Z Browser - Tool for Visualisation of Z Specifications

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Abstract
This article presents Z Browser - Microsoft Windows based tool which helps
novices starting to learn Z, even those with little knowledge of Z, to easier
comprehend Z specifications. First, Z Browser and its integrated help facility
for the Z notation (Z Help) is described. Further, we describe the tests which
we carried out in order to find out how much Z Browser reduces the time
needed for comprehension of Z specifications and if the quality of
comprehension is better. For Z Help, we designed a graphical representation
of data types of Z language and the operations on them.

1. Introduction
The usual approach to teaching formal specification languages (not only Z) is
to teach the students the notation first and possibly demonstrate individual concepts
of the language on small examples. It takes some time until the students are able to
read and comprehend more complex specifications where they can see how they can
benefit from formal methods. The period of learning might be rather exhausting
because they do not have motivation for learning as they do not see any benefits.
This might lead to the condition where many students build a pessimistic attitude
toward formal methods just from the beginning of their study.

Z Browser is a tool which is able to relieve this problem. It enables even users
with small knowledge of Z to read and comprehend Z specifications, and so explore
the benefits in a very early stage of studying Z.

Z Browser is a Microsoft Windows based tool for quick and comfortable
browsing through formal specifications in Z language. It consists of the Microsoft
Windows application, and the integrated help facility for the entire Z language
according to The Z Notation, A Reference Manual [1]. Its target audience are mostly
novices of Z; like students of computer science taking their formal methods courses,
individuals trying to teach themselves Z, and clients being given presentations of Z
specifications by software developers.

There are two reasons which motivated us to do this research. First, it is our
conviction that formal methods are the means for increasing software quality and
reliability. Second, it was the experience that formal methods are often rejected at the
beginning by users for their presumed complexity and mathematical background. Having a tool which would enable novice users to understand Z specifications and explore the advantages in the early stages of their study might increase the use of Z.

Z Browser, we concluded, is the tool which is able to reduce essentially the time needed for reading and comprehension of Z specifications. We believe that it is the tool which can help many novices to start to learn Z and focus on the meaning of Z specifications without the previous long study of, for many students quite complicated, Z notation and/or the mathematical background of Z.

As the input format we have chosen LaTeX format and zed and fuzz LaTeX styles because the largest number of Z specifications written so far use these two LaTeX styles.

The rest of this article is organised as follows: Chapter 2 describes in more detail what Z Browser is capable of doing and the reasons why we have designed it in the way it has been designed. In Chapter 3, the Z Browser program is described. Chapter 4 outlines Z Help which is integrated into Z Browser. Chapter 5 is about testing Z Browser. And, Chapter 6 contains conclusions and suggestions for further research.

2. Foundations upon Z Browser is based

At the beginning we tried to find out why Z may seem to be difficult for the novice users and how these difficulties might be overcome. The three main difficulties we identified are:

1. Mathematical background of Z language.
2. Complicated notation with many symbols not frequently used in mathematics nor other formal languages.
3. Complex structure of Z specifications where, for example, schemas contain references to other paragraphs of a Z specification making it difficult to keep track of all these relationships.

For the design of Z Browser, we used human-computer interaction methods as we found the problem of displaying formal notation in a more understandable way similar to the problem of designing comprehensible user interfaces. Modern graphical user interfaces are designed in such a way that they should be comprehensible for the novice and casual users. Also, they should be designed in such a way that most of the users can use them without previous training. Our problem was similar: we wanted to make a Z specification comprehensible to novice users who might have minimal knowledge about Z. We also did not find much literature about visualisation of formal methods [5] so we let ourselves be inspired mostly by the human-computer interaction research [7][11][4][9]. We were also studying visual programming languages [6][12] while we were designing the graphical representation of operations on Z data types. Although visual programming might appear to be a better starting point, the research performed so