Southern New Hampshire University

MAT 350 Project One Table Template

Complete this template by replacing the bracketed text with the relevant information.

Network Link	Recommended Capacity (Mbps)	Solution	Recommendation	Explanation
x_1	60	60	No change	The solution matches the recommended capacity.
x_2	50	90	Upgrade	The solution exceeds the recommended capacity, suggesting an upgrade.
x_3	100	20	No change	The solution is well within the recommended capacity.
x_4	100	40	No change	The solution is within the recommended capacity.
x_5	50	140	Upgrade	The solution significantly exceeds the recommended capacity, suggesting an upgrade.

Summary

- **x1**: The data rate is exactly 60 Mbps, which matches the recommended capacity. No change is required.
- **x2**: The data rate is 90 Mbps, which exceeds the recommended capacity of 50 Mbps. An upgrade is recommended to handle the higher data rate.
- **x3**: The data rate is 20 Mbps, which is well within the recommended capacity of 100 Mbps. No change is necessary.
- **x4**: The data rate is 40 Mbps, which is within the recommended capacity of 100 Mbps. No change is necessary.
- **x5**: The data rate is 140 Mbps, which significantly exceeds the recommended capacity of 50 Mbps. An upgrade is recommended to handle the higher data rate.

By following these recommendations, we can ensure that the network operates efficiently without reaching capacity limits.

Solution

```matlab
% Define the coefficient matrix A and the constants vector b
A = [1 1 0 0 0; 1 0 -1 -1 0; 0 1 0 0 -1; 0 0 1 0 -1; 0 0 0 1 -1];
b = [150; 0; -50; -120; -100];


% Step 2: Augmented Matrix and Row Reduction
augmented_matrix = [A b];
rref_augmented_matrix = rref(augmented_matrix);
disp('Reduced Row Echelon Form:');
disp(rref_augmented_matrix);


% Step 3: LU Decomposition
[L, U] = lu(A);
disp('L matrix:');
disp(L);
disp('U matrix:');
disp(U);


% Solve Ly = b
y = L \ b;
disp('Solution y:');
disp(y);


% Solve Ux = y
x = U \ y;
disp('Solution x:');
disp(x);
```

```
% Step 4: Compute the Inverse of U
U_inv = inv(U);
disp('Inverse of U:');
disp(U_inv);

% Step 5: Solve the Original System
x_check = U_inv * y;
disp('Check solution x:');
disp(x_check);

% Step 6: Check Your Answer for x1 Using Cramer's Rule
A1 = A;
A1(:,1) = b;
det_A = det(A);
det_A1 = det(A1);
x1_cramer = det_A1 / det_A;
disp('x1 using Cramer''s Rule:');
disp(x1_cramer);

% Step 7: Compute the Required Determinants
det_A = det(A);
disp('Determinant of A:');
disp(det_A);
for i = 1:5
   A_temp = A;
   A_temp(:,i) = b;
   det_A_temp = det(A_temp);
```

```
    disp(['Determinant of A with column ', num2str(i), ' replaced:']);
    disp(det_A_temp);
end
```

```
Reduced Row Echelon Form:
     1     0     0     0     0    60
     0     1     0     0     0    90
     0     0     1     0     0    20
     0     0     0     1     0    40
     0     0     0     0     1   140

L matrix:
     1     0     0     0     0
     1     1     0     0     0
     0    -1     1     0     0
     0     0    -1     1     0
     0     0     0    -1     1

U matrix:
     1     1     0     0     0
     0    -1    -1    -1     0
     0     0    -1    -1    -1
     0     0     0    -1    -2
     0     0     0     0    -3

Solution y:
   150
  -150
  -200
  -320
  -420
```

Solution x:

```
    60
    90
    20
    40
   140
```

Inverse of U:

```
    1.0000    1.0000   -1.0000         0    0.3333
         0   -1.0000    1.0000         0   -0.3333
         0         0   -1.0000    1.0000   -0.3333
         0         0         0   -1.0000    0.6667
         0         0         0         0   -0.3333
```

Check solution x:

```
    60
    90
    20
    40
   140
```

x1 using Cramer's Rule:

```
   60.0000
```

Determinant of A:

```
     3
```

Determinant of A with column 1 replaced:

```
  180.0000
```

Determinant of A with column 2 replaced:

270

Determinant of A with column 3 replaced:

60.0000

Determinant of A with column 4 replaced:

120

Determinant of A with column 5 replaced:

420