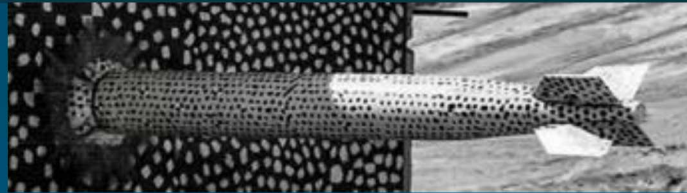




Sandia
National
Laboratories

SAND2019-12766PE

Performance Testing



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PRESENTED BY

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Trilinos User-Developer Group Meeting
Albuquerque, New Mexico



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SAND

Two key problems:

1. Need ability to showcase performance improvements to stakeholders
2. Need ability to identify and assess performance variations

Issue:

- Manual, periodic performance analysis across HPC platforms (time consuming)
- Focusing more on evaluation rather than improving performance

Solution:

- Extend nightly testing framework to include performance testing

Cmake is used to define tests; automated using cron or Jenkins

Issue: Allocate 16 nodes, run all tests

#create test

```
add_test(${testName}_R0_np48 ${Np48MiniEM.exe} --inputFile=maxwell-blob-R0.xml --solver=MueLu-RefMaxwell --numTimeSteps=10 --linAlgebra=T
add_test(${testName}_R0_np96 ${Np96MiniEM.exe} --inputFile=maxwell-blob-R0.xml --solver=MueLu-RefMaxwell --numTimeSteps=10 --linAlgebra=T
add_test(${testName}_R0_np192 ${Np192MiniEM.exe} --inputFile=maxwell-blob-R0.xml --solver=MueLu-RefMaxwell --numTimeSteps=10 --linAlgebra=T
add_test(${testName}_R0_np384 ${Np384MiniEM.exe} --inputFile=maxwell-blob-R0.xml --solver=MueLu-RefMaxwell --numTimeSteps=10 --linAlgebra=T
add_test(${testName}_R1_np384 ${Np384MiniEM.exe} --inputFile=maxwell-blob-R1.xml --solver=MueLu-RefMaxwell --numTimeSteps=10 --linAlgebra=T
add_test(${testName}_R1_np768 ${Np768MiniEM.exe} --inputFile=maxwell-blob-R1.xml --solver=MueLu-RefMaxwell --numTimeSteps=10 --linAlgebra=T
```

Results are posted on Cdash

6 tests passed.

Name ^	Status ^	Time	History	Summary
perf_tests_R0_np192	Passed	9s 820ms	Stable	Stable
perf_tests_R0_np384	Passed	9s 380ms	Stable	Stable
perf_tests_R0_np48	Passed	1m 10s 960ms	Stable	Stable
perf_tests_R0_np96	Passed	14s 480ms	Unstable	Stable
perf_tests_R1_np384	Passed	2m 830ms	Stable	Stable
perf_tests_R1_np768	Passed	35s 340ms	Stable	Stable

Python is used extract relevant data from output

- Relevant data stored using a json file

```
{"perf_tests_R0_np192": {"case": "R0", "np": 192, "date": 20191016, "timers": {"Stratimikos: BelosLOWS": 0.0499643, "panzer::ModelEvaluator::evalModel(J)": 0.050389, "GMRES block system: Operation Prec*x": 0.0457109, "CG S_E: BlockCGSolMgr total solve time": 0.0280341}, "passed": true}, "perf_tests_R1_np768": {"case": "R1", "np": 768, "date": 20191016, "timers": {"Stratimikos: BelosLOWS": 0.6289990000000001, "panzer::ModelEvaluator::evalModel(J)": 0.094112, "GMRES block system: Operation Prec*x": 0.227481, "CG S_E: BlockCGSolMgr total solve time": 0.173643}, "passed": true}, "perf_tests_R0_np48": {"case": "R0", "np": 48, "date": 20191016, "timers": {"Stratimikos: BelosLOWS": 4.84077, "panzer::ModelEvaluator::evalModel(J)": 0.152233, "GMRES block system: Operation Prec*x": 4.40166, "CG S_E: BlockCGSolMgr total solve time": 0.15391300000000002}, "passed": true}, "perf_tests_R0_np96": {"case": "R0", "np": 96, "date": 20191016, "timers": {"Stratimikos: BelosLOWS": 0.382743, "panzer::ModelEvaluator::evalModel(J)": 0.082625, "GMRES block system: Operation Prec*x": 0.14091599999999999, "CG S_E: BlockCGSolMgr total solve time": 0.0374254}, "passed": true}, "perf_tests_R0_np384": {"case": "R0", "np": 384, "date": 20191016, "timers": {"Stratimikos: BelosLOWS": 0.0490269, "panzer::ModelEvaluator::evalModel(J)": 0.0342041, "GMRES block system: Operation Prec*x": 0.0448546, "CG S_E: BlockCGSolMgr total solve time": 0.0292845}, "passed": true}, "perf_tests_R1_np384": {"case": "R1", "np": 384, "date": 20191016, "timers": {"Stratimikos: BelosLOWS": 10.8557, "panzer::ModelEvaluator::evalModel(J)": 0.153052, "GMRES block system: Operation Prec*x": 10.0583, "CG S_E: BlockCGSolMgr total solve time": 0.21819899999999998}, "passed": true}}
```

- **Issue**: All output compressed and stored for future extraction

Currently only processing case, date, pass/fail and timers but could extract other components (as long as history is there)

- **Issue**: Cdash sometimes crashes and data is only store for fixed periods

Data Visualization (I)

Jupyter notebook is used to visualize data

- Exported as html for website (view only)

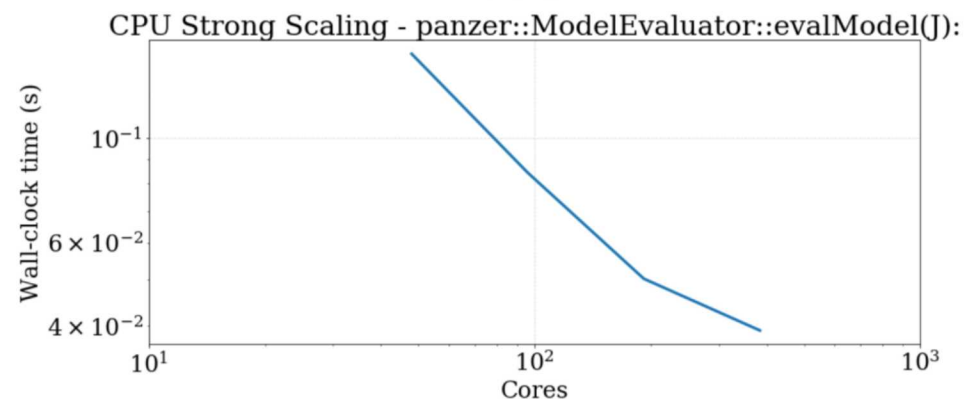
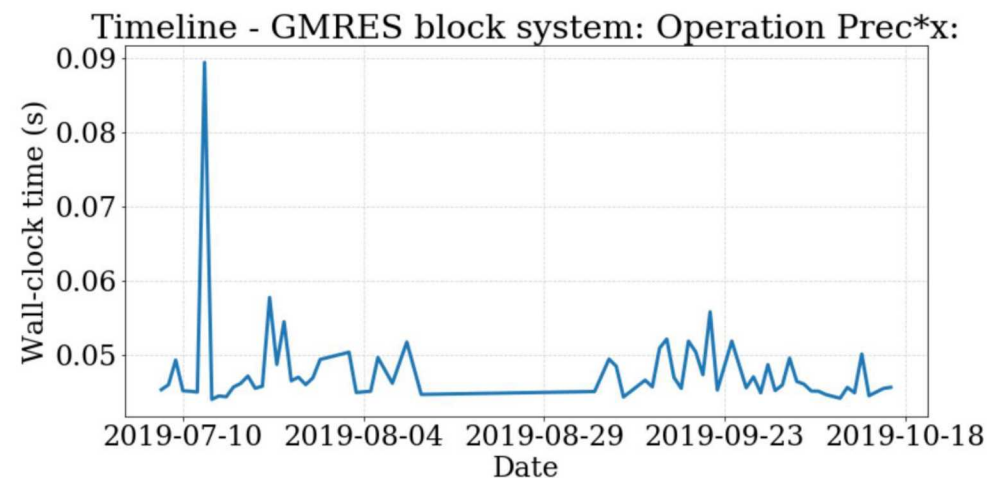
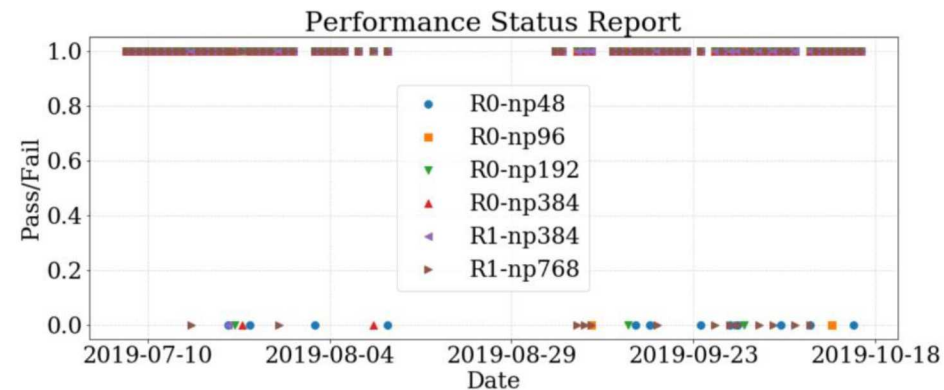
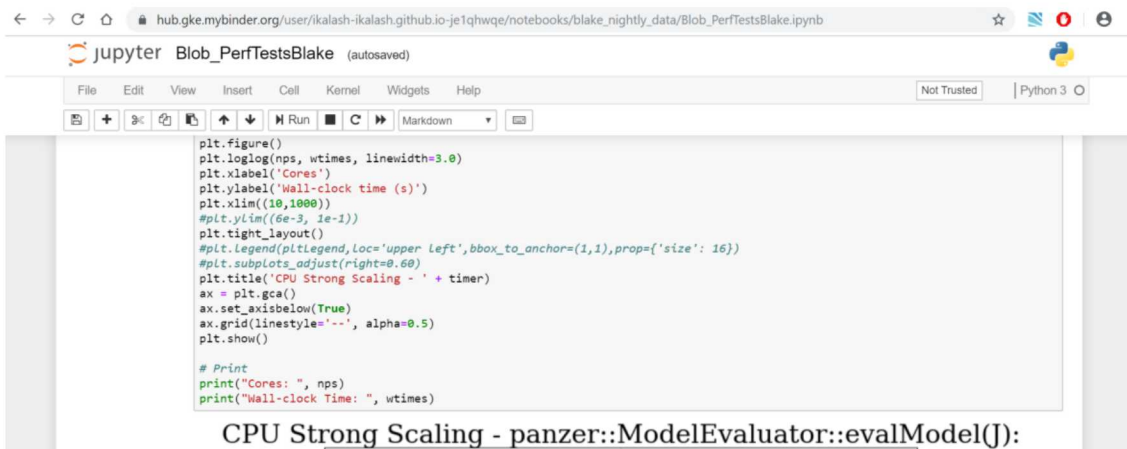
ikalash.github.io

MiniEM Blob Tests on Blake

The performance of the MiniEM blob test on blake is documented using Jupyter notebooks stored by date:

- [08 03 2019.](#)
- [08 04 2019.](#)
- [08 05 2019.](#)
- [08 06 2019.](#)
- [08 08 2019](#)

- Can be modified via browser using binder



Data Assessment (2)



Variations in performance data can be tracked and developers can be pinged if performance changes (work-in-progress)

Status

Name	Run Test	Performance Tests (Passes/Warnings/Fails)
AIS-8km-l5-np16	Passed	2/0/0
AIS-4km-l10-np64	Passed	0/2/0
AIS-2km-l20-np256	Failed	0/0/0
AIS-1km-l40-np2048	Passed	1/0/1

AIS-8km-l5-np16 Timers (s)

Timer	Measured	Mean	Std
NOX Lin Solve	200.1	195.2	10.4
Alb. Total Fill	450.1	445.2	10.4

AIS-4km-l10-np64 Timers (s)

Timer	Measured	Mean	Std
NOX Lin Solve	250.1	195.2	10.4
Alb. Total Fill	550.1	445.2	10.4

AIS-2km-l20-np256 test failed...

AIS-1km-l40-np2048 Timers (s)

Timer	Measured	Mean	Std
NOX Lin Solve	202.1	195.2	10.4
Alb. Total Fill	460.1	445.2	10.4

Challenges – Maintenance!



- Adding/maintaining a good performance test via ctest is difficult (particularly for next gen hardware)
- Adding/maintaining performance tests at scale is difficult (hope the cluster isn't down/over allocated/has a bad node, someone has to monitor the build)
- Adding/maintaining parsing scripts is difficult (one small change results in the person who created the scripts to be available to fix issues)

Hopefully maintenance cost < manual assessment cost

(Monitoring performance variations is a new capability so should be worth it)