**Assignment 1: Portfolio**

**Swathi Anil**

**8905477**

**Virtualization and Cloud Computing, Conestoga College**

**SYST8101: Foundations of Virtualization**

**Temidayo**

**16-02-2024**

**Introduction**

In computing, Multiprocessing is a type of operation in which two or more processors in a computer process simultaneously multiple tasks (set of instructions) or different portions of the same program. Multiprocessing is possible with the help or two or more microprocessors, each of which is in effect a central processing unit also know as CPU. Millions of such microprocessors are combined to interpret and execute instructions this is called as Supercomputers (Gregersen., 2021).

**Examining the Laws of Multiprocessor computing. Information on the authors of the Law surrounding multiprocessing computing.**

While exploring the laws surrounding Multiprocessor computing the two main laws that attract and refers are Amdahl’s Law and Gustafson’s Law.

**Amdahl’s Law**

**About Author:** Amdahl’s Law is named after Gene Myron Amdahl. Born in November 16, 1922 and died in November 10, 2015.

**Background:** Amdahl was an American computer scientist. He completed his bachelor’s in engineering physics from South Dakota Sate University. He pursued his master’s and PhD in Theoretical Physics from the University of Wisconsin-Madison.

**Contribution:** Back in 1967, during the conference at the Spring Joint Computer Conference, Dr. Gene Amdahl laid his thoughts on the multiprocessor approach. It argues that the overall speedup of a program due to parallelization is controlled by the number of the programs that must run sequentially.

**Gustafson’s Law**

**About Author:** Gustafson’s Law is named after John L Gustafson. Born in June 29, 1955.

**Background:** Gustafson’s was an American computer scientist. He is famous for his contributions to high- performance computing. He completed his bachelor’s in applied mathematics from California Institute of Technology (Caltech). He obtained his Ph. D in Applied Mathematics from Lowa State University. (Gustafson, n.d.)

**Contribution:** Back in 1988, According to Gustafson, it’s more realistic to assume that the runtime remains relatively constant rather that the problem size. Gustafson states that the parallel or vector fraction of a program grows in proportion to the problem size.

**Layman’s Explanation**

* According to Layman’s Explanation if there is program that take 20 hours to finish with a single thread processor.
* There might be a fraction of program that cannot be parallelized as it must run in a sequential manner.
* In the above scenario the minimum execution time will be always longer.
* Therefore, the theoretical speedup achieved by parallel computing is less than **20 times** the single-thread performance.

**Fundamental concepts of Moore’s Law and its applicability in today’s Computing landscape.**

Moore’s Law states that the number of transistors on a silicon chip roughly doubles every two years, even though the capacity and performance of the computer consistently increases while the price of the computers decreases.

This law is a contribution by American engineer Gordon Moore in 1965 (Jayachandran, 2024)*.*

**Application and Examples:**

Mobile Devices:

* Tablets and mobile devices have improved with Moor’s law.
* This leads to the implementation of more powerful processors by shrinking the transistor while maintaining energy efficiency.
* It also enables additional features such as complex apps, high-resolution displays, and efficient battery life.

Self-Driving cars:

* Automated vehicles rely on powerful computing for their data processing requirements and complex algorithms (Nayan, 2023).
* With Moore’s Law, chips are built with millions of transistors which are then installed in these cars.
* These chips enable decision-making, real-time sensing analysis, and decision for safety navigation.

**Background**

**Contributions made by Ibuka and Morita, to Parallel Computing**

The remarkable contributions of Masaru Ibuka and Akio Morita are two well-known visionary entrepreneurs (Energy, n.d.).

1. **Masaru Ibuka**

* Ibuka is the Co- founder of **Tokyo Telecommunications Engineering Corporation** later known as Sony Cooperation in 1994.
* Under the leadership of Ibuka Sony made its entry into global electronics giants.

1. **Akio Morita**

* Morita was also a Co-founder of Sony Corporation.
* Morita’s vision made Sony products iconic like the Walkman and PlayStation.

Parallel Computing Connection:

* Even though neither Ibuka nor Morita have a direct connection to parallel computing architecture or algorithms, their technological advancements indirectly influenced the field.

**5 Organization That Impacted the Evolution of Parallel Computing**

The five organizations that have impacted the evolution of parallel computing and their contributions are as follows:

1. **Argonne National Laboratory (ANL):**

ANL played a major role in the evolution of parallel computing and its software.

**Contributions:**

* Through programming and outreach ANIL scientists made their essential contributions.
* To extract maximum speed and power from dozens of computing cores working simultaneously they optimized programs.
* Concurrent projects at ANIL in 1980s led to creation of NWChem. (Mitchum, 2013).

1. National Science Foundation:

* NSF played a pivotal role in the field of research and development in parallel computing.
* The High-Performance Computing (HPC) program and the Large-Scale Computing Systems program are some of the initiatives of NSF supporting parallel computing advancements.

1. Intel Corporation:

* Intel has played a crucial role in the development of processor development, which drives parallelism.
* Thes chips are responsible for powering everything from personal computers to data centers and scientific simulations.

**Java, C++, and C# involvement in parallel Computing with Real -World Implementations**

Below are some of the use cases of Jave, C++, and C# in parallel Computing. Each language has its own Strength and applications:

1. JAVA

**Support for Parallelism:**

* Java ensures support for threats and concurrency.
* Key libraries and frameworks include Fork framework, Executor framework and parallel streams.

**Real-World Examples**:

* **Databases and Data Mining:**
  + The main advantage of Parallel Java applications is that it can efficiently process large datasets, optimize queries, and mine patterns from databases.
* **Advanced Graphics and Virtualization**
  + Java Complex 3Dscenes, visualizations, and augmented reality is rendered with Parallel Java Programs (Introduction to Parallel Computing, 2021).

1. **C++**

**Parallelism Strengths:**

* **C++, even with its low-level control, is claimed to be a powerful language.**
* **The main features are memory management and fine-grained parallelism.**

**Real-World Applications:**

* **Video Game Engines:**
  + **Unreal and Unity are some of the game engines powered by C++, it uses parallel processing for rendering and other AI related tasks.**
* **Financial Modeling Software:**
  + **With parallel C++ codes tools like risk management and High-frequency trading systems get the speed and accuracy.** (Gossett, 2022)

1. **C#**

**Parallel Computing:**

* **It provides Parallel Programming features through libraries such as Task Parallel Library (TPL).**
* **It is compatible in both Windows machine and UNIZ platforms.**

**Real-World Applications:**

* **Medical Imaging:**
  + **MRI scans and similar medical images are some applications of Parallel C# applications processing.**
* **Advanced Graphics and Augmented Reality:**
  + 3D graphics, virtual reality experiences and game development are some powerful features of C# (João Fernando Ferreira).

**Discussion**  
**Three technologies that were used to partition computing resources prior to 2005**

1. **Logical Partition (LPAR):**

An LPAR is a virtualization technique that divides a physical machine into multiple logical partitions, each running its own operating system instance. PR/SM, a standard feature on IBM Z and IBM LinuxONE systems, has been integrated with IBM Z machines since 1988. (Logical partition, n.d.)

1. **Amdahl Corporation’s Multiple Domain Facility (MDF):**

Amdahl Corporation introduced MDF in 1982, enabling a single mainframe to be divided into multiple domains with distinct resources, allowing for separate operating systems and applications.

1. **IBM POWER Hypervisor (PHYP):**

PHYP, also known as the POWER Hypervisor, enabled logical partitioning on IBM POWER systems from 2000 to 2005, allowing multiple partitions to run on the same hardware. (Examples: Logically partitioned systems, 2020)

**Different classifications of cloud computing, along with their origins, use cases, and cost structures**

1. **Public Cloud**:

* Public clouds are owned and controlled by third-party cloud service providers (such as Google Cloud, Amazon Web Services, and Microsoft Azure). They evolved as a scalable option for delivering on-demand computer resources via the Internet.
* Use Case: Public clouds provide users with resources such as computing, storage, networking, and applications over the internet. Organizations use public clouds for a variety of reasons, including online hosting, development and testing, data analytics, and collaboration tools.
* Cost Structure: Public cloud services normally operate on a pay-as-you-go basis, with customers only paying for the resources they utilize. Pricing depends on criteria including CPU utilization, storage, data transport, and other services used (What are the different types of cloud computing?, n.d.).

1. **Private Cloud**:
   * Origin: Private clouds are created, managed, and used by a single organization. They were created to give users more control, customization, and security than public clouds do.
   * Use Case : Organizations use private clouds on-premises or in their data centers. They are appropriate for sensitive workloads, regulatory needs, and applications that require specialized resources. Financial firms, healthcare organizations, and government entities are some examples.
   * Cost Structure: Private clouds have upfront charges for infrastructure setup and ongoing maintenance. While they provide control, they have resource constraints similar to traditional IT settings (Hat, 2022).
2. **Hybrid Cloud**
   * Origin: Hybrid clouds originated as a way to combine the advantages of public and private clouds. Organizations sought flexibility to choose the best environment for diverse workloads.
   * **Use Case**: Hybrid clouds mix private and public environments, allowing for seamless workload transfer between the two, such as employing a private cloud for important data and a public cloud for bursty workloads.
   * **Cost Structure:** Hybrid cloud costs are determined by the combination of public and private resources, thus enterprises must account for both public usage fees and private cloud infrastructure expenses.
3. **Multi cloud:**
   * Origin: Multi cloud environments arose as businesses accepted services from many cloud providers. It eliminates reliance on a single provider and lowers the likelihood of vendor lock-in.
   * Use Case: Multi cloud refers to leveraging services from many cloud providers (public or private) simultaneously. Organizations can select the best-fitting solutions for their specific needs. For example, use Google Cloud for machine learning and Amazon Web Services for storage.
   * Cost Structure: Multi cloud does not have a fixed cost structure; instead, it is determined by the services used from each provider. It offers flexibility, but competent management is required to optimize costs.

**Conclusion**

Cloud services are divided into four categories: infrastructure as a service (IaaS), platform as a service (PaaS), software as a service (SaaS), and serverless computing. IaaS provides virtualized computing resources on demand, PaaS provides a framework for application development, SaaS delivers software applications, and Serverless Computing enables developers to run applications.

With continuous improvement in technology, the concept of parallel processing will increase its popularity. This will strengthen improvements in both hardware and software. Virtualization is predicted to become even more flexible and seamless, erasing the divide between physical and virtual resources. There are some challenges in the case of scalability and security. It is crucial to invest a good amount of time and resources into the research and development of this field.

# References

Energy, P. (n.d.). *Masaru Ibuka*. From computinghistory: https://www.computinghistory.org.uk/det/32495/Masaru-Ibuka/

*Examples: Logically partitioned systems*. (2020, April 18). From IBM Corporation 2020: https://www.ibm.com/docs/en/power9/9009-42A?topic=overview-examples-logically-partitioned-systems

Gossett, S. (2022, Oct 21). *Parallel processing is bringing drug research, energy exploration and more up to lightning speed.* From Built In National: https://builtin.com/hardware/parallel-processing-example

Gregersen., E. (2021, Nov 11). *Britannica, The Editors of Encyclopaedia. "multiprocessing".* . From Encyclopedia Britannica: https://www.britannica.com/technology/multiprocessing

Gustafson, D. J. (n.d.). *Gustafson's Law*. From Dr. John L. Gustafson: http://www.johngustafson.net/glaw.html

Hat, R. (2022, July 25). *Types of cloud computing*. From www.redhat.com: https://www.redhat.com/en/topics/cloud-computing/public-cloud-vs-private-cloud-and-hybrid-cloud

*Introduction to Parallel Computing*. (2021, Jun 04). From geeksforgeeks: https://www.geeksforgeeks.org/introduction-to-parallel-computing/

Jayachandran, A. (2024). *Moore’s Law*. From https://www.wallstreetmojo.com/: https://www.wallstreetmojo.com/moores-law/

João Fernando Ferreira, J. L. (n.d.). ParC#: Parallel Computing with C# in .Net. *Departamento de Informática - Universidade do Minho*, pp. 1-10.

*Logical partition*. (n.d.). From wikipedia: https://en.wikipedia.org/wiki/Logical\_partition

Mitchum, R. (2013, May 17). *The Parallel Path to Computing Present and Future*. From voices.uchicago.edu: https://voices.uchicago.edu/compinst/blog/parallel-path-computing-present-and-future/

Nayan, A. M. (2023, March 26). *Moore's Law: The Enduring Legacy of Gordon Moore and its Impact on Technology Today*. From https://www.linkedin.com/: https://www.linkedin.com/pulse/moores-law-enduring-legacy-gordon-moore-its-impact-today-md-nayan

*What are the different types of cloud computing?* (n.d.). From Google Cloud: https://cloud.google.com/discover/types-of-cloud-computing