Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
Hingna Road, Wanadongri, Nagpur - 441 110
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Department of Computer Technology

Vision of the Department

To be a well-known centre for pursuing computer education through innovative pedagogy, value-based education and industry collaboration.

Mission of the Department

To establish learning ambience for ushering in computer engineering professionals in core and multidisciplinary area by developing Problem-solving skills through emerging technologies.

Session 2025-2026

Vision: To help businesses uncover crucial insights	**Mission:** To be a good data scientist

Program Educational Objectives of the program (PEO): (broad statements that describe the professional and career accomplishments)

PEO1	**Preparation**	**P: Preparation**	**Pep-CL abbreviation pronounce as Pep-si-lL easy to recall**
PEO2	**Core Competence**	**E: Environment (Learning Environment)**	
PEO3	**Breadth**	**P: Professionalism**	
PEO4	**Professionalism**	**C: Core Competence**	
PEO5	**Learning Environment**	**L: Breadth (Learning in diverse areas)**	

Program Outcomes (PO): 1. Understand and Apply Parallel Programming Concepts

2. Analyse and Improve Program Performance.

3. Demonstrate Practical Skills in HPC Tools and Environments.

Keywords of POs:
Engineering knowledge, Problem analysis, Design/development of solutions, Conduct Investigations of Complex Problems, Engineering Tool Usage, The Engineer and The World, Ethics, Individual and Collaborative Team work, Communication, Project Management and Finance, Life-Long Learning

PSO Keywords: Cutting edge technologies, Research

"I am an engineer, and I know how to apply engineering knowledge to investigate, analyse and design solutions to complex problems using tools for entire world following all ethics in a collaborative way with proper management skills throughout my life." *to contribute to the development of cutting-edge technologies and Research*.

Integrity: I will adhere to the Laboratory Code of Conduct and ethics in its entirety.

Name and Signature of Student and Date
Soham pimpalgaonkar – 28/10/2025

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Session	**2025-26 (ODD)**	**Course Name**	**HPC Lab**
Semester	**7**	**Course Code**	22ADS706
Roll No	62	**Name of Student**	Soham pimpalgaonkar

Practical Number	6
Course Outcome	1. Understand and Apply Parallel Programming Concepts 2. Analyse and Improve Program Performance
Aim	Parallel Pi Calculation using MPI
Problem Definition	Parallel Pi Calculation using MPI
Theory (100 words)	The value of π can be approximated using the Monte Carlo method or numerical integration. One common numerical method is based on the integration of the area under a curve: $$\pi = 4\int_0^1 \frac{1}{1+x^2}dx$$ This integral can be approximated by dividing the interval [0,1] into N subintervals and summing the area of rectangles: $$\pi \approx 4 \times \frac{1}{N}\sum_{i=0}^{N-1}\frac{1}{1+x_i^2}$$ Where $x_i = \frac{i+0.5}{N}$. Using MPI, the work of summing these rectangles can be distributed among multiple processes. Each process computes a partial sum, and the master process (rank 0) collects the results to compute the final value of π. Software/Hardware Requirements: Hardware: Multi-core CPU or cluster with multiple nodes Software: o Linux/Unix OS

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	o MPICH or OpenMPI o GCC Compiler **Algorithm:** 1. Initialize MPI environment using MPI_Init. 2. Get the rank (ID) of each process and total number of processes using MPI_Comm_rank and MPI_Comm_size. 3. Divide the range [0,1] among processes. Each process computes a partial sum of π for its assigned range. 4. Use MPI_Reduce to collect and sum all partial results at the root process. 5. The root process prints the final value of π. 6. Finalize MPI using MPI_Finalize.

Code:	#include <stdio.h>
	#include <mpi.h>
	
	int main(int argc, char* argv[]) {
	int rank, size, n = 1000000, i;
	double h, sum = 0.0, x, local_sum = 0.0, pi;
	
	MPI_Init(&argc, &argv);
	MPI_Comm_rank(MPI_COMM_WORLD, &rank);
	MPI_Comm_size(MPI_COMM_WORLD, &size);
	
	h = 1.0 / (double) n;
	
	// Each process computes its portion
	for (i = rank; i < n; i += size) {
	x = h * (i + 0.5);
	local_sum += 4.0 / (1.0 + x * x);
	}
	local_sum *= h;
	
	// Reduce all local sums to get the final result
	MPI_Reduce(&local_sum, &pi, 1, MPI_DOUBLE, MPI_SUM, 0, MPI_COMM_WORLD);
	
	if (rank == 0) {
	printf("Calculated value of Pi = %.16f\n", pi);
	}
	
	MPI_Finalize();

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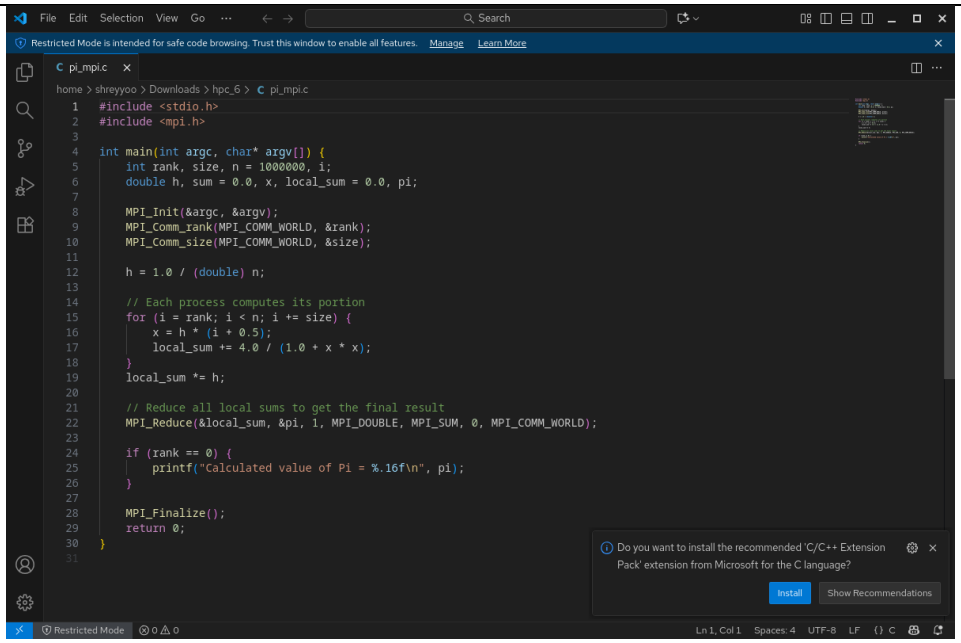
	return 0; }
Output	

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	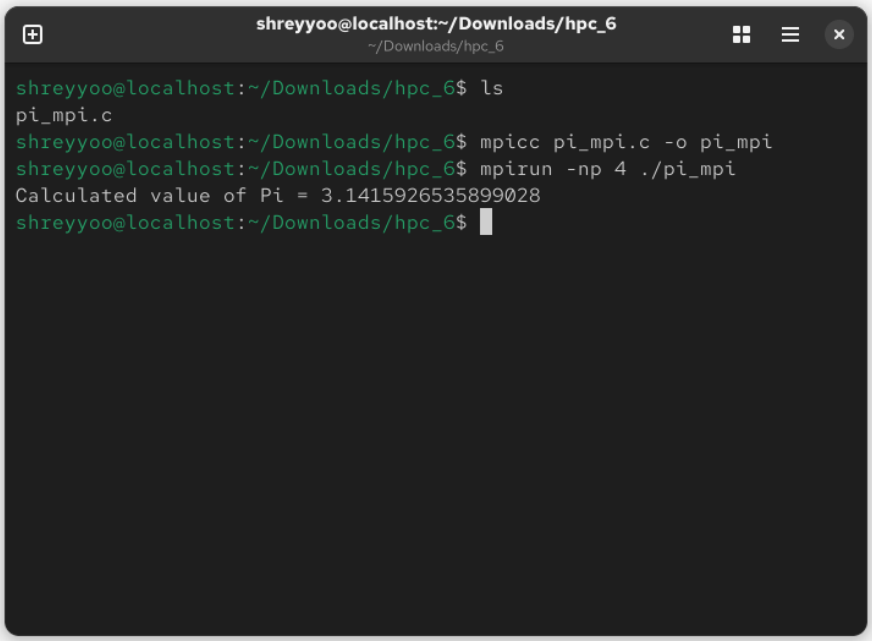
Output Analysis	OpenMPI executes the program successfully and gives us the calculated value of Pi.
Link of student Github profile where lab assignment has been uploaded	**https://github.com/Sohampimpalgaonkar/HPC**
Conclusion	The Parallel Pi Calculation using MPI experiment successfully demonstrated that utilizing the Message Passing Interface significantly reduces the computation time compared to a sequential approach by distributing the numerical integration workload among multiple processes.

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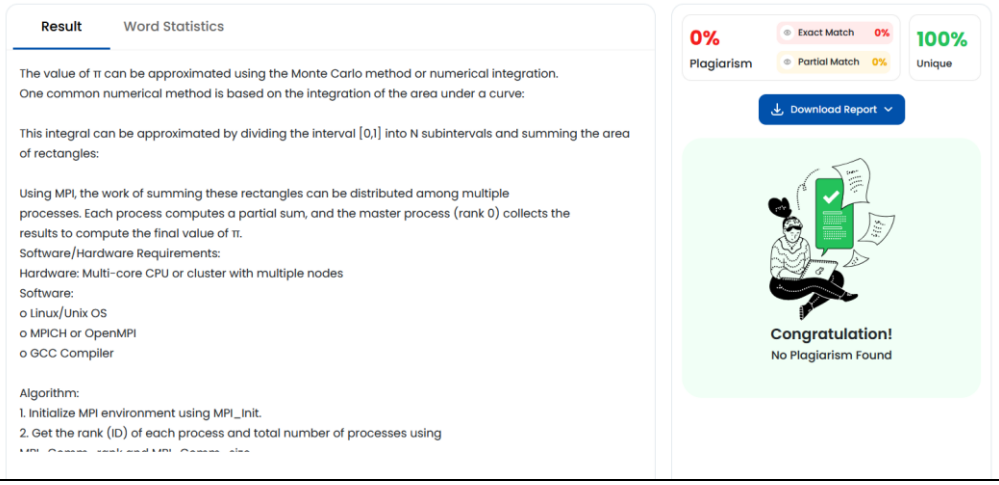
Plag Report (Similarity index < 12%)	
Date	28/10/2025