Tutorial 3 - Lecture

```
A1 = {
    {1, 3, 5},
    {2, 10, 12},
    {15, 20, 25}
   };
xvec = {
    {x1},
    {x2},
    {x3}
   };
yvec = {{y1, y2, y3}};

Print[Dimensions[A1], Dimensions[xvec], Dimensions[yvec]]

Tr[A1];
Det[A1];
Inverse[A1] // MatrixForm;
Dimensions[A1];
IdentityMatrix[3] // MatrixForm;

a A1 + b * IdentityMatrix[3] + c * A1.A1 + Inverse[A1].A1 // MatrixForm

A2 = {
    {c, 3 - a i},
    {3 + a i, d}
   };
A3 = {
    {c + a i, 3 - a i},
    {3 + a i, d - a i}
   };

Simplify[Conjugate[Transpose[A2]], {a ∈ Reals, c ∈ Reals,  d ∈ Reals}] - A2 //
 MatrixForm
Simplify[Conjugate[Transpose[A3]], {a ∈ Reals, c ∈ Reals,  d ∈ Reals}] - A3 // MatrixForm
```

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

$$\begin{pmatrix} 1+a+b+82c & 3a+133c & 5a+166c \\ 2a+202c & 1+10a+b+346c & 12a+430c \\ 15a+430c & 20a+745c & 1+25a+b+940c \end{pmatrix}$$

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

$$\begin{pmatrix} -2ia & 0 \\ 0 & 2ia \end{pmatrix}$$

```
A = {
    {a, b},
    {c, d}
   };
A.A - Tr[A] A + Det[A] IdentityMatrix[2] // MatrixForm
Simplify[A.A - Tr[A] A + Det[A] IdentityMatrix[2]] // MatrixForm
```

$$\begin{pmatrix} a^2 + a\,d - a\,(a+d) & a\,b + b\,d - b\,(a+d) \\ a\,c + c\,d - c\,(a+d) & a\,d + d^2 - d\,(a+d) \end{pmatrix}$$

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

Tutorial 3 - Exercises

```
xvec = {
    {x1},
    {x2},
    {x3}
   };

dotProd = (Transpose[xvec].xvec)[[1, 1]]
rotMatrixZ = {
    {Cos[θ], -Sin[θ], 0},
    {Sin[θ], Cos[θ], 0},
    {0, 0, 1}
   };
rotMatrixY = {
    {Cos[ϕ], 0, -Sin[ϕ]},
    {0, 1, 0},
    {Sin[ϕ], 0, Cos[ϕ]}
   };
rotMatrixX = {
    {1, 0, 0},
    {0, Cos[Ω], -Sin[Ω] },
    {0, Sin[Ω], Cos[Ω]}
   };

rotVec = rotMatrixX.(rotMatrixY.(rotMatrixZ.xvec)) ;
Simplify[Transpose[rotVec].rotVec][[1, 1]]
```

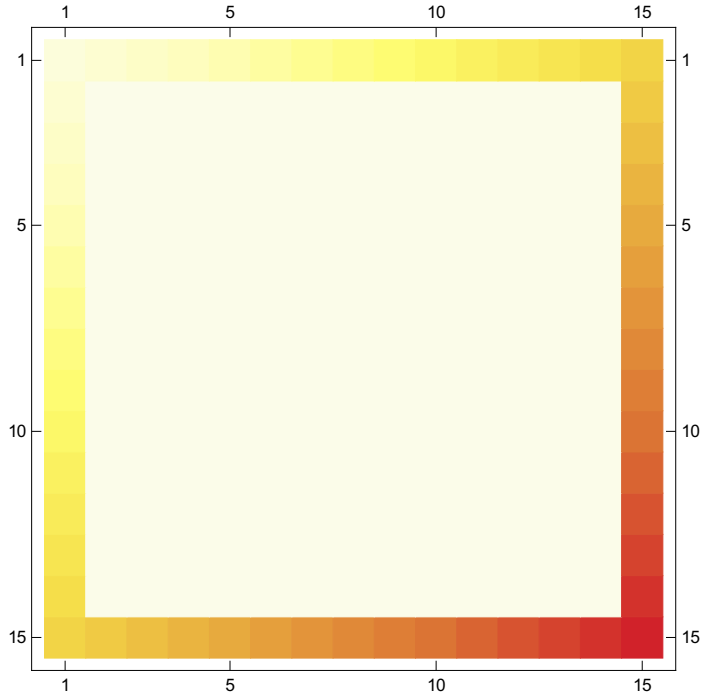
$$x1^2 + x2^2 + x3^2$$

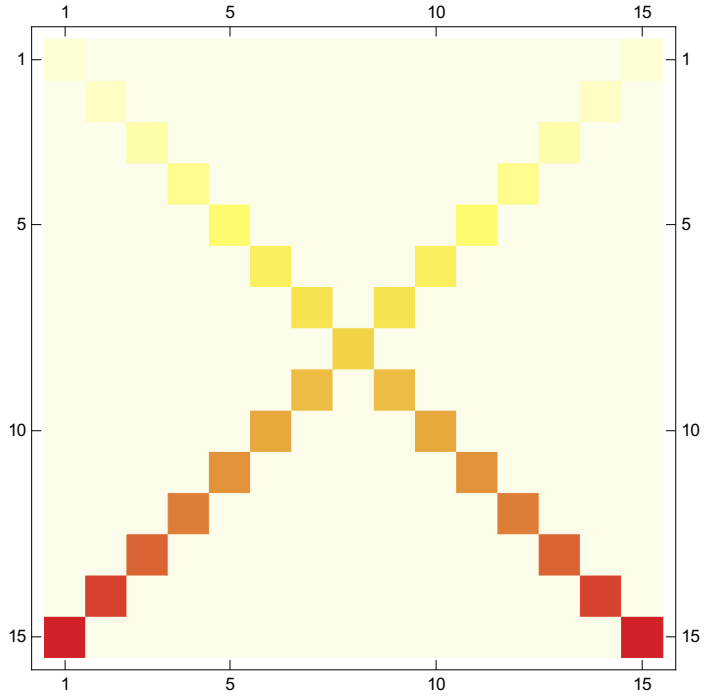
$$x1^2 + x2^2 + x3^2$$

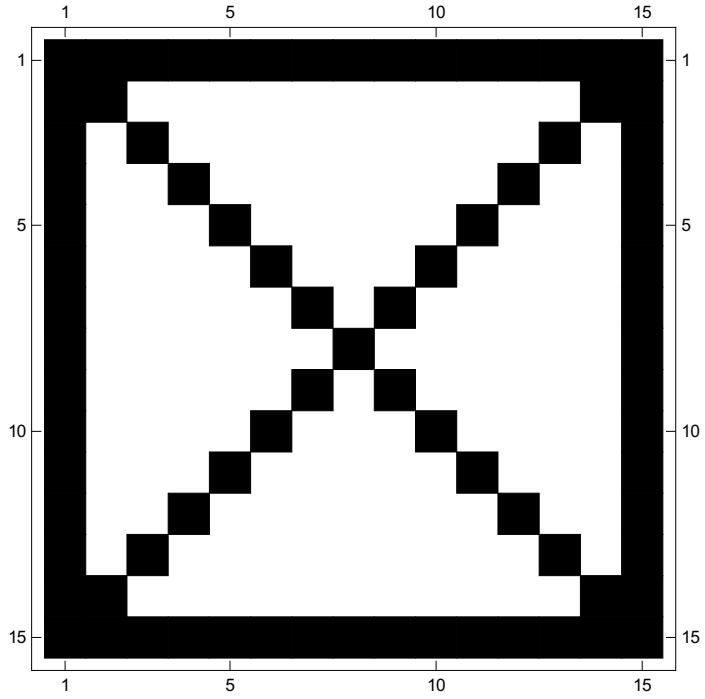
```
n = 15;
newMatrix1 = ConstantArray[0, {n, n}];
For[i = 1, i ≤ n, i = i + 1,
  For[j = 1, j ≤ n , j = j + 1,
    If[i == 1 || i == n || j == 1 || j == n,
     newMatrix1[[i, j]] = i + j;
    ]
   ];
 ];
MatrixForm[newMatrix1]

newMatrix2 = ConstantArray[0, {n, n}];
For[i = 1, i ≤ n, i = i + 1,
  For[j = 1, j ≤ n , j = j + 1,
    If[i + j == n + 1 || i == j,
     newMatrix2[[i, j]] = i;
    ]
   ];
 ];

MatrixForm[newMatrix2]
MatrixPlot[newMatrix1, ColorFunction → "TemperatureMap"]
MatrixPlot[newMatrix2, ColorFunction → "TemperatureMap"]
MatrixPlot[newMatrix2 + newMatrix1, ColorFunction → "Monochrome"]
```

$$\begin{pmatrix}
2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & 12 & 13 & 14 & 15 & 16 \\
3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 17 \\
4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 18 \\
5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 19 \\
6 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 20 \\
7 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 21 \\
8 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 22 \\
9 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 23 \\
10 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 24 \\
11 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 25 \\
12 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 26 \\
13 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 27 \\
14 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 28 \\
15 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 29 \\
16 & 17 & 18 & 19 & 20 & 21 & 22 & 23 & 24 & 25 & 26 & 27 & 28 & 29 & 30
\end{pmatrix}$$

$$\begin{pmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 & 0 \\
0 & 0 & 3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3 & 0 & 0 \\
0 & 0 & 0 & 4 & 0 & 0 & 0 & 0 & 0 & 0 & 4 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 5 & 0 & 0 & 0 & 0 & 5 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 6 & 0 & 0 & 0 & 6 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 7 & 0 & 7 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 8 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 9 & 0 & 9 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 10 & 0 & 0 & 0 & 10 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 11 & 0 & 0 & 0 & 0 & 0 & 11 & 0 & 0 & 0 \\
0 & 0 & 0 & 12 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 12 & 0 & 0 \\
0 & 0 & 13 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 13 & 0 & 0 \\
0 & 14 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 14 & 0 \\
15 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 15
\end{pmatrix}$$


1
5
10
15
1
5
10
15


1
5
10
15
1
5
10
15


1
5
10
15
1
5
10
15
1
5
10
15
1
5
10
15