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 August 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	2
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	Measuring Program Performance
Theory (100 words)	1. Definition: Program performance refers to how efficiently a program uses system resources (CPU, memory, I/O) to complete tasks. 2. Key Metrics**:** • Execution time (response time / latency). • Throughput (tasks completed per unit time). • CPU utilization**.** • Memory usage**.** • I/O performance**.** 3. Measurement Tools: Profilers (`gprof`, `perf`), timers, benchmarking frameworks. 4. Performance Factors: Algorithm efficiency, coding style, compiler optimizations, hardware limitations. 5. Bottlenecks: Identified in CPU, memory, or I/O that slow down execution. 6. Optimization: Achieved through better algorithms, parallelization, and resource management.
Procedure and Execution (100 Words)	Algorithm: • nano filename.extension: open file in editor • gcc –o filename filename.extension: compile file • ./filename: run file
	Code:

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```c
#include <stdio.h>
#include <stdlib.h>
#include <time.h>

void matmul(int N, double *A, double *B, double *C) {
    for (int i = 0; i < N; i++)
        for (int j = 0; j < N; j++) {
            double sum = 0;
            for (int k = 0; k < N; k++)
                sum += A[i*N+k] * B[k*N+j];
            C[i*N+j] = sum;
        }
}

int main(int argc, char **argv) {
    if (argc < 2) {
        printf("Usage: %s matrix_size\n", argv[0]);
        return 1;
    }
    int N = atoi(argv[1]);
    double *A = malloc(N*N*sizeof(double));
    double *B = malloc(N*N*sizeof(double));
    double *C = malloc(N*N*sizeof(double));

    // Initialize matrices A and B
    for (int i = 0; i < N*N; i++) {
        A[i] = 1.0;
        B[i] = 2.0;
    }

    clock_t start = clock();
    matmul(N, A, B, C);
    clock_t end = clock();

    double time_spent = (double)(end - start) / CLOCKS_PER_SEC;
    printf("Serial MatMul elapsed time: %f seconds\n", time_spent);

    free(A); free(B); free(C);
    return 0;
}
```

```c
#include <stdio.h>
#include <stdlib.h>
#include <omp.h>

void matmul(int N, double *A, double *B, double *C) {
    #pragma omp parallel for collapse(2)
    for (int i = 0; i < N; i++)
        for (int j = 0; j < N; j++) {
            double sum = 0;
            for (int k = 0; k < N; k++)
                sum += A[i*N+k] * B[k*N+j];
            C[i*N+j] = sum;
        }
}

int main(int argc, char **argv) {
    if (argc < 2) {
        printf("Usage: %s matrix_size\n", argv[0]);
        return 1;
    }
    int N = atoi(argv[1]);
    double *A = malloc(N*N*sizeof(double));
    double *B = malloc(N*N*sizeof(double));
    double *C = malloc(N*N*sizeof(double));

    for (int i = 0; i < N*N; i++) {
        A[i] = 1.0;
        B[i] = 2.0;
    }

    double start = omp_get_wtime();
    matmul(N, A, B, C);
    double end = omp_get_wtime();

    printf("OpenMP MatMul elapsed time: %f seconds\n", end - start);

    free(A); free(B); free(C);
    return 0;
}
```

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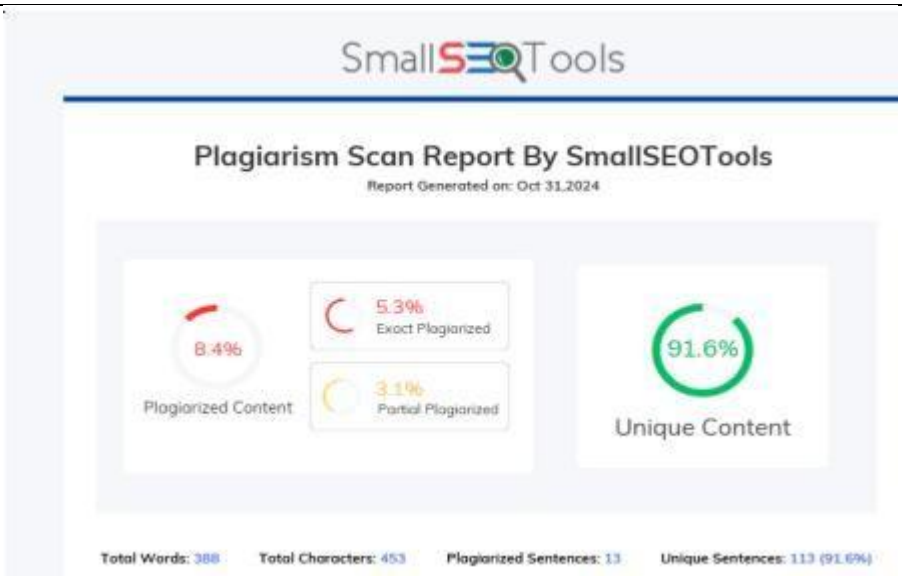
	Output:
	
	`[lab1@localhost ~]$ nano matmul_serial.c`
	`[lab1@localhost ~]$ gcc -o matmul_serial matmul_serial.c`
	`[lab1@localhost ~]$ ./matmul_serial 500`
	`Serial MatMul elapsed time: 0.326071 seconds`
	`[lab1@localhost ~]$ nano matmul_openmp.c`
	`[lab1@localhost ~]$ gcc -fopenmp -o matmul_openmp matmul_openmp.c`
	`[lab1@localhost ~]$ ./matmul_openmp 500`
	`OpenMP MatMul elapsed time: 0.033727 seconds`
	`[lab1@localhost ~]$`

Output Analysis	Performance measurement shows how effectively a program utilizes available resources. It helps identify bottlenecks like high execution time or memory overhead, guiding improvements for speed and efficiency.
Github Link	https://github.com/Prerana-Bijekar/HPC
Conclusion	Measuring program performance is crucial to ensure optimized execution. By analyzing metrics and eliminating bottlenecks, developers can enhance program efficiency, scalability, and reliability across different computing environments.
Plag Report (Similarity index < 12%)	
Date	28 August 2025