ALGORÍTMICA

PRÁCTICA 2: ALGORITMOS DIVIDE Y VENCERÁS

Memoria final de la práctica

Ignacio Aguilera Martos
Luis Balderas Ruiz
Diego Asterio de Zaballa Rodríguez
Miguel Ángel Torres López

ugr | Universidad de Granada

ÍNDICE

En lo que sigue, los miembros del grupo combinamos sistemas operativos y maquinas diferentes para experimentar de la forma más completa y variada la eficiencia de los algoritmos. Estas son las prestaciones de las máquinas:

- Luis: Fujitsu. Intel Core i5. Ubuntu 14.04
- Ignacio: Toshiba. Intel Core i7. Ubuntu 14.04
- Diego: Mac. Intel Core i7. OS X El Capitán
- Miguel Ángel: Toshiba. Intel Core i7. Windows 10

1. Serie unimodal de números

Nuestro problema consistía en que se nos daba un vector de números que crecía estrictamente hasta un determinado índice a partir del cual decrecía de manera estricta. Debemos devolver mediante nuestros algoritmos el índice en el que dicho cambio de crecimiento se produce.

1.1 Algoritmo Evidente

En este primer algoritmo que hemos implementado para la resolución de nuestro problema hemos utilizado una versión muy simple que recorre el vector de manera secuencial. Nuestra intención es ir recorriéndolo desde la posición 0 hasta el final. Si nos encontramos un punto en el que el vector en vez de crecer decrece no continuamos avanzando ya que hemos llegado al punto que andábamos buscando, es decir, si v[i]>v[i+1] siendo el índice i el primero con el que ocurre esto.

Presentamos el código:

```
#include <iostream>
#include <vector>
#include <cstdlib>
#include <cstdio>
#include <ctime>
#include <climits>
#include <cassert>
#include <chrono>

using namespace std;

double uniforme()
{
double u;
  u = (double) rand();
  u = u/(double)(RAND_MAX+1.0);
 return u;
}

int serie_unimodal_secuencial(int *v, int n)
{
        int i=0;
        int maximo=0;
        while(v[i]<v[i+1] && ((i+1)<n))
                i++;
```

```
        //maximo=v[i];
        return i;
}

using namespace std::chrono;

int main(int argc, char * argv[])
{
  high_resolution_clock::time_point t1, t2;
  if (argc != 2)
    {
      cerr << "Formato " << argv[0] << " <num_elem>" << endl;
      return -1;
    }

  int n = atoi(argv[1]);

  int * T = new int[n];
  assert(T);

srand(time(0));
double u=uniforme();
int p=1+(int)((n-2)*u);
T[p]=n-1;
for (int i=0; i<p; i++) T[i]=i;
for (int i=p+1; i<n; i++) T[i]=n-1-i+p;

  t1=high_resolution_clock::now();
  int pos_maximo_secuencial=serie_unimodal_secuencial(T,n);
  t2=high_resolution_clock::now();
  duration<double> transcurrido = duration_cast<duration<double> >(t2-t1);
  cout << n << " " << transcurrido.count() << "\n";

  return 0;
}
```

Vemos que la eficiencia del algoritmo en este caso es lineal comparando entre sí la suma al cuadrado de los residuos de los distintos ajustes realizados.
Lineal = 9.07552e-06
nlogarítmica = 9.73699e-06
logarítmica = 7.55603e-05

Datos:
-**Tabla y gŕafica de Nacho(Toshiba,Linux):**

Tamaño	Tiempo
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30001	3.4822e-05
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40001	4.6336e-05
45001	5.3974e-05
50001	5.7989e-05
55001	6.3656e-05
60001	6.9476e-05
65001	7.5713e-05
70001	8.1491e-05
75001	9.7841e-05
80001	9.3249e-05
85001	9,90E-002
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95001	0.000202677
100001	0.000213223
105001	0.000224879
110001	0.000234944
115001	0.000246068
120001	0.000269558
125001	0.000289279
130001	0.000277595
135001	0.000291965
140001	0.000311541
145001	0.000338547
150001	0.000346358
155001	0.000335746
160001	0.000348103
165001	0.000355319
170001	0.000366716
175001	0.000377835
180001	0.000387789
185001	0.000523113
190001	0.000566678
195001	0.000578435

200001	0.000590914
205001	0.000500872
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215001	0.000485209
220001	0.000505239
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230001	0.000496295
235001	0.000506936
240001	0.000628285
245001	0.000527266
250001	0.000596488
255001	0.000784005
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265001	0.000781397
270001	0.000581821
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365001	0.001119
370001	0.00113662
375001	0.0011993
380001	0.00116807

385001	0.00127384
390001	0.00123833
395001	0.00123346
400001	0.00122626
405001	0.00124616
410001	0.00128398
415001	0.00128159
420001	0.00131595
425001	0.00135981
430001	0.00132351
435001	0.0013351
440001	0.00137901
445001	0.00139873
450001	0.00132308
455001	0.00134034
460001	0.00143829
465001	0.0013664
470001	0.00138172
475001	0.00145137
480001	0.0014284
485001	0.00149353
490001	0.00150792
495001	0.00149775
500001	0.00106973
505001	0.0010926
510001	0.00120486
515001	0.00111586
520001	0.00111548
525001	0.00112312
530001	0.00115674
535001	0.00118471
540001	0.00112244
545001	0.0011931
550001	0.00124476
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560001	0.0012001
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590001	0.0013715
595001	0.00127158
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615001	0.00136257
620001	0.00133047
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640001	0.00227042
645001	0.00264473
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655001	0.00141823
660001	0.00151978
665001	0.00269443
670001	0.00198452
675001	0.00232555
680001	0.00278734
685001	0.0021844
690001	0.00206358
695001	0.00203935
700001	0.00210445
705001	0.00213257
710001	0.0020844
715001	0.00258757
720001	0.00153732
725001	0.00163313
730001	0.00155058
735001	0.00245493
740001	0.00157173
745001	0.00164656
750001	0.00156051

755001	0.00297318
760001	0.00362019
765001	0.00415503
770001	0.00172869
775001	0.00177365
780001	0.00166782
785001	0.00171216
790001	0.0018537
795001	0.00244351
800001	0.00455048
805001	0.00419158
810001	0.00389429
815001	0.0041388
820001	0.00363567
825001	0.00179199
830001	0.00182496
835001	0.00328139
840001	0.00332854
845001	0.00205908
850001	0.00182589
855001	0.00177933
860001	0.00185662
865001	0.00441101
870001	0.00201723
875001	0.0019275
880001	0.00185379
885001	0.00225509
890001	0.00196903
895001	0.00190935
900001	0.00193913
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915001	0.00293374
920001	0.00469932
925001	0.00192188
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935001	0.00224927

940001	0.00204386
945001	0.00213312
950001	0.00332134
955001	0.00205959
960001	0.00328309
965001	0.00209894
970001	0.00223038
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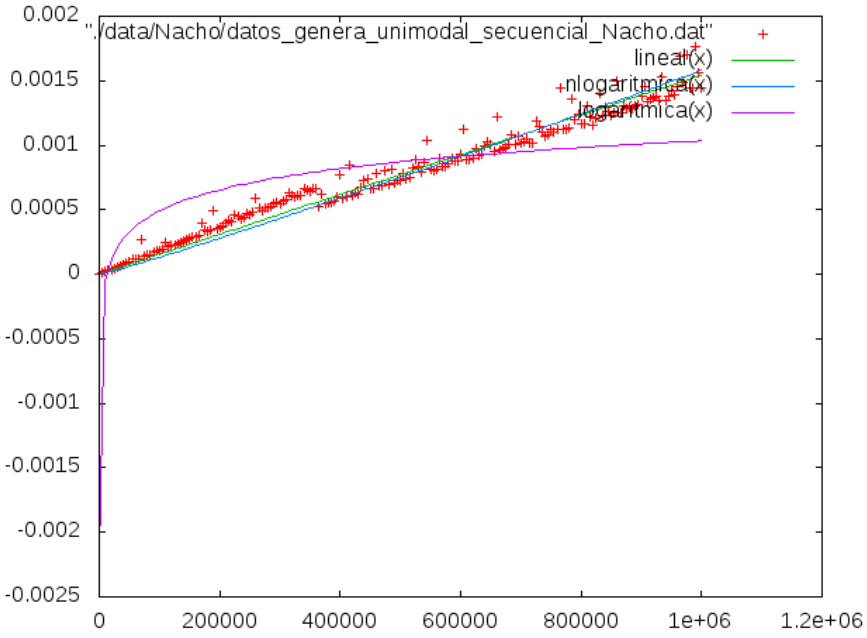
990001	0.00222124
995001	0.00212957
1000001	0.00221753



-**Tabla y gŕafica de Luis(Fujitsu,Linux):**

Tamaño	Tiempo
1	1.65e-07
5001	8,93E-003
10001	1,42E-002
15001	2.2072e-05

20001	2,93E-002
25001	7.3206e-05
30001	4.3995e-05
35001	8.1913e-05
40001	5.8538e-05
45001	0.000131739
50001	7.3047e-05
55001	0.000109569
60001	8.7776e-05
65001	9.5069e-05
70001	0.000102334
75001	0.000109621
80001	0.000166209
85001	0.000149099
90001	0.000168333
95001	0.000231621
100001	0.000153719
105001	0.000159431
110001	0.000210312
115001	0.000176271
120001	0.000198383
125001	0.000240096

130001	0.000190838
135001	0.000212365
140001	0.000244785
145001	0.000213011
150001	0.000228014
155001	0.000234689
160001	0.000248774
165001	0.000280106
170001	0.000296496
175001	0.000258078
180001	0.000264963
185001	0.000262612
190001	0.00026995
195001	0.000356971
200001	0.000294089
205001	0.000301725
210001	0.000308938
215001	0.000315664
220001	0.00034824
225001	0.0003289
230001	0.000354303

235001	0.000654191
240001	0.000627257
245001	0.000615984
250001	0.000628281
255001	0.000673397
260001	0.000729668
265001	0.000966332
270001	0.00131237
275001	0.00117727
280001	0.000782564
285001	0.0007658
290001	0.000808406
295001	0.000836961
300001	0.000780479
305001	0.000950285
310001	0.000810363
315001	0.000792879
320001	0.00095634
325001	0.000883486
330001	0.000941352
335001	0.000935697

340001	0.000883123
345001	0.00092245
350001	0.000982877
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360001	0.00100362
365001	0.000950843
370001	0.000961586
375001	0.000943435
380001	0.000982561
385001	0.000997226
390001	0.00103753
395001	0.00119681
400001	0.00110818
405001	0.00104414
410001	0.00106905
415001	0.00125756
420001	0.00108333
425001	0.00110324
430001	0.00112414
435001	0.00117496
440001	0.00117137

445001	0.00111849
450001	0.00113079
455001	0.00123885
460001	0.00120047
465001	0.0011865
470001	0.00124812
475001	0.00152137
480001	0.00129417
485001	0.00125638
490001	0.0012734
495001	0.00133921
500001	0.0012837
505001	0.00128129
510001	0.00135213
515001	0.00133157
520001	0.00137378
525001	0.00135834
530001	0.0014917
535001	0.00140768
540001	0.00146108
545001	0.0014126

550001	0.00138364
555001	0.00139476
560001	0.00140883
565001	0.00162786
570001	0.00159838
575001	0.0014476
580001	0.00244171
585001	0.00286447
590001	0.00227871
595001	0.00217518
600001	0.00204661
605001	0.00188058
610001	0.00187855
615001	0.00177752
620001	0.00205222
625001	0.00165675
630001	0.00180923
635001	0.00173059
640001	0.00166831
645001	0.00169786
650001	0.00182026

655001	0.00164627
660001	0.00172811
665001	0.00194293
670001	0.00169218
675001	0.00171823
680001	0.0018487
685001	0.00179305
690001	0.00177858
695001	0.00192259
700001	0.00182309
705001	0.00205372
710001	0.00204714
715001	0.00188209
720001	0.00183284
725001	0.00206286
730001	0.0020021
735001	0.00191744
740001	0.00221491
745001	0.00187354
750001	0.00198633
755001	0.00205921

760001	0.00195037
765001	0.00202878
770001	0.00206821
775001	0.00194542
780001	0.00200215
785001	0.00219116
790001	0.00202818
795001	0.00252695
800001	0.00239506
805001	0.00230549
810001	0.00251272
815001	0.0022299
820001	0.00215939
825001	0.00215938
830001	0.00222084
835001	0.00210033
840001	0.00217242
845001	0.00237756
850001	0.00231043
855001	0.00225258
860001	0.00361198

865001	0.002218
870001	0.00239355
875001	0.00226665
880001	0.0025828
885001	0.00265594
890001	0.00225736
895001	0.00243189
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905001	0.00241975
910001	0.00229155
915001	0.00256359
920001	0.00240987
925001	0.00233638
930001	0.00242957
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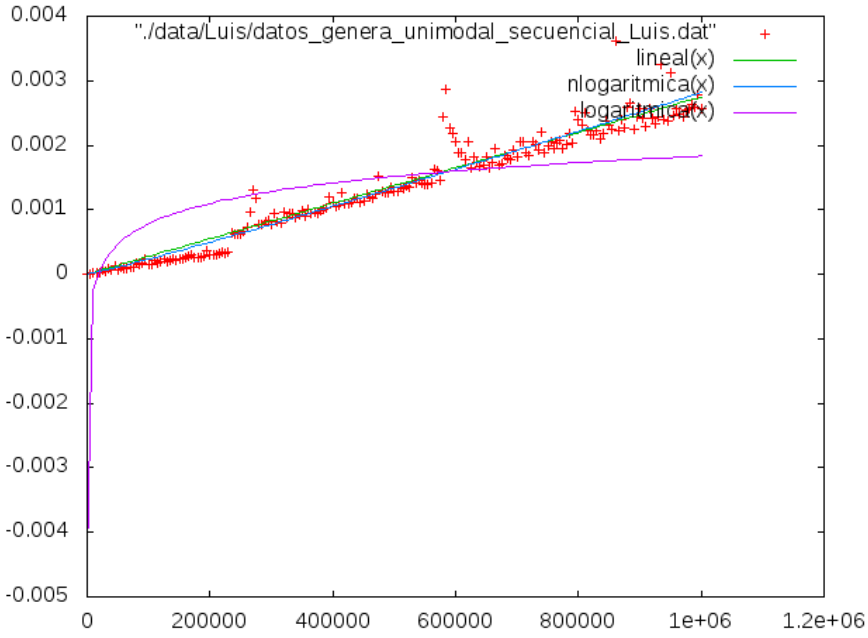
945001	0.00237946
950001	0.00312879
955001	0.00246237
960001	0.0025721
965001	0.00248514

970001	0.00244678
975001	0.00254417
980001	0.00256283
985001	0.00263438
990001	0.00259345
995001	0.00278291
1000001	0.00255994



-**Tabla y gŕafica de Miguel(Toshiba,Windows):**

Tamaño	Tiempo
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5001	2.0955e-005
10001	4.14824e-005
15001	6.20098e-005
20001	8.21096e-005
25001	7.22735e-005

30001	8.63861e-005
35001	0.000100926
40001	0.000115039
45001	0.00013129
50001	0.000144547
55001	0.000158232
60001	0.0001732
65001	0.000188168
70001	0.000202708
75001	0.000216821
80001	0.000230505
85001	0.000244618
90001	0.000260441
95001	0.000273699
100001	0.000289522
105001	0.000308766
110001	0.000328438
115001	0.000379329
120001	0.00041012
125001	0.000360085
130001	0.000374197
135001	0.000388737
140001	0.000404133
145001	0.00041739
150001	0.000431503
155001	0.000449037
160001	0.000461011
165001	0.000475124
170001	0.00049223
175001	0.00050677
180001	0.000608552
185001	0.000611545
190001	0.000546969
195001	0.000561082
200001	0.000579044
205001	0.000591018
210001	0.000629934

215001	0.000618388
220001	0.000637204
225001	0.000649179
230001	0.000663719
235001	0.000715037
240001	0.000715893
245001	0.00095153
250001	0.000719742
255001	0.000735565
260001	0.000748394
265001	0.000764645
270001	0.00077662
275001	0.000791588
280001	0.000807411
285001	0.000847183
290001	0.000976334
295001	0.000849748
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305001	0.000886527
310001	0.000894652
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320001	0.000928864
325001	0.000942977
330001	0.00106272
335001	0.000963932
340001	0.000988308
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350001	0.00100798
355001	0.0010315
360001	0.00103749
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370001	0.00106785
375001	0.00109565
380001	0.00109351
385001	0.00110976
390001	0.00112687
395001	0.00115167

400001	0.00115467
405001	0.00123164
410001	0.00121924
415001	0.00119786
420001	0.00121283
425001	0.00134925
430001	0.00124191
435001	0.00127612
440001	0.00128125
445001	0.00132701
450001	0.00129451
455001	0.00139928
460001	0.00141639
465001	0.00135566
470001	0.00135994
475001	0.00138432
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485001	0.00140185
490001	0.00143264
495001	0.00146899
500001	0.00144462
505001	0.00147412
510001	0.00160883
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520001	0.00150449
525001	0.00151561
530001	0.0015464
535001	0.00161824
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565001	0.00188382
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575001	0.00208952
580001	0.00167427

585001	0.00169351
590001	0.00173371
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620001	0.0021464
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655001	0.00189622
660001	0.00193428
665001	0.00195566
670001	0.00194412
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695001	0.0020459
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705001	0.00210449
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715001	0.0021558
720001	0.00208481
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735001	0.00216222
740001	0.00221268
745001	0.00216393
750001	0.00223663
755001	0.00218959
760001	0.0025702
765001	0.00225288

770001	0.00224091
775001	0.00225203
780001	0.00226186
785001	0.00243335
790001	0.00228966
795001	0.00239401
800001	0.00253128
805001	0.00233927
810001	0.0023444
815001	0.00239999
820001	0.00238161
825001	0.00244661
830001	0.0024094
835001	0.00242565
840001	0.00280284
845001	0.00246371
850001	0.00246927
855001	0.00271175
860001	0.00254198
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870001	0.00257106
875001	0.00254411
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885001	0.00273399
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915001	0.00278531
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940001	0.00273314
945001	0.00274853
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955001	0.00300726
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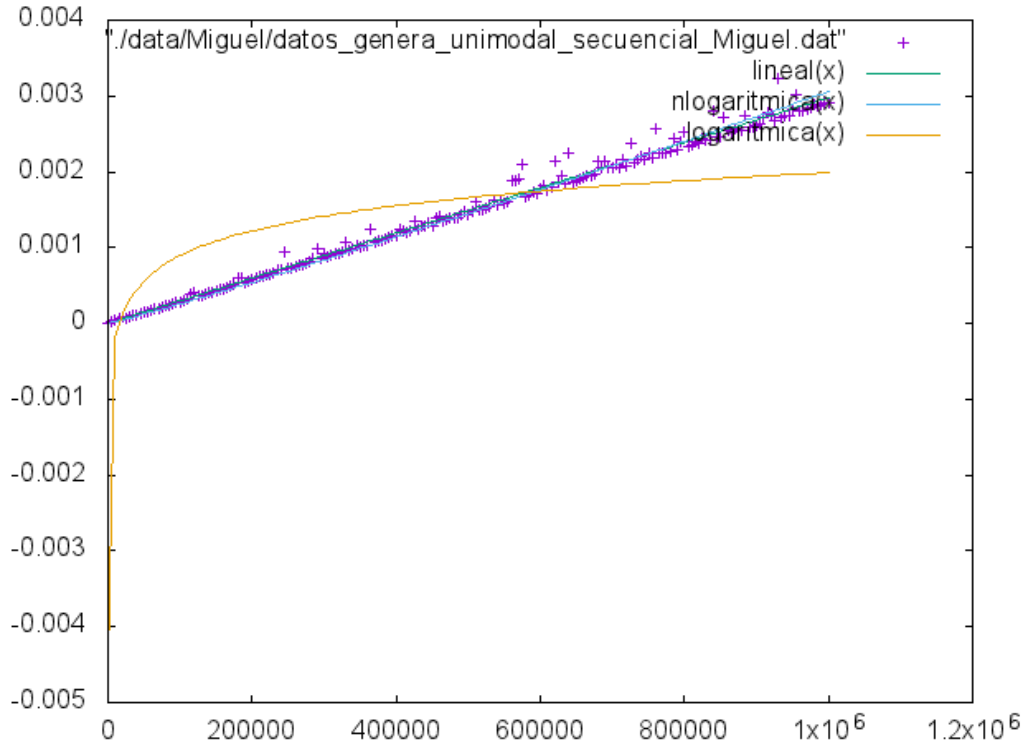
995001	0.00290634
1000001	0.00290078



-**Tabla y gŕafica de Diego(MacBook Pro,MacOS El Capitán):**

Tamaño	Tiempo
1	1.46e-07
5001	3,36E-003
10001	8,49E-003
15001	9,62E-003
20001	1,55E-002
25001	1.5962e-05
30001	1.9068e-05
35001	2.2213e-05

40001	2.5339e-05
45001	2,87E-002
50001	3.1768e-05
55001	4,70E-002
60001	3.7973e-05
65001	4.1143e-05
70001	5,07E-002
75001	4.7415e-05
80001	5.0665e-05
85001	5.3868e-05
90001	5.6742e-05
95001	6.0481e-05
100001	6,32E-002
105001	6.6451e-05
110001	7.0348e-05
115001	8.8778e-05
120001	7.6379e-05
125001	9.0963e-05
130001	9.1459e-05
135001	0.000107813
140001	9.1485e-05
145001	9.2429e-05
150001	9,54E-002
155001	9,82E-002
160001	0.000104178
165001	0.000105868
170001	0.000110005
175001	0.000134818
180001	0.000120587
185001	0.000117758
190001	0.000120811
195001	0.000128354
200001	0.000126392
205001	0.000126681
210001	0.000133319
215001	0.000160284
220001	0.00013935

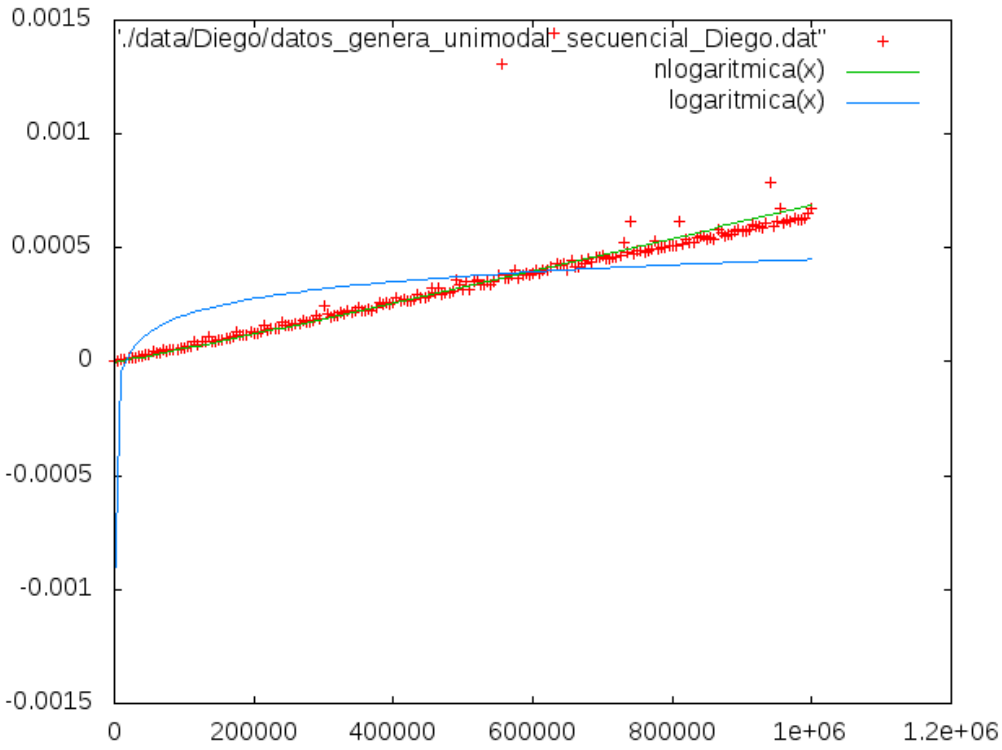
225001	0.000145601
230001	0.000145432
235001	0.000148843
240001	0.00017237
245001	0.000163304
250001	0.000158448
255001	0.000161332
260001	0.000165799
265001	0.000167015
270001	0.000180577
275001	0.000174203
280001	0.000177898
285001	0.000181299
290001	0.000203045
295001	0.000189335
300001	0.000243855
305001	0.000209938
310001	0.000197697
315001	0.00020097
320001	0.000201959
325001	0.000217791
330001	0.000209303
335001	0.000226739
340001	0.00021565
345001	0.000227974
350001	0.000236384
355001	0.000224983
360001	0.000227792
365001	0.000231807
370001	0.000222246
375001	0.000239658
380001	0.000261648
385001	0.000255104
390001	0.00025941
395001	0.000249444
400001	0.000260502
405001	0.000278876

410001	0.000270764
415001	0.000273193
420001	0.000267023
425001	0.000268917
430001	0.000271674
435001	0.00029611
440001	0.000279738
445001	0.000282297
450001	0.000287967
455001	0.000323654
460001	0.000301068
465001	0.000320741
470001	0.000296488
475001	0.000301187
480001	0.000303277
485001	0.000308092
490001	0.000360423
495001	0.000338067
500001	0.000316215
505001	0.000351308
510001	0.000317327
515001	0.000354469
520001	0.000360321
525001	0.000337517
530001	0.000337848
535001	0.000356139
540001	0.000340637
545001	0.000351936
550001	0.000381576
555001	0.00131066
560001	0.00036644
565001	0.000366209
570001	0.000378712
575001	0.00040349
580001	0.000367093
585001	0.000384168
590001	0.000390739

595001	0.000380573
600001	0.000385717
605001	0.000400861
610001	0.000388419
615001	0.000403319
620001	0.000405218
625001	0.000417977
630001	0.00144584
635001	0.000432179
640001	0.000422046
645001	0.000433095
650001	0.000400294
655001	0.000447429
660001	0.000416906
665001	0.000420302
670001	0.000444847
675001	0.000433178
680001	0.000453603
685001	0.000436862
690001	0.000458462
695001	0.000457254
700001	0.000468636
705001	0.000449562
710001	0.000449301
715001	0.000460481
720001	0.000459029
725001	0.00047007
730001	0.000526514
735001	0.000483886
740001	0.000614908
745001	0.000475854
750001	0.000486656
755001	0.000488968
760001	0.000480878
765001	0.000490991
770001	0.000494276
775001	0.000528421

780001	0.000495862
785001	0.000500321
790001	0.000502949
795001	0.000509235
800001	0.000511808
805001	0.000512701
810001	0.000618346
815001	0.000515731
820001	0.000535681
825001	0.00052634
830001	0.000525296
835001	0.000546462
840001	0.000548839
845001	0.000553154
850001	0.000536715
855001	0.000545815
860001	0.000540395
865001	0.000578994
870001	0.000566133
875001	0.000554675
880001	0.000561063
885001	0.000559228
890001	0.000570502
895001	0.000580354
900001	0.000571243
905001	0.000572548
910001	0.000577582
915001	0.000602889
920001	0.000596908
925001	0.000595489
930001	0.000591235
935001	0.000605916
940001	0.000790384
945001	0.000597289
950001	0.00061543
955001	0.000671175
960001	0.000611545

965001	0.000627043
970001	0.000617976
975001	0.000631645
980001	0.000621345
985001	0.000625939
990001	0.000632142
995001	0.000655101
1000001	0.000671709



1.2 Primera Solución DyV

En esta primera solución en la que empleamos DyV. Comenzamos presentando el código:

```
#include <iostream>
#include <vector>
#include <cstdlib>
#include <cstdio>
#include <ctime>
#include <climits>
#include <cassert>
#include <chrono>

using namespace std;
```

```
int& buscaPuntoDeCambio(int* v, int indice1, int indice2, int& res)
{
  int indi=(indice1+indice2)/2;
  if(v[indice1]>v[indice1+1])
  {
    res=indice1;
    return res;
  }
  else if(v[indice2]>v[indice2-1])
  {
    res=indice2;
    return res;
  }
  else if(v[indi]-v[indi-1]>0 &&  v[indi]-v[indi+1]>0)
  {
    res=indi;
    return res;
  }
  else
  {
    buscaPuntoDeCambio(v, indice1, indi, res);
    buscaPuntoDeCambio(v, indi, indice2, res);
  }

}

double uniforme()
{
double u;
  u = (double) rand();
  u = u/(double)(RAND_MAX+1.0);
 return u;
}


using namespace std::chrono;

int main(int argc, char* argv[])
{
  high_resolution_clock::time_point t1, t2;
  if(argc<2)
  {
    cout << "Falta el numero de componentes.\n";
    exit(1);
  }
  int n = atoi(argv[1]);

  int * T = new int[n];
  assert(T);

  srand(time(0));
  double u=uniforme();
```

```
  int p=1+(int)((n-2)*u);
  T[p]=n-1;
  for (int i=0; i<p; i++) T[i]=i;
  for (int i=p+1; i<n; i++) T[i]=n-1-i+p;

  int res=0;
  t1=high_resolution_clock::now();
  buscaPuntoDeCambio(T,0,n-1, res);
  t2=high_resolution_clock::now();
  int punto_cambio=res;
  duration<double> transcurrido = duration_cast<duration<double> >(t2-t1);
  cout << n << " " << transcurrido.count() << "\n";

  return 0;
}
```

En esta implementación el método que seguimos para obtener el punto de cambio es:
1) Obtenemos el punto medio del vector.
2) Comprobamos si los extremos son el punto que andamos buscando. Si el extremo izquierdo fuera este punto entonces el vector decrecería a partir de dicho punto. Si el extremo derecho fuera el punto entonces el vector crecería hasta dicho extremo.
3) Comprobamos si el punto de cambio es el propio punto medio mediante la comprobación del elemento que antecede al punto medio y el elemento que precede al mismo.
4) Si ninguna de estas comprobaciones nos otorga el punto entonces llamamos recursivamente al algoritmo para una sola de las partes del vector. Si a la derecha del punto medio el vector sigue creciendo descartamos la parte izquierda, si a la izquierda del punto medio el vector decrece descartamos la parte derecha.

Vemos que la eficiencia de dicho algoritmo es logarítmica, lo cual es confirmado al ajustar la función a los datos obtenidos. Lo observamos en este caso con la suma al cuadrado de los residuos obtenida en los ajustes.
Lineal = 2.85144e-10
nlogarítmica = 3.7745e-10
logarítmica = 2.42327e-10

Datos:
-**Tabla y gŕafica de Nacho(Toshiba,Linux):**

Tamaño	Tiempo
10000	7.36e-07
20000	6.27e-07
30000	6.12e-07
40000	8.56e-07
50000	7.62e-07
60000	6.61e-07
70000	9.82e-07
80000	8.24e-07

90000	7.98e-07
100000	7.25e-07
110000	7.54e-07
120000	5.34e-07
130000	9.76e-07
140000	1,27E-003
150000	8.12e-07
160000	6.92e-07
170000	9.05e-07
180000	7.45e-07
190000	7.69e-07
200000	9.82e-07
210000	7.07e-07
220000	5,25E-003
230000	1,25E-003
240000	1,09E-003
250000	7.46e-07
260000	6.09e-07
270000	7.91e-07
280000	7.34e-07
290000	7,71E-003
300000	7.38e-07
310000	1,11E-003
320000	9.39e-07
330000	1,44E-003
340000	1,14E-003
350000	9.78e-07
360000	7,04E-003
370000	9.27e-07
380000	9.86e-07
390000	1,09E-003
400000	2,12E-003
410000	1,40E-003
420000	1,21E-003
430000	7.75e-07
440000	8.51e-07
450000	1,57E-003

460000	1,31E-003
470000	5,00E-006
480000	1,28E-003
490000	1.49e-06
500000	1,24E-003
510000	1,72E-003
520000	1.17e-06
530000	1,48E-003
540000	1,80E-003
550000	1,58E-003
560000	1,20E-003
570000	1,64E-003
580000	1,55E-003
590000	1,33E-003
600000	1,89E-003
610000	1,67E-003
620000	1,66E-003
630000	1,49E-003
640000	2,04E-003
650000	1,24E-003
660000	2,00E-003
670000	1,30E-003
680000	2,58E-003
690000	1,53E-003
700000	1,62E-003
710000	1.33e-06
720000	1,51E-003
730000	1,43E-003
740000	1,12E-003
750000	1,93E-003
760000	1.03e-06
770000	1,26E-003
780000	1,94E-003
790000	1,36E-003
800000	1,09E-003
810000	1,51E-003
820000	1,48E-003

830000	1,36E-003
840000	8.07e-07
850000	1,73E-003
860000	5,06E-003
870000	9.55e-07
880000	1,42E-003
890000	1,26E-003
900000	1,08E-003
910000	1,40E-003
920000	1,13E-003
930000	1,16E-003
940000	2.35e-06
950000	1,29E-003
960000	8.61e-07
970000	4,00E-003
980000	1,33E-003
990000	1,33E-003
1000000	9.71e-07
1010000	1,60E-003
1020000	1.58e-06
1030000	1,90E-003
1040000	1,61E-003
1050000	1,12E-003
1060000	4,15E-003
1070000	1,25E-003
1080000	1,39E-003
1090000	1,70E-003
1100000	8.77e-07
1110000	1,05E-003
1120000	2,05E-003
1130000	1,19E-003
1140000	9.06e-07
1150000	1,34E-003
1160000	1,38E-003
1170000	1,59E-003
1180000	1,29E-003
1190000	8.55e-07

1200000	1,05E-003
1210000	1.06e-06
1220000	1,07E-003
1230000	9.1e-07
1240000	1,19E-003
1250000	8.73e-07
1260000	9.25e-07
1270000	1,61E-003
1280000	1,23E-003
1290000	1,87E-003
1300000	1,32E-003
1310000	1,12E-003
1320000	1,16E-003
1330000	1,43E-003
1340000	1,69E-003
1350000	1,56E-003
1360000	1.45e-06
1370000	1,29E-003
1380000	1,08E-003
1390000	1,23E-003
1400000	8.36e-07
1410000	9.96e-07
1420000	1,34E-003
1430000	1,21E-003
1440000	1,10E-003
1450000	1,01E-003
1460000	1,31E-003
1470000	1,20E-003
1480000	1,09E-003
1490000	2.41e-06
1500000	1,91E-003
1510000	2,09E-003
1520000	1.7e-06
1530000	1,44E-003
1540000	1,11E-003
1550000	1,18E-003
1560000	9.82e-07

1570000	3,18E-003
1580000	8.8e-07
1590000	9.01e-07
1600000	1,36E-003
1610000	1,24E-003
1620000	3,42E-003
1630000	1,26E-003
1640000	1,16E-003
1650000	1,04E-003
1660000	1,16E-003
1670000	1,06E-003
1680000	1,41E-003
1690000	1,99E-003
1700000	1,08E-003
1710000	1,06E-003
1720000	1,61E-003
1730000	1,70E-003
1740000	1,46E-003
1750000	1,33E-003
1760000	1,72E-003
1770000	1,43E-003
1780000	1,48E-003
1790000	1,59E-003
1800000	1,17E-003
1810000	2,18E-003
1820000	1,03E-003
1830000	9.69e-07
1840000	9.58e-07
1850000	1,15E-003
1860000	2,10E-003
1870000	8.73e-07
1880000	2,18E-003
1890000	1,99E-003
1900000	1,28E-003
1910000	1,37E-003
1920000	1,16E-003
1930000	1.74e-06

1940000	1,04E-003
1950000	2,90E-003
1960000	1,05E-003
1970000	1,59E-003
1980000	1,58E-003
1990000	1,47E-003
2000000	1,43E-003
2010000	1.52e-06
2020000	2,39E-003
2030000	1,39E-003
2040000	2,14E-003
2050000	1,30E-003
2060000	1,58E-003
2070000	3,51E-003
2080000	1,23E-003
2090000	1,84E-003
2100000	2,21E-003
2110000	1,38E-003
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2130000	2,07E-003
2140000	2,19E-003
2150000	1,36E-003
2160000	1,81E-003
2170000	1,49E-003
2180000	1,31E-003
2190000	1.98e-06
2200000	1,26E-003
2210000	1,87E-003
2220000	1,17E-003
2230000	1,31E-003
2240000	1,11E-003
2250000	1.77e-06
2260000	2,18E-003
2270000	1,90E-003
2280000	2,18E-003
2290000	1,02E-003
2300000	2,27E-003

2310000	9.21e-07
2320000	1,43E-003
2330000	1,36E-003
2340000	2,03E-003
2350000	1,83E-003
2360000	2.57e-06
2370000	3,33E-003
2380000	3,09E-003
2390000	1,43E-003
2400000	4,36E-003
2410000	1,80E-003
2420000	3,48E-003
2430000	2,19E-003
2440000	1,71E-003
2450000	1,66E-003
2460000	1,38E-003
2470000	2,60E-003
2480000	2,01E-003
2490000	2,37E-003
2500000	1,42E-003
2510000	2,23E-003
2520000	1,54E-003
2530000	1,37E-003
2540000	2,45E-003
2550000	1,52E-003
2560000	2,13E-003
2570000	1,32E-003
2580000	2.7e-06
2590000	1,63E-003
2600000	1,51E-003
2610000	2,06E-003
2620000	1,79E-003
2630000	2,74E-003
2640000	1.69e-06
2650000	1,47E-003
2660000	1,71E-003
2670000	1.98e-06

2680000	2,02E-003
2690000	1,51E-003
2700000	1,84E-003
2710000	2,34E-003
2720000	1,70E-003
2730000	1,48E-003
2740000	2,22E-003
2750000	1,64E-003
2760000	1,30E-003
2770000	2,37E-003
2780000	5.36e-06
2790000	1,35E-003
2800000	1,42E-003
2810000	1.1669e-05
2820000	1,83E-003
2830000	1,58E-003
2840000	1.0257e-05
2850000	1.56e-06
2860000	2,38E-003
2870000	2,04E-003
2880000	1,46E-003
2890000	7.07e-06
2900000	1,39E-003
2910000	1,65E-003
2920000	1,38E-003
2930000	1,39E-003
2940000	1,99E-003
2950000	1,91E-003
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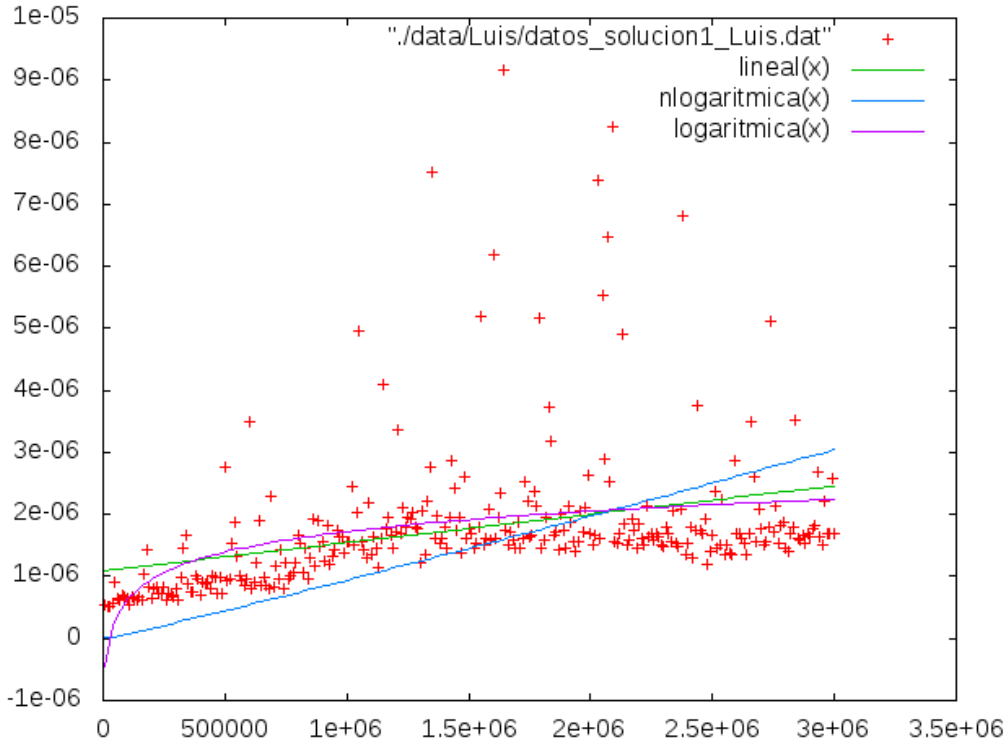
2970000	1,60E-003
2980000	1,72E-003
2990000	1,70E-003



-<u>Tabla y gráfica de Luis(Fujitsu,Linux):</u>

Tamaño	Tiempo
10001	5.38e-07
20001	5.25e-07
30001	5.15e-07
40001	5.7e-07
50001	9.15e-07
60001	6.54e-07
70001	6.3e-07
80001	6.95e-07
90001	6.68e-07
100001	6.39e-07
110001	5.31e-07
120001	6.83e-07
130001	6.41e-07
140001	6.17e-07
150001	6.83e-07
160001	6.19e-07
170001	1,04E-03

180001	1,42E-03
190001	8.2e-07
200001	6.57e-07
210001	8.14e-07
220001	8.35e-07
230001	7.37e-07
240001	7.21e-07
250001	8.33e-07
260001	6.32e-07
270001	7.13e-07
280001	7.09e-07
290001	6.61e-07
300001	7.95e-07
310001	6.32e-07
320001	9.93e-07
330001	1.46e-06
340001	1,66E-03
350001	8.88e-07
360001	7.42e-07
370001	7.39e-07
380001	1,01E-03
390001	9.49e-07
400001	7.05e-07
410001	9.08e-07
420001	8.92e-07
430001	9.02e-07
440001	8.09e-07
450001	1,01E-03
460001	9.88e-07
470001	7.19e-07
480001	9.75e-07
490001	7.25e-07
500001	2,76E-03
510001	9.36e-07
520001	9.53e-07
530001	1,55E-03
540001	1,89E-03

550001	1,33E-03
560001	1,02E-03
570001	9.29e-07
580001	8.6e-07
590001	9.59e-07
600001	3,50E-03
610001	8.07e-07
620001	8.96e-07
630001	1,23E-03
640001	1.9e-06
650001	8.56e-07
660001	9.9e-07
670001	8.56e-07
680001	7.94e-07
690001	2,29E-03
700001	8.4e-07
710001	1.16e-06
720001	9.58e-07
730001	1,44E-03
740001	8.1e-07
750001	1,21E-03
760001	9.53e-07
770001	1,02E-03
780001	1,05E-03
790001	1,21E-03
800001	1.66e-06
810001	1,54E-03
820001	1,07E-03
830001	1,46E-03
840001	9.5e-07
850001	1,30E-03
860001	1,93E-03
870001	1,18E-03
880001	1,91E-03
890001	1,49E-03
900001	1,55E-03
910001	1,25E-03

920001	1,81E-03
930001	1,20E-03
940001	1,32E-03
950001	1,43E-03
960001	1,74E-03
970001	1,63E-03
980001	1,63E-03
990001	1.39e-06
1000001	1,56E-03
1010001	1,57E-03
1020001	2,45E-03
1030001	1,51E-03
1040001	2,02E-03
1050001	4,97E-03
1060001	1,56E-03
1070001	1,44E-03
1080001	1.29e-06
1090001	2,19E-03
1100001	1,36E-03
1110001	1,63E-03
1120001	1,45E-03
1130001	1,14E-03
1140001	1,61E-03
1150001	4,09E-03
1160001	1,76E-03
1170001	1,95E-03
1180001	1,67E-03
1190001	1,44E-03
1200001	1,71E-03
1210001	3,36E-03
1220001	1,69E-03
1230001	2,11E-03
1240001	1,81E-03
1250001	1.94e-06
1260001	1,94E-03
1270001	2.02e-06
1280001	1,79E-03

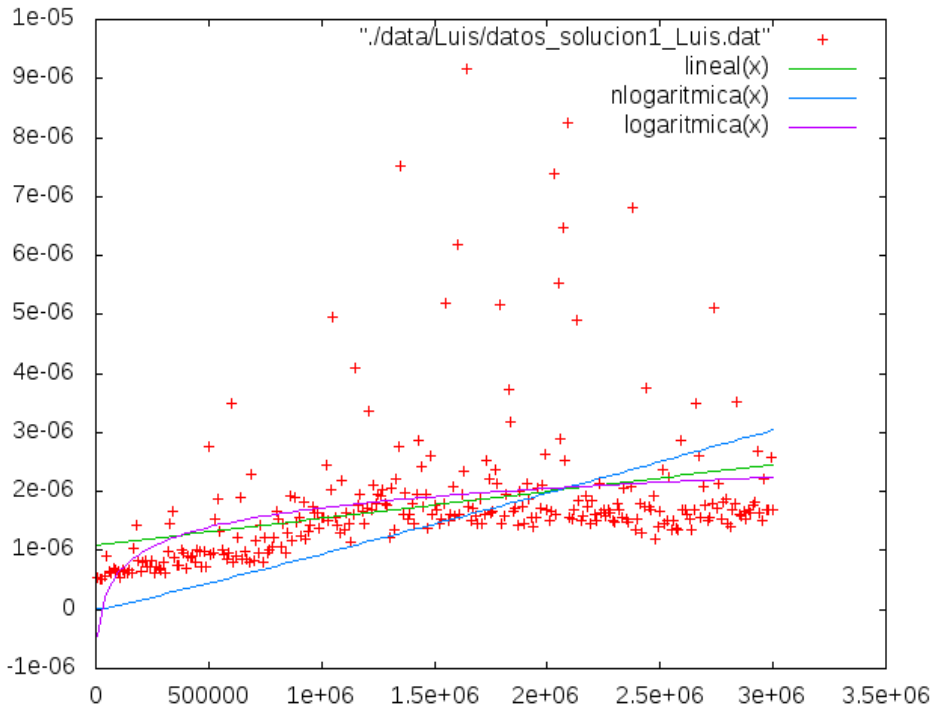
1290001	1,77E-03
1300001	1,23E-03
1310001	2,04E-03
1320001	1,36E-03
1330001	2,23E-03
1340001	2,75E-03
1350001	7,52E-03
1360001	1,60E-03
1370001	1,97E-03
1380001	1,54E-03
1390001	1.61e-06
1400001	1.79e-06
1410001	1,45E-03
1420001	1,95E-03
1430001	2,87E-03
1440001	2.43e-06
1450001	1,74E-03
1460001	1,96E-03
1470001	1,39E-03
1480001	2,62E-03
1490001	1,61E-03
1500001	1,76E-03
1510001	1.68e-06
1520001	1,46E-03
1530001	1.53e-06
1540001	1,80E-03
1550001	5,20E-03
1560001	1,50E-03
1570001	1,62E-03
1580001	2.09e-06
1590001	1,59E-03
1600001	6,19E-03
1610001	1,62E-03
1620001	1.95e-06
1630001	2,35E-03
1640001	9,17E-03
1650001	1.75e-06

1660001	1,51E-03
1670001	1,73E-03
1680001	1,59E-03
1690001	1,45E-03
1700001	1,88E-03
1710001	1,45E-03
1720001	1,61E-03
1730001	2,52E-03
1740001	2,20E-03
1750001	1,63E-03
1760001	1,66E-03
1770001	2,36E-03
1780001	2,12E-03
1790001	5,18E-03
1800001	1,45E-03
1810001	1,59E-03
1820001	1,94E-03
1830001	3,72E-03
1840001	3,18E-03
1850001	1,67E-03
1860001	1,71E-03
1870001	1.44e-06
1880001	2,00E-03
1890001	1,74E-03
1900001	1,46E-03
1910001	2,15E-03
1920001	1,89E-03
1930001	1,57E-03
1940001	1,39E-03
1950001	1.56e-06
1960001	2.07e-06
1970001	1,73E-03
1980001	2.1e-06
1990001	2,63E-03
2000001	1,70E-03
2010001	1,50E-03
2020001	1,67E-03

2030001	7,38E-03
2040001	1,62E-03
2050001	5,55E-03
2060001	2,88E-03
2070001	6,47E-03
2080001	2,52E-03
2090001	8,26E-03
2100001	1,57E-03
2110001	1.53e-06
2120001	1,69E-03
2130001	4,91E-03
2140001	1,84E-03
2150001	1,50E-03
2160001	1,59E-03
2170001	1,93E-03
2180001	1,75E-03
2190001	1,46E-03
2200001	1,86E-03
2210001	1,62E-03
2220001	1.51e-06
2230001	2,13E-03
2240001	1.63e-06
2250001	1,70E-03
2260001	1,59E-03
2270001	1,69E-03
2280001	1,63E-03
2290001	1,51E-03
2300001	1,47E-03
2310001	1,81E-03
2320001	1,69E-03
2330001	1,56E-03
2340001	2,05E-03
2350001	1,55E-03
2360001	1,49E-03
2370001	2.08e-06
2380001	6,82E-03
2390001	1.36e-06

2400001	1,53E-03
2410001	1,81E-03
2420001	1,30E-03
2430001	1,75E-03
2440001	3,76E-03
2450001	1,74E-03
2460001	1,70E-03
2470001	1,92E-03
2480001	1,20E-03
2490001	1,40E-03
2500001	1,68E-03
2510001	2,38E-03
2520001	1,46E-03
2530001	1,51E-03
2540001	2,23E-03
2550001	1,35E-03
2560001	1,51E-03
2570001	1,38E-03
2580001	1,34E-03
2590001	2,86E-03
2600001	1,70E-03
2610001	1,70E-03
2620001	1,62E-03
2630001	1,52E-03
2640001	1,35E-03
2650001	1,69E-03
2660001	3.5e-06
2670001	2,60E-03
2680001	1,57E-03
2690001	2,08E-03
2700001	1,78E-03
2710001	1,50E-03
2720001	1,57E-03
2730001	1,79E-03
2740001	5,12E-03
2750001	1,73E-03
2760001	2,14E-03

2770001	1,54E-03
2780001	1,82E-03
2790001	1,86E-03
2800001	1,47E-03
2810001	1.4e-06
2820001	1,70E-03
2830001	1,79E-03
2840001	3,52E-03
2850001	1,61E-03
2860001	1,58E-03
2870001	1,67E-03
2880001	1,53E-03
2890001	1,70E-03
2900001	1.63e-06
2910001	1,78E-03
2920001	1,82E-03
2930001	2.68e-06
2940001	1,63E-03
2950001	1,51E-03
2960001	2.22e-06
2970001	1.7e-06
2980001	1,68E-03
2990001	2,59E-03
3000001	1,69E-03



-**Tabla y gŕafica de Miguel(Toshiba,Windows):**

Tamaño	Tiempo
10001	4.27654e-007
20001	4.27654e-007
30001	4.27654e-007
40001	4.27654e-007
50001	8.55308e-007
60001	4.27654e-007
70001	8.55308e-007
80001	4.27654e-007
90001	8.55308e-007
100001	4.27654e-007
110001	4.27654e-007
120001	8.55308e-007
130001	4.27654e-007
140001	4.27654e-007
150001	4.27654e-007
160001	4.27654e-007
170001	4.27654e-007
180001	4.27654e-007
190001	8.55308e-007
200001	4.27654e-007
210001	8.55308e-007
220001	4.27654e-007
230001	4.27654e-007
240001	4.27654e-007
250001	4.27654e-007
260001	4.27654e-007
270001	4.27654e-007
280001	8.55308e-007
290001	4.27654e-007
300001	8.55308e-007
310001	8.55308e-007
320001	8.55308e-007
330001	8.55308e-007

340001	8.55308e-007
350001	8.55308e-007
360001	4.27654e-007
370001	8.55308e-007
380001	5.13185e-006
390001	8.55308e-007
400001	8.55308e-007
410001	8.55308e-007
420001	4.27654e-007
430001	8.55308e-007
440001	4.27654e-007
450001	8.55308e-007
460001	8.55308e-007
470001	8.55308e-007
480001	4.27654e-007
490001	8.55308e-007
500001	8.55308e-007
510001	8.55308e-007
520001	4.27654e-007
530001	8.55308e-007
540001	4.27654e-007
550001	8.55308e-007
560001	4.27654e-007
570001	8.55308e-007
580001	8.55308e-007
590001	8.55308e-007
600001	8.55308e-007
610001	4.27654e-007
620001	4.27654e-007
630001	4.27654e-007
640001	8.55308e-007
650001	8.55308e-007
660001	8.55308e-007
670001	8.55308e-007
680001	8.55308e-007
690001	1.28296e-006
700001	4.27654e-007

710001	8.55308e-007
720001	8.55308e-007
730001	4.27654e-007
740001	4.27654e-007
750001	8.55308e-007
760001	4.27654e-007
770001	8.55308e-007
780001	8.55308e-007
790001	4.27654e-007
800001	8.55308e-007
810001	8.55308e-007
820001	4.27654e-007
830001	4.27654e-007
840001	4.27654e-007
850001	1.28296e-006
860001	8.55308e-007
870001	8.55308e-007
880001	1.28296e-006
890001	8.55308e-007
900001	8.55308e-007
910001	4.27654e-007
920001	8.55308e-007
930001	8.55308e-007
940001	8.55308e-007
950001	4.27654e-007
960001	4.27654e-007
970001	4.27654e-007
980001	8.55308e-007
990001	8.55308e-007
1000001	8.55308e-007
1010001	8.55308e-007
1020001	8.55308e-007
1030001	4.27654e-007
1040001	8.55308e-007
1050001	4.27654e-007
1060001	8.55308e-007
1070001	8.55308e-007

1080001	4.27654e-007
1090001	1.71062e-006
1100001	8.55308e-007
1110001	4.27654e-007
1120001	8.55308e-007
1130001	4.27654e-007
1140001	3.42123e-006
1150001	8.55308e-007
1160001	8.55308e-007
1170001	8.55308e-007
1180001	1.28296e-006
1190001	8.55308e-007
1200001	8.55308e-007
1210001	8.55308e-007
1220001	1.28296e-006
1230001	4.27654e-007
1240001	8.55308e-007
1250001	1.28296e-006
1260001	4.27654e-007
1270001	8.55308e-007
1280001	8.55308e-007
1290001	8.55308e-007
1300001	8.55308e-007
1310001	8.55308e-007
1320001	8.55308e-007
1330001	8.55308e-007
1340001	8.55308e-007
1350001	8.55308e-007
1360001	8.55308e-007
1370001	8.55308e-007
1380001	8.55308e-007
1390001	4.27654e-007
1400001	8.55308e-007
1410001	8.55308e-007
1420001	8.55308e-007
1430001	8.55308e-007
1440001	8.55308e-007

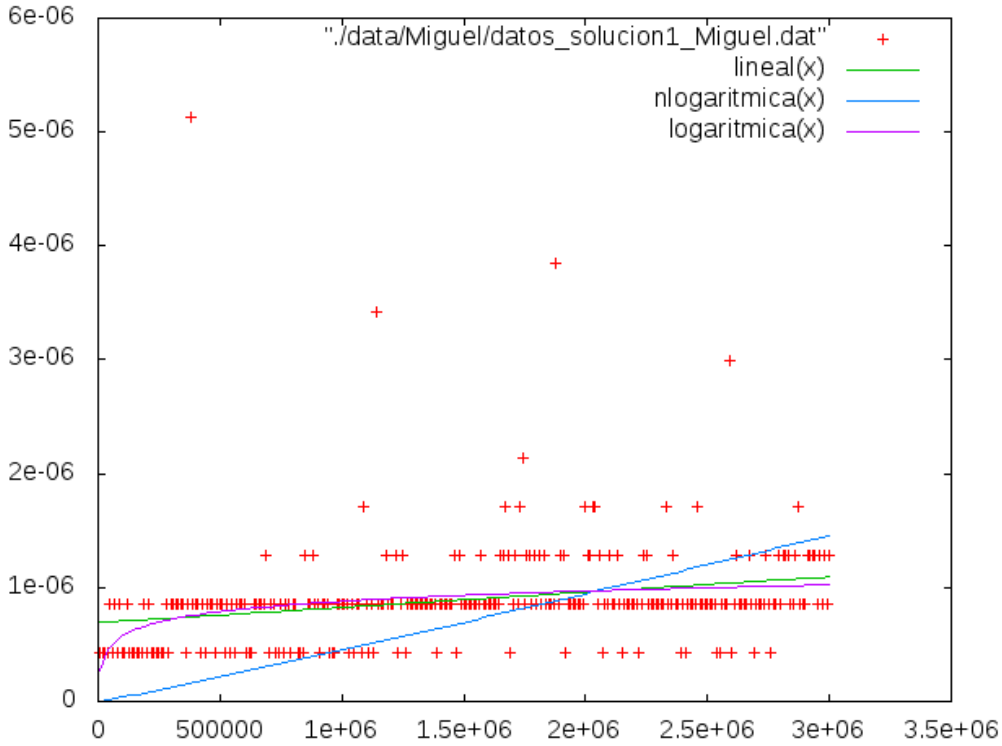
1450001	8.55308e-007
1460001	1.28296e-006
1470001	4.27654e-007
1480001	1.28296e-006
1490001	8.55308e-007
1500001	8.55308e-007
1510001	8.55308e-007
1520001	8.55308e-007
1530001	8.55308e-007
1540001	8.55308e-007
1550001	8.55308e-007
1560001	8.55308e-007
1570001	1.28296e-006
1580001	8.55308e-007
1590001	8.55308e-007
1600001	8.55308e-007
1610001	8.55308e-007
1620001	8.55308e-007
1630001	8.55308e-007
1640001	8.55308e-007
1650001	1.28296e-006
1660001	1.28296e-006
1670001	1.71062e-006
1680001	1.28296e-006
1690001	4.27654e-007
1700001	8.55308e-007
1710001	1.28296e-006
1720001	8.55308e-007
1730001	1.71062e-006
1740001	2.13827e-006
1750001	8.55308e-007
1760001	1.28296e-006
1770001	1.28296e-006
1780001	8.55308e-007
1790001	1.28296e-006
1800001	8.55308e-007
1810001	1.28296e-006

1820001	8.55308e-007
1830001	1.28296e-006
1840001	8.55308e-007
1850001	8.55308e-007
1860001	8.55308e-007
1870001	8.55308e-007
1880001	3.84889e-006
1890001	8.55308e-007
1900001	1.28296e-006
1910001	1.28296e-006
1920001	4.27654e-007
1930001	8.55308e-007
1940001	8.55308e-007
1950001	8.55308e-007
1960001	8.55308e-007
1970001	8.55308e-007
1980001	8.55308e-007
1990001	8.55308e-007
2000001	1.71062e-006
2010001	1.28296e-006
2020001	1.28296e-006
2030001	1.71062e-006
2040001	1.71062e-006
2050001	8.55308e-007
2060001	1.28296e-006
2070001	4.27654e-007
2080001	8.55308e-007
2090001	8.55308e-007
2100001	1.28296e-006
2110001	8.55308e-007
2120001	8.55308e-007
2130001	1.28296e-006
2140001	8.55308e-007
2150001	4.27654e-007
2160001	8.55308e-007
2170001	8.55308e-007
2180001	8.55308e-007

2190001	8.55308e-007
2200001	8.55308e-007
2210001	8.55308e-007
2220001	4.27654e-007
2230001	8.55308e-007
2240001	1.28296e-006
2250001	1.28296e-006
2260001	8.55308e-007
2270001	8.55308e-007
2280001	8.55308e-007
2290001	8.55308e-007
2300001	8.55308e-007
2310001	8.55308e-007
2320001	8.55308e-007
2330001	1.71062e-006
2340001	8.55308e-007
2350001	8.55308e-007
2360001	1.28296e-006
2370001	8.55308e-007
2380001	8.55308e-007
2390001	4.27654e-007
2400001	8.55308e-007
2410001	4.27654e-007
2420001	8.55308e-007
2430001	8.55308e-007
2440001	8.55308e-007
2450001	8.55308e-007
2460001	1.71062e-006
2470001	8.55308e-007
2480001	8.55308e-007
2490001	8.55308e-007
2500001	8.55308e-007
2510001	8.55308e-007
2520001	8.55308e-007
2530001	8.55308e-007
2540001	4.27654e-007
2550001	4.27654e-007

2560001	8.55308e-007
2570001	8.55308e-007
2580001	8.55308e-007
2590001	2.99358e-006
2600001	4.27654e-007
2610001	8.55308e-007
2620001	1.28296e-006
2630001	8.55308e-007
2640001	8.55308e-007
2650001	8.55308e-007
2660001	8.55308e-007
2670001	1.28296e-006
2680001	8.55308e-007
2690001	4.27654e-007
2700001	8.55308e-007
2710001	8.55308e-007
2720001	8.55308e-007
2730001	8.55308e-007
2740001	1.28296e-006
2750001	8.55308e-007
2760001	4.27654e-007
2770001	8.55308e-007
2780001	8.55308e-007
2790001	1.28296e-006
2800001	8.55308e-007
2810001	1.28296e-006
2820001	1.28296e-006
2830001	1.28296e-006
2840001	8.55308e-007
2850001	8.55308e-007
2860001	1.28296e-006
2870001	1.71062e-006
2880001	8.55308e-007
2890001	8.55308e-007
2900001	8.55308e-007
2910001	1.28296e-006
2920001	1.28296e-006

2930001	1.28296e-006
2940001	1.28296e-006
2950001	8.55308e-007
2960001	1.28296e-006
2970001	8.55308e-007
2980001	1.28296e-006
2990001	8.55308e-007
3000001	1.28296e-006



-**<u>Tabla y gŕafica de Diego(MacBook Pro,MacOS El Capitán):</u>**

Tamaño	Tiempo
10001	6.32e-07
20001	8.81e-07
30001	1,03E-003
40001	9.8e-07
50001	7.97e-07
60001	8.5e-07
70001	8.73e-07
80001	9.93e-07
90001	7.97e-07
100001	7.32e-07
110001	9.24e-07

120001	1,05E-003
130001	2,04E-003
140001	6.74e-07
150001	7.88e-07
160001	7.73e-07
170001	7.93e-07
180001	7.54e-07
190001	7.2e-07
200001	7.85e-07
210001	7.48e-07
220001	9.95e-07
230001	7.35e-07
240001	8.44e-07
250001	9.41e-07
260001	7.51e-07
270001	1,00E-003
280001	7.06e-07
290001	1,36E-003
300001	8.46e-07
310001	8.52e-07
320001	8.57e-07
330001	1,43E-003
340001	9.36e-07
350001	1,02E-003
360001	1,08E-003
370001	1,04E-003
380001	8.15e-07
390001	7.89e-07
400001	9.87e-07
410001	2,32E-003
420001	1,18E-003
430001	1,08E-003
440001	9.72e-07
450001	9.13e-07
460001	9.78e-07
470001	1,36E-003
480001	1,10E-003

490001	7.99e-07
500001	2,65E-003
510001	1,40E-003
520001	9.56e-07
530001	1,88E-003
540001	1.18e-06
550001	9.22e-07
560001	1,25E-003
570001	1.0517e-05
580001	1,26E-003
590001	1,47E-003
600001	1,18E-003
610001	1,36E-003
620001	1.15e-06
630001	1,06E-003
640001	2.18e-06
650001	1,93E-003
660001	1.3e-06
670001	9.56e-07
680001	1,51E-003
690001	1,12E-003
700001	1,18E-003
710001	1,67E-003
720001	1.69e-06
730001	1,68E-003
740001	1,35E-003
750001	1,63E-003
760001	1,71E-003
770001	1,18E-003
780001	8.05e-07
790001	2,77E-003
800001	1.31e-06
810001	1,60E-003
820001	1,05E-003
830001	1,23E-003
840001	1,73E-003
850001	1,63E-003

860001	1,76E-003
870001	1,64E-003
880001	1,85E-003
890001	1,84E-003
900001	1,11E-003
910001	2,61E-003
920001	1,14E-003
930001	1.84e-06
940001	1.49e-06
950001	1,68E-003
960001	1.19e-06
970001	1,51E-003
980001	1,37E-003
990001	1,53E-003
1000001	1,87E-003
1010001	1,28E-003
1020001	1,64E-003
1030001	1,63E-003
1040001	1,74E-003
1050001	1,57E-003
1060001	1,85E-003
1070001	1,72E-003
1080001	2,13E-003
1090001	1,21E-003
1100001	1,25E-003
1110001	1,45E-003
1120001	2,70E-003
1130001	1,70E-003
1140001	1,28E-003
1150001	1,13E-003
1160001	1,24E-003
1170001	1,79E-003
1180001	1,53E-003
1190001	1.78e-06
1200001	1,78E-003
1210001	1.57e-06
1220001	1,66E-003

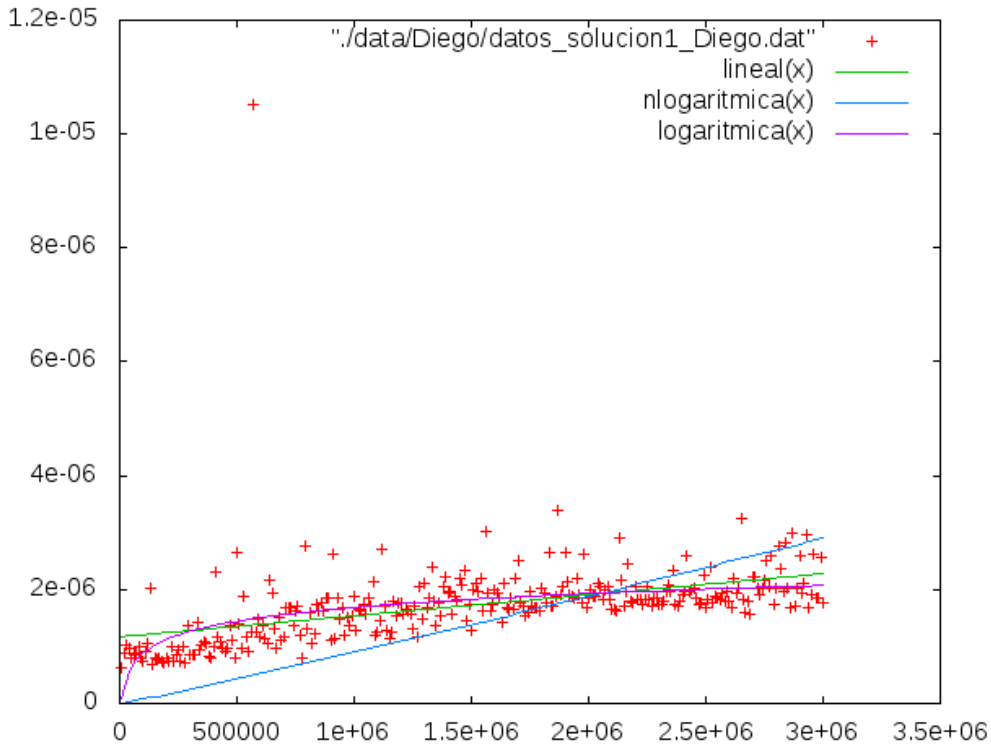
1230001	1,62E-003
1240001	1,56E-003
1250001	1,32E-003
1260001	1,71E-003
1270001	1,17E-003
1280001	2,06E-003
1290001	1,48E-003
1300001	2,10E-003
1310001	1,69E-003
1320001	1,86E-003
1330001	2,39E-003
1340001	1,79E-003
1350001	1,37E-003
1360001	1,77E-003
1370001	1,53E-003
1380001	2.06e-06
1390001	2,22E-003
1400001	1,94E-003
1410001	1,97E-003
1420001	1,56E-003
1430001	1,89E-003
1440001	1,81E-003
1450001	2,18E-003
1460001	2,08E-003
1470001	2,34E-003
1480001	1,46E-003
1490001	1,75E-003
1500001	1,29E-003
1510001	1,99E-003
1520001	2,11E-003
1530001	1,96E-003
1540001	2,20E-003
1550001	1,63E-003
1560001	3.02e-06
1570001	1.94e-06
1580001	1,63E-003
1590001	1,74E-003

1600001	2,01E-003
1610001	1,93E-003
1620001	1.84e-06
1630001	1,44E-003
1640001	2,10E-003
1650001	1,67E-003
1660001	1,64E-003
1670001	1,86E-003
1680001	1,66E-003
1690001	2.19e-06
1700001	2,51E-003
1710001	1,76E-003
1720001	1,71E-003
1730001	1,53E-003
1740001	1,60E-003
1750001	1,97E-003
1760001	1,70E-003
1770001	1,68E-003
1780001	1,69E-003
1790001	1,62E-003
1800001	2,04E-003
1810001	1,93E-003
1820001	1,76E-003
1830001	2,66E-003
1840001	1,72E-003
1850001	1,72E-003
1860001	1,88E-003
1870001	3,40E-003
1880001	1,92E-003
1890001	2,06E-003
1900001	2,65E-003
1910001	2,15E-003
1920001	1,91E-003
1930001	1,87E-003
1940001	1,85E-003
1950001	2,21E-003
1960001	1,92E-003

1970001	1,76E-003
1980001	2,62E-003
1990001	1,68E-003
2000001	1,85E-003
2010001	1,98E-003
2020001	1,89E-003
2030001	1,88E-003
2040001	2,12E-003
2050001	2,05E-003
2060001	1,81E-003
2070001	2,00E-003
2080001	2,04E-003
2090001	1,82E-003
2100001	1,66E-003
2110001	1,65E-003
2120001	1,61E-003
2130001	2,92E-003
2140001	2,17E-003
2150001	1,72E-003
2160001	1,97E-003
2170001	2,44E-003
2180001	1,79E-003
2190001	1,78E-003
2200001	2,04E-003
2210001	1,83E-003
2220001	1,84E-003
2230001	1,74E-003
2240001	1.81e-06
2250001	2,05E-003
2260001	1,82E-003
2270001	1,72E-003
2280001	1,85E-003
2290001	1,84E-003
2300001	1,73E-003
2310001	1.73e-06
2320001	1,79E-003
2330001	1,97E-003

2340001	2,08E-003
2350001	1,97E-003
2360001	2,35E-003
2370001	1,75E-003
2380001	1,72E-003
2390001	1,80E-003
2400001	1,92E-003
2410001	1,95E-003
2420001	2,59E-003
2430001	1,97E-003
2440001	1,99E-003
2450001	2,03E-003
2460001	1,85E-003
2470001	1.75e-06
2480001	1,77E-003
2490001	2,26E-003
2500001	1,70E-003
2510001	1,83E-003
2520001	2,40E-003
2530001	1,76E-003
2540001	1,87E-003
2550001	1,86E-003
2560001	1.82e-06
2570001	1,95E-003
2580001	1,78E-003
2590001	1,96E-003
2600001	1,80E-003
2610001	1,69E-003
2620001	2,19E-003
2630001	1,95E-003
2640001	2,03E-003
2650001	3,25E-003
2660001	1,83E-003
2670001	1,61E-003
2680001	1,79E-003
2690001	1,57E-003
2700001	2,23E-003

2710001	2,24E-003
2720001	2,02E-003
2730001	1,90E-003
2740001	2,03E-003
2750001	2,15E-003
2760001	2,51E-003
2770001	2,06E-003
2780001	2,59E-003
2790001	1,75E-003
2800001	2.02e-06
2810001	2,76E-003
2820001	2,36E-003
2830001	1,98E-003
2840001	2,82E-003
2850001	2,01E-003
2860001	1,69E-003
2870001	3,00E-003
2880001	1,71E-003
2890001	2,03E-003
2900001	2,60E-003
2910001	1,94E-003
2920001	2,12E-003
2930001	2,97E-003
2940001	1,68E-003
2950001	1,92E-003
2960001	2,63E-003
2970001	1,85E-003
2980001	1,86E-003
2990001	2,57E-003
3000001	1,76E-003



1.3 Segunda Solución DyV

En esta segunda solución que planteamos para nuestro problema comenzaremos como en la anterior, presentando el código:

```
#include <iostream>
using namespace std;
#include <ctime>
#include <cstdlib>
#include <climits>
#include <cassert>
//#include <mach/mach_time.h>
#include <cstdio>
#include <chrono>

int &  rift_lims(int* arr, int beg, int end, int & res){

  int N = end - beg;

  if (N  == 1) {
    res = beg;
    return arr[beg];
  }
  else if (arr [beg + N/2 - 1] < arr [end - 1])
    return rift_lims(arr, beg + N/2 , end, res);
  else
    return rift_lims(arr,beg, beg + N/2, res);
}
```

```
int rift(int * arr, int n, int & res){

  int beg = 0, end = n;

  return rift_lims(arr,beg,end,res);
}

double uniforme()
{
double u;
  u = (double) rand();
  u = u/(double)(RAND_MAX+1.0);
 return u;
}

int main(int argc, char * argv[])
{

  if (argc != 2)
    {
      cerr << "Formato " << argv[0] << " <num_elem>" << endl;
      return -1;
    }

  int n = atoi(argv[1]);

  int * T = new int[n];
  assert(T);

  srand(time(0));
  double u=uniforme();
  int p=1+(int)((n-2)*u);
  T[p]=n-1;
  for (int i=0; i<p; i++) T[i]=i;
  for (int i=p+1; i<n; i++) T[i]=n-1-i+p;

#ifdef _PRINT_IT_
  cout << "El vector generado es:" << endl;
  for (int j=0; j<n; j++) {cout << T[j] << " ";}
  cout << endl;
#endif

int res=0;
std::chrono::high_resolution_clock::time_point t1, t2;

t1=std::chrono::high_resolution_clock::now();
rift(T,n,res);
t2=std::chrono::high_resolution_clock::now();
int punto_cambio=res;

std::chrono::duration<double>                                    transcurrido                                    =
std::chrono::duration_cast<std::chrono::duration<double> >(t2-t1);
```

```
cout << n << " " << transcurrido.count() << "\n";

#ifdef _PRINT_IT_
cout << endl << "La posicion en la que cambia la monotonia es: " << punto_cambio << endl ;
#endif
}
```

El algoritmo utilizado en esta segunda solución es el siguiente:
1) Aprovechando la estructura con la que se genera el vector aleatorio tomamos inicialmente el punto medio y el extremo derecho del vector. Si el valor almacenado en el punto medio es mayor que el almacenado en el punto extremo tomamos la parte izquierda del vector. Si el valor almacenado en el punto medio es menor que el del extremo tomaremos la parte derecha del vector.
2) Repetiremos esto hasta llegar al caso en que el tamaño del vector sea 1 y por tanto el punto sea el único que nos queda.

La eficiencia de este algoritmo es logarítmica como se observa en la suma al cuadrado de los residuos que nos arroja el ajuste de las funciones mediante gnuplot:
nlogarítmica = 1.0888e-10
logarítmica = 6.58058e-11

Pasamos a exponer los datos y gráficas obtenidas:

Datos:
-**Tabla y gŕafica de Nacho(Toshiba,Linux):**

Tamaño	Tiempo
1	1.34e-07
5001	3.71e-07
10001	4.65e-07
15001	7.23e-07
20001	5.42e-07
25001	5.18e-07
30001	6.48e-07
35001	6.85e-07
40001	6.48e-07
45001	7.77e-07
50001	1,01E-003
55001	8,00E-007
60001	1,65E-003
65001	1,30E-003
70001	1,51E-003
75001	1,08E-003
80001	9.79e-07
85001	1,08E-003

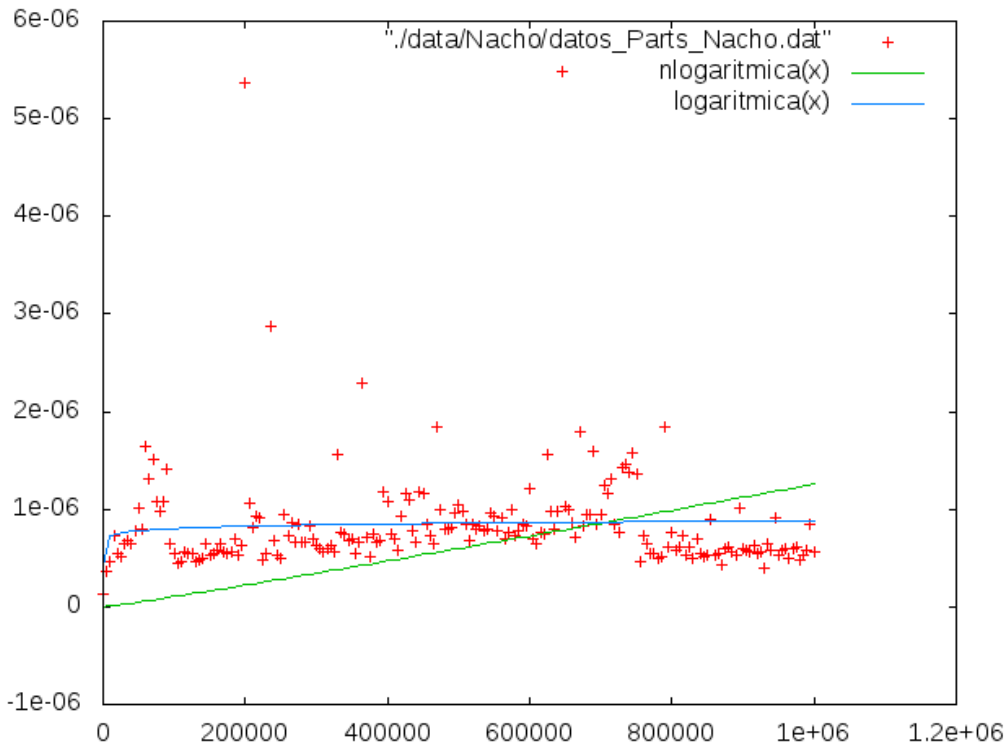
90001	1,40E-003
95001	6.52e-07
100001	5.43e-07
105001	4.48e-07
110001	4.66e-07
115001	5.67e-07
120001	5.42e-07
125001	5.41e-07
130001	4.64e-07
135001	4.82e-07
140001	4.95e-07
145001	6.45e-07
150001	5.29e-07
155001	5.54e-07
160001	5.85e-07
165001	6.48e-07
170001	5.65e-07
175001	5.44e-07
180001	5.57e-07
185001	6.91e-07
190001	5.38e-07
195001	6.32e-07
200001	5,37E-003
205001	1.06e-06
210001	8.08e-07
215001	9.24e-07
220001	9.12e-07
225001	4.86e-07
230001	5.44e-07
235001	2,87E-003
240001	6.74e-07
245001	5.3e-07
250001	4.99e-07
255001	9.51e-07
260001	7.32e-07
265001	8.61e-07
270001	6.55e-07

275001	8.5e-07
280001	6.63e-07
285001	6.71e-07
290001	8.31e-07
295001	6.98e-07
300001	6.29e-07
305001	6.02e-07
310001	5.59e-07
315001	5.97e-07
320001	6.24e-07
325001	5.7e-07
330001	1,57E-003
335001	7.67e-07
340001	7.46e-07
345001	6.87e-07
350001	6.92e-07
355001	5.52e-07
360001	6.64e-07
365001	2,30E-003
370001	7.07e-07
375001	5.12e-07
380001	7.48e-07
385001	6.69e-07
390001	6.86e-07
395001	1,18E-003
400001	1,07E-003
405001	7.38e-07
410001	6.94e-07
415001	5.86e-07
420001	9.21e-07
425001	1,16E-003
430001	1,10E-003
435001	7.87e-07
440001	6.62e-07
445001	1,18E-003
450001	1,17E-003
455001	8.52e-07

460001	7.28e-07
465001	6.49e-07
470001	1,85E-003
475001	9.92e-07
480001	7.9e-07
485001	7.95e-07
490001	8.13e-07
495001	9.6e-07
500001	1,04E-003
505001	9.72e-07
510001	8.53e-07
515001	6.87e-07
520001	8.4e-07
525001	8.02e-07
530001	8.37e-07
535001	7.8e-07
540001	7.9e-07
545001	9.61e-07
550001	9.27e-07
555001	7.75e-07
560001	9.06e-07
565001	6.97e-07
570001	7.61e-07
575001	9.99e-07
580001	7.22e-07
585001	7.76e-07
590001	8.43e-07
595001	8.35e-07
600001	1,22E-003
605001	6.98e-07
610001	6.41e-07
615001	7.57e-07
620001	7.51e-07
625001	1,57E-003
630001	9.71e-07
635001	7.9e-07
640001	9.72e-07

645001	5,49E-003
650001	1,03E-003
655001	9.92e-07
660001	8.6e-07
665001	7.13e-07
670001	1,79E-003
675001	8.22e-07
680001	9.47e-07
685001	9.41e-07
690001	1.6e-06
695001	8.41e-07
700001	9.45e-07
705001	1,24E-003
710001	1,17E-003
715001	1,30E-003
720001	8.45e-07
725001	7.68e-07
730001	1,43E-003
735001	1,46E-003
740001	1,38E-003
745001	1,58E-003
750001	1,36E-003
755001	4.69e-07
760001	7.21e-07
765001	6.44e-07
770001	5.44e-07
775001	5.45e-07
780001	5.01e-07
785001	5.1e-07
790001	1,85E-003
795001	6.2e-07
800001	7.57e-07
805001	5.77e-07
810001	6.05e-07
815001	7.31e-07
820001	5.32e-07
825001	6.13e-07

830001	4.91e-07
835001	7.02e-07
840001	5.54e-07
845001	5.18e-07
850001	5.25e-07
855001	8.97e-07
860001	5.38e-07
865001	5.45e-07
870001	4.3e-07
875001	5.95e-07
880001	6.2e-07
885001	5.57e-07
890001	5.27e-07
895001	1,01E-003
900001	5.95e-07
905001	5.87e-07
910001	5.57e-07
915001	6.36e-07
920001	5.43e-07
925001	5.71e-07
930001	4.02e-07
935001	6.4e-07
940001	5.78e-07
945001	9.07e-07
950001	5.37e-07
955001	5.78e-07
960001	6.04e-07
965001	5.02e-07
970001	5.95e-07
975001	6.16e-07
980001	4.86e-07
985001	5.34e-07
990001	5.72e-07
995001	8.5e-07
1000001	5.71e-07



-**Tabla y gŕafica de Luis(Fujitsu,Linux):**

Tamaño	Tiempo
1	2.19e-07
5001	4.42e-07
10001	4.13e-07
15001	4.04e-07
20001	4.16e-07
25001	4.43e-07
30001	4.42e-07
35001	5.34e-07
40001	4.08e-07
45001	9.12e-07
50001	6.3e-07
55001	8.93e-07
60001	4.91e-07
65001	4.79e-07
70001	5.8e-07
75001	5.62e-07
80001	5.65e-07
85001	5.3e-07

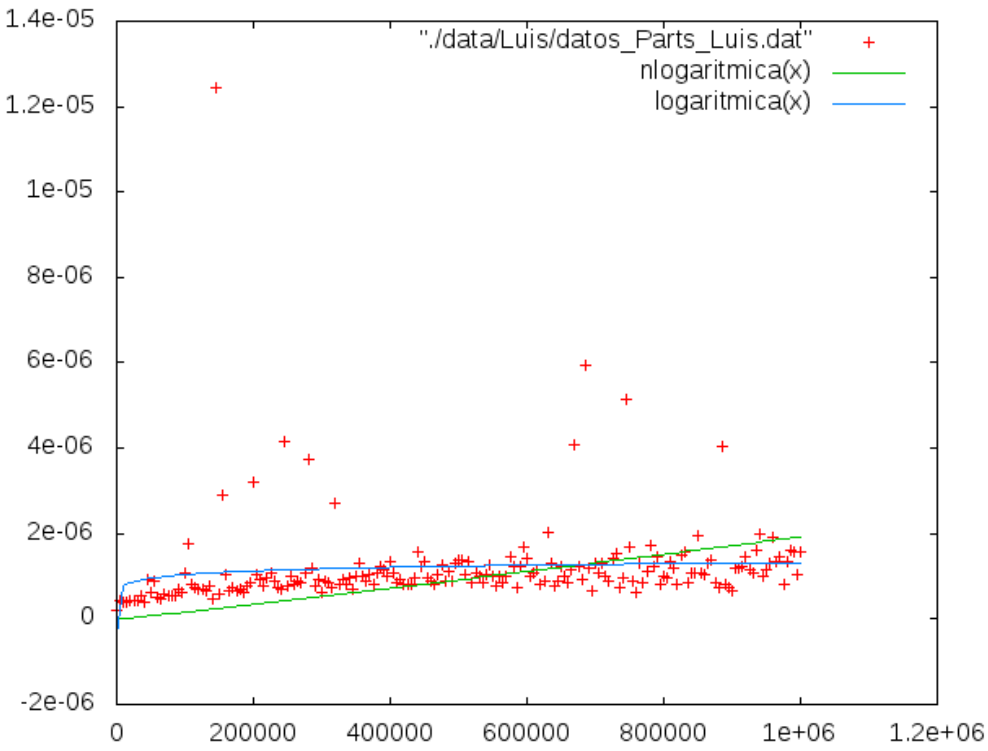
90001	6.8e-07
95001	6.4e-07
100001	1,09E-003
105001	1,77E-003
110001	8.01e-07
115001	7.36e-07
120001	7.04e-07
125001	7.07e-07
130001	6.76e-07
135001	7.59e-07
140001	4.74e-07
145001	1.2453e-05
150001	5.95e-07
155001	2,91E-003
160001	1,05E-003
165001	6.61e-07
170001	7.47e-07
175001	6.63e-07
180001	7.07e-07
185001	6.28e-07
190001	7.89e-07
195001	8.39e-07
200001	3,21E-003
205001	1,03E-003
210001	9.16e-07
215001	7.6e-07
220001	9.73e-07
225001	1,06E-003
230001	8.9e-07
235001	7.19e-07
240001	7.15e-07
245001	4,16E-003
250001	7.56e-07
255001	9.84e-07
260001	8.19e-07
265001	8.82e-07
270001	8.69e-07

275001	1,07E-003
280001	3,73E-003
285001	1,18E-003
290001	7.71e-07
295001	9.32e-07
300001	6.11e-07
305001	9.04e-07
310001	8.47e-07
315001	7.55e-07
320001	2,69E-003
325001	8.17e-07
330001	9.2e-07
335001	7.97e-07
340001	9.46e-07
345001	7.06e-07
350001	1,01E-003
355001	1.3e-06
360001	1,01E-003
365001	8.94e-07
370001	1,04E-003
375001	8.23e-07
380001	1,07E-003
385001	1,24E-003
390001	1,16E-003
395001	1,01E-003
400001	1,35E-003
405001	1,09E-003
410001	8.66e-07
415001	9.32e-07
420001	7.98e-07
425001	8.2e-07
430001	8.13e-07
435001	9.59e-07
440001	1,58E-003
445001	1.24e-06
450001	1,34E-003
455001	9.76e-07

460001	9.02e-07
465001	8.29e-07
470001	1,06E-003
475001	1,26E-003
480001	9.03e-07
485001	1,13E-003
490001	8.8e-07
495001	1,32E-003
500001	1,38E-003
505001	1,37E-003
510001	1,05E-003
515001	1,33E-003
520001	8.37e-07
525001	1,06E-003
530001	9.95e-07
535001	8.42e-07
540001	1,06E-003
545001	1,27E-003
550001	1,02E-003
555001	7.93e-07
560001	1,01E-003
565001	8.61e-07
570001	9.86e-07
575001	1,46E-003
580001	1,23E-003
585001	7.21e-07
590001	1,22E-003
595001	1,67E-003
600001	1,43E-003
605001	9.9e-07
610001	1,07E-003
615001	1,15E-003
620001	8.14e-07
625001	8.82e-07
630001	2,02E-003
635001	1,31E-003
640001	7.59e-07

645001	8.73e-07
650001	1,24E-003
655001	1,02E-003
660001	8.39e-07
665001	1,17E-003
670001	4,10E-003
675001	1,21E-003
680001	9.38e-07
685001	5,95E-003
690001	1,20E-003
695001	6.64e-07
700001	1,32E-003
705001	1,07E-003
710001	1.3e-06
715001	9.98e-07
720001	8.94e-07
725001	1,43E-003
730001	1,55E-003
735001	7.43e-07
740001	9.66e-07
745001	5,13E-003
750001	1.69e-06
755001	8.74e-07
760001	6.24e-07
765001	1,29E-003
770001	8.49e-07
775001	1,13E-003
780001	1,73E-003
785001	1,24E-003
790001	1,46E-003
795001	8.03e-07
800001	9.92e-07
805001	9.59e-07
810001	1,35E-003
815001	1,21E-003
820001	8.3e-07
825001	1.49e-06

830001	1,58E-003
835001	8.47e-07
840001	1,09E-003
845001	1,07E-003
850001	1.94e-06
855001	1,07E-003
860001	1,05E-003
865001	1,31E-003
870001	1,38E-003
875001	8.39e-07
880001	7.52e-07
885001	4,03E-003
890001	8.14e-07
895001	7.49e-07
900001	6.65e-07
905001	1,19E-003
910001	1,18E-003
915001	1,22E-003
920001	1,45E-003
925001	1,16E-003
930001	1,07E-003
935001	1,59E-003
940001	1,97E-003
945001	9.96e-07
950001	1,15E-003
955001	1,29E-003
960001	1,92E-003
965001	1,33E-003
970001	1,48E-003
975001	8.06e-07
980001	1.33e-06
985001	1.62e-06
990001	1,56E-003
995001	1,04E-003
1000001	1,58E-003



-<u>Tabla y gŕafica de Miguel(Toshiba, Windows):</u>

Tamaño	Tiempo
1	0,00E+000
10001	4.27654e-007
20001	4.27654e-007
30001	0,00E+000
40001	4.27654e-007
50001	4.27654e-007
60001	4.27654e-007
70001	4.27654e-007
80001	0,00E+000
90001	4.27654e-007
100001	4.27654e-007
110001	4.27654e-007
120001	0,00E+000
130001	4.27654e-007
140001	4.27654e-007
150001	4.27654e-007
160001	0,00E+000
170001	4.27654e-007

180001	4.27654e-007
190001	4.27654e-007
200001	4.27654e-007
210001	4.27654e-007
220001	0,00E+000
230001	4.27654e-007
240001	0,00E+000
250001	4.27654e-007
260001	4.27654e-007
270001	4.27654e-007
280001	4.27654e-007
290001	4.27654e-007
300001	4.27654e-007
310001	4.27654e-007
320001	0,00E+000
330001	4.27654e-007
340001	4.27654e-007
350001	0,00E+000
360001	4.27654e-007
370001	0,00E+000
380001	0,00E+000
390001	4.27654e-007
400001	4.27654e-007
410001	4.27654e-007
420001	4.27654e-007
430001	4.27654e-007
440001	4.27654e-007
450001	4.27654e-007
460001	4.27654e-007
470001	0,00E+000
480001	4.27654e-007
490001	4.27654e-007
500001	4.27654e-007
510001	4.27654e-007
520001	4.27654e-007
530001	4.27654e-007
540001	8.55308e-007

550001	4.27654e-007
560001	4.27654e-007
570001	4.27654e-007
580001	4.27654e-007
590001	4.27654e-007
600001	4.27654e-007
610001	4.27654e-007
620001	8.55308e-007
630001	4.27654e-007
640001	4.27654e-007
650001	8.55308e-007
660001	4.27654e-007
670001	4.27654e-007
680001	4.27654e-007
690001	1.71062e-006
700001	4.27654e-007
710001	4.27654e-007
720001	4.27654e-007
730001	4.27654e-007
740001	4.27654e-007
750001	4.27654e-007
760001	8.55308e-007
770001	4.27654e-007
780001	4.27654e-007
790001	4.27654e-007
800001	8.55308e-007
810001	4.27654e-007
820001	4.27654e-007
830001	4.27654e-007
840001	4.27654e-007
850001	4.27654e-007
860001	4.27654e-007
870001	4.27654e-007
880001	8.55308e-007
890001	4.27654e-007
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920001	4.27654e-007
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960001	8.55308e-007
970001	4.27654e-007
980001	2.13827e-006
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1030001	4.27654e-007
1040001	4.27654e-007
1050001	8.55308e-007
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1070001	4.27654e-007
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1120001	4.27654e-007
1130001	4.27654e-007
1140001	4.27654e-007
1150001	4.27654e-007
1160001	4.27654e-007
1170001	4.27654e-007
1180001	4.27654e-007
1190001	4.27654e-007
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1280001	4.27654e-007

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1330001	4.27654e-007
1340001	4.27654e-007
1350001	4.27654e-007
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1600001	4.27654e-007
1610001	4.27654e-007
1620001	4.27654e-007
1630001	4.27654e-007
1640001	8.55308e-007
1650001	8.55308e-007

1660001	4.27654e-007
1670001	4.27654e-007
1680001	4.27654e-007
1690001	4.27654e-007
1700001	4.27654e-007
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1720001	4.27654e-007
1730001	4.27654e-007
1740001	8.55308e-007
1750001	8.55308e-007
1760001	8.55308e-007
1770001	8.55308e-007
1780001	4.27654e-007
1790001	8.55308e-007
1800001	8.55308e-007
1810001	4.27654e-007
1820001	4.27654e-007
1830001	8.55308e-007
1840001	4.27654e-007
1850001	8.55308e-007
1860001	4.27654e-007
1870001	4.27654e-007
1880001	4.27654e-007
1890001	4.27654e-007
1900001	1.71062e-006
1910001	4.27654e-007
1920001	4.27654e-007
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1940001	4.27654e-007
1950001	8.55308e-007
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1970001	4.27654e-007
1980001	4.27654e-007
1990001	8.55308e-007
2000001	4.27654e-007
2010001	4.27654e-007
2020001	8.55308e-007

2030001	4.27654e-007
2040001	4.27654e-007
2050001	8.55308e-007
2060001	8.55308e-007
2070001	8.55308e-007
2080001	4.27654e-007
2090001	8.55308e-007
2100001	4.27654e-007
2110001	4.27654e-007
2120001	4.27654e-007
2130001	8.55308e-007
2140001	4.27654e-007
2150001	4.27654e-007
2160001	4.27654e-007
2170001	8.55308e-007
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2220001	4.27654e-007
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2250001	4.27654e-007
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2290001	4.27654e-007
2300001	4.27654e-007
2310001	4.27654e-007
2320001	4.27654e-007
2330001	4.27654e-007
2340001	4.27654e-007
2350001	4.27654e-007
2360001	4.27654e-007
2370001	1.28296e-006
2380001	4.27654e-007
2390001	4.27654e-007

2400001	8.55308e-007
2410001	4.27654e-007
2420001	4.27654e-007
2430001	8.55308e-007
2440001	8.55308e-007
2450001	4.27654e-007
2460001	8.55308e-007
2470001	4.27654e-007
2480001	8.55308e-007
2490001	4.27654e-007
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2520001	4.27654e-007
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2540001	8.55308e-007
2550001	8.55308e-007
2560001	4.27654e-007
2570001	8.55308e-007
2580001	8.55308e-007
2590001	8.55308e-007
2600001	4.27654e-007
2610001	4.27654e-007
2620001	8.55308e-007
2630001	8.55308e-007
2640001	4.27654e-007
2650001	4.27654e-007
2660001	8.55308e-007
2670001	4.27654e-007
2680001	4.27654e-007
2690001	8.55308e-007
2700001	4.27654e-007
2710001	8.55308e-007
2720001	4.27654e-007
2730001	4.27654e-007
2740001	1.28296e-006
2750001	4.27654e-007
2760001	4.27654e-007

2770001	8.55308e-007
2780001	8.55308e-007
2790001	1.28296e-006
2800001	4.27654e-007
2810001	4.27654e-007
2820001	4.27654e-007
2830001	4.27654e-007
2840001	8.55308e-007
2850001	8.55308e-007
2860001	4.27654e-007
2870001	8.55308e-007
2880001	8.55308e-007
2890001	4.27654e-007
2900001	8.55308e-007
2910001	8.55308e-007
2920001	4.27654e-007
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2950001	4.27654e-007
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2990001	4.27654e-007
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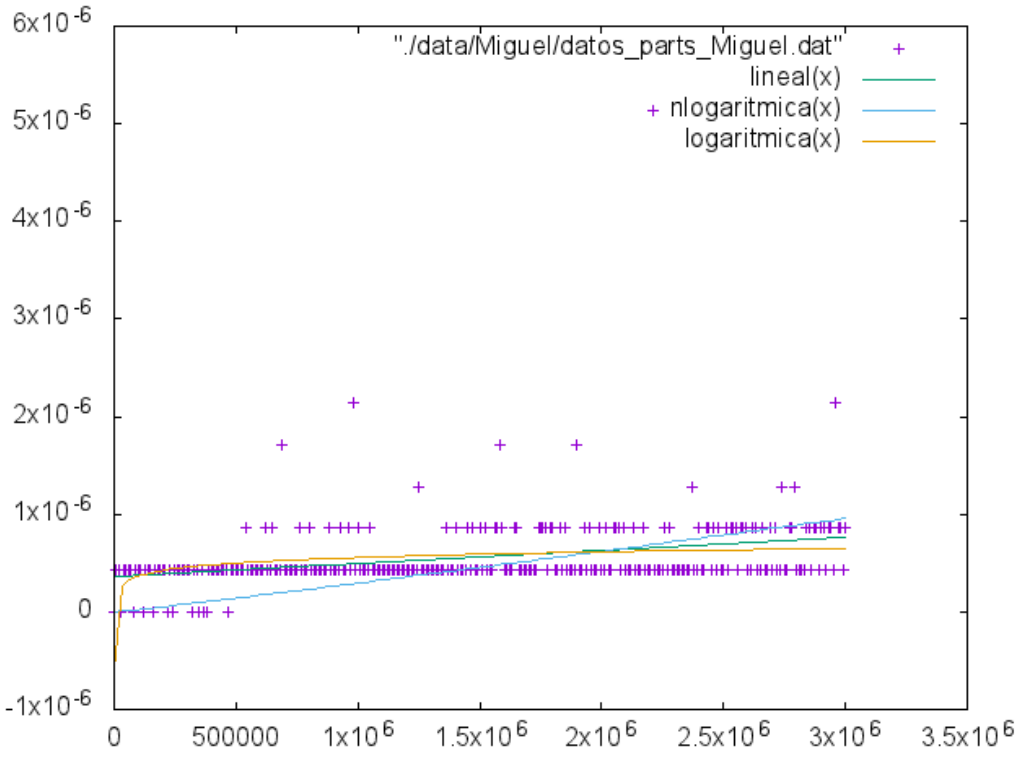

-<u>Tabla y gráfica de Diego(MacBook Pro,MacOS El Capitán):</u>

Tamaño	Tiempo
1	2.34e-07
5001	6.35e-07
10001	6.9e-07
15001	5.58e-07
20001	5.28e-07
25001	6.74e-07
30001	5.33e-07
35001	5.96e-07
40001	7.28e-07
45001	6.3e-07
50001	5.86e-07
55001	6.07e-07
60001	8.7e-07
65001	7.1e-07
70001	8.5e-07
75001	8.11e-07
80001	6.72e-07
85001	8.74e-07
90001	6.72e-07

95001	6.14e-07
100001	1,04E-003
105001	8.95e-07
110001	7.66e-07
115001	8.16e-07
120001	6.03e-07
125001	8.28e-07
130001	8.11e-07
135001	9.06e-07
140001	8.57e-07
145001	1,07E-003
150001	1,11E-003
155001	7.15e-07
160001	8.27e-07
165001	7.7e-07
170001	1,16E-003
175001	9.08e-07
180001	1.31e-06
185001	1,74E-003
190001	7.88e-07
195001	7.76e-07
200001	1,02E-003
205001	7.02e-07
210001	8.63e-07
215001	9.41e-07
220001	8.99e-07
225001	1.33e-06
230001	1,38E-003
235001	9.95e-07
240001	1,03E-003
245001	9.44e-07
250001	9.38e-07
255001	8.46e-07
260001	8.86e-07
265001	1,18E-003
270001	9.37e-07
275001	1,14E-003

280001	1,23E-003
285001	9.73e-07
290001	9.31e-07
295001	9.39e-07
300001	1,32E-003
305001	8.88e-07
310001	1,24E-003
315001	9.73e-07
320001	1,13E-003
325001	1,34E-003
330001	9.59e-07
335001	1,22E-003
340001	1,26E-003
345001	1,55E-003
350001	1,10E-003
355001	1,36E-003
360001	1,18E-003
365001	1,04E-003
370001	1,04E-003
375001	9.46e-07
380001	1,31E-003
385001	1,55E-003
390001	1,11E-003
395001	1,24E-003
400001	1,27E-003
405001	1.38e-06
410001	1,03E-003
415001	1,33E-003
420001	1,20E-003
425001	1,20E-003
430001	1,40E-003
435001	1,10E-003
440001	1,11E-003
445001	1,36E-003
450001	1,20E-003
455001	1,35E-003
460001	1,45E-003

465001	1,25E-003
470001	1,05E-003
475001	1,30E-003
480001	1,31E-003
485001	9.73e-07
490001	1,36E-003
495001	1,14E-003
500001	1,25E-003
505001	1,35E-003
510001	1,42E-003
515001	9.46e-07
520001	1.59e-06
525001	1,14E-003
530001	1,26E-003
535001	1,31E-003
540001	1,33E-003
545001	1,18E-003
550001	1,20E-003
555001	1,34E-003
560001	1,18E-003
565001	1,46E-003
570001	2,94E-003
575001	1,20E-003
580001	1,10E-003
585001	1,47E-003
590001	1,20E-003
595001	1,13E-003
600001	1,50E-003
605001	1,51E-003
610001	9.87e-07
615001	1,14E-003
620001	1,47E-003
625001	1,28E-003
630001	1.27e-06
635001	1,46E-003
640001	1,40E-003
645001	1,48E-003

650001	1,63E-003
655001	1,34E-003
660001	1,44E-003
665001	1,81E-003
670001	1,11E-003
675001	1,25E-003
680001	1,93E-003
685001	1,39E-003
690001	1,50E-003
695001	1,79E-003
700001	1,36E-003
705001	2,19E-003
710001	1,52E-003
715001	1,08E-003
720001	1,11E-003
725001	1.14e-06
730001	1,02E-003
735001	1,08E-003
740001	1,35E-003
745001	1,02E-003
750001	1,11E-003
755001	1,55E-003
760001	1,37E-003
765001	1,36E-003
770001	1,80E-003
775001	1,66E-003
780001	1,48E-003
785001	1,54E-003
790001	1,49E-003
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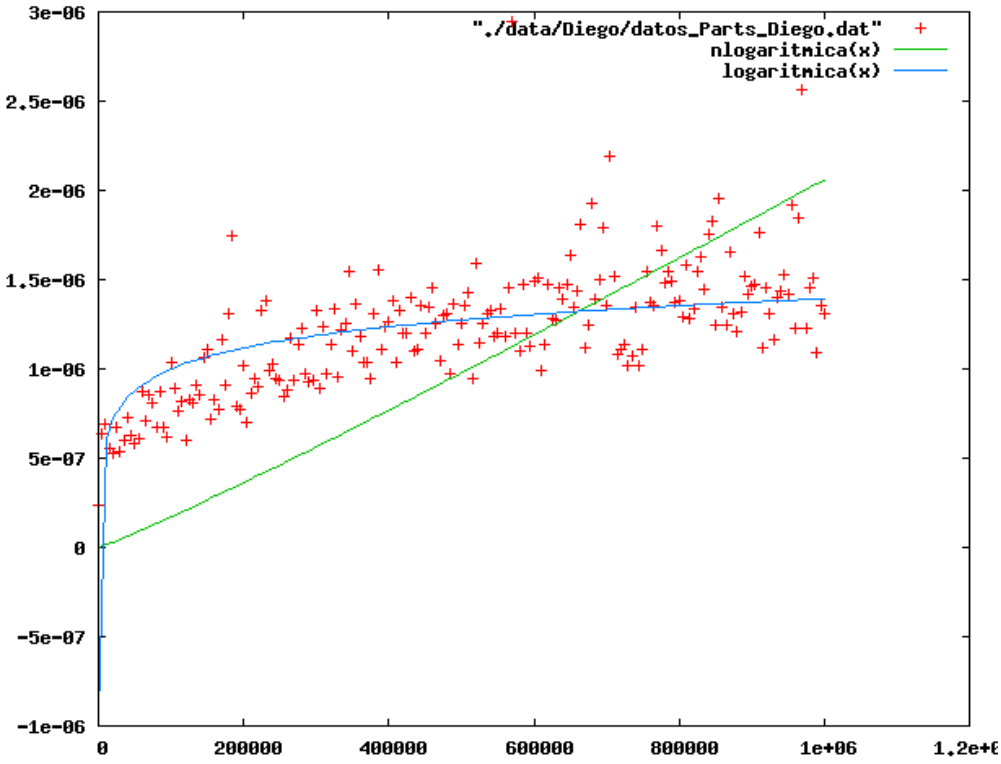
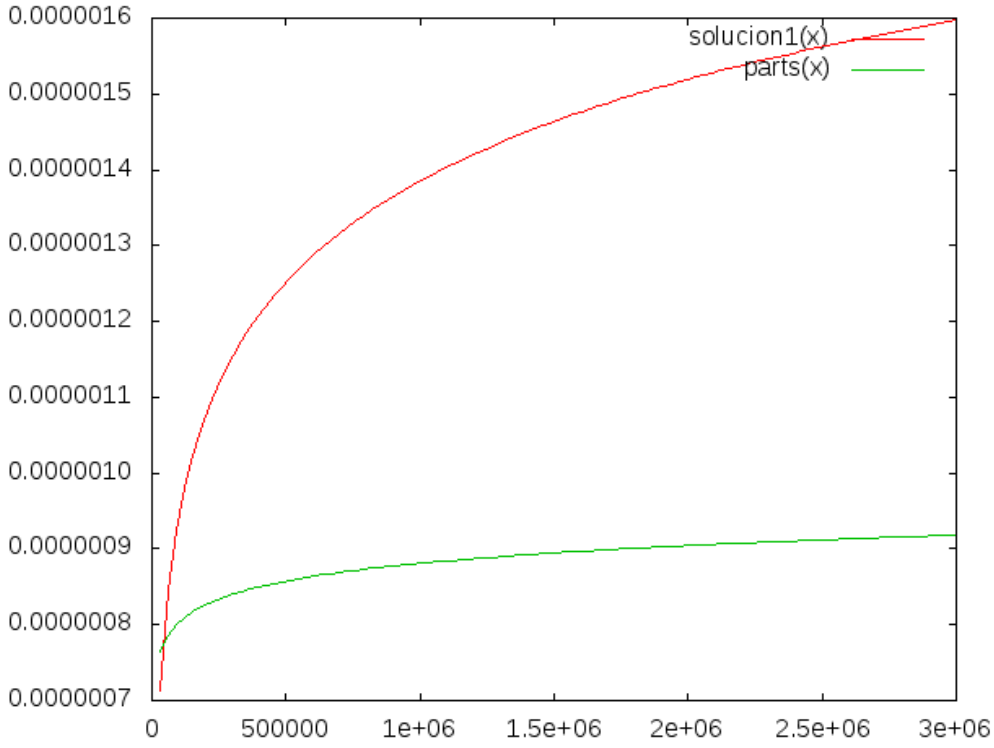
800001	1,39E-003
805001	1,29E-003
810001	1,58E-003
815001	1,28E-003
820001	1,34E-003
825001	1,55E-003
830001	1,63E-003

835001	1,45E-003
840001	1,76E-003
845001	1,82E-003
850001	1,25E-003
855001	1,96E-003
860001	1,35E-003
865001	1,24E-003
870001	1,65E-003
875001	1,31E-003
880001	1,21E-003
885001	1.32e-06
890001	1,52E-003
895001	1,42E-003
900001	1,46E-003
905001	1,47E-003
910001	1,77E-003
915001	1,12E-003
920001	1.45e-06
925001	1,31E-003
930001	1,17E-003
935001	1,40E-003
940001	1,44E-003
945001	1,52E-003
950001	1,42E-003
955001	1,92E-003
960001	1,23E-003
965001	1,85E-003
970001	2,57E-003
975001	1.23e-06
980001	1.45e-06
985001	1,51E-003
990001	1,09E-003
995001	1,35E-003
1000001	1,31E-003



1.1 Comparación entre algoritmos

Para la comparación nos valdremos de la función logarítmica que hemos ajustado para la primera y la segunda solución DyV planteadas en la resolución del problema.



Como se puede observar en la gráfica la primera opción propuesta es menos eficiente que la segunda ya que la función ajustada y evaluada en el mismo rango de puntos perteneciente al primer algoritmo crece más rápido que la función ajustada para el segundo algoritmo.