nbody.py

326007706 function calls in <mark>65.673</mark> seconds

   Ordered by: cumulative time

ncalls	tottime	percall	cumtime	percall	filename:lineno(function)
1	0.000	0.000	65.673	65.673	{built-in method builtins.exec}
1	0.000	0.000	65.673	65.673	nbody.py:1(<module>)
1	0.343	0.343	65.673	65.673	nbody.py:125(nbody)
2000000	14.930	0.000	65.312	0.000	nbody.py:67(advance)
20000000	15.445	0.000	45.406	0.000	nbody.py:54(update_vs)
120000000	14.339	0.000	29.962	0.000	nbody.py:47(compute_b)
120000000	15.623	0.000	15.623	0.000	nbody.py:51(compute_mag)
10000000	1.618	0.000	1.618	0.000	nbody.py:62(update_rs)
20002000	1.587	0.000	1.587	0.000	nbody.py:44(compute_deltas)
20002000	0.997	0.000	0.997	0.000	{method 'append' of 'list' objects}
14001401	0.774	0.000	0.774	0.000	{method 'keys' of 'dict' objects}
100	0.016	0.000	0.016	0.000	{built-in method builtins.print}
200	0.002	0.000	0.003	0.000	nbody.py:88(report_energy)
2000	0.000	0.000	0.000	0.000	nbody.py:85(compute_energy)
1	0.000	0.000	0.000	0.000	nbody.py:108(offset_momentum)
1	0.000	0.000	0.000	0.000	{method 'disable' of '_lsprof.Profiler' objects}

nbody_1.py

96008706 function calls in <mark>37.967</mark> seconds

   Ordered by: cumulative time

ncalls	tottime	percall	cumtime	percall	filename:lineno(function)
1	0.000	0.000	37.967	37.967	{built-in method builtins.exec}
1	0.000	0.000	37.967	37.967	nbody_1.py:1(<module>)
1	0.271	0.271	37.967	37.967	nbody_1.py:193(nbody)
2000000	9.152	0.000	37.671	0.000	nbody_1.py:105(advance)
50000000	25.409	0.000	26.375	0.000	nbody_1.py:88(aggregate_advance)
10000000	1.403	0.000	1.403	0.000	nbody_1.py:62(update_rs)
20002000	0.966	0.000	0.966	0.000	{method 'append' of 'list' objects}
14001401	0.742	0.000	0.742	0.000	{method 'keys' of 'dict' objects}

```
   100    0.022    0.000    0.022    0.000 {built-in method builtins.print}
   200    0.001    0.000    0.003    0.000 nbody_1.py:158(report_energy)
  5000    0.002    0.000    0.002    0.000
nbody_1.py:146(aggregate_report_energy)
     1    0.000    0.000    0.000    0.000 nbody_1.py:176(offset_momentum)
     1    0.000    0.000    0.000    0.000 {method 'disable' of
'_lsprof.Profiler' objects}
```

nbody_2.py

```
        312006305 function calls in 61.478 seconds

   Ordered by: cumulative time

   ncalls  tottime  percall  cumtime  percall filename:lineno(function)
        1    0.000    0.000   61.478   61.478 {built-in method builtins.exec}
        1    0.000    0.000   61.478   61.478 nbody_2.py:1(<module>)
        1    0.298    0.298   61.478   61.478 nbody_2.py:126(nbody)
  2000000   11.841    0.000   61.158    0.000 nbody_2.py:67(advance)
 20000000   15.569    0.000   45.323    0.000 nbody_2.py:54(update_vs)
120000000   14.272    0.000   29.753    0.000 nbody_2.py:47(compute_b)
120000000   15.481    0.000   15.481    0.000 nbody_2.py:51(compute_mag)
 10000000    1.550    0.000    1.550    0.000 nbody_2.py:62(update_rs)
 20002000    1.524    0.000    1.524    0.000 nbody_2.py:44(compute_deltas)
 20002000    0.920    0.000    0.920    0.000 {method 'add' of 'set' objects}
      100    0.019    0.000    0.019    0.000 {built-in method builtins.print}
      200    0.002    0.000    0.003    0.000 nbody_2.py:88(report_energy)
     2000    0.000    0.000    0.000    0.000 nbody_2.py:85(compute_energy)
        1    0.000    0.000    0.000    0.000 nbody_2.py:109(offset_momentum)
        1    0.000    0.000    0.000    0.000 {method 'disable' of
'_lsprof.Profiler' objects}
```

nbody_3.py

Since this program always try to modify the BODIES variable(updating the states) and in python pass by reference is a default behavior for dictionary. So we cannot optimize the code in this area.

```
         326007706 function calls in 68.708 seconds

   Ordered by: cumulative time

   ncalls  tottime  percall  cumtime  percall filename:lineno(function)
        1    0.000    0.000   68.708   68.708 {built-in method builtins.exec}
        1    0.000    0.000   68.708   68.708 nbody_3.py:1(<module>)
        1    0.374    0.374   68.708   68.708 nbody_3.py:88(nbody)
  2000000   15.656    0.000   68.312    0.000 nbody_3.py:30(advance)
 20000000   16.302    0.000   47.406    0.000 nbody_3.py:17(update_vs)
120000000   14.686    0.000   31.104    0.000 nbody_3.py:10(compute_b)
120000000   16.418    0.000   16.418    0.000 nbody_3.py:14(compute_mag)
 10000000    1.681    0.000    1.681    0.000 nbody_3.py:25(update_rs)
 20002000    1.664    0.000    1.664    0.000 nbody_3.py:7(compute_deltas)
 20002000    1.074    0.000    1.074    0.000 {method 'append' of 'list'
objects}
 14001401    0.832    0.000    0.832    0.000 {method 'keys' of 'dict' objects}
      100    0.019    0.000    0.019    0.000 {built-in method builtins.print}
      200    0.002    0.000    0.003    0.000 nbody_3.py:51(report_energy)
     2000    0.001    0.000    0.001    0.000 nbody_3.py:48(compute_energy)
        1    0.000    0.000    0.000    0.000 nbody_3.py:71(offset_momentum)
        1    0.000    0.000    0.000    0.000 {method 'disable' of
'_lsprof.Profiler' objects}
```

nbody_4.py

```
         306004706 function calls in 62.328 seconds

   Ordered by: cumulative time

   ncalls  tottime  percall  cumtime  percall filename:lineno(function)
        1    0.000    0.000   62.328   62.328 {built-in method builtins.exec}
        1    0.000    0.000   62.328   62.328 nbody_4.py:1(<module>)
        1    0.334    0.334   62.328   62.328 nbody_4.py:123(nbody)
  2000000    9.685    0.000   61.973    0.000 nbody_4.py:68(advance)
 20000000   16.129    0.000   47.069    0.000 nbody_4.py:55(update_vs)
120000000   14.721    0.000   30.940    0.000 nbody_4.py:48(compute_b)
120000000   16.220    0.000   16.220    0.000 nbody_4.py:52(compute_mag)
 10000000    1.866    0.000    3.449    0.000 nbody_4.py:81(inner)
 10000000    1.583    0.000    1.583    0.000 nbody_4.py:63(update_rs)
 20002000    1.552    0.000    1.552    0.000 nbody_4.py:45(compute_deltas)
  4000401    0.219    0.000    0.219    0.000 {method 'keys' of 'dict' objects}
```

```
     100    0.019    0.000    0.019    0.000 {built-in method builtins.print}
     200    0.002    0.000    0.002    0.000 nbody_4.py:90(report_energy)
    2000    0.000    0.000    0.000    0.000 nbody_4.py:87(compute_energy)
       1    0.000    0.000    0.000    0.000 nbody_4.py:106(offset_momentum)
       1    0.000    0.000    0.000    0.000 {method 'disable' of
'_lsprof.Profiler' objects}
```

nbody_opt.py

The final optimization combines acceleration from nbody_1.py, nbody_2.py and
nbody_4.py

34002505 function calls in <mark>25.677</mark> seconds

   Ordered by: cumulative time

```
  ncalls  tottime  percall  cumtime  percall filename:lineno(function)
       1    0.000    0.000   25.677   25.677 {built-in method builtins.exec}
       1    0.000    0.000   25.677   25.677 nbody_opt.py:1(<module>)
       1    0.202    0.202   25.677   25.677 nbody_opt.py:137(nbody)
 2000000    4.331    0.000   25.455    0.000 nbody_opt.py:83(advance)
20000000   19.677    0.000   19.677    0.000
nbody_opt.py:68(aggregate_advance)
10000000    1.346    0.000    1.346    0.000 nbody_opt.py:63(update_rs)
 2000200    0.102    0.000    0.102    0.000 {method 'keys' of 'dict' objects}
     100    0.018    0.000    0.018    0.000 {built-in method builtins.print}
     200    0.001    0.000    0.002    0.000 nbody_opt.py:105(report_energy)
    2000    0.001    0.000    0.001    0.000
nbody_opt.py:98(aggregate_report_energy)
       1    0.000    0.000    0.000    0.000 nbody_opt.py:120(offset_momentum)
       1    0.000    0.000    0.000    0.000 {method 'disable' of
'_lsprof.Profiler' objects}
```