# Report for Project 4

## 运行

```
gcc .\test.c .\matrix.c -mfma -static -I ./OpenBLAS/include/ -L ./OpenBLAS/lib -lopenblas -lpthread -lgfortran; .\a.exe
```

## 一、思路

在project3的基础上，对比不同的矩阵乘法实现的计算速度

利用SIMD等方法对矩阵乘法进行加速

## 二、Highlight

1. 良好的代码风格
2. 加速效果对比

## 三、代码结构

```c
typedef struct matrix
{
    size_t col;
    size_t row;
    float *data;
} MATRIX;

MATRIX *createMatrix(int row, int col, float *data);

MATRIX *create_random_Matrix(int row, int col);

MATRIX *matmul_plain(MATRIX *a, MATRIX *b);

MATRIX *matmul_improved(MATRIX *a, MATRIX *b);

MATRIX *matmul_openblas(MATRIX *m1, MATRIX *m2);

void printMatrix(MATRIX *const m);

```

## 四、实验对比（单位：微秒）

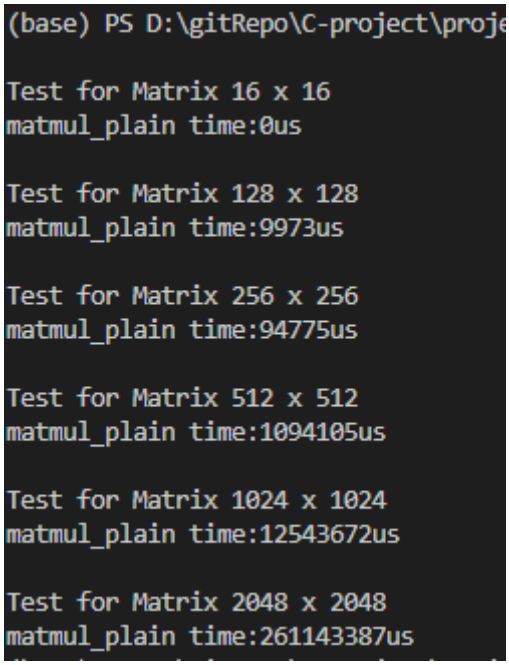
| N | matmul_plain | matmul_improved | matmul_openblas |
|---|---|---|---|
| 16 | 0 | 0 | 0 |
| 128 | 9973 | 1031 | 0 |
| 256 | 94775 | 8004 | 1961 |
| 512 | 1094105 | 65371 | 4955 |
| 1024 | 12543672 | 521605 | 30409 |
| 2048 | 261143387 | 5549194 | 107677 |
| 4096 | —— | 49706198 | 721038 |
| 8192 | —— | —— | 6259263 |

实验总结：

- 使用SIMD可以起到非常显著的加速效果
- 实验中openMP并没有显著提升，且有时反而会减缓计算速度
- openblas提速效果非常明显，使用了多线程

# 五、实验结果截图

- 基础矩阵乘法




- 使用SIMD进行加速

```
(base) PS D:\gitRepo\C-project\project4>

Test for Matrix 16 x 16
matmul_improved time:0us

Test for Matrix 128 x 128
matmul_improved time:1031us

Test for Matrix 256 x 256
matmul_improved time:8004us

Test for Matrix 512 x 512
matmul_improved time:65371us

Test for Matrix 1024 x 1024
matmul_improved time:521605us

Test for Matrix 2048 x 2048
matmul_improved time:5549194us

Test for Matrix 4096 x 4096
matmul_improved time:49706198us
```

- 使用openblas加速

```
(base) PS D:\gitRepo\C-project\project4>

Test for Matrix 16 x 16
matmul_openblas time:0us

Test for Matrix 128 x 128
matmul_openblas time:0us

Test for Matrix 256 x 256
matmul_openblas time:997us

Test for Matrix 512 x 512
matmul_openblas time:3988us

Test for Matrix 1024 x 1024
matmul_openblas time:29943us

Test for Matrix 2048 x 2048
matmul_openblas time:110668us

Test for Matrix 4096 x 4096
matmul_openblas time:704119us

Test for Matrix 8192 x 8192
matmul_openblas time:7519860us
```