Hypatheon: A Searchable Database Capability for Formalized Mathematics

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Making the Most of the PVS Libraries

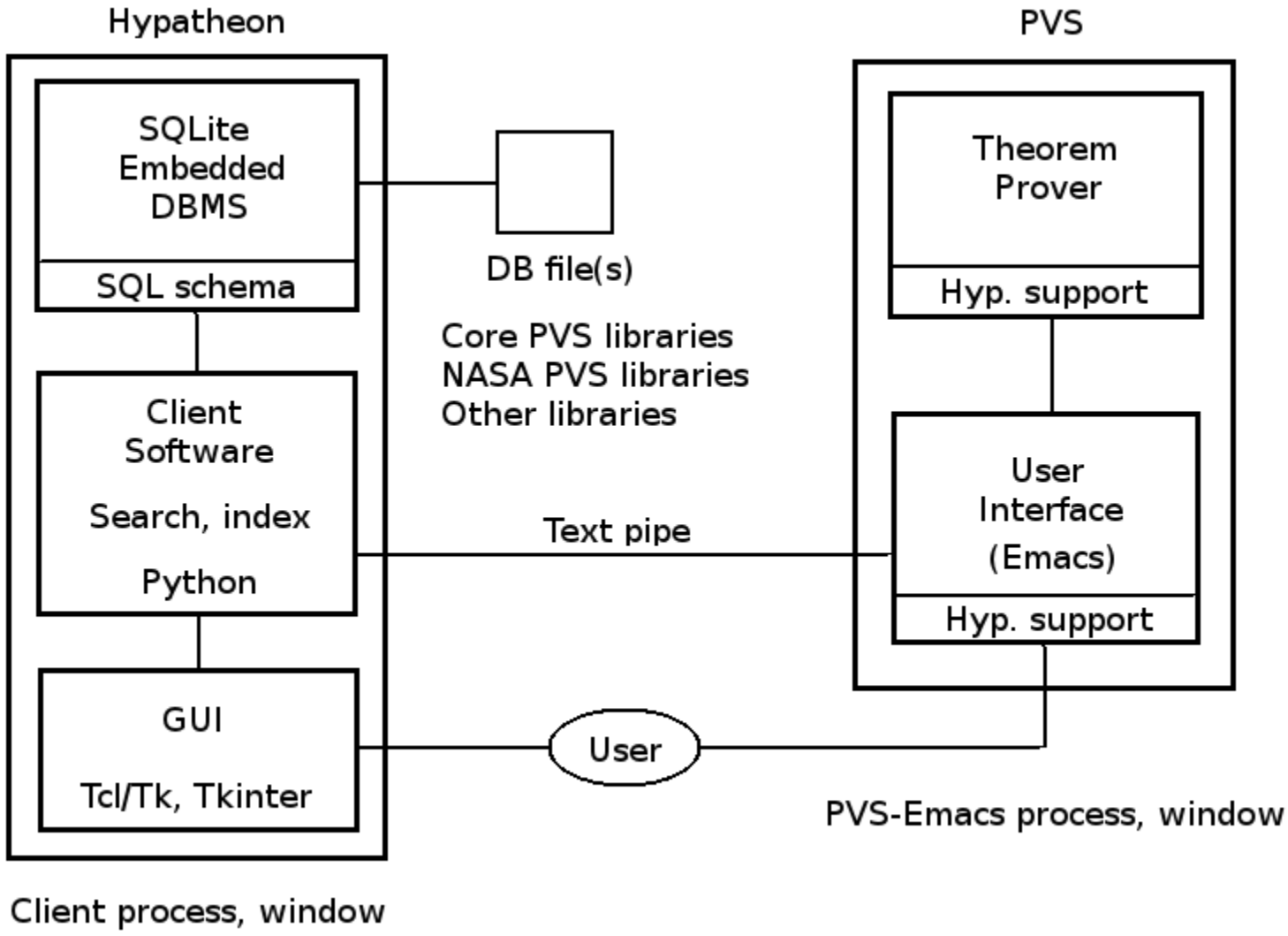
- The PVS library collection is a great asset.
- But, we don't want to spend too much time...
  - Searching for mathematical knowledge in the libraries.
  - Teaching the prover about facts that are already there.
- So we're providing some automation to help:
  - A database capability to collect and organize PVS entities.
  - Tools to search these databases and present the results.
  - A direct connection to PVS so the tools can offer "proof-side assistance."
- We have developed the Hypatheon capability to achieve these goals.
  - Originated in 2003 as a small project aiming to build a web service.
  - Downsized in recent years to a more modest, self-contained implementation.

Desktop Version of Hypatheon

Current approach is to host Hypatheon entirely on the desktop.

- It runs as a separate process with the SQLite embedded database engine.
  - Normally as a client/helper application for the PVS-Emacs process.
  - If desired, it can also run in stand-alone mode.
- Queries are initiated in the client.
  - Search engine-style results are displayed in the client window.
  - User can examine lemmas and other declarations in context.
- User can select a lemma to use; a command is then formatted and sent directly to the prover.
- Indexing support is also provided.
  - Library distributions (e.g., NASA libraries) or user/project libraries.

Hypatheon Architecture



Database Objects

Hypatheon indexes and searches for these PVS entities:

- Libraries (core + user-developed)
- Modules
  - Theories
  - Datatypes
- Steps (prover commands)
  - Primitive rules
  - Defined rules
  - Strategies
- Declarations
  - Formulas
  - Functions
  - Constants
  - Judgements
  - Types
- Proofs
  - Formula proofs
  - Judgement proofs

Demo

Hypatheon demo (20 minutes).

Status

- Open-source release of Hypatheon is imminent.
  - Will be available to all PVS users.
  - Pre-built databases to be included with NASA PVS libraries.
  - Users can index their own libraries/theories.
- Performance goal is to support:
  - 1 K libraries
  - 10 K theories
  - 100 K function definitions
  - 1 M theorems (formulas)
- User participation is encouraged.
  - Development of new PVS libraries
  - Contributions to Mathematical Knowledge Management
  - Feedback on Hypatheon