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
NAAC A++
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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 harness the power of artificial intelligence and data science to solve real-world problems and enhance human potential.	**Mission:** To acquire skills through coursework, projects, and internships, while actively engaging in research and collaboration with peers to innovate and apply AI solutions.

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): (statements that describe what a student should be able to do and know by the end of a program)

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.

Prerana Bijekar 28 October 2025
Name and Signature of Student and Date
(Signature and Date in Handwritten)

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Session	2025-26 (ODD)	**Course Name**	HPC Lab
Semester	7	**Course Code**	22ADS706
Roll No	11	**Name of Student**	Prerana Bijekar

Practical Number	6
Course Outcome	**CO1:** Understand and Apply Parallel Programming Concepts **CO2:** Analyze and Improve Program Performance. **CO3:** Demonstrate Practical Skills in HPC Tools and Environments.
Aim	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:
	  ○ Linux/Unix OS
	  ○ MPICH or OpenMPI
	  ○ GCC Compiler

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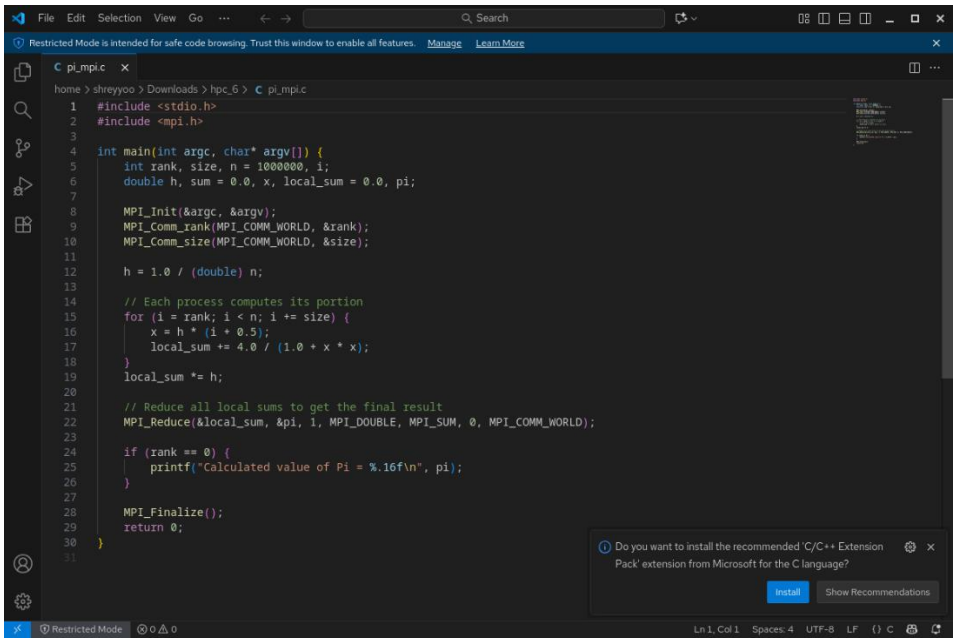
Procedure and Execution (100 Words)

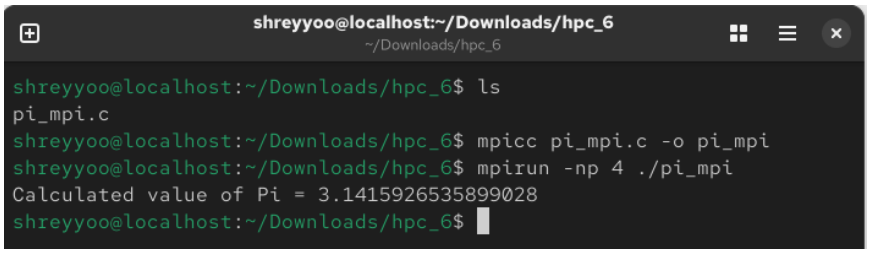
Algorithm:

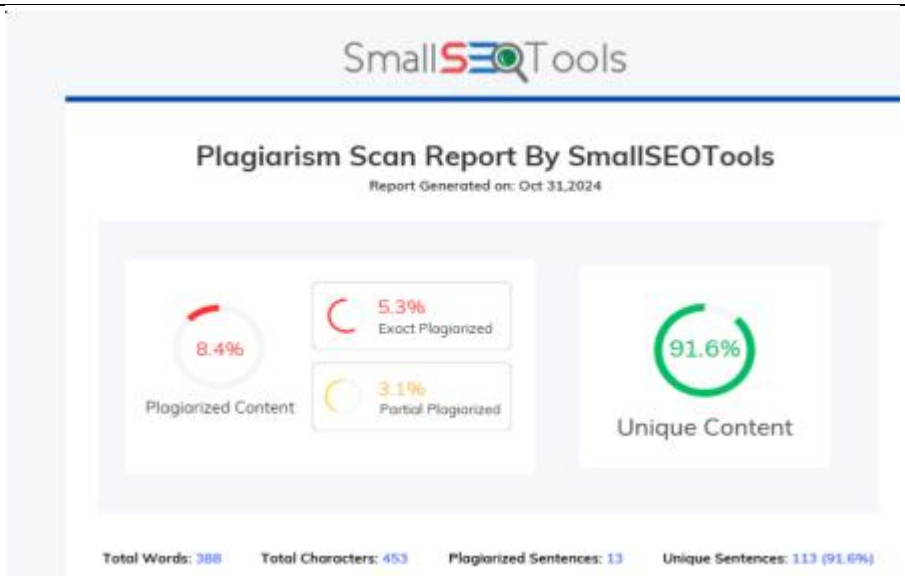
- Initialize MPI environment using MPI_Init.
- Get the rank (ID) of each process and total number of processes using MPI_Comm_rank and MPI_Comm_size.
- Divide the range [0,1] among processes. Each process computes a partial sum of π for its assigned range.
- Use MPI_Reduce to collect and sum all partial results at the root process.
- The root process prints the final value of π.
- Finalize MPI using MPI_Finalize.

Code:



Output:



Output Analysis	OpenMPI executes the program successfully and gives us the calculated value of Pi.
Github Link	https://github.com/Prerana-Bijekar/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.
Plag Report (Similarity index < 12%)	
Date	28 October 2025