An implementation of Lupin's plot web service

Takumi Watanabe, Ikko Kadota
Department of Computer Science, Ehime University

Yukihiro Morizane, Masahiro Kono, Li Kai
Graduate School of Science and Engineering, Ehime University

Hiroshi Kai, Matu-Tarow Noda
Department of Computer Science, Ehime University

Lupin [1] is an ongoing research subject in Ehime University that aims at:

- Establishing a Web-based mechanism and framework that allows easy and systematic creation and construction of computational Problem Solving Environments (PSEs),
- Exploiting the standard Web technologies to support the infrastructure,
- Implementing a prototype to demonstrate the feasibility.

Among the Web-based technologies, we focused on the term *Web Service* to support the implementation of Lupin's architecture, which is composed of the standard protocols such as SOAP, WSDL, UDDI, as well as the mathematical markup language MathML, Computer Algebra System (CAS), and the relevant XML technologies.

This poster presents an implementation of Lupin's plot web service for polynomials on a 2D plane, and its application to mathematics education.

The Lupin's plot web service has the following features:

- A client sends bivariate polynomials (MathML expressions) and a range of each variable via SOAP message (Figure 1),
- The plot is computed by the algorithm described in [3] using Risa/Asir CAS,
- Among available XML graphics representations, we chose Scalable Vector Graphics(SVG).

With SVG, it is easily available to create a union of several plots (Figure 2, 3, 4). A problem is, while rescaling them, the operation sometimes may cause unsatisfactory plots. However, using the algorithm [3], we may still get a nice one at a low computation cost by previous information.

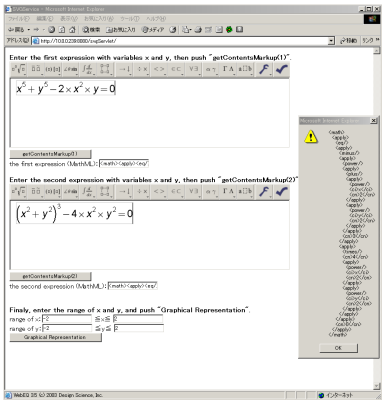

Figure 1: client for plot service

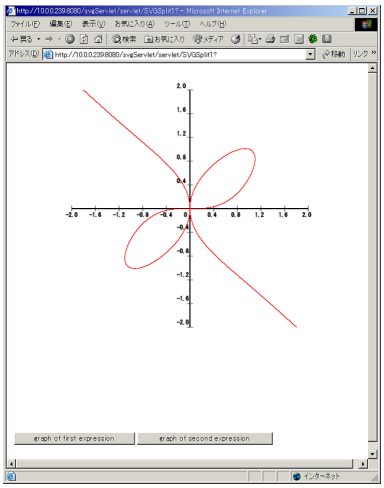

Figure 2: plot of the first expression

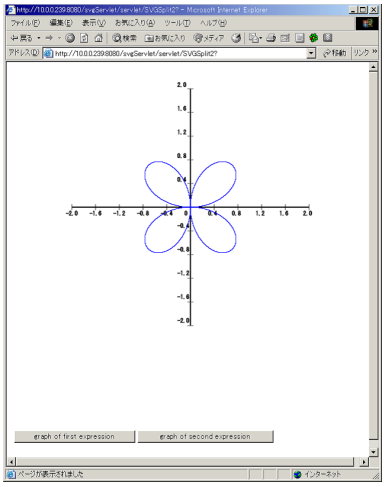

Figure 3: plot of the second expression

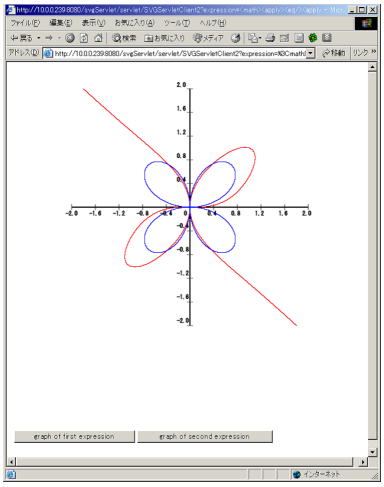

Figure 4: union of plots

Next we consider an application of the Lupin's plot web service in a context of mathematics education. We refer to WME [2] to create a mathematics education webpage. In the framework, we may extend MeML [2] to call our plot web service. In the poster, we will demonstrates sample MeML pages containing SVG output.

References

[1] K. Li, M. Sakai, Y. Morizane, M. Kono, M.T. Noda, Lupin : Towards the Framework of Web-based Problem Solving Environments, *Proc. ATCM'2003*, pp.276–285.

[2] P. S. Wang, N. Kajler, Y. Zhou, X. Zou, WME : Towards a Web for Mathematics Education, *Proc. ISSAC'2003*, pp.258–265.

[3] T. Saito, An extension of Sturm's theorem to two dimensions, *Proc. the Japan Academy*, Vol.73 A, pp. 18–19, 1997.