Algorithm 1 INCREMENTAL SEARCH

Input: f, x_0, h, n_{max}
Output: $a, b, iter$

$x_{ant} \leftarrow x_o$
$f_{ant} \leftarrow f(x_{ant})$
$x_{act} \leftarrow x_{ant} + h$
$f_{act} \leftarrow f(a_{ct})$
For $i \leftarrow 1, n_{max}$ **do**
  if $f_{ant} * f_{act} < 0$ **Then**
    break
  End if
  $x_{ant} \leftarrow x_{act}$
  $f_{ant} \leftarrow f_{act}$
  $x_{act} \leftarrow x_{ant} + h$
  $f_{act} \leftarrow f(x_{act})$
End For
$a \leftarrow x_{ant}$
$b \leftarrow x_{act}$
$iter \leftarrow i$
Return $a, b, iter$

Algorithm 2 BISECTION

Input: f, a, b, tol, n_{max}
Output: $x, iter, err$

$fa \leftarrow f(a)$
$f_{pm} \leftarrow (a+b)/2$
$f_{pm} \leftarrow f(pm)$
$E \leftarrow 1000$
$cont \leftarrow 1$
While $(E > tol)$ & $(cont < N_{max})$ **do**
  if $(f_a * f_{pm} < 0)$ **Then**
    $b \leftarrow pm$
  else if
    $a \leftarrow pm$
  End if
  $p_0 \leftarrow pm$
  $pm \leftarrow (a+b)/2$
  $f_{pm} \leftarrow f(pm)$
  $E \leftarrow |pm - p_0|$
  $cont \leftarrow cont + 1$
End While
$x \leftarrow pm$
$iter \leftarrow cont$
$err \leftarrow E$
Return $x, iter, err$

Algorithm 3 FALSE RULE

Input: f, a, b, tol, N_{max}
Output: $x, iter, err$

```
f_a ← f(a)
f_b ← f(b)
f_pm ← f(pm)
E ← 1000
cont ← 1
While (E > tol) & (cont < N_max) do
   if (f_a * f_pm < 0) Then
      b ← pm
   else if
      a ← pm
   End if
   p_0 ← pm
   pm ← (f(b) * a − f(a) * b)/f(b) − f(a))
   f_pm ← f(pm)
   E ← |pm − p_0|
   cont ← cont + 1
End While
x ← pm
iter ← cont
err ← E
Return x, iter, err
```

z

Algorithm 4 FIXED POINT

Input: g, x_0, tol, N_{max}
Output: $x, iter, err$

```
x_ant ← x0
E ← 1000
cont ← 1
While (E > tol) & (cont < N_max) do
   x_act ← g(x_ant)
   E ← |x_act − x_ant|
   cont ← cont + 1
   x_ant ← x_act
End While
x ← x_act
iter ← cont
err ← E
Return x, iter, err
```

Algorithm 5 NEWTON

Input: f, df, x_0, tol, N_{max}
Output: $x, iter, err$

```
x_ant ← x0
f_ant ← f(x_ant)
E ← 1000
cont ← 0
While (E > tol) & (cont < N_max) do
    x_act ← (x_ant − f_ant)/(df(x_ant))
    f_act ← f(x_act)
    E ← |x_act − x_ant|
    cont ← cont + 1
    x_ant ← x_act
    f_ant ← f_act
End While
x ← x_act
iter ← cont
err ← E
Return x, iter, err
```

Algorithm 6 SEC

Input: $f, x_0, x_1, tol, N_{max}$
Output: $x, iter, err$

```
f_0 ← f(x_0)
f_1 ← f(x_1)
E ← 1000
cont ← 1
While (E > tol) & (cont < N_max) do
    x_act ← x1 − f1 ∗ (x_1 − x_0)/(f_1 − f_0)
    f_act ← f(x_act)
    E ← |x_act − x_1|
    cont ← cont + 1
    x_0 ← x_1
    f_0 ← f_1
    x_1 ← x_act
    f_1 ← f_act
End While
x ← x_act
iter ← cont
err ← E
Return x, x_act, err
```

Algorithm 7 MULTIPLE ROOTS

Input: $f, f', f'', x0, tol, N_{max}$
Output: $x, iter, err$

$x_{ant} \leftarrow x0$
$f_{ant} \leftarrow f(act)$
$E \leftarrow 1000$
$cont \leftarrow 0$
While $(E > tol)$ & $(cont < N_{max})$ **do**
  $x_{act} \leftarrow (x_{ant} - f_{ant}) * f''(x_{ant})/(f'(x_{ant})^2 - f_{ant} * f''(x_{ant}))$
  $fa_{ct} \leftarrow f(x_{act})$
  $E \leftarrow |x_{act} - x_{ant}|$
  $cont \leftarrow cont + 1$
  $x_{ant} \leftarrow x_{act}$
  $f_{ant} \leftarrow f_{act}$
End While
$x \leftarrow x_{act}$
$iter \leftarrow cont$
$err \leftarrow E$
Return $x, iter, err$

Algorithm 8 GAUSSIAN ELIMINATION

Input: A, b
Output: x

$n \leftarrow size(A, 1)$
$M \leftarrow [Ab]$
For $i \leftarrow 0, n-1$ **do**
  For $j \leftarrow i+1, n$ **do**
    if $M(j,i) \neq 0$ **Then**
      $M(j, i : n+1) \leftarrow M(j, i : n+1) - (M(j,i)/M(i,i)) * M(i, i : n+1)$
    End if
  End For
End For
$x \leftarrow backsubstitution(M)$
Return x

Algorithm 9 GAUSSIAN ELIMINATION WITH PARCIAL PIVOTING

Input: A, b
Output: x
  $n \leftarrow size(A, 1)$
  $M \leftarrow [Ab]$
  For $i \leftarrow 1, n-1$ **do**
    $[aux0, aux] \leftarrow max|M(i+1:n, 1)|$
    if $aux_0 > |M(i,i)|$ **Then**
      $aux_2 \leftarrow M(i+aux, i:n+1)$
      $M(aux+i, i:n+1) \leftarrow M(i, i:n+1)$
      $M(i, i:n+1) \leftarrow aux_2$
    End if
    For $j \leftarrow i+1, n$ **do**
      if $M(j,i) \neq 0$ **Then**
        $M(j, i:n+1) \leftarrow M(j, i:n+1) - (M(j,i)/M(i,i)) * M(i, i:n+1)$
      End if
    End For
  End For
  $x \leftarrow backsubstitution(M)$
  Return x

Algorithm 10 LU SIMPLE

Input: U, a, L, Z, Y

Output: x

```
if n = m Then
  d ←= diag(a)
  For j ← 1, n − 1 do
    For i ← 1, m do
      if d(i) = 0 Then
        The matrix has zeros on the diagonal, so please make a change of rows
      End if
    End For
  End For
End if
if U(k, k) ≠ 0 Then
  For i ← (k + 1), n do
    m(i, k) ← U(i, k)/U(k, k)
    For j ← k, n do
      U(i, j) ← U(i, j) − m(i, k) ∗ U(k, j)
      if i > j Then
        L(i, j) ← m(i, k)
      End if
      if i == j Then
        L(i, j) ← 1
      End if
      if i < j Then
        L(i, j) ← 0
      End if
    End For
  End For
End if
if U(1, 1) ≠ 0 Then
  Z(1) ← b(1)/L(1, 1)
  For i ← 2, n do
    Z(i) ← (b(i) − L(i, 1 : i − 1) ∗ Z(1 : i − 1))/L(i, i)
  End For
End if
if U(1, 1) ≠ 0 Then
  X(n) ← Z(n)/U(n, n)
  For k ← n − 1 : −1 : 1 do
    X(k) ← (Z(k) − U(k, k + 1 : n) ∗ X(k + 1 : n))/U(k, k)
  End For
End if
Return x
```

Algorithm 11 LU PAR

Input: A, b

Output: L, Pb, d, x

```
[m, n] ← A
For k ← 1, n do
   [pm] ← max(|U(k : n, k)|)
   m ← m + k − 1
   if m ≠ k Then
      temp ← U(k, :)
      U(k, :) ← U(m, :)
      temp ← P(k, :)
      P(k, :) ← P(m, :
      P(m, :) ← temp
      if k > 2 Then
         temp ← L(k, 1 : k − 1)
         L(k, 1 : k − 1) ← L(m, 1 : k − 1)
         L(m, 1 : k − 1) ← temp
      End if
      For j ← k + 1, n do
         L(j, k) ← U(j, k)/U(k, k)
         U(j :) ← U(j, :) − L(j, k) ∗ U(k :)
      End For
   End if
End For
P_b ← P ∗ b
d ← L\Pb
x ← U\d
Return  L, P_b, d, x
```

Algorithm 12 Crout

Input: A, b
Output: x

$[n, m] \leftarrow size(A)$
if $n == a$ **Then**
  For $k \leftarrow 1, n$ **do**
    $u(k, k) \leftarrow 1$
    $addition \leftarrow 0$
    For $p \leftarrow 1, k - 1$ **do**
      $addition \leftarrow addition + L(k, p) * u(p, k)$
    End For
    $L(k, k) \leftarrow A(k, k) - addition$
    For $i \leftarrow k + 1, n$ **do**
      $addition \leftarrow 0$
      For $r \leftarrow 1, k + 1$ **do**
        $addition \leftarrow addition + L(i, r) * u(r, k)$
      End For
      $L(i, k) \leftarrow A(i, k) - addition$
    End For
    For $j \leftarrow k + 1, n$ **do**
      $addition \leftarrow 0$
      $addition \leftarrow addition + L(k, s) * u(s, j)$
    End For
    $u(k, j) \leftarrow A(k, j) - addition/L(k, k)$
  End For
End if
$memU \leftarrow 1$
$memL \leftarrow 1$
For $i \leftarrow 1, n$ **do**
  $memL \leftarrow memL * L(i, i)$
End For
$product \leftarrow memL * memU$
if $product \neq 0$ **Then**
  For $i \leftarrow 1, n$ **do**
    $addition \leftarrow 0$
    For $p \leftarrow 1, i - 1$ **do**
      $addition \leftarrow addition + L(i, p) * z(p)$
    End For
    $z(i) \leftarrow (b(i) - addition)/L(i, i)$
  End For
  For $i \leftarrow n, -1 : 1$ **do**
    $addition \leftarrow 0$
    For $p \leftarrow (i + 1), n$ **do**
      $addition \leftarrow addition + u(i, p) * x(p)$
    End For
    $x(i) \leftarrow (z(i) - addition)/U(i, i)$
  End For
End if
Return x

Algorithm 13 Doolittle

Input: A, b

Output: x

```
[a, m] ← size(A)
Ab ← [A, b]
if n == m Then
  For k ← 1, n do
    L(k, k) ←
    addition ← 0
    For p ← 1, k − 1 do
      addition ← addition + L(k, p) ∗ u(p, k)
    End For
    u(k, k) ← (A(k, k) − addition)
    For i ← k + 1, n do
      addition ← 0
      For r ← 1, k + 1 do
        addition ← addition + L(i, r) ∗ u(r, k)
      End For
      L(i, k) ← (A(i, k) − addition)/u(k, k)
    End For
    For j ← k + 1, n do
      addition ← 0
      For s ← 1, k + 1 do
        addition ← 0
        For s ← 1, k − 1 do
          addition ← addition + L(k, s) ∗ u(s, j)
        End For
        u(k, j) ← (A(k, j) − addition)
      End For
    End For
    memU ← 1
    memL ← 1
    For i ← 1, n do
      memU ← memU ∗ i(i, i)
    End For
    product ← memL ∗ memU
    if product ≠ 0 Then
      For i ← 1, n do
        addition ← 0
        For p ← 1, i − 1 do
          addition ← addition + L(i, p) ∗ z(p)
        End For
        z(i) = (b(i) − addition)/L(i, i)
      End For
      For i ← n − 1, 1 do
        addition ← 0
        For p ← i + 1, n do
          addition ← addition + u(i, p) ∗ x(p)
        End For
        x(i) ← (z(i) − addition)/u(i, i)
      End For
    else if
      The determinant is equal to zero, so the system has infinite or no solutions.
    End if
  End For
End if
Return x
```

Algorithm 14 Cholesky

Input: A, b
Output: x

```
[n, m] ← size(A)
For k ← 1, n do
  cont ← 0
  For p ← 1, k − 1 do
    cont ← cont + L(k, p) ∗ U(p, k)
  End For
  L(k, k) ← √(A(k, k) − cont)
  U(k, k) ← L(k, k)
  For i ← a, n do
    cont2 ← 0
    For p ← 1, k − 1 do
      cont2 ← cont2 + L(i, p) ∗ U(p, k)
    End For
    L(i, k) ← (A(i, k) − cont2)/L(k, k)
  End For
  For j ← k, n do
    cont3 ← 0
    For p ← 1, k − 1 do
      cont3 ← cont3 + L(k, p) ∗ U(p, j)
    End For
    U(k, j) ← (A(k, j) − cont3)/L(k, k)
  End For
End For
The augmented matrix [L,b] is shown
For i ← 1, n do
  sum ← 0
  For p ← 1, i − 1 do
    sum ← sum + Lb(i, p) ∗ z(p, 1)
  End For
  z(i, 1) ← (Lb(i, n + 1) − sum)/Lb(i, i)
End For
For i ← n, −1 : 1 do
  sum ← 0
  For p ← i + 1, n do
    sum ← sum + UB(i, p) ∗ X(p.1)
  End For
  X(i, 1) ← (UB(i, n + 1) − sum)/UB(i, i)
End For
Return X
```

Algorithm 15 Jacobi

Input: A, b, x_0, tol, N_max

Output: $x, iter, err$

$D \leftarrow diag(diag(A))$
$L \leftarrow -tril(A) + D$
$U \leftarrow -triu(A) + D$
$T \leftarrow inv(D) * (L + U)$
$C \leftarrow inv(D) * b$
$x_{ant} \leftarrow x_0$
$E \leftarrow 1000$
$cont \leftarrow 0$
$n \leftarrow size(A, 1)$
$n_1 \leftarrow size(T, 1)$
$n_2 \leftarrow size(C, 1)$
$specratio \leftarrow max(|eig(T)|)$
While $E > tol \ \ \& \ \ cont < N_max$ **do**
  $x_{act} \leftarrow T * x_{ant} + C$
  $E \leftarrow norm(x_{a_t - x_{a_t)}}$
  $x_{ant} \leftarrow x_{act}$
  $cont \leftarrow cont + 1$
End While
$x \leftarrow x_a - c_t$
$iter \leftarrow cont$
$err \leftarrow E$
Return $x, iter, err$

Algorithm 16 Gauss-Seidel

Input: A, b, x_0, tol, N_max
Output: $x, iter, err$
$D \leftarrow diag(diag(A))$
$L \leftarrow -tril(A) + D$
$U \leftarrow -triu(A) + D$
$T \leftarrow inv(D - L) * (U)$
$C \leftarrow inv(D - L) * b$
$x_{ant} \leftarrow x_0$
$E \leftarrow 1000$
$cont \leftarrow 0$
$n \leftarrow size(A, 1)$
$n_1 \leftarrow size(T, 1)$
$n_2 \leftarrow size(C, 1)$
$specratio \leftarrow max(|eig(T)|)$
While $E > tol$ & $cont < N_max$ **do**
  $x_{act} \leftarrow T * x_{ant} + C$
  $E \leftarrow norm(x_{a_t - x_{a_t})}$
  $x_{ant} \leftarrow x_{act}$
  $cont \leftarrow cont + 1$
End While
$x \leftarrow x_a - c_t$
$iter \leftarrow cont$
$err \leftarrow E$
Return $x, iter, err$

Algorithm 17 SOR

Input: A, b, w, x_0, tol, N_max

Output: $x, iter, err$

$D \leftarrow diag(diag(A))$
$L \leftarrow -tril(A) + D$
$U \leftarrow -triu(A) + D$
$T \leftarrow inv(D - w * L) * ((1 - w) * D + w * U)$
$C \leftarrow inv(D - w * L) * b$
$x_{ant} \leftarrow x_0$
$E \leftarrow 1000$
$cont \leftarrow 0$
$n \leftarrow size(A, 1)$
$n_1 \leftarrow size(T, 1)$
$n_2 \leftarrow size(C, 1)$
$specratio \leftarrow max(|eig(T)|)$
While $E > tol$ & $cont < N_max$ **do**
  $x_{act} \leftarrow T * x_{ant} + C$
  $E \leftarrow norm(x_{a_t - x_{a_t})}$
  $x_{ant} \leftarrow x_{act}$
  $cont \leftarrow cont + 1$
End While
$x \leftarrow x_a - c_t$
$iter \leftarrow cont$
$err \leftarrow E$
Return $x, iter, err$

Algorithm 18 jacobi

Input: X, Y

Output: $Coef, A, M$

$n \leftarrow length(X)$
$A \leftarrow zeros(n)$
$M \leftarrow []$
For $i \leftarrow 1, n$ **do**
  $A(:, i) \leftarrow (X.^(n - i))$
End For
$Coef \leftarrow A \backslash Y'$
Return $Coef, A, M$

Algorithm 19 Newton split differences

Input: X, Y
Output: $Coef, M$
  $n \leftarrow length(X)$
  $A \leftarrow zeros(n)$
  $D(:, 1) \leftarrow Y$
  For $i \leftarrow 2, n$ **do**
    $aux0 \leftarrow D(i - 1 : n, i - 1)$
    $aux \leftarrow diff(aux0)$
    $aux2 \leftarrow X(i : n) - X(1 : n - i + 1)$
    $D(i : n, i) \leftarrow aux./aux2'$
  End For
  $M \leftarrow D$
  $Coef \leftarrow diag(D)$
  Return $Coef, M$

Algorithm 20 Lagrangre

Input: X, Y
Output: $L, Coef$
  $n \leftarrow length(X)$
  $L \leftarrow zeros(n)$
  For $i \leftarrow 1, n$ **do**
    $aux_0 \leftarrow setdiff(X, X(i))$
    $aux \leftarrow [1 - aux0(1)]$
    For $[1 - aux_0(1)]$ **do**
      $aux \leftarrow conv(aux.[aux_0(j)])$
    End For
    $L(i, :) \leftarrow aux/polyval(aux, X(i))$
  End For
  $Coef \leftarrow Y * L$
  Return $L, Coef$

Algorithm 21 Linear spline

Input: X, Y

Output: $Coef, A, b, M$

$n \leftarrow length(X)$
$m \leftarrow 2 * (n-1)$
$A \leftarrow zeros(m)$
$b(m, 1)$
$Coef \leftarrow zeros(n-1, 2)$
$M \leftarrow []$
For $i \leftarrow 1, length(X) - 1$ **do**
    $A(i+1, [2*i-12*i]) \leftarrow [X(i+1)1]$
    $b(i+1) \leftarrow Y(i+1)$
End For
$A(1, [12]) \leftarrow [x(1)1]$
$b(1) \leftarrow Y(1)$
For $i \leftarrow 2, length(X) - 1$ **do**
    $A(length(X) - 1 + i, 2*i-3 : 2*i) \leftarrow [X(i)1 - X(i) - 1]$
    $b(length(X) - 1 + i) \leftarrow 0$
End For
$Saux = A\backslash b;$
For $i \leftarrow 1, length(X) - 1$ **do**
    $Coef(i, :) \leftarrow Saux([2*i-12*i])$
End For
Return $Coef, A, b, M$

Algorithm 22 Quadratic spline

Input: X, Y

Output: $Coef, A, b, M$

$n \leftarrow length(X)$

$m \leftarrow 3 * (n - 1)$

$A \leftarrow zeros(m)$

$b(m, 1)$

$Coef \leftarrow zeros(n - 1, 3)$

$M \leftarrow []$

For $i \leftarrow 1, length(X) - 1$ **do**

$A(i + 1, 3 * i - 2 : 3 * i]) \leftarrow [X(i + 1)^2 X(i + 1)1]$

$b(i + 1) \leftarrow Y(i + 1)$

End For

$A(1, 1 : 3) \leftarrow [x(1)^2 X(1)^1 1]$

$b(1) \leftarrow Y(1)$

For $i \leftarrow 2, length(X) - 1$ **do**

$A(length(X) - 1 + i, 3 * i - 5 : 3 * i) \leftarrow [X(i)^2 - X(i)1 - X(1)^2 - X(i) - 1]$

$b(length(X) - 1 + i) \leftarrow 0$

End For

For $i \leftarrow 2, length(X) - 1$ **do**

$A(2 * n - 3 + i, 3 * i - 5 : 3 * i :) \leftarrow [2 * X(i)10 - 2 * X(i) - 10]$

End For

$A(m, 1) \leftarrow 2$

$b(m) \leftarrow 0$

$Saux = A \backslash b;$

For $i \leftarrow 1, length(X) - 1$ **do**

$Coef(i, :) \leftarrow Saux([3 * i - 23 * i])$

End For

Return $Coef, A, b, M$

Algorithm 23 Cubic spline

Input: X, Y

Output: $Coef, A, b, M$

$n \leftarrow length(X)$
$m \leftarrow 4 * (n-1)$
$A \leftarrow zeros(m)$
$b(m, 1)$
$Coef \leftarrow zeros(n-1, 4)$
$M \leftarrow []$
For $i \leftarrow 1, length(X) - 1$ **do**
  $A(i+1, 4*i-3 : 4*i]) \leftarrow [X(i+1)^3 X(i+1)1]$
  $b(i+1) \leftarrow Y(i+1)$
End For
$A(1, 1:4) \leftarrow [x(1)^3 X(1)^2 1]$
$b(1) \leftarrow Y(1)$
For $i \leftarrow 2, length(X) - 1$ **do**
  $A(length(X) - 1 + i, 4*i-7 : 4*i) \leftarrow [X(i)^3 X(i)^2 X(i) 1 - X(i)^3 - X(i)^2 - X(i) - 1]$
  $b(length(X) - 1 + i) \leftarrow 0$
End For
For $i \leftarrow 2, length(X) - 1$ **do**
  $A(2*n-3+i, 4*i-7 : 4*i :) \leftarrow [3*X(i)^2 2*X(i) 10 - 3*X(i)^2 - 10]$
End For
For $i \leftarrow 1, length(X) - 1$ **do**
  $A(3*n-5+i, 4*i-7 : 4*i :) \leftarrow [6*X(i) 200 - 6*X(i) - 200]$
  $b(n+5+i) \leftarrow 0$
End For
$A(m-1, 1:2) \leftarrow [6*X(1)2]$
$b(m-1) \leftarrow 0$
$A(m, m-3 : m-2) \leftarrow [6*X(end)2]$
$b(m) \leftarrow 0$
$Saux = A \backslash b;$
For $i \leftarrow 1, length(X) - 1$ **do**
  $Coef(i, :) \leftarrow Saux([4*i-3 : 4*i])$
End For
Return $Coef, A, b, M$

Simple LU

```
Etapa 1

L:
 1.000000  0.000000  0.000000  0.000000
 0.250000  1.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000
 3.500000  0.000000  0.000000  1.000000

U:
 4.000000  -1.000000  0.000000  3.000000
 0.000000  15.750000  3.000000  7.250000
 0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000

Etapa 2

L:
 1.000000  0.000000  0.000000  0.000000
 0.250000  1.000000  0.000000  0.000000
 0.000000  -0.082540  1.000000  0.000000
 3.500000  0.539683  0.000000  1.000000

U:
 4.000000  -1.000000  0.000000  3.000000
 0.000000  15.750000  3.000000  7.250000
 0.000000  0.000000  -3.752381  1.698413
 0.000000  0.000000  0.000000  0.000000

Etapa 3

L:
 1.000000  0.000000  0.000000  0.000000
 0.250000  1.000000  0.000000  0.000000
 0.000000  -0.082540  1.000000  0.000000
 3.500000  0.539683  0.964467  1.000000

U:
 4.000000  -1.000000  0.000000  3.000000
 0.000000  15.750000  3.000000  7.250000
 0.000000  0.000000  -3.752381  1.698413
 0.000000  0.000000  0.000000  13.949239

Etapa 4

L:
 1.000000  0.000000  0.000000  0.000000
 0.250000  1.000000  0.000000  0.000000
 0.000000  -0.082540  1.000000  0.000000
 3.500000  0.539683  0.964467  1.000000

U:
 4.000000  -1.000000  0.000000  3.000000
 0.000000  15.750000  3.000000  7.250000
 0.000000  0.000000  -3.752381  1.698413
 0.000000  0.000000  0.000000  13.949239


z:
 1.000000  0.750000  1.061905  -3.928934


x:
 0.525109  0.255459  -0.410480  -0.281659
```

Partial LU

```
Etapa 1

L:
 1.000000  0.000000  0.000000  0.000000
 0.071429  1.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000
 0.285714  0.000000  0.000000  1.000000

U:
 14.000000  5.000000  -2.000000  30.000000
 0.000000  15.142857  3.142857  5.857143
 0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000

Etapa 2

L:
 1.000000  0.000000  0.000000  0.000000
 0.071429  1.000000  0.000000  0.000000
 0.000000  -0.085849  1.000000  0.000000
 0.285714  -0.160377  0.000000  1.000000

U:
 14.000000  5.000000  -2.000000  30.000000
 0.000000  15.142857  3.142857  5.857143
 0.000000  0.000000  -3.730189  1.602830
 0.000000  0.000000  0.000000  0.000000

Etapa 3

L:
 1.000000  0.000000  0.000000  0.000000
 0.071429  1.000000  0.000000  0.000000
 0.000000  -0.085849  1.000000  0.000000
 0.285714  -0.160377  -0.288316  1.000000

U:
 14.000000  5.000000  -2.000000  30.000000
 0.000000  15.142857  3.142857  5.857143
 0.000000  0.000000  -3.730189  1.602830
 0.000000  0.000000  0.000000  -4.169954

Etapa 4

L:
 1.000000  0.000000  0.000000  0.000000
 0.071429  1.000000  0.000000  0.000000
 0.000000  -0.085849  1.000000  0.000000
 0.285714  -0.160377  -0.288316  1.000000

U:
 14.000000  5.000000  -2.000000  30.000000
 0.000000  15.142857  3.142857  5.857143
 0.000000  0.000000  -3.730189  1.602830
 0.000000  0.000000  0.000000  -4.169954


z:
 1.000000  0.928571  1.079717  1.174507


x:
 0.525109  0.255459  -0.410480  -0.281659
```

Crout

```
Etapa 1

L:
 4.000000  0.000000  0.000000  0.000000
 1.000000  1.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000
 14.000000  0.000000  0.000000  1.000000

U:
 1.000000  -0.250000  0.000000  0.750000
 0.000000  1.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000
 0.000000  0.000000  0.000000  1.000000

Etapa 2

L:
 4.000000  0.000000  0.000000  0.000000
 1.000000  15.750000  0.000000  0.000000
 0.000000  -1.300000  1.000000  0.000000
 14.000000  8.500000  0.000000  1.000000

U:
 1.000000  -0.250000  0.000000  0.750000
 0.000000  1.000000  0.190476  0.460317
 0.000000  0.000000  1.000000  0.000000
 0.000000  0.000000  0.000000  1.000000

Etapa 3

L:
 4.000000  0.000000  0.000000  0.000000
 1.000000  15.750000  0.000000  0.000000
 0.000000  -1.300000  -3.752381  0.000000
 14.000000  8.500000  -3.619048  1.000000

U:
 1.000000  -0.250000  0.000000  0.750000
 0.000000  1.000000  0.190476  0.460317
 0.000000  0.000000  1.000000  -0.452623
 0.000000  0.000000  0.000000  1.000000

Etapa 4

L:
 4.000000  0.000000  0.000000  0.000000
 1.000000  15.750000  0.000000  0.000000
 0.000000  -1.300000  -3.752381  0.000000
 14.000000  8.500000  -3.619048  13.949239

U:
 1.000000  -0.250000  0.000000  0.750000
 0.000000  1.000000  0.190476  0.460317
 0.000000  0.000000  1.000000  -0.452623
 0.000000  0.000000  0.000000  1.000000


z:
 0.250000  0.047619  -0.282995  -0.281659


x:
 0.525109  0.255459  -0.410480  -0.281659
```

Doolittle

```
Etapa 1

L:
 1.000000  0.000000  0.000000  0.000000
 0.250000  1.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000
 3.500000  0.000000  0.000000  1.000000

U:
 4.000000  -1.000000  0.000000  3.000000
 0.000000  1.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000
 0.000000  0.000000  0.000000  1.000000

Etapa 2

L:
 1.000000  0.000000  0.000000  0.000000
 0.250000  1.000000  0.000000  0.000000
 0.000000  -0.082540  1.000000  0.000000
 3.500000  0.539683  0.000000  1.000000

U:
 4.000000  -1.000000  0.000000  3.000000
 0.000000  15.750000  3.000000  7.250000
 0.000000  0.000000  1.000000  0.000000
 0.000000  0.000000  0.000000  1.000000

Etapa 3

L:
 1.000000  0.000000  0.000000  0.000000
 0.250000  1.000000  0.000000  0.000000
 0.000000  -0.082540  1.000000  0.000000
 3.500000  0.539683  0.964467  1.000000

U:
 4.000000  -1.000000  0.000000  3.000000
 0.000000  15.750000  3.000000  7.250000
 0.000000  0.000000  -3.752381  1.698413
 0.000000  0.000000  0.000000  1.000000

Etapa 4

L:
 1.000000  0.000000  0.000000  0.000000
 0.250000  1.000000  0.000000  0.000000
 0.000000  -0.082540  1.000000  0.000000
 3.500000  0.539683  0.964467  1.000000

U:
 4.000000  -1.000000  0.000000  3.000000
 0.000000  15.750000  3.000000  7.250000
 0.000000  0.000000  -3.752381  1.698413
 0.000000  0.000000  0.000000  13.949239


z:
 1.000000  0.750000  1.061905  -3.928934


x:
 0.525109  0.255459  -0.410480  -0.281659
```

Cholesky

```
Etapa 1

L:
 2.000000  0.000000  0.000000  0.000000
 0.500000  1.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000
 7.000000  0.000000  0.000000  1.000000

U:
 2.000000  -0.500000  0.000000  1.500000
 0.000000  1.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000
 0.000000  0.000000  0.000000  1.000000

Etapa 2

L:
 2.000000  0.000000  0.000000  0.000000
 0.500000  3.968627  0.000000  0.000000
 0.000000  -0.327569  1.000000  0.000000
 7.000000  2.141799  0.000000  1.000000

U:
 2.000000  -0.500000  0.000000  1.500000
 0.000000  3.968627  0.755929  1.826828
 0.000000  0.000000  1.000000  0.000000
 0.000000  0.000000  0.000000  1.000000

Etapa 3

L:
 2.000000  0.000000  0.000000  0.000000
 0.500000  3.968627  0.000000  0.000000
 0.000000  -0.327569  0.000000  0.000000
 7.000000  2.141799  0.000000  1.000000

U:
 2.000000  -0.500000  0.000000  1.500000
 0.000000  3.968627  0.755929  1.826828
 0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  1.000000

Etapa 4

L:
 2.000000  0.000000  0.000000  0.000000
 0.500000  3.968627  0.000000  0.000000
 0.000000  -0.327569  0.000000  0.000000
 7.000000  2.141799  0.000000  3.734868

U:
 2.000000  -0.500000  0.000000  1.500000
 0.000000  3.968627  0.755929  1.826828
 0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  3.734868


z:
 0.500000  0.188982  0.000000  -1.051961


x:
 0.525109  0.255459  -0.410480  -0.281659
```

Jacobi Initial Phase

```
D:
 4.000000  0.000000  0.000000  0.000000
 0.000000  15.500000  0.000000  0.000000
 0.000000  0.000000  -4.000000  0.000000
 0.000000  0.000000  0.000000  30.000000

L:
 0.000000  0.000000  0.000000  0.000000
 -1.000000  0.000000  0.000000  0.000000
 0.000000  1.300000  0.000000  0.000000
 -14.000000  -5.000000  2.000000  0.000000

U:
 0.000000  1.000000  0.000000  -3.000000
 0.000000  0.000000  -3.000000  -8.000000
 0.000000  0.000000  0.000000  -1.100000
 0.000000  0.000000  0.000000  0.000000

T:
 0.000000  0.250000  0.000000  -0.750000
 -0.064516  0.000000  -0.193548  -0.516129
 0.000000  -0.325000  0.000000  0.275000
 -0.466667  -0.166667  0.066667  0.000000

C:
 0.250000  0.064516  -0.250000  0.033333


Spectral Radio (T): 0.753517

Euclidean Norm (A): 35.430911
```

Jacobi Itaretions 1

```
x(1): 1.000000  1.000000  1.000000  1.000000
x(2): -0.250000  -0.709677  -0.300000  -0.533333
x(3): 0.472581  0.413978  -0.166022  0.248280
x(4): 0.167285  -0.061984  -0.316266  -0.267269
x(5): 0.434956  0.252882  -0.303354  -0.055487
x(6): 0.354835  0.123806  -0.347445  -0.232016
x(7): 0.454964  0.228621  -0.354042  -0.176054
x(8): 0.439196  0.194554  -0.372717  -0.240690
x(9): 0.479156  0.232547  -0.379420  -0.228898
x(10): 0.479810  0.225180  -0.388525  -0.254325
x(11): 0.497039  0.240024  -0.393123  -0.254010
x(12): 0.500513  0.239639  -0.397860  -0.264830
x(13): 0.508532  0.245917  -0.400711  -0.266703
x(14): 0.511507  0.246918  -0.403266  -0.271682
x(15): 0.515491  0.249790  -0.404961  -0.273407
x(16): 0.517503  0.250752  -0.406369  -0.275858
x(17): 0.519582  0.252159  -0.407355  -0.277051
x(18): 0.520828  0.252832  -0.408141  -0.278322
x(19): 0.521949  0.253559  -0.408709  -0.279068
x(20): 0.522691  0.253982  -0.409150  -0.279750
x(21): 0.523308  0.254372  -0.409475  -0.280196
x(22): 0.523740  0.254625  -0.409725  -0.280571
x(23): 0.524084  0.254839  -0.409910  -0.280831
x(24): 0.524333  0.254987  -0.410051  -0.281040
x(25): 0.524527  0.255106  -0.410157  -0.281190
x(26): 0.524669  0.255191  -0.410237  -0.281307
x(27): 0.524778  0.255258  -0.410297  -0.281393
x(28): 0.524859  0.255307  -0.410342  -0.281459
x(29): 0.524921  0.255345  -0.410376  -0.281508
x(30): 0.524967  0.255372  -0.410402  -0.281546
x(31): 0.525002  0.255394  -0.410421  -0.281574
x(32): 0.525029  0.255410  -0.410436  -0.281595
x(33): 0.525049  0.255422  -0.410447  -0.281611
x(34): 0.525063  0.255431  -0.410455  -0.281623
```

Jacobi Iterations 2

```
x(35): 0.525075  0.255438  -0.410461  -0.281632
x(36): 0.525083  0.255443  -0.410466  -0.281639
x(37): 0.525090  0.255447  -0.410470  -0.281644
x(38): 0.525094  0.255450  -0.410472  -0.281648
x(39): 0.525098  0.255452  -0.410474  -0.281650
x(40): 0.525101  0.255453  -0.410476  -0.281653
x(41): 0.525103  0.255455  -0.410477  -0.281654
x(42): 0.525104  0.255456  -0.410478  -0.281656
x(43): 0.525106  0.255456  -0.410478  -0.281657
x(44): 0.525106  0.255457  -0.410479  -0.281657
x(45): 0.525107  0.255457  -0.410479  -0.281658
x(46): 0.525108  0.255458  -0.410480  -0.281658
x(47): 0.525108  0.255458  -0.410480  -0.281658
x(48): 0.525108  0.255458  -0.410480  -0.281659
x(49): 0.525109  0.255458  -0.410480  -0.281659
x(50): 0.525109  0.255458  -0.410480  -0.281659
x(51): 0.525109  0.255458  -0.410480  -0.281659
x(52): 0.525109  0.255458  -0.410480  -0.281659
x(53): 0.525109  0.255458  -0.410480  -0.281659
x(54): 0.525109  0.255458  -0.410480  -0.281659

x:
 0.525109  0.255458  -0.410480  -0.281659

Error:
 7.93e-08
```

Gauss Seide Initial Phase

```
D:
 4.000000  0.000000  0.000000  0.000000
 0.000000  15.500000  0.000000  0.000000
 0.000000  0.000000  -4.000000  0.000000
 0.000000  0.000000  0.000000  30.000000

L:
 0.000000  0.000000  0.000000  0.000000
 -1.000000  0.000000  0.000000  0.000000
 0.000000  1.300000  0.000000  0.000000
 -14.000000  -5.000000  2.000000  0.000000

U:
 0.000000  1.000000  0.000000  -3.000000
 0.000000  0.000000  -3.000000  -8.000000
 0.000000  0.000000  0.000000  -1.100000
 0.000000  0.000000  0.000000  0.000000

T:
 0.000000  0.250000  0.000000  -0.750000
 0.000000  -0.016129  -0.193548  -0.467742
 0.000000  0.005242  0.062903  0.427016
 0.000000  -0.113629  0.036452  0.456425

C:
 0.250000  0.048387  -0.265726  -0.109113


Spectral Radio: 0.599488

Euclidean Norm (A): 35.430911
```

Gauss Seidel Iterations 1

```
x(1): 1.000000  1.000000  1.000000  1.000000
x(2): -0.250000  -0.629032  0.229435  0.270134
x(3): -0.109859  -0.112227  -0.139239  0.094023
x(4): 0.151426  0.033168  -0.234923  -0.058522
x(5): 0.302183  0.120694  -0.305319  -0.148156
x(6): 0.391291  0.174833  -0.347564  -0.201579
x(7): 0.444892  0.207124  -0.372750  -0.233654
x(8): 0.477021  0.226481  -0.387861  -0.252881
x(9): 0.496281  0.238087  -0.396921  -0.264407
x(10): 0.507827  0.245045  -0.402351  -0.271317
x(11): 0.514749  0.249215  -0.405607  -0.275459
x(12): 0.518898  0.251716  -0.407559  -0.277942
x(13): 0.521386  0.253215  -0.408729  -0.279431
x(14): 0.522877  0.254113  -0.409430  -0.280324
x(15): 0.523771  0.254652  -0.409851  -0.280859
x(16): 0.524307  0.254975  -0.410103  -0.281179
x(17): 0.524628  0.255169  -0.410254  -0.281372
x(18): 0.524821  0.255285  -0.410345  -0.281487
x(19): 0.524936  0.255354  -0.410399  -0.281556
x(20): 0.525006  0.255396  -0.410432  -0.281597
x(21): 0.525047  0.255421  -0.410451  -0.281622
x(22): 0.525072  0.255436  -0.410463  -0.281637
x(23): 0.525087  0.255445  -0.410470  -0.281646
x(24): 0.525096  0.255450  -0.410474  -0.281651
```

Gauss Seidel Iterations 2

```
x(25): 0.525101  0.255454  -0.410477  -0.281655

x(26): 0.525104  0.255456  -0.410478  -0.281657

x(27): 0.525106  0.255457  -0.410479  -0.281658

x(28): 0.525107  0.255457  -0.410480  -0.281658

x(29): 0.525108  0.255458  -0.410480  -0.281659

x(30): 0.525109  0.255458  -0.410480  -0.281659

x(31): 0.525109  0.255458  -0.410480  -0.281659

x(32): 0.525109  0.255458  -0.410480  -0.281659

x(33): 0.525109  0.255458  -0.410480  -0.281659

x(34): 0.525109  0.255458  -0.410480  -0.281659


x:
 0.525109  0.255458  -0.410480  -0.281659

Error:
 7.47e-08
```

SOR Initial Phase

```
D:
 4.000000  0.000000  0.000000  0.000000
 0.000000  15.500000  0.000000  0.000000
 0.000000  0.000000  -4.000000  0.000000
 0.000000  0.000000  0.000000  30.000000

L:
 0.000000  0.000000  0.000000  0.000000
 -1.000000  0.000000  0.000000  0.000000
 0.000000  1.300000  0.000000  0.000000
 -14.000000  -5.000000  2.000000  0.000000

U:
 0.000000  1.000000  0.000000  -3.000000
 0.000000  0.000000  -3.000000  -8.000000
 0.000000  0.000000  0.000000  -1.100000
 0.000000  0.000000  0.000000  0.000000

T:
 -0.500000  0.375000  0.000000  -1.125000
 0.048387  -0.536290  -0.290323  -0.665323
 -0.023589  0.261442  -0.358468  0.736845
 0.335544  -0.102283  0.036734  0.527515

C:
 0.375000  0.060484  -0.404486  -0.268070


Spectral Radio: 0.631208

Euclidean Norm (A): 35.430911
```

SOR Iterations 2

```
x(31): 0.525109  0.255460  -0.410481  -0.281659

x(32): 0.525110  0.255458  -0.410480  -0.281660

x(33): 0.525109  0.255459  -0.410481  -0.281659

x(34): 0.525109  0.255458  -0.410480  -0.281659

x(35): 0.525109  0.255459  -0.410481  -0.281659

x(36): 0.525109  0.255459  -0.410480  -0.281659

x(37): 0.525109  0.255458  -0.410480  -0.281659

x(38): 0.525109  0.255459  -0.410480  -0.281659

x(39): 0.525109  0.255458  -0.410480  -0.281659


x:
 0.525109  0.255458  -0.410480  -0.281659

Error:
 8.45e-08
```

Vandermonde

```
A:
 -1.000000  1.000000  -1.000000  1.000000
 0.000000  0.000000  0.000000  1.000000
 27.000000  9.000000  3.000000  1.000000
 64.000000  16.000000  4.000000  1.000000

Coef:
 -1.141667  5.825000  -5.533333  3.000000
```

Newton

```
D:
 15.500000  0.000000  0.000000  0.000000
 3.000000  -12.500000  0.000000  0.000000
 8.000000  1.666667  3.541667  0.000000
 1.000000  -7.000000  -2.166667  -1.141667

Coef:
 15.500000  -12.500000  3.541667  -1.141667
```

Lagrange

```
L:
 -0.050000  0.350000  -0.600000  -0.000000
 0.083333  -0.500000  0.416667  1.000000
 -0.083333  0.250000  0.333333  -0.000000
 0.050000  -0.100000  -0.150000  0.000000

Coef:
 -1.141667  5.825000  -5.533333  3.000000
```

Lineal Spline

```
A:
 -1.000000  1.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  1.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  3.000000  1.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000  4.000000  1.000000
 0.000000  1.000000  -0.000000  -1.000000  0.000000  0.000000
 0.000000  0.000000  3.000000  1.000000  -3.000000  -1.000000

Coef:
 -12.500000  3.000000
 1.666667  3.000000
 -7.000000  29.000000
```

Cuadratic Spline

```
A:
 1.000000  -1.000000  1.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  1.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  9.000000  3.000000  1.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  16.000000  4.000000  1.000000
 0.000000  0.000000  1.000000  -0.000000  -0.000000  -1.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  9.000000  3.000000  1.000000  -9.000000  -3.000000  -1.000000
 0.000000  1.000000  0.000000  -0.000000  -1.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  6.000000  1.000000  0.000000  -6.000000  -1.000000  0.000000
 2.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000

Coef:
 0.000000  -12.500000  3.000000
 4.722222  -12.500000  3.000000
 -22.833333  152.833333  -245.000000
```

Cubi Spline

```
A:
 -1.000000  1.000000  -1.000000  1.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  1.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000  27.000000  9.000000  3.000000  1.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  64.000000  16.000000  4.000000  1.000000
 0.000000  0.000000  0.000000  1.000000  -0.000000  -0.000000  -0.000000  -1.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000  27.000000  9.000000  3.000000  1.000000  -27.000000  -9.000000  -3.000000  -1.000000
 0.000000  0.000000  1.000000  0.000000  -0.000000  -0.000000  -1.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000  27.000000  6.000000  1.000000  0.000000  -27.000000  -6.000000  -1.000000  0.000000
 0.000000  2.000000  0.000000  0.000000  -0.000000  -2.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000  18.000000  2.000000  0.000000  0.000000  -18.000000  -2.000000  0.000000  0.000000
 -6.000000  2.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
 0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  24.000000  2.000000  0.000000  0.000000

Coef:
 2.533333  7.600000  -7.433333  3.000000
 -1.522222  7.600000  -7.433333  3.000000
 2.033333  -24.400000  88.566667  -93.000000
```