CMS W-mass Performance Analysis

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ROOT Data Analysis Framework https://root.cern

Overview

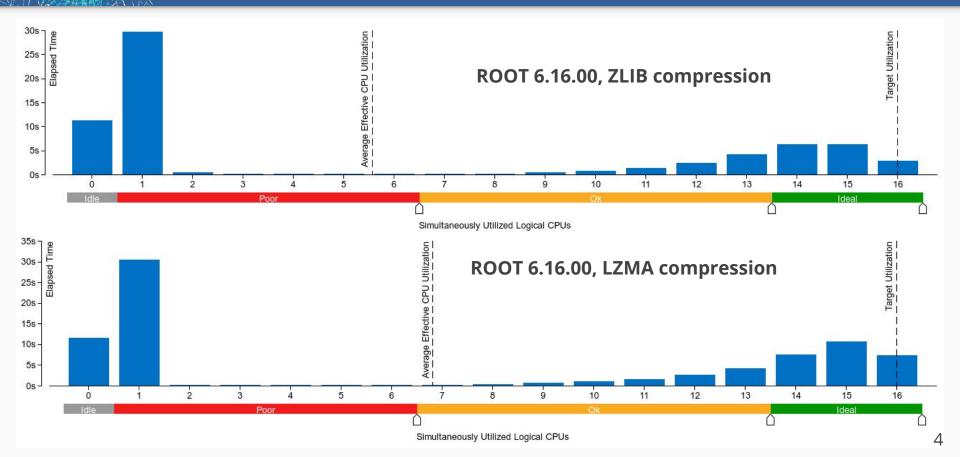
- CMS W-mass analysis from Elisabetta Manca
- Python 2.7 script using RDataFrame via PyROOT
- Run on titanx.cern.ch machine (Core i7 7820X @ 3.6GHz)
- Run with ROOT 6.16 and master branches
- ROOT compiled with -march=native -O2 -g
- Input files: ~9G (LZMA), ~12G (ZLIB)
- VTune 2018, perf (visualization with gprof2dot + flamegraph)
- No valgrind (does not work with AVX512)

VTune Amplifier XE: Summary

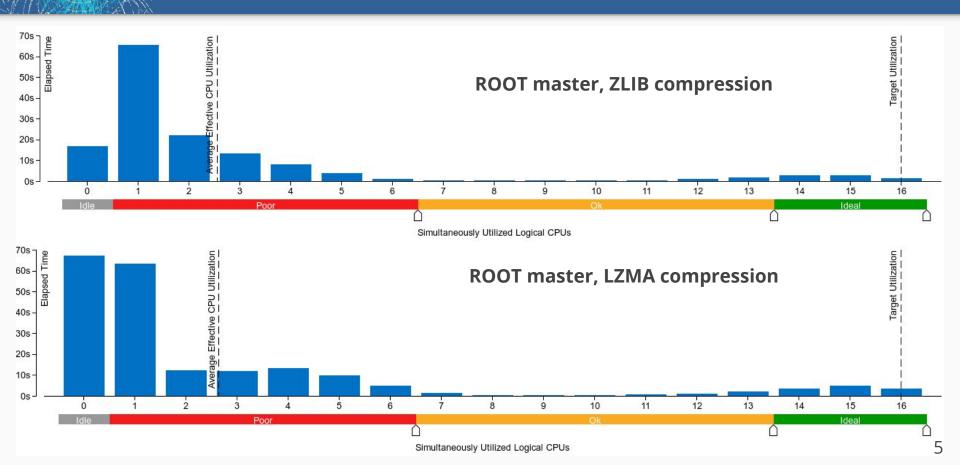
| Runtime | 6.16.00 | master@dc11db1b | | |
|---------|--|--|--|--|
| ZLIB | Elapsed Time ⁽²⁾ : 67.560s Solution CPU Time ⁽²⁾ : 435.480s Solution Effective Time ⁽²⁾ : 376.365s Solution Spin Time ⁽²⁾ : 1.970s Solution Overhead Time ⁽²⁾ : 57.145s ► Total Thread Count: Faused Time ⁽²⁾ : 0s | Elapsed Time ⁽²⁾ : 143.813s | | |
| LZMA | Elapsed Time ^② : 79.754s | Elapsed Time ⁽²⁾ : 203.433s | | |

note: outside of VTune, the runtime is not that different between 6.16.00 and master

VTune Amplifier XE: CPU Utilization



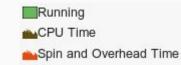
VTune Amplifier XE: CPU Utilization



VTune Amplifier XE: Platform Overview

ROOT 6.16.00, ZLIB compression

| , ○: + = ☞ ☞ ⁰s | 10s | 20s | 30s | 40s | 50s | 60s |
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| CPU Utilization | | | | | | |



VTune Amplifier XE: Platform Overview

ROOT master, ZLIB compression

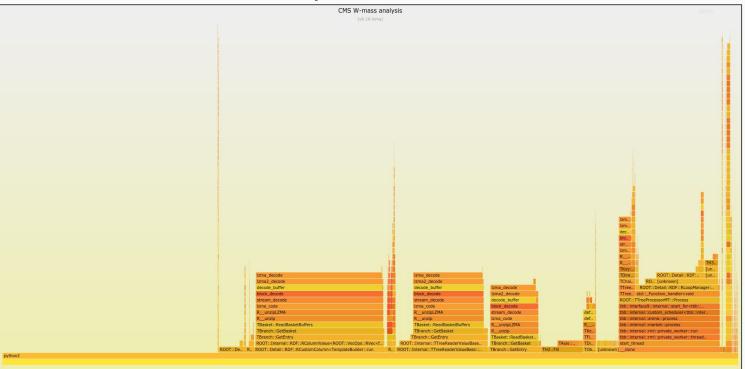
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| python2 (TID: 14862) | | | | | | | | |
| CPU Utilization | | | | | | and the second second | | |



| Module / Function / Call Stack 🛦 | CPU Time: Difference | CPU Time: hs-master-Izma | | | CPU Time: new-6.16-lzma | | |
|----------------------------------|----------------------|---------------------------------|-----------|---------------|--|-------------|---------------|
| | | Effective Time by Utilization 🔅 | Spin Time | Overhead Time | Effective Time by Utilization | » Spin Time | Overhead Time |
| ▶ [Unknown] | | 131.355s | 0.010s | 0.040s | 161.757s 6 16 16 16 16 16 16 16 16 16 16 16 16 16 | 0s | |
| AngCoeff.so | -1.619s | 8.355s | 0s | 0s | 9.974s 📙 | 0s | 0s |
| GetWeights.so | -2.898s | 10.068s 📙 | 0s | 0s | 12.966s 📕 | 0s | 0s |
| Id-linux-x86-64.so.2 | -0.010s | 0.090s | 0s | Os | 0.100s | 0s | 0s |
| libc-dynamic.so | 0.010s | 0.276s | 0s | 0s | 0.266s | 0s | |
| ▶ libc.so.6 | -0.030s | 0.140s | 0.010s | 0s | 0.180s | 0s | 0s |
| ▶ libCling.so | 1.402s | 1.402s | 0s | 0s | | | |
| libCling.so | -1.150s | | | | 1.150s | 0s | 0s |
| libCore.so.6.16 | -0.220s | | | | 0.220s | 0s | 0s |
| libCore.so.6.17 | 0.100s | 0.100s | 0s | 0s | | | |
| ▶ libdl.so.2 | 0.007s | 0.381s | 0s | 0s | 0.374s | 0s | 0s |
| ▶ libHist.so.6.16 | -16.970s | | | | 16.970s 📔 | 0s | 0s |
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| libImt.so.6.16 | -40.253s | | | 8 | 0s | 0.020s | 40.233s |
| libImt.so.6.17 | 44.933s | 0s | 0s | 44.933s | | | |
| libLLVMBitReader.so.5 | -0.010s | | | | 0.010s | 0s | 0s |
| libLLVMCore.so.5 | 0.020s | 0.030s | 0s | 0s | 0.010s | 0s | 0s |
| libLLVMRuntimeDyld.so.5 | -0.050s | 0.270s | 0s | 0s | 0.320s | 0s | 0s |
| libLLVMSelectionDAG.so.5 | 0.060s | 0.100s | 0s | 0s | 0.040s | 0s | 0s |
| libLLVMSupport.so.5 | 0.070s | 0.070s | 0s | 0s | | | |
| libLLVMX86CodeGen.so.5 | 0.020s | 0.060s | 0s | 0s | 0.040s | 0s | 0s |
| libLLVMX86Desc.so.5 | -0.010s | | | | 0.010s | 0s | 0s |
| liblzma.so.5 | 0.030s | 0.100s | 0s | 0s | 0.070s | 0s | 0s |
| libm.so.6 | 0.099s | 3.080s | 0s | 0s | 2.981s | 0s | 0s |
| ▶ libpin3dwarf.so | -0.036s | 0.064s | 0s | 0s | 0.100s | 0s | 0s |
| libpthread.so.0 | 0.117s | 0.297s | 0.070s | 0s | 0.210s | 0.040s | 0s |
| libPyROOT.so | 0.100s | 0.100s | 0s | 0s | | | |
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| libpython2.7.so.1.0 | -0.091s | 22.920s 🛑 | 0s | 0s | 23.011s 🛑 | 0s | 0s |
| libROOTDataFrame.so.6.16 | -7.006s | | | | 7.006s 📗 | 0s | 0s |
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| libROOTVecOps.so.6.16.00 | -0.430s | | | | 0.430s | 0s | 0s |
| libROOTVecOps.so.6.17 | 0.260s | 0.260s | 0s | 0s | | | |
| libstdc++.so.6 | -0.010s | 0.020s | Os | 0s | 0.030s | 0s | Os |
| ▶ libtbb.so.2 | 6.584s | 0.120s | 5.330s | 37.576s | 0.030s | 1.600s | 34.812s |
| libThread.so.6.17 | 0.010s | 0.010s | 0s | 0s | | | |
| libTree.so.6.16 | -0.790s | | | | 0.790s | 0s | 0s |
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| libTreePlayer.so.6.16 | -241.738s | | | | 241.738s | 0s | 0s |
| ▶ libTreePlayer.so.6.17 | 292.339s | 292.339s | 0s | Os | | | |
| ▶ TemplateBuilder.so | -22.784s | 43.189s 📕 | 0s | 0s | 65.973s | 0s | 0s |

Perf data visualizations

Data available at https://cern.ch/amadio/wmass



- No clear bottleneck, but there is scheduling overhead
- zlib vs Izma: 15% faster, at the cost of 30% larger files
- Something seems strange from 6.16 to master
- Not all VTune analysis types work, had to use a basic one
- Next step is to make changes to master and re-measure
- Would be nice to have JIT with debugging symbols
- Also ran with python2 -m cProfile, but no useful info