

LLVM-based Software for Guided Parallelization with OpenMP

Manuel Arenaz

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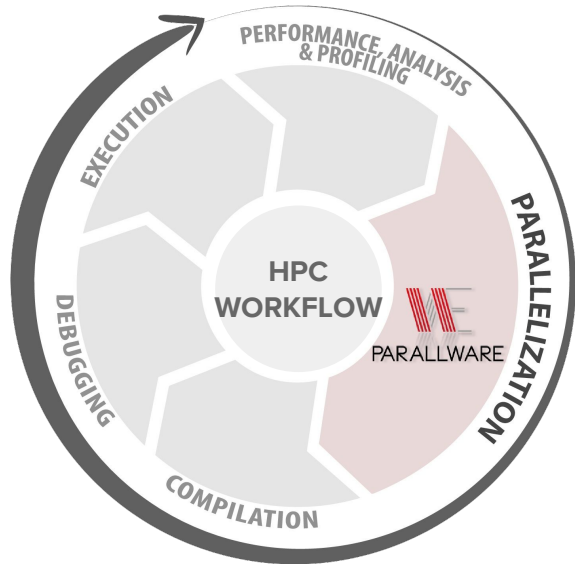


OUTLINE

- **Why Parallware?**
- ORNL & Appentra
- Parallware Trainer (DEMO)
- Conclusions

WHY DEVELOPING PARALLWARE?

Software modernization through parallelization with MPI+X
High-level programming: X = OpenMP or OpenACC



PARALLEL PROGRAMMING IS HARD!

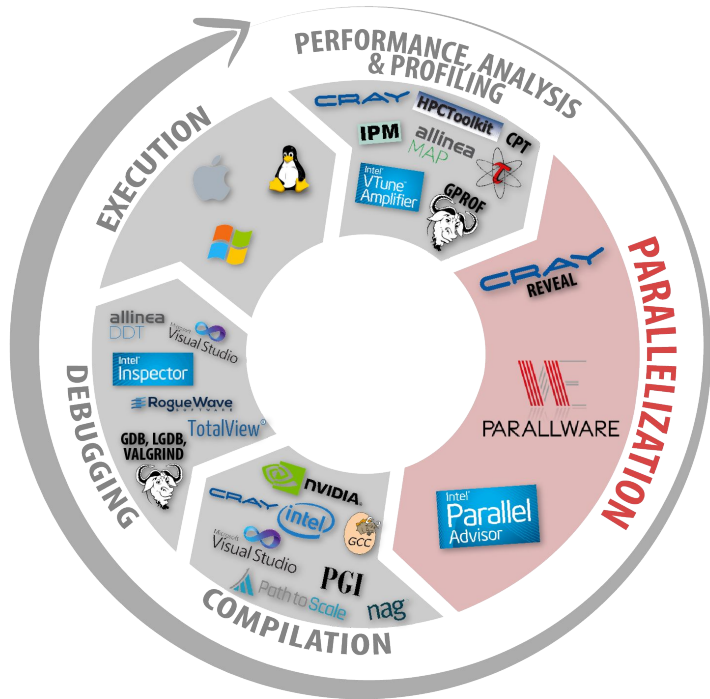
Currently a manual process

Can we make it easier?

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ORNL & APPENTRA



COLLABORATION ON TOOLS INNOVATION

Fernanda Foertter

Oscar Hernandez



ORNL Industrial Partnership Program, project CSC193: "Porting Parallware Tools to Large HPC Installations including Titan" (2015-2016)

Jacobo Lobeiras, Manuel Arenaz, Oscar Hernández: Experiences in extending parallware to support OpenACC. WACCPD@SC 2015: 4:1-4:12

ORNL & APPENTRA

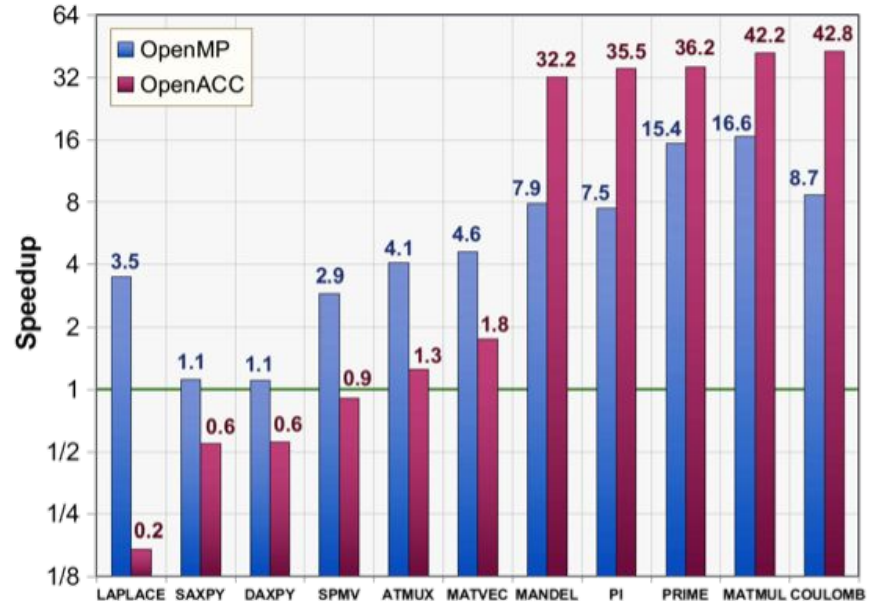
TECHNOLOGY

Validation
Deployment
Real environment

2x - 40x

Titan

Microbenchmarks



This research used resources of the Oak Ridge Leadership Computing Facility, which is a DOE Office of Science User Facility supported under Contract DE-AC05-00OR22725.

ORNL & APPENTRA

TRAINING

Newcomers
Learning
Microbenchmarks

Work on
specification of
new tools for
productive HPC
training

The screenshot displays the Parallewre Trainer interface. The main window shows the source code for the COULOMB benchmark in C. The code includes a list of charged particles, calculates the distance between them, and updates the matrix. The code is annotated with OpenMP pragmas for parallelization. The bottom status bar shows the execution results for the OpenMP profile:

```
make -C "/home/user1/devel/parallewre-test/benchmarking/COULOMB" run PROFILE=OpenMP  
- Executing test...  
time (s)= 1.923598  
size = 300  
chksum = 4363673967  
OpenMP> 1.933 seconds
```

A dialog box titled "Select Parallewre flags" is open in the foreground, showing the "Paradigm" set to "<none>" and "Dependencies" set to "Independent".

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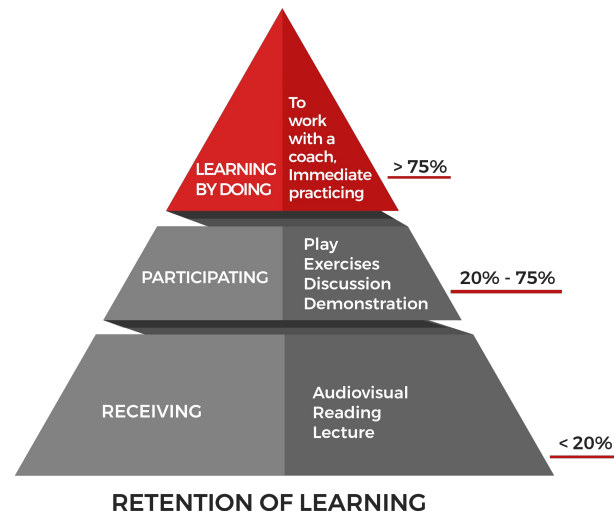
Interactive Tool for HPC Training

"Tell me, I will forget,
Show me, I may remember,
Involve me, I will understand." - Confucius



EXPERIENTIAL LEARNING

- Higher productivity in HPC training
- “Learn by Doing” & “Student-Centric”



SC16
Salt Lake City, Utah | hpc matters.

Emerging
Technologies

Interactive Tool for HPC Training

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MICROBENCHMARKS

- Mandelbrot
- Sparse Matrix - Vector product
- Laplace computations
- PGI compiler OpenMP & OpenACC



Interactive Tool for HPC Training

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TECHNICAL FEATURES

- Interactive real-time editor GUI
- Assisted code parallelization using OpenMP & OpenACC
- Programming language C
- Detailed report of the parallelism discovered in the code
- Support for multiple compilers

"Take-away your work"
(based on make & ssh)

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- **Present Parallware Trainer at SC16 Emerging Technologies Showcase**
 - Tuesday, Wednesday, Thursday 9:00 AM - 17:30 PM, Room 155-B
 - Also booth talks at DoE, OpenMP and OpenACC
- Parallware Trainer Early Access Program:
 - Invitation to participate (we need feedback)
 - Contact me <manuel.arenaz@appentra.com>
- Continue ORNL & Appentra collaboration:
 - Prototype of Parallware Assistant for HPC developers
 - Search other innovative tools based on Parallware

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