Projects for the Summer School on Galois Representations 2018 by Bas Edixhoven

1 Brute force numerical computation of Galois representations using Pari

(adventurous, really computational)

See the article [CE12].

Assistant: Bas Edixhoven.

2 WD-representations: theory, computations

(theoretically more advanced, but with real algorithms, already implemented in Magma and Sage, nice for experimentation)

See [LW12].

Assistant: Samuele Anni.

3 Genus of $X_{\Gamma(N)}(\mathbb{C})$

(theoretically more basic, at a starting level, no computer computations, but useful to understand better the objects)

Compute the genus of $X_{\Gamma(N)}(\mathbb{C})$ for $N \geq 3$ by applying the Hurwitz formula to the map to $X_{\mathrm{SL}_2(\mathrm{Z})}$. Then compute the genus of $X_{\Gamma_1(N)}$ for $N \geq 5$. Use the Riemann-Roch theorem to compute the dimensions of the $S_k(\Gamma_1(N))$, for $N \geq 5$ and $k \geq 2$. This can be looked up in a book (Henri's notes?), but it is good to do it once for yourself.

Assistant: Jean-Stefan Koskivirta, Tomomi Ozawa.

References

[CE12] Jean-Marc Couveignes and Bas Edixhoven. Approximate computations with modular curves. In *Geometry and arithmetic*, EMS Ser. Congr. Rep., pages 91–112. Eur. Math. Soc., Zürich, 2012.

[LW12] David Loeffler and Jared Weinstein. On the computation of local components of a newform. *Math. Comp.*, 81(278):1179–1200, 2012.