Exercise Sheet 2

Exercise 1   (Cluster Computing)

1. Give a short definition of Cluster Computing.

2. What is a Cluster of Workstations?

3. Name an advantage of Clusters, which follow the Glass-house installation concept.

4. Name a drawback of Clusters, which follow the Glass-house installation concept.

5. Name an advantage of Clusters, which follow the Campus-wide installation concept.

6. Name a drawback of Clusters, which follow the Campus-wide installation concept.

7. How can the availability of a system be calculated?

8. What is the objective of High Availability Clustering?

9. By which approach does High Availability Clustering achieve its objective?

10. What is an Active/Active-Cluster?

11. What is an Active/Passive-Cluster?

12. What is the meaning of Failover?

13. What is the meaning of Failback?

14. What causes a Split Brain?

15. What is the result of a Split Brain?

16. Explain the difference between the Shared Nothing and the Shared Disk Clusters.

17. Explain the main difference between a SAN (Storage Area Network) and a NAS (Network Attached Storage).

18. What is the objective of High Performance Clustering?

19. Name an advantage of High Performance Clusters versus supercomputers.

20. Name a drawback of High Performance Clusters versus supercomputers.

21. What is a Beowulf Cluster?

22. What is a Wulfpack Cluster?

23. What is the objective of High Throughput Clustering?

24. Can High Throughput Clusters be used to process the same tasks as High Performance Clusters?

Exercise 2   (MPI Cluster)

Build up a MPI Cluster with at least 2 virtual nodes (e.g. with VirtualBox or any other virtualization software) or alternatively with at least 2 physical nodes.

Write down precise instructions with the steps you performed to build up the MPI cluster.

Execute a simple program to demonstrate the functioning of your cluster.

Exercise 3   (Approximate π via Monte Carlo)

π can be approximated via Monte Carlo simulation.

Approach: Inscribe a circle of radius r inside a square with side length $2r$.

Generate random dots in the square. The number of dots in A_C in relation to the number of dots in A_S is equal to the surface ratio.

$$A_S = (2r)^2 = 4r^2$$

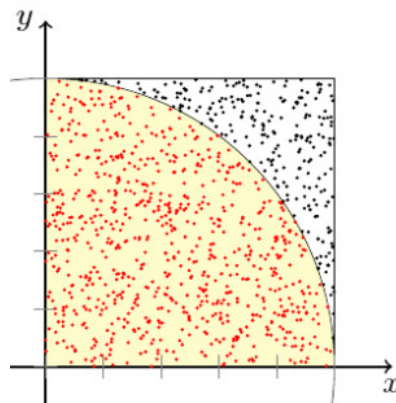$$A_C = \pi r^2 \implies \pi = \frac{A_C}{r^2}$$

$$\frac{A_C}{A_S} = \frac{\pi r^2}{4r^2} \implies \frac{A_C}{A_S} = \frac{\pi}{4}$$

The dots can be generated in parallel by the workers. The master receives the dots and calculates π.
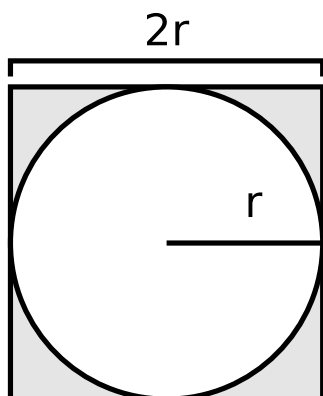
A = Surface ratio
r = Radius
C = Circle
S = Square

Image source: Wikipedia

Develop a MPI application, which calculates π via Monte Carlo simulation.

Test your MPI application with with the MPI cluster you already created and with different numbers or worker nodes to discover if your application scales well with a growing number of worker nodes.