Problem 5 (15 Points)

Find the current listing (18th) for the Green500 list for November 2024. Review the system architecture for each of the top 10 systems on this list. Discuss the differences that you see from this list and the list for the Top500 you found in question 4. Also compare it to the 1st Green500 list for June 2013.

*Answers to this question should be included in your homework 1 write-up in pdf format.

**This question is worth 15 extra credit quiz points for undergraduate and Plus-One students.

Green500 List, November 2024: *https://top500.org/lists/green500/list/2024/11/*
Green500 List, June 2013: *https://top500.org/lists/green500/list/2013/06/*

Answers

November 2024 Listings

Listing #18: El Capitan

- **Architecture**: x86_64, AMD 4th Gen EPYC 24C 1.8GHz, AMD INSTINCT MI300A
- **Interconnect**: Slingshot-11
- **Cores**: 11,039,616
- *Theoretical Peak Performance*: 2,746.38 PFlop/s
- *Energy Efficiency*: 58.889 GFlops/watts

Listing #1: JEDI

- **Architecture**: BullSequana XH3000, Grace Hopper Superchip 72C 3GHz, NVIDIA GH200 Superchip
- **Interconnect**: Quad-Rail NVIDIA InfiniBand NDR200
- **Cores**: 19,584
- *Theoretical Peak Performance*: 5.13 PFlop/s
- *Energy Efficiency*: 72.733 GFlops/watts

Listing #2: ROMEO-2025 - **Architecture**: BullSequana XH3000, Grace Hopper Superchip 72C 3GHz, NVIDIA GH200 Superchip - **Interconnect**: Quad-Rail NVIDIA InfiniBand NDR200 - **Cores**: 47,328 - *Theoretical Peak Performance*: 11.20 PFlop/s - *Energy Efficiency*: 70.912 GFlops/watts

Listing #3: Adastra 2 - **Architecture**: HPE Cray EX255a, AMD 4th Gen EPYC 24C 1.8GHz, AMD Instinct MI300A - **Interconnect**: Slingshot-11 - **Cores**: 16,128 - *Theoretical Peak Performance*: 4.06 PFlop/s - *Energy Efficiency*: 69.098 GFlops/watts

Listing #4: Isambard-AI phase 1 - **Architecture**: HPE Cray EX254n, NVIDIA Grace 72C 3.1GHz, NVIDIA GH200 Superchip - **Interconnect**: Slingshot-11 - **Cores**: 34,272 - *Theoretical Peak Performance*: 9.29 PFlop/s - *Energy Efficiency*: 68.835 GFlops/watts

Listing #5: Capella - **Architecture**: Lenovo ThinkSystem SD665-N V3, AMD EPYC 9334 32C 2.7GHz, Nvidia H100 SXM5 94Gb - **Interconnect**: Infiniband NDR200 - **Cores**: 85,248 - *Theoretical Peak Performance*: 37.67 PFlop/s - *Energy Efficiency*: 68.053 GFlops/watts

Listing #6: JETI - JUPITER Exascale Transition Instrument - **Architecture**: BullSequana XH3000, Grace Hopper Superchip 72C 3GHz, NVIDIA GH200 Superchip - **Interconnect**: Quad-Rail NVIDIA InfiniBand NDR200 - **Cores**: 391,680 - *Theoretical Peak Performance*: 94.00 PFlop/s - *Energy Efficiency*: 67.963 GFlops/watts

Listing #7: Helios GPU - **Architecture**: HPE Cray EX254n, NVIDIA Grace 72C 3.1GHz, NVIDIA GH200 Superchip - **Interconnect**: Slingshot-11 - **Cores**: 89,760 - *Theoretical Peak Performance*: 30.44 PFlop/s - *Energy Efficiency*: 66.948 GFlops/watts

Listing #8: Henri - **Architecture**: ThinkSystem SR670 V2, Intel Xeon Platinum 8362 32C 2.8GHz, NVIDIA H100 80GB PCIe - **Interconnect**: Infiniband HDR - **Cores**: 8,288 - *Theoretical Peak Performance*: 3.58 PFlop/s - *Energy Efficiency*: 65.396 GFlops/watts

Listing #9: HoreKa-Teal - **Architecture**: ThinkSystem SD665-N V3, AMD EPYC 9354 32C 3.25GHz, Nvidia H100 94Gb SXM5 - **Interconnect**: Infiniband NDR200 - **Cores**: 13,616 - *Theoretical Peak Performance*: 5.96 PFlop/s - *Energy Efficiency*: 62.964 GFlops/watts

Listing #10: rzAdams - **Architecture**: HPE Cray EX255a, AMD 4th Gen EPYC 24C 1.8GHz, AMD Instinct MI300A - **Interconnect**: Slingshot-11 - **Cores**: 129,024 - *Theoretical Peak Performance*: 32.10 PFlop/s - *Energy Efficiency*: 62.803 GFlops/watts

June 2013 Listings

Listing #1: CINECA

- **Architecture**: Eurotech Aurora HPC 10-20, Xeon E5-2687W 8C 3.100GHz, NVIDIA K20
- **Interconnect**: Infiniband QDR
- *Energy Efficiency*: 3208.8 MFlops/watts

Listing #2: Selex ES Chieti - **Architecture**: Eurotech Aurora HPC 10-20, Xeon E5-2687W 8C 3.100GHz, NVIDIA K20 - **Interconnect**: Infiniband QDR - *Energy Efficiency*: 3179.9 MFlops/watts

Listing #3: National Institute for Computational Sciences/University of Tennessee - **Architecture**: Appro GreenBlade GB824M, Xeon E5-2670 8C 2.600GHz, Intel Xeon Phi 5110P - **Interconnect**: Infiniband FDR - *Energy Efficiency*: 2449.6 MFlops/watts

Listing #4: King Abdulaziz City for Science and Technology - **Architecture**: Adtech, ASUS ESC4000/FDR G2, Xeon E5-2650 8C 2.000GHz, AMD FirePro S10000 - **Interconnect**: Infiniband FDR - *Energy Efficiency*: 2351.1 MFlops/watts

Listing #5: IBM Thomas J. Watson Research Center - **Architecture**: BlueGene/Q, Power BQC 16C 1.60GHz - **Interconnect**: Custom Interconnect - *Energy Efficiency*: 2299.1 MFlops/watts

Listing #6: DOE/SC/Argonne National Laboratory - **Architecture**: BlueGene/Q, Power BQC 16C 1.60GHz - **Interconnect**: Custom Interconnect - *Energy Efficiency*: 2299.1 MFlops/watts

Listing #7: Ecole Polytechnique Federale de Lausanne - **Architecture**: BlueGene/Q, Power BQC 16C 1.60GHz - **Interconnect**: Custom Interconnect - *Energy Efficiency*: 2299.1 MFlops/watts

Listing #8: Interdisciplinary Centre for Mathematical and Computational Modelling, University of Warsaw - **Architecture**: BlueGene/Q, Power BQC 16C 1.60GHz - **Interconnect**: Custom Interconnect - *Energy Efficiency*: 2299.1 MFlops/watts

Listing #9: DOE/SC/Argonne National Laboratory - **Architecture**: BlueGene/Q, Power BQC 16C 1.60GHz - **Interconnect**: Custom Interconnect - *Energy Efficiency*: 2299.1 MFlops/watts

Listing #10: University of Rochester - **Architecture**: BlueGene/Q, Power BQC 16C 1.60GHz - **Interconnect**: Custom Interconnect - *Energy Efficiency*: 2299.1 MFlops/watts

Analysis

The Green500 list for November 2024 and the Top500 list for November 2024 have some similarities and differences. The Green500 list focuses on energy efficiency, while the Top500 list focuses on performance. The Green500 list includes the energy efficiency of the systems in GFlops/watts, while the Top500 list includes the theoretical peak performance of the systems in PFlop/s. Interesting to note is that the most energy efficient systems are typically not the most powerful systems. The Green500 list includes systems with lower theoretical peak performance (roughly two orders of magnitude lower) but higher energy efficiency. The Top500 list includes systems with higher theoretical peak performance but slightly lower energy efficiency.

Comparing the Green500 list for November 2024 to the 1st Green500 list for June 2013, we see a significant improvement in energy efficiency. The energy efficiency of the systems in the November 2024 list is in the range of 62.803 GFlops/watts to 72.733 GFlops/watts, while the energy efficiency of the systems in the June 2013 list is in the range of 2299.1 MFlops/watts to 3208.8 MFlops/watts. This represents an improvement of roughly one order of magnitude in energy efficiency over the past decade.