Ruby Association 2012 Grant

Creosote

Intermediate Report

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Targets

The targets for this intermediate report include the following:

1. Up-to-date GMP, MPFR, and Msieve libraries, and extensive documentation for each
2. Ruby bindings for GMP-ECM
3. Ruby bindings for MPC
4. Creosote, a library allowing various mathematics libraries to be bridged, in Ruby

Effort was made against each of these targets, except for the second. Bindings for GMP-ECM will be written during the second half of the grant period.

1. Up-to-date GMP, MPFR, and Msieve libraries, and extensive documentation for each

These three projects are grouped together because they are the three projects that I had already started, and largely completed. Bindings for GMP and MPFR are packaged into a single gem, `gmp`. Msieve is packaged in its own gem, `msieve`.

GMP

The `gmp` gem has been improved upon during this half of the grant period. Highlights include:

- Implement `GMP::sprintf` (d53c40a). This is discussed in a blog post for the project:

  ```
  GMP.sprintf("%5Zd * %d = %5Zd, %s", z127, 2, z254, "Yay!")
  => "  127 * 2 =   254, Yay!"
  GMP.sprintf("0x%Zx * %d = 0x%Zx, %s", z127, 2, z254, "Yay!")
  => "0x7f * 2 = 0xfe, Yay!"
  ```

  Very exciting. This also represents the very first Ruby code in the `gmp` gem; its the first time I've had resort to falling back to Ruby.

- extend `GMP::F#to_s` to allow a base to be passed in (5d340a4). This was necessary for the `gnu_mpc` gem tests, allowing for things like:

  ```
  GMP::F.new("0x1921FB54442D18p-51", 53, 16)
  => 0.31415926535897931e+1
  ```

So $0x1921FB54442D18p-51$ is an approximation of pi written in Hex Float format.

- Add `Rakefile`! (3be64a5).
- Add some `GMP::F#to_s` tests (3be64a5), (9a1630f).

At this point, the `gmp` gem exposes over 70 functions from GMP's Integer Functions interface, over 25 from the Rational Number Functions interface, and over 33 from the Floating-point Functions interface.

In addition, seven Ruby methods expose the Random Number Functions interface.

The `gmp` gem is currently documented with a 31-page manual and rdoc.

MPFR

The MPFR bindings, inside the `gmp` gem, have been improved upon during this half of the grant period. Highlights include:

- implement `GMP::F#integer?` (36f0735).
- MPFR 3.1's PRNG changed; fix tests (092db3c).

At this point the `gmp` gem exposes over 55 functions from MPFR's interface.

The Msieve bindings in the `gmp` gem are currently documented with a 31-page manual and rdoc.

Msieve

No new features were added to the `msieve` gem during this half of the grant period. Only two real changes were made:

- Fixed memory freeing issue that caused a Segmentation Fault.
- Upgraded tests to work under Ruby 1.9.

2. Ruby Bindings for GMP-ECM

Bindings for GMP-ECM will be written during the second half of the grant period.

3. Ruby Bindings for MPC

Bindings for GNU's MPC library were written from the ground up, and largely completed during the first half of the grant period:

- more than 40 functions from the MPC Complex Numbers interface have been bridged in the `gnu_mpc` gem.
- more than 90% of the methods exposed in the `gnu_mpc` gem are heavily tested. The test suite includes over 160 test examples.
- Approximately 10 functions from the MPC interface have not been bridged.
- The `gnu_mpc` gem has largely been documented in `manual.md`, which gets compiled into a 12-page `manual.pdf` and `manual.html`, using Pandoc.

4. Creosote, a library allowing various mathematics libraries to be bridged, in Ruby

This libaray is well underway. At present, the library "knows about" GMP, MPFR, MPC, and Msieve. It can be queried for the latest version of each package. It can also unpack, configure, make, check, and install GMP as a pilot project. At present, the packages install to `$HOME/.creosote/usr`. However, I plan to allow `/usr/local` if this directory is writeable (i.e., we are root).

This project uses Vagrant for reusable virtual machines where we can assume certain libraries are available, and others aren't.

As creosote grows to help users install the dependant packages, it will also be able to help in bridging individual libraries together.