HPCG BENCHMARK ON CORAL SYSTEMS

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GPUs in HPC:

- Flops: DP, SP, HP
- Memory BW*: 
  - P100 16GB: 559 GB/s TRIAD STREAM (76.4%) (Peak: 715 MHz x 4096 bit= 732 GB/s)
  - V100 16GB: 851 GB/s TRIAD STREAM (94.8%) (Peak: 877 MHz x 4096 bit= 898 GB/s)
  - V100 32GB: 826 GB/s TRIAD STREAM (92.1%) (Peak: 877 MHz x 4096 bit= 898 GB/s)

- Power efficiency

HPCG is all about:

- local memory bandwidth
- network (at large scale)

* CUDA/DRIVER: 10.0.130/410.48, GB=10^9 bytes
HPCG ON GPU

- HPCG GPU implementation in CUDA:
  - Details in “A CUDA implementation of the HPCG benchmark”, PBMS@SC14
  - Improved Symmetric Gauss-Seidel (Kumahata et al, SC 16 HPCG BOF)

- GPUs are the fastest processor to run HPCG
CORAL SYSTEMS

SUMMIT at ORNL:
- 4608 nodes with 2 IBM Power9 and 6 Nvidia V100 GPUs
- Dual rail EDR Infiniband in fat-tree topology
- #1 system in Nov18 Top500 (143.5 PF)
- #1 system in Nov18 HPCG (2.926 PF on 4356 nodes)

SIERRA at LLNL:
- 4238 nodes with 2 IBM Power9 and 4 Nvidia V100 GPUs
- Dual rail EDR Infiniband in fat-tree topology
- #2 system in Nov18 Top500 (94.6 PF)
- #2 system in Nov18 HPCG (1.796 PF on 4096 nodes)

Coral systems are the first to break the PF barrier in HPCG
Current reporting does not capture relevant information:

- No mentions of the size of the machine or memory subsystem
FLOPS WRONG METRIC

GM200 chip: DP:SP=1:32, SP=6.72 TF, DP=0.21 TF, 384 bit at 6 GHz

GK210 chip: DP:SP=1:3, SP=4.37 TF, DP=1.45 TF, 384 bit at 5 GHz

1 x K80 (2 GK210 GPUs), ECC enabled, clk=875
2x1x1 process grid
256x256x256 local domain
SpMV = 49.1 GF (309.1 GB/s Effective) 24.5 GF_per (154.6 GB/s Effective)
SymGS = 62.2 GF (480.2 GB/s Effective) 31.1 GF_per (240.1 GB/s Effective)
total = 58.7 GF (445.3 GB/s Effective) 29.4 GF_per (222.7 GB/s Effective)
final = 55.1 GF (417.5 GB/s Effective) 27.5 GF_per (208.8 GB/s Effective)

1.8% of peak

2 x M40 (2 GM200 GPUs), ECC enabled, clk=1114
2x1x1 process grid
256x256x256 local domain
SpMV = 69.4 GF (437.2 GB/s Effective) 34.7 GF_per (218.6 GB/s Effective)
SymGS = 83.7 GF (645.7 GB/s Effective) 41.8 GF_per (322.8 GB/s Effective)
total = 79.6 GF (603.7 GB/s Effective) 39.8 GF_per (301.9 GB/s Effective)
final = 74.2 GF (562.7 GB/s Effective) 37.1 GF_per (281.4 GB/s Effective)

18% of peak
<table>
<thead>
<tr>
<th>System</th>
<th>HPCG Flops (TF)</th>
<th>#Proc</th>
<th>HPCG/proc</th>
<th>BW/proc GB/s</th>
<th>Total BW GB/S</th>
<th>Eff. (F/B)</th>
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</thead>
<tbody>
<tr>
<td>Summit</td>
<td>2950000</td>
<td>26136</td>
<td>112 GF</td>
<td>851 (898)</td>
<td>22241736 (23470128)</td>
<td>.131 .124</td>
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<td>16384</td>
<td>109.6 GF</td>
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<tr>
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<td>5320</td>
<td>91 GF</td>
<td>559 (732)</td>
<td>2973880 (3894240)</td>
<td>.162 .124</td>
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