Numbench

A benchmarking tool for Gentoo

Google Summer of Code 2011 project
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Numbench

• Tool targeted for Gentoo
• Modular structure, written in Python
• Can test:
  – Implementations of standard library interfaces
  – Libraries
  – Programs
• Generates HTML reports with plots
Outline

1. Motivation
2. Implementation
3. Results
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Motivation: BLAS

- Standard fortran API for basic linear algebra subroutines

Example:

```c
void dgemv_(char*, int*, int*, double*, double*, int*, double*, int*, double*, double*, int*)
```

```plaintext
y <- α A x + β y
```

- Widely used in scientific applications (and not only)
- Many implementations exist. Usually they are targeted for specific systems, CPUs, OSs,...
- Gentoo offers many choices: reference, atlas, openblas, eigen, mkl, acml
- Every package installs one or more implementations
Motivation: BLAS

Find the best solution for the local machine by:

• comparing different implementations
• comparing different versions of the implementation
• compiling the packages with specific flags (CFLAGS)
• using different compilers of compiler versions
• using different run-time environments (e.g. OMP_NUM_THREADS)
Motivation: FFTW

“Just” a library: only one implementation. However, we can:

• compare different versions (does it improve?)
• compile it with different CFLAGS (how relevant are they)
• compile it with different compilers (is icc better than gcc?)

Motivation: Metis

It is an application for graph and partitioning

• Same questions as above

In general:

• Does the performance depend on the compilation target?
Motivation

Let's answers these questions by BENCHMARKING
Implementation

Three components:

- Main script
- Modules
- Benchmarking programs
Implementation: scheme

- Based on BTL (Bench Template Library)

- Input parser
  - Portage interface
  - Compiles the benchmarking program
  - Runs the benchmarking program
- Module lapackAccuracy
- LAPACK accuracy benchmarker
- BLAS performance benchmarker
- Report generator
- Log manager
- Receives part of input
- Stores the results
- Searches for implementations
- Metis internal timing

BLAS performance benchmarker
LAPACK accuracy benchmarker
Module lapackAccuracy
Receives part of input
Stores the results
Searches for implementations
Metis internal timing
Compiles the benchmarking program
Runs the benchmarking program
Input parser
Portage interface
Report generator
Log manager
Based on BTL (Bench Template Library)
Implementation: input

Input is given through an XML document. It specifies:

- Module that has to be run (with arguments)
- Test cases

A test case is basically an atom with some information:

- Emerge-time environment
- Run-time environment
- Implementations that should be skipped
Implementation: results

- Numbench expects benchmarking results as DAT files
- It generates plots
- And an HTML document, ready for publishing
- Report gives access to logs
Implementation: features

- Completely automatized benchmarking tool
- Benchmarking programs for numerics based on the high-quality Bench Template Library
- Sandbox execution: it does not require superuser privileges
- In case of error, the intermediate results are re-usable
- Everything is logged, even the correct linkage of the benchmarking program
Results

BLAS: matrix-matrix multiply serial implementations on Quad-Core AMD Opteron(tm) Processor 8354
132363512 kB total memory
Results

BLAS: matrix-matrix multiply, openblas threaded implementation
Intel(R) Core(TM) i7-2600K CPU @ 3.40GHz
8 GB total memory
Results

BLAS: matrix-matrix multiply
Intel(R) Core(TM) i7-2600K CPU @ 3.40GHz
VirtualBox machine with 4 cores, 4 GB RAM
LAPACK: LU decomposition, relative error
Intel(R) Core(TM) i7-2600K CPU @ 3.40GHz
Outlook

Goals for the future:

- Complete the accuracy benchmark modules
- Add some more numerical modules
- Complete the web interface
- Enlarge the user base
- Enlarge the developers team
Outlook: other possible uses

- What numbench basically does:
  - Automatically install packages with specific environments
  - Perform some (highly customizable) tests with those packages
  - Displays results in form of graphs
- It can be used for many other tasks than benchmarking
- It is more a tool related to Gentoo than a tool devoted to numerics
References

- The project is hosted on Github: https://github.com/andyspiros/numbench
- The ebuild is available in the science overlay: app-benchmark/numbench
- Feel free to contact me directly: spiros@gentoo.org

Thanks for your attention