Assignment 2: Programming in C

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1 Compilation

```
[cw162@cobalt homework_2]$ mkdir -p homework_2/include homework_2/src
[cw162@cobalt homework_2]$ /cd homework_2
[cw162@cobalt homework_2]$ cd include
[cw162@cobalt homework_2]$ touch matrix.h
[cw162@cobalt homework_2]$ emacs matrix.h
[cw162@cobalt homework_2]$ cd src
[cw162@cobalt homework_2]$ touch matirx.c  (Note: It looks like there is a typo here;
it should probably be matrix.c)
[cw162@cobalt homework_2]$ emacs matrix.c
[cw162@cobalt homework_2]$ gcc -c -I./include src/matrix.c
```

2 Verification

```
[cw162@cobalt homework_2]$ gcc -I./include matrix.o verification.c -o a.out
[cw162@cobalt homework_2]$ ./a.out
The error in computing b=Ax for matvec with contiguous matrix storage is 0.00000e+00
The error in computing b=A^Tx for matvec_transpose with contiguous matrix storage
is 0.00000e+00
The error in computing b=Ax for matvec with non-contiguous matrix storage is 0.00000e+00
The error in computing b=A^Tx for matvec_transpose with non-contiguous matrix storage
is 0.00000e+00
```

3 Timing

	m = n = 1000	**m = n = 2000**	**m = n = 3000**	**m = n = 4000**
matvec (Contiguous)	0.003593s	0.012977s	0.029939s	0.053122s
matvec (NonContiguous)	0.003275s	0.013951s	0.030855s	0.053853s
matvec_transpose (Contiguous)	0.003993s	0.021261s	0.044808s	0.095121s
matvec_transpose (NonContiguous)	0.004292s	0.019463s	0.048595s	0.092097s
matvec MATLAB Implementation	0.0199s	0.0188s	0.0516s	0.1234s
matvec Python Implementation	0.4929s	1.9842s	4.6507s	7.5338s

Table 1: Average Time for Different Operations without gcc -O3

	m = n = 1000	**m = n = 2000**	**m = n = 3000**	**m = n = 4000**
matvec (Contiguous) -O3	0.000997s	0.003793s	0.008186s	0.014676s
matvec (NonContiguous) -O3	0.001047s	0.004103s	0.009251s	0.016566s
matvec_transpose (Contiguous) -O3	0.001098s	0.006585s	0.013971s	0.036236s
matvec_transpose (NonContiguous) -O3	0.001197s	0.006587s	0.026736s	0.068446s

Table 2: Average Time for Different Operations with gcc -O3