

Nbody:

(base) Seonhyes-MacBook-Pro:dsga 1019 seonhyeyang\$ for f in nbody.py; do python -m cProfile -s cumulative \$f; done

-0.16908926275527172
-0.1690524049239141
-0.16901474404530115
-0.16902307738080738
-0.1690798593916716
-0.1690837851340391
-0.1690461237029509
-0.1690141632287673
-0.1690277860596755
-0.16908371256964286
-0.16908078067628346
-0.16904474158017624
-0.16901196403207439
-0.16903317301080864
-0.16908783999484456
-0.16908019793585344
-0.16904027123722912
-0.16900666759845165
-0.1690385994000913
-0.1690927820263521
-0.16907709741618646
-0.1690318157474469
-0.16900365578743826
-0.16904872400310705
-0.16909656666618936
-0.16907120739400114
-0.16902491372614678
-0.1690054028562737
-0.1690615084418881
-0.16909732952330989
-0.16906445026914277
-0.16901977601924423
-0.1690087837330612
-0.16906942996092264
-0.1690936981250834
-0.16905776550855287
-0.16901607122935539
-0.16901202092861942
-0.1690769590988439
-0.16909176966916228
-0.16905402040535616
-0.16901235909925366
-0.16901736033369455
-0.1690847459685499
-0.16909035534676262
-0.16904838452880422
-0.16900663034076266
-0.16902335367423574
-0.16909124149510837
-0.16908618459859356
-0.16904015517545168
-0.16900291923555205
-0.16903287494400335
-0.16909558331070956
-0.16908055117120765

-0.16903390308620184
 -0.16900274590721814
 -0.16904459300211724
 -0.16909854774651836
 -0.16907499697399825
 -0.16902883385621698
 -0.16900287426063337
 -0.16905344993896332
 -0.16909778695827116
 -0.1690688542355601
 -0.16902288517135491
 -0.1690034111639226
 -0.16906323202819348
 -0.16909793327535813
 -0.16906372791458069
 -0.16901758963658736
 -0.16900762655227408
 -0.16907413362652127
 -0.1690966701276139
 -0.16905715253841647
 -0.16901176533650106
 -0.16901316541886924
 -0.16908223578125162
 -0.1690918842838697
 -0.1690491567289713
 -0.1690084483625472
 -0.16902057135969534
 -0.16908716660200046
 -0.16908658831414558
 -0.16904412116934314
 -0.16900740673825185
 -0.16902932050670785
 -0.16909180276278374
 -0.16908292959405574
 -0.16903991544261052
 -0.16900522540601676
 -0.16903656773659115
 -0.16909410318888132
 -0.169078466211733
 -0.16903274720873912
 -0.16900284987920383
 -0.1690462807510843
 -0.1690971767866576
 -0.16907293588692712
 -0.16902628585294033

326007706 function calls in 107.243 seconds

Ordered by: cumulative time

ncalls	tottime	percall	cumtime	percall	filename:lineno(function)
1	0.000	0.000	107.243	107.243	{built-in method builtins.exec}
1	0.000	0.000	107.243	107.243	nbody.py:3(<module>)
1	0.574	0.574	107.243	107.243	nbody.py:125(nbody)
2000000	22.726	0.000	106.663	0.000	nbody.py:67(advance)
20000000	26.677	0.000	75.522	0.000	nbody.py:54(update_vs)
120000000	23.876	0.000	48.845	0.000	nbody.py:47(compute_b)
120000000	24.970	0.000	24.970	0.000	nbody.py:51(compute_mag)

10000000	3.085	0.000	3.085	0.000	nbody.py:62(update_rs)
20002000	2.581	0.000	2.581	0.000	nbody.py:44(compute_deltas)
20002000	1.631	0.000	1.631	0.000	{method 'append' of 'list' objects}
14001401	1.117	0.000	1.117	0.000	{method 'keys' of 'dict' objects}
200	0.002	0.000	0.003	0.000	nbody.py:88(report_energy)
100	0.002	0.000	0.002	0.000	{built-in method builtins.print}
2000	0.001	0.000	0.001	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:

(base) Seonhyes-MacBook-Pro:dsga 1019 seonhyeyang\$ for f in nbody_1.py; do python -m cProfile -s cumulative \$f; done

0.003959169632271232
0.055635122763465224
-0.14661455724744712
0.22191568205511827
-0.11472606105002506
0.0006395576452171881
0.21055477756999041
-0.1501562521128173
-0.039957451696149816
0.1633940267932302
-0.1438430749987711
0.10924698455661283
-0.07520384697746187
-0.029695461329295885
0.228664941049278
-0.1341520510961053
-0.04964758938232902
0.15534568132266793
-0.14249682247642814
0.07143709035968902
-0.07207351067275633
0.022775055388803304
0.22594039438426414
-0.14369373938268584
-0.04800533907920077
0.15481347171686483
-0.14389098914167536
0.13976044047139133
-0.08765759940814613
-0.052524881064930445
0.22306663041253597
-0.1516945942333786
-0.025672813052606356
0.042585415560672545
-0.1513591202822914
0.17706414571959653
-0.1067655522668855
-0.051583743525365024
0.36817228727816226
-0.15651457822164436
-0.07394543366880002
0.09590079652292494

-0.16119084600601752
0.08496271456241755
-0.0907214300295352
-0.10348739108660779
0.45627105293755676
-0.15078873479556998
-0.11018438702002477
0.22575881040630338
-0.14934268912092974
-0.04925491644695193
-0.04643773777520006
-0.14894749040704783
0.34014784434365936
-0.1414130764890797
-0.10579520013887433
0.03844680873202862
-0.14687639402519126
0.19716657053619838
-0.1125920063715911
-0.14777351450224246
0.3988999900505123
-0.12156087120447824
-0.04643810660959552
-0.03690796215259111
-0.1551413666985101
0.2882222123051375
-0.11873000871264973
-0.14595831493199088
0.3960878971548534
-0.08231293851740125
-0.08521988423992716
0.06630804711054282
-0.15584535196496788
0.19488695214655374
-0.0878798916959345
-0.14261235081357532
0.3301854754947477
-0.06293903479148479
-0.05979282774990408
0.04670316620780934
-0.1520821641700103
0.122571331276311
-0.09087151521347825
-0.12770044811493694
0.20330873577849085
-0.07734993504885064
-0.00182241380651874
-0.056663044688306824
-0.13771463227696962
0.2634961629566778
-0.10752452432589263
-0.09224826900372296
0.054145748605678265
-0.10441492003425869
0.08530219213747695
-0.09549401523266833
-0.11588239428858803

0.17749617894335895

16003706 function calls in 42.786 seconds

Ordered by: cumulative time

ncalls	tottime	percall	cumtime	percall	filename:lineno(function)
1	0.000	0.000	42.786	42.786	{built-in method builtins.exec}
1	0.000	0.000	42.786	42.786	nbody_1.py:3(<module>)
1	0.439	0.439	42.786	42.786	nbody_1.py:142(nbody)
2000000	41.489	0.000	42.342	0.000	nbody_1.py:67(advance)
14001401	0.853	0.000	0.853	0.000	{method 'keys' of 'dict' objects}
100	0.003	0.000	0.003	0.000	{built-in method builtins.print}
200	0.002	0.000	0.003	0.000	nbody_1.py:103(report_energy)
2000	0.000	0.000	0.000	0.000	{method 'append' of 'list' objects}
1	0.000	0.000	0.000	0.000	nbody_1.py:125(offset_momentum)
1	0.000	0.000	0.000	0.000	{method 'disable' of '_lsprof.Profiler' objects}

Nbody_2:

(base) Seonhyes-MacBook-Pro:dsga 1019 seonhyeyang\$ for f in nbody_2.py; do python -m cProfile -s cumulative \$f; done

-0.16908926275527172
-0.1690524049239141
-0.16901474404530115
-0.16902307738080738
-0.1690798593916716
-0.1690837851340391
-0.1690461237029509
-0.1690141632287673
-0.1690277860596755
-0.16908371256964286
-0.16908078067628346
-0.16904474158017624
-0.16901196403207439
-0.16903317301080864
-0.16908783999484456
-0.16908019793585344
-0.16904027123722912
-0.16900666759845165
-0.1690385994000913
-0.1690927820263521
-0.16907709741618646
-0.1690318157474469
-0.16900365578743826
-0.16904872400310705
-0.16909656666618936
-0.16907120739400114
-0.16902491372614678
-0.1690054028562737
-0.1690615084418881
-0.16909732952330989
-0.16906445026914277
-0.16901977601924423
-0.1690087837330612
-0.16906942996092264
-0.1690936981250834
-0.16905776550855287
-0.16901607122935539
-0.16901202092861942

-0.1690769590988439
-0.16909176966916228
-0.16905402040535616
-0.16901235909925366
-0.16901736033369455
-0.1690847459685499
-0.16909035534676262
-0.16904838452880422
-0.16900663034076266
-0.16902335367423574
-0.16909124149510837
-0.16908618459859356
-0.16904015517545168
-0.16900291923555205
-0.16903287494400335
-0.16909558331070956
-0.16908055117120765
-0.16903390308620184
-0.16900274590721814
-0.16904459300211724
-0.16909854774651836
-0.16907499697399825
-0.16902883385621698
-0.16900287426063337
-0.16905344993896332
-0.16909778695827116
-0.1690688542355601
-0.16902288517135491
-0.1690034111639226
-0.16906323202819348
-0.16909793327535813
-0.16906372791458069
-0.16901758963658736
-0.16900762655227408
-0.16907413362652127
-0.1690966701276139
-0.16905715253841647
-0.16901176533650106
-0.16901316541886924
-0.16908223578125162
-0.1690918842838697
-0.1690491567289713
-0.1690084483625472
-0.16902057135969534
-0.16908716660200046
-0.16908658831414558
-0.16904412116934314
-0.16900740673825185
-0.16902932050670785
-0.16909180276278374
-0.16908292959405574
-0.16903991544261052
-0.16900522540601676
-0.16903656773659115
-0.16909410318888132
-0.169078466211733
-0.16903274720873912

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-0.16900284987920383
-0.1690462807510843
-0.1690971767866576
-0.16907293588692712
-0.16902628585294033
    306005706 function calls in 99.303 seconds
```

Ordered by: cumulative time

```
ncalls  tottime  percall  cumtime  percall filename:lineno(function)
      1  0.000    0.000   99.303   99.303 {built-in method builtins.exec}
      1  0.000    0.000   99.303   99.303 nbody_2.py:3(<module>)
      1  0.461    0.461   99.303   99.303 nbody_2.py:125(nbody)
2000000 18.695    0.000   98.837    0.000 nbody_2.py:67(advance)
20000000 26.090    0.000   73.583    0.000 nbody_2.py:54(update_vs)
120000000 23.108    0.000   47.493    0.000 nbody_2.py:47(compute_b)
120000000 24.385    0.000   24.385    0.000 nbody_2.py:51(compute_mag)
10000000  3.003    0.000    3.003    0.000 nbody_2.py:62(update_rs)
20002000  2.566    0.000    2.566    0.000 nbody_2.py:44(compute_deltas)
14001401  0.990    0.000    0.990    0.000 {method 'keys' of 'dict' objects}
    200  0.002    0.000    0.003    0.000 nbody_2.py:88(report_energy)
    100  0.002    0.000    0.002    0.000 {built-in method builtins.print}
    2000  0.001    0.000    0.001    0.000 nbody_2.py:85(compute_energy)
      1  0.000    0.000    0.000    0.000 nbody_2.py:108(offset_momentum)
      1  0.000    0.000    0.000    0.000 {method 'disable' of '_lsprof.Profiler' objects}
```

Nbody_3:

(base) Seonhyes-MacBook-Pro:dsga 1019 seonhyeyang\$ for f in nbody_3.py; do python -m cProfile -s cumulative \$f; done

```
-0.16908926275527172
-0.1690524049239141
-0.16901474404530115
-0.16902307738080738
-0.1690798593916716
-0.1690837851340391
-0.1690461237029509
-0.1690141632287673
-0.1690277860596755
-0.16908371256964286
-0.16908078067628346
-0.16904474158017624
-0.16901196403207439
-0.16903317301080864
-0.16908783999484456
-0.16908019793585344
-0.16904027123722912
-0.16900666759845165
-0.1690385994000913
-0.1690927820263521
-0.16907709741618646
-0.1690318157474469
-0.16900365578743826
-0.16904872400310705
-0.16909656666618936
-0.16907120739400114
-0.16902491372614678
-0.1690054028562737
```

-0.1690615084418881
-0.16909732952330989
-0.16906445026914277
-0.16901977601924423
-0.1690087837330612
-0.16906942996092264
-0.1690936981250834
-0.16905776550855287
-0.16901607122935539
-0.16901202092861942
-0.1690769590988439
-0.16909176966916228
-0.16905402040535616
-0.16901235909925366
-0.16901736033369455
-0.1690847459685499
-0.16909035534676262
-0.16904838452880422
-0.16900663034076266
-0.16902335367423574
-0.16909124149510837
-0.16908618459859356
-0.16904015517545168
-0.16900291923555205
-0.16903287494400335
-0.16909558331070956
-0.16908055117120765
-0.16903390308620184
-0.16900274590721814
-0.16904459300211724
-0.16909854774651836
-0.16907499697399825
-0.16902883385621698
-0.16900287426063337
-0.16905344993896332
-0.16909778695827116
-0.1690688542355601
-0.16902288517135491
-0.1690034111639226
-0.16906323202819348
-0.16909793327535813
-0.16906372791458069
-0.16901758963658736
-0.16900762655227408
-0.16907413362652127
-0.1690966701276139
-0.16905715253841647
-0.16901176533650106
-0.16901316541886924
-0.16908223578125162
-0.1690918842838697
-0.1690491567289713
-0.1690084483625472
-0.16902057135969534
-0.16908716660200046
-0.16908658831414558
-0.16904412116934314

-0.16900740673825185
-0.16902932050670785
-0.16909180276278374
-0.16908292959405574
-0.16903991544261052
-0.16900522540601676
-0.16903656773659115
-0.16909410318888132
-0.169078466211733
-0.16903274720873912
-0.16900284987920383
-0.1690462807510843
-0.1690971767866576
-0.16907293588692712
-0.16902628585294033

326007706 function calls in 105.655 seconds

Ordered by: cumulative time

ncalls	tottime	percall	cumtime	percall	filename:lineno(function)
1	0.000	0.000	105.655	105.655	{built-in method builtins.exec}
1	0.000	0.000	105.655	105.655	nbody_3.py:3(<module>)
1	0.532	0.532	105.655	105.655	nbody_3.py:86(nbody)
2000000	22.060	0.000	105.118	0.000	nbody_3.py:28(advance)
20000000	26.352	0.000	74.723	0.000	nbody_3.py:15(update_vs)
120000000	23.529	0.000	48.371	0.000	nbody_3.py:8(compute_b)
120000000	24.843	0.000	24.843	0.000	nbody_3.py:12(compute_mag)
10000000	3.036	0.000	3.036	0.000	nbody_3.py:23(update_rs)
20002000	2.538	0.000	2.538	0.000	nbody_3.py:5(compute_deltas)
20002000	1.631	0.000	1.631	0.000	{method 'append' of 'list' objects}
14001401	1.130	0.000	1.130	0.000	{method 'keys' of 'dict' objects}
200	0.002	0.000	0.003	0.000	nbody_3.py:49(report_energy)
100	0.002	0.000	0.002	0.000	{built-in method builtins.print}
2000	0.001	0.000	0.001	0.000	nbody_3.py:46(compute_energy)
1	0.000	0.000	0.000	0.000	nbody_3.py:69(offset_momentum)
1	0.000	0.000	0.000	0.000	{method 'disable' of '_lsprof.Profiler' objects}

Nbody_4:

(base) Seonhyes-MacBook-Pro:dsga 1019 seonhyeyang\$ for f in nbody_4.py; do python -m cProfile -s cumulative \$f; done

-0.16908926275527172
-0.1690524049239141
-0.16901474404530115
-0.16902307738080738
-0.1690798593916716
-0.1690837851340391
-0.1690461237029509
-0.1690141632287673
-0.1690277860596755
-0.16908371256964286
-0.16908078067628346
-0.16904474158017624
-0.16901196403207439
-0.16903317301080864
-0.16908783999484456
-0.16908019793585344
-0.16904027123722912
-0.16900666759845165

-0.1690385994000913
-0.1690927820263521
-0.16907709741618646
-0.1690318157474469
-0.16900365578743826
-0.16904872400310705
-0.16909656666618936
-0.16907120739400114
-0.16902491372614678
-0.1690054028562737
-0.1690615084418881
-0.16909732952330989
-0.16906445026914277
-0.16901977601924423
-0.1690087837330612
-0.16906942996092264
-0.1690936981250834
-0.16905776550855287
-0.16901607122935539
-0.16901202092861942
-0.1690769590988439
-0.16909176966916228
-0.16905402040535616
-0.16901235909925366
-0.16901736033369455
-0.1690847459685499
-0.16909035534676262
-0.16904838452880422
-0.16900663034076266
-0.16902335367423574
-0.16909124149510837
-0.16908618459859356
-0.16904015517545168
-0.16900291923555205
-0.16903287494400335
-0.16909558331070956
-0.16908055117120765
-0.16903390308620184
-0.16900274590721814
-0.16904459300211724
-0.16909854774651836
-0.16907499697399825
-0.16902883385621698
-0.16900287426063337
-0.16905344993896332
-0.16909778695827116
-0.1690688542355601
-0.16902288517135491
-0.1690034111639226
-0.16906323202819348
-0.16909793327535813
-0.16906372791458069
-0.16901758963658736
-0.16900762655227408
-0.16907413362652127
-0.1690966701276139
-0.16905715253841647

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-0.16901176533650106
-0.16901316541886924
-0.16908223578125162
-0.1690918842838697
-0.1690491567289713
-0.1690084483625472
-0.16902057135969534
-0.16908716660200046
-0.16908658831414558
-0.16904412116934314
-0.16900740673825185
-0.16902932050670785
-0.16909180276278374
-0.16908292959405574
-0.16903991544261052
-0.16900522540601676
-0.16903656773659115
-0.16909410318888132
-0.169078466211733
-0.16903274720873912
-0.16900284987920383
-0.1690462807510843
-0.1690971767866576
-0.16907293588692712
-0.16902628585294033

```

294005109 function calls in 93.841 seconds

Ordered by: cumulative time

```

ncalls  tottime  percall  cumtime  percall filename:lineno(function)
   1  0.000   0.000   93.841   93.841 {built-in method builtins.exec}
   1  0.000   0.000   93.841   93.841 nbody_4.py:3(<module>)
   1  0.426   0.426   93.840   93.840 nbody_4.py:126(nbody)
2000000 13.588   0.000   93.408   0.000 nbody_4.py:71(advance)
20000000 26.153   0.000   74.067   0.000 nbody_4.py:58(update_vs)
120000000 23.151   0.000   47.915   0.000 nbody_4.py:51(compute_b)
120000000 24.763   0.000   24.763   0.000 nbody_4.py:55(compute_mag)
10000000 3.080   0.000   3.080   0.000 nbody_4.py:66(update_rs)
20002000 2.508   0.000   2.508   0.000 nbody_4.py:48(compute_deltas)
2000402 0.165   0.000   0.165   0.000 {method 'keys' of 'dict' objects}
   200 0.003   0.000   0.004   0.000 nbody_4.py:89(report_energy)
   100 0.002   0.000   0.002   0.000 {built-in method builtins.print}
   201 0.000   0.000   0.001   0.000 <frozen importlib._bootstrap>:1009(_handle_fromlist)
  2000 0.001   0.000   0.001   0.000 nbody_4.py:86(compute_energy)
   201 0.000   0.000   0.000   0.000 {built-in method builtins.hasattr}
   1  0.000   0.000   0.000   0.000 nbody_4.py:109(offset_momentum)
   1  0.000   0.000   0.000   0.000 {method 'disable' of '_lsprof.Profiler' objects}

```

(base) Seonhyes-MacBook-Pro:dsga 1019 seonhyeyang\$ for f in nbody_opt.py; do python -m cProfile -s cumulative \$f; done

```

-0.16908926275527172
-0.1690524049239141
-0.16901474404530115
-0.16902307738080738
-0.1690798593916716
-0.1690837851340391
-0.1690461237029509

```

-0.1690141632287673
-0.1690277860596755
-0.16908371256964286
-0.16908078067628346
-0.16904474158017624
-0.16901196403207439
-0.16903317301080864
-0.16908783999484456
-0.16908019793585344
-0.16904027123722912
-0.16900666759845165
-0.1690385994000913
-0.1690927820263521
-0.16907709741618646
-0.1690318157474469
-0.16900365578743826
-0.16904872400310705
-0.16909656666618936
-0.16907120739400114
-0.16902491372614678
-0.1690054028562737
-0.1690615084418881
-0.16909732952330989
-0.16906445026914277
-0.16901977601924423
-0.1690087837330612
-0.16906942996092264
-0.1690936981250834
-0.16905776550855287
-0.16901607122935539
-0.16901202092861942
-0.1690769590988439
-0.16909176966916228
-0.16905402040535616
-0.16901235909925366
-0.16901736033369455
-0.1690847459685499
-0.16909035534676262
-0.16904838452880422
-0.16900663034076266
-0.16902335367423574
-0.16909124149510837
-0.16908618459859356
-0.16904015517545168
-0.16900291923555205
-0.16903287494400335
-0.16909558331070956
-0.16908055117120765
-0.16903390308620184
-0.16900274590721814
-0.16904459300211724
-0.16909854774651836
-0.16907499697399825
-0.16902883385621698
-0.16900287426063337
-0.16905344993896332
-0.16909778695827116

```

-0.1690688542355601
-0.16902288517135491
-0.1690034111639226
-0.16906323202819348
-0.16909793327535813
-0.16906372791458069
-0.16901758963658736
-0.16900762655227408
-0.16907413362652127
-0.1690966701276139
-0.16905715253841647
-0.16901176533650106
-0.16901316541886924
-0.16908223578125162
-0.1690918842838697
-0.1690491567289713
-0.1690084483625472
-0.16902057135969534
-0.16908716660200046
-0.16908658831414558
-0.16904412116934314
-0.16900740673825185
-0.16902932050670785
-0.16909180276278374
-0.16908292959405574
-0.16903991544261052
-0.16900522540601676
-0.16903656773659115
-0.16909410318888132
-0.169078466211733
-0.16903274720873912
-0.16900284987920383
-0.1690462807510843
-0.1690971767866576
-0.16907293588692712
-0.16902628585294033

```

6000708 function calls in 21.487 seconds

Ordered by: cumulative time

```

ncalls  tottime  percall  cumtime  percall filename:lineno(function)
      1  0.000    0.000   21.487   21.487 {built-in method builtins.exec}
      1  0.000    0.000   21.487   21.487 nbody_opt.py:3(<module>)
      1  0.377    0.377   21.487   21.487 nbody_opt.py:137(nbody)
2000000 20.865    0.000   21.107    0.000 nbody_opt.py:71(advance)
4000401  0.241    0.000    0.241    0.000 {method 'keys' of 'dict' objects}
    100  0.002    0.000    0.002    0.000 {built-in method builtins.print}
    200  0.001    0.000    0.001    0.000 nbody_opt.py:103(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 <frozen importlib._bootstrap>:1009(_handle_fromlist)
      1  0.000    0.000    0.000    0.000 {built-in method builtins.hasattr}
      1  0.000    0.000    0.000    0.000 {method 'disable' of '_lsprof.Profiler' objects}

```

(base) Seonhyes-MacBook-Pro:dsga 1019 seonhyeyang\$

