

[illegible]

```
ec2-user@ip-172-31-32-184: ~$ cat Exercise_1.c
24 | return 0;
Exercise_1.c:24:11: error: stray '\302' in program
24 | return 0;
^
[ec2-user@ip-172-31-32-184 ~]$ gcc -fopenmp Exercise_1.c -o Exercise_1.o -lm
Exercise_1.c: In function 'main':
Exercise_1.c:24:11: error: stray '\302' in program
24 | return 0;
^
Exercise_1.c:24:2: error: stray '\302' in program
24 | return 0;
^
Exercise_1.c:24:3: error: stray '\302' in program
24 | return 0;
^
Exercise_1.c:24:4: error: stray '\302' in program
24 | return 0;
^
Exercise_1.c:24:11: error: stray '\302' in program
24 | return 0;
^
[ec2-user@ip-172-31-32-184 ~]$ sed -i 's/^[[:print:]]\t[/g' Exercise_1.c
[ec2-user@ip-172-31-32-184 ~]$ ls
Exercise_1 Exercise_1.c exercise01 exercise01.c exercise02 exercise02.c
[ec2-user@ip-172-31-32-184 ~]$ gcc -fopenmp Exercise_1.c -o Exercise_1 -lm
./Exercise_1
Parallel Pi value: 3.141592652589258
Execution time (seconds): 1.857739
[ec2-user@ip-172-31-32-184 ~]$
```

Exercise 2

```
geeth@DESKTOP-3400SVB:~$ cd /mnt/c/Users/geeth2001/Downloads
geeth@DESKTOP-3400SVB:~/Downloads$ chmod 400 ~/labsuser.pem
geeth@DESKTOP-3400SVB:~/Downloads$ ssh -i ~/labsuser.pem ec2-user@54.80.194.111

Amazon Linux 2023

Last login: Mon Aug 11 13:23:06 2025 from 124.43.209.181
[ec2-user@ip-172-31-32-184 ~]$ gcc -fopenmp Exercise_2.c -o Exercise_2
[ec2-user@ip-172-31-32-184 ~]$ ./Exercise_2 1000000000 4
Usage: ./Exercise_2 <N> <threads>
Threads: 4
Parallel Pi value: 3.141592652589210
Execution time (seconds): 16.139113
[ec2-user@ip-172-31-32-184 ~]$ gcc -fopenmp Exercise_2.c -o Exercise_2
[ec2-user@ip-172-31-32-184 ~]$ ./Exercise_2 1000000000 16
Usage: ./Exercise_2 <N> <threads>
Threads: 16
Parallel Pi value: 3.141592652590204
Execution time (seconds): 16.179222
[ec2-user@ip-172-31-32-184 ~]$
```

```
x
Exercise_1.c
./Exercise_1
/usr/bin/ld: cannot find Ex: No such file or directory
collect2: error: ld returned 1 exit status
Exercise_1.c: command not found
-bash: ./Exercise_1: No such file or directory
geeth@DESKTOP-3400SVB:~/Downloads$ gcc -o Exercise_1
Exercise_1.c
./Exercise_1
/usr/bin/ld: cannot find Ex: No such file or directory
collect2: error: ld returned 1 exit status
Exercise_1.c: command not found
-bash: ./Exercise_1: No such file or directory
geeth@DESKTOP-3400SVB:~/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_1.c ec2-user@54.80.194.111:~/Exercise_1.c
100% 541 1.5KB/s 00:00
geeth@DESKTOP-3400SVB:~/Downloads$ nano Exercise_1.c
geeth@DESKTOP-3400SVB:~/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_1.c ec2-user@54.80.194.111:~/Exercise_1.c
100% 541 1.8KB/s 00:00
geeth@DESKTOP-3400SVB:~/Downloads$ nano Exercise_1.c
geeth@DESKTOP-3400SVB:~/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_1.c ec2-user@54.80.194.111:~/Exercise_1.c
100% 628 2.2KB/s 00:00
geeth@DESKTOP-3400SVB:~/Downloads$ nano Exercise_2.c
geeth@DESKTOP-3400SVB:~/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_2.c ec2-user@54.80.194.111:~/Exercise_2.c
100% 628 2.3KB/s 00:00
geeth@DESKTOP-3400SVB:~/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_2.c ec2-user@54.80.194.111:~/Exercise_2.c
100% 822 3.1KB/s 00:00
geeth@DESKTOP-3400SVB:~/Downloads$ nano Exercise_2.c
geeth@DESKTOP-3400SVB:~/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_2.c ec2-user@54.80.194.111:~/Exercise_2.c
100% 817 2.9KB/s 00:00
geeth@DESKTOP-3400SVB:~/Downloads$ nano Exercise_2.c
geeth@DESKTOP-3400SVB:~/Downloads$
```

```
GNU nano 7.2 Exercise_2.c
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include <omp.h>

int main(int argc, char *argv[]) {
    if (argc < 3) {
        printf("Usage: %s <N> <threads>\n", argv[0]);
        return 1;
    }

    long long int N = atoll(argv[1]); // number of iterations
    int threads = atoi(argv[2]); // number of threads
    double pi = 0.0;
    double tstart, tstop, tcalc;

    omp_set_num_threads(threads);

    tstart = omp_get_wtime();

    #pragma omp parallel for reduction(+:pi)
    for (long long int i = 0; i < N; i++) {
        pi += pow(-1, i) / (2.0 * i + 1.0);
    }
    pi *= 4.0;

    tstop = omp_get_wtime();
    tcalc = tstop - tstart;

    printf("Threads: %d\n", threads);
    printf("Parallel Pi value: %.15f\n", pi);
    printf("Execution time (seconds): %f\n", tcalc);

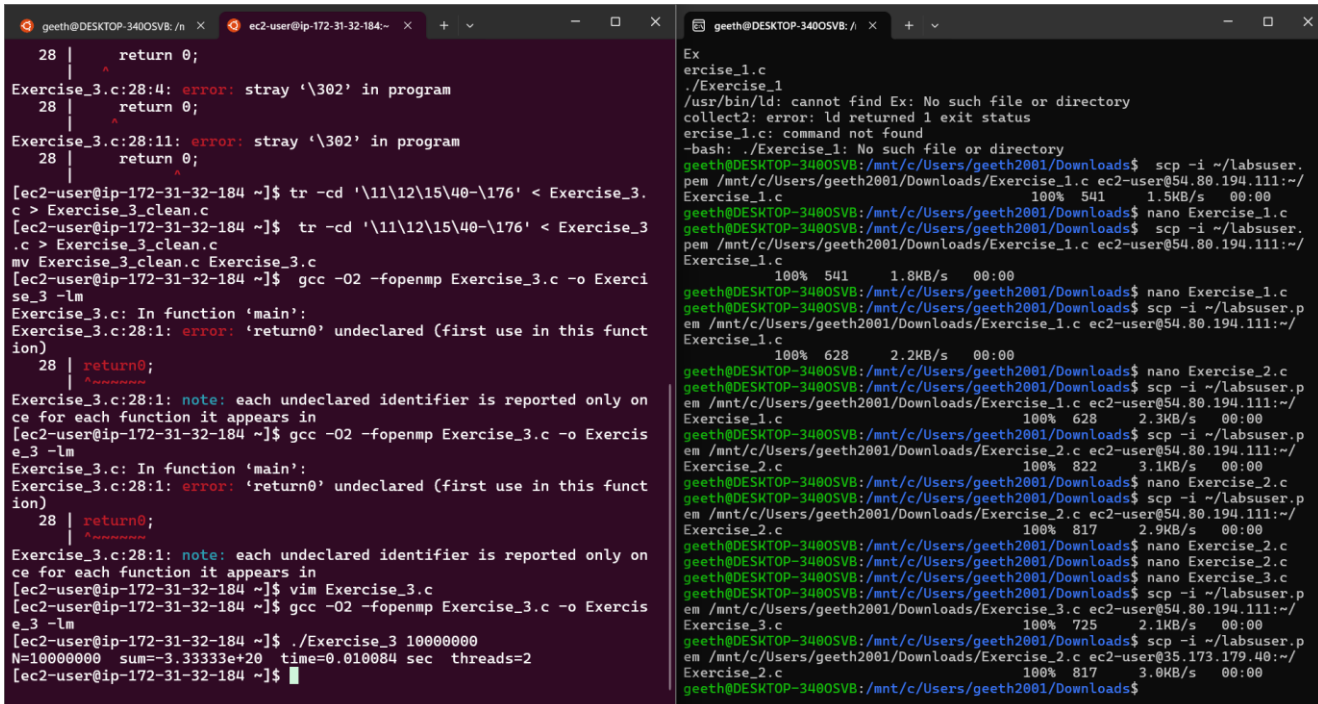
    return 0;
}
```

[Read 35 lines]

^G Help ^O Write Out ^W Where Is ^K Cut ^T Execute
^X Exit ^R Read File ^\ Replace ^U Paste ^J Justify

Exercise 3

```
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ tr -cd '\11\12\15\40-\176' < Exercise_3.c > Exercise_3_clean.c
mv Exercise_3_clean.c Exercise_3.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ gcc -O2 -fopenmp Exercise_3.c -o Exercise_3 -lm
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ ./Exercise_3 10 000000
N=10000000 sum=-3.33333e+20 time=0.003850 sec threads=4
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$
```



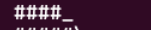
```
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ gcc -O2 -fopenmp Exercise_3.c -o Exercise_3 -lm
Exercise_3.c: In function 'main':
Exercise_3.c:28:1: error: 'return0' undeclared (first use in this function)
    28 |     return0;
       |     ^~~~~~
Exercise_3.c:28:1: note: each undeclared identifier is reported only once for each function it appears in
[ec2-user@ip-172-31-32-184 ~]$ gcc -O2 -fopenmp Exercise_3.c -o Exercise_3 -lm
Exercise_3.c: In function 'main':
Exercise_3.c:28:1: error: 'return0' undeclared (first use in this function)
    28 |     return0;
       |     ^~~~~~
Exercise_3.c:28:1: note: each undeclared identifier is reported only once for each function it appears in
[ec2-user@ip-172-31-32-184 ~]$ vim Exercise_3.c
[ec2-user@ip-172-31-32-184 ~]$ gcc -O2 -fopenmp Exercise_3.c -o Exercise_3 -lm
[ec2-user@ip-172-31-32-184 ~]$ ./Exercise_3 10000000
N=10000000 sum=-3.33333e+20 time=0.010084 sec threads=2
[ec2-user@ip-172-31-32-184 ~]$
```

```
Ex
ercise_1.c
./Exercise_1
/usr/bin/ld: cannot find Ex: No such file or directory
collect2: error: ld returned 1 exit status
ercise_1.c: command not found
-bash: ./Exercise_1: No such file or directory
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_1.c ec2-user@54.80.194.111:~/Exercise_1.c
100% 541 1.5KB/s 00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ nano Exercise_1.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_1.c ec2-user@54.80.194.111:~/Exercise_1.c
100% 541 1.8KB/s 00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ nano Exercise_1.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_1.c ec2-user@54.80.194.111:~/Exercise_1.c
100% 628 2.2KB/s 00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ nano Exercise_2.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_2.c ec2-user@54.80.194.111:~/Exercise_2.c
100% 628 2.3KB/s 00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_2.c ec2-user@54.80.194.111:~/Exercise_2.c
100% 822 3.1KB/s 00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ nano Exercise_2.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_2.c ec2-user@54.80.194.111:~/Exercise_2.c
100% 817 2.9KB/s 00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ nano Exercise_2.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ nano Exercise_2.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ nano Exercise_3.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_3.c ec2-user@54.80.194.111:~/Exercise_3.c
100% 725 2.1KB/s 00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Downloads/Exercise_2.c ec2-user@35.173.179.40:~/Exercise_2.c
100% 817 3.0KB/s 00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$
```

Exercise 4

```
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ nano Exercise_4.c
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ scp -i ~/labsuser.pem /mnt/c/Users/geeth2001/Do
wnloads/Exercise_4.c ec2-user@35.173.179.40:~/
Exercise_4.c                                     100% 1675      5.9KB/s   00:00
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ |
```

```
geeth@DESKTOP-3400SVB:~$ cd /mnt/c/Users/geeth2001/Downloads
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ chmod 400 ~/labsuser.pem
geeth@DESKTOP-3400SVB:/mnt/c/Users/geeth2001/Downloads$ ssh -i ~/labsuser.pem ec2-user@35.173.179.40
```



Amazon Linux 2023

<https://aws.amazon.com/linux/amazon-linux-2023>

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```
[ec2-user@ip-172-31-32-184 ~]$ ls
```

[Exercise_2](#) [Exercise_3.c](#) [exercise01](#) [exercise02.c](#)

```
[ec2-user@ip-172-31-32-184 ~]$
```

```
[ec2-user@ip-172-31-32-184 ~]$ ./e4 1
```

```
./Exercise_4 2
```

```
./Exercise_4 4
```

```
./Exercise_4 8
```

```
./Exercise_4 16
```

Threads: 1

Estimated Pi: 3.1413864000000000

Execution Time (seconds): 0.148750

Threads: 2

Estimated Pi: 3.1412652000000000

Execution Time (seconds): 0.098132

Threads: 4

Estimated Pi: 3.1408764000000000

Execution Time (seconds): 0.099273

Threads: 8

Estimated Pi: 3.1411240000000000

```
Execution Time (seconds): 0.099911
```

Threads: 16

Estimated Pi: 3.1415400000000000

Execution Time (seconds): 0.1006

```
[ec2-user@ip-172-31-47-133 ~]$ {
```

```
./Exercise_4 1
```

```
./Exercise_4 2
```

```
./Exercise_4 4
```

```
./Exercise_4 8
```

```
./Exercise_4 16
```

```
} > Exercise_4_results.txt
```

```
-bash: ./e4: No such file or directory
```

Final Estimation of $\pi = 3.141960$

Final Estimation of $\pi = 3.137510$

Final Estimation of Pi = 3.139050