**nbody.py**

326007706 function calls in 65.673 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 37.967 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 25.677 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}