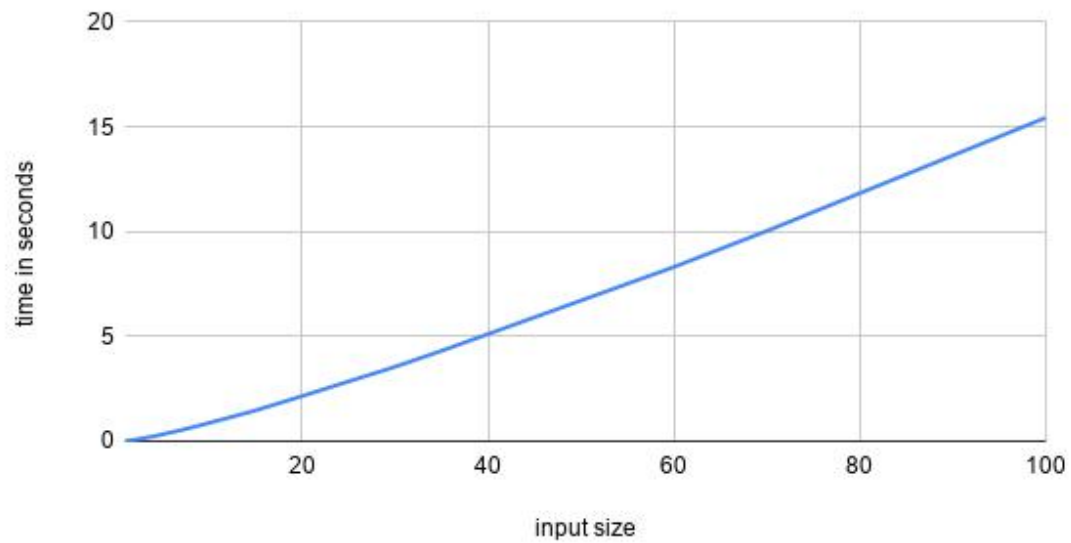


Mahantesh Gattina
1BM19CS219

Merge sort:

input size	time in seconds
1	0.010001
2	0.070007
3	0.150008
4	0.230008
5	0.33002
6	0.430023
7	0.53002
10	0.870034
15	1.470053
20	2.150107
25	2.850129
30	3.550168
35	4.310182
40	5.110275
45	5.910269
50	6.710307
60	8.310384
70	10.030413
90	13.630645
100	15.430686

Mahantesh Gattina time in seconds vs. input
size time complexity = $\theta(n \log n)$

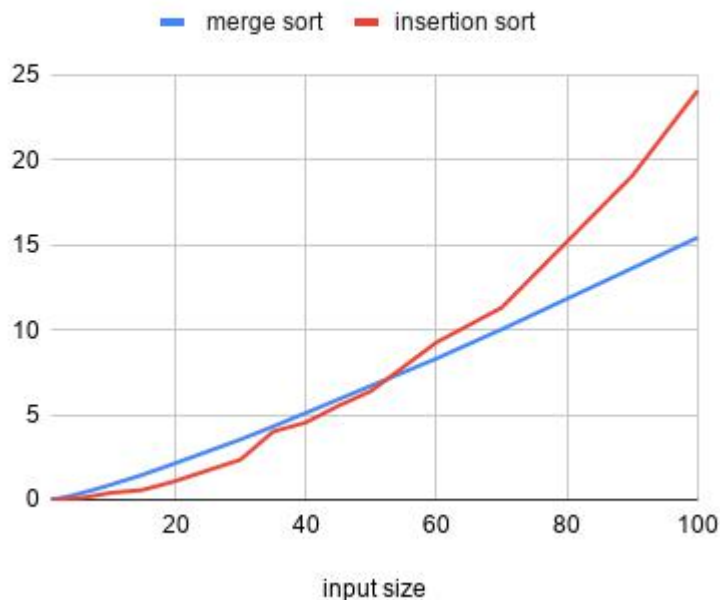


Mergesort vs insertion sort

input size	merge sort	insertion sort
1	0.010001	0.000002
2	0.070007	0.020002
3	0.150008	0.030002
4	0.230008	0.080001
5	0.33002	0.100007
6	0.430023	0.130011
7	0.53002	0.200007
10	0.870034	0.400016
15	1.470053	0.580028
20	2.150107	1.100048
25	2.850129	1.730071
30	3.550168	2.360094
35	4.310182	4.010228
40	5.110275	4.55022
45	5.910269	5.530298
50	6.710307	6.40029
60	8.310384	9.260383
70	10.030413	11.310601

90	13.630645	19.070851
100	15.430686	24.081167

merge sort and insertion sort



Output:

```
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5
Enter the elements of the array: 5 4 3 2 1
After sorting: 1 2 3 4 5
time taken = 0.330013 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5
Enter the elements of the array: 1 2 3 4 5
After sorting: 1 2 3 4 5
time taken = 0.330020 seconds
~/ada/lab7/ $ make mergesort
clang -ggdb3 -O0 -std=c11 -Wall -Werror -Wextra -Wno-sign-compare
-Wno-unused-parameter -Wno-unused-variable -Wshadow mergesort.c -lcrypt
-lcs50 -lm -o mergesort
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 10
do you want random input: After sorting: 335 383 386 421 492 649 777
793 886 915
time taken = 0.870030 seconds
~/ada/lab7/ $ make mergesort
clang -ggdb3 -O0 -std=c11 -Wall -Werror -Wextra -Wno-sign-compare
-Wno-unused-parameter -Wno-unused-variable -Wshadow mergesort.c -lcrypt
-lcs50 -lm -o mergesort
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5
do you want random input: y
```

```

Random input is : 383 886 777 915 793 After sorting: 383 777 793
886 915
time taken = 0.330016 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5
do you want random input: y
Random input is : 383 886 777 915 793 After sorting: 383 777 793
886 915
time taken = 0.330015 seconds
~/ada/lab7/ $ make mergesort
bash: make: command not found
~/ada/lab7/ $ make mergesort
clang -ggdb3 -O0 -std=c11 -Wall -Werror -Wextra -Wno-sign-compare
-Wno-unused-parameter -Wno-unused-variable -Wshadow mergesort.c -lcrypt
-lcs50 -lm -o mergesort
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5
do you want random input: 5
Random input is : 383 886 777 915 793
After sorting: 383 777 793 886 915
time taken = 0.330016 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 1
do you want random input: y
Random input is : 383
After sorting: 383
time taken = 0.010001 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 2
do you want random input: y
Random input is : 383 886
After sorting: 383 886
time taken = 0.070007 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 3
do you want random input: y
Random input is : 383 886 777
After sorting: 383 777 886
time taken = 0.150008 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 4
do you want random input: y
Random input is : 383 886 777 915
After sorting: 383 777 886 915
time taken = 0.230008 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5
do you want random input: y
Random input is : 383 886 777 915 793
After sorting: 383 777 793 886 915
time taken = 0.330020 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 6
do you want random input: y
Random input is : 383 886 777 915 793 335
After sorting: 335 383 777 793 886 915
time taken = 0.430023 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 7

```

```

do you want random input: y
Random input is : 383 886 777 915 793 335 386
After sorting: 335 383 386 777 793 886 915
time taken = 0.530020 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5
do you want random input: 5 4 3 2 1
Random input is : 383 886 777 915 793
After sorting: 383 777 793 886 915
time taken = 0.330019 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5
do you want random input: n
Enter the elements of the array: 5 4 3 2 1

After sorting: 1 2 3 4 5
time taken = 0.330015 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 20
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736
After sorting: 27 59 172 335 362 383 386 421 426 492 540 649
690 736 763 777 793 886 915 926
time taken = 2.150107 seconds
~/ada/lab7/ $ y
bash: y: command not found
~/ada/lab7/ $ make mergesort
clang -ggdb3 -O0 -std=c11 -Wall -Werror -Wextra -Wno-sign-compare
-Wno-unused-parameter -Wno-unused-variable -Wshadow mergesort.c -lcrypt
-lcs50 -lm -o mergesort
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 10
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421
After sorting: 335 383 386 421 492 649 777 793 886 915
time taken = 0.870034 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 30
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135
After sorting: 27 59 67 123 135 172 211 335 362 368 383 386
421 426 429 492 530 540 567 649 690 736 763 777 782 793
862 886 915 926
time taken = 3.550168 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 40
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135 929 802 22 58 69 167 393 456 11 42
After sorting: 11 22 27 42 58 59 67 69 123 135 167 172 211
335 362 368 383 386 393 421 426 429 456 492 530 540 567
649 690 736 763 777 782 793 802 862 886 915 926 929
time taken = 5.110275 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 50

```

```

do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135 929 802 22 58 69 167 393 456 11 42 229
373 421 919 784 537 198 324 315 370
After sorting: 11 22 27 42 58 59 67 69 123 135 167 172 198
211 229 315 324 335 362 368 370 373 383 386 393 421 421
426 429 456 492 530 537 540 567 649 690 736 763 777 782
784 793 802 862 886 915 919 926 929
time taken = 6.710307 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 15
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763
After sorting: 27 59 335 362 383 386 421 492 649 690 763 777
793 886 915
time taken = 1.470053 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 25
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782
After sorting: 27 59 172 211 335 362 368 383 386 421 426 429
492 540 567 649 690 736 763 777 782 793 886 915 926
time taken = 2.850129 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 35
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135 929 802 22 58 69
After sorting: 22 27 58 59 67 69 123 135 172 211 335 362 368
383 386 421 426 429 492 530 540 567 649 690 736 763 777
782 793 802 862 886 915 926 929
time taken = 4.310182 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 45
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135 929 802 22 58 69 167 393 456 11 42 229
373 421 919 784
After sorting: 11 22 27 42 58 59 67 69 123 135 167 172 211
229 335 362 368 373 383 386 393 421 421 426 429 456 492
530 540 567 649 690 736 763 777 782 784 793 802 862 886
915 919 926 929
time taken = 5.910269 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 100
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135 929 802 22 58 69 167 393 456 11 42 229
373 421 919 784 537 198 324 315 370 413 526 91 980 956
873 862 170 996 281 305 925 84 327 336 505 846 729 313
857 124 895 582 545 814 367 434 364 43 750 87 808 276 178
788 584 403 651 754 399 932 60 676 368 739 12 226 586 94
539

```

```

After sorting: 11 12 22 27 42 43 58 59 60 67 69 84 87 91 94
123 124 135 167 170 172 178 198 211 226 229 276 281 305
313 315 324 327 335 336 362 364 367 368 368 370 373 383
386 393 399 403 413 421 421 426 429 434 456 492 505 526
530 537 539 540 545 567 582 584 586 649 651 676 690 729
736 739 750 754 763 777 782 784 788 793 802 808 814 846
857 862 862 873 886 895 915 919 925 926 929 932 956 980
996
time taken = 15.430686 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 60
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135 929 802 22 58 69 167 393 456 11 42 229
373 421 919 784 537 198 324 315 370 413 526 91 980 956
873 862 170 996 281
After sorting: 11 22 27 42 58 59 67 69 91 123 135 167 170 172
198 211 229 281 315 324 335 362 368 370 373 383 386 393
413 421 421 426 429 456 492 526 530 537 540 567 649 690
736 763 777 782 784 793 802 862 862 873 886 915 919 926
929 956 980 996
time taken = 8.310384 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 70
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135 929 802 22 58 69 167 393 456 11 42 229
373 421 919 784 537 198 324 315 370 413 526 91 980 956
873 862 170 996 281 305 925 84 327 336 505 846 729 313
857
After sorting: 11 22 27 42 58 59 67 69 84 91 123 135 167 170
172 198 211 229 281 305 313 315 324 327 335 336 362 368
370 373 383 386 393 413 421 421 426 429 456 492 505 526
530 537 540 567 649 690 729 736 763 777 782 784 793 802
846 857 862 862 873 886 915 919 925 926 929 956 980 996
time taken = 10.030413 seconds
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 90
do you want random input: y
Random input is : 383 886 777 915 793 335 386 492 649 421 362
27 690 59 763 926 540 426 172 736 211 368 567 429 782 530
862 123 67 135 929 802 22 58 69 167 393 456 11 42 229
373 421 919 784 537 198 324 315 370 413 526 91 980 956
873 862 170 996 281 305 925 84 327 336 505 846 729 313
857 124 895 582 545 814 367 434 364 43 750 87 808 276 178
788 584 403 651 754 399
After sorting: 11 22 27 42 43 58 59 67 69 84 87 91 123 124
135 167 170 172 178 198 211 229 276 281 305 313 315 324
327 335 336 362 364 367 368 370 373 383 386 393 399 403
413 421 421 426 429 434 456 492 505 526 530 537 540 545
567 582 584 649 651 690 729 736 750 754 763 777 782 784
788 793 802 808 814 846 857 862 862 873 886 895 915 919
925 926 929 956 980 996
time taken = 13.630645 seconds
~/ada/lab7/ $
~/ada/lab7/ $ ./mergesort
Enter the size of the array: 5

```

```

do you want random input: y
Random input is : 383 886 777 915 793
After sorting: 383 777 793 886 915
time taken = 0.330025 seconds
~/ada/lab7/ $ cd ..
~/ada/ $ cd lab5
~/ada/lab5/ $ ls
bfs* bfs.c insertionsort* insertionsort.c
~/ada/lab5/ $ make insertion sort
make: *** No rule to make target 'insertion'. Stop.
~/ada/lab5/ $ make insertionsort
clang -ggdb3 -O0 -std=c11 -Wall -Werror -Wextra -Wno-sign-compare
-Wno-unused-parameter -Wno-unused-variable -Wshadow insertionsort.c
-lcrypt -lcs50 -lm -o insertionsort
~/ada/lab5/ $ ./insertionsort
bash: ./insertionsort: No such file or directory
~/ada/lab5/ $ ./insertionsort
How many elements do you want to enter: ^C
~/ada/lab5/ $
~/ada/lab5/ $ ls
bfs* bfs.c insertionsort* insertionsort.c
~/ada/lab5/ $ ./insertionsort
How many elements do you want to enter: 1
Do you want to enter the elements?
n
After sorting:
8973

time taken = 0.000002 seconds
~/ada/lab5/ $
~/ada/lab5/ $ ./insertionsort
How many elements do you want to enter: 2
Do you want to enter the elements?
n
After sorting:
1534 8599

time taken = 0.020002 seconds
~/ada/lab5/ $ ./insertionsort
How many elements do you want to enter: 3
Do you want to enter the elements?
n
After sorting:
6885 8261 8423

time taken = 0.030002 seconds
~/ada/lab5/ $ ./insertionsort
How many elements do you want to enter: 4
Do you want to enter the elements?
n
After sorting:
369 1335 2250 7959

time taken = 0.080001 seconds
~/ada/lab5/ $ ./insertionsort
How many elements do you want to enter: 5
Do you want to enter the elements?
n
After sorting:

```


25 2352 7636 7693 9413

time taken = 0.100007 seconds

~/ada/lab5/ \$./insertionsort

How many elements do you want to enter: 6

Do you want to enter the elements?

n

After sorting:

3034 3851 3947 4369 7463 8755

time taken = 0.130011 seconds

~/ada/lab5/ \$./insertionsort

How many elements do you want to enter: 7

Do you want to enter the elements?

n

After sorting:

1577 1820 6420 7269 7514 8334 8455

time taken = 0.200007 seconds

~/ada/lab5/ \$./insertionsort

How many elements do you want to enter: 10

Do you want to enter the elements?

n

After sorting:

729 2003 2382 2767 2971 3995 4525 4806 6226 6903

time taken = 0.400016 seconds

~/ada/lab5/ \$./insertionsort

How many elements do you want to enter: 15

Do you want to enter the elements?

n

After sorting:

2396 2935 3219 4022 5018 5405 5578 6872 7013 7186 7337 8769 8825 9572
9646

time taken = 0.580028 seconds

~/ada/lab5/ \$./insertionsort

How many elements do you want to enter: 20

Do you want to enter the elements?

n

After sorting:

113 406 1555 2212 4036 4447 4495 5090 5640 6009 6062 6117 6143 6766 6901
7572 8023 8506 8826 9439

time taken = 1.100048 seconds

~/ada/lab5/ \$./insertionsort

How many elements do you want to enter: 25

Do you want to enter the elements?

n

After sorting:

161 385 634 847 1015 2076 2227 4643 4746 5165 5236 5643 5762 6115 6392
6732 7426 7667 7936 8288 8861 9052 9099 9829 9933

time taken = 1.730071 seconds

~/ada/lab5/ \$./insertionsort

How many elements do you want to enter: 30

Do you want to enter the elements?

n

After sorting:

511 677 1059 1107 1235 1423 2123 2196 2399 2459 2713 2797 3181 5278 5630
5972 6032 6116 6210 6243 7086 7270 7716 7817 8415 9066 9222 9432 9455
9662

time taken = 2.360094 seconds
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 35
Do you want to enter the elements?

n
After sorting:
148 737 891 1651 2084 2152 2206 2267 3131 3174 4591 4714 4722 4887 5382
5603 5808 6144 6173 6418 6485 6492 6640 6692 6991 7407 7844 8425 8495
8602 8710 9105 9586 9608 9832

time taken = 4.010228 seconds
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 40
Do you want to enter the elements?

n
After sorting:
89 298 602 763 983 1170 1580 1821 2331 2422 2462 2527 2696 2817 4203 5246
5302 5449 5696 5715 5771 5815 6149 6466 6686 7328 7346 7579 7587 7692
7730 7772 7922 8033 8175 8389 8473 8487 8562 9627

time taken = 4.550220 seconds
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 45
Do you want to enter the elements?

n
After sorting:
47 192 416 508 891 949 2026 2357 2766 2948 3435 4047 4086 4247 4310 4342
4369 4770 5143 5640 6483 6491 6801 6932 6978 7252 7317 7428 7850 8099
8224 8378 8431 8507 8743 8779 9102 9364 9365 9614 9662 9821 9872 9984
10031

time taken = 5.530298 seconds
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 55
Do you want to enter the elements?

n
^C
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 50
Do you want to enter the elements?
n
After sorting:
258 368 886 1061 1177 1285 1340 1469 1567 1623 1770 1832 1862 2623 2742
2821 2833 2887 3065 3779 3886 4163 4629 4752 4909 5326 5356 5474 5498
6177 6212 6322 6415 6417 6717 6884 6892 7336 7735 7793 7880 7993 8421
8529 8622 8640 8949 9811 9869 9876

time taken = 6.400290 seconds
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 60
Do you want to enter the elements?

n
After sorting:
455 502 972 1326 1373 1478 1503 1563 1656 1846 2422 2730 2817 3087 3253
3404 4231 4257 4289 4360 4419 4488 4756 4915 4927 4982 5104 5370 5447

5552 6181 6199 6250 6286 6313 6471 6529 6550 7309 7342 7735 7856 7882
8135 8263 8321 8360 8491 8502 8949 9082 9156 9201 9306 9493 9613 9666
9709 9847 9878

time taken = 9.260383 seconds
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 70
Do you want to enter the elements?

n
After sorting:
59 243 270 666 710 843 1226 1415 1677 1779 1831 1891 2247 2327 2462 2777
2839 2940 3003 3059 3250 3263 3322 3606 3652 3663 3917 3958 4017 4213
4443 4506 4524 5006 5055 5234 5325 5382 5402 5431 5736 5799 5872 6109
6309 6320 6791 6942 6979 7026 7065 7116 7127 7203 7628 7945 8207 8411
8460 8662 8883 8956 8982 9084 9085 9375 9646 9648 9866 9921

time taken = 11.310601 seconds
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 90
Do you want to enter the elements?

n
After sorting:
50 141 151 414 789 903 1003 1270 1295 1470 1495 1634 1881 1980 2175 2386
2455 2479 2498 2567 2608 2742 2855 2908 3001 3254 3298 3540 3587 3666
3753 3804 3806 3937 4067 4246 4281 4285 4286 4642 4940 5036 5132 5176
5177 5273 5323 5374 5517 5673 5680 5687 5939 5939 6044 6509 6556 6702
6712 6792 6842 6893 6964 7057 7156 7277 7485 7648 7656 7732 7779 7912
7913 8131 8135 8545 8761 8809 8923 9012 9274 9279 9349 9356 9458 9613
9793 9797 9826 9894

time taken = 19.070851 seconds
~/ada/lab5/ \$./insertionsort
How many elements do you want to enter: 100
Do you want to enter the elements?

n
After sorting:
5 94 236 315 436 549 667 734 1068 1198 1263 1623 1656 1739 1862 2126 2299
2377 2462 2535 2590 2613 2821 3024 3125 3146 3262 3332 3354 3470 3626
3673 3713 3824 3826 3927 3940 3976 4059 4184 4193 4367 4412 4482 4482
4537 4626 4721 4767 4767 4878 4886 5156 5183 5188 5215 5296 5486 5511
5687 5781 5950 6005 6068 6292 6529 6630 6743 6793 7103 7229 7342 7369
7373 7380 7564 7651 7745 7814 7886 7908 7929 7929 8022 8035 8339 8472
8502 8657 8711 8795 8858 8927 9119 9291 9360 9670 9776 9984 9984

time taken = 24.081167 seconds
~/ada/lab5/ \$