```
function x2=Jacobi(A,b,acc,maxiter)
  n = length(b);
  x1 = zeros (1, n);
  x2 = x1;

  itr = 0;
  flag = 0;
  while (itr < maxiter && flag == 0)
    for i=1:n
      sum = 0;
      TempA = A;

      for j=1:n #compute sum
        TempA(j, j) = 0;
        sum += TempA(i, j) * x1(j);
      endfor

      x2(i)=  (b(i) - sum)/A(i, i);
    endfor

    itr += 1;
    rel_norm_dif = (norm(x2 - x1, inf))/(norm(x2, inf));

    if (rel_norm_dif <= acc)
      flag = 1;
    endif
    x1 = x2;

  endwhile
  disp('iterations=')
  disp(itr)
  if (flag == 0)
    disp('Wanted accuracy was not achieved')
  endif

endfunction
```

```
>> A=[10 -1 2 0; -1 11 -1 3; 2 -1 10 -1;0 3 -1 8]

A =

    10    -1     2     0
    -1    11    -1     3
     2    -1    10    -1
     0     3    -1     8

>> b=[6;25;-11;15]

b =

     6
    25
   -11
    15

>> A\b

ans =

    1
    2
   -1
    1

>> x=Jacobi(A,b,1e-3,1000)
iterations=
9
x =

    0.9997    2.0004   -1.0004    1.0006
```

```
>> A=[19 2 0 3 9; -1 23 -1 3 7; 2 -1 15 -1 5; 0 3 -1 8 2; 4 3 2 1 13]
A =

   19    2    0    3    9
   -1   23   -1    3    7
    2   -1   15   -1    5
    0    3   -1    8    2
    4    3    2    1   13
>> b=[6;25;-11;15;2]
b =

    6
   25
  -11
   15
    2

>> A\b
ans =

   0.029671
   0.898099
  -0.546778
   1.493185
  -0.093278

>> x=Jacobi(A,b,1e-3,1000)
iterations=
14
x =

   0.029313   0.897920  -0.547007   1.492980  -0.093609

>> x=Jacobi(A,b,1e-2,1000)
iterations=
9
```

```
x =

   0.034329   0.900345  -0.543823   1.495937  -0.088538

>> x=Jacobi(A,b,1e-1,1000)
iterations=
5
x =

   0.065980   0.915200  -0.524239   1.515335  -0.053691

>> x=Jacobi(A,b,1e-4,1000)
iterations=
18
x =

   0.029627   0.898077  -0.546806   1.493160  -0.093319

>> x=Jacobi(A,b,1e-40,1000)
iterations=
1000
Wanted accuracy was not achieved
x =

   0.029671   0.898099  -0.546778   1.493185  -0.093278

>> x=Jacobi(A,b,1e-15,1000)
iterations=
67
x =

   0.029671   0.898099  -0.546778   1.493185  -0.093278

>> A=[1 10 -1;11 -1 3; 2 -1 10]
A =
```

```
     1    10    -1
    11    -1     3
     2    -1    10

>> b=[6;25;-11]
b =

     6
    25
   -11

>> A\b
ans =

    2.7322
    0.1638
   -1.6301
>> x=Jacobi(A,b,1e-1,5)
iterations=
5
Wanted accuracy was not achieved
x =

    4.3394e+04  -3.0353e+05   5.1060e+03
>> x=Jacobi(A,b,1e-1,15)
iterations=
15
Wanted accuracy was not achieved
x =

   -8.3878e+14   4.8421e+15  -8.0031e+13
>> x=Jacobi(A,b,1e-1,50)
iterations=
50
Wanted accuracy was not achieved
x =
```

```
   2.3556e+51   7.3307e+50  -3.6650e+49
```

```
function x2=GaussSeidel(A,b,acc,maxiter)
  n = length(b);
  x1 = zeros (1, n);
  x2 = x1;

  itr = 0;
  flag = 0;
  while (itr < maxiter && flag == 0)
    for i=1:n
      sum1 = 0;
      sum2 = 0;

      for j=1:(i-1) #compute sum1
        sum1 += A(i, j) * x2(j);
      endfor

      for j=(i+1):n #compute sum2
        sum2 += A(i, j) * x1(j);
      endfor

      sum = sum1 + sum2;
      x2(i)=  (b(i) - sum)/A(i, i);
    endfor

    itr += 1;
    rel_norm_dif = (norm(x2 - x1, inf))/(norm(x2, inf));

    if (rel_norm_dif <= acc)
      flag = 1;
    endif
    x1 = x2;
```

```
  endwhile
  disp('iterations=')
  disp(itr)
  if (flag == 0)
    disp('Wanted accuracy was not achieved')
  endif

endfunction
```

```
>> x=GaussSeidel(A,b,1e-3,1000)
iterations=
5
x =

   1.0001   2.0000  -1.0000   1.0000
```

Gia ton 5x5

```
>> x=GaussSeidel(A,b,1e-1,1000)
iterations=
3
x =

   0.036608   0.906298  -0.536938   1.498371  -0.099217

>> x=GaussSeidel(A,b,1e-2,1000)
iterations=
4
x =

   0.030802   0.899707  -0.544496   1.494352  -0.094438

>> x=GaussSeidel(A,b,1e-3,1000)
iterations=
6
x =
```

```
   0.029706   0.898157  -0.546690   1.493229  -0.093319

>> x=GaussSeidel(A,b,1e-4,1000)
iterations=
7
x =

   0.029677   0.898110  -0.546761   1.493193  -0.093285

>> x=GaussSeidel(A,b,1e-40,1000)
iterations=
24
x =

   0.029671   0.898099  -0.546778   1.493185  -0.093278

>> x=GaussSeidel(A,b,1e-15,1000)
iterations=
22
x =

   0.029671   0.898099  -0.546778   1.493185  -0.093278
```

3x3

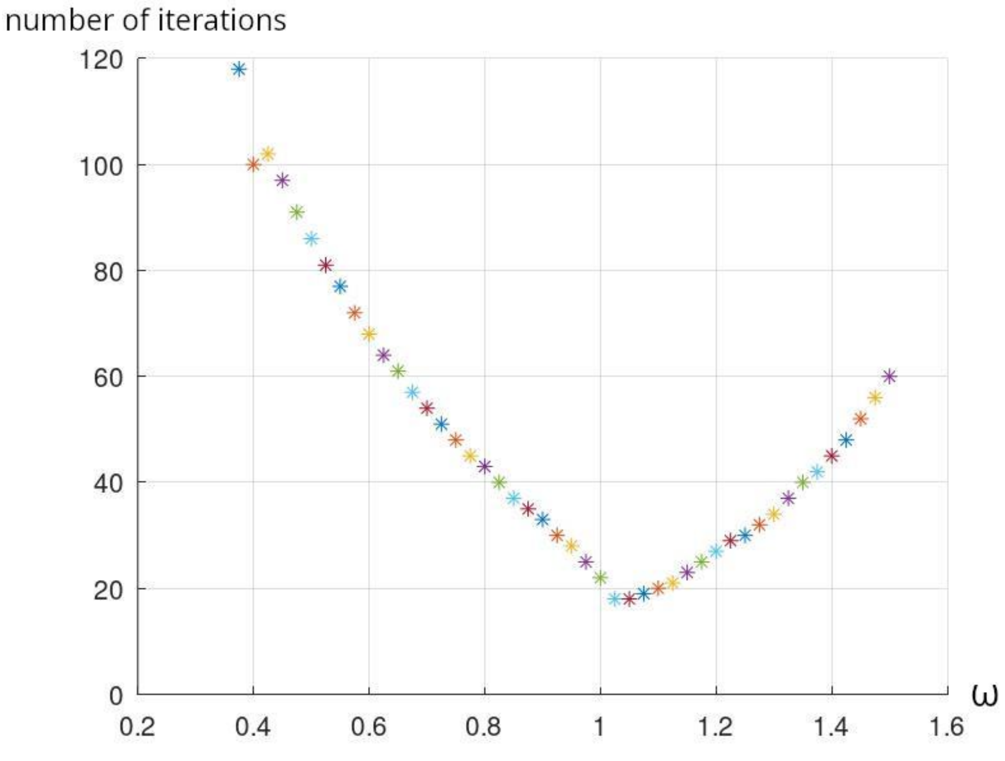
```
>> x=GaussSeidel(A,b,1e-1,5)
iterations=
5
Wanted accuracy was not achieved
x =

   5.2228e+08   5.7321e+09   4.6876e+08

>> x=GaussSeidel(A,b,1e-1,15)
iterations=
```

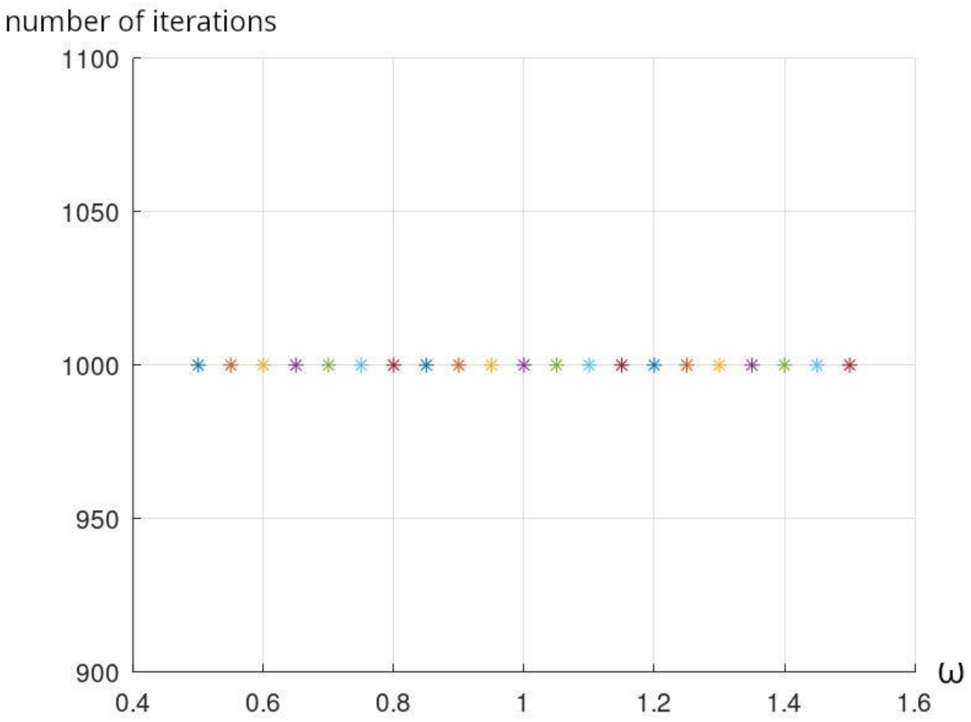
```
15
Wanted accuracy was not achieved
x =

   1.2201e+29   1.3391e+30   1.0951e+29

>> x=GaussSeidel(A,b,1e-1,50)
iterations=
50
Wanted accuracy was not achieved
x =

  -2.3774e+100  -2.6093e+101  -2.1338e+100
```

```
function x2=sor(A,b,acc,maxiter,om)
  n = length(b);
  x1 = zeros (1, n);
  x2 = x1;

  itr = 0;
  flag = 0;
  while (itr < maxiter && flag == 0)
    for i=1:n
      sum1 = 0;
      sum2 = 0;

      for j=1:(i-1) #compute sum1
        sum1 += A(i, j) * x2(j);
      endfor

      for j=(i+1):n #compute sum2
        sum2 += A(i, j) * x1(j);
      endfor
```

```
      sum = sum1 + sum2;
      x2(i)= (1 - om)*x1(i) + om * (b(i) - sum)/A(i, i);
    endfor

    itr += 1;
    rel_norm_dif = (norm(x2 - x1, inf))/(norm(x2, inf));

    if (rel_norm_dif <= acc)
      flag = 1;
    endif
    x1 = x2;

  endwhile
  disp('iterations=')
  disp(itr)
  if (flag == 0)
    disp('Wanted accuracy was not achieved')
  endif
endfunction

function plot_omega_itr(A,b,acc,maxiter)
hold
for om=15:60
  om=om/40;
  iter=sor(A,b,acc,maxiter,om);
  disp([num2str(om),' ',num2str(iter)])
  plot(om,iter,'*')
endfor
endfunction

>> x=sor(A,b,1e-5,1000,1)
iterations=
7
x =
```

```
   1.0000   2.0000  -1.0000   1.0000


>> x=sor(A,b,1e-5,1000,1.02)
iterations=
6
x =

   1.0000   2.0000  -1.0000   1.0000


>> x=sor(A,b,1e-5,1000,1.04)
iterations=
7
x =

   1.0000   2.0000  -1.0000   1.0000
```





Παρατηρούμε αναμενόμενα(από τις δοκιμές της Jacobi) ότι για την επίτευξη μεγαλύτερης ακρίβειας απαιτούνται περισσότερες επαναλήψεις. Επιπλέον σε όλες τις μεθόδους ο επιλεγμένος 3x3 μη διαγώνια υπέρτερος πίνακας δεν συγκλίνει. Για τον δοσμένο 4x4 και τον επιλεγμένο 5x5 πίνακα, παρατηρούμε ότι η Gauss-Seidel επιτυγχάνει την απαιτούμενη ακρίβεια με λιγότερες επαναλήψεις σε σχέση με την Jacobi. Τέλος η SOR, για τον 5x5 πίνακα, παρατηρούμε ότι με ω=41/40 και 42/40 επιτυγχάνει την απαιτούμενη ακρίβεια στις ελάχιστες επαναλήψεις.