

**Introduction to Computation Library
"DoctorK"
on Knot and Geometry using Java**

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What is DoctorK?

- Computation Library based on Java

We can compute

- **Twisted Alexander Invariant for Finitely presentable group**
- **Representation of Finitely presentable group**



And so on.



Feature of DoctorK

- I. Input and output is easily possible in "TeX" form.**
- II. You can extend DoctorK as Java Library.**
- III. It's Easy to install DoctorK.**

(Java version 1.4.0 or higher is required)

Example 1:

Twisted Alexander Invariant



Sample 1

The twisted Alexander invariants associated to all $SL_2(\mathbb{F}_p)$ -representations for a knot

Feature:

We can easily replace a targeted group
with some other group.

Ex) $SO(2)$, $U(2)$, $SL_3(\mathbb{R})$

Example 2:

Twisted Alexander Invariant pt.2



Sample 2

Twisted Alexander invariant associated to a given $SL_2(\mathbb{F}_p)$ -representation for a finitely presentable group



Sample 3

Twisted Alexander invariant associated to a given $SL_2(\mathbb{C})$ -representation for a finitely presentable group



About speed of computation

The twisted Alexander invariants associated to all $SL_2(\mathbb{F}_{13})$ -representations for $(9,9,6,7)$ -pretzel

**Number of the conjugacy classes
of the representations : 4673**

Computation time : 501 sec



**OS; WindowsXP
CPU; MPentium 1.6GHz
RAM; 758MB
Java version 1.4.2 ,**



About numerical errors

In mathematics

$$AA^{-1} = E$$

In computation

$$AA^{-1} \neq E$$

$$AA^{-1} = E + \epsilon$$

In DoctorK,

fix some sufficiently small δ ,

$$AB = E + \epsilon, \|\epsilon\| < \delta \Rightarrow B = A^{-1}$$





Example 3: Abelianization and so on.



Sample 4

**Abelianization of some knot group
and some finitely presented group**

And so on...



DoctorK as Java Library

What is **Java ?**

“Write Once, Run Anywhere.”

***“Write Once Carefully,
Run Anywhere Conditionally”***



DoctorK as Java Library pt2

What is Java **Library** ?



**A collection of programs
of basic functions**



**You can modify Input & Output system.
extend DoctorK as you like.**

Merits and Demerits of Java

■ merits



“Write Once, Run Anywhere.”

Easy and Free.

Standard documentation.

■ demerits



“Computation using Java” run slowly !?



Examples using “DoctorK”

Some examples on my HomePage.

<http://www.ms.u-tokyo.ac.jp/~kehorie/>

“DoctorK” or “horie keiichi” on google



Java Applet for N-data.



Install DoctorK on your PC

- Install Java. (Windows user)
Java version 1.4.0 or higher is required.
- Download “DoctorK.jar”
- Move “DoctorK.jar” to some directory.

Further details; on

<http://www.ms.u-tokyo.ac.jp/~kehorie/>



At the end

Please use “DoctorK**” !**

I’m waiting for your **e-mail.**

Thank you.