Tutorial Assignment 2 -Solutions

Q1

```
A = {{2, 0, -1, 0}, {-4, 3, 2, 2}, {6, 0, -2, 4}, {0, -3, 2, 4}};
```

```
A // MatrixForm
```

$$\begin{pmatrix} 2 & 0 & -1 & 0 \\ -4 & 3 & 2 & 2 \\ 6 & 0 & -2 & 4 \\ 0 & -3 & 2 & 4 \end{pmatrix}$$

```
LUDecomposition[A];
```

```
LU = {{2, 0, -1, 0}, {-2, 3, 0, 2}, {3, 0, 1, 4}, {0, -1, 2, -2}}
```

```
{{2, 0, -1, 0}, {-2, 3, 0, 2}, {3, 0, 1, 4}, {0, -1, 2, -2}}
```

```
LU // MatrixForm
```

$$\begin{pmatrix} 2 & 0 & -1 & 0 \\ -2 & 3 & 0 & 2 \\ 3 & 0 & 1 & 4 \\ 0 & -1 & 2 & -2 \end{pmatrix}$$

```
L = ( 1   0  0  0
     -2   1  0  0
      3   0  1  0
      0  -1  2  1 );
```

```
U = ( 2  0  -1   0
      0  3   0   2
      0  0   1   4
      0  0   0  -2 );
```

```
L.U - A // MatrixForm
```

$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

Q2

```
b = {-6, 2, -34, -12};
```

```
y = LinearSolve[L, b]
```

```
{-6, -10, -16, 10}
```

```
x = LinearSolve[U, y]
```

```
{-1, 0, 4, -5}
```

```
A.x == b
```

```
True
```

Q3

a)

```
U = CholeskyDecomposition[{{4, 4, -2}, {4, 5, 1}, {-2, 1, 19}}]
```

```
{{2, 2, -1}, {0, 1, 3}, {0, 0, 3}}
```

```
U // MatrixForm
```

$$U = \begin{pmatrix} 2 & 2 & -1 \\ 0 & 1 & 3 \\ 0 & 0 & 3 \end{pmatrix}$$

```
{{4, 4, -2}, {4, 5, 1}, {-2, 1, 19}} == Transpose[U].U
```

```
True
```

b)

```
b = {2, 8, 26};
```

```
y = LinearSolve[Transpose[U], b]
```

```
{1, 6, 3}
```

```
x = LinearSolve[U, y]
```

```
{-2, 3, 1}
```

```
{{4, 4, -2}, {4, 5, 1}, {-2, 1, 19}}.x == b
```

```
True
```

Q4

```
MatrixForm[{{2, -2, 0}, {2, 1, -3}, {-1, 4, -5}}]
```

$$A = \begin{pmatrix} 2 & -2 & 0 \\ 2 & 1 & -3 \\ -1 & 4 & -5 \end{pmatrix}$$

```
{{2, -2, 0}, {2, 1, -3}, {-1, 4, -5}}
```

$$L = \begin{pmatrix} 2 & 0 & 0 \\ 2 & 3 & 0 \\ -1 & 3 & -2 \end{pmatrix};$$

$$U = \begin{pmatrix} 1 & -1 & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{pmatrix};$$

```
L.U == A
```

```
True
```

```
b = {2, 14, 15};
```

```
y = LinearSolve[L, b]
```

```
{1, 4, -2}
```

```
x = LinearSolve[U, y]
```

```
{3, 2, -2}
```

```
A.x == b
```

```
True
```

Q5

None of the matrices are diagonaly dominant so we can not be sure if A = LU decomposition exists.