Домашна работа 3

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2.1

a) Compact vs Slack
    i) Compact - Centralized, enclosed, homogeneous - dedicated cluster
    ii) Slack - Decentralized, exposed, heterogeneous - cloud cluster
b) Centralized vs Decentralized
    i) Centralized - The concentration of control of an activity or organization under a single authority
    ii) Decentralized - Movement of departments of a large organization away from a single administrative center to other locations
c) Homogeneous vs Heterogeneous
    i) Homogenous - Made of computers with the same specifications
    ii) Heterogenous - Can contain computers with different specifications
d) Enclosed vs Exposed
    i) Enclosed - The computers cannot be accessed outside an organization (are not exposed to the internet for example)
    ii) Exposed - The computer systems can be accessed from outside the organization
e) Dedicated vs Enterprise clusters
    i) Dedicated clusters - These are positioned generally in one place and are made of a single type of computer
    ii) Enterprise clusters - Can be distributed all over the world and contain different computers

2.2

a) Availability = (uptime) / (uptime + downtime)
b) 100%, because only one node is taken down, the others are still working

2.4

a) This indicates how well the performance of a scalable parallel computer will improve with additional processors. The resources increased are most frequently processors, but they could also be memory capacity and I/O capability. There also exist a maximum number of processors a system can accommodate and thus impose an upper bound of scalability over machine size.
b) This indicates how well the system can handle larger problems with lager data size and workload. Apart from depending on machine size, it also depends on the memory capacity, and communication capability of the machine

c) This refers to gaining higher performance or functionality by increasing the machine size (i.e. the number of processors), investing in more storage (cache, main memory, disks), improving the software, etc. Within this dimension, three categories have to be considered. Machine size scalability indicates how well the performance will improve with additional processors. Scaling up in resources means gaining higher performance by investing more memory, bigger off-chip caches, bigger disks, and so on. Finally, software scalability indicates how the performance of a system be improved by a newer version of the OS that has more functionalities, a better compiler with more efficient optimizations, more efficient mathematical and engineering libraries, more efficient and easy-to-use applications software, and a more user-friendly programming environment.
d) This refers to the capability of a system to scale up the performance using the next-generation components, such as a faster processor, faster memory, a newer version of the operating system, a more powerful compiler, etc, with the rest of the system be usable and modifiable as little as possible

2.7

Generally, the top places have shifted from using x86 to ARM processors and I couldn't find any in the top 10 list using x86

2.9

Top 3 from the top 500 list from November 2022

- Frontier - HPE Cray EX235a, AMD Optimized 3rd Generation EPYC 64C 2GHz, AMD Instinct MI250X, Slingshot-11
- Supercomputer Fugaku - Supercomputer Fugaku, A64FX 48C 2.2GHz, Tofu interconnect D
- LUMI - HPE Cray EX235a, AMD Optimized 3rd Generation EPYC 64C 2GHz, AMD Instinct MI250X, Slingshot-11

All of these systems have some kind of GPU acceleration to complement the CPU cores.

2.10

One major weakness of all of the supercomputers in the list is the huge power they require. Also, they are not universal and generally specify in one area (ex. CPU power, GPU power, speed, etc.)

2.16

a) A single user can connect to the cluster instead of a specific node.
b) Is a design that offers a single user interface single process space, single memory space, single file hierarchy, and single control point.
c) All nodes are interconnected and share the same file hierarchy

d) Every node shares the same I/O space, henceforth every node “listens” to the same “messages” from the outside user.
e) Every node is interconnected with each other on one data highway, if that highway fails, the whole system is compromised.
f) One controller over everyone
g) The GUI is always the same and doesn’t change. Useful for easy relocation and easy debugging from different locations. Also useful for control (The user/controller doesn’t need to update his knowledge while accessing different nodes)
h) The single process gives us a huge computational power, but everyone wants to use that power, Deadlocks and Race Conditions all over the place.