

```

> with(LinearAlgebra);
[&x, Add, Adjoint, BackwardSubstitute, BandMatrix, Basis, BezoutMatrix, BidiagonalForm, BilinearForm, (1)
  CARE, CharacteristicMatrix, CharacteristicPolynomial, Column, ColumnDimension,
  ColumnOperation, ColumnSpace, CompanionMatrix, CompressedSparseForm, ConditionNumber,
  ConstantMatrix, ConstantVector, Copy, CreatePermutation, CrossProduct, DARE, DeleteColumn,
  DeleteRow, Determinant, Diagonal, DiagonalMatrix, Dimension, Dimensions, DotProduct,
  EigenConditionNumbers, Eigenvalues, Eigenvectors, Equal, ForwardSubstitute, FrobeniusForm,
  FromCompressedSparseForm, FromSplitForm, GaussianElimination, GenerateEquations,
  GenerateMatrix, Generic, GetResultDataType, GetResultShape, GivensRotationMatrix, GramSchmidt,
  HankelMatrix, HermiteForm, HermitianTranspose, HessenbergForm, HilbertMatrix,
  HouseholderMatrix, IdentityMatrix, IntersectionBasis, IsDefinite, IsOrthogonal, IsSimilar, IsUnitary,
  JordanBlockMatrix, JordanForm, KroneckerProduct, LA_Main, LUdecomposition, LeastSquares,
  LinearSolve, LyapunovSolve, Map, Map2, MatrixAdd, MatrixExponential, MatrixFunction,
  MatrixInverse, MatrixMatrixMultiply, MatrixNorm, MatrixPower, MatrixScalarMultiply,
  MatrixVectorMultiply, MinimalPolynomial, Minor, Modular, Multiply, NoUserValue, Norm,
  Normalize, NullSpace, OuterProductMatrix, Permanent, Pivot, PopovForm, ProjectionMatrix,
  QRdecomposition, RandomMatrix, RandomVector, Rank, RationalCanonicalForm,
  ReducedRowEchelonForm, Row, RowDimension, RowOperation, RowSpace, ScalarMatrix,
  ScalarMultiply, ScalarVector, SchurForm, SingularValues, SmithForm, SplitForm,
  StronglyConnectedBlocks, SubMatrix, SubVector, SumBasis, SylvesterMatrix, SylvesterSolve,
  ToeplitzMatrix, Trace, Transpose, TridiagonalForm, UnitVector, VandermondeMatrix, VectorAdd,
  VectorAngle, VectorMatrixMultiply, VectorNorm, VectorScalarMultiply, ZeroMatrix, ZeroVector, Zip]

```

```

> A :=

```

$$\begin{bmatrix}
5 & -1 & 0 & 0 & 0 \\
-1 & 5 & -1 & 0 & 0 \\
0 & -1 & 5 & -1 & 0 \\
0 & 0 & -1 & 5 & -1 \\
0 & 0 & 0 & -1 & 5
\end{bmatrix};$$

```

A :=

```

$$\begin{bmatrix}
5 & -1 & 0 & 0 & 0 \\
-1 & 5 & -1 & 0 & 0 \\
0 & -1 & 5 & -1 & 0 \\
0 & 0 & -1 & 5 & -1 \\
\vdots & \vdots & \vdots & \vdots & \vdots
\end{bmatrix}$$

(2)

```

> Eigenvalues(A);

```

$$\begin{bmatrix} 5 \\ 6 \\ 4 \\ 5 - \sqrt{3} \\ \vdots \end{bmatrix}$$

(3)

> evalf(%);

$$\begin{bmatrix} 5. \\ 6. \\ 4. \\ 3.267949192 \\ \vdots \end{bmatrix}$$

(4)

>  $M := \begin{bmatrix} 2 & -1 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 \\ 0 & 0 & -1 & 2 & -1 \\ 0 & 0 & 0 & -1 & 2 \end{bmatrix};$

$$M := \begin{bmatrix} 2 & -1 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 \\ 0 & 0 & -1 & 2 & -1 \\ \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

(5)

> Eigenvalues(M);

$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 2 - \sqrt{3} \\ \vdots \end{bmatrix}$$

(6)

> evalf(%);

$$\begin{bmatrix} 1. \\ 2. \\ 3. \\ 0.267949192 \\ \vdots \end{bmatrix}$$

(7)

```
> MM :=
```

$$\begin{bmatrix} 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 \end{bmatrix};$$

```
MM :=
```

$$\begin{bmatrix} 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 2 & -1 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

(8)

```
> evalf(Eigenvalues(MM));
```

$$\begin{bmatrix} 2.284629677 + 2. \times 10^{-11} I \\ 0.317492935 + 1. \times 10^{-10} I \\ 3.309721467 + 3. \times 10^{-10} I \\ 3.918985947 + 0. I \\ 1.169169974 - 1. \times 10^{-10} I \\ 1.715370324 + 1.1 \times 10^{-9} I \\ 0.081014054 + 0. I \\ 3.682507065 - 1.0 \times 10^{-9} I \\ 2.830830025 - 1.4 \times 10^{-9} I \\ 0.690278532 + 6. \times 10^{-10} I \end{bmatrix}$$

(9)

```
> sort(%);
```

$$\begin{aligned} & 0.081014054 + 0.I \\ & 0.317492935 + 1. \times 10^{-10} I \\ & 0.690278532 + 6. \times 10^{-10} I \\ & 1.169169974 - 1. \times 10^{-10} I \\ & 1.715370324 + 1.1 \times 10^{-9} I \\ & 2.284629677 + 2. \times 10^{-11} I \\ & 2.830830025 - 1.4 \times 10^{-9} I \\ & 3.309721467 + 3. \times 10^{-10} I \\ & 3.682507065 - 1.0 \times 10^{-9} I \\ & 3.918985947 + 0.I \end{aligned}$$

(10)

>