

Practical 7

SOR Method

SOR method with number of iterations as stopping criteria:

Q1. Use the SOR iteration method to solve the system of equations in 7 iterations

$$4x_1 - 2x_2 + 0x_3 = 8$$

$$-2x_1 + 6x_2 - 5x_3 = -29$$

$$0x_1 - 5x_2 + 11x_3 = 43$$

with the initial vector $x^{(0)} = (0, 0, 0)$.

```
w = 1.2;
SOR[A0_, B0_, X0_, max_] :=
Module[{A = N[A0], B = N[B0], i, j, k = 0, n = Length[X0], X = X0, Xk = X0},
Print["X"0, "=", X];
While[k < max,
For[i = 1, i ≤ n, i++,
X[[i]] = (1 - w) X[[i]] +  $\frac{w}{A[[i, i]]} \left( B[[i]] + A[[i, i]] X[[i]] - \sum_{j=1}^n A[[i, j]] X[[j]] \right)$ ;
Print["X"_{k+1}, "=", X];
Xk = X;
k = k + 1];
Print["No. of iterations performed ", k];
Return[X];];
A = {{4, -2, 0}, {-2, 6, -5}, {0, -5, 11}};
B = {8, -29, 43};
X0 = {0, 0, 0};
SOR[A, B, X0, 7]
```

```

X0={0, 0, 0}
X1={2.4, -4.84, 2.05091}
X2={-0.984, -3.17469, 2.54908}
X3={0.691985, -2.33919, 2.90517}
X4={0.858089, -2.08375, 2.97328}
X5={0.978129, -2.01872, 2.99514}
X6={0.993145, -2.00386, 2.99887}
X7={0.999053, -2.00074, 2.99982}
No. of iterations performed 7
{0.999053, -2.00074, 2.99982}

```

Q2. Use the SOR iteration method to solve the system of equations in 9 iterations

$$3x_1 - x_2 + x_3 = -1$$

$$-x_1 + 3x_2 - x_3 = 7$$

$$x_1 - x_2 + 3x_3 = -7$$

with the initial vector $x^{(0)} = (0, 0, 0)$.

```

w = 1.25;
SOR[A0_, B0_, X0_, max_] :=
Module[{A = N[A0], B = N[B0], i, j, k = 0, n = Length[X0], X = X0, Xk = X0},
Print["X"0, "=", X];
While[k < max,
For[i = 1, i ≤ n, i++,
X[[i]] = (1 - w) X[[i]] +  $\frac{w}{A[[i,i]]} \left( B[[i]] + A[[i,i]] X[[i]] - \sum_{j=1}^n A[[i,j]] X[[j]] \right)$ ;
Print["X"_{k+1}, "=", X];
Xk = X;
k = k + 1];
Print["No. of iterations performed ", k];
Return[X];];
A = {{3, -1, 1}, {-1, 3, -1}, {1, -1, 3}};
B = {-1, 7, -7};
X0 = {0, 0, 0};
SOR[A, B, X0, 9]

```

$$X_0 = \{0, 0, 0\}$$

$$X_1 = \{-0.416667, 2.74306, -1.60012\}$$

$$X_2 = \{1.49715, 2.188, -2.22878\}$$

$$X_3 = \{1.04937, 1.87824, -2.01411\}$$

$$X_4 = \{0.942803, 2.00073, -1.97234\}$$

$$X_5 = \{1.00308, 2.01263, -2.00294\}$$

$$X_6 = \{1.00572, 1.998, -2.00248\}$$

$$X_7 = \{0.998772, 1.99895, -1.9993\}$$

$$X_8 = \{0.999581, 2.00038, -1.99984\}$$

$$X_9 = \{1.0002, 2.00005, -2.0001\}$$

No. of iterations performed 9

$$\{1.0002, 2.00005, -2.0001\}$$
