CSE 5441
Programming Assignment 1
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Summary of timing results:
(all tests are run with `AFFECT_RATE = 0.02` and `EPSILON = 0.02`)

Input	System calls		POSIX real time library	Unix time utility		
	time()	clock()		real	user	sys
testgrid_50_78	0	20000	19762.000000	0m0.032s	0m0.021s	0m0.003s
testgrid_50_201	0	80000	83292.000000	0m0.093s	0m0.086s	0m0.003s
testgrid_200_1166	2	2390000	2394450.000000	0m2.410s	0m2.399s	0m0.005s
testgrid_400_1636	6	5650000	5644848.000000	0m5.675s	0m5.651s	0m0.004s
testgrid_400_12206	197	197220000	197247896.000000	3m17.312s	3m17.239s	0m0.025s

Observations:

- The running times of the programs were measured in 3 ways: (i) using the `time()` and `clock()` system calls, (ii) using the POSIX real-time (`rt`) library and (iii) using the Unix command `time`. Among these, the system call `time()`, the `rt` library and the `real` component of time measured by the `time` command measures the “wall clock” time (merely the difference of timestamps of starting and finishing the convergence loop). So the time measured in these three ways is almost equal. But the `clock()` system call measures the actual processing (active CPU usage) time of the program, where the processing in each CPU core counts. This value is almost equal to the sum of the `user` and `sys` components of `time` command. In both aspects, the time measured by different means is very coherent.
- The wall clock time and the active CPU usage time are almost equal. This means it runs in a single core. The `sys` component is very low compared to the other two, which means most of the work is done in user mode.

The detailed program output is given below-

Compilation:

[biplob@owens-login04 lab1]$ make
icc -O3 -lrt amr_serial.c

Output for input file `testgrid_50_78`

```
[biplob@owens-login04 lab1]$ time ./a.out .02 .02 < testgrid_50_78

************************************************************************
dissipation converged in 10900 iterations,
    with max DSV = 22.3824719 and min DSV = 21.9350047
    affect rate  = 0.020000; epsilon = 0.020000

elapsed convergence loop time  (clock): 20000
elapsed convergence loop time   (time): 0
elapsed convergence loop time (chrono): 19762.000000
************************************************************************

real    0m0.032s
user    0m0.021s
sys     0m0.003s
```

Output for input file `testgrid_50_201`

```
[biplob@owens-login04 lab1]$ time ./a.out .02 .02 < testgrid_50_201

************************************************************************
dissipation converged in 20445 iterations,
    with max DSV = 4.6027510 and min DSV = 4.5106974
    affect rate  = 0.020000; epsilon = 0.020000

elapsed convergence loop time  (clock): 80000
elapsed convergence loop time   (time): 0
elapsed convergence loop time (chrono): 83292.000000
************************************************************************

real    0m0.093s
user    0m0.086s
sys     0m0.003s
```

Output for input file `testgrid_200_1166`

```
[biplob@owens-login04 lab1]$ time ./a.out .02 .02 < testgrid_200_1166

**************************************************************************
dissipation converged in 134921 iterations,
    with max DSV = 0.7817613 and min DSV = 0.7661265
    affect rate  = 0.020000; epsilon = 0.020000
elapsed convergence loop time  (clock): 2390000
elapsed convergence loop time   (time): 2
elapsed convergence loop time (chrono): 2394450.000000
**************************************************************************

real    0m2.410s
user    0m2.399s
sys     0m0.005s
```

Output for input file `testgrid_400_1636`

```
[biplob@owens-login04 lab1]$ time ./a.out .02 .02 < testgrid_400_1636

**************************************************************************
dissipation converged in 221824 iterations,
    with max DSV = 1.1407454 and min DSV = 1.1179306
    affect rate  = 0.020000; epsilon = 0.020000
elapsed convergence loop time  (clock): 5650000
elapsed convergence loop time   (time): 6
elapsed convergence loop time (chrono): 5644848.000000
**************************************************************************

real    0m5.675s
user    0m5.651s
sys     0m0.004s
```

Output for input file `testgrid_400_12206`

```
[biplob@owens-login04 lab1]$ time ./a.out .02 .02 < testgrid_400_12206

**************************************************************************
dissipation converged in 794818 iterations,
    with max DSV = 0.0846372 and min DSV = 0.0829445
    affect rate  = 0.020000; epsilon = 0.020000
elapsed convergence loop time  (clock): 197220000
elapsed convergence loop time   (time): 197
elapsed convergence loop time (chrono): 197247896.000000
**************************************************************************

real    3m17.312s
user    3m17.239s
sys     0m0.025s
```