The L-functions and Modular Forms DataBase

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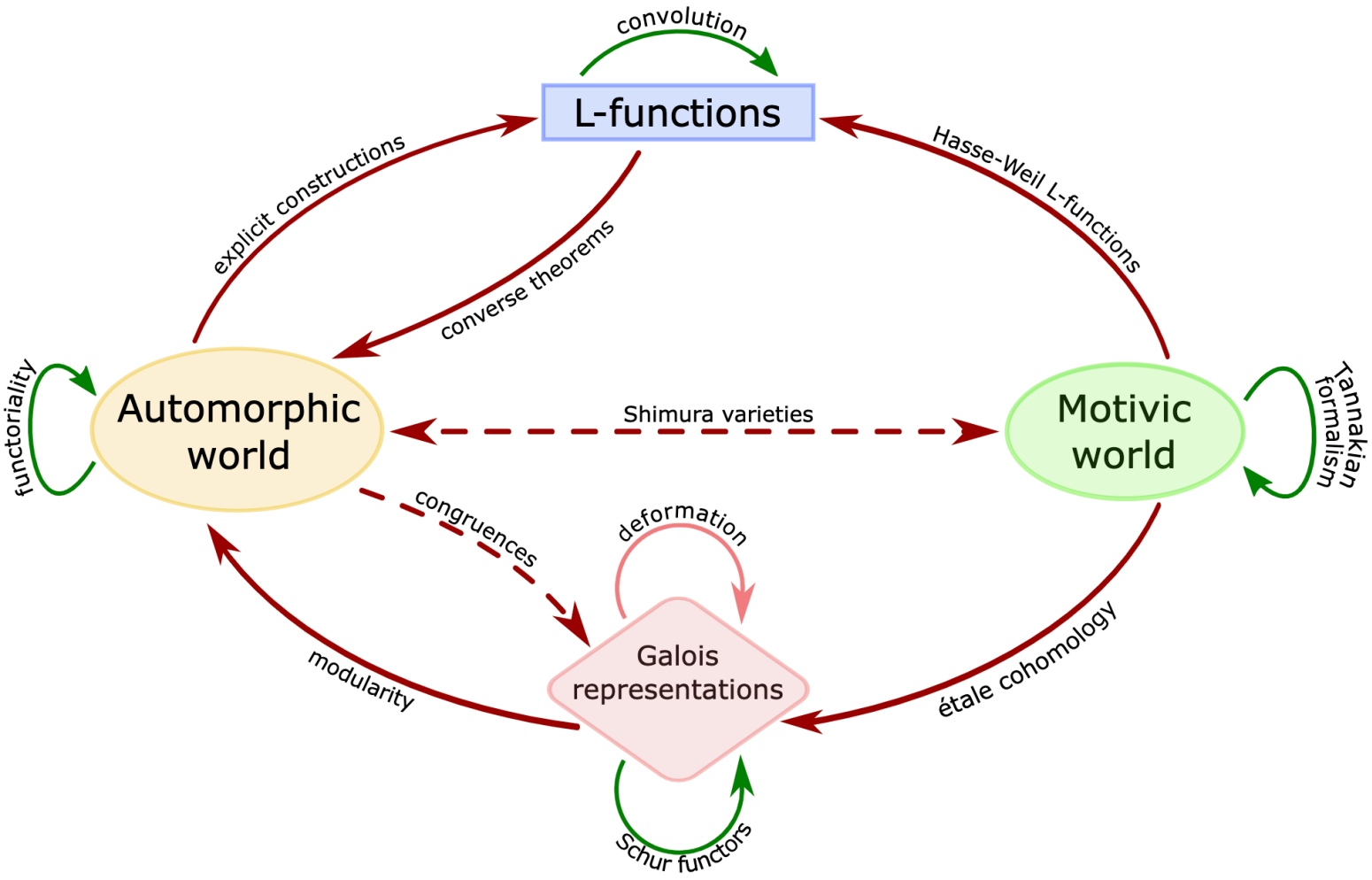
The LMFDB is a collection of databases centered around the Langlands program, which relates complex analytic functions (like L-functions and zeta functions), Galois representations (such as Tate-modules of elliptic curves) and automorphic forms and representations (modular forms).



Demo

beta.lmfdb.org

Sections of the LMFDB

- **L-functions** – rational and otherwise
- **Modular forms** – classical, Hilbert, Bianchi, Maass, Siegel
- **Varieties** – elliptic curves over $\mathbb{Q}$ and over number fields, genus 2 curves, abelian varieties, higher genus families, Belyi maps
- **Fields** – number fields and p-adic fields
- **Groups** – abstract finite groups, permutation groups, Sato-Tate groups, and lattices
- **Representations** – Artin representations and Dirichlet characters
- **Motives** – hypergeometric

Statistics

Size

About 3TB static (Riemann zeta zeros and class groups of imaginary quadratic fields) and 875GB searchable data, 450GB of search indexes (more details).

Number of objects

24M L-functions, 850k modular forms, 7.5M varieties, 21M fields, 800k groups, 30M Dirichlet characters, 650k Artin representations, 60k families of hypergeometric motives.

Statistics for each section

Most sections of the LMFDB have a statistics page.

User interface

- Two versions of the website:
  1. lmfdb.org – hosted on google cloud,
  2. beta – hosted at MIT, includes more experimental sections like finite groups, Belyi maps, lattices.
- Runs an open source Flask frontend, allowing for templated webpages that are filled in from the database.
- The backend uses PostgreSQL (switched from MongoDB several years ago), with data access also available through the API or Python.

Features

- Knowls – often used for defining terms, expand on the same page. Editable online.
- Aim at both experts and novices. Both search and browse modes, interesting examples.
- Completeness – describe regimes in which data is complete.
- Source and reliability – describe how data was computed, any assumptions used and verifications made
- Results can be further refined, resorted, with displayed columns customized.
- Properties box (often with a picture) and related objects.
- Aim to have downloads in various formats.
- Each object has a label and homepage.