

## Report for Project 4

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# Report for Project 4

代码可见: [C-project/project4 at main · Cheese-Bar/C-project \(github.com\)](https://github.com/Cheese-Bar/C-project)

## 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

```
1  typedef struct matrix  
2  {  
3      size_t col;  
4      size_t row;  
5      float *data;  
6  } MATRIX;  
7  
8  MATRIX *createMatrix(int row, int col, float *data);  
9  
10 MATRIX *create_random_Matrix(int row, int col);  
11  
12 MATRIX *matmul_plain(MATRIX *a, MATRIX *b);  
13  
14 MATRIX *matmul_improved(MATRIX *a, MATRIX *b);  
15  
16 MATRIX *matmul_openblas(MATRIX *m1, MATRIX *m2);  
17  
18 void printMatrix(MATRIX *const m);  
19
```

## 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

```
(base) PS D:\gitRepo\C-project\proj...
Test for Matrix 16 x 16
matmul_plain time:0us

Test for Matrix 128 x 128
matmul_plain time:9973us

Test for Matrix 256 x 256
matmul_plain time:94775us

Test for Matrix 512 x 512
matmul_plain time:1094105us

Test for Matrix 1024 x 1024
matmul_plain time:12543672us

Test for Matrix 2048 x 2048
matmul_plain time:261143387us
```

- 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
```