Домашна Работа 3

Паралелно и Дистрибуирано Процесирање

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2.1

a. Compact versus slack clusters

Compact clusters	Slack clusters
- Centralized - Homogeneous - Enclosed - EX: Dedicated cluster	- Decentralized - Heterogeneous - Exposed - EX: Enterprise cluster

b. Centralized versus decentralized

Centralized	Decentralized
Concentration of control of an activity or organization under a single authority	Movement of departments of a large organization away from a single administrative center to other locations

c. Homogeneous versus heterogeneous clusters

Homogeneous clusters	Heterogeneous clusters
Homogeneous clusters only contain computers with the same specifications (OSs, etc.)	Heterogeneous clusters contain computers with different types of specifications

d. Enclosed versus exposed clusters

Enclosed clusters	Exposed clusters
Contrary to Exposed clusters. ->	The communication paths among the nodes are exposed to the outside world An outside machine can access the communication paths, and thus the individual nodes.

e. Dedicated versus enterprise clusters

Dedicated clusters	Enterprise clusters
Is typically installed in a deskside rack in a central computer room. It is homogeneously configured with the same type of computer nodes and managed by a single administrator group like a frontend host.	Is mainly used to utilize idle resources in the nodes. Each node is usually a full-fledged SMP, workstation or PC, with all the necessary peripherals attached. Nodes are geographically distributed, not necessarily in the same room or even building.

2.2

a. availability = $\frac{uptime}{uptime+downtime}$

b. It depends on the number of nodes, the higher the availability, the better the performance we get.

2.4

Define and distinguish among the following terms on scalability

a. Scalability over machine size

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. Scalability over problem size

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 memory capacity, and communication capability of the machine

c. Resource scalability

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 resource 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 more user-friendly programming environment.

d. Generation scalability

This refers to the capability of a system to scal up the performance using the next generation components, such as a faster processor, a faster memory, a newer version of operating system, a more powerful compiler, etc, with the rest of the system be usable and modifiable as little as possible

2.7

CPU	Core Count	Frequency	GPU Acceleration
Power9	24 Cores	4GHz	Tesla V100
SW26010	260 Cores (yes, manycore)	1.45GHz	Tesla V100
Xeon E5-2696 v2	12 Cores	2.4GHz	Tesla P100

2.9

Winners:

- Shoubu System B (Cores: 953,280)
- DGX SaturnV Volta (Cores 22,440)
- IBM Summit (Cires 2,397,824)

IBM Summit

Summit is a supercomputer developed by IBM for use at Oak Ridge National Laboratory, which as of November 2018 is the fastest supercomputer in the world, capable of 200 petaflops. Its current LINPACK benchmark is clocked at 143.5 petaflops. As of November 2018, the supercomputer is also the 3rd most energy efficient in the world with a measured power efficiency of 14.668 GFlops/watt. Summit is the first supercomputer to reach exaop (exa operations per second) speed, achieving 1.88 exaops during a genomic analysis and is expected to reach 3.3 exaops using mixed precision calculations.

2.10

The weaknesses are the use of power and the TDP output of the processors,

IBM is placing less emphasis on high cycle rates and is focusing on the high data throughput. This is one of the reasons why IBM's Power9 outperforms Intel's Xeon series processors and is the best choice for clouds and servers.

The clusters mainly use InfiniBand or Gigabit Ethernet technologies to interconnect the supercomputers in the institutes.

2.16

a. A single user can connect to the cluster instead of a specific node.

- No control on the user, the user can connect to any node, and affect the whole cluster.

b. Is a design that offers single user interface single process space, single memory space, single file hierarchy and single control point.

- Every node sees the same memory, and file hierarchy. If one node is compromised, the whole cluster is in danger.

c. All nodes are interconnected and share the same file hierarchy

- If a node is compromised and/or damaged, the whole cluster might feel the impact on the file system (one node might not be able to access data on a different location)

d. Every node shares the same I/O space, henceforth every node “listens” to the same “messages” from the outside user.

- Everyone listens, node-specific tasks become hard to evaluate/process

e. The cluster exists on only one network (LAN etc)

- If the network fails, the whole cluster is compromise (the synchronization is mainly affected).

f. Every node is interconnected with each other on one data highway, if that highway fails, the whole system is compromised.

g. One controller over everyone.

- One computer controls everyone, connect this with ruling of a King, he controls EVERYTHING, and has the power to shut everything down. If he is compromised, he can destroy the entire empire.

h. N/A

i. 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)

j. Single process gives us a huge computational power, but everyone wants to use that power, Deadlocks and Race Conditions all over the place.