7.1 MATRICES

In[ ]:=
$$\mathcal{M} = \begin{pmatrix} 1 & 4 & 6 & 8 & 90 & 6 \\ 6 & 8 & 9 & 5 & 34 & 8 \\ 8 & 0 & 7 & 5 & 3 & 9 \\ 7 & 7 & 89 & 8 & 5 & 3 \\ 78 & 9 & 9 & 5 & 3 & 9 \end{pmatrix}$$

Out[ ]=
```
{{1, 4, 6, 8, 90, 6}, {6, 8, 9, 5, 34, 8},
 {8, 0, 7, 5, 3, 9}, {7, 7, 89, 8, 5, 3}, {78, 9, 9, 5, 3, 9}}
```

In[ ]:=
```
𝒩 = {{1, 2, 3}, {3, 4, 5}, {5, 6, 7}} // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 5 & 6 & 7 \end{pmatrix}$$

In[ ]:=
```
Dimensions[𝒩]
```

Out[ ]=
```
{5, 6}
```

In[ ]:=
```
RandomInteger[50, {3, 5}] // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 48 & 9 & 16 & 15 & 47 \\ 33 & 17 & 17 & 14 & 5 \\ 50 & 16 & 24 & 9 & 38 \end{pmatrix}$$

In[ ]:=
```
Table[i + 2 j, {i, 5}, {j, 5}] // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 3 & 5 & 7 & 9 & 11 \\ 4 & 6 & 8 & 10 & 12 \\ 5 & 7 & 9 & 11 & 13 \\ 6 & 8 & 10 & 12 & 14 \\ 7 & 9 & 11 & 13 & 15 \end{pmatrix}$$

In[ ]:=
```
Table[i + 2 j, {i, -2, 3}, {j, 0, 2}] // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} -2 & 0 & 2 \\ -1 & 1 & 3 \\ 0 & 2 & 4 \\ 1 & 3 & 5 \\ 2 & 4 & 6 \\ 3 & 5 & 7 \end{pmatrix}$$

In[ ]:=
```
Table[0, {3}, {4}] // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
Table[π, {3}, {4}] // MatrixForm
```

Out[ ]//MatrixForm=

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

In[ ]:=
```
ConstantArray[0, {3, 4}] // MatrixForm
```

Out[ ]//MatrixForm=

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

In[ ]:=
```
ConstantArray[π, {3, 4}] // MatrixForm
```

Out[ ]//MatrixForm=

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

In[ ]:=
```
Table[If[i ≥ j, i + 2 j, 0], {i, 4}, {j, 4}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 3 & 0 & 0 & 0 \\ 4 & 6 & 0 & 0 \\ 5 & 7 & 9 & 0 \\ 6 & 8 & 10 & 12 \end{pmatrix}$$

In[ ]:=
```
Table[If[i ≥ j, i^2, j], {i, 4}, {j, 4}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 4 & 4 & 3 & 4 \\ 9 & 9 & 9 & 4 \\ 16 & 16 & 16 & 16 \end{pmatrix}$$

In[ ]:=
```
Table[If[i == j, 0, i^2], {i, 4}, {j, 4}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 1 & 1 & 1 \\ 4 & 0 & 4 & 4 \\ 9 & 9 & 0 & 9 \\ 16 & 16 & 16 & 0 \end{pmatrix}$$

In[ ]:=
```
Array[Min, {4, 5}] // MatrixForm
```

Out[ ]//MatrixForm=

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

In[ ]:=
```
Clear[f];
f[i_, j_] := i^3 + j^2;
Array[f, {2, 3}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 2 & 5 & 10 \\ 9 & 12 & 17 \end{pmatrix}$$

In[ ]:=
```
Clear[a, mat];
mat = Array[a## &, {3, 4}];

mat // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} & a_{1,4} \\ a_{2,1} & a_{2,2} & a_{2,3} & a_{2,4} \\ a_{3,1} & a_{3,2} & a_{3,3} & a_{3,4} \end{pmatrix}$$

In[ ]:=
```
IdentityMatrix[4] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
DiagonalMatrix[{a, b, c, d}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a & 0 & 0 & 0 \\ 0 & b & 0 & 0 \\ 0 & 0 & c & 0 \\ 0 & 0 & 0 & d \end{pmatrix}$$

In[ ]:=
```
DiagonalMatrix[{1, 1, 1, 1}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

In[ ]:=
```
DiagonalMatrix[{a, b, c}, 1] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & a & 0 & 0 \\ 0 & 0 & b & 0 \\ 0 & 0 & 0 & c \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

In[ ]:=
```
DiagonalMatrix[{a, b, c}, -1] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ a & 0 & 0 & 0 \\ 0 & b & 0 & 0 \\ 0 & 0 & c & 0 \end{pmatrix}$$

In[ ]:= **DiagonalMatrix[{a, b}, -2] // MatrixForm**

Out[ ]//MatrixForm=

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

In[ ]:= **DiagonalMatrix[{a}, -3] // MatrixForm**

Out[ ]//MatrixForm=

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

In[ ]:= **DiagonalMatrix[{a, b}, 2] // MatrixForm**

Out[ ]//MatrixForm=

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

In[ ]:= **mat1 = RandomInteger[9, {3, 4}] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 8 & 9 & 9 & 3 \\ 5 & 6 & 8 & 7 \\ 3 & 3 & 3 & 5 \end{pmatrix}$$

In[ ]:= **mat2 = RandomInteger[9, {3, 4}] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 8 & 0 & 5 & 0 \\ 1 & 7 & 8 & 3 \\ 0 & 4 & 6 & 5 \end{pmatrix}$$

In[ ]:= **ArrayFlatten[{{mat1}, {mat2}}] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} \begin{pmatrix} 8 & 9 & 9 & 3 \\ 5 & 6 & 8 & 7 \\ 3 & 3 & 3 & 5 \end{pmatrix} \\ \begin{pmatrix} 8 & 0 & 5 & 0 \\ 1 & 7 & 8 & 3 \\ 0 & 4 & 6 & 5 \end{pmatrix} \end{pmatrix}$$

In[ ]:= **ArrayFlatten[{{mat1, mat2}}] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} \begin{pmatrix} 8 & 9 & 9 & 3 \\ 5 & 6 & 8 & 7 \\ 3 & 3 & 3 & 5 \end{pmatrix} & \begin{pmatrix} 8 & 0 & 5 & 0 \\ 1 & 7 & 8 & 3 \\ 0 & 4 & 6 & 5 \end{pmatrix} \end{pmatrix}$$

In[ ]:= **bm = ArrayFlatten[{{mat1, 0}, {0, mat2}}] // MatrixForm**

$$\begin{pmatrix} \begin{pmatrix} 8 & 9 & 9 & 3 \\ 5 & 6 & 8 & 7 \\ 3 & 3 & 3 & 5 \end{pmatrix} & 0 \\ \begin{pmatrix} \square & \square & \square & \square & \square & \square \\ \square & \square & \square & \square & \square & \square \\ \square & \square & \square & \square & \square & \square \\ \square & \square & \square & \square & \square & \square \\ \square & \square & \square & \square & \square & \square \end{pmatrix} & 0 \begin{pmatrix} 8 & 0 & 5 & 0 \\ 1 & 7 & 8 & 3 \\ 0 & 4 & 6 & 5 \end{pmatrix} \end{pmatrix}$$

In[ ]:= **Grid[bm, Dividers → {{5 → True}, {4 → True}}, Frame → True]**

Out[ ]= Grid[$\begin{pmatrix} \begin{pmatrix} 8 & 9 & 9 & 3 \\ 5 & 6 & 8 & 7 \\ 3 & 3 & 3 & 5 \end{pmatrix} & 0 \\ 0 & \begin{pmatrix} 8 & 0 & 5 & 0 \\ 1 & 7 & 8 & 3 \\ 0 & 4 & 6 & 5 \end{pmatrix} \end{pmatrix}$, Dividers → {{5 → True}, {4 → True}}, Frame → True]

In[ ]:= $\mathbf{m} = \begin{pmatrix} 1 & 4 & 76 & 8 & 3 & 32 \\ 7 & 54 & 23 & 6 & 8 & 5 \\ 23 & 5 & 7 & 8 & 4 & 6 \\ 34 & 6 & 8 & 56 & 3 & 2 \\ 7 & 8 & 54 & 7 & 8 & 54 \end{pmatrix};$

Grid[m, Dividers → {{4 → True}, {5 → True}}, Frame → True]

Out[ ]=

1	4	76	8	3	32
7	54	23	6	8	5
23	5	7	8	4	6
34	6	8	56	3	2
7	8	54	7	8	54

In[ ]:= **Grid[m, Dividers → {{1 → True, 7 → True}, False}]**

Out[ ]=

1	4	76	8	3	32
7	54	23	6	8	5
23	5	7	8	4	6
34	6	8	56	3	2
7	8	54	7	8	54

In[ ]:= **Grid[m, Dividers → {False, {1 → True, 6 → True}}]**

Out[ ]=

1	4	76	8	3	32
7	54	23	6	8	5
23	5	7	8	4	6
34	6	8	56	3	2
7	8	54	7	8	54

In[ ]:= **Grid[m, Dividers → All]**

Out[ ]=

1	4	76	8	3	32
7	54	23	6	8	5
23	5	7	8	4	6
34	6	8	56	3	2
7	8	54	7	8	54

.

In[ ]:= **? mat1**

Out[ ]= Missing[UnknownSymbol, mat1]

In[ ]:= **Clear[mat, mat1, mat2]**

In[ ]:= **mat1 = $\begin{pmatrix} 5 & 1 & 7 & 1 \\ 7 & 0 & 6 & 2 \\ 8 & 4 & 3 & 7 \end{pmatrix}$;**

mat1[[2]]

Out[ ]= {7, 0, 6, 2}

In[ ]:= **mat1⟦2⟧**

Out[ ]= {7, 0, 6, 2}

In[ ]:= **mat1⟦3, 4⟧**

Out[ ]= 7

In[ ]:= **mat1[[All, 3]]**

Out[ ]= {7, 6, 3}

In[ ]:= **mat1[[All, 2 ;; 4]] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 7 & 1 \\ 0 & 6 & 2 \\ 4 & 3 & 7 \end{pmatrix}$$

In[ ]:= **mat1[[All, 1 ;; 3]] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 5 & 1 & 7 \\ 7 & 0 & 6 \\ 8 & 4 & 3 \end{pmatrix}$$

In[ ]:= **Clear[mat, a]**

In[ ]:=
```
mat = Array[a##& , {5, 5}];
mat // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} & a_{1,4} & a_{1,5} \\ a_{2,1} & a_{2,2} & a_{2,3} & a_{2,4} & a_{2,5} \\ a_{3,1} & a_{3,2} & a_{3,3} & a_{3,4} & a_{3,5} \\ a_{4,1} & a_{4,2} & a_{4,3} & a_{4,4} & a_{4,5} \\ a_{5,1} & a_{5,2} & a_{5,3} & a_{5,4} & a_{5,5} \end{pmatrix}$$

In[ ]:=
```
Take[mat, 3] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} & a_{1,4} & a_{1,5} \\ a_{2,1} & a_{2,2} & a_{2,3} & a_{2,4} & a_{2,5} \\ a_{3,1} & a_{3,2} & a_{3,3} & a_{3,4} & a_{3,5} \end{pmatrix}$$

In[ ]:=
```
Take[mat, -2] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{4,1} & a_{4,2} & a_{4,3} & a_{4,4} & a_{4,5} \\ a_{5,1} & a_{5,2} & a_{5,3} & a_{5,4} & a_{5,5} \end{pmatrix}$$

In[ ]:=
```
Take[mat, {2, 4}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{2,1} & a_{2,2} & a_{2,3} & a_{2,4} & a_{2,5} \\ a_{3,1} & a_{3,2} & a_{3,3} & a_{3,4} & a_{3,5} \\ a_{4,1} & a_{4,2} & a_{4,3} & a_{4,4} & a_{4,5} \end{pmatrix}$$

In[ ]:=
```
Take[mat, {1, 5, 2}] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} & a_{1,4} & a_{1,5} \\ a_{3,1} & a_{3,2} & a_{3,3} & a_{3,4} & a_{3,5} \\ a_{5,1} & a_{5,2} & a_{5,3} & a_{5,4} & a_{5,5} \end{pmatrix}$$

In[ ]:=
```
Take[mat, 2, -4] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,2} & a_{1,3} & a_{1,4} & a_{1,5} \\ a_{2,2} & a_{2,3} & a_{2,4} & a_{2,5} \end{pmatrix}$$

In[ ]:=
```
Take[mat, 5, 1] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,1} \\ a_{2,1} \\ a_{3,1} \\ a_{4,1} \\ a_{5,1} \end{pmatrix}$$

In[ ]:= **Take[mat, 5, -5] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} & a_{1,4} & a_{1,5} \\ a_{2,1} & a_{2,2} & a_{2,3} & a_{2,4} & a_{2,5} \\ a_{3,1} & a_{3,2} & a_{3,3} & a_{3,4} & a_{3,5} \\ a_{4,1} & a_{4,2} & a_{4,3} & a_{4,4} & a_{4,5} \\ a_{5,1} & a_{5,2} & a_{5,3} & a_{5,4} & a_{5,5} \end{pmatrix}$$

In[ ]:= **Take[mat, 4, 3] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \\ a_{3,1} & a_{3,2} & a_{3,3} \\ a_{4,1} & a_{4,2} & a_{4,3} \end{pmatrix}$$

In[ ]:= **Take[mat, All, -3] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,3} & a_{1,4} & a_{1,5} \\ a_{2,3} & a_{2,4} & a_{2,5} \\ a_{3,3} & a_{3,4} & a_{3,5} \\ a_{4,3} & a_{4,4} & a_{4,5} \\ a_{5,3} & a_{5,4} & a_{5,5} \end{pmatrix}$$

In[ ]:= **Take[mat, {2, 4}, {3, 5}] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{2,3} & a_{2,4} & a_{2,5} \\ a_{3,3} & a_{3,4} & a_{3,5} \\ a_{4,3} & a_{4,4} & a_{4,5} \end{pmatrix}$$

In[ ]:= **Take[mat, {1, 4, 3}, {2, 4, 2}] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} a_{1,2} & a_{1,4} \\ a_{4,2} & a_{4,4} \end{pmatrix}$$

Exercise 7.1

(1)

In[ ]:= **Table[Which[i == j, i, i > j, 0, True, 1], {i, 10}, {j, 10}] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 2 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 3 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 4 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 5 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 6 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 7 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 8 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 9 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 10 \end{pmatrix}$$

(3)

```
In[ ]:= blockmatrix[n_] :=
          ArrayFlatten[ReplacePart[Table[0, {n}], Table[#, {#}, {#}], #] & /@ Range[n]];
        blockmatrix[5] // MatrixForm
```

Out[ ]//MatrixForm=

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

7.2 PERFORMING GAUSSIAN ELIMINATION

In[ ]:= $m = \begin{pmatrix} 1 & 1 & 4 & 25 \\ 2 & 1 & 0 & 7 \\ -3 & 0 & 1 & -1 \end{pmatrix};$

```
RowReduce[m] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 5 \end{pmatrix}$$

```
In[ ]:= m[[2]] = 0 - m[[2]];
        m // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 1 & 4 & 25 \\ -2 & -1 & 0 & -7 \\ -3 & 0 & 1 & -1 \end{pmatrix}$$

```
In[ ]:= Clear[m];
```

In[ ]:=
$$m = \begin{pmatrix} 1 & 1 & 4 & 25 \\ 2 & 1 & 0 & 7 \\ -3 & 0 & 1 & -1 \end{pmatrix};$$

```
m[[2]] = m[[2]] - 2 m[[1]];
m // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 1 & 1 & 4 & 25 \\ 0 & -1 & -8 & -43 \\ -3 & 0 & 1 & -1 \end{pmatrix}$$

In[ ]:=
```
m[[3]] = m[[3]] + 3 m[[1]];
m // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 1 & 1 & 4 & 25 \\ 0 & -1 & -8 & -43 \\ 0 & 3 & 13 & 74 \end{pmatrix}$$

In[ ]:=
```
m[[2]] = 0 - m[[2]];
m // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 1 & 1 & 4 & 25 \\ 0 & 1 & 8 & 43 \\ 0 & 3 & 13 & 74 \end{pmatrix}$$

In[ ]:=
```
m[[1]] = m[[1]] - m[[2]];
m // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 1 & 0 & -4 & -18 \\ 0 & 1 & 8 & 43 \\ 0 & 3 & 13 & 74 \end{pmatrix}$$

In[ ]:=
```
m[[3]] = m[[3]] - 3 m[[2]];
m // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 1 & 0 & -4 & -18 \\ 0 & 1 & 8 & 43 \\ 0 & 0 & -11 & -55 \end{pmatrix}$$

In[ ]:=
```
m[[3]] = (-1 / 11) m[[3]];
m // MatrixForm
```

Out[ ]//MatrixForm=
$$\begin{pmatrix} 1 & 0 & -4 & -18 \\ 0 & 1 & 8 & 43 \\ 0 & 0 & 1 & 5 \end{pmatrix}$$

```
In[ ]:= m[[2]] = m[[2]] - 8 m[[3]];
        m // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & -4 & -18 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 5 \end{pmatrix}$$

```
In[ ]:= m[[1]] = m[[1]] + 4 m[[3]];
        m // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 5 \end{pmatrix}$$

Exercise 7.2

(2)

```
In[ ]:= Clear[m]
```

```
In[ ]:= m = {{2, 1, 0, 0, 0, 721},
             {0, 3, 1, 0, 0, 721},
             {0, 0, 4, 1, 0, 721},
             {0, 0, 0, 5, 1, 721},
             {1, 0, 0, 0, 6, 721}};
```

```
        RowReduce[m] // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 265 \\ 0 & 1 & 0 & 0 & 0 & 191 \\ 0 & 0 & 1 & 0 & 0 & 148 \\ 0 & 0 & 0 & 1 & 0 & 129 \\ 0 & 0 & 0 & 0 & 1 & 76 \end{pmatrix}$$

```
In[ ]:= Clear[m]
```

7.3 MATRIX OPERATIONS

```
In[ ]:= c = {{1, 0, 0}, {2, 3, 4}, {-1, 5, -1}};
```

```
        d = {{2, 2, 3}, {0, 0, 1}, {5, 5, 5}};
```

```
        c + d // MatrixForm
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} 3 & 2 & 3 \\ 2 & 3 & 5 \\ 4 & 10 & 4 \end{pmatrix}$$

In[ ]:= **c - d // MatrixForm**

Out[ ]//MatrixForm=

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

In[ ]:= **7 * c // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 7 & 0 & 0 \\ 14 & 21 & 28 \\ -7 & 35 & -7 \end{pmatrix}$$

In[ ]:= **c.d // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 2 & 2 & 3 \\ 24 & 24 & 29 \\ -7 & -7 & -3 \end{pmatrix}$$

In[ ]:= **c * d // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 2 & 0 & 0 \\ 0 & 0 & 4 \\ -5 & 25 & -5 \end{pmatrix}$$

In[ ]:= **Transpose[c] // MatrixForm**

Out[ ]//MatrixForm=

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

In[ ]:= **MatrixPower[c, 10] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 \\ 10\,249\,364 & 36\,166\,989 & 20\,498\,728 \\ 7\,834\,130 & 25\,623\,410 & 15\,668\,261 \end{pmatrix}$$

In[ ]:= **Inverse[c] // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 \\ \frac{2}{23} & \frac{1}{23} & \frac{4}{23} \\ -\frac{13}{23} & \frac{5}{23} & -\frac{3}{23} \end{pmatrix}$$

In[ ]:= **Inverse[c].c // MatrixForm**

Out[ ]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$