Office hour

火曜8限 @ 演習室4 / 8th period on Tue. @ std4

メールの送り方/How to send a mail

質問等がある場合, TAにメールを送ってください/If you have a question, send a mail to TA

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注意/Remark

- 件名に [PCS] を入れること/To put [PCS] in a subject
- 本文に学籍番号と氏名を入れること/To write your student ID and your name in a body

レポートの書き方/How to write a report

1. 学籍番号, 名前, レポート回数を必ず含めること

2. プログラムの実行環境, コンパイルオプションを明記すること
3. プログラムの作成に当たって創意工夫した点があれば言及すること
4. 実行結果は図だけではなく, 表にもまとめて載せること
5. なぜそのような実行結果になったのか, 実行結果からどのようなことが言えるのか等, 十分に考察すること

LaTeXを使用する場合は以下のリンクを参考にしてください/If you use LaTeX, access the following link
LaTeXを使用したレポートの作成/How to write a report in LaTeX

Ex01

Gnuplot

Data

ex01.dat

```
# x1 y1
10   3
100  6
1000 9
```

Plot script

ex01.plt

```
set term pngcairo
set output "ex01.png"
set logscale x
set xlabel "Number of partitions"
set ylabel "Elapsed time/seconds"
plot "ex01.dat" with lines
```

実行方法/How to run in your terminal

Terminal

```
$ gnuplot ex01.plt
```

Shell Script

Script for measurement

ex01.sh

```
#!/usr/local/gnu/bin/bash
for i in {10..30}; do
    n=$((2 ** i))
    echo $n
    time ./ex01 $n
done
```

実行方法/How to run in your terminal

Terminal

```
$ chmod 700 ex01.sh
$ ./ex01.sh
```

Ex02

Fileの読み取りかた/Read data from a file

ex02_fp.c

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

int main (int argc, char* argv[]) {
    FILE* fp;

    fp = fopen("sample.dat", "r");
    // Error check
    if (fp == NULL) {
        exit(-1);
    }

    // Input data from a file
    fscanf(fp, "format", ...);

    fclose(fp);

    return 0;
}
```

2次元配列の動的確保/Allocate memory for 2-dimensional array dynamically

ex02_mem.c

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

int main (int argc, char* argv[]) {
    double** array;
    unsigned int i, j, nx, ny;

    /*
        Initialize nx and ny
    */

    // Allocate memory for 2-dimensional array
    array = (double**)malloc(sizeof(double*)*ny);
    for (i = 0; i < ny; i++) {
        array[i] = (double*)malloc(sizeof(double)*nx);
    }

    for (i = 0; i < ny; i++) {
        for (j = 0; j < nx; j++) {
            /*
                Initialize array[i][j]
            */
        }
    }

    // Release memory for 2-dimensional array
    for (i = 0; i < ny; i++) {
        free(array[i]);
    }
    free(array);

    return 0;
}
```

注意/Remark

全データをソートする場合，2次元配列のままソートするのはあまり上手な方法とは言えません．
1次元配列としてデータを初期化し，いずれかのソート手法を使うと良いでしょう．
/It is not good way to sort data of 2-dimensional array in case of sorting all data. You use 1-dimensional array for using a sort algorithm.

Ex03

テンプレート/Template

ex03_template.c

```c
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <sys/time.h>
#include <sys/resource.h>

/*
    Define macro for a matrix described in Lec04
*/

/*
    Insert e_time() explained in Ex01
*/

int main (int argc, char* argv[]) {
    unsigned int i, j, k;
    unsigned int N;
/*
    Declare pointers for matrix
*/
    double st, en;

    if (argc != 2) {
        N = 128;
    } else {
/*
    Input N, that is size of matrix, from a command line argument
*/
    }

/*
    Allocate memory for matrices as explained in Lec04
*/

/*
```

```
    Initialize the input matrices with random numbers
*/

    st = e_time();
/*
    Compute matrix-multiplication
*/
    en = e_time();

    printf("%.10e\n", en - st);

/*
    Release memory for matrices
*/
    return 0;
}
```

計測方法の例/Example of measurement

Example of script for measurement

ex03.sh

```
#!/usr/local/gnu/bin/bash
for i in {1..5}; do
    # Change the matrix size n as 2, 4, 8, 16, 32
    n=$((2 ** i))
    echo $n

    if [ -f "tmp" ]; then
        rm tmp
    fi
    # Repeat the measurement of computation time 5 times
    for j in {1..5}; do
        ./ex03 $n >> tmp
    done

    # Calculate and display average elapsed time
    cat tmp | awk '{sum += $1} END {print sum/NR}'
done
```

実行方法/How to run in your terminal

Terminal

```
$ chmod 700 ex03.sh
$ ./ex03.sh
```

グラフの作成方法の例/Example of plotting data

Data

ex03.dat

```
# size elapsedTime(-O0) elapsedTime(-O2)
2 6.400000e-8 1.600000e-8
4 5.100000e-7 1.300000e-7
8 4.100000e-6 1.000000e-6
```

Plot script

ex03.plt

```
set term pngcairo
set output "ex03.png"
set title "Performance for matrix-multiplication as double precision"
set xlabel "Size of matrix"
set ylabel "Performance/MFLOPS"
set xrange [1:10]
set logscale x 2
plot "ex03.dat" using 1:(2*$1*$1*$1/$2/1.0e6) title "-O0" with lines,\
    "ex03.dat" using 1:(2*$1*$1*$1/$3/1.0e6) title "-O2" with lines
```

実行方法/How to run in your terminal

Terminal

```
$ gnuplot ex03.plt
```