

Calculate pi Benchmark

Presenter: Qihao He(Jonas)

Apply on: VW-Haswell, VM-pi-cluster, Kent,Nick,Maxx-pi-cluster

Calculate pi benchmark

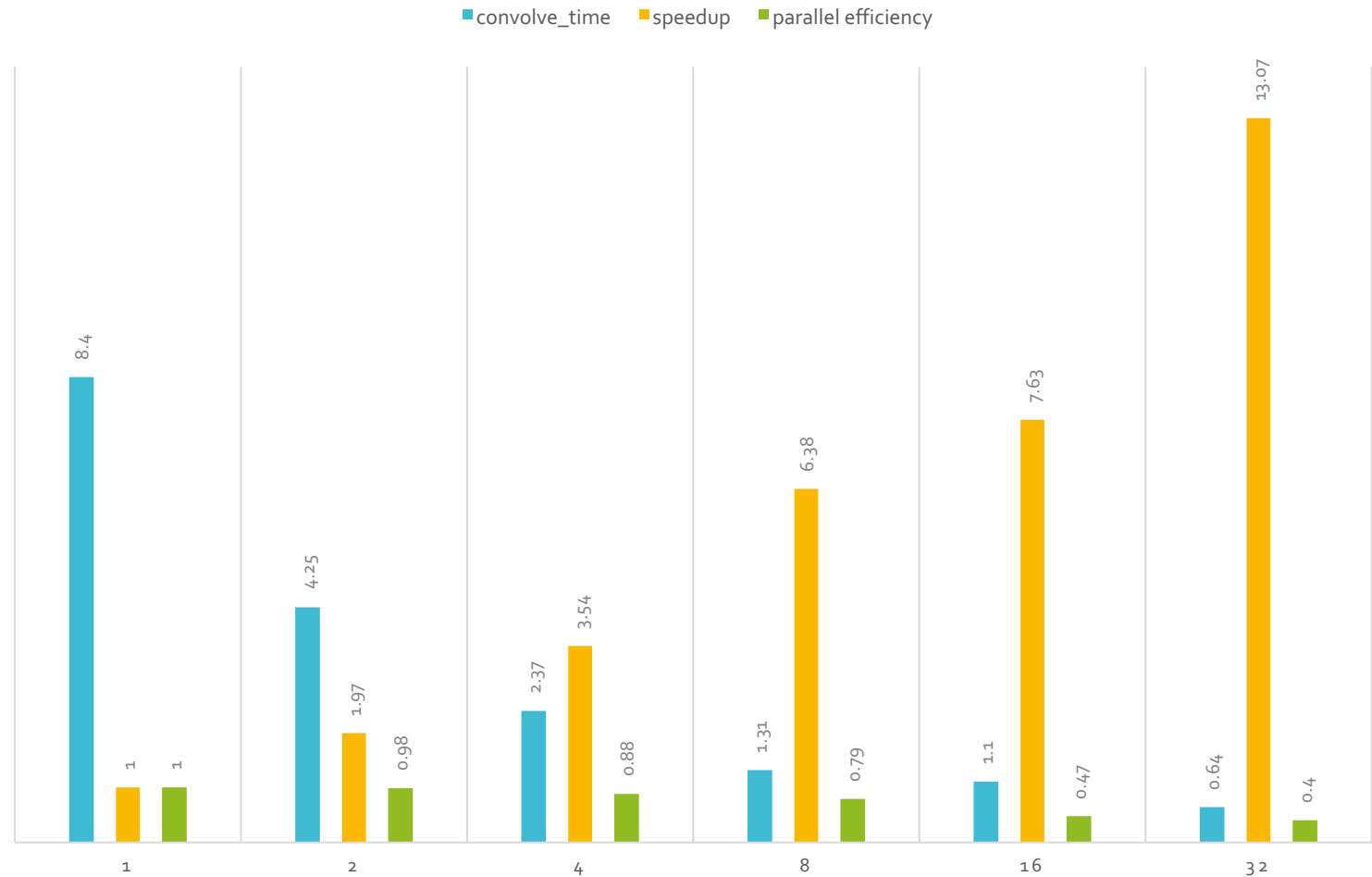
$$\int_a^b f(x) dx \approx \frac{h}{3} \left[f(x_0) + 4f(x_1) + 2f(x_2) + 4f(x_3) + 2f(x_4) + \cdots + 4f(x_{n-1}) + f(x_n) \right] = \frac{h}{3} \sum_{j=1}^{n/2} \left[f(x_{2j-2}) + 4f(x_{2j-1}) + f(x_{2j}) \right].$$

- Message Passing Interface (MPI)
- Theory: Simpson's Rule
 - A better numerical integration algorithm than the rectangle rule
 - Converges more quickly
- Working and shows pretty good scaling factor at multiple nodes.

Benchmark VW-Haswell machine Shared memory system.

Parallel efficiency drops down
pretty bad.

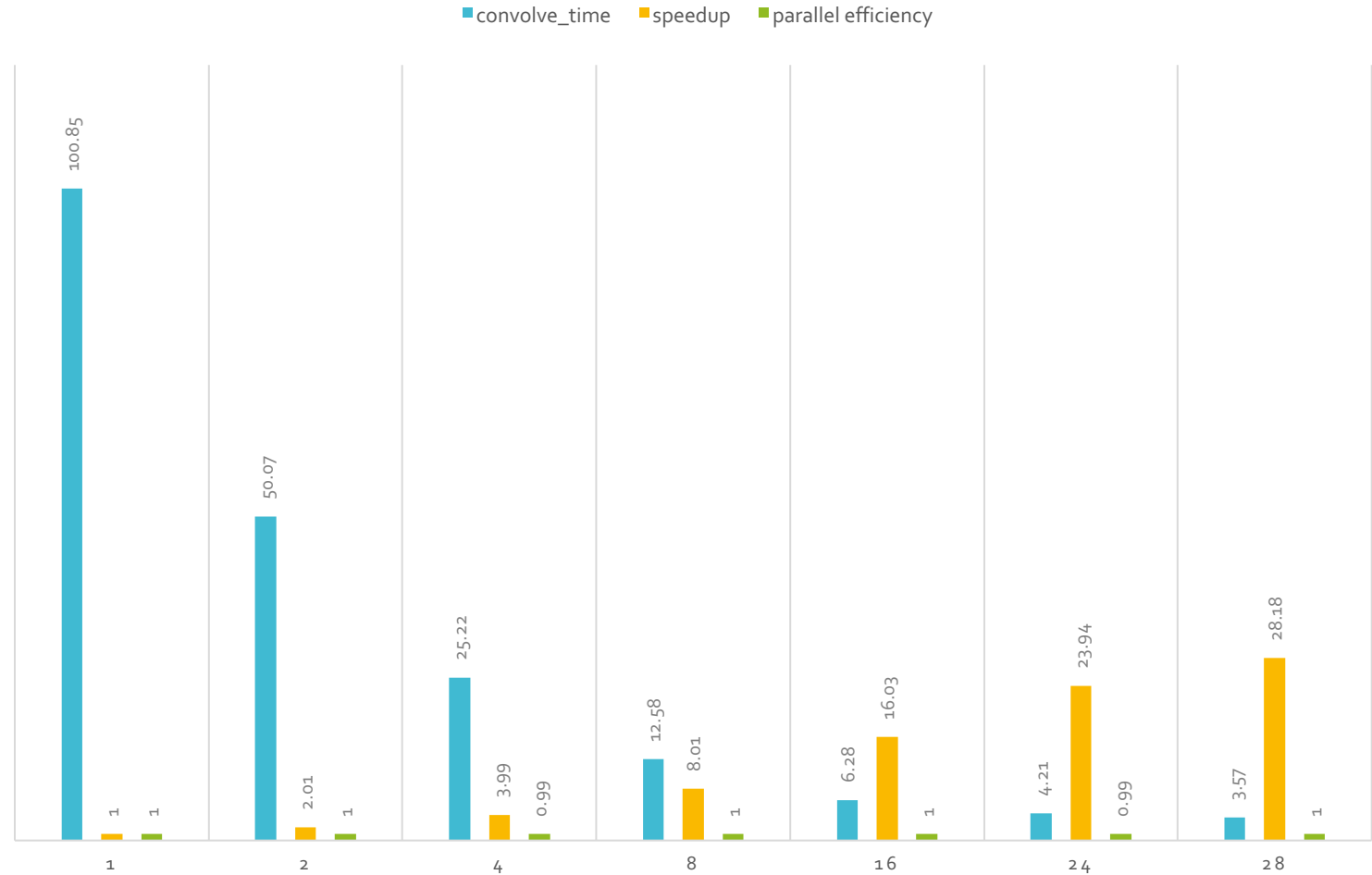
BENCHMARK VW-HASWELL



Benchmark VW-24-nodes- pi-cluster

Great scale factor, the parallel efficiency holds pretty stable at 1.

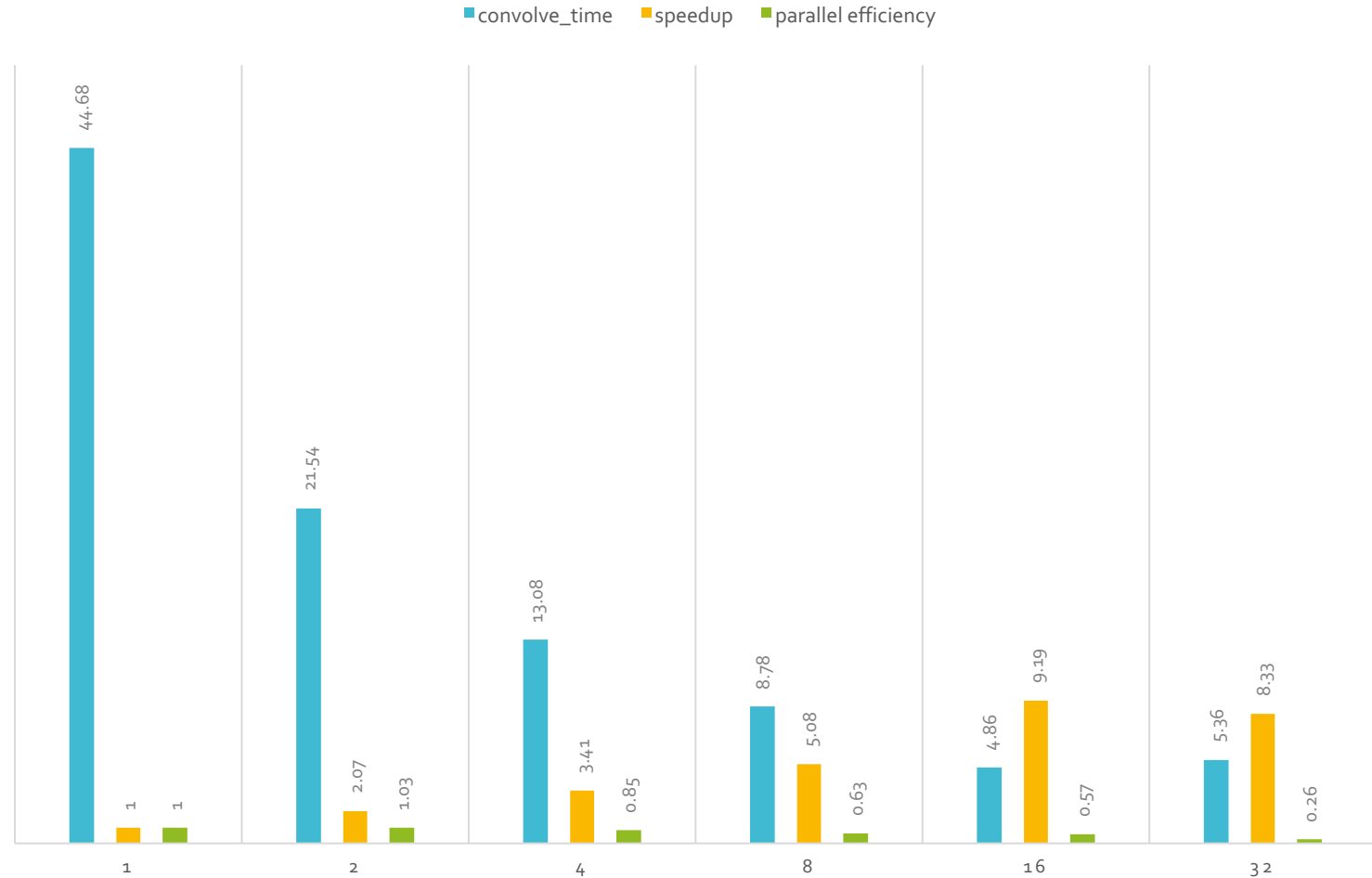
BENCHMARK VW-PI-CLUSTER



Benchmark Kent, Nick, Max x Pi3 Cluster

Faster than VW's cluster with
faster processor, but not so
good in parallel efficiency

BENCHMARK KENT, NICK, MAXX PI₃ CLUSTER



Challenge

- Serial code is giving more accurate results(the correct digits after decimal point) than the parallel code.
- Probably cause by when the double precision data is passed among the nodes, the last few digits of the double precision data is not holding pretty good, rounding errors, cause the calculation of pi last few digits after the decimal points are not correct.

Other attempts

- Add other remote nodes to pi-cluster, but it is behind the firewall, very difficult.
- Propose Matrix multiply but it is too common.
- Solve Ordinary differential equation using parallel code, then find that the data points are dependent, there are articles about 4th order problem, could not understand.
- Solve initial condition boundary optimization problem using parallel code, but it also requires gradient search that is dependent.
- Finally find that the integral would not be dependent so attempt on find pi with integration.

Conclusion and future work

- Fast Fourier transform algorithm using parallel programming, using GPU.
- Energy measure.

Questions