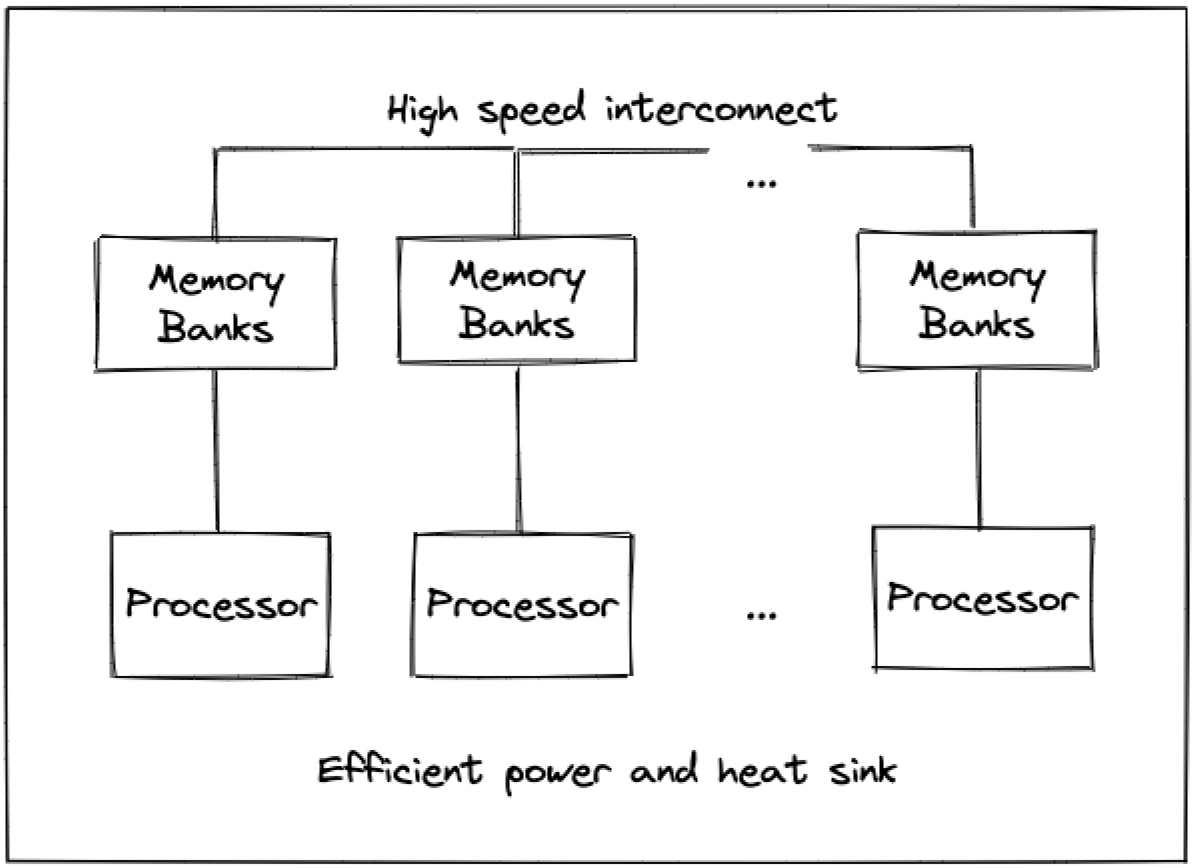
Q4.

Here is the trends I noticed:

As for CPUs, 5 of 10 uses AMD processors. We can see that AMD has great advantages in HPC. For the 2 most impressive Frontier and LUMI, they both use the new HPE Cray EX architecture that combines 3rd Gen AMD EPYC™ CPUs optimized for HPC and AI. The main difference between them two is that Frontier has 8,730,112 cores, which is nearly 8 times more than LUMI. So I guess if LUMI could be equipped with the same amount of cores or co-processors, it could perform better because both of the performance and power consumption is linearly less than Frontier. For the rest of 5 supercomputers, 2 of them are equipped with IBM processors and the ranking is 4 and 5 and one of them is using Intel Xeon. So we could tell that IBM and Intel also attribute much to the HPC. For the rest of 2, they use domestic processors ranking of 2 and 6. The ranking and performance of them are impressive, however, Supercomputer Fugaku from Japan uses 7,630,848 cores and Sunway TaihuLight from China uses 10,649,600 cores, which is the most among the TOP10. So as for the average performance and power consumption of the two supercomputers, they are less efficient than the rest of computers which use AMD or IBM processors. I believe they may have impressive performance on the schedule of parallel tasks.

The system I would design:

As for the supercomputer system I would consider for HPC, there are three main factors I would think about. First is parallelism, which is the primary key word of the HPC. So, I will design a multi-core processor with hyper-threading, which means I could get the most access to instruction parallelism. Then I will consider the connection between processors or nodes with main memories. Although shared memory multiprocessors which are known as SMP are normal in our daily life such as laptops or mobile phones, supercomputers aim at runtime speedup. So from my perspective, my supercomputer should have non uniform memory access with a single main memory for each multi-core processor with interconnection of high speed network. Under these circumstances, we benefit from easily scaling the number of processors which would be available for parallelism as well as faster local memory access for processors. The second thing I consider is the speed. Besides the parallelism, I still want to improve the calculation speed on each parallelism as well as the data transfer speed between processors and main memory. That requires high quality interconnect on the database as well as the networking between other servers. I hope I could learn something from Slingshot11, which is commonly used among Cray based supercomputers. The third thing I would consider is power. Despite the system’s great performance, we should care about the power efficiency as well as the heat density. First, we should have a heat sink regardless of water or other solutions. Second, I should reduce the power as much as possible to enhance the power efficiency. Here is the diagram of the system I would design.


High speed interconnect
Memory Banks
Memory Banks
...
Memory Banks
Processor
Processor
...
Processor
Efficient power and heat sink