1.

1: Tianhe-2(MilkyWay-2) is the number 1 supercomputer located in Guangzhou, China. It was made by NUDT, has 3.12 Million Cores with 1.024 Million Gigabytes of Memory. It can achieve 33,862.7 Teraflops per second using Linpack Performance, and has a theoretical peak of 54.902.4 Teraflops per second. It apparently uses 17,808 kilowatts of power. But, with all this power and performance, it still won’t be used to crunch data for the nearby antineutrino detector at the Daya Bay nuclear plant. Dr. Cao Jun says that the sheer “amount of data could choke the computational monster” and that data flowing from calculating unit to calculating unit can be rather slow. Tianhe-2’s expected jobs range from controlling traffic lights, predicting earthquakes, developing new drugs, creating movie special effects, and designing cars.. The computer is predicted to be idle for long periods of time because machines like it are not especially good at anything. It’s not focused enough. A surprise among others is that it runs on Intel Ivy Bridge and Xeon Phi processors, and cost about $3 billion. Many Chinese officials are hoping Tianhe-2 can be used to solve China’s car industry issues.

Sources: <http://www.scmp.com/news/china/article/1264529/worlds-fastest-computer-tianhe-2-might-get-very-little-use>

2: Number 2 on the list is Titan, made by Cray Inc, located in Oak Ridge, Tennessee. It only has 560,640 cores with 710,144 Gigabytes of Memory. Its Linpack Performance is 17,590 Teraflops per second, with its theoretical peak running at 27,112.5 Teraflops per second all the while consuming 8,209 kilowatts. Titan is a hybrid of AMD Opteron CPUs and Nvidia Tesla GPUs, designed to improve energy efficiency. Titan is available for use for any scientific purpose with access depending on the importance of the project and its exploitation of the hybrid structure of Titan. At first, many new projects were halted to upgrade the code to take advantage of the newly added GPUs. The primary change being an increase in the degree of parallelism. A cool thing I found was that Titan has a carbon fibre flywheel power storage unit which lasts 16 seconds, 7 more than is need for the Diesel generators to fire up and reach full power. For the most part, Titan has been used to simulate particles and molecules. Each program run on Titan must be able to run on solely CPU-based systems so they don’t rely solely on Titan for computation.

Sources: http://en.wikipedia.org/wiki/Titan\_%28supercomputer%29

3: Third on the list is Sequoia. It is manufactured by IBM and located in Livermore, California. Sequoia can achieve 20 petaflops per second. But, it will only do 17,173.2 Teraflops per second according to its Linpack performance rating. Theoretically, it can achieve 20,132.7 Teraflops per second with 1,572,864 cores, and 1,572,864 Gigabytes of Memory. In total, it consumes 7,890 kilowatts. Sequoia’s main purpose is to carry out nuclear weapons testing. This with figure out how to extend the life of aging nuclear weapons and help avoid live underground tests. Upon first completion, it ran for over 23 hours running the Linpack performance testing program without losing a single core.

Sources: <https://www.llnl.gov/news/newsreleases/2009/NR-09-02-01.html>

<http://www.techspot.com/news/49026-ibm-supercomputer-overtakes-japans-fujitsu-as-worlds-fastest.html>

4: The number 4 top 500 is K computer, built by Fujitsu. It is located at the RIKEN Advanced Institute for Computational Science in Japan. K computer has 705,024 cores and 1,410,048 gigabytes of Memory. Its Linpack Rmax is 10,510 teraflops per second, with a theoretical peak or 11,280.4 teraflops per second. It consumes 12,659.89 kilawatts of power. K computer uses a SPARC64 VIIIfx CPU designed by Fujitsu. It was conceptualized in 3006, and went into service in September 2012. Using the Tofu interconnect, the K computer can achieve six-dimensional interconnection. K computer is being used to underpin critical research in drug design, nano technology, energy research, and climate prediction. A major part of designing this machine was to get the top place in supercomputing in the world. Notably, it uses iced-water cooling systems directly built into the printed circuit boards.

Sources: <http://www.fujitsu.com/global/about/tech/k/>

<http://www.computerweekly.com/news/2240158238/Worlds-fastest-supercomputer-to-drive-breakthroughs-in-engineering-medicine-and-science>

5: Mira, and IBM production, ranks 5th on the top500. It is located at the Argonne National Laboratory in Illinois. Mira has a total of 786,432 cores and an unknown amount of Memory. It is capable of 10 petaflops per second, but has an Linpack performance rating of 8,586.6 teraflops per second with a theoretical peak of 10,066.3 teraflops per second. Consuming 3,945 kilawatts, Mira is a beast, and so far also has the coolest name. It’s initial roles included measuring the role and impact of clouds on climate, modeling earthquakes, and studying the quantum mechanics of new materials. Mira was created as part of the America COMPETES Act signed by Presidents Bush and Obama to compete with the world in many fields, especially supercomputing, with sights on outperforming China. Mira replaces an only 4 year old system called Intrepid. 60% of Mira’s time will go to projects selected by the INCITE program. Another 40% will go to projects accepted by the Advanced Science Computing Research Leadership Computing Challenge, which in itself requires a supercomputer just to write the name. The last 10% will go to ‘immediate need’ projects.

Sources: <http://www.informationweek.com/applications/national-lab-replaces-supercomputer-with-newer-faster-model/d/d-id/1105573>?

<http://www.pcworld.com/article/218951/us_commissions_beefy_ibm_supercomputer.html>

6: Located at the Swiss National Supercomputing Center in Switzerland, Piz Daint is number 6 system on the top 500. Piz Daint is another supercomputer manufactured by Cray Inc. It has 115,984 cores and an unknown amount of Memory. Linpack says Piz Daint can do 6.271 teraflops per second with 7,788.9 teraflops per second as its theoretical peak. Piz Daint consumes 2,325 kilawatts. Currently, Piz Daint is being upgraded to a CPU/GPU hybrid by removing one of the two Xeon processors in a compute node, and replacing it with an Nvidia Tesla GPU. Also, the Interconnecting network has been upgraded for performance and efficiency. Piz Daint was the first system to have this hybrid implementation. Goals for the upgrade included energy efficiency and numerical computing as Piz Daint is partially used for the Large Hadron Collider in Cern.

Sources: <https://docs.google.com/file/d/0B8QCZ3jIFMVlR05DOEZfLW5ucFk/edit>

<http://www.cscs.ch/computers/piz_daint/index.html>

7: 7th on the list is Stampede, a Dell creation located at the Texas Advanced Computing Center in Texas. Stampede has 462,462 cores with 192,192 gigabytes of Memory. Stampede’s Linpack Rmax is 5,168.1 teraflops per second, with a theoretical peak of 8,520.1 teraflops per second. Stampede consumes 4,510 kilawatts of power during normal use. Stampede is used to model and analyze anything ranging from large planets and drug molecules to expensive and dangerous car crash tests to earthquake predication and renewable energy solar panels. Stampede was built inside an 11,000 square feet data center and has a 1.2 million Gallon thermal storage tank. 75 miles of network cables, primarily fibre optic, were used. Stampede is a semi-hybrid with some nodes being Xeon Phi nodes, some being dual Xeon Phi nodes, and some outfitted with one or more Nvidia Kepler GPU.

Sources: <https://www.tacc.utexas.edu/stampede/>

<http://en.community.dell.com/techcenter/high-performance-computing/b/general_hpc/archive/2012/11/14/tacc-s-stampede-gallops-to-7-fastest-computer-in-the-world.aspx>

<http://www.statesman.com/news/business/stampede-supercomputer-tives-scientists-a-powerful/nSzmH/>

8: Juqueen, an IBM creation, is located in the Forschungszentrum Juelich in Germany. It has 458,752 cores and 458,752 gigabytes of Memory. Linpack clocks Juqueen at 5,008.9 teraflops per second with a theoretical peak of 5,872 teraflops per second, all the while consuming 2,301 kilawatts. Compared to the other systems, Juqueen only has 28 racks, and takes up a surprising small amount of space. Over the past year, Juqueen has been upgraded from 8 racks to 28, keeping it on the top 500. Currently, Juqueen also sits at position 20 on the Green500 list.

Sources: <http://www.green500.org/lists/green201311&green500from=1&green500to=100>

<http://www.fz-juelich.de/SharedDocs/Meldungen/IAS/JSC/EN/2012/2012-04-juqueen.html>

<http://www.fz-juelich.de/ias/jsc/EN/Expertise/Supercomputers/JUQUEEN/JUQUEEN_node.html>

9: System number 9 is Vulcan, made by IBM, and located in Livermore California is yet another BlueGene/Q computer in the top 10. Vulcan has 393,216 cores and 393,216 gigabytes of Memory. It consumes 1,972 kilawatts of power and reaches 4,293.3 teraflops per second through Linpack with a theoretical peak of 5,033.2 teraflops per second. Vulcan’s primary uses are for Lab-industry projects through Livermore’s High Performance Computing Innovation Center. It will also support academic collaborations and the National Nuclear Security Administration. Vulcan raised the amount of computing and the LLNL for external collaborations by a full order of magnitude.

Sources: <https://www.llnl.gov/news/newsreleases/2013/Jun/NR-13-06-05.html>

<http://en.wikipedia.org/wiki/Blue_Gene>

10: The last supercomputer on this list is SuperMUC, yet another IBM creation, located at the Leibniz Rechenzentrum in Germany. It has 147,456 cores with an unknown amount of Memory. Linpack rates it at 2,897 teraflops per second with a theoretical peak of 3,185.1 teraflops per second. It consumes 3,422.67 kilawatts. Like all other systems on this list, it runs a Linux-based Operating System. But, SuperMUC is the prettiest. It has an awesome, clean colourscheme that no system has matched. Mira has some cool drawings, but SuperMUC looks cleaner and more organized. SuperMUC was designed to strengthen Germany’s Gauss Center for Supercomputing withing Europe’s computing ecosystem. SuperMUC was designed with warm-water cooling rather than cold-water cooling. This means water does not have to be cooled as aggressively as other systems require. But, the outlet temperature is also not especially high. But, the outlet water suffices to heat surrounding buildings and help recover some of the energy used.

Sources: <http://www.lrz.de/services/compute/supermuc/>

2. The Linpack benchmark measures the ‘best’ performance of the system. It is very widely used and has therefore is often chosen as the benchmarking tool of choice. It enforces double precision floating point operations with a minimum precision of 64 bits. Rpeak refers to the maximum number of full precision floating-point additions and multiplications that can be completed in the cycle time of the system. Rmax refers to the maximum number of full precision floating-point additions and multiplications that can be completed on the Linpack algorithms in the cycle time of the system. Both R-statistics in the Top500 are for normal GPU clock rates. Nmax refers to the maximum problem size that Linpack runs, while Nhalf refers to half of Nmax. The key to Nmax is finding the largest problem size capable of fitting in Memory.

3. The performance measure to rate the systems in the Green500 is megaflops per second per watt. 16 of the top 60 have Nvidia GPUs, but only 10 have Xeon Phi coprocessors.