Rozwiązanie zadania 4N z zestawu 2

Rozwiązać równanie $\mathbf{A}\mathbf{x} = \mathbf{e}$, gdzie \mathbf{A} jest macierzą (5) z zad 3, natomiast \mathbf{e} jest wektorem, którego wszystkie składowe są równe 1, za pomocą

- (a) metody Gaussa-Seidela
- (b) metody gradientów sprzężonych

Metoda Gaussa-Seidela:

```
#include <iostream>
#include <cmath>
#include <iomanip>
using namespace std;
const int wymiar = 128;
const int iteracje = 40;
int main() {
            double A[wymiar][wymiar] = \{0\};
            double x[wymiar]; //rozwiazania
            double e[wymiar]; //wyraz wolny
            double norma[wymiar];
            double nowanorma[wymiar];
            for(int i=0; i<wymiar; i++){</pre>
                                         x[i] = e[i] = norma[i] = 1;
                                         for(int j=0; j<wymiar; j++) {
                                                              if(i==j) {
                                                                          A[i][j] = 4;
                                                                          if(j < wymiar - 1) A[i+1][j] = A[i][j+1] = 1;
                                                                           if(j < wymiar - 4) A[i+4][j] = A[i][j+4] = 1;
                                                              }
                                         }
             }
            for(int i=0; i<iteracje; i++) {</pre>
                        x[0] = (e[0]-A[0][1]*x[1]-A[0][4]*x[4])/4;
                        x[1] = (e[1]-A[1][0]*x[0]-A[1][2]*x[2]-A[1][5]*x[5])/4;
                        x[2] = (e[2]-A[2][1]*x[1]-A[2][3]*x[3]-A[2][6]*x[6])/4;
                        x[3] = (e[3]-A[3][2]*x[2]-A[3][4]*x[4]-A[3][7]*x[7])/4;
                         \textbf{for}(\textbf{int} \ j = 4; j < wymiar - 4; j + +) \ x[j] = (e[j] - A[j][j - 4] * x[j - 4] - A[j][j - 1] * x[j - 1] - A[j][j + 1] * x[j + 1] - A[j][j - 1] * x[j - 1] - A[j][
                                                                                                              A[j][j+4]*x[j+4])/4;
                        x[wymiar-4] = (e[wymiar-4]-A[wymiar-4][wymiar-8]*x[wymiar-8]-A[wymiar-4][wymiar-5]*
                                                             x[wymiar-5]-A[wymiar-4][wymiar-3]*x[wymiar-3])/4;
                        x[wymiar-3] = (e[wymiar-3]-A[wymiar-3][wymiar-7]*x[wymiar-7]-A[wymiar-3][wymiar-4]*
                                                             x[wymiar-4]-A[wymiar-3][wymiar-2]*x[wymiar-2])/4;
                        x[wymiar-2] = (e[wymiar-2]-A[wymiar-2][wymiar-6]*x[wymiar-6]-A[wymiar-2][wymiar-3]*
                                                             x[wymiar-3]-A[wymiar-2][wymiar-1]*x[wymiar-1])/4;
                        x[wymiar-1] = (e[wymiar-1]-A[wymiar-1][wymiar-5]*x[wymiar-5]-A[wymiar-1][wymiar-2]*
                                                             x[wymiar-2])/4;
```

```
for(int j=0; j<wymiar; j++) nowanorma[j] = x[j];

double norm= 0;
for(int j=0; j<wymiar; j++) norm = norm+(nowanorma[j]-norma[j])*(nowanorma[j]-norma[j]);
norm = sqrt(norm);

for(int j=0; j<wymiar; j++) norma[j] = nowanorma[j];

if(i>=1) cout << setprecision(12) << fixed << "||xk - x(k-1)|| = " << norm << endl;
}

for(int i=0; i<wymiar; i++) cout << "x" << i << " = " << x[i] << endl;
}</pre>
```

Metoda gradientów sprzężonych:

```
#include <iostream>
#include <cmath>
#include <iomanip>
using namespace std;
const int wymiar = 128;
const int iteracje = 40;
int main() {
     double A[wymiar][wymiar] = {0};
     double x[wymiar]; //rozwiazania
     double e[wymiar]; //wyraz wolny
     double p[wymiar]; //wektor p ze wzoru na gradienty sprzezone
     double r[wymiar]; //tez ze wzoru
     double Ap[wymiar];
     double rn[wymiar]; //ze wzoru r(k+1)
     double pn[wymiar]; //p(k+1)
     double norma[wymiar];
     double nowanorma[wymiar];
     for(int i=0; i<wymiar; i++){</pre>
          x[i] = e[i] = norma[i] = 1;
          for(int j=0; j<wymiar; j++) {</pre>
               if(i==j) {
                    A[i][j] = 4;
                    if(j < wymiar-1) A[i+1][j] = A[i][j+1] = 1;
                    if(j<wymiar-4) A[i+4][j] = A[i][j+4] = 1;
          }
     }
     r[0] = e[0] + (-A[0][0] * x[0] - A[0][1] * x[1] - A[0][4] * x[4]);
     r[1] = e[1] + (-A[1][0] *x[0] - A[1][1] *x[1] - A[1][2] *x[2] - A[1][5] *x[5]);
```

```
r[2] = e[2] + (-A[2][1] * x[1] - A[2][2] * x[2] - A[2][3] * x[3] - A[2][6] * x[6]);
r[3] = e[3] + (-A[3][2] * x[2] - A[3][3] * x[3] - A[3][4] * x[4] - A[3][7] * x[7]);
for(int j=4; j< wymiar-4; j++) r[j] = e[j]-(A[j][j-4]*x[j-4]+A[j][j-1]*x[j-1]+A[j][j]*
                                                              x[j]+A[j][j+1]*x[j+1]+A[j][j+4]*x[j+4]);
r[wymiar-4] = e[wymiar-4] + (-A[wymiar-4][wymiar-8] *x[wymiar-8] - A[wymiar-4][wymiar-5] *
                         x[wymiar-5]-A[wymiar-4][wymiar-4]*x[wymiar-4]-A[wymiar-4][wymiar-3]*x[wymiar-3]);
r[wymiar-3] = e[wymiar-3] + (-A[wymiar-3][wymiar-7] * x[wymiar-7] - A[wymiar-3][wymiar-4] *
                         x[wymiar-4]-A[wymiar-3][wymiar-3]*x[wymiar-3]-A[wymiar-3][wymiar-2]*x[wymiar-2]);
r[wymiar-2] = e[wymiar-2] + (-A[wymiar-2][wymiar-6] + x[wymiar-6] - A[wymiar-2][wymiar-3] + x[wymiar-6] + x[wymi
                         x[wymiar-3]-A[wymiar-2][wymiar-2]*x[wymiar-2]-A[wymiar-2][wymiar-1]*x[wymiar-1]);
r[wymiar-1] = e[wymiar-1] + (-A[wymiar-1][wymiar-5] * x[wymiar-5] - A[wymiar-1][wymiar-2] *
                         x[wymiar-2]-A[wymiar-1][wymiar-1]*x[wymiar-1]);
for(int i=0; i<wymiar; i++) p[i] = r[i];
for(int i=0; i<iteracje; i++) {</pre>
        Ap[0] = A[0][0]*p[0]+A[0][1]*p[1]+A[0][4]*p[4];
        Ap[1] = A[1][0]*p[0]+A[1][1]*p[1]+A[1][2]*p[2]+A[1][5]*p[5];
        Ap[2] = A[2][1]*p[1]+A[2][2]*p[2]+A[2][3]*p[3]+A[2][6]*p[6];
        Ap[3] = A[3][2]*p[2]+A[3][3]*p[3]+A[3][4]*p[4]+A[3][7]*p[7];
        for(int j=4; j< wymiar-4; j++) Ap[j] = A[j][j-4]*p[j-4]+A[j][j-1]*p[j-1]+A[j][j]*p[j]+A[j][j+1]*
                                                                           p[j+1]+A[j][j+4]*p[j+4];
        Ap[wymiar-4] = A[wymiar-4][wymiar-8]*p[wymiar-8]+A[wymiar-4][wymiar-5]*
                                      p[wymiar-5]+A[wymiar-4][wymiar-4]*p[wymiar-4]+A[wymiar-4][wymiar-3]*
                                      p[wymiar-3];
        Ap[wymiar-3] = A[wymiar-3][wymiar-7] + A[wymiar-3][wymiar-4] *
                                      p[wymiar-4]+A[wymiar-3][wymiar-3]*p[wymiar-3]+A[wymiar-3][wymiar-2]*
                                      p[wymiar-2];
        Ap[wymiar-2] = A[wymiar-2][wymiar-6]*p[wymiar-6]+A[wymiar-2][wymiar-3]*
                                      p[wymiar-3]+A[wymiar-2][wymiar-2]*p[wymiar-2]+A[wymiar-2][wymiar-1]*
                                      p[wymiar-1];
        Ap[wymiar-1] = A[wymiar-1][wymiar-5] * p[wymiar-5] + A[wymiar-1][wymiar-2] *
                                      p[wymiar-2]+A[wymiar-1][wymiar-1]*p[wymiar-1];
        double licznik, mianownik, alfa, beta;
        licznik = mianownik = alfa = beta = 0;
        for(int j=0; j<wymiar; j++) {</pre>
                 licznik = licznik + r[j]*r[j];
                 mianownik = mianownik + p[j]*Ap[j];
       alfa = licznik/mianownik;
       for(int j=0; j<wymiar; j++) {</pre>
                 rn[j] = r[j] - alfa*Ap[j];
                 x[j] = x[j] + alfa*p[j];
         }
        mianownik = licznik;
        licznik = 0;
        for(int j=0; j<wymiar; j++) licznik = licznik + rn[j]*rn[j];</pre>
```

Wyniki działania programów

Metoda Gaussa-Seidela:

Metoda gradientów sprzężonych:

```
||xk - x(k-1)|| = 4.347526282501
                                                                         ||xk - x(k-1)|| = 0.332773183960
||xk - x(k-1)|| = 1.430748983160
                                                                         ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.074073759768
||x\mathbf{k} - x(\mathbf{k}-1)|| = 0.471072861006
                                                                         ||xk - x(k-1)|| = 0.023176288362
\|xk - x(k-1)\| = 0.154869041634
                                                                         ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.010205400914
||xk - x(k-1)|| = 0.051372333179
                                                                         ||xk - x(k-1)|| = 0.004870100518
||xk - x(k-1)|| = 0.017263732423
                                                                         ||xk - x(k-1)|| = 0.002793505377
||xk - x(k-1)|| = 0.006242350825
                                                                         ||xk - x(k-1)|| = 0.002110760773
||xk - x(k-1)|| = 0.002642480878
                                                                         ||xk - x(k-1)|| = 0.001485902085
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.001439319880
                                                                         ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000884308742
||xk - x(k-1)|| = 0.000915965548
                                                                         ||xk - x(k-1)|| = 0.000429385951
||x\mathbf{k} - x(\mathbf{k-1})|| = 0.000625614674
                                                                         ||xk - x(k-1)|| = 0.000211693992
||xk - x(k-1)|| = 0.000437571586
                                                                         ||xk - x(k-1)|| = 0.000117530404
||xk - x(k-1)|| = 0.000310315435
                                                                         ||xk - x(k-1)|| = 0.000073097644
||xk - x(k-1)|| = 0.000222012213
                                                                         ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000049650735
||xk - x(k-1)|| = 0.000160001310
                                                                         ||xk - x(k-1)|| = 0.000030263434
||xk - x(k-1)|| = 0.000116009217
                                                                         ||xk - x(k-1)|| = 0.000016614641
                                                                         ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000008596052
||xk - x(k-1)|| = 0.000084551844
||xk - x(k-1)|| = 0.000061903004
                                                                         ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000004698531
||xk - x(k-1)|| = 0.000045499954
                                                                         ||xk - x(k-1)|| = 0.000002881458
||xk - x(k-1)|| = 0.000033559499
                                                                         ||xk - x(k-1)|| = 0.000001584908
||xk - x(k-1)|| = 0.000024828561
                                                                         ||xk - x(k-1)|| = 0.000000554669
```

```
||xk - x(k-1)|| = 0.000018419295
                                                                     ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000363768
||xk - x(k-1)|| = 0.000013697926
                                                                     ||xk - x(k-1)|| = 0.000000129328
||xk - x(k-1)|| = 0.000010209164
                                                                     ||xk - x(k-1)|| = 0.000000049167
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000007624073
                                                                     ||xk - x(k-1)|| = 0.000000026565
||xk - x(k-1)|| = 0.000005703819
                                                                     ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000019393
||xk - x(k-1)|| = 0.000004274222
                                                                     ||xk - x(k-1)|| = 0.00\overline{0000013728}
                                                                     ||xk - x(k-1)|| = 0.0000000005886
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000003207749
                                                                     ||xk - x(k-1)|| = 0.000000002334
||xk - x(k-1)|| = 0.000002410698
||xk - x(k-1)|| = 0.000001813999
                                                                     ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000000821
                                                                     ||xk - x(k-1)|| = 0.0000000000521
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000001366602
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000001030672
                                                                     ||xk - x(k-1)|| = 0.000000000328
                                                                     ||xk - x(k-1)|| = 0.000000000238
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000778106
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000587987
                                                                     ||x\mathbf{k} - x(\mathbf{k-1})|| = 0.000000000097
||xk - x(k-1)|| = 0.000000444713
                                                                     ||xk - x(k-1)|| = 0.000000000044
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000336629
                                                                     ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.0000000000021
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000255011
                                                                     ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000000011
||xk - x(k-1)|| = 0.000000193322
                                                                     ||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000000005
||\mathbf{x}\mathbf{k} - \mathbf{x}(\mathbf{k}-1)|| = 0.000000146656
                                                                     ||xk - x(k-1)|| = 0.0000000000003
x0 = 0.194276803143
                                                                     x0 = 0.194276795444
                                                                     x1 = 0.130930202478
x1 = 0.130930197375
x2 = 0.146794905195
                                                                     x2 = 0.146794908343
x3 = 0.162311327101
                                                                     x3 = 0.162311315286
x4 = 0.091962599350
                                                                     x4 = 0.091962615745
x5 = 0.135207496702
                                                                     x5 = 0.135207486300
x6 = 0.119578852038
                                                                     x6 = 0.119578848862
x7 = 0.111997198113
                                                                     x7 = 0.111997214768
x8 = 0.140353962114
                                                                     x8 = 0.140353939990
x9 = 0.116698372525
                                                                     x9 = 0.116698387716
x10 = 0.127684994343
                                                                     x10 = 0.127684995141
x11 = 0.129767053859
                                                                     x11 = 0.129767036788
x12 = 0.117925997315
                                                                     x12 = 0.117926021811
x13 = 0.129960046367
                                                                     x13 = 0.129960027706
x14 = 0.123215743391
                                                                     x14 = 0.123215746070
x15 = 0.123323606434
                                                                     x15 = 0.123323621125
x16 = 0.128214932301
                                                                     x16 = 0.128214908273
x17 = 0.122319713141
                                                                     x17 = 0.122319733580
x18 = 0.126168377920
                                                                     x18 = 0.126168371747
x19 = 0.125507835221
                                                                     x19 = 0.125507824368
x20 = 0.123570968833
                                                                     x20 = 0.123570990391
x21 = 0.126377778548
                                                                     x21 = 0.126377757954
x22 = 0.124283199980
                                                                     x22 = 0.124283208997
x23 = 0.124905712643
                                                                     x23 = 0.124905719266
                                                                     x24 = 0.125615547841
x24 = 0.125615565858
x25 = 0.124315015689
                                                                     x25 = 0.124315035216
x26 = 0.125415325979
                                                                     x26 = 0.125415315047
x27 = 0.124970544514
                                                                     x27 = 0.124970541729
x28 = 0.124746049459
                                                                     x28 = 0.124746063762
x29 = 0.125331256117
                                                                     x29 = 0.125331238295
x30 = 0.124769941940
                                                                     x30 = 0.124769953871
x31 = 0.125050735124
                                                                     x31 = 0.125050735008
x32 = 0.125098428297
                                                                     x32 = 0.125098417087
x33 = 0.124843977875
                                                                     x33 = 0.124843993972
x34 = 0.125122908307
                                                                     x34 = 0.125122896169
x35 = 0.124958145590
                                                                     x35 = 0.124958147283
```

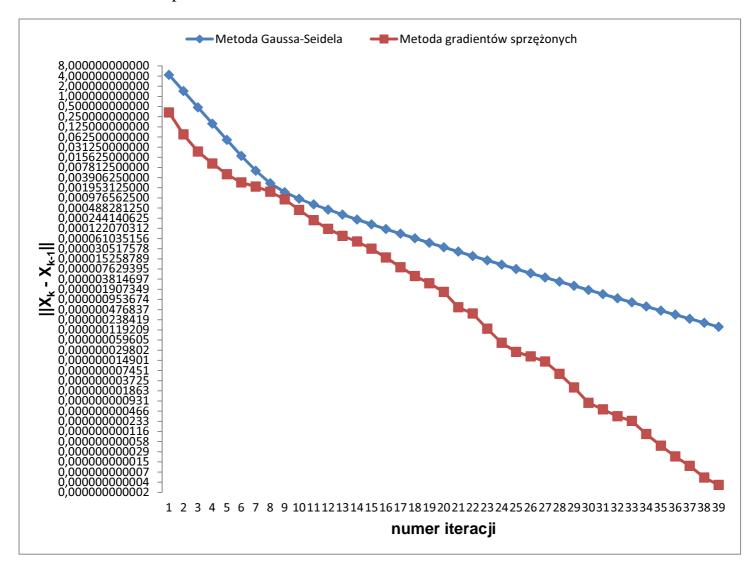
x36 = 0.124965538910

x36 = 0.124965529538

\$38 = 0.125071487401 \$38 = 0.1250936308568 \$38 = 0.125028242411 \$40 = 0.125009816653 \$41 = 0.125009816653 \$42 = 0.125009816653 \$42 = 0.125032120003 \$43 = 0.124968224294 \$42 = 0.125032120003 \$43 = 0.1249682762309 \$43 = 0.124987762309 \$43 = 0.124987762309 \$44 = 0.124998723958 \$44 = 0.124998723958 \$44 = 0.124998723958 \$44 = 0.124998733895 \$45 = 0.1250138597920 \$45 = 0.1250138597920 \$45 = 0.125003863339 \$47 = 0.125009863339 \$47 = 0.125009863339 \$48 = 0.124999825855 \$48 = 0.124999825855 \$49 = 0.1249944381122 \$49 = 0.1249944381122 \$49 = 0.1249944381122 \$49 = 0.1249944381122 \$49 = 0.124994637485 \$52 = 0.125001280596 \$53 = 0.125001280596 \$53 = 0.125001280596 \$53 = 0.125001280596 \$53 = 0.125001280596 \$55 = 0.1250012911241 \$55 = 0.1250012911241 \$55 = 0.12500139134 \$56 = 0.1249991301652 \$58 = 0.1249991301652 \$59 = 0.124999784148 \$56 = 0.125000301168 \$60 = 0.125000301168 \$60 = 0.125000301168 \$60 = 0.12500034180 \$65 = 0.124999280122 \$65 = 0.124999280122 \$65 = 0.124999280122 \$65 = 0.124999280122 \$65 = 0.124999280122 \$65 = 0.124999280122 \$65 = 0.124999280122 \$65 = 0.124999280122 \$65 = 0.125000384389 \$67 = 0.125000384389 \$67 = 0.125000384389 \$68 = 0.124999280122 \$75 = 0.125000384389 \$77 = 0.125000384389 \$78 = 0.124999714759 \$79 = 0.124999714759 \$79 = 0.124999714759 \$79 = 0.12499973885 \$77 = 0.125000187385 \$77 = 0.125000187385 \$78 = 0.124999488335 \$76 = 0.12500038721 \$75 = 0.12500037444 \$77 = 0.12500038721 \$75 = 0.124998824174 \$79 = 0.124998824174 \$79 = 0.124998824174 \$79 = 0.124998824174 \$79 = 0.124998824180 \$78 = 0.12499883358 \$76 = 0.12499883358 \$77 = 0.12500078390 \$78 = 0.124998824174 \$79 = 0.124998824180 \$78 = 0.12499882368 \$78 = 0.12499883385 \$76 = 0.12499883385 \$77 = 0.12500783068 \$78 = 0.12499883385 \$79 = 0.12499882368 \$79 = 0.12499882368 \$79 = 0.12499882368 \$79 = 0.12499882368 \$79 = 0.12499882368 \$79 = 0.12499882368 \$79 = 0.12499883385 \$70 = 0.12499883385 \$71 = 0.12500783904488 \$72 = 0.1250078301848 \$73 = 0.12499882368 \$74 = 0.12499883386 \$75 = 0.12499883386 \$77 = 0.12500783804 \$78 = 0.124998823688 \$79 = 0.12499882368		
x39 = 0.125028240784 x40 = 0.125009816653 x41 = 0.125009816653 x42 = 0.125032120003 x42 = 0.125032120003 x43 = 0.1249876232399 x44 = 0.124987623258 x45 = 0.125013597920 x46 = 0.1249984214534 x47 = 0.125009863339 x47 = 0.125009863339 x48 = 0.12499438122 x49 = 0.124994438122 x49 = 0.124994438122 x49 = 0.124994438122 x49 = 0.12499463285 x51 = 0.12409463745 x52 = 0.12501250956 x53 = 0.12500128096 x53 = 0.12500128096 x53 = 0.12500128096 x53 = 0.125001299325 x54 = 0.12499443145 x55 = 0.12500129325 x54 = 0.124994497314 x55 = 0.12499136652 x56 = 0.124999136652 x57 = 0.124999784148 x60 = 0.125000301168 x61 = 0.125000301168 x62 = 0.125000361480 x63 = 0.12500036480 x65 = 0.124999240122 x66 = 0.12500038479 x64 = 0.12500038479 x65 = 0.124999714759 x69 = 0.12500038479 x64 = 0.12500038479 x64 = 0.12500038479 x65 = 0.124999240122 x66 = 0.125000351480 x67 = 0.124999240122 x68 = 0.125000357478 x79 = 0.12499921105 x77 = 0.12499911105 x77 = 0.12499911105 x77 = 0.12499921105 x77 = 0.12499921105 x77 = 0.12499921105 x77 = 0.12499921105 x77 = 0.1249992105 x77 = 0.1249992105 x77 = 0.1249992105 x78 = 0.1249994116 x73 = 0.125000357488 x79 = 0.125000377485 x70 = 0.12499883315 x76 = 0.12499883315 x77 = 0.12500753108 x88 = 0.12499883315 x79 = 0.12500753208 x88 = 0.12499883315 x79 = 0.12500753008 x88 = 0.124998833168 x79 = 0.12500753008 x88 = 0.124998833168 x79 = 0.12500753008 x88 = 0.124998833168 x79 = 0.125007530068 x78 = 0.124998833168 x88 = 0.124998833168 x89 = 0.124908331293 x88 = 0.125003307943 x88 = 0.12498833618 x89 = 0.124983031293 x89 = 0.125007532008 x99 = 0.1250075432 x89 = 0.1249074322 x99 = 0.1250075432 x89 = 0.124908331293 x89 = 0.12498331293 x89 = 0.124983312		
x40 = 0.125009816653 x40 = 0.125009807432 x41 = 0.124968242394 x41 = 0.124968256682 x42 = 0.125031210003 x42 = 0.125032109690 x43 = 0.124987762309 x43 = 0.124987672958 x44 = 0.124998722958 x44 = 0.124998733955 x45 = 0.125013857920 x43 = 0.125013883391 x46 = 0.124984214534 x46 = 0.124984222410 x47 = 0.125009863339 x47 = 0.125009867832 x48 = 0.124994438122 x49 = 0.124994452650 x50 = 0.125007553103 x50 = 0.125007299834 x51 = 0.124994643745 x51 = 0.124994637345 x51 = 0.124994643745 x51 = 0.124994637344 x52 = 0.125001280596 x52 = 0.125001299834 x53 = 0.125002732188 x55 = 0.125002732188 x55 = 0.125002732188 x55 = 0.125002731144 x55 = 0.124999159324 x55 = 0.12499917975 x58 = 0.125001562962 x58 = 0.125001562962 x59 = 0.124999784148 x59 = 0.12499978427 x60 = 0.125000301168 x60 = 0.125000331594 x61 = 0.12500034180 x62 = 0.124999280122 x63 = 0.12500035643 x65 = 0.124999280122 x65 = 0.12499928077		
x41 = 0.124968242394 x41 = 0.124968256662 x42 = 0.125032120003 x42 = 0.125032109090 x43 = 0.12498762309 x43 = 0.12498761950 x44 = 0.124987722958 x44 = 0.124987761950 x44 = 0.124987722958 x44 = 0.12498733895 x45 = 0.125013597920 x45 = 0.12501383391 x47 = 0.125009863339 x47 = 0.125009867832 x48 = 0.124998925855 x48 = 0.1249981447 x50 = 0.125007553103 x50 = 0.125007549247 x51 = 0.12499463745 x51 = 0.12499463745 x52 = 0.125001280596 x52 = 0.125001299834 x53 = 0.125002189325 x53 = 0.125002145113 x54 = 0.124996497314 x54 = 0.124996497314 x55 = 0.1250073188 x55 = 0.125002751634 x56 = 0.12499915052 x56 = 0.1249991911241 x57 = 0.12499915052 x56 = 0.1249991911241 x57 = 0.12499915052 x56 = 0.1249991911241 x58 = 0.125001562962 x58 = 0.125001573657 x58 = 0.1250019168 x56 = 0.124999754274 x61 = 0.12500041769 x62 = 0.124999284036 x63 = 0.124999305590 x63 = 0.124999284036 x64 = 0.125000264480 x64		
x42 = 0.125032120003 x42 = 0.125032109600 x43 = 0.124987762309 x43 = 0.124987761950 x44 = 0.12498722958 x44 = 0.12498723895 x45 = 0.125013597920 x45 = 0.125013583591 x46 = 0.124984214534 x46 = 0.124984222410 x7 = 0.12509863339 x47 = 0.12509867832 x48 = 0.12499438122 x49 = 0.1249944352650 x50 = 0.125007553103 x50 = 0.125007549247 x51 = 0.124994438122 x49 = 0.124994452650 x52 = 0.125001280596 x52 = 0.125001280596 x52 = 0.12500273148 x54 = 0.124994697314 x54 = 0.124994697314 x55 = 0.125002751634 x55 = 0.125002732188 x55 = 0.125002751634 x56 = 0.124999130652 x56 = 0.1249991111241 x57 = 0.12499169324 x57 = 0.124998784148 x56 = 0.124999754274 x68 = 0.125001573657 x59 = 0.124098784148 x59 = 0.124098784274 x61 = 0.125000491374 x61 = 0.125000301168 x60 = 0.125000491374 x61 = 0.125000326019 x62 = 0.12499980122 x65 = 0.124999284036 x63 = 0.125000284379 x63 = 0.125000362019 x64 = 0.125000385643 x67 = 0.1250001570478 x70 = 0.12500157047	110 0/12000 020000	
x43 = 0.124982762309 x44 = 0.124998722958 x44 = 0.124998722958 x45 = 0.1250138597920 x46 = 0.124984214534 x47 = 0.125009863339 x47 = 0.125009863339 x48 = 0.124998925855 x49 = 0.124994438122 x50 = 0.125007553103 x51 = 0.125007553103 x51 = 0.125001280596 x52 = 0.125001280596 x53 = 0.125001280596 x53 = 0.125001280596 x53 = 0.125001280596 x54 = 0.12499443714 x54 = 0.12499413714 x55 = 0.12499433652 x57 = 0.12500129835 x58 = 0.12500129835 x59 = 0.12500129835 x50 = 0.1250012732188 x50 = 0.1250013734 x50 = 0.125000331594 x50 = 0.125000331594 x50 = 0.125000331594 x50 = 0.125000331594 x51 = 0.125000331594 x52 = 0.12500331594 x53 = 0.125000331594 x54 = 0.125000331594 x55 = 0.12500331594 x55 = 0.124999280122 x56 = 0.124999280122 x56 = 0.124999280122 x57 = 0.124998714759 x59 = 0.125001573657 x70 = 0.124999171975 x71 = 0.12499171975 x71 =		
x44 = 0.124998722958 x45 = 0.1250135879790 x45 = 0.125013583591 x46 = 0.124984214534 x47 = 0.125009863339 x48 = 0.12499825855 x48 = 0.124998911447 x49 = 0.125007555103 x51 = 0.124994438122 x50 = 0.125007555103 x51 = 0.12499463735 x52 = 0.12500125935 x53 = 0.12500125935 x54 = 0.125002732188 x55 = 0.125002732188 x55 = 0.125002732188 x56 = 0.12499140522 x59 = 0.125001259324 x58 = 0.125001259324 x58 = 0.125001259324 x59 = 0.125001259324 x50 = 0.125001573657 x59 = 0.12499913032 x50 = 0.125001331594 x60 = 0.125000301168 x61 = 0.125000361480 x62 = 0.125000361480 x63 = 0.125000345439 x64 = 0.125000345439 x65 = 0.124999284036 x66 = 0.125000345439 x67 = 0.125000345439 x68 = 0.124998754274 x69 = 0.125000345439 x69 = 0.125000345499 x79 = 0.124999874478 x69 = 0.125000345499 x71 = 0.124999111241 x72 = 0.125002794116 x72 = 0.125002794116 x73 = 0.1249998824174 x79 = 0.124998824174 x79 = 0.124998824174 x79 = 0.124998824174 x80 = 0.1250073300 x81 = 0.124998824174 x80 = 0.125009733005 x82 = 0.125009733005 x83 = 0.124998824174 x80 = 0.125009733005 x84 = 0.124998824174 x80 = 0.125009708804 x85 = 0.124998714855 x85 = 0.125009708804 x86 = 0.12499873493 x86 = 0.12499873493 x87 = 0.12499873493 x86 = 0.124998824174 x89 = 0.125007733006 x87 = 0.12499873005 x86 = 0.124998734855 x87 = 0.125009708804 x86 = 0.124998734855 x87 = 0.125009708804 x87 = 0.125009708804 x88 = 0.1250028240784 x89 = 0.1250027412559		
x45 = 0.125013597920 x45 = 0.124984214534 x46 = 0.124984214534 x46 = 0.124984222410 x47 = 0.125009863339 x47 = 0.125009867832 x48 = 0.12499423812 x49 = 0.1249994452650 x50 = 0.125007553103 x50 = 0.125007549247 x51 = 0.124994438122 x39 = 0.125007549247 x51 = 0.124994643745 x51 = 0.1249946332863 x52 = 0.125001280596 x52 = 0.125001299834 x53 = 0.125002159325 x53 = 0.125002145113 x54 = 0.124996497314 x54 = 0.124999150087 x55 = 0.125002751634 x55 = 0.125002751634 x55 = 0.12500273188 x55 = 0.125002751634 x56 = 0.124999150324 x57 = 0.124999171975 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124998784148 x60 = 0.125000331594 x61 = 0.12500031168 x60 = 0.125000331594 x61 = 0.12500031168 x60 = 0.125000331594 x62 = 0.124999305590 x62 = 0.12499928402 x63 = 0.124999280122 x65 = 0.124999284036 x65 = 0.124999280122 x65 = 0.124998714759 x66 = 0.125000385643 x67 = 0.125000331594 x70 = 0.125001570478 x70 = 0.124999111241 x72 = 0.12500237		
x46 = 0.124984214534 x46 = 0.125009863339 x47 = 0.125009863339 x47 = 0.125009867832 x48 = 0.124998925855 x48 = 0.124994418122 x50 = 0.125007553103 x50 = 0.125007549247 x51 = 0.124994643745 x51 = 0.124994632863 x52 = 0.125001280596 x52 = 0.125001299834 x53 = 0.125002159325 x53 = 0.125002732188 x55 = 0.125002732188 x55 = 0.125002732188 x55 = 0.125002732188 x55 = 0.125002731634 x56 = 0.124999136052 x57 = 0.124999111241 x57 = 0.124999150324 x57 = 0.124999171975 x58 = 0.125001562962 x58 = 0.125000331594 x50 = 0.12499978784148 x50 = 0.1249998784148 x60 = 0.125000491374 x61 = 0.125000482090 x62 = 0.124999305590 x62 = 0.124999784036 x63 = 0.125000284379 x63 = 0.125000361480 x64 = 0.125000361480 x64 = 0.125000361480 x65 = 0.124999741759 x66 = 0.125000331594 x66 = 0.125000447690 x66 = 0.125000331594 x68 = 0.1250001570478 x69 = 0.125000331594 x69 = 0.1250003794116 x72 = 0.125000234173 x70 = 0.124999840912 x71 = 0.1249999111241 x72 = 0		
x47 = 0.125009867832 x48 = 0.124998025855 x48 = 0.12499811447 x49 = 0.124994438122 x49 = 0.12499445650 x50 = 0.125007553103 x50 = 0.125007549247 x51 = 0.124994643745 x51 = 0.124994632863 x52 = 0.125001280596 x52 = 0.125001299834 x53 = 0.125002159325 x53 = 0.125001245113 x54 = 0.124996497314 x54 = 0.124996495087 x55 = 0.125002732188 x55 = 0.125002751634 x56 = 0.124999136052 x56 = 0.1249991171975 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124999784148 x59 = 0.1249987754274 x60 = 0.125000301168 x60 = 0.12500031594 x61 = 0.125000491374 x61 = 0.125000445299 x62 = 0.124999305590 x62 = 0.12499928012 x63 = 0.125000284379 x63 = 0.125000361480 x65 = 0.124999280122 x65 = 0.12499928012 x66 = 0.125000447690 x66 = 0.12500035649 x67 = 0.124999280127 x67 = 0.12499928012 x70 = 0.1249999117975 x70 = 0.12499917975 x71 = 0.12499917975 x70 = 0.12499917975 x72 = 0.125001570478 x69 = 0.125001570478 x70 = 0.12499986496330 x73 = 0.1249964950		
x48 = 0.124998925855 x48 = 0.124998438122 x50 = 0.125007553103 x50 = 0.125007549247 x51 = 0.124994643745 x51 = 0.124994632863 x52 = 0.125001280596 x52 = 0.125001299834 x53 = 0.125002159325 x53 = 0.125002145113 x54 = 0.124996497314 x55 = 0.125002751634 x55 = 0.125002732188 x55 = 0.125002751634 x55 = 0.124999136052 x55 = 0.124999111241 x57 = 0.124999159324 x57 = 0.124999171975 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124999784148 x59 = 0.124999754274 x60 = 0.125000301168 x60 = 0.125000331594 x61 = 0.125000491374 x61 = 0.125000482090 x62 = 0.124999305590 x62 = 0.12499928012 x63 = 0.125000284379 x63 = 0.125000326019 x64 = 0.125000361480 x64 = 0.125000326019 x65 = 0.124999280122 x65 = 0.12499928036 x66 = 0.125000447690 x66 = 0.125000482090 x67 = 0.125000385643 x67 = 0.125000331594 x69 = 0.1249987447459 x69 = 0.124998754274 x70 = 0.124999744921 x71 = 0.124999171975 x71 = 0.124999744921 x72 = 0.125001573657 x79 = 0.124999	312 312 312 312 312 312 312 312 312 312	1110 01121301221110
x49 = 0.124994438122 x49 = 0.124994452650 x50 = 0.125007553103 x50 = 0.125007549247 x51 = 0.125904643745 x51 = 0.124994632863 x52 = 0.125001280596 x52 = 0.125001299834 x53 = 0.125002159325 x53 = 0.125002145113 x54 = 0.12499940497314 x54 = 0.124996495087 x55 = 0.124999136052 x56 = 0.124999111241 x57 = 0.124999159324 x57 = 0.124999171975 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124998784148 x59 = 0.124998754274 x60 = 0.125000301168 x60 = 0.125000331594 x61 = 0.125000491374 x61 = 0.125000482090 x62 = 0.124999305590 x62 = 0.12499924036 x63 = 0.125000284379 x63 = 0.125000326019 x64 = 0.125000361480 x64 = 0.12500036047690 x66 = 0.124999280122 x65 = 0.12499928034 x67 = 0.125001570478 x68 = 0.124998754274 x68 = 0.1249997416 x72 = 0.125000331594 x70 = 0.124999171975 x71 = 0.124999171975 x71 = 0.124999171975 x72 = 0.125001570478 x69 = 0.125001570478 x69 = 0.125001573657 x70 = 0.1249999171975 x71 = 0.124999171975 x71 = 0.1249		
x50 = 0.125007553103 x50 = 0.125007559247 x51 = 0.124994643745 x51 = 0.124994632863 x52 = 0.125001280596 x52 = 0.12500129834 x53 = 0.125002159325 x53 = 0.125002145113 x54 = 0.124996497314 x54 = 0.124996495087 x55 = 0.125002732188 x55 = 0.125002751634 x56 = 0.124999136052 x56 = 0.124999171975 x57 = 0.124999159324 x57 = 0.124999171975 x58 = 0.125001562962 x59 = 0.124998784148 x60 = 0.125000301168 x60 = 0.125000341374 x61 = 0.125000491374 x61 = 0.125000482090 x62 = 0.124999305590 x62 = 0.124999284036 x63 = 0.125000284379 x63 = 0.125000326019 x64 = 0.125000361480 x66 = 0.125000361480 x65 = 0.124999280122 x65 = 0.124999284036 x66 = 0.125000447690 x67 = 0.125000385643 x68 = 0.12499714759 x68 = 0.124998714759 x69 = 0.125001570478 x69 = 0.125001573657 x70 = 0.124999220377 x71 = 0.124999171975 x71 = 0.124999416 x72 = 0.125002794116 x73 = 0.12499460606330 x74 = 0.12500279416 x75 = 0.1250017530068 x77 = 0.12500754024 x79 = 0.124994583		
x51 = 0.124994643745 x52 = 0.125001280596 x53 = 0.125001299334 x53 = 0.125002159325 x53 = 0.12500273141 x55 = 0.124996497314 x55 = 0.1249996497314 x55 = 0.124999130652 x57 = 0.124999159324 x58 = 0.125001562962 x58 = 0.124999171975 x59 = 0.124998784148 x60 = 0.12500301168 x61 = 0.125000491374 x62 = 0.124999305500 x63 = 0.12500284379 x64 = 0.125000341480 x65 = 0.125000341480 x66 = 0.125000341480 x67 = 0.125000341480 x68 = 0.125000341480 x69 = 0.125000341480 x60 = 0.125000341480 x60 = 0.125000331594 x61 = 0.125000341480 x62 = 0.124999280122 x66 = 0.124999280122 x66 = 0.124999280122 x66 = 0.125000341480 x67 = 0.125000331594 x68 = 0.124999714759 x69 = 0.125001570478 x70 = 0.124998744759 x69 = 0.125001570478 x70 = 0.1249992404921 x72 = 0.12500274116 x73 = 0.124999044921 x74 = 0.12500236330 x74 = 0.12500236330 x74 = 0.12500236330 x74 = 0.125002751634 x73 = 0.124994527652 x79 = 0.125007530068 x78 = 0.124994527652 x79 = 0.125007530068 x78 = 0.124998821474 x80 = 0.12500913805 x81 = 0.124998821474 x80 = 0.12500913805 x82 = 0.12509378806 x83 = 0.12499883165 x84 = 0.124998821474 x80 = 0.125009713805 x85 = 0.125009713805 x86 = 0.1249988911447 x80 = 0.125009713805 x86 = 0.12499883365 x87 = 0.1250097138068 x87 = 0.125009718305 x88 = 0.12509978804 x88 = 0.125032079743 x86 = 0.12499883365 x84 = 0.12499883688 x85 = 0.125032079743 x86 = 0.12499883698 x87 = 0.125009708804 x88 = 0.125032079743 x88 = 0.12500288914 x88 = 0.125028288914 x88 = 0.125028288914 x88 = 0.125028288914 x88 = 0.125071472559	3.00	
x52 = 0.125001280596 x52 = 0.12500129834 x53 = 0.125002159325 x53 = 0.125002145113 x54 = 0.124996497314 x54 = 0.1249996495087 x55 = 0.125002732188 x55 = 0.125002751634 x56 = 0.124999159324 x56 = 0.124999111241 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124998784148 x59 = 0.124998754274 x60 = 0.125000301168 x60 = 0.12500034594 x61 = 0.125000491374 x61 = 0.125000482090 x62 = 0.124999305590 x62 = 0.124999284036 x63 = 0.125000341480 x63 = 0.125000326019 x64 = 0.12500034147690 x65 = 0.124999284036 x65 = 0.12499978714759 x66 = 0.125000385643 x68 = 0.124998714759 x68 = 0.124998714759 x69 = 0.125001570478 x69 = 0.1250001570478 x70 = 0.124999204921 x71 = 0.124999171975 x71 = 0.12499944921 x72 = 0.125002794116 x73 = 0.124996506330 x73 = 0.124996506330 x74 = 0.125002751634 x75 = 0.125001377485 x76 = 0.124994588335 x76 = 0.12499463863 x77 = 0.125007530068 x77 = 0.125007530068 x78 = 0.124998824174		
x53 = 0.125002159325 x53 = 0.125002145113 x54 = 0.124996497314 x54 = 0.124996495087 x55 = 0.125002732188 x55 = 0.125002751634 x56 = 0.124999136052 x56 = 0.124999111241 x57 = 0.124999159324 x57 = 0.124999171975 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124998784148 x59 = 0.124998754274 x60 = 0.125000301168 x60 = 0.125000491374 x61 = 0.125000491374 x61 = 0.125000351594 x62 = 0.124999305590 x63 = 0.125000326019 x64 = 0.125000361480 x65 = 0.124999284036 x65 = 0.124999280122 x65 = 0.124999284036 x65 = 0.125000347690 x66 = 0.125000335194 x67 = 0.125000385643 x67 = 0.125000331594 x68 = 0.12499871474759 x68 = 0.124998754274 x69 = 0.125001570478 x69 = 0.125001570478 x70 = 0.124999220377 x71 = 0.124999171975 x71 = 0.124999044921 x71 = 0.124999171975 x72 = 0.125002794116 x72 = 0.125002751634 x73 = 0.1249964506330 x73 = 0.124996495087 x74 = 0.12500208271 x74 = 0.125002145113 x75 = 0.125001377485 x75 = 0.125007549247 x79 = 0.124	1101 0121 155 10 10 110	
x54 = 0.124996497314 x54 = 0.124996495087 x55 = 0.125002732188 x55 = 0.125002751634 x56 = 0.124999150652 x56 = 0.124999171975 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124998784148 x59 = 0.124998754274 x60 = 0.125000301168 x60 = 0.125000491374 x61 = 0.125000284379 x62 = 0.124999284036 x63 = 0.125000361480 x63 = 0.125000326019 x65 = 0.124999280122 x65 = 0.124999284036 x66 = 0.125000385643 x67 = 0.125000331594 x68 = 0.124998714759 x68 = 0.124998754274 x69 = 0.12501570478 x69 = 0.125001373657 x70 = 0.124999220377 x71 = 0.12499954807 x71 = 0.124999404921 x71 = 0.124999511241 x72 = 0.125002794116 x72 = 0.125002751634 x73 = 0.124994580335 x74 = 0.125001279834 x76 = 0.124994580335 x76 = 0.124994580335 x77 = 0.125007530068 x77 = 0.125007549247 x78 = 0.124994824174 x80 = 0.124998824174 x80 = 0.125009913805 x81 = 0.124984248180 x82 = 0.125013498730 x82 = 0.125032079743 x85 = 0.1249882368 x87 = 0.12500867832 x87 = 0.1249863474	x52 = 0.125001280596	x52 = 0.125001299834
x55 = 0.125002732188 x55 = 0.125002751634 x56 = 0.124999136052 x56 = 0.124999111241 x57 = 0.124999159324 x57 = 0.124999171975 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124998784148 x59 = 0.124998754274 x60 = 0.125000301168 x60 = 0.125000331594 x61 = 0.125000491374 x61 = 0.125000482090 x62 = 0.124999305590 x62 = 0.124999284036 x63 = 0.125000361480 x64 = 0.125000326019 x65 = 0.124999280122 x65 = 0.124999284036 x66 = 0.125000447690 x66 = 0.125000482090 x67 = 0.125001570478 x68 = 0.12499874274 x69 = 0.125001570478 x69 = 0.125001573657 x70 = 0.124999220377 x70 = 0.124999171975 x71 = 0.124999044921 x71 = 0.124999111241 x72 = 0.125002794116 x72 = 0.125002751634 x73 = 0.124996506330 x73 = 0.124996495087 x74 = 0.125002082721 x74 = 0.125002145113 x75 = 0.125001573068 x77 = 0.1250015749247 x78 = 0.124994527652 x78 = 0.124998824174 x80 = 0.125009867832 x81 = 0.124988248180 x82 = 0.125013498730 x82 = 0.125013498730 x82 = 0.125013498730		
$\begin{array}{c} x56 = 0.124999136052 \\ x57 = 0.124999159324 \\ x58 = 0.125001562962 \\ x58 = 0.125001562962 \\ x59 = 0.124998784148 \\ x60 = 0.125000301168 \\ x61 = 0.125000491374 \\ x62 = 0.124999305590 \\ x64 = 0.125000284379 \\ x65 = 0.125000361480 \\ x66 = 0.125000361480 \\ x66 = 0.125000361480 \\ x66 = 0.1250003461480 \\ x66 = 0.1250003461480 \\ x66 = 0.1250003461480 \\ x66 = 0.1250003461480 \\ x66 = 0.125000346019 \\ x67 = 0.125000385643 \\ x68 = 0.124999280122 \\ x68 = 0.124999280122 \\ x69 = 0.125001350476790 \\ x69 = 0.125000385643 \\ x70 = 0.125000385643 \\ x70 = 0.125000385643 \\ x70 = 0.124999220377 \\ x70 = 0.124999220377 \\ x71 = 0.124999220377 \\ x71 = 0.124999244921 \\ x71 = 0.1249996506330 \\ x74 = 0.125002794116 \\ x73 = 0.125002794116 \\ x75 = 0.125001377485 \\ x76 = 0.125001377485 \\ x76 = 0.125001377485 \\ x77 = 0.125007530068 \\ x77 = 0.125007530068 \\ x78 = 0.124994527652 \\ x79 = 0.124998824174 \\ x80 = 0.125013498730 \\ x81 = 0.12499882368 \\ x84 = 0.1249982714825 \\ x85 = 0.125032079743 \\ x86 = 0.12499882368 \\ x84 = 0.124998236804 \\ x85 = 0.125099708804 \\ x86 = 0.1249963632228 \\ x87 = 0.125009708804 \\ x88 = 0.124936351228 \\ x90 = 0.125071380468 \\ x90 = 0.125071472559 \\ x50 = 0.1249936320200 \\ x90 = 0.125071380468 \\ x90 = 0.125071472559 \\ x85 = 0.125071380468 \\ x90 = 0.125071472559 \\ x85 = 0.125071380468 \\ x90 = 0.125071472559 \\ x85 = 0.125071472559 \\ x85 = 0.125071380468 \\ x85 = 0.125071472559 \\ x85 = 0.125071472559 \\ x85 = 0.125071380468 \\ x90 = 0.125071472559 \\ x90 = $		
x57 = 0.124999159324 x57 = 0.124999171975 x58 = 0.125001562962 x58 = 0.125001573657 x59 = 0.124998784148 x59 = 0.124998754274 x60 = 0.125000301168 x60 = 0.125000491374 x61 = 0.12500025500 x62 = 0.124999284020 x63 = 0.125000284379 x63 = 0.125000326019 x64 = 0.125000361480 x66 = 0.125000326019 x65 = 0.124999280122 x65 = 0.1249992804036 x66 = 0.125000385643 x67 = 0.125000331594 x68 = 0.124998714759 x68 = 0.124998754274 x69 = 0.125001570478 x69 = 0.125001573657 x70 = 0.124999220377 x70 = 0.124999111241 x72 = 0.12499944921 x71 = 0.124999111241 x72 = 0.125002794116 x72 = 0.125002751634 x73 = 0.124996506330 x73 = 0.125001377485 x76 = 0.124994588335 x76 = 0.12499458335 x76 = 0.124994588335 x76 = 0.12499452652 x79 = 0.124998824174 x80 = 0.1250097849247 x80 = 0.1249988234180 x81 = 0.1249984222410 x82 = 0.125013498730 x82 = 0.125013489730 x83 = 0.12499882368 x84 = 0.124988733895 x84 = 0.124988714825 x84 = 0.124988733895 x85 = 0.125003	x55 = 0.125002732188	x55 = 0.125002751634
x58 = 0.125001562662 x58 = 0.125001573657 x59 = 0.124998784148 x59 = 0.124998754274 x60 = 0.125000301168 x60 = 0.125000491374 x62 = 0.124999305590 x62 = 0.124999284036 x63 = 0.125000284379 x63 = 0.125000326019 x64 = 0.12500031480 x64 = 0.125000326019 x65 = 0.124999280122 x65 = 0.124999284036 x66 = 0.125000447690 x66 = 0.12500031594 x68 = 0.124998714759 x68 = 0.124998714759 x69 = 0.125001570478 x69 = 0.125001570478 x70 = 0.124999220377 x70 = 0.124999211241 x72 = 0.125002794116 x72 = 0.125002794116 x73 = 0.124996506330 x73 = 0.124996495087 x74 = 0.125002082721 x74 = 0.125001377485 x75 = 0.125001377485 x75 = 0.1250015730068 x77 = 0.124994588335 x76 = 0.12499458263 x77 = 0.124998824174 x80 = 0.124998824174 x80 = 0.12499873480 x81 = 0.124984248180 x82 = 0.125013498730 x82 = 0.125013498730 x83 = 0.124982714825 x84 = 0.124982761950 x85 = 0.125032079743 x85 = 0.125032079743 x86 = 0.12496351228 x87 = 0.1250071472559 x90 = 0		
$\begin{array}{llllllllllllllllllllllllllllllllllll$	x57 = 0.124999159324	x57 = 0.124999171975
$\begin{array}{llllllllllllllllllllllllllllllllllll$		
$\begin{array}{llllllllllllllllllllllllllllllllllll$	x59 = 0.124998784148	x59 = 0.124998754274
$\begin{array}{llllllllllllllllllllllllllllllllllll$	$\mathbf{x}60 = 0.125000301168$	$\mathbf{x}60 = 0.125000331594$
x63 = 0.125000284379 x63 = 0.125000326019 x64 = 0.125000361480 x64 = 0.125000326019 x65 = 0.124999280122 x65 = 0.124999284036 x66 = 0.125000447690 x66 = 0.125000331594 x68 = 0.124998714759 x68 = 0.124998754274 x69 = 0.125001570478 x69 = 0.125001573657 x70 = 0.124999220377 x70 = 0.124999171975 x71 = 0.124999044921 x72 = 0.125002751634 x73 = 0.124996506330 x73 = 0.124996495087 x74 = 0.12500282721 x74 = 0.125002145113 x75 = 0.125001377485 x75 = 0.125001299834 x76 = 0.124994588335 x76 = 0.124994632863 x77 = 0.125007530068 x77 = 0.125007549247 x78 = 0.124998824174 x80 = 0.124998824174 x80 = 0.125009913805 x81 = 0.124984248180 x82 = 0.125013498730 x82 = 0.125013498730 x83 = 0.124998828368 x84 = 0.124982714825 x85 = 0.125032079743 x85 = 0.125032079743 x86 = 0.124968347493 x86 = 0.124968351228 x87 = 0.125007380468 x87 = 0.125014986320200	x61 = 0.125000491374	$\mathbf{x}61 = 0.125000482090$
$\begin{array}{llllllllllllllllllllllllllllllllllll$	x62 = 0.124999305590	x62 = 0.124999284036
$\begin{array}{c} x65 = 0.124999280122 \\ x66 = 0.125000447690 \\ x67 = 0.125000385643 \\ x68 = 0.124998714759 \\ x69 = 0.125001570478 \\ x70 = 0.124999220377 \\ x71 = 0.124999044921 \\ x72 = 0.125002794116 \\ x73 = 0.124996506330 \\ x74 = 0.125001377485 \\ x75 = 0.125001377485 \\ x76 = 0.124994527485 \\ x76 = 0.124994527485 \\ x77 = 0.124996506330 \\ x73 = 0.124996495087 \\ x74 = 0.125002082721 \\ x74 = 0.125002145113 \\ x75 = 0.125001377485 \\ x76 = 0.1249945288335 \\ x77 = 0.125007530068 \\ x79 = 0.124994527652 \\ x79 = 0.124994527652 \\ x79 = 0.124998824174 \\ x80 = 0.125001391805 \\ x81 = 0.124994248180 \\ x82 = 0.125013498730 \\ x83 = 0.12499882368 \\ x84 = 0.1249982714825 \\ x85 = 0.125032079743 \\ x86 = 0.124968347493 \\ x86 = 0.124968347493 \\ x87 = 0.125009708804 \\ x88 = 0.125028288914 \\ x89 = 0.124936351228 \\ x90 = 0.125071380468 \\ \end{array}$	x63 = 0.125000284379	$\mathbf{x}63 = 0.125000326019$
$\begin{array}{llllllllllllllllllllllllllllllllllll$		
$\begin{array}{c} x67 = 0.125000385643 \\ x68 = 0.124998714759 \\ x69 = 0.125001570478 \\ x70 = 0.124999220377 \\ x71 = 0.124999044921 \\ x72 = 0.125002794116 \\ x73 = 0.124996506330 \\ x74 = 0.12500282721 \\ x75 = 0.12500278455 \\ x76 = 0.125002794156 \\ x77 = 0.124994588335 \\ x76 = 0.125001377485 \\ x78 = 0.1250027530068 \\ x77 = 0.125007530068 \\ x78 = 0.124994527652 \\ x79 = 0.12500913805 \\ x81 = 0.124998824174 \\ x80 = 0.125009913805 \\ x81 = 0.12499882480 \\ x82 = 0.125013498730 \\ x83 = 0.124998828368 \\ x84 = 0.1249882714825 \\ x85 = 0.125032079743 \\ x86 = 0.124988347493 \\ x86 = 0.125009708804 \\ x87 = 0.12500708804 \\ x89 = 0.12500708068 \\ x89 = 0.125009807432 \\ x88 = 0.125028288914 \\ x89 = 0.12501380468 \\ \end{array}$		
$\begin{array}{llllllllllllllllllllllllllllllllllll$		1100 01111000101000
$\begin{array}{llllllllllllllllllllllllllllllllllll$	x67 = 0.125000385643	
$\begin{array}{c} x70 = 0.124999220377 \\ x71 = 0.124999044921 \\ x72 = 0.125002794116 \\ x73 = 0.124996506330 \\ x74 = 0.125002082721 \\ x75 = 0.125001377485 \\ x76 = 0.124994588335 \\ x77 = 0.125007530068 \\ x78 = 0.124994527652 \\ x79 = 0.124994527652 \\ x79 = 0.12499824174 \\ x80 = 0.125009913805 \\ x81 = 0.12499824380 \\ x82 = 0.125013498730 \\ x83 = 0.1249982824174 \\ x84 = 0.12500348180 \\ x85 = 0.12499822410 \\ x85 = 0.125032079743 \\ x85 = 0.125002708804 \\ x86 = 0.1250029807432 \\ x87 = 0.1250029807432 \\ x88 = 0.1250029807432 \\ x89 = 0.1250029807432 \\ x80 = 0.1250028074784 \\ x80 = 0.1250029807432 \\ x81 = 0.12498824100 \\ x82 = 0.125032079743 \\ x83 = 0.124988347493 \\ x84 = 0.1249883144 \\ x85 = 0.125028288914 \\ x87 = 0.125028288914 \\ x88 = 0.125028240784 \\ x89 = 0.124936351228 \\ x89 = 0.125071380468 \\ x90 = 0.125071472559 \\ \end{array}$	x68 = 0.124998714759	$\mathbf{x}68 = 0.124998754274$
$\begin{array}{c} x71 = 0.124999044921 \\ x72 = 0.125002794116 \\ x73 = 0.124996506330 \\ x74 = 0.125002082721 \\ x75 = 0.125001377485 \\ x76 = 0.124994588335 \\ x77 = 0.125007530068 \\ x78 = 0.124994527652 \\ x79 = 0.124998824174 \\ x80 = 0.125009913805 \\ x81 = 0.124998828368 \\ x84 = 0.124998828368 \\ x84 = 0.124998828368 \\ x85 = 0.125032079743 \\ x86 = 0.124988347493 \\ x86 = 0.125009708804 \\ x87 = 0.125009708804 \\ x89 = 0.125009708804 \\ x89 = 0.125009708804 \\ x89 = 0.125071380468 \\ \end{array}$	3122332333	
x72 = 0.125002794116 x72 = 0.125002751634 x73 = 0.124996506330 x73 = 0.124996495087 x74 = 0.125002082721 x74 = 0.125002145113 x75 = 0.125001377485 x75 = 0.125001299834 x76 = 0.124994588335 x76 = 0.124994632863 x77 = 0.125007530068 x77 = 0.125007549247 x78 = 0.124994527652 x78 = 0.12499841447 x80 = 0.125009913805 x80 = 0.125009867832 x81 = 0.124984248180 x81 = 0.124984222410 x82 = 0.125013498730 x82 = 0.125013583591 x83 = 0.1249982714825 x84 = 0.124982761950 x85 = 0.125032079743 x85 = 0.125032109690 x86 = 0.124968347493 x86 = 0.124968256682 x87 = 0.125009708804 x87 = 0.125009807432 x88 = 0.125028288914 x89 = 0.124936351228 x89 = 0.124936351228 x89 = 0.124936320200 x90 = 0.125071380468 x90 = 0.125071472559		
$\begin{array}{llllllllllllllllllllllllllllllllllll$		
$\begin{array}{c} x74 = 0.125002082721 \\ x75 = 0.125001377485 \\ x76 = 0.124994588335 \\ x77 = 0.125007530068 \\ x78 = 0.124994527652 \\ x79 = 0.12499824174 \\ x80 = 0.125009913805 \\ x81 = 0.124984248180 \\ x82 = 0.125013498730 \\ x83 = 0.1249982714825 \\ x84 = 0.124982714825 \\ x85 = 0.125032079743 \\ x86 = 0.125009708804 \\ x87 = 0.125009867832 \\ x81 = 0.12498274823 \\ x81 = 0.124982714825 \\ x82 = 0.125032079743 \\ x85 = 0.125032079743 \\ x86 = 0.125009708804 \\ x87 = 0.125009807432 \\ x88 = 0.125028288914 \\ x89 = 0.124936351228 \\ x90 = 0.125071380468 \\ \end{array}$		
$\begin{array}{llllllllllllllllllllllllllllllllllll$		
$\begin{array}{llllllllllllllllllllllllllllllllllll$		
x77 = 0.125007530068 x77 = 0.125007549247 x78 = 0.124994527652 x78 = 0.124994452650 x79 = 0.124998824174 x79 = 0.124998911447 x80 = 0.125009913805 x80 = 0.125009867832 x81 = 0.124984248180 x81 = 0.124984222410 x82 = 0.125013498730 x82 = 0.125013583591 x83 = 0.124998828368 x83 = 0.124998733895 x84 = 0.124982714825 x84 = 0.124982761950 x85 = 0.125032079743 x85 = 0.125032109690 x86 = 0.124968347493 x86 = 0.124968256682 x87 = 0.125009708804 x87 = 0.125009807432 x88 = 0.125028288914 x88 = 0.125028240784 x89 = 0.124936351228 x89 = 0.124936320200 x90 = 0.125071380468 x90 = 0.125071472559		
$\begin{array}{llllllllllllllllllllllllllllllllllll$	1170 0722 157 1500000	
$\begin{array}{llllllllllllllllllllllllllllllllllll$		
$\begin{array}{llllllllllllllllllllllllllllllllllll$		
$\begin{array}{llllllllllllllllllllllllllllllllllll$		
$\begin{array}{lll} x82 = 0.125013498730 & x82 = 0.125013583591 \\ x83 = 0.124998828368 & x83 = 0.124998733895 \\ x84 = 0.124982714825 & x84 = 0.124982761950 \\ x85 = 0.125032079743 & x85 = 0.125032109690 \\ x86 = 0.124968347493 & x86 = 0.124968256682 \\ x87 = 0.125009708804 & x87 = 0.125009807432 \\ x88 = 0.125028288914 & x88 = 0.125028240784 \\ x89 = 0.124936351228 & x89 = 0.124936320200 \\ x90 = 0.125071380468 & x90 = 0.125071472559 \\ \end{array}$		
$\begin{array}{lll} x83 = 0.124998828368 & x83 = 0.124998733895 \\ x84 = 0.124982714825 & x84 = 0.124982761950 \\ x85 = 0.125032079743 & x85 = 0.125032109690 \\ x86 = 0.124968347493 & x86 = 0.124968256682 \\ x87 = 0.125009708804 & x87 = 0.125009807432 \\ x88 = 0.125028288914 & x88 = 0.125028240784 \\ x89 = 0.124936351228 & x89 = 0.124936320200 \\ x90 = 0.125071380468 & x90 = 0.125071472559 \\ \end{array}$		
$\begin{array}{lll} x84 = 0.124982714825 & x84 = 0.124982761950 \\ x85 = 0.125032079743 & x85 = 0.125032109690 \\ x86 = 0.124968347493 & x86 = 0.124968256682 \\ x87 = 0.125009708804 & x87 = 0.125009807432 \\ x88 = 0.125028288914 & x88 = 0.125028240784 \\ x89 = 0.124936351228 & x89 = 0.124936320200 \\ x90 = 0.125071380468 & x90 = 0.125071472559 \end{array}$		
$x85 = 0.125032079743 \\ x86 = 0.124968347493 \\ x87 = 0.125009708804 \\ x88 = 0.125028288914 \\ x89 = 0.124936351228 \\ x90 = 0.125071380468$ $x85 = 0.125032109690 \\ x86 = 0.124968256682 \\ x87 = 0.125009807432 \\ x88 = 0.125028240784 \\ x89 = 0.124936351228 \\ x90 = 0.125071380468$		
$\begin{array}{lll} x86 = 0.124968347493 & x86 = 0.124968256682 \\ x87 = 0.125009708804 & x87 = 0.125009807432 \\ x88 = 0.125028288914 & x88 = 0.125028240784 \\ x89 = 0.124936351228 & x89 = 0.124936320200 \\ x90 = 0.125071380468 & x90 = 0.125071472559 \end{array}$		
x87 = 0.125009708804 $x88 = 0.125009807432$ $x88 = 0.125028288914$ $x89 = 0.124936351228$ $x89 = 0.125071380468$ $x80 = 0.125071472559$		
x88 = 0.125028288914 $x89 = 0.125028240784$ $x89 = 0.124936351228$ $x89 = 0.125071380468$ $x90 = 0.125071472559$		
x89 = 0.124936351228 $x89 = 0.124936320200$ $x90 = 0.125071380468$ $x90 = 0.125071472559$		
x90 = 0.125071380468 $x90 = 0.125071472559$		
x91 = 0.124965638166 x91 = 0.124965538910		
	x91 = 0.124965638166	x91 = 0.124965538910

x92 = 0.124958098410	x92 = 0.124958147283
x93 = 0.125122867283	x93 = 0.125122896169
x94 = 0.124844082450	x94 = 0.124843993972
x95 = 0.125098321003	x95 = 0.125098417087
x96 = 0.125050783992	$\mathbf{x}96 = 0.125050735008$
x97 = 0.124769977848	x97 = 0.124769953871
x98 = 0.125331157945	x98 = 0.125331238295
$\mathbf{x}99 = 0.124746152896$	$\mathbf{x}99 = 0.124746063762$
x100 = 0.124970493785	x100 = 0.124970541729
x101 = 0.125415297794	x101 = 0.125415315047
x102 = 0.124315103869	x102 = 0.124315035216
x103 = 0.125615469051	x103 = 0.125615547841
x104 = 0.124905764516	x104 = 0.124905719266
x105 = 0.124283218952	x105 = 0.124283208997
x106 = 0.126377703190	x106 = 0.126377757954
x107 = 0.123571056211	x107 = 0.123570990391
x108 = 0.125507783772	x108 = 0.125507824368
x109 = 0.126168368391	x109 = 0.126168371747
x110 = 0.122319773860	x110 = 0.122319733580
x111 = 0.128214856955	x111 = 0.128214908273
x112 = 0.123323655134	x112 = 0.123323621125
x113 = 0.123215744559	x113 = 0.123215746070
x114 = 0.129960000943	x114 = 0.129960027706
x115 = 0.117926058396	x115 = 0.117926021811
x116 = 0.129767010886	x116 = 0.129767036788
x117 = 0.127684999186	x117 = 0.127684995141
x118 = 0.116698403211	x118 = 0.116698387716
x119 = 0.140353917045	x119 = 0.140353939990
x120 = 0.111997231780	x120 = 0.111997214768
x121 = 0.119578844670	x121 = 0.119578848862
x122 = 0.135207479020	x122 = 0.135207486300
x123 = 0.091962627321	x123 = 0.091962615745
x124 = 0.162311307093	x124 = 0.162311315286
x125 = 0.146794910818	x125 = 0.146794908343
x126 = 0.130930204793	x126 = 0.130930202478
x127 = 0.194276791972	x127 = 0.194276795444

Graficzne tempo zbieżności:



Dla macierzy z naszego zadania złożoność obliczeniowa dla rozkładu Cholesky'ego wynosi 5n². W wypadku metody Gaussa-Seidela mamy złożoność m*5n (m – liczba iteracji, n – wymiar macierzy), natomiast dla zapełnionej niezerowymi wyrazami macierzy metoda ta kosztuje m*n². Tak samo jest w przypadku metody gradientów sprzężonych.