

Tugas 2
IF3230 Sistem Paralel dan Terdistribusi
Trapezoidal Rule in MPI



Disusun oleh:

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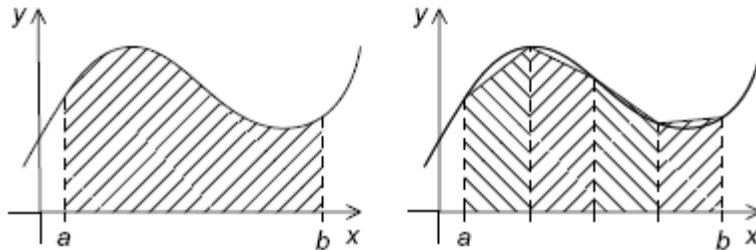
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Deskripsi

MPI adalah library yang dirancang untuk pemrograman distributed-memory system. MPI menyediakan mekanisme untuk mengirim pesan.

Tugas ini merupakan implementasi trapezoidal rule dalam MPI. Trapezoidal rule dapat digunakan untuk mengaproksimasi area antara grafik $f(x)$, dua garis vertikal, dan x-axis. Caranya yaitu dengan membagi interval pada x-axis menjadi n subinterval yang sama.



Pada tugas ini akan digunakan $f(x) = \sin(x)$, dengan jumlah partisi $n = 10$ dan $n = 20$.

Hasil

Repositori: <https://github.com/nlatifahulfah/trapezoidal-rule-mpi>

Source Code:

```
#include <stdio.h>
#include <string.h>
#include <mpi.h>
#include <math.h>

#define PI 3.14159265

double Trap(double left_endpt, double right_endpt, int trap_count, double base_len);
double f(double x);
void Get_input(int my_rank, int comm_sz, double* a_p, double* b_p, int* n_p);

int main(void) {
    int my_rank, comm_sz, n, local_n;
    double a, b, h, local_a, local_b;
    double local_int, total_int;
    int source;

    MPI_Init(NULL, NULL);
    MPI_Comm_rank(MPI_COMM_WORLD, &my_rank);
    MPI_Comm_size(MPI_COMM_WORLD, &comm_sz);

    Get_input(my_rank, comm_sz, &a, &b, &n);

    h = (b-a)/n;
    local_n = n/comm_sz;

    local_a = a + my_rank*local_n*h;
    local_b = local_a + local_n*h;
    local_int = Trap(local_a, local_b, local_n, h);

    if (my_rank != 0) {
        MPI_Send(&local_int, 1, MPI_DOUBLE, 0, 0, MPI_COMM_WORLD);
    } else {
        total_int = local_int;
        for (source = 1; source < comm_sz; source++) {
            MPI_Recv(&local_int, 1, MPI_DOUBLE, source, 0, MPI_COMM_WORLD,
MPI_STATUS_IGNORE);
            total_int += local_int;
        }
    }
}
```

```

        if (my_rank == 0) {
            printf("With n = %d trapezoids, our estimate\n", n);
            printf("of the integral from %f to %f = %.15e\n", a, b, total_int);
        }

        MPI_Finalize();
        return 0;
    } /* main */

double Trap(
    double left_endpt,
    double right_endpt,
    int trap_count,
    double base_len) {

    double estimate, x;
    int i;

    estimate = (f(left_endpt) + f(right_endpt))/2.0;
    for (i = 1; i <= trap_count-1; i++) {
        x = left_endpt + i*base_len;
        estimate += f(x);
    }
    estimate = estimate*base_len;

    return estimate;
} /* Trap */

double f(double x) {
    double val, ret;

    val = PI / 180;
    ret = sin(x*val);

    return ret;
}

void Get_input(int my_rank,
               int comm_sz,
               double* a_p,
               double* b_p,
               int* n_p) {

    int dest;

    if (my_rank == 0) {
        printf("Enter a, b, and n\n");
        scanf("%lf %lf %d", a_p, b_p, n_p);
        for (dest = 1; dest < comm_sz; dest++) {
            MPI_Send(a_p, 1, MPI_DOUBLE, dest, 0, MPI_COMM_WORLD);
            MPI_Send(b_p, 1, MPI_DOUBLE, dest, 0, MPI_COMM_WORLD);
            MPI_Send(n_p, 1, MPI_INT, dest, 0, MPI_COMM_WORLD);
        }
    } else { /* my rank != 0 */
        MPI_Recv(a_p, 1, MPI_DOUBLE, 0, 0, MPI_COMM_WORLD, MPI_STATUS_IGNORE);
        MPI_Recv(b_p, 1, MPI_DOUBLE, 0, 0, MPI_COMM_WORLD, MPI_STATUS_IGNORE);
        MPI_Recv(n_p, 1, MPI_INT, 0, 0, MPI_COMM_WORLD, MPI_STATUS_IGNORE);
    }
}
/* Get input */

```

Screenshot:

Jumlah proses = 1, $a = 0^\circ$, $b = 90^\circ$, $n = 10$ dan 20

```
nl@nl-Inspiron-3458: ~/Sister
nl@nl-Inspiron-3458:~/Sister$ make run1
mpiexec -n 1 ./tugas_2
Enter a, b, and n
0 90 10
With n = 10 trapezoids, our estimate
of the integral from 0.000000 to 90.000000 = 5.717792127576247e+01
nl@nl-Inspiron-3458:~/Sister$ make run1
mpiexec -n 1 ./tugas_2
Enter a, b, and n
0 90 20
With n = 20 trapezoids, our estimate
of the integral from 0.000000 to 90.000000 = 5.726632401626994e+01
nl@nl-Inspiron-3458:~/Sister$
```

Jumlah proses = 2, $a = 0^\circ$, $b = 90^\circ$, $n = 10$ dan 20

```
nl@nl-Inspiron-3458: ~/Sister
nl@nl-Inspiron-3458:~/Sister$ make run2
mpiexec -n 2 ./tugas_2
Enter a, b, and n
0 90 10
With n = 10 trapezoids, our estimate
of the integral from 0.000000 to 90.000000 = 5.717792127576248e+01
nl@nl-Inspiron-3458:~/Sister$ make run2
mpiexec -n 2 ./tugas_2
Enter a, b, and n
0 90 20
With n = 20 trapezoids, our estimate
of the integral from 0.000000 to 90.000000 = 5.726632401626994e+01
nl@nl-Inspiron-3458:~/Sister$
```

Jumlah proses = 3, $a = 0^0$, $b = 90^0$, $n = 10$ dan 20

```
nl@nl-Inspiron-3458: ~/Sister
nl@nl-Inspiron-3458:~/Sister$ make run3
mpirun -n 3 ./tugas_2
Enter a, b, and n
0 90 10
With n = 10 trapezoids, our estimate
of the integral from 0.000000 to 90.000000 = 4.823332374422153e+01
nl@nl-Inspiron-3458:~/Sister$ make run3
mpirun -n 3 ./tugas_2
Enter a, b, and n
0 90 20
With n = 20 trapezoids, our estimate
of the integral from 0.000000 to 90.000000 = 4.830789724930243e+01
nl@nl-Inspiron-3458:~/Sister$
```

Jumlah proses = 4, $a = 0^0$, $b = 90^0$, $n = 10$ dan 20

```
nl@nl-Inspiron-3458: ~/Sister
nl@nl-Inspiron-3458:~/Sister$ make run4
mpirun -n 4 ./tugas_2
Enter a, b, and n
0 90 10
With n = 10 trapezoids, our estimate
of the integral from 0.000000 to 90.000000 = 3.950897189134915e+01
nl@nl-Inspiron-3458:~/Sister$ make run4
mpirun -n 4 ./tugas_2
Enter a, b, and n
0 90 20
With n = 20 trapezoids, our estimate
of the integral from 0.000000 to 90.000000 = 5.726632401626993e+01
nl@nl-Inspiron-3458:~/Sister$
```

Kesimpulan

1. Perhitungan area kurva suatu fungsi dapat dilakukan dengan membagi area ke dalam subinterval, mengaproksimasi dengan trapesium, dan menjumlahkan area dari masing-masing subinterval tersebut.
2. Jumlah data / trapesium lebih besar, area estimasi lebih mendekati area sebenarnya
3. Implementasi hanya menangani jumlah data genap yang dapat dibagi habis oleh jumlah proses yang digunakan, ditunjukkan pada penggunaan 3 dan 4 proses yang hasilnya tidak sesuai.

Referensi

Peter Pacheco. 2011. An Introduction to Parallel Programming (1st ed.). Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.