH=320
HEIGHT=150</embed></p>
</body>
</html>
```

Z Browser Plug-in is able to display symbols of the Z notation in different color and when user clicks by mouse on such a symbol once, short description of the symbol is displayed in the status bar of Netscape. After a double-click, help topic for selected symbols is displayed in Windows Help utility. The help file for the Z Notation is identical with the one provided with Z Browser [6].

Z Browser ActiveX Control

ActiveX is just another term for COM/OLE based technology from Microsoft Inc. It is currently available under (albeit not limited to) the MS Windows operating systems. MS Internet Explorer supports objects according to the HTML 3.2 object model. Objects add functionality to HTML document by letting you insert images, video, and programs, such as JAVA applets, and ActiveX controls. To insert an ActiveX control you use the OBJECT element, supplying attribute values that specify the object type, location, initial data, and so on. If the object has configurable properties, you can set these using the PARAM element. The following example shows how to insert the Z Browser ActiveX control and fill it with content:

```
<OBJECT
ID="Z Browser" ALIGN=CENTER
CLASSID="clsid:1a4da620-6217-11cf-be62-0080c72edd2d"
WIDTH=320 HEIGHT=150 BORDER=1 HSPACE=5>
<PARAM NAME="szURL" VALUE="phbook1.zed">
</OBJECT>
```

If the control uniquely identified by its CLASSID is not yet installed and registered on the client's workstation, it gets downloaded from the specified location (the specification is not included in this example), registered and executed after

authentication (signature check). Note that the actual value of CLSID is just an example of a GUID.

Conclusions

Making Z specifications easily available on World Wide Web is an important action in order to popularize this formal notation and its benefits among the rapidly growing number of Internet users. Easy access to the HTML pages with Z specifications via links from other HTML pages can bring into contact with Z more users than ever before. Having the interactive help functionality, users can learn basics of Z just by viewing HTML pages with Z specifications and reading appropriate help topics.

Many researchers will appreciate the possibility to publish their Z specifications on World Wide Web. This possibility was missing before, and so either LaTeX documents had to be e-mailed to those who were interested or the hard copies had to be sent.

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